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INDICE

Rivista di Economia Agraria, Anno LXX, n. 1, 2015: 5-6

Editoriale

Sono particolarmente lieto di questa occasione che mi consente di annunciare la rinascita della Rivista di Economia Agraria - REA, fondata nel 1945 dall'Istituto Nazionale di Economia Agraria (INEA) e pubblicata, a partire dalla fine degli anni settanta, in collaborazione con la Società Italiana degli Economisti Agrari (SIDEA). Oggi la REA è sostenuta dal Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria (CREA), ente che mi onoro di dirigere.

Fin dall'origine la Rivista si è collocata in una posizione di centrale autorevolezza e impatto nel dibattito scientifico sui temi dell'economia e della politica agraria e agroalimentare, nonché della sostenibilità ambientale e socio economica del settore primario e delle attività connesse, includendovi il settore della pesca.

Il rilancio della REA vuole porre all'attenzione il contributo straordinario che gli economisti agrari possono fornire per individuare equilibrati percorsi evolutivi del settore agroalimentare nel suo complesso e coadiuvare i policy makers nella individuazione di strategie politiche efficaci.

Mi piace ricordare che l'agricoltura, così come lo sviluppo delle aree rurali, sta rivendicando, specie negli ultimi anni, la centralità all'interno della sfera di azione politica per il rilancio dell'economia e dell'occupazione.

A ciò si aggiunga l'attenzione del consumatore e del mercato verso le tematiche di sicurezza e qualità delle produzioni alimentari, verso gli aspetti salutistici e nutrizionali che indirizzano scelte d'acquisto sempre più consapevoli e che, di conseguenza, stimolano diversi approcci alla produzione e all'organizzazione e gestione economica delle filiere.

Alla luce di queste evidenze è chiaro che la ricerca scientifica e l'innovazione diventano il motore irrinunciabile su cui si fonda lo sviluppo economico futuro di un Paese. La promozione della ricerca scientifica, volta a favorire lo sviluppo ispirato a criteri di qualità, sostenibilità e multifunzionalità dell'agricoltura, dei sistemi agroambientali e forestali e della competitività agroalimentare, deve diventare per il nostro Paese una priorità assoluta.

È opinione largamente diffusa che i sistemi di conoscenza agricola e innovazione debbano essere rafforzati. La priorità per l'innovazione nell'ambito dei programmi di sviluppo rurale (PSR) per il periodo 2014-2020 consentirà di garantire che le nuove idee innovative non passino inosservate e che lo scambio di conoscenze divenga lo strumento a cui ricorrere per superare i problemi emergenti.

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La comunicazione e il trasferimento di conoscenza diventano strumenti indispensabili per facilitare il processo di sviluppo.

La REA assume così il ruolo straordinario di comunicatore della conoscenza sui temi economici, rivolta a tutti gli operatori interessati a vario titolo alle tematiche dell'agricoltura, dello sviluppo rurale e dell'ambiente.

E come non citare la straordinaria coincidenza che vede la rinascita della REA collocarsi in un momento propizio, l'anno dell'Esposizione universale EXPO, un grande appuntamento che apre una discussione internazionale sul carattere strategico del comparto agricolo e agroalimentare per l'Europa del futuro e per il mondo.

Nella speranza che la REA possa interpretare al meglio l'arricchimento culturale e scientifico nel campo economico agrario, e contribuire a una fruttuosa e sempre più accesa collaborazione tra SIDEA e CREA, auguro a tutti un gratificante lavoro.

Salvatore Parlato
Commissario straordinario CREA

Rivista di Economia Agraria, Anno LXX, n. 1, 2015: 7-31

Deborah Bentivoglio,
Michele Rasetti

Department of Agricultural, Food and Environmental Sciences, University Politecnica Marche, Monte Dago, Ancona, Italy

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JEL Codes: Q01, Q16, Q42

Biofuel sustainability: review of implications for land use and food price

This article reviews the main findings, obtained from the literature, on two aspects that question first generation biofuel sustainability: the consequences of increased biofuel production on indirect land use change (ILUC) and related emissions and the impact of biodiesel on food-commodities prices.
The measurement of ILUC, although necessary, is currently highly uncertain as demonstrated by the wide variation in estimates; in any case it seems that none of the first generation biofuels will be able to fulfill the sustainability criteria imposed by the RE Directive.
Regarding the food-fuel debate, even if discrepancies in results have been observed, this review suggests that changes in biofuel prices have little impact on food prices. On the other hand, the impact of an increasing production of biofuel on food prices is not negligible.

1. Introduction

Industrialized countries' dependence on fossil fuels has been distressing for a long time for countries that do not have self-sufficiency, whether for environmental, economic, geopolitical or other reasons. The burning of fossil fuels contributes to greenhouse gas emissions increasing the risk of intensifying climatic disturbances that can deteriorate the processes of production, consumption and welfare in the world (Shikida *et al.*, 2014). Therefore, the development of renewable energy sources (including biofuels) could provide a valid alternative to fossil fuels (Jaeger and Egelkraut, 2011).

Biofuel have become a high priority issue in the European Union as well as in many other Countries around the world, due to concerns regarding oil dependence and an interest in reducing CO_2 emissions. Nowadays, worldwide biofuels markets are dominated by ethanol (79%) and biodiesel (21%) (REN, 2013; Finco, 2012).

However, several authors (De Fraiture, 2008; Campbell and Doswald, 2009; Demirbas, 2009; Diaz- Chavez, 2011; Ajanovic, 2011; Finco *et al.*, 2012; Padella *et al.*, 2012) have recently raised concerns about the environmental benefits and social-economic implications of biofuel production such as underlying

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uncertainties over the life cycle emissions of greenhouse gas emissions (GHG), possible deforestation for feedstock production, degradation of soil and air quality, increased water consumption, possible loss of biodiversity, possible competition with food production, and other potential social imbalances (Gnansounou, 2011).

In order to be sustainable, biofuels should be carbon neutral, especially considering the necessity of fossil fuel substitution and global warming mitigation. In addition, biofuels should contribute to the economic development and equity. Moreover, they should not affect the quality, quantity, and use of natural resources as water and soil, not to affect biodiversity and not have undesirable social consequences (Lora *et al.*, 2011).

Nevertheless, the length and complexity of biofuel supply chains make the sustainability issue very challenging. Biofuel' pathways include several successive segments over the fuels' life cycle (e.g. feedstock production, conversion of the feedstock to biofuels, wholesale trade, retail, and use in engines) and multiple actors (e.g. feedstock suppliers, biofuel producers, biofuel consumers, and public authorities).

Land-use change is considered one of the most important environmental impacts to address, mainly because of its impacts on GHG and wider ecosystems. Careful assessment of these impacts has given rise to criticisms from economists, ecologists, NGOs, and international organizations, who call for additional analysis of biofuels' effects. Furthermore, the European Union and several countries have adopted certification scheme for biofuels to respond to these growing concerns and to address the sustainability issues derived from the expanding production of biofuels.

At the same time, the impact of biofuels on food prices has been fiercely debated principally in the light of the agricultural commodity price spikes in 2007/2008 and again more recently in 2010/2011. This is because most of the feedstocks currently used to produce biofuels, such as oilseeds in Europe, are also important globally traded food commodities.

This work summarizes the main findings of different lines of research on these two aspects that put at risk first generation biofuels sustainability. Two bodies of literature are revised: one on the consequences of increased biofuel production on land use change and another on the impact of biodiesel on food-commodities prices.

2. Impact of biofuel on land use change

Reducing the greenhouse gas emissions of the transport sector, particularly road transport, is one of the major challenges for policy makers when it

comes to tackling climate change. With liquid fuels likely to remain the primary energy source for road transport for at least the next few decades, biofuels have been widely accepted for years as one of the potential solutions for lowering the greenhouse gas emissions of transport (Ernst & Young, 2011). In other words, there was general agreement that production and consumption of biofuels could entail emission savings compared to conventional fuels. This is because the crops used to make the fuels absorb carbon dioxide (CO_2) as they grow. The gas is later released when the biofuels are used.

However, using plant carbon is not free because it means the carbon, or the ability of land to support photosynthesis of other plants, cannot be used for other purposes. Sometimes that means a direct loss of carbon sequestration. Sometimes it means the diversion of carbon in crops from serving their typical purposes as food or feed. It is necessary to calculate both direct and indirect land use change to determine if there is in fact a net gain to diverting plants or the land that produces them to biofuels (Edwards *et al.*, 2010).

It is necessary to clarify the difference between direct and indirect land use changes and understand their consequences. They are defined as follows:

- ***Direct Land Use Change:*** when demand for biofuels increases, farmers will have an incentive to meet this demand by producing more feedstock for biofuels production. This increase in production of feed- and foodstock can either be met by increasing the yield (output) of existing cropland (yield intensification), or increasing cropland area by cultivating previously uncultivated land. The higher the carbon stock of the specific vegetation the more carbon will be emitted into the atmosphere from cropland expansion. The release of carbon from expanding cropland for biofuel feedstock production in natural lands (due to burning or microbial decomposition of organic carbon stored in plants and soil) is known as the direct land-use change effect. It is theoretically possible to observe direct land-use change. This is done e.g. by keeping track of the land-use before potential cropland expansion. Since it is possible to observe the effect it is also possible to regulate. For example, in order for a specific biofuel to be sustainable, in the terminology of the EU Renewable Energy Directive, it must not be grown in an area, which used to contain high carbon stock.
- ***Indirect Land Use Change:*** when feedstock used for biofuels is produced on existing cropland there are no direct land use change effects. However, since agriculture production is displaced, the price of the displaced products will increase. Due to the relatively high substitutability between agricultural products the global food price will increase in response to the reduced supply. In turn, the increase in food prices creates an incentive to expand cropland for agricultural production. The release of carbon from

expanding cropland for production of displaced agriculture products, known as the indirect land-use change effect, could negate the carbon benefits associated with biofuel programs and affect the biodiversity, the soil quality, and the natural resources in a certain region (Perimenis *et al.*, 2011; Copenhagen Economics, 2011). In other words, indirect effects are mainly market related effects; changing market prices of different products is the link between biofuel promotion and indirect effects (Delzeit *et al.*, 2011; Zilberman *et al.*, 2010).

These aspects were taken into account for the first time in two studies published in 2008 (Searchinger *et al.*, 2008; Fargione *et al.*, 2008) which affected the good reputation of first generation biofuels. Using economic models they found that large scale biofuel production induced by current policies, in addition to the emissions accounted for in the production of feedstocks up to tailpipe emissions, are also responsible for other adverse impacts linked to changes in the use of land due to feedstock production (Di Lucia *et al.*, 2012). When these LUC emissions are taken into account, the GHG mitigation benefits of biofuels could be eroded or even negated and hence biofuels may create a "carbon debt" with a long payback period (Khanna *et al.*, 2011; Zezza, 2011).

These concerns on the negative consequences of dLUC and especially ILUC on GHG emissions, had impact on policymaking. Within the EU, in 2009 the Renewable Energy Directive (RED) and Fuel Quality Directive (FQD) were introduced with a set of sustainability criteria for biofuels and bioliquids used to achieve the Directive targets (Alhgren *et al.*, 2014). In particular, the RE Directive established that the GHG emission reduction from the use of biofuels compared to the use of fossil fuel shall be at least 35% for current biofuels and at least 50% from 1 January 2017 onwards (Art. 17(2)). From 1 January 2018, the emission reduction shall be at least 60% for biofuels produced in installations in which the production started on or after 1 January 2017. According to the RED, the value of carbon content for fossil fuel to consider in the comparison should be 83.8 gCO_2eq/MJ[1]. If we consider, for example, the current 35% level this means that a biofuel is not allowed to exceed ~54.5 gCO2eq/MJ emission in the whole production process. The EC has only determined standardized default values for direct emission produced during the whole production process (*cultivation*, *processing*, *transport* and *distribution*) which represent a conservative estimate of the actual values. Nevertheless, for the sake of the comparison with fossil fuels, in addition to these emissions, the ones coming from land use change must be taken into account.

[1] Other studies argue that this value is too low and instead a value of 90.3 gCO_2eq/MJ should be taken into account (Laborde, 2011).

At that time though, the LUC science was in its infancy (Finkbeiner, 2013), so that the RE Directive reports as following:

> The Commission should develop a concrete methodology to minimize greenhouse gas emissions caused by indirect land-use changes. To this end, the Commission should analyze, on the basis of best available scientific evidence, in particular, the inclusion of a factor for indirect land-use changes in the calculation of greenhouse gas emissions and the need to incentivize sustainable biofuels which minimize the impacts of land-use change and improve biofuels sustainability with respect to indirect land-use change.

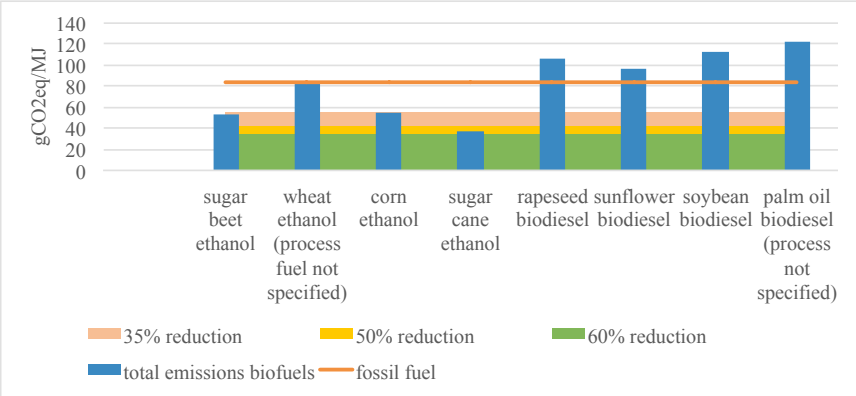
As a result, a large number of studies, using various economic models, were commissioned by the EC itself and other stakeholders, initially to measure the implications in terms of price trends (and their contribution to food crises) and subsequently to investigate the possible range of ILUC "coefficients" (or factors) linked to first generation biofuels production (Dunkelberg *et al.*, 2012; Gohin, 2013). These coefficients are generally stated in grams of CO_2 equivalent per Megajoule of biofuel (gCO_2e/MJ). The EU uses a 20-year period to sum the emissions due to land conversion, and also biofuel production on the converted land. The emissions have to be estimated over an extended period because some emissions are released slowly, while other emissions are released more quickly (Darlington *et al.*, 2013).

In 2012, the Commission released a proposal of Directive (COM 595, 2012) with the aim of improving the reporting of greenhouse gas emissions by obliging Member States and fuel suppliers to report the estimated indirect land-use change emissions of biofuels as a complement to the reduction of the usual life cycle assessment (LCA) of different biofuels pathways (Bernesson *et al.*, 2004; Mortimer and Elsayed, 2006; Hansson *et al.*, 2007; Zah *et al.*, 2007; Halleux *et al.*, 2008; Stephenson *et al.*, 2008; Lechon *et al.*, 2009; Thamsiriroj and Murphy, 2009; Herrmann *et al.*, 2012; Nanaki and Koroneos, 2012; Gonzalez-Garcia *et al.*, 2013; Malca *et al.*, 2014; Rasetti *et al.*, 2014). The Commission introduced ILUC factors relying on the results of a study of land use change emissions completed in 2011 by the International Food Policy Institute (IFPRI) for the Directorate General for Trade of the European Commission.

Therefore, total policy-estimated GHG emissions should be given by the sum of the default values of direct emissions established in the RED and the ILUC factors proposed by the COM 595 (Ahlgren *et al.*, 2014), as shown in Figure 1.

From this Figure we can see that if the proposed values were to be introduced into the EU policy to assess compliance with the minimum saving requirements,

Fig. 1. Biofuel policy-estimated emissions versus fossil fuel emissions[1]



[1] There are different values of emissions for wheat ethanol in the RE Directive depending on the type of production process considered; the lowest emission is obtained with straw as process fuel in CHP plant (26 g of CO2/MJ).
Source: our processing of data from RED and COM 595.

none of the (first-generation) biodiesel fuels would be able to fulfil the 35%, let alone the 50% and 60%, reduction requirement (Croezen *et al.*, 2010; Ahlgren *et al.*, 2014). Hence, a specific ILUC factor of 55 g of CO_2 per megajoule for oils plants would mean the end for biodiesel, plant oil-based HVOs and also for the not yet approved co-refining of plant oils in oil refineries (UFOP website[2]).

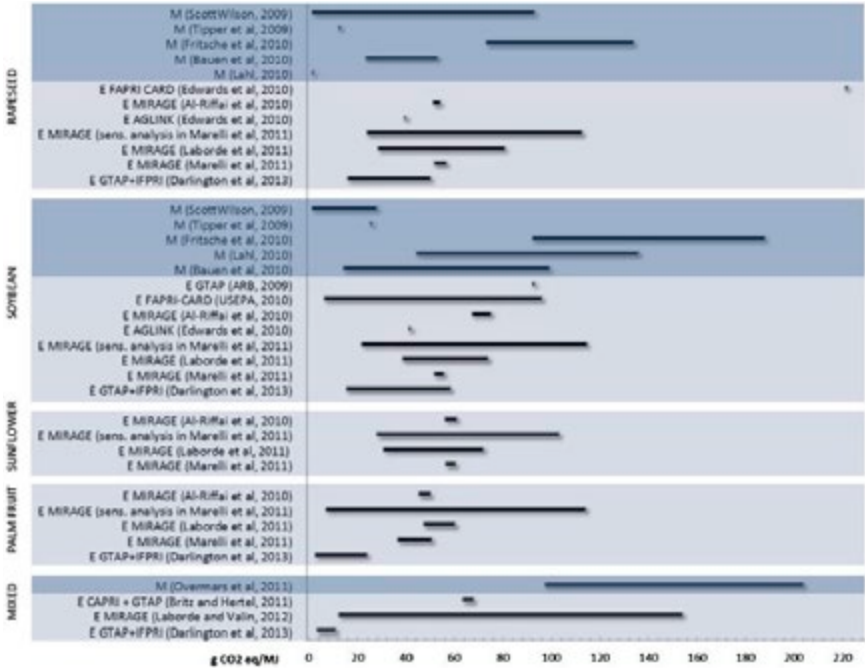
On the other hand, all types of ethanol fuels would be able to comply with the 35% minimum reduction requirement (except for wheat ethanol produced with a non specified process), whereas the 50% requirement will be difficult to fulfil for all but sugar cane ethanol. Instead, none of the first generation bio-ethanol fuels would be able to fulfill the 60% requirement.

However, many scientists questioned the validity of ILUC factors as efficient indicators of ILUC emissions for different reasons.

First of all, most models are not able to distinguish between dLUC and ILUC. This surprising statement also explicitly applies to the Laborde investigation (Laborde, 2011), the one used by the Commission for the ILUC proposal. The models are only able to measure total LUC (i.e. dLUC + ILUC). Why then we are talking about ILUC factor and not LUC factor? The reason is that dLUC is expected to approach zero by 2020 and hence ILUC will probably oc-

[2] <http://www.ufop.de/iluc-english/iluc-hypothesis/> (14/08/2014).

Fig. 2. Review of modelled greenhouse gas (GHG) emissions due to indirect land use change (ILUC) of biodiesel



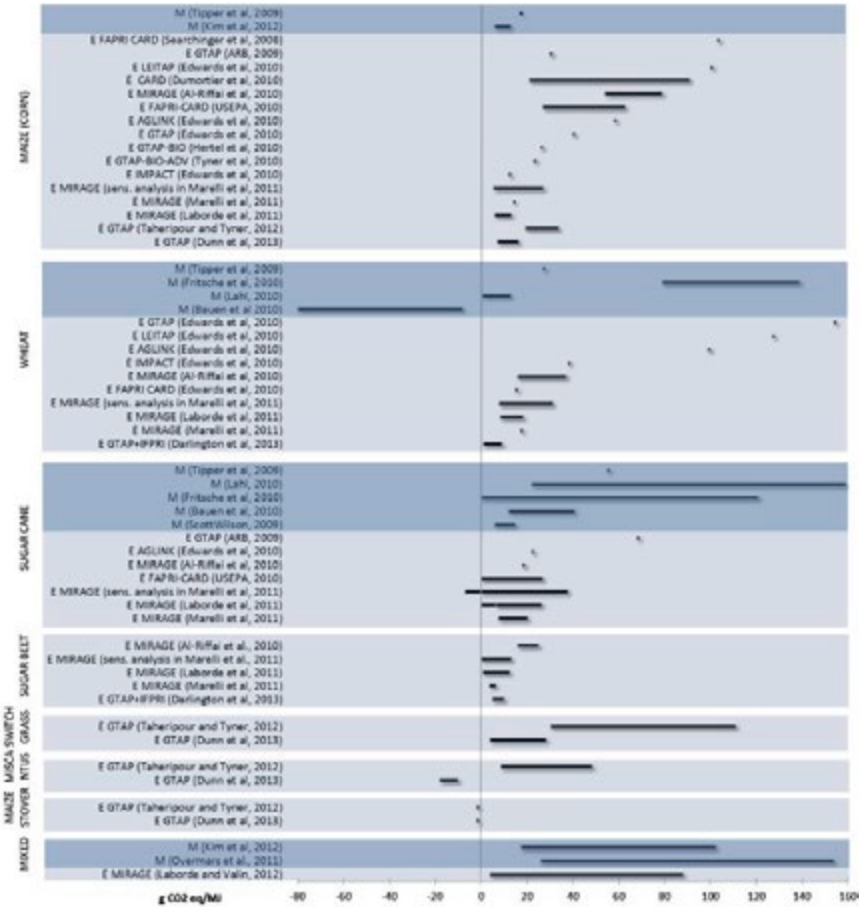
Source: Ahlgren *et al.,* 2014 (Values recalculated to a 20-year allocation base. Lines = intervals; dots= specific values. E = economic modelling and M = other modelling).

cupy a proportion of LUC so high to come very close to the (not very scientific) premise ILUC = LUC (Lahl, 2014).

Besides, the current ILUC estimations found in the existing literature are subject to enormous variations, even after attempts to harmonize these models (Edwards *et al.*, 2010).

Many attempts to calculate ILUC emissions have been made over time and in order to draw conclusions on the validity of this variable, many authors tried to compare the results of different models available in the international literature (Copenhagen Economics, 2014; Croezen *et al.*, 2010; DG Energy, 2010; Djomo and Ceulemans, 2012; Dunkelberg *et al.*, 2011; Edwards *et al.*, 2010; Lahl, 2010; Ostwald and Henders, 2014; Prins *et al.*, 2010; Berndes *et al.*, 2011; Dehue *et al.*, 2011; Malins, 2012; Lahl, 2014; Warner *et al.*, 2013; Wicke *et al.*, 2012; Di Lucia *et al.*, 2012). Not all these reviews have the same level of completeness and clarity.

Fig. 3. Review of modelled greenhouse gas (GHG) emissions due to indirect land use change (ILUC) of ethanol biofuels



Source: Ahlgren *et al.,* 2014 (Values recalculated to a 20-year allocation base. Lines = intervals; dots= specific values. E = economic modelling and M = other modelling).

The overview of LUC-related GHG emissions determined by different studies proposed here and provided in Figure 2 for biodiesel fuels and in Figure 3 for ethanol fuels, is based on the work of Ahlgren *et al.* (2014) since it is one of the most recent and complete.

The review shows that within the selected sample of papers, most modeling was carried out for ethanol, especially with maize as feedstock and that

most studies employed general or partial economic equilibrium models.

The first thing that becomes clear looking at the figures is that large ranges in LUC-related GHG emissions are found within and across the different types of models and for the different feedstock conversion routes (Wicke *et al.*, 2012).

The largest variation in results was detected for wheat ethanol and soybean biodiesel. However, over time there was some convergence of results, particularly regarding ethanol from maize, which has undergone much modeling effort. Sugarcane and wheat showed similar patterns. In general, the values reported for biodiesel fuels showed greater variation than those for ethanol (Ahlgren *et al.*, 2014).

The ranges for the ILUC factors published are really enormous. Just the ILUC factor of biofuels (notwithstanding their GHG values for agricultural production, fuel production etc.) can be either some 200% below or some 1700% above the fossil fuels value. It can be positive or negative value. This clearly indicates the absence of any scientific robustness for claiming a particular ILUC factor (Finkbeiner, 2013).

Variations in estimated GHG emissions from biofuel-induced LUC are driven by the lack of a common modeling structure (different approaches and models exist), the differences in scenarios assessed, the assumptions that were made, distinct definitions (LUC), time horizon considered, disparities in data availability and quality, accounting for the effects of by-products and so on (Copenhagen Economics, 2011; Warner *et al.*, 2013; De Rosa *et al.*, 2014).

Therefore, comparing the results obtained from these studies is really a difficult and risky task.

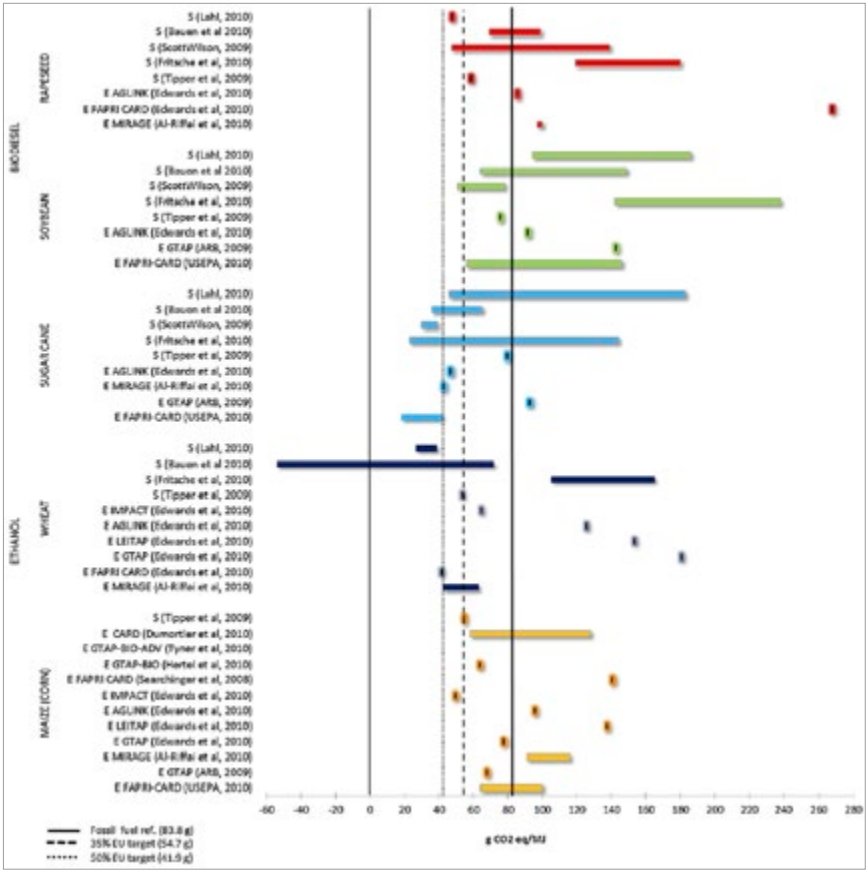
However, an interesting trend in the development of ILUC estimations based on economic models over time has been observed. Even though the time series is still short and all the uncertainties discussed above obviously apply to this trend as well, it is striking that refined and improved models in newer studies predict a lower ILUC impact compared to earlier esteems (Finkbeiner, 2013, De Rosa *et al.*, 2014).

Despite the high variability of results presented above, it has been observed that adding the direct emissions from the RE Directive to these modelling ILUC results, we can draw conclusions, about compliance with the minimum saving requirements, in many cases similar to those already observed for policy results (Fig. 1).

This is clear looking at Figure 4, which shows total biofuel emission values on the base of a literature review made by Di Lucia *et al.* (2012) which considered the same studies presented above, with the exception of more recent researches.

From this figure we can see that, according to many studies ethanol fuels should be able to comply with the 35% minimum reduction requirement, where-

Fig. 4. Total biofuels and fossil fuels GHG emissions including RE Directive emission savings requirements



Source: Di Lucia *et al.*, 2012.

as the 50% requirement will be difficult to fulfill for all but sugar cane ethanol (with a couple of results in favor to wheat ethanol too). Ethanol fuel results seem to be, at a certain degree, in line with the policy values (Ahlgren *et al.*, 2014).

In the case of biodiesel fuels, there is an even bigger variation of results from the models; in some cases, the policy estimates are higher than the range of values reported in the modeling exercises, in some other cases it is the contrary. In any case, it is quite safe to state that none of the biodiesel fuels would be able to fulfill the GHG reduction requirements of the EU directive.

3. Impact of biofuels on food commodity price

The price boom that emerged in the mid-2000s has been especially marked for agricultural commodity. In particular, the prices have been rather stable until the end of 2006, while from 2007 to 2008, they more than doubled, declining again in 2009, reaching the 2006 level. In the second semester of 2010, the price registered again an increase followed by a slight fall in 2011. A vast literature has emerged on the causes of this boom (The World Bank, 2008; Ranswant *et al.*, 2008; Sexton *et al.*, 2008; Trostle, 2008Abbott and di Battisti, 2009a; Balcombe, 2009; Sarris, 2009; Gilbert, 2010; Gilbert *et al.*, 2010; De Schutter, 2010; Jacks, 2010; Huchet-Bourdon, 2011; Muller *et al.*, 2011; OECD-FAO, 2011) some of which have been hotly debated as the role of speculation, the increased energy prices, the export policy changes, the declining US dollar, and especially, in the case of food commodities, the biofuels' role.

In recent years, the role of biofuel in the determination of the high agricultural commodity prices and in particular, the price linkages between the food, energy and biofuel markets, have become one of the issues most widely debated by energy, environmental and agricultural economists interested in the question of the sustainable development of biofuels (Kristoufek *et al.*, 2012a; Schimmenti *et al.*, 2012). The so-called «food crisis», which was characterized by sharply increasing prices for agricultural commodities and crude oil as well as for retail fuels and biofuels, captured a great deal of academic and political attention during 2008 and this debate on food versus biofuel issues has continued in more recent years affecting policies (Vacha *et al.*, 2012).

To date existing literature has fallen into two categories: one on the relationship between food commodity pricies and biofuel prices and another on the impact of increased biofuel production/consumption on food commodity prices. The first problem is investigated using the Time-series econometrics methodology (Zilberman *et al.*, 2012); the latter relies on the use of partial or general equilibrium models (Serra and Zilbermann, 2013).

3.1 Impact of biofuel prices on food commodity price

Although a great number of studies and reports investigate the dynamics of price level links between the commodity and biofuel sectors, current research has mainly concentrated on the US and Brazilian ethanol markets, while the European biodiesel market has not received much attention (Bentivoglio *et al.*, 2014). The biofuel-related price transmission literature has focused on studying price level links using cointegration analysis and VECM (Vector Error Correction Model). More recently, price volatility interactions

have also been assessed by means of multivariate versions of ARCH (AutoRegressive Conditional Heteroskedasticity) or GARCH (generalized autoregressive conditional heteroskedasticity) models.

The link between EU biodiesel and agricultural commodity prices has been examined by Busse *et al.* (2010 and 2012), Hassouneh *et al.* (2012), Kristoufek *et al.* (2012b) and Vacha *et al.* (2012).

Busse *et al.* (2010) investigated vertical price transmission in the biodiesel supply chain during the rapid growth in German biodiesel demand from 2002 until its decline in 2009, by focusing on the connections between the prices of rapeseed oil, soy oil, biodiesel and crude oil. They found evidence of a strong impact of crude oil prices on biodiesel prices, and of biodiesel prices on rapeseed oil prices. However, in both cases, the price adjustment behavior was found to be regime-dependent. In a later paper, using a methodological approach which includes a regime-dependent MS-VECM, Busse *et al.* (2012) found evidence of cointegration between diesel and biodiesel prices, the latter being the endogenous variable, as well as between biodiesel, soybean and rapeseed prices, with the latter being the endogenous variable.

Hassouneh *et al.* (2012) studied the Spanish biodiesel industry. They found not only that there is a long-run equilibrium relationship between biodiesel, sunflower and crude oil prices but also that biodiesel is the only variable that adjusts to deviations from the long-run relationship and that sunflower oil prices are influenced by energy prices through short-run price dynamics.

Kristoufek *et al.* (2012b) investigate the relationship between biodiesel, ethanol and related fuels and commodity prices in the US and Germany using weekly, monthly and quarterly data. The analysis is based on minimal spanning and hierarchical trees. They find that biofuel is affected by food and fuel prices. However, biofuel prices show a limited capacity to determine food prices. The same authors also find out that the relationship between prices varies according to the data frequency used.

Vacha *et al.* (2012) analyzed the interconnections between ethanol and biodiesel systems and a wide range of related commodities, using wavelet coherence analysis. They find biodiesel prices to be more connected to fuel prices (German diesel), while ethanol is more related to food prices (corn).

Relatively to the Brasilian ethanol market and in particular the link between sugar and energy market, ethanol and crude oil/gasoline, was examined by Rapsomanikis and Hallam (2006), Balcombe and Rapsomanikis (2008), Serra *et al.* (2011b) and Serra (2011).

Rapsomanikis and Hallam (2006) and Balcombe and Rapsomanikis (2008) use ethanol, sugar and crude oil prices to investigate the Brazilian ethanol industry. Both articles rely on generalized (non-linear) versions of error-correction models. While sugar–oil and ethanol–oil are found to be nonlinearly co-

integrated, ethanol–sugar prices are linearly co-integrated. Both articles provide evidence that crude oil prices drive long-run feedstock price levels, while the latter drive long-run biofuel prices. The Brazilian ethanol industry is not found able to influence crude oil long-run price levels.

A study on Brazil by Serra *et al.* (2011b) used weekly international crude oil and ethanol and sugar prices, observed from July 2000 to February 2008, to assess volatility spillovers in Brazilian ethanol and related markets. They found that the ethanol prices are positively related to both sugar and oil prices in equilibrium. Markets transmit the volatility in the oil and sugar markets to ethanol markets with minimal transfer of volatility in the other direction.

Another study on Brazil by Serra (2011) uses nonparametric correction to time series estimations and supports the long-run linkage between ethanol and sugarcane prices and finds that crude oil and sugarcane prices drive ethanol prices and not vice versa.

Relatively to the most recent time-series studies on US ethanol market, Zhang *et al.* (2009) focus on volatility of ethanol and commodity prices using cointegration, VECM and mGARCH models. The authors analyze weekly wholesale price series of the US ethanol, corn, soybean, gasoline and oil from the last week of March 1989 through the first week of December 2007. They find that there are no long-run relations among fuel (ethanol, oil and gasoline) prices and agricultural commodity (corn and soybean) prices in recent years. The same authors further analyze long- and short-run interactions with a use of cointegration estimation and vector error corrections model with Granger-type causality tests (Zhang *et al.*, 2010). They examine corn, rice, soybeans, sugar, and wheat prices along with prices of energy commodities such as ethanol, gasoline and oil from March 1989 through July 2008. They find no direct long-run price relations between fuel and agricultural commodity prices, and only limited if there are any direct short-run relationships.

Tyner (2010) finds that since 2006, the ethanol market has established a link between crude oil and corn prices that did not exist historically. He finds that the correlation between crude oil and corn prices was negative (–0.26) from 1988 to 2005; in contrast, it reached a value of 0.80 during the 2006–2008. However, only the price series are analyzed, which raises serious questions about stationarity of the data.

Serra *et al.* (2011a) uses autoregression analysis to identify the relationship between corn, ethanol, gasoline, and oil prices in the United States, using monthly data from 1990–2008. They found that the four prices are related in the long run through two cointegration relationships: one representing the equilibrium within the ethanol industry and the other representing the equilibrium in the oil-refining industry. The ethanol market provides a strong link between corn and energy markets, and the price of ethanol increases as the

prices of both corn and gasoline increase, with the price of corn being the dominant factor when it is relatively high. Thus, the corn biorefineries may suffer losses when corn prices are high if the price of ethanol does not fully adjust to the rise in the price of corn. Saghaian (2010) supports cointegration between crude oil, ethanol, wheat, corn and soybean prices. Crude oil drives corn, soybean, wheat and ethanol equilibrium prices, while ethanol affects long-run corn prices.

Wixson and Katchova (2012) show on monthly US data from 1995 to 2010 that price of corn Granger-causes price of ethanol and that ethanol does not Granger-causes wheat.

Qiu *et al.* (2012) using a structural VAR model, provide evidence that fossil fuel and biofuel market shocks do not spill over grain prices.

Du and McPhail, 2012 conclude that ethanol, gasoline, and corn prices are found to be more closely linked. Specifically, ethanol (corn) shocks have the largest impact on corn (ethanol) price. The strengthened corn-ethanol relation can be largely explained by the new developments of the biofuel industry and related policy instruments.

All studies considered provide evidence of integration between the market of fossil fuel, biofuels and related agricultural commodities. Nevertheless, conclusions appear to be mixed and the results show that changes in biofuel prices have limited impact on food prices.

3.2 Impact of biofuel production on food price and security

Rapid growth in biofuel production has the potential to affect food security at both the national and household levels mainly through its impact on food prices. Expenditures on food amount to a large part of the budget of the poorest households, and so rising food prices threaten them with food insecurity, which is the lack of secure access to enough safe and nutritious for normal growth and development and for an active, healthy life (Timilsina and Shrestha, 2010).

One of the major forces through which the biofuel may contribute to the increase of the food prices is the diversion of land use from food-crops production to the production of biofuel feedstock (Janda *et al.*, 2011). This phenomenon takes place because increased demand of energy crops results in higher prices; higher energy crops prices in turn provide greater incentives for farmers to increase acreage. As more hectares are converted to the production of energy crops, fewer hectares are available for food crops that compete for the same land (Alexander and Hurt, 2007). Thus, the resulting scarcity of food crops drives food price inflation.

According to the reconstruction of von Witzke and Noleppa (2014), in the year 2008 the World Bank tried to give an explanation to these agricultural commodity price peaks and published a study in which more than 70% of the price increase at that time was attributed to the growth in global biofuel production (Mitchell, 2008). This study was harshly criticized for overestimating the impact of growing global biofuel production on agricultural commodity prices.

Another study published by the World Bank two years later, stated that the earlier study was likely to have overestimated the impact of biofuel production on agricultural commodity prices (Baffes and Haniotis, 2010). They argued that worldwide, biofuels accounted for only 1.5 percent of the area under grains/oilseeds and this raises serious doubts about claims that biofuels account for a big shift in global demand. Additionally, they reported that the effect of biofuels on food prices has not been as large as originally thought, but the use of commodities by investment funds may have been partly responsible for the 2007/08 spike.

An impact analysis, prepared by IPTS[3] (Institute for Prospective Technological Studies)[4] in 2008 shows that world market prices for biodiesel feedstocks are more sensitive to the EU's biofuels policies. This is because ethanol production is a relatively small component of total demand for the agricultural commodities that also serve as ethanol feedstocks, whereas demand for oilseeds and vegetable oils for biodiesel is a much larger component of total world demand for biodiesel feedstocks. They conclude that any direct pressure on global food markets due to EU biofuel policies will affect vegetable oils rather than grains or sugar (Fonseca *et al.*, 2010).

The OECD/FAO Outlook (2011) sustains that average crop prices over the next ten years are projected to be above the levels of the decade prior to the 2007/08 peaks, in both nominal and real terms. For example, average wheat and coarse grain prices are projected to be nearly 15-40% higher in real terms relative to 1997-2006, while for vegetable oils real prices are expected to be more than 40% higher.

Based on their review of 25 studies, Abbott *et al.* (2009b) identified three broad sets of forces that drove up food prices in 2008: the global changes in production and consumption of key commodities, the depreciation of the dollar, and the growth in the production of biofuels. Even in their follow-up study after the financial crisis, they found out that the key drivers of food prices remain the same: crop supply and utilization, the exchange rate and world macroeconomic factors, and the agricultural-energy linkage through the biofuel market.

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[3] Web site: <http://ipts.jrc.ec.europa.eu/>.

[4] The study was prepared for DG Agriculture and Rural Development (DG Agri).

In their synthesis of several studies that assessed the impact of biofuel development on food prices, Gerber *et al.* (2009) found that it is difficult to reconcile the various calculations of the impacts of biofuel production on food and commodity prices to-date. This is largely due to the intricate set of assumptions, the differences in the baseline scenario, and the projection horizon they are built upon. However, despite considerable differences in projection results, methodologies and assumptions, some common trends can be observed: the latest EU and US biofuel programs are expected to raise prices of vegetable oils the most, with smaller price increases for corn, wheat, and soybean; whilst the price of oilseed meals is widely predicted to decline. They also conclude that the future impact (i.e. beyond the short-term crisis) of the current biofuel policies and inherent production trends on food bills should decrease and 2007/08 should be considered the peak of food price growth.

Ajanovic (2011) considers that the most important impact factors on feedstock prices are biofuel production, land use, yields, feedstock, and crude oil prices. Ajanovic concludes that in the period 2000/2009, the increase, or better the volatility, of commodities prices has not been the only consequence of continuously increasing biofuel production, but by far the largest part of these volatilities was caused by other impact parameters such as oil price and speculation.

Sexton *et al.*, 2008 conclude that biofuels have a nontrivial impact on food security. They argue that underinvestment in research and overregulation of agricultural biotechnology led to a decline in productivity growth that is also responsible for higher prices and must be reversed if global food and energy security are to improve.

Most of the analysis reviewed in this section suggests that increased biofuel production could potentially have a significant impact on food-commodity price. However, although results vary, there is a broad agreement that the price increases are due to several factors including but by no means restricted to biofuels.

4. Conclusion

The sustainability of biofuels derived from agricultural biomass is widely debated nowadays. On the one hand the production of biofuels should ensure energy security for the historically non-oil producing countries, on the other hand it turns on the food versus fuel debate and the land use chance issue, generally responsible for a net loss in GHG emissions savings related to biofuel production and consumption.

The overview of LUC-related GHG emissions determined by different studies showed results with large variations within and across different types

of models and for different feedstock conversion routes. The wide variation in estimates suggests that the measurement of ILUC is highly uncertain (Khanna *et al.*, 2011). There is agreement in the scientific community that the uncertainty of current ILUC factor is way beyond a level that is usually aimed for in quantitative science. Hence, scientific results do not deliver the answer from which policy makers easily can make policy options (Di Lucia *et al.*, 2012). There is a conflict between the demand from EU policymakers for exact, highly specific values and the capacity of the current models to supply results with that level of precision. As there is no consensus on ILUC predictions, it is arguable that any choice of ILUC emission factors will, to a large extent, be based on subjective decisions, even when objectivity is endeavored (Copenhagen Economics, 2014). This is why the European Commission attempt to impose very specific ILUC factors, is clearly at odds with the uncertainty in results emerging from modelling exercises to date (Ahlgren *et al.*, 2014). As a consequence, using such uncertain ILUC factors as a basis for regulation could weaken the credibility of EU biofuel policy (Copenhagen Economics, 2014).

Concern over competition between biofuels and food production has been particularly acute, given the overwhelming use of food and feed crops for biodiesel production (HLPE, 2013). To date, the literature has been very wide-ranging. According to Hochman *et al.* (2011) and Kristoufek *et al.* (2011), the relationship between fuels and agri-food commodity prices depends on the market analysed (EU, US and Brazilian context), on the types of commodities, on the specification of the model and on the time series data and observation period (weekly, monthly or quarterly). Moreover, the dynamics of commodity prices are complicated and different factor may be affecting these markets (Nazlioglu *et al.*, 2012).

The various calculations of the impacts of biofuel production on the mid-term projections of food and agricultural commodity prices are difficult to reconcile. This is largely due to the specific assumptions underlying each model, the scope of the studies (national/international), their time horizon, the choices of different policy scenarios, or even more simply the definition of «food prices» and of aggregate commodity prices (Gerber *et al.*, 2008). For similar reasons, studies evaluating the impact of biofuel production on food and commodity prices to date do not provide a clear consensus.

On the one hand, this review underlines that the time-series analysis linking food and fuel prices shows that biofuel prices are increasing with both fuels and food prices, but it also shows that changes in biofuel prices have little impact on food prices. On the other hand, the impact of an increasing production of first generation biofuels on food prices is not negligible and varies across crops and locations. For example, if biofuel crops are cultivated exclusively on set-aside lands or marginal lands, with little competition with food

crops, the impacts on food prices can be theoretically minimal. But in reality biofuels may still compete for other resources like water or labor and thus impact food production (Rajagopal *et al.*, 2007).

The main findings, that emerged from the literature review, have important policy implications. In order to promote biofuels that deliver substantial GHG savings (including ILUC emissions) and reduce competition with food crops, the Commission developed a Proposal of Directive (COM 595, 2012) with the aim of limiting the contribution of first generation biofuels towards attainment of the targets in the RED in favor of 2nd and 3rd generation biofuels. However, the effectiveness of this policy measure has been criticized since the production of advanced biofuels is still not economically sustainable, so at the moment 1st generation biofuels seem to be the most viable agro-industrial chain.

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Tania Smaniotto Silveira,
Diuslene Rodrigues Fabris,
Antonio Nogueirra Neto,
Carlos Alberto Gonçalves Jùnior,
Barbara Françoise Cardoso,
Pery Francisco Assis Shikida

Regional Development and Agribusiness at State University of West of Paranà (UNIOESTE), Toledo, Paranà, Brasil, CEP 85

Keywords: Agricultural and livestock sector, Input-output matrix, Brazilian economy.
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Input-Output Analysis for agricultural and livestock sector in the Brazilian economy

This paper aims at assessing the behaviour's evolution in the agricultural and livestock sectors in the Brazilian economy by domestic input-output matrix for 1995, 2000, 2005 and 2009. These matrices were used to calculate the forward and backward linkages indices as well as the production, employment and income generators, enabling the analysis of the relationship among the agricultural and livestock sector and other sectors. The results showed that the agricultural and livestock sector is gaining importance in the Brazilian economy, especially as input for other sectors. Furthermore, the production, employment and income generators corroborated the importance of this sector, especially the employment generator, which depicts that this sector is the major employment generator among the sectors.

1. Introduction

In the early 90s profound changes affected the Brazilian economy, standing out the fiscal crisis of the Federal Government, leading to measures to reduce public spending; trade opening, which allowed greater competitiveness of domestic goods against international goods; and the withdrawal of the subsidy of some agricultural and livestock activities – the subsidy policy was replaced by policies regulating production and subsequently by deregulation. Macroeconomic policies became more specific to the productive sectors, which were more exposed to competitive markets and product reality, due to greater integration of trade with other countries (Jank *et al*., 2005).

The economic measures adopted for these transformations have also established the reduction in credit granting by official sources and hence the scarcity of resources for agricultural and livestock research and extension. These measures resulted in the increase of interest rates, reduction of existing rural credit subsidies and policies to guarantee minimum prices. In addition, the State began a process of deregulation of the economy, no longer regulating some productive activities and extinguishing companies and federal authorities (Bacha, 2004).

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However, even with all the changes occurring in the Brazilian economy, the agricultural and livestock sector showed a real growth rate of the gross value of production (GVP) of 88.4% between 1995 and 2012. Within the periods analyzed in this article, the growth of this sector's GVP was 15.2% between 1995 and 2000; 28% (2000-2005); 17.3% (2005-2009); and 9% (2009-2012) (FAO, 2014).

Given the promising and challenging scenario that the Brazilian agricultural and livestock sector has shown, this study aims at assessing the evolution of the behaviour of the agricultural and livestock sector in the Brazilian economy through input-output analysis for the years 1995, 2000, 2005 and 2009.

Therefore, this article is divided into five sections, including this brief introduction. Section 2 discusses the importance of the agricultural and livestock sector for the Brazilian economy, highlighting its production and participation as input for other industries. Section 3 presents the input-output matrix, which is the method of analysis used in this research. The fourth section presents the results and their discussion. The fifth section presents the main conclusions and suggestions for further research.

2. The importance of the agricultural and livestock sector in the brazilian economy

In economic theory, the role of agriculture for the economic growth of a country has been highlighted by various authors since the 1960s such as William Petty (1623-1687), François Quesnay (1694-1774) (Petty, 1983), Hwa (1988) and Bacha (2004). Hwa (1988) carried out a statistical analysis on the contribution of agriculture to the economic growth and concluded that agricultural and livestock growth, although strongly linked to industrial growth throughout the development process also contributes to global economic growth, due to favorable impacts that it produces in total productivity of the factors.

According to Pimbert (1999) and Bacha (2004), the agricultural and livestock sector has five important basic functions for the development of a country: (i) to provide capital for the expansion of non-agricultural and livestock sector; (ii) to provide workforce for the growth and diversification of activities in the economy; (iii) to provide foreign exchange for the purchase of inputs and capital goods required for the development of economic activities; (iv) to constitute a consumer market for the products of the non-agricultural sector; and (v) to provide input needed for industrial development.

Brazilian agricultural and livestock sector stands out not only for its economic role, but also for social aspects (employment) and for national territory occupation by exploring livestock, crops such as sugarcane and coffee and timber harvesting.

Data from FAO (2014) show that gross domestic production (GDP – at constant 2006 prices) of the Brazilian agricultural and livestock sector increased from R$ 47.3 billion in 1990 to R$ 62 billion in 1995, reaching R$ 73.8 billion in 2000, R$ 95 billion in 2005 and R$ 115.1 billion in 2010. Between 1990 and 1995 there was a growth of 30.9%, while from 1995 to 2000 this percentage accounted for 19.0%, between 2000 and 2005 the growth was 28.7%, and from 2005 to 2010, 21.1%.

Small farmers, those who have properties of until 100 ha, represent 91% of all agricultural and livestock properties and occupy 21% of all the agricultural land. They produce about 70% of all food produced in Brazil, participate in the economy with 35% of the Brazilian GDP, and employ 40% of the economically active workforce. With respect to food production, small farmers produce about 87% of cassava, 70% of beans, 60% of milk, 59% of pig meat, 50% of poultry, 46% of maize, 38% of coffee, 34% of rise, 30% of cattle meat, and 21% of wheat (IBGE, 2006).

In the 2010/2011 and 2011/2012 harvests, Brazilian grain production increased from 122.5 million tons to 163 million tons. The farming area of these crops increased 4.3%, while the average yield increased from 2.6 tons/ha to 3.3 tons/ha, i.e. 26.9%, also increasing productivity gains. Exports of the agriculture and livestock sector, according to Central Bank of Brazil (Bacen, 2014), accounted for about 80% of Brazil's total exports in 2012, generating approximately 41.1% of the total revenue from exports, i.e. US$ 83.4 billion. In terms of revenue, the main products exported were cereals and soybean, whose revenue was US$ 26.1 billion, followed by meat sector (US$ 14.9 billion) and sugarcane sector (US$ 15.0 billion).

In general, Brazilian agricultural and livestock sector has played an important role in the world economy. According to FAO (2014), in 2012, Brazil was the world leader in the production of sugar, coffee and orange juice; the second largest world producer of soybeans, cattle meat, tobacco and ethanol; the third largest world producer of poultry and corn; the fourth largest world producer of pig meat, soybean oil and soybean meal; and the fifth largest world producer of cotton. In terms of trade, Brazilian agricultural and livestock sector also has been important in the international context. In 2012, Brazil was the world leader in the exportation of orange juice, representing 85% of the world trade, sugar (50%), soybeans (40%), poultry (38%), coffee (27%) and tobacco (11%); the second largest world exporter of cattle meat, representing 39% of the world trade, ethanol (27%), maize (25%), soybean oil (19%) and soybean meal (8%); the fourth largest world exporter of pig meat, representing 22% of the world trade, and cotton (11%).

According to Adler and Sosa (2011), international commodity prices showed an upward trend since 2001, and the explanation for this is the influ-

ence of the acceleration of the economic activity in major world economies and the growth of income in emerging economies, especially in Asia, where increased demand for primary products intensified the growth of basic commodities. Even with the shock in agricultural prices that occurred from May 2007 to July 2008 and from June 2010 to February 2011, international prices remained high. Fact perceived by the increase of 44.5% and 72.4%, respectively, of the Commodities Index-Brazil (CI-Br) Agriculture and Livestock, measured in American dollars in these periods. It is worth mentioning that the shock in agricultural prices was due to weather problems, which reduced the global supply of grains and oilseeds.

In July 2012, the CI-Br Agriculture and Livestock recorded a monthly increase of 11.4% and a decrease of 0.94% in August. The evolution of this index reflected the rise in agricultural prices, particularly in wheat prices (33.7%), maize (33.2%), and soybeans (19.2%), reflecting the drought in the USA and some countries in Eastern Europe, especially Russia (Gruss, 2014).

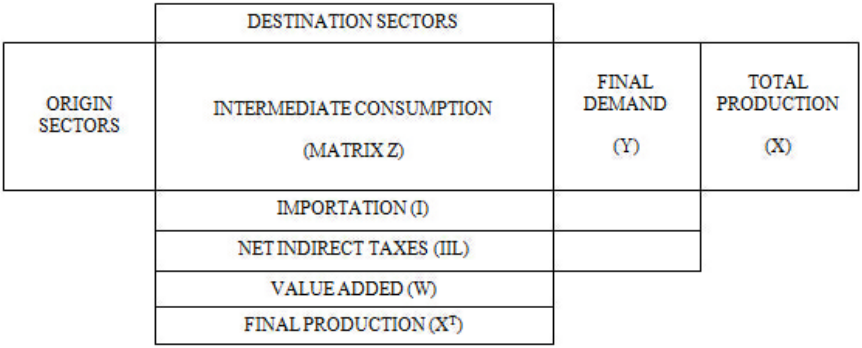
The favorable scenario for the Brazilian agricultural and livestock sector is due, in part, to the fact that there was an increase in agricultural borders, i.e. areas that were not occupied with agriculture, such as the areas in the Northeast and Central West regions. Insofar as the agricultural border was extended to Piauí, Bahia, Maranhão and Tocantins, there was a pressure on the agricultural and livestock sector, which required a new infrastructure for those regions, enabling their growth. Since then, there have been stimuli to improve the living standard of urban centers, significantly altering the landscape of these regions and promoting development. In fact, the Brazilian agriculture and livestock has transformed large areas of the country, from the productive land use to the qualification of the labor employed in agricultural and livestock activities (Barros, 2014).

However, the importance of the agricultural and livestock sector in the Brazilian economy should not be measured solely by GDP, production or exports, because its growth also induces other sectors of the economy such as food industries, footwear, textiles, financial activities, equipment supply, insurance, and other inputs. Thus, the relationship of the agricultural and livestock sector with other sectors of the economy is equally important to measure the prestige of the agricultural and livestock sector in the domestic context (Jank *et al.*, 2005).

Bacha (2004) complements stating that agriculture has always provided the input for the process of industrialization and there is a strong intensification of the process of linking agriculture with other sectors of the economy that influence and are influenced by the production of the agricultural and livestock sector.

Costa *et al.* (2013) complements affirming that the stimuli in final demand (via exports) in some specific sectors of agribusiness (forward linkage of the

Fig. 1. Basic input-output relationship among sectors of the economy



Source: Adapted from Guilhoto (2000).

agricultural and livestock sector) cause an increase in the value of production, the share of GDP, and employment generation, demonstrating the degree of importance of the agricultural and livestock sector for the economic growth.

3. Theory and methodology: Input-Output Matrix

3.1 The Input-Output Matrix

Input-output analysis is the name given to an analytical framework developed by Wassily Leontief in the late 1930s, in which the primary purpose was to analyze the interdependence of industries in an economy. In other words, the means used for the analysis of inputs used by the economy for the production of the final product, therefore the product of a sector can be the input of another (Leontief, 1966).

The economic sectors are grouped into a matrix in which the rows record the outflow of production, showing how the production of an activity sector is distributed among the other sectors of the economy. The columns of the matrix record the necessary inputs for production, showing the structure of inputs used by each sector of the productive activity.

As shown in Figure 1, each row of the matrix *Z* indicates the intersectoral flow, i.e. the intermediate consumption of goods and services in each sector. The matrix *Y* records the final consumption, divided into household consumption, government consumption, exports, gross fixed capital formation and changes in inventories. The lines below the *Z* and *Y* matrices record import spending (I), net indirect taxes (IIL) and value added (W) (compen-

sation for the production factor services). The totals of the columns and the rows of the matrix (vector X and X^T) record the total output of each sector, which should be equal, indicating the balance of the economy, where the costs of each sector are equal to their respective revenues.

3.2 Rasmussen-Hirschman and Pure linkage indices

From the basic Leontief model, you can determine which sectors have greater linkage power within the economic system through the methodology proposed by Rasmussen and Hirschman. This methodology allows calculating the backward linkage indices – that would provide how much the respective sector demands from the other sectors of the economy – and the forward linkage indices – that would provide the quantity of products demanded from other sectors to the respective sector. It is noteworthy that Rasmussen and Hirschman forward and backward linkage indices have long been applied, widespread by authors such as McGilvray (1977), Hewings (1982), Guilhoto *et al.* (1996) among others. These measures originally created by Rasmussen (1956), were used as a means of identifying key sectors by Hirschman (1958).

The backward linkage index U_j, or the dispersion power of the sector, can be estimated by the equation:

$$U_j = [B_{(*j)}/n]/B^* \quad (1)$$

The forward linkage index U_i, or dispersion sensitivity, can be estimated by the equation:

$$U_i=[G_{i*}/n]G^* \quad (2)$$

Where B is the Leontief inverse matrix, B^* is the average of all elements of B, B_{*j}, is the sum of a typical column, is the sum of a typical line and n is the number of sectors. G is the Ghosh matrix, where $G = (I - F)^{-1}$, F is the matrix of row coefficients derived from the intermediate consumption matrix, G^* is the average of all elements of G, and G_{i*} is the sum of a typical line of G.

Thus, for the interpretation of the results of these equations, it can be emphasized that values greater than the unity for the forward and backward linkage indices in a respective sector means that it has linkages above the average of the economy as a whole, so they are considered key sectors for the economy.

However, Rasmussen-Hirschman linkage indices ignore the different levels of production for each sector of the economy. To improve this approach, Guil-

hoto *et al.* (1996) developed a new pure linkage index called GHS with new definitions for backward linkage (PBL) and forward linkage (PFL):

$$PBL=\Delta_r A_{rj}\ \Delta_j\ Y_j \tag{3}$$

$$PFL=\Delta_j A_{jr}\Delta_r Y_r \tag{4}$$

PBL indicates the pure impact of the value of total production in sector *j* for the rest of the economy. PFL indicates the pure impact of the value of total production from the rest of the economy *r* over the sector *j*. The impact is considered pure because it is free of demand for inputs produced by sector *j* to sector *j*, and free of returns to the sector *j* from the rest of the economy, and vice versa. As the PBL and PFL are expressed in value of production, the total for the economy can be obtained by adding both in the following way:

$$PTL = PBL + PFL \tag{5}$$

Once the pure linkage indices are expressed in value of total production, it is necessary to normalize them so that you can compare these indices in different periods. Normalization is performed by dividing the value of production in each sector by the average value of the economy.

The normalized pure backward linkage index is calculated as follows:

$$PBLN = PBL \Big/ \left(\sum_i^n PBL / n\right) \tag{6}$$

The normalized pure forward linkage index is represented by:

$$PFLN = PFL \Big/ \left(\sum_i^n PFL / n\right) \tag{7}$$

And the normalized pure total linkage index of each sector is represented by:

$$PTLN = PTL \Big/ \left(\sum_i^n PTL / n\right) \tag{8}$$

Considering the normalization of indices, it is necessary to emphasize that the pure index of total linkage is no longer called by the sum of the pure forward and backward linkage indices, once its value is not expressed in current values.

These techniques allow the decomposition of impacts among sectors, enabling an analysis of the integration in a domestic economy. In addition to identifying the key sectors, it is possible to identify the sources of changes in the economy.

3.3 Production, Employment and Income Generators

From Leontief model, one can estimate the direct and indirect impacts that a change in demand generates on production for each sector of the economy (Miller and Blair, 1985). Thus, we have:

$$\Delta X = (I - A)^{-1}\Delta Y \tag{9}$$

In which ΔX is the total production; $(I - A)^{-1}$ is Leontief inverse matrix; and ΔY is final demand.

Summing all elements of the vector X (total production), one obtains the impact on the total volume of production. Besides the production, there is also the impact on other variables such as employment, imports, taxes and wages, estimated by the equation:

$$\Delta V = \hat{v}\Delta X \tag{10}$$

In which ΔV is a vector ($nx1$) that indicates the impact on each variable, $\hat{v}$ is a diagonal matrix (nxn), in which the diagonal elements are the coefficients of the variables. These values are obtained by dividing the value of these variables used in total production by total production, for each sector.

The coefficient of employment can be estimated as follows:

$$CPO = PO.\hat{X} \tag{11}$$

In which PO is the number of employees; and X is the total production.

From this, it is possible to estimate the employment and income generators with the following calculus:

$$GV_j = \sum_{i=1}^{n} b_{ij} v_i \tag{12}$$

In which GV_j is the total impact, direct and indirect, on the variable analyzed; b_{ij} is ij-th element of the Leontief inverse matrix; and v_i is direct coefficient of the variable analyzed.

In this study, the generators of employment and income will be analyzed. The result of each generator expresses the amount of employment (or income) needed in all sectors of the economy to meet the increase of a monetary unit in the final demand of a given sector.

In this analysis, it is necessary to take into account that the input-output matrix depicts as «employment» the number of employed persons in each group of activities, which includes all those working in the activity. This includes owners, partners and family members who do any work in the company, even without payment. This value also includes the amount of informal labor. Regarding compensation (income) of employees, this involves all payments made by the productive units to their employees: wages, overtime hours, 13th salary, productivity bonuses, payments in goods and services, and social contributions that are the responsibility of the employer. It must be taken into consideration that the input-output matrix covers the total number of employed persons and their compensation, even without any employment relationship.

The input-output matrices used in this study are disaggregated into 42 economic sectors for the years 1995, 2000 and 2005, and estimated for the year 2009 by the Regional and Urban Economics Lab of the University of São Paulo – NEREUS.

3.4 Application of input-output analysis in the evaluation of agriculture's role in the economy

In order to analyze how important is the link between agriculture and industry or and other sectors of the economy, many authors have studied the importance of this sector and its role in the economy in many countries by input-output matrices.

Peterson and Heady (1955), Holland and Martin (1993) and Hale (2012) have studied the dependence of the agricultural sector on other sectors. According to their studies, we can observe an increased evolution of the importance of this sector in the American economy from 1929 to 2010. Peterson and Heady (1955) studied the interdependence coefficients between agriculture and industry for the years 1929, 1939 and 1949 in the United States. The analysis for this period showed that the coefficient for the dependence of primary agriculture on industry has increased from 0.36 to 0.56, while the coefficient for the dependence of secondary agriculture on industry remained constant at 0.56. On the other hand, the dependence of secondary agriculture on primary agriculture has decreased from 0.96 to 0.66. Holland and Martin (1993) analyzed output changes in the United States agricultural economy from 1972 to

1977. Their results showed that the real output in agriculture expended 9.43%, in which 7.56% was accounted by the export, domestic final demand accounted for 3.21%, import substitution increased 0.69%, and technical change was negative account for -2.02%. Hale (2012) has studied the impact of the agriculture in the Haywood Country (USA) in 2010. The results showed that labor income and employment proportions were 0.74% and 13.6%, respectively. The multipliers showed that the agriculture had an impact per dollar of output of US$ 0.33 on the rest of the economy, while the largest manufacturing industry had an impact per dollar of output of US$ 0.19 on the rest of the economy.

Henry and Schluter (1985) by measuring the backward and forward linkages of food and fiber sector in USA, stressed the importance of agriculture. They stated that the impact of agriculture in the whole economy is influenced not only by the magnitude of the linkages and the interdependence among the sectors of the economy, but also by the structure of the particular economy and the relative shares of the raw and processed food sectors.

Hamilton *et al.* (1991) and Baumol and Wolff (1994), both in their studies stressed the significance of indirect effects of agriculture in the economy. However, a little analysis has taken place about the impact of disaggregated farming systems on the development of rural areas.

Sonis *et al.* (1995) analyzed the Brazilian economy evolution from 1959 to 1980. Their results show that agricultural and livestock sector was a key sector for the national economy having an important role on the development of the other sectors of the economy.

Cummings *et al.* (2000) investigated the role of farming sector in the local economy of Ontario region and evaluated the direct and indirect effects of agriculture to the rest sectors.

Giannakis (2010) analyzed the impact of extensive versus intensive farming systems on rural development in Greece. His results suggest that intensive crops create stronger backward linkages from extensive ones. Almost all farming systems appear to have rather low income and employment multipliers. Amongst them extensive crops seem to have the greatest due to high direct income and employment effects they create.

Heringa *et al.* (2013) analyzed the economic impact of multifunctional agriculture in four Dutch regions – Flevoland, Noordoost-Noord Brabant, Overig Zeeland, and Zuid-Limburg – in 2007. Their results showed that, in terms of output and employment, multifunctional agriculture was not a main driver for economic growth. Moreover, it appeared that multifunctional agriculture led in particular to more expenditure in the agricultural sector itself, rather than in any other economic sector. The indirect feedback effects of multifunctional agriculture on the non-agricultural sectors in the Dutch economy appeared rather small. Although the absolute size of employment in

multifunctional agriculture was very small, the employment per unit of output was high, especially when compared with the employment/production rate in primary agriculture.

Zuhdi *et al.* (2014a) analyzed the dynamics of total output of Japanese livestock sector caused by final demand changes in 2005. They employed a tool of analysis and two conditions in order to describe those changes. Those conditions are «whole sector change» and «pure change». Their results show that those conditions have different patterns and suggest to both conditions regarding import activity, the restriction of what is needed in order to increase the total output of Japanese livestock sector in the future period.

Zuhdi *et al.* (2014b) analyzed the dynamics of total output of livestock sectors of Indonesia caused by final demand changes in 2005. Their results suggest that livestock sectors of Indonesia have similar pattern and the biggest impact to their total output on future period comes from change of household consumption.

Many other studies have been made in order to show the importance of the agricultural and livestock sector in the world.

4. Results and Discussions

The results obtained from the application of the methodology proposed by Rasmussen and Hirschman, and also the GHS method, demonstrated which sectors have greater linkage power within the economic system, through backward and forward linkage indices, as shown in Tab. 1. It is important to highlight that the PBLN and PFLN indices show how much the agricultural

Tab. 1. Pure linkage indices and Rasmussen-Hirschman for the domestic matrices in the analyzed years, highlighting the agricultural sector

	1995		2000		2005		2009	
	Value	Rk*	Value	Rk	Value	Rk	Value	Rk
PBLN	0.91	14	0.98	15	1.17	12	1.17	11
PFLN	3.17	4	3.09	3	3.21	4	3.09	4
PTLN	0.56	26	2.03	4	2.19	5	2.13	7
HRBL	0.81	37	0.83	38	0.88	32	0.87	34
HRFL	1.07	18	1.08	18	1.1	17	1.09	18

* Rk is the domestic ranking, considering the 42 sectors analyzed, shown in Tab. 3.
Source: Research data (2014).

and livestock sector demands from other sectors, and the quantity demanded of other sectors of the economy by the agricultural and livestock sector. The main difference between these indices and the Rasmussen-Hirschman indices is that these last show the sectors with greatest linkage power within the economy considering the demand from agricultural and livestock sector to the own sector.

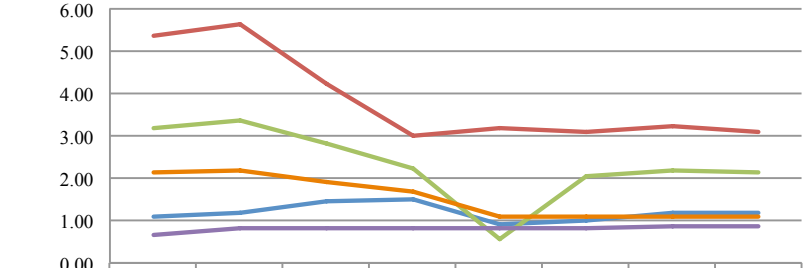
The pure backward linkage index (PBLN) signals to what extent a sector demands inputs from the economy in relation to the others, i.e. values over the unit indicate a highly dependent sector from the rest of the economy. It is observed in Table 1 that the agricultural and livestock sector had lower values than the unity for 1995 and 2000, standing in the 14th and 15th positions, respectively, in the domestic ranking. This indicates that the agriculture and livestock did not show any dependence on other sectors of the economy that serve as inputs for its production in these years. For 2005 and 2009, the agricultural and livestock sector recorded higher values than the unity, which positioned itself respectively in 12th and 11th positions in the domestic ranking values. This fact expresses the increasing dependence of the agricultural and livestock sector as a demander of inputs needed for production (fertilizers, seeds, machinery, implements, equipment, vaccines, feed etc.).

The pure forward linkage index (PFLN) indicates the extent to which a sector has its inputs demanded by the economy in relation to other sectors. Thus, values higher than the unity represent a sector whose production is widely used by other sectors of the economy. It can be seen in Tab. 1 that for all the years studied, the agricultural and livestock sector had higher values than the unity, indicating that the agricultural and livestock sector was very demanded by other sectors. This indicates that the agricultural and livestock sector is considered an important offering of inputs for other downstream sectors.

The total pure linkage index (PTLN) indicates the importance of a sector within the economy, considering the other sectors both upstream and downstream, but without distinguishing them. Thus, values above the unity means that the sector is important for the development of the others, both as a demander and as a supplier of inputs. In Table 1 it is observed that the value of this index was lower than the unity only in 1995, showing that the agricultural and livestock sector is important for the development of other sectors of the economy as a whole.

Previous studies support this result. Furtuoso and Guilhoto (2000), for example, showed the importance of the agricultural and livestock sector as a demander of goods and services and supplier of inputs for the non-agricultural and livestock sector. Costa *et al.* (2013) highlighted Brazil as one of the largest global producers in this sector, emphasizing that the entire agribusiness has

Fig. 2. Pure linkage indices and Rasmussen-Hirschman evolution for the agricultural sector



	1959	1970	1975	1980	1995	2000	2005	2009
PBLN	1.11	1.20	1.47	1.49	0.91	0.98	1.17	1.17
PFLN	5.38	5.62	4.21	2.98	3.17	3.09	3.21	3.09
PTLN	3.18	3.37	2.81	2.22	0.56	2.03	2.19	2.13
HRBL	0.66	0.82	0.82	0.81	0.81	0.83	0.88	0.87
HRFL	2.14	2.20	1.91	1.70	1.07	1.08	1.10	1.09

Source: Sonis *et al.* (1995) and research data (2014).

generated 28% of the GDP in 2005 and, in 2007, the value of the Brazilian agriculture and livestock production was third in global rankings.

The Rasmussen and Hirschman backward (HRBL) and forward (HRFL) linkage indices indicate that for values higher than the unity, the interpretation is that the sector presents higher linkage than the average of the economy as a whole and that the sector is considered a key sector for the economy.

In the case of HRBL index, for all years analyzed, this index was smaller than unity, ie, the agricultural and livestock sector recorded backward linkage below the average of the economy and considering it the agriculture cannot be considered a key sector for the development of the upstream sectors. On the other hand, the HRFL index had its values above unity for all years analyzed, indicating that the agricultural and livestock sector has forward linkages above average of the economy and thus it is considered a key sector for the development of the downstream sectors.

Comparing these results with Sonis *et al.* (1995) ones, we can observe that the agricultural and livestock sector has reduced its dependence from the other sectors that serve as inputs for its production, and as supplier for downstream sectors. In addition, the role of this sector as key sector for the economy also has reduced from 1959 to 2009 (Fig. 2).

In addition to the analysis of the importance of agriculture as a key sector for the development of the national economy, there are the production, employment and income generators, which measure the impact on final de-

mand of each sector on production, employment and income of all economy. To analyze comparatively the period, the value of the shock on final demand has been revised for the year 2009 using the implicit GDP deflator, provided by Fundação Getúlio Vargas. This is, it was considered a shock of 1.00 million Reais in 1995, R$ 1.4958 million for 2000, R$ 2.3738 million for 2005 and R$ 3.0995 million for 2009. The analysis of these generators for the agricultural and livestock sector is exposed in Table 2.

It is observed in the Table 2 that the production generator evolved positively over the years. While in 1995 each million Reais of increased final demand generated 1.56 million Reais in the value of agricultural and livestock production, in 2009 the amount equivalent to one million Reais in 1995 generated 5.27 million Reais in the value of production. It is noticed that from 1995 to 2000, the value of the production generator increased from 1.56 to 2.44, however, the agricultural and livestock sector reduced a position in the domestic ranking. This fact implies that the other sectors of the economy also showed increase in the production generator proportionally higher than the agricultural and livestock sector. The same fact can be observed from 2005 to 2009.

Regarding the employment generator, we note that there was a decrease every year, i.e. while in 1995 each million Reais of increase in the final demand generated 405.78 jobs, in 2009 the amount equivalent to one million Reais in 1995 produced an average of 327.30 jobs. Even with the decrease in the value of the employment generator from one year to another, from 1995 to 2000, the agricultural and livestock sector remained the main employment generator,

Tab. 2. Production, employment and income generators for the domestic matrices for the analyzed years

	1995		2000		2005		2009	
	Value	Rk	Value	Rk	Value	Rk	Value	Rk
Production generator	1.56	37	2.44	38	4.18	32	5.27	34
Employment generator	405.78	1	327.3	1	283.89	2	230.89	2
Income generator	372,360.11	24	538,039.63	22	853,896.96	15	967,612.34	36
Income generated by employment in minimal wage of the period.	91,764,037		108,865,198		100,260,019		901,249,818	

Source: Research data (2014).

and from 2000 to 2005 its position slipped to second place, and remained so in 2009. Likewise, it is highlighted the importance of the agricultural and livestock sector as a major employment generator in the country. These results are confirmed by the studies of Ichihara *et al.* (2007) and Costa *et al.* (2013).

The fall of the employment generator over the years can be partly explained by the mechanization of agriculture, which somehow reduced the number of jobs in the field, whether in agriculture or livestock. Moreover, all sectors have also suffered falls of the employment generator, which can be partly explained by trade opening in the 1990s, since the competition between companies made small and inefficient firms go bankrupt and/or were bought by larger and more efficient firms, reducing the number of jobs in the sectors and enabling technological development and increased imports.

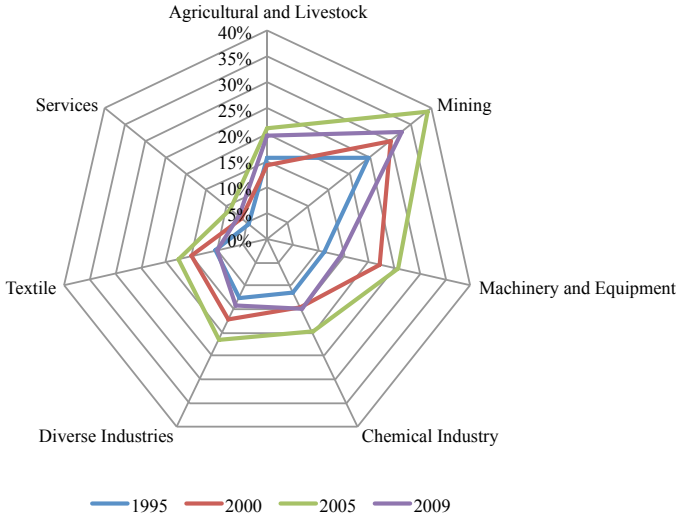
With regard to the income generator, its evolution has been positive over the years. While in 1995 each million Reais of increase in the final demand generated R$ 372,360 of income for the agricultural and livestock sector, in 2009 the equivalent of a million Reais in 1995 value generated R$ 967.6. This real increase in the income generator from 1995 to 2009, improved the position of the agricultural and livestock sector in the domestic ranking, which implies that in the period analyzed the gains of the agricultural and livestock sector were proportionally higher than some other sectors.

The increase in the values of the income generator of the agricultural and livestock sector is related to the correction of the shock value given in the final demand as aforementioned. Only by dividing the income generator by the employment generator, and dividing again by the minimum wage in the period, it is noticed that the average income generated by each job remains constant, around 10 minimum wages, according to Table 2.

Furthermore, the macroeconomic scenario of this period reflected negatively on the performance of the Brazilian economy by virtue of national and international events that occurred as the terrorist attack in the United States on September 11, 2001; the Argentina crisis; and energy rationing and high interest rates in Brazil in 2001 and 2005, respectively. On the other hand, the GDP grew by 1.31% in 2001 thanks to the good performance of the agricultural and livestock sector which presented a historical harvest and strengthened foreign trade, as in 2004 exports records were registered, influenced by high external demand, mainly of commodities (Santana and Nascimento, 2012).

In reference to the percentage of the domestic product linked to foreign demand in the period analyzed, Figure 3 shows this percentage for the seven aggregated sectors, in which contain the 42 individual sectors considered in this analysis (Tab. 3). Analyzing the percentage of the domestic production linked to external demand, which is considered as the greatest route of increase in the final demand of agricultural products in Brazil, it is observed that the

Fig. 3. Percentage of domestic production linked to external demand for the analyzed period



Source: Research data (2014).

mining is the sector that had higher participation in domestic production linked to external demand for all years.

Considering the seven aggregated sectors (Fig. 3), the agricultural and livestock sector showed a little increase in participation in domestic production linked to external demand between 1995 and 2009. Even if this sector continues in the 2nd position, in 2000 and 2005 it was in the 6th and 4th position, respectively. It is important to highlight that the participation of the agricultural and livestock sector in the domestic production decreased from 2005 (21.23%) to 2009 (19.85%) while the position in the ranking increased from 4th to 2nd position. It can be explained by the fact that others sectors reduced more their participation in domestic production linked to external demand.

If we analyze 42 individual sectors (Tab. 3), we can observe that the agricultural sector increased its participation in domestic production and its position in the ranking. From 1995 to 2009, the participation of agricultural sector rose from 12.91% (17th position) to 24.25% (8th position) while the participation of livestock sector (animal slaughtering) rose from 8.32% (25th position) to 22.37% (10th position). It is emphasized that 2005 is the only year that livestock sector showed higher participation in domestic production (28.60% - 10th position) than the agricultural sector (25.35% - 14th position). It is due to the fact that 2005 was characterized by problems that have affected the Brazil-

Tab. 3. Percentage of domestic production linked to external demand for the analyzed period

	1995	2000	2005	2009
Agricultural	12.9	16.5	25.4	24.3
Mining	38.2	53.4	69.0	67.1
Petroleum and gas	17.5	19.4	35.4	37.1
Non-metalic mineral	7.0	10.9	17.0	8.9
Steel	36.6	41.7	48.5	33.2
Non-ferrous metals	44.9	51.1	55.9	47.7
Other metals	12.9	16.0	22.9	16.0
Machinery and equipment	15.5	18.0	26.8	15.4
Electric material	9.8	15.3	19.4	12.6
Eletronics	4.8	15.5	18.0	9.6
Cars/lorries/buses	6.0	14.8	23.4	7.6
Other vehicles and parts	19.8	46.5	41.5	26.2
Wood and furniture	8.6	15.9	23.6	9.5
Pulp, paper and printing	16.2	17.7	21.0	17.5
Rubber industry	17.9	25.1	31.3	22.8
Chemical elements	14.3	17.5	27.4	22.1
Petroleum refining	16.0	18.6	26.1	20.3
Other chemicals	16.8	19.1	24.4	18.3
Pharmacy and veterinary	4.3	5.6	6.1	4.9
Plastic products	10.5	15.4	21.4	14.4
Textile	9.4	11.5	18.1	11.1
Manufacture of clothing	2.1	2.6	3.0	1.2
Manufacture of shoes	19.5	31.1	32.1	17.2
Coffee industry	18.2	10.0	14.5	10.5
Processing of vegetable production	18.6	11.9	15.2	14.3
Animal slaughtering	8.3	13.4	28.6	22.4
Dairy products	0.8	0.9	1.8	1.1
Manufacture of sugar	24.8	21.0	40.3	47.5
Manufacture of vegetable oil	36.5	33.3	38.6	34.6
Other food products	4.3	4.7	5.5	4.0
Diverse industries	7.8	9.8	10.1	6.2
S.I.U.P. (Industrial services of public utility)	5.9	7.7	12.1	8.8
Construction	0.3	1.4	1.5	1.2
Trade	8.7	12.7	18.5	13.0
Transport	11.9	12.0	18.6	13.9
Communication	4.3	6.6	9.4	7.0
Financial institutions	4.6	6.1	7.7	7.0
Services provided to families	5.7	3.8	5.6	4.0
Services provided to firms	7.1	14.3	19.3	16.6
Real estate rental	1.3	1.7	3.1	3.1
Public administration	0.3	0.4	0.5	0.3
Non-market private services	2.2	3.4	4.5	3.0

Source: Research data (2014).

ian agricultural and livestock sector. In this year has occurred strong drought and agricultural crop failures followed by falling prices of major products, currency appreciation and animal health problems. However, agricultural sector was more affected by these factors than livestock sector.

It is noticed that the trade opening that occurred in the 90s made the participation of the agriculture and livestock production linked to external demand, increase over this period, with a slight stabilization in 2009, where we can relate the international crisis of 2008. Nevertheless, even in this period, it is emphasized that the agricultural and livestock sector was less affected than other sectors of the economy, considering its evolution in the domestic ranking.

Notwithstanding this scenario, the Brazilian agriculture and livestock sector showed to have an important role in the national economy. In general, this sector has showed its importance for the economic development in many countries, especially those developing.

5. Conclusion

The aim of this paper was to assess the behaviour's evolution in the agricultural and livestock sector in the Brazilian economy by input-output matrix for the years 1995, 2000, 2005 and 2009.

The empirical results confirm the importance of agriculture for the Brazilian economy, in terms of its trade relations with the other activities, as an important buyer of inputs as an important supplier of inputs to other sectors. This highlights two main roles of the agriculture in the economic development process: to constitute a consumer market for the products of the non-agricultural sector, and to provide input needed for industrial development.

The pure linkage indices calculated showed the importance of the agricultural and livestock sector to the economy. The pure backward linkage index (PBLN) showed that the sector has no great dependence on upstream sectors, but the pure forward linkages (PFLN) showed that the agricultural and livestock sector is large offering of input for downstream sectors. Overall, the total pure linkage index (PTLN) showed that the agricultural and livestock sector is important for the development of other sectors of the economy as a whole.

The Rasmussen-Hirschman linkage indices showed the degree of linkage of the agricultural and livestock sector with other sectors. The Rasmussen and Hirschman backward linkage (HRBL) showed the agricultural and livestock sector with a linkage level below the average of the economy, and therefore the agricultural and livestock sector does not represent a key sector upstream. On the other hand, the Rasmussen and Hirschman forward linkage index (HRFL) showed the agricultural and livestock sector with a linkage level above the av-

erage of the economy, which implies that the agricultural and livestock sector is regarded as a key downstream sector. Overall, agriculture proved to be a key sector for the development of the economy as a whole.

Therefore, the evolution of these indices show that the agricultural and livestock sector is increasing its dependence on sectors that serve as inputs, strengthening backward linkage, although it does not represent a key sector for the development of upstream sectors. On the other hand, this evolution also shows that the sector is losing relative importance as a supplier of inputs, but this loss is still insignificant, since this sector is considered a key sector for the development of other downstream sectors and has been strengthening forward linkage.

In addition, it means that the supply chains, which belong to agricultural and livestock sector, are more organized than before, i.e. there are more coordination among the stakeholders in this sector. It can be explained by the agricultural polices existing in Brazil, which subsidizes small farmers and production and commercialization of some crops, as well as guarantees their minimum price.

Despite the agricultural and livestock sector is a key sector for the development of the other sectors in the Brazilian economy, it did not show much dynamism on the capability to generate employees in opposite to generate production and income. The employment generator showed decrease in all of periods analyzed, while the production and income generators presented increases in all of the periods. It can be inferred that the fall in the number of jobs created in the economy by the agricultural and livestock sector was mainly due to the process of mechanization of the industry, which intensified with the economic opening in the 90s. However, real income in terms of minimum wages generated by employment in the agricultural and livestock sector remains constant, around 10 minimum wages.

It suggests that, insofar as the agricultural and livestock sector is specializing and increases the use of capital, it requires fewer people to work directly. Similarly, it will need more inputs and more people to work in other activities, so that the surplus of work, which initially worked directly in the agricultural and livestock sector, moves to other activities. Thus, another important function of agriculture and livestock of economic development was observed: to provide workforce for the growth and diversification of activities in the economy.

In this context, it can be concluded that the economic opening that happened in the country, especially after 1995, intensified the process of agricultural mechanization by facilitating imports, which reduced the number of jobs generated in each shock in the final demand, nevertheless the average income generated by employment remained constant. On the other hand, also from

1995, the percentage of agricultural and livestock sector production linked to external demand increased, which shows the gain of competitiveness of the sector in international trade.

Moreover, it is clear the resistance of the sector to international setbacks, vis a vis other sectors of the national economy, considering the maintenance of the percentage of its production linked to external demand, even after the crisis of 2008, which did not happen with the other sectors of the economy, which consequently improved the position of agriculture in the domestic ranking.

Thus, since the agricultural and livestock sector is important for the development of the country, Brazilian specific policies could be enhanced in order to improve this sector. Some aspects related to this sector still need to be improved such as production, infrastructure, logistic, market and investment.

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Antonio Lopolito[1],
Roberta Sisto[2],
Angela Barbuto[1],
Riccardo Da Re[3]

[1] Department of Agricultural, Food and Environmental Sciences, University of Foggia, Italy
[2] Department of Economics, University of Foggia, Italy
[3] Department TeSAF, University of Padua, Legnaro (PD), Italy

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What is the impact of LEADER on the local social resources? Some insights on Local Action Group's aggregative role

The Local Action Groups (LAGs) are supposed to contribute to the local development process through the enhancement of the territorial social capital. Stressing their aggregative role, the objective of this work is twofold: to find empirical evidence that LAGs' operation can foster the social capital of the local partnerships, and to contribute to the methodological advancement in detecting social capital. The relational computational system here presented detects the contribution of LAGs on logical basis by comparing the relations actually existing and the relations created independently of the LAGs' operation. The analysis reveals that the LAGs modified the morphology of their networks fostering the connectivity of their members and exalting the role of some actors as bridges among different polarities.

1. Introduction

The emphasis assigned to the concept of social capital as a potential driver for rural development is particularly evident in the case of LEADER Programme. Thus, the LEADER could be considered as a programme addressing the issue of rural development through the accumulation and use of social capital. Many studies (Scott, 2004; Pylkkänen, 2006; Nardone, 2010) highlight as the LEADER Programme contributed remarkably to the aggregation of groups with a high level of social capital even if, as Shucksmith (2000) observed, this is not an explicit aim of the initiative.

In this framework, the European Commission (2013) encourages the adoption of a Community-Led Local Development (CLLD) approach that should be community-led, and implemented by Local Action Groups (LAGs), that is the local development agencies of the LEADER[1] Programme. The underlying idea is that socio-economic well-being can be better achieved by focusing on needs and resources valorisation at local level.

[1] The European Commission initiative Liaisons Entre Actions de Developpement de l'Economie Rurale aims at fostering integrated rural development strategies at the level of very small rural territories.

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This policy direction unavoidably leads to the decentralization of responsibility for intervention design and implementation to local communities (Ray, 2006). However, this power devolvement is strongly associated with the formalisation of the evaluation tools such as the programme evaluation (Moseley, 2003). According to the endogenous rural development logic, the evaluation process should account not only for the effectiveness of spending, but also for less tangible and locally-rooted effects such as the quality of participative process, the identity raising from the local community (Ray, 2006) and the improvement of the social resources (social capital) endowment.

Léon (2005) highlights as a community combining strong internal social bonds and a capacity to maintain diversified relations with the outside world enjoys real advantages and lower transaction costs for its development. Indeed it is the capacity of territories to enhance the value of social relations that underpins the LEADER Programme.

In this view, the research questions of this paper are: have the LAGs contributed to the enhancement of social capital of their partnerships? There has been a real improvement of the structural dimension of social capital?

From these questions derive the two specific objectives of this study: 1) to find an empirical validation of the hypothesis that LAGs activity can foster the social capital of the local partnerships; 2) to contribute to the methodological advancement in detecting social capital. The object of the analysis is the structural dimension of the social capital produced by the LAGs members during the operational period. The latter objective relates to the development of a relational computational system. This leads to the achievement of the former objective, since this computational system allows the identification of the contribution of LAGs in terms of relations created among their members.

The definition of social capital[2] here adopted stems from the work of Bourdieu (1986: p. 249) which, conceives it as "the sum of the actual and potential resources embedded within, available through and derived from the network of relationships possessed by an individual or social unit". It fits particularly well with the aim of the paper, that is to investigate the changes in the structure of the partnership of the LAG.

Others relevant contributions to the aim of the paper are the work of Burt (1992) that, focusing on the presence of structural holes, looks at network

[2] The literature on social capital can be distinguished in: the micro level carried out by two of the most important researchers on social capital, Bourdieu and Coleman, who focused on individuals or small groups as units of analysis, and the macro level that considers social capital not as an individual asset but as an attribute of the community itself. This approach argues that nations or regions can have different stock of social capital affecting the level of democracy, crime rates, corruption or economic growth (Putnam, 1993; Fukuyama, 1995).

variables, and the multidimensional approach of Nahapiet and Ghoshal (1998), that allows the identification of three specific dimensions of social capital: structural, normative, and cognitive.

Across most of the literature on social capital there is widespread agreement on the importance of networks for social capital's existence and functioning. Differently from the individualistic approach, the network view emphasizes the structural dimension of social capital. This emphasis on social capital as a relational and embedded resource, led several scholars to adopt Social Network Analysis (SNA) as a technique for studying the characteristics of the social capital endowment of individuals and groups.

In particular, in the study, the network-based approach enabled us to investigate the structural dimension of social capital. This approach refers to the set of social structures allowing interaction among individuals and regards the global model of the connections between two actors belonging to the same community. Therefore, the total size of this kind of social capital in a defined community depends on the total amount of its links.

This theoretical point of view is translated in an operational way with the use of the SNA as a suitable and powerful methodology in the assessment of structural dimension of social capital at a *meso* level of analysis.

The SNA is still a very active research area, as shown from the many recent publications on this approach. Its development improved a lot in the early 80s, mostly due to the institutionalization of social network analysis. With mathematical graph theory as its basis, SNA is a useful tool for the description and the evaluation of social phenomena especially because it allows both a quantitative and qualitative approach to the problem.

Specifically, starting from the data gathered in some Italian LAGs, we have focused on their internal network. This choice enabled us to get insights on the social interaction mechanisms within the LAGs considered, highlighting how they have affected the quantity and quality of the social links in the partnership's network.

The reason for choosing the LAG as survey unit is threefold. First, because the LAG is the expression of local public-private partnerships among entrepreneurs, local authorities, rural associations, voluntary organizations etc. representing the organizational form of the local development agency (Romeo and Marcianò, 2014). Second, because the LAGs are the units targeted for intervention under the CLLD approach at the local level. Third because, despite the huge literature on LEADER and rural partnerships, relatively few empirical studies investigate social capital features processes within these partnerships applying quantitative analyses of networks characteristics. Therefore, in an attempt to overcome some of the limits affecting previous research, this work aims at contributing to the evaluation process

by proposing a framework for assessing the quality and quantity of social capital developed in the LAG partnership.

Section 2 provides a brief theoretical overview of the link between the Community-Led Local Development approach and social capital. Section 3 describes the SNA and the adopted methodology. Section 4 presents the case studies, the results and conclusion are in Section 5. Finally, section 6 concludes.

2. The Community-Led Local Development approach and social capital

The LEADER Programme is a key example of the European Rural Development Programmes' commitment to subsidiarity and partnership models as essential to area-based development. This is believed to occur through the project process, and through the creation of participatory decision-making structures, such as partnerships, in localities.

The emergence of LEADER reflected a growing consensus in Europe concerning what integrated rural development is and how it is best promoted. In many ways, LEADER embodies the essential elements of the bottom-up approach to rural development, which includes for example, an endogenous development accent, a territorial focus with the creation and implementation of local development programmes geared to local requirements, an emphasis on public–private–voluntary sector partnerships, and the genuine involvement of local people, through a mobilising process as resource for rural development. The promotion of LEADER, therefore, indicates the realisation within the European Commission that rural development involves «development by and of the local community, not just for it» (Moseley, 1997, p. 202) and the growing sense that decisions are more likely to 'stick' if they are taken locally and reflect a community consensus.

As highlighted by Macken-Walsh and Curtin (2012), the LEADER model was designed to operate on the basis of two principles: decision-making taking place as close as possible to the site of implementation (principle of subsidiarity); and hierarchical decision-making structures being replaced by mechanisms involving representatives from a wide range of governmental and non-governmental groups (principle of partnership) (Osti, 2000). Clearly inspired by models of integrated rural development (Shucksmith, 2010), underpinning the concept of intersectoral partnership boards (LAGs), in the LEADER Programme there is a strategy to facilitate the representation of different sectoral interests in local rural development decision-making processes.

By 2007, LEADER was delivered through over 1200 local action groups in the EU's 27 Member States, with funds in the order of 7 billion euro available between 2000 and 2007 alone.

Most of the LEADER projects have targeted specific needs of communities, such as strengthening economic capital through the promotion of rural tourism (approximately 30% of LEADER projects EU-wide), by adding value to agricultural production through local branding initiatives or other initiatives emphasising the value of locally produced food (15%), or by supporting small firms and craft industries (12%), and some LEADER projects have focused on strengthening social capital at community level by focusing on training and human development initiatives (10%).

As asserted by European Commission (2013), in the next programming period (2014-2020), there will be a more explicit support to the creation of multi-fund local community-led strategies.

CLLD, as part of LEADER, was designed to help rural actors considering the long-term potential of their local region, and proved to be an effective and efficient tool in the delivery of development policies. This approach aims at mobilizing and involving local communities and organizations to contribute to achieving the Europe 2020 Strategy goals of smart, sustainable and inclusive growth, fostering territorial cohesion and reaching specific policy objectives. Among the chief aims is the enablement of all areas to receive funds supporting the improvement of local public and private partnerships, capacity building, networking etc.

The units targeted for intervention are the local action groups (LAGs) as local public-private partnerships among entrepreneurs, local authorities, rural associations, groups of citizens, voluntary organisations etc. At the same time the local development strategies have to be coherent with the relevant programs of the European Structural and Investment Funds, thus a strategic approach is needed.

The study of Cavaye (1999) shows that a community-oriented approach not only stimulates community empowerment and involvement, but also social capital.

Even if this is not an explicit aim of the Initiative (Shucksmith, 2000), Yamaoka *et al.*, (2008) highlight the relevance of the LEADER Initiative for the creation of social capital as a publicly owned key resource that ensures sustainable development.

This is what should happen within LEADER Programme and, consequently, with Community-Led Local Development approach. On the one hand social capital in its several forms (networks, trust, affinity) encourages cooperation among local actors (Coleman, 1990). Furthermore, the heterogeneity and extension of social networks is «associated with openness to resources that are not generally accessible in the immediate surroundings and that help to strengthen and advance a project» (Franke, 2005, p. 16). On the other hand, once the plans are implemented, the interaction among group members and the effects of ac-

tion stabilise behavioural norms within the group. Finally, the perceived success of the project, its social consensus and the legitimisation gained by LAGs can produce stability in the relationships. Thus the use of social capital in participatory development projects can start a virtuous self-sustaining development process in which the outcome affects its corresponding input.

3. Methodology

3.1 The structural dimension of social capital

Nahapiet and Ghoshal (1998) argue that social capital is composed of three main dimensions: structural, relational and cognitive. The structural dimension gives an idea of the presence of social capital by enabling the access to resources depending on the relational structure within a social network. The total size of this kind of social capital in a network depends on the total amount of the links connecting its actors. The relational dimension refers to the kind of interactions between the individuals as a result of long lasting relationships. Thus, this dimension regards the governance mechanisms of relations embedded in these ties, that is, the kind of behavioral norms fostering cooperation such as confidence, reciprocity and solidarity. Finally, the cognitive dimension considers elements of social organization (values, beliefs etc.) that allow individuals belonging to a community to reach a shared vision of their own community.

As the aim of the paper is to evaluate the improvement of the social capital in the LAGs from a quantitative point of view, we will focus on the structural component.

In particular, the structural dimension can be studied adopting either an egocentric approach that is focusing on the potential of the network of which the individuals have use of, or a socio-centric approach, that is examining the total relations in a system to determine the endowment of social capital. In the present study, the study of social capital and in particular of its structural dimension, is addressed through the 'social network' approach and in particular SNA.

Social network analysis aims at investigating the network structure by description, visualization, and statistical modeling. It relies on social network data. Following the definition by Wasserman and Faust (1994), social network data can be viewed as a social relational system characterized by a set of actors and their social ties. Eventually, additional information such as actor attribute variables or multiple relations can be part of the social relational system. Social networks are defined as a set of nodes, individuals or groups, that are tied

by one or more types of relations (Wasserman and Faust, 1994). Network data are defined by actors (nodes) and by relations (edges). Network analysis focuses on relations between actors, and not on individual actors and their attributes as traditional analysis does. This relevant difference implies that, while non-network studies sample nodes independently, network analysis cannot sample nodes in the same way and sometimes does not use samples at all.

While traditional individualistic social theory and data analysis consider individual actors making without taking into consideration the social context, social network analysis focuses on relational data: the relationships between actors are the first priority, while individual properties are secondary.

A computational system for LAG contributions

To investigate the aggregative role of the LAGs, we adopted the SNA (Wassermann and Faust, 1994). Different authors have applied the SNA to analyze LAGs contribution to the network creation. In particular, Cristini *et al.* 2013 introduce the use of SNA as a tool for analysis of relational networks promoted by LAGs in Liguria to support the development of the local partnerships. Pisani & Burighel (2014) use SNA to assess the structures and the dynamics of transnational cooperation projects promoted by LAGs in the Veneto Region. Pappalardo *et al.* (2014) apply SNA as a methodological approach for investigating relationships within two LAGs from Sicily. At European level, Marquardt & Pappalardo (2012) employed SNA to assess how key LEADER features, such as the bottom-up and the participatory approach, are implemented in Romania.

Here we propose a computational system of the relations among local actors, produced by the LAGs operation, where the contribution of LAGs is detected on logical basis by the comparison among the relations actually existing and the relations created independently of the LAGs' activity.

SNA allows to analyze the relationships between different social entities. Within this frame, the social entities, representing the units of analysis, can be individual or collective and are defined actors. This does not imply that social entities have necessary a will or the ability to act. Some examples of actors can be the single persons in a group, the different departments in a company, the different towns of a country etc. The relationship can assume different forms and may include interpersonal relationships (e.g. friendship, affinity etc.), the transfer of materials or resources from one entity to the other (e.g. business transaction), affiliation relationships (belonging to the same group), behavioral relationships (e.g. exchange of information).

In this study, the units of analysis (i.e. the actors under investigation) were represented by the members of the LAGs. The relationships we considered were behavioral in nature, and were represented by: 1) exchange of information (this is referred to strategic or economic information transmitted by telephone, pa-

per, e-mail etc.) and 2) projects cooperation (this is referred to the collaboration between the LAG's members in one or more projects). We collected information on all the relationships belonging to these groups among LAGs' members, regardless to their association with the implementation of the local development plan of the LAGs. Indeed the aim of the survey was to depict the overall information and cooperation exchange among the investigated actors.

The analysis was dynamic, that is it focused not only on the number of the relationships but also on their evolution. Specifically, to measure the aggregative role of the LAG, the study took into account how the relationships were formed, without the LAG (members already knew each other or already cooperated in one or more projects before the LAG intervention) and through the LAG (members exchanged information or collaborated in one or more project following the LAG intervention).

In order to trace the evolutionary dynamics of these relationships we used the following variables:

- *tie* ($t_{i,j}$), it indicates the kind of relationship between each pair *i,j* of LAG's members and takes the following values:

$$t_{i,j} = \begin{cases} 0 \text{ if the relation does not exist at all} \\ 1 \text{ if the pair exchanges information} \\ 2 \text{ if the pair cooperates in one or more projects} \end{cases}$$

- *extra LAG tie* ($et_{i,j}$), it takes positive values if the relationship between each pair of members *i,j* was established regardless of LAG, as specified below:

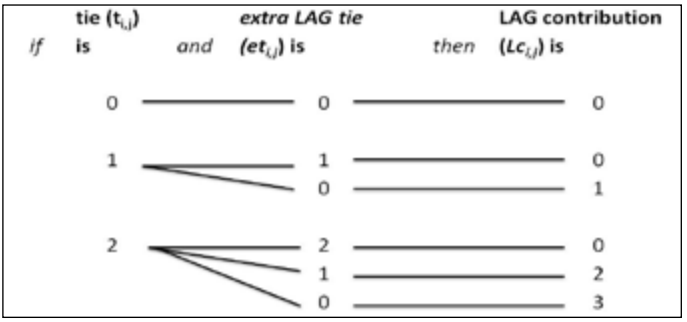
$$et_{i,j} = \begin{cases} 1 \text{ if the pair exchanges information independently of the LAG operation} \\ 2 \text{ if the pair cooperates in one or more projects independently of the LAG operation} \\ 0 \text{ otherwise} \end{cases}$$

The LAG contribution for each pair of members *i,j* ($Lc_{i,j}$) was then defined on logical basis by the comparison of $t_{i,j}$ and $et_{i,j}$ as explained in the following diagram:

Explicating, the values assumed by $Lc_{i,j}$ are:

- 0 if the LAG had no impact on the relation dynamics in the pair *i,j*;
- 1 if the LAG favored the information exchange in the pair *i,j*;
- 2 if the LAG favored the collaboration in one or more projects between the pair of *i,j* but they exchanged information independently from the LAG

Fig. 1. A computational system for LAG contributions



Source: our processing.

operation (i.e. they knew each other before becoming LAG members and they kept in touch);

- 3 when the LAG favored both information exchange and collaboration between the pair of *i,j*.

The analysis was facilitated using matrix calculation. The variables were represented in matrix form using the adjacency matrix reporting the relations between each pair of actors.

The basic assumption of this computational experiment were:

A1: the relations evolve, along a fashion of three stages of intensity: 1) not existing, 2) information exchange, 3) project collaboration. Implicitly we assume that the late stages include also the characteristics of the earlier stage, that is the project collaboration also implies an information exchange.

A2: We also assume that the higher the overall intensity of the relations the better the quality of the network social capital.

The former was assumed to characterize the contributions of the LAGs, the latter gave a direction in the interpretation of the results.

3.2 The SNA indexes

In order to give a more complete overview of LAGs' contribution in creating social capital among their members, the analysis is completed with a visual examination of the networks (pre and post LAG's operation) and with the use of some SNA indexes. We used (i) density and compactness index to analyze the overall network structure, (ii) core/periphery analysis to study the intermediate groups within each network, and (iii) average degree and normalized betweenness scores to examine actor's position in the network.

As we are working with binary networks, density is simply the proportion between the ties actually present in each network and all possible ties; the compactness of the network indicates the capacity of each node to reach quickly all the other nodes, in a range from 0 to 1, where bigger values indicate larger cohesiveness; core/periphery analysis identifies the most densely-connected block of core actors who have a structural advantage in coordinating and managing the decision making of the network; average degree is the average number of ties that each actor has with the other nodes of the network; finally, betweenness centrality is a measure showing the number of times a node acts as a bridge along the shortest path between two other nodes.

4. An empirical application

The investigation was conducted in two Italian Regions, Veneto in the North-East and Apulia in the South of Italy (Fig. 2), from September 2012 to February 2013.

The data used for the analysis were collected through face-to-face interviews, during a research project aiming at studying the social capital, either structural and normative-cognitive, promoted by selected Italian LAGs.

Each interview lasted about 20-30 minutes and the interviewed members were asked to compare their relations before and after the first edition of LEADER initiative to which their LAG participated.

In Veneto region two LAGs were selected as case studies: Prealpi LAG in Belluno Province, and Bassa Padovana LAG in Padova Province. They represent two different areas of the region, with different social and economic backgrounds (Tab. 1).

The former, Prealpi LAG, has a long history and includes 26 municipalities in a large, but fragmented, mountain territory. It is characterized by the presence of the National Park of Belluno

Fig. 2 LAG Location

Source: our processing.

Tab. 1. Key features of the study cases

Key features	Gargano	Meridaunia	Bassa Padovana	Prealpi
Number of Municipalities	14	30	30	26
Surface (square Kms)	1,7	2,275	526	1,344
Inhabitants	126	98,1	110	138,871
Population density (Inhabitants per square Kms)	74	43	209	103
Members	61	85	12	25
Total funds (euro)	25,285,770	21,757,985	9,515,451	18,103,048
public funds (euro)	15,231,048	14,564,803	5,538,834	10,141,914
Public Expenditure per inhabitants (euro)	121	159	87	130

Source: our processing on data from ISTAT and LAGs' Local Action Plans.

Dolomites, 19 Natura 2000 areas (covering about 36% of the area), 8 national natural reserves and 2 regional reserves. Its territory is considered a rural area affected from marginality in relation to the main infrastructures of the region.

Bassa Padovana LAG is a recent LAG, and is located in a flat area, including 30 municipalities, in the Southern part of the Province. Its territory presents a composite landscape, with a rich naturalistic, historical, and gastronomic heritage, and it is characterized by historic towers and castles of the medieval period and elegant villas born during the Republic of Venice.

In Apulia region, the investigation was conducted in collaboration with two LAGs (Meridaunia, and Gargano) operating in the Province of Foggia. Their socio-economic background is quite similar (Tab. 1). They share the most important social and economic features common to nearly all parts of the province. Except for the capital town of Foggia, the rest of the territory is rural. On average, more than 15% of total production in these areas comes from the agricultural sector and agricultural employment varies between a minimum value of 20% and a maximum of 40%.

In particular, the Meridaunia LAG is located in a mountainous area, characterized by a severe emigration flow and aging of the current residents. The main activity is the agriculture, particularly based on the cultivation of durum wheat and on the rearing of goats and sheep. It was formed during the second edition of LEADER and accumulated a certain amount of experience in planning activities but they faced different problems.

Most of the GDP of coastal areas of the Gargano comes from tourism. On the contrary, the economy of internal areas relies on the agricultural sector.

This LAG faces problems related to the failure of local initiatives during the first edition of LEADER. As a result, this area experienced a loss of faith in local institutions which prevented the formation of a partnership during the second edition of LEADER. The current partnership was formed with LEADER +.

Table 2 gives an idea of the action undertaken by the LAGs in order to stimulate the local development. It highlights the differences in the development strategies and the relative success in terms of socio-economic revitalization (participation of local actors) with respect to the resources employed. The Apulia LAGs have greater founds on the whole that are concentrated in measures supporting firms development (diversification and tourism activities). These measure have attracted the most part of applications in the period considered. The LAGs from Veneto are more interested in the conservation and upgrading of their rural heritage. They have also activated measure external to axis three (e.g. modernization and non productive investments). The most part of their effort is devoted to foster the cultural valorization and revitalization of rural landscape.

5. Results and discussion

5.1 The aggregative role of the LAGs

Table 2 shows the contribution of the LAGs in creating and transforming the relations among their members. Row (a) represents the number n of members belonging each LAG, row (b) is the number of possible relations occurring within each LAG. This number is calculated as $n^*(n\text{-}1)$. Row (c) reports the amount of relations among the n members of each LAG, existing independently of the LAG's operation, that is the relations generated by other (alter) mechanisms or mechanisms external to the LAG. These relations are distinguished in information exchange (row d) and projects cooperation (row e). Each measure is expressed both in absolute terms and as a proportion on the total number of possible relations (in brackets).

Very interesting is the row (f) showing the amount of relations affected by the LAG's activity. These amounts have been split into three parts: relations of information exchange created *ex-novo* by the LAG (row g), projects collaborations created *ex-novo* by the LAG (row i), and existing information exchange evolved in projects collaborations thanks to the LAG (row h).

For each measure, three kinds of data are available: the absolute amount, and two relative measures expressed as the ratio of the relations affected by the LAG on 1) the total number of possible relations (in brackets) and, according to the A1, 2) the number of relations potentially under the effect of

Tab. 2 Advancement of LAGs expenditure

Measures activated	Gargano*			Meridaunia*			Bassa Padovana**			Prealpi**		
	Allocat.	Spent	Applicat.	Allocat.	Spent	Applicat.	Allocat.	Spent	Applicat.	Allocat.	Spent	Applicat.
121 - Modernisation	-	-	-	-	-	-	566	532	29	456	189	5
123 - Agric. and forest. Prod.	-	-	-	-	-	-	130		3	192	67	6
227 - Non-productive investments	-	-	-	-	-	-	-	-	-	245	34	5
311- Diversification	3,606	1,881	50	2,656	1,393	26	800	250	15	873	873	17
312- Business Creat. and Devel.	1	129	19	667	290	38	153	0	0	1	801	37
313- Tourism Activities	3,54	1,118	27	5,094	2,75	33	213	0	3	1,793	319	21
321- Services for Rural Popul.	1,26	578	10	1,115	271	8	-	-	-	568	156	4
323- Rural Heritage	500	165	50	1	51	1	1,963	24	32	2,412	179	98
331- Training and information	1,307	-	11	1	-	0	-	-	-	99	99	6
421- Cooperation	496	-	-	496	-	-	-	-	-	-	-	-
431-LAG Management	2,752	973	1	2,686	1,62	1	626	491	1	1,146	626	1
Total	**14,461**	**4,843**	**168**	**14,113**	**6,375**	**107**	**4,451**	**1,297**	**83**	**8,784**	**3,343**	**200**

** data refers to 31/12/2013.*
*** data refers to 30/06/2013.*
Source: National Rural Network, 2013.

Tab. 3. The aggregative role of the LAGs

Indexes	Gargano	Meridaunia	Bassa Padovana	Prealpi
# Actors (a)	61	85	12	25
# of possible relations (b)	3660	7140	132	600
Alter (%tot) (c)	933(0.255)	214(0.030)	61(0.462)	254(0.433)
alt-info (%tot) (d)	653(0.178)	191(0.027)	41(0.303)	160(0.255)
alt-Coop (%tot) (e)	280(0.077)	23(0,003)	20(0.152)	94(0.168)
Lag (%tot) (f)	474(0.129)	399(0.056)	47(0.356)	247(0.411)
Lag-info (%tot) [%potential] (g)	177(0.048)[0.065]	262(0.036)[0.038]	7(0.049)[0.098]	78(0.123)[0.223]
Lag-info_into_ Coop(%tot) [%potential] (h)	280(0.075)[0.429]	0(0.0) [0.0]	40(0.278)[1]	155(0.245)[0.969]
Lag-Coop (%tot) [%potential] (i)	17(0.005)[0.006]	137(0.019)[0.020]	0(0.0)[0.0]	17(0.027)[0.049]

Source: our processing.

the LAG [in square brackets], that is those relations the LAG can potentially improve according to the computational system depicted in figure 1. Consequently, the potential of improvement depends on the kind of the relations under scrutiny. For the information exchange (row g), the potential is represented by all the possible relations that do not exist yet (b-c). For the projects cooperation (row i), the potential is represented by all the potential relations that are not yet projects cooperation (a-e). Finally, for the information exchanges transformed in cooperation (row h), the potential is represented by the relations that are already information exchanges (d).

As shown, the LAGs impacted on a large part of the potential relations. Their contributions are various and range from 5.6% to the 41% of the total relations. In absolute terms the largest contribution comes from Gargano LAG that affects 474 relations, however, as it has a large number of members, this represents the 13% of the potential. On the other hand, the best contribution in relative terms comes from Prealpi that reaches the 41% of the potential.

Some peculiarities emerge looking at the kind of links created by the LAGs. The LAG Meridaunia has created 262 information exchanges, but none of the 191 information exchanges due to alter mechanisms have been upgraded to the cooperation status. On the contrary the other three LAGs are very

good in doing this. They transformed a large part of pre-existing information exchange in cooperation (Bassa Padovana reaches almost a 100% rate of transformation). On the other hand, their contributions are marginal in producing cooperation *ex-novo* (row h). This is not true for Meridaunia that fostered the cooperation among 137 couples of members.

The analysis is completed with a visual inspection of the transformation of the relational patterns operated by the LAGs. The visual inspection is provided with the following 4 figures representing the status of the network *pre* (panel A) and *post* (panel B) LAG's operation. Neglecting the nature of the relations (information exchange and cooperation), the figures depict the overall relational patterns of the groups. The visual analysis vividly sketches the role of the LAGs in enhancing the aggregative of the partnerships. In order to have more in-depth hints on the overall contribution of the LAGs, we also represented a specific actors' attribute, namely their category of interest: public (red circles) or private (blue squares).

As shown, the networks become more dense when they pass from status A (relations generated independently from the LAGs) to status B (all the relations, including those generated by the LAGs). In absolute terms, the highest increase is related to Prealpi that improved its density from 42% to 58% (that is, after LAG operation the 58% of members are connected) and the average degree from 10 to 14. This corresponds to an improvement in connectivity around the 40%.

The highest contribution in relative terms comes from Meridaunia that produced an overall enhancement of 58% (that is an increase of the density from 10% to 16%). Concerning the average degree, its level was 3.74 in the pre-LAGs status (panel A) and 5.90 in post-LAG status (panel B).

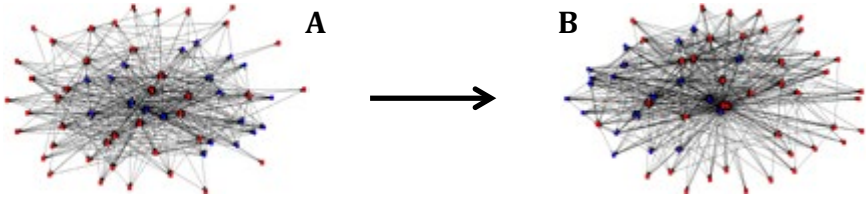
The contribution of Gargano in relative terms is a 20% improvement in the aggregation of the group. It is an important increase in connectivity: the density improved from 25% to 30%, and the average degree from 15.21 to 18.18.

Bassa Padovana was already highly connected in status A (46% of density and 5 average degree) thus it shows the lowest improvement margin. In status B the density became 52% and the average degree 5.67. This corresponds to an overall improvement of 11%.

5.2 The role of key actors

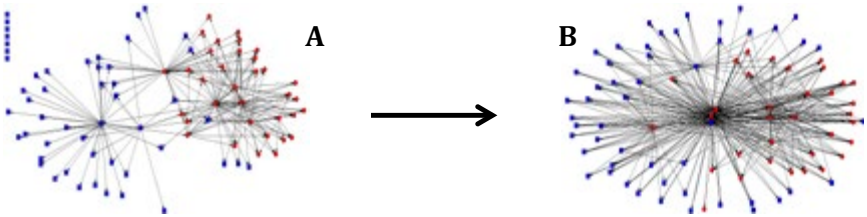
In addition, the visual inspection allows to grasp information on the role of some actors and on the public-private inter-connectivity (Figs. 3, 4, 5 and 6). Some central actors seem to play as relational hubs, as their removal from the diagram would disconnect many actors from the net. This is true in particular for the LAGs from Apulia, and especially for Meridaunia, that has few

Fig. 3. The relational transformation of Gargano



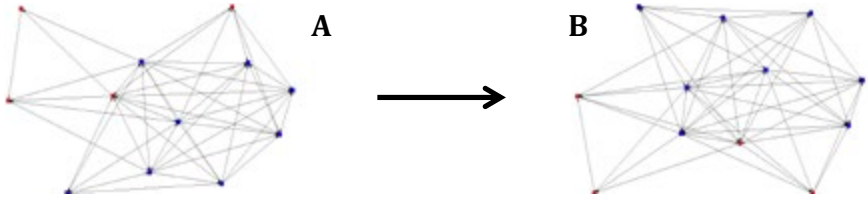
Source: our processing.

Fig. 4. The relational transformation of Meridaunia



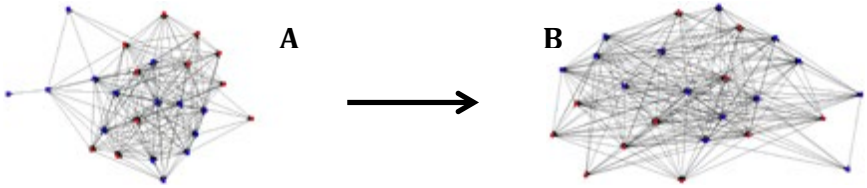
Source: our processing.

Fig. 5. The relational transformation of Bassa Padovana



Source: our processing.

Fig. 6. The relational transformation of Prealpi



Source: our processing.

key actors who occupy very central positions. In the pre-LAG status 6 actors (all public) have a very high betweenness degree: it means that the majority of the remaining actors had the possibility to communicate or collaborate with other local stakeholders only through these central nodes of the network. Instead in the post-LAG status the compactness of the network has increased and only 3 members still maintain a considerable betweenness degree. Meridaunia is interesting also for another aspect: in its A status, it appears very polarized with two, highly centralized, groups of homophiles actors. That is the two groups are formed of actors belonging to the same category (private on one hand, and public on the other hand) with a couple of private actors playing the roles of bridges among the two groups. More than in the other cases, in this case the LAG acted as a facilitator, reducing the social distance from the two groups and increasing the connections among them.

Table 3 reports some indexes relating the position of actors to the overall structure of the LAGs' network they belong to. Row (a) reports the compactness of the network in a range from 0 to 1, where bigger values indicate larger cohesiveness. Row (b) shows the percentage of LAG's private members; row (c) reports the percentage of private members who belong to the core of the network, that is the most densely connected sub-group of actors; while in row (d) the difference in percentage of the two previous measures is reported. Finally, row (e) is the average normalized betweenness score.

Each index was calculated both in the pre-LAG status and in the post-LAG one.

Data immediately confirm the aggregative role of the LAGs, as shown by the previous graphs. In addition to this, Table 4 highlights that the presence of the LAG allowed to reduce the distance in the network among actors: the four LAGs have increased the compactness of the network, creating opportunities of direct contacts among their members. Moreover the equilibrium in decision making among the public operators and the private sector is better guaranteed in all case studies' status B: the percentage of private actors, considered on paper optimal by the LAG, in the core of the network has become concrete thanks to the LAG itself. The lowest contribution comes from Gargano LAG, whose network structure doesn't significantly change from status A to status B, due mainly to the fact that the percentage of private members in the centre of the LAG's network reflects perfectly the preexisting balance pre-LAG.

6. Concluding remarks

The contribution of the study is twofold, on one hand it is directed at finding empirical validation of the hypothesis that LAGs activity can foster the so-

Tab. 4. Private and public actors within the LAGs' networks

LAG	Gargano		Meridaunia		Bassa Padovana		Prealpi	
Pre/Post Status	A	B	A	B	A	B	A	B
Compactness (a)	0.042361111	0.044444444	00:23	00:37	0.05	0.053472222	0.045138889	0.052777778
%Private (b)	0.05		0.041666667		0.052083333		00:56	
%PrivateCore (c)	0.049305556	0.049305556	00:50	00:58	0.041666667	0.049305556	00:54	0.041666667
Delta (d)	0.06875	0.06875	0.0625	0.068055556	0.059027778	0.066666667	0.068055556	0.066666667
nBetweenness mean (e)	01:23	01:17	0.066666667	0.051388889	0.301388889	0.220138889	02:21	01:36

Source: our processing.

cial capital of the local partnerships, on the other hand it sought advancement in detecting social capital methods.

Concerning the former aspect, the specific focus of the work is the structural dimension of social capital that is the structural characteristics of the network of relations among LAG's partners. Two kinds of relations were considered: information exchange and project cooperation. The analysis reveals that the LAGs enhanced the social capital of their partnerships producing a diverse contribution in terms of kind of relations activated/enhanced. The LAGs modified the morphology of their networks fostering the connectivity of their members, connecting different groups of partners (public/private) and exalting the role of some actors as bridges among different polarities.

Another aspect that calls for a more close scrutiny is to investigate the kind of norms established within these networks, entering the domain of the cognitive social capital.

Regarding the latter aspect (methodological advancement), a relational computational system is set, allowing to answer to the research question. Specifically, starting from the available data, the contribution of the LAGs emerges on logical basis by the comparison among the relations actually existing and the relations created independently of the LAGs' activity. Moreover, the methodology proposed allows to identify the position and role of actors.

The variables studied in this work can contribute both to LAGs evaluation and selection processes by Managing Authorities (MAs). Concerning the evaluation, the indicators used can complete the assessment framework in order to evaluate the enhancement by the local agencies in the domain of social interaction, especially for the ability shown by these agencies to transform the social interaction in actual cooperation relationships. For what concerns the selection issue, the idea is to use these indicators as additional criteria to justify rewarding mechanisms for LAGs that exhibited virtuous interaction processes in previous editions. In particular, in order to endorse social resources as elements of rural development processes, these indicators can help in taking into account the social capital issue since the earlier phases of program elaboration (e.g. the set of intervention logic and the context analysis under Art. 8 of Reg. [EU] 1305/13). The analysis presented rests in the structural domain neglecting the outcomes of the structure investigated. However, the peculiarity showed by these structures deserves further investigation in order to study their attitude toward information spread and behaviors diffusion, that are the basic mechanisms in local development processes. In particular, the next step of the research will focus on the type of two-way impact, if any, between the endowment of LAG's social capital and all over the territory of the local community concerned by the implementation of the CLLD approach.

In order to foster the social capital of local partnerships, it is important, in particular, to involve the most active actors in the area. With this aim, the method here illustrated allows to identify the 'natural' leaders within the partnerships that should play relevant roles in future projects.

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Elisa Giampietri,
Erika Rutkowsky,
Adele Finco

Department of Agricultural, Food and Environmental Sciences (3A), University Politecnica Marche, Monte Dago, Ancona, Italy

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PAC II pilastro: prime valutazioni nella programmazione 2007-2013

Nowadays, there is no doubt that Common Agricultural Policy (CAP) represents the main support to rural development across the whole Italian territory. Offering the potential to learn from experience, the paper is here concerned with the quantitative evaluation of Italian regional programs under the 2007-2013 CAP's Pillar II, considering both national and the European Agricultural Fund for Rural Development's funding to Pillar II at the end of December 2013. The empirical analysis shows some relevant discrepancies in funding allocation among both rural development's axis and measures and different regions in Italy, and also between planned and declared expenditure. This reflects a scarce efficiency of public spending and some unsatisfactory rural development's performance.

1. Introduzione

Gran parte del territorio europeo risulta dominato dalle aree rurali. In termini di superficie, in Italia queste rappresentano complessivamente il 50% del territorio nazionale, generando un PIL pro capite più alto della media delle regioni rurali dell'OCSE; in particolare, le aree prevalentemente rurali incidono per il 27% sulla superficie territoriale italiana (OECD, 2009; INEA, 2013). Ciò è dovuto in parte alla prossimità con le aree urbane e a una base economica diversificata legata alla cultura locale, alle tradizioni, alle amenità naturalistiche. Tuttavia, poiché funzionali all'individuazione delle priorità della politica territoriale in Europa (Lucatelli, Carlucci, 2013; Storti, 2013), le aree rurali esigono una mappatura e una classificazione dettagliate alla vigilia della nuova Politica Agricola Comune. La strategia di sviluppo rurale 2007-2013 ha promosso una serie di azioni finalizzate al raggiungimento degli obiettivi Comunitari e Nazionali[1], contribuendo a fronteggiare le disparità economiche,

[1] Il Piano Strategico Nazionale (PSN) garantisce sia la coerenza tra le linee guida comunitarie (Orientamenti Strategici Comunitari) e i programmi regionali, sia la coerenza tra i vari Programmi di Sviluppo Rurale (PSR).

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sociali e territoriali fra le diverse regioni, favorendo uno sviluppo economico sostenibile in termini ambientali e il supporto delle attività nelle zone rurali, nonché il mantenimento della vitalità delle campagne. Le misure previste nei 21 Programmi di Sviluppo Rurale (PSR) regionali in Italia si sono articolate finora in quattro Assi di intervento, volti rispettivamente al miglioramento della competitività del settore agricolo e forestale (Asse 1), dell'ambiente e dello spazio rurale (Asse 2) (Finco, 2007), della qualità della vita nelle zone rurali e la diversificazione dell'economia rurale (Asse 3) e, infine, alla strategia LEADER[2] (Asse 4). Per fronteggiare al meglio le nuove sfide economiche, ambientali e territoriali (EC, 2010a e 2010b), garantendo il futuro a lungo termine del settore agricolo e delle zone rurali in Europa, la nuova programmazione prevede, almeno sulla carta, azioni sempre più concrete in termini sia di pianificazione finanziaria sia di programmazione strategica. La lunga fase legislativa intrapresa nel 2010 (COM(2010)672) si è conclusa con l'emanazione del reg. (UE) 1305/2013 recante disposizioni in merito allo sviluppo rurale. Quest'ultimo è oggi considerato sempre più una politica di coesione territoriale e per questo, sulla scia di quanto accaduto anche nelle passate esperienze (Copus, 2010), vanta una maggiore integrazione del FEASR con gli altri fondi strutturali europei[3], allineati attraverso il Quadro Strategico Comune (QSC) (Gigante, 2014), l'Accordo di Partenariato e gli altri Programmi Operativi Nazionali e/o Regionali di durata settennale. Sebbene confermato l'impianto generale in due pilastri, la struttura del II pilastro presenta tuttavia una rinnovata architettura (EU, 2013b), merito della soppressione degli Assi e della definizione di 6 priorità di intervento generali quali: rafforzamento e trasferimento delle conoscenze e innovazione (priorità 'orizzontale' o priorità 1); aumento della competitività e sostenibilità economica (priorità 2); organizzazione delle filiere e gestione del rischio (priorità 3); tutela degli ecosistemi agroforestali (priorità 4); gestione efficiente delle risorse e azione sul clima (priorità 5); inclusione sociale e sviluppo economico nelle zone rurali (priorità 6). Tali priorità sono scomposte in 18 focus area (o sottoinsiemi di misure). Le misure rimangono lo strumento di intervento finanziario dei PSR (Mantino, 2013), dimezzandosi numericamente rispetto alla passata programmazione. Sono infine previsti dei sottoprogrammi tematici per i giovani agricoltori, le piccole aziende agri-

[2] L'approccio LEADER, mutuato dalla precedente programmazione 2000-2006, è stato disegnato per aiutare gli attori locali a implementare strategie per il potenziamento delle aree locali, mediante l'implementazione di strategie integrate per lo sviluppo sostenibile delle aree locali attraverso la progettazione dal basso (bottom-up) e il coinvolgimento di partenariati chiamati Gruppi di Azione Locale (GAL).

[3] Fondo Europeo di Sviluppo Regionale (FESR); Fondo Sociale Europeo (FSE); Fondo di Coesione (FC); Fondo Europeo per gli Affari Marittimi e la Pesca (FEAMP).

cole, le zone montane, le filiere corte, le donne nelle zone rurali, la mitigazione dei cambiamenti climatici e l'adattamento ad essi nonché la biodiversità. Dal punto di vista dei contenuti, le principali novità riguardano: la cooperazione, l'associazionismo e l'integrazione nel sistema produttivo agroalimentare (artt. 35-44); la diffusione di strumenti per la gestione del rischio (artt. 36-37-38-39) legato a crisi di mercato o calamità naturali (Finco *et al.*, 2013); l'innovazione e il trasferimento dei risultati della ricerca, mediante la creazione del Partenariato Europeo per l'Innovazione (PEI) (artt. 53-55-56-57). L'innovazione, intesa nella semplice accezione del fare o vedere qualcosa in un nuovo modo, emerge infatti come un importante concetto per l'Europa (Dwyer, 2013). Infine, l'approccio LEADER, rafforzato oggi dall'integrazione del Community-led local development[4], si riconferma quale valido strumento attraverso le sue attività di animazione territoriale (Zanetti, 2013). Ciò a ribadire l'importanza del capitale sociale (Lee *et al.*, 2005) che, catturando gli aspetti intangibili o non prettamente economici di una comunità o di un territorio rurale, ne promuove tuttavia la crescita sostenibile (Shucksmith, 2010) o, in termini più ampi, lo sviluppo positivo, tanto quanto viene fatto dai diversi settori produttivi ivi insediati. L'iter legislativo per la definizione della politica di sviluppo rurale 2014-2020 in Italia è giunto pressoché alla conclusione, con l'emanazione nei prossimi mesi dei nuovi 21 PSR regionali e dei 4 programmi nazionali[5]. Relativamente alla pianificazione finanziaria per la PAC 2014-2020 (EC, 2013), l'UE ha assegnato complessivamente circa 52 miliardi di euro all'Italia (MIPAAF, 2014), di cui 21 miliardi per il II pilastro (stanziati per metà da Fondi europei e per metà da una quota nazionale); di questi circa l'89% andrà ai 21 PSR delle regioni amministrative e delle 2 Province Autonome (Bolzano e Trento), mentre l'11% (2,2 miliardi di euro) sarà gestito a livello statale per l'attuazione dei sopracitati 4 programmi nazionali. L'UE finanzierà l'Italia per una quota complessiva pari a 10,4 miliardi di euro, con assegnazioni annue pari a circa 1,4 miliardi di euro. Ne risulta che, contrariamente al I pilastro, il budget europeo per il II pilastro risulta rafforzato rispetto alla precedente programmazione (8,98 miliardi di euro) (Pierangeli, 2013). Al fine di incoraggiare una giusta messa in opera della nuova programmazione e buone performance da parte della politica (Bradley *et al.*, 2010), risulta qui utile analizzare l'esperienza appena trascorsa. Attraverso un'attenta analisi *ex post* del finanziamento pubblico allo sviluppo rurale 2007-2013, questo lavoro ha l'obiettivo di evidenziare quali siano stati i risultati della passata programmazione. Tali evidenze hanno

[4] Si tratta di un insieme di interventi rispondenti a obiettivi e bisogni di un territorio omogeneo (sub-regionale), gestito da un Gruppo di Azione Locale (GAL).

[5] Questi prevedono un intervento statale, essendo relativi a tematiche complesse quali la gestione del rischio, la biodiversità animale, il piano irriguo e la Rete Rurale Nazionale.

valenza sia in termini economici, attraverso le risultanze relative all'efficienza della spesa pubblica (data dal confronto tra la spesa pubblica programmata e quella realmente sostenuta), sia in termini di pianificazione strategico-territoriale, mediante l'analisi dell'allocazione delle risorse pubbliche in relazione tanto alle diverse azioni intraprese (Assi e misure maggiormente finanziati) quanto alla geografia dell'Italia rurale (macro aree Nord-Centro e Sud Italia; Regioni amministrative e Province Autonome).

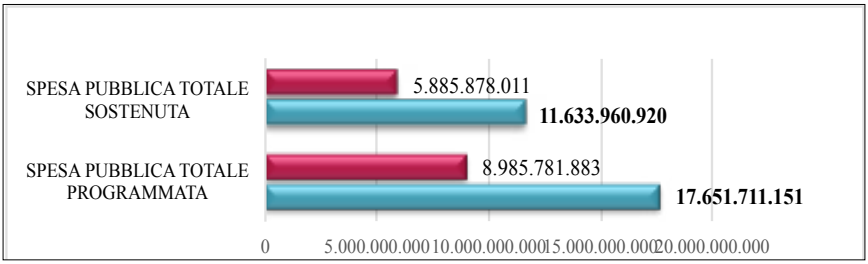
2. Metodologia di analisi

L'analisi intende fornire una valutazione dello stato di esecuzione del finanziamento pubblico al II pilastro PAC in Italia, relativamente alla programmazione 2007-2013. Facendo riferimento ai dati forniti dalla Rete Rurale Nazionale e relativi al periodo 1 gennaio 2007-31 dicembre 2013 (Ottaviani, Lafiandra, 2014), di seguito vengono analizzate la spesa pubblica programmata per il periodo 2007-2013 e la spesa pubblica effettivamente sostenuta; quest'ultima viene ripartita per Assi e per misure. Di fianco al finanziamento pubblico totale, costituito da una quota comunitaria e una quota nazionale, è stata analizzata anche la quota del bilancio comunitario derivante dal Fondo Europeo Agricolo per lo Sviluppo Rurale (FEASR). A una prima quantificazione e ripartizione della spesa pubblica sostenuta a livello nazionale nel periodo di riferimento, segue un'analisi a livello delle macro-regioni Nord, Centro e Sud Italia. Successivamente, viene analizzata l'allocazione della dotazione pubblica nella regione amministrativa maggiormente finanziata all'interno di ciascuna di queste tre macro-aree, considerando questa rappresentativa di tutte le Regioni e Province Autonome e tenendo conto dei rispettivi PSR 2007-2013.

3. Risultati

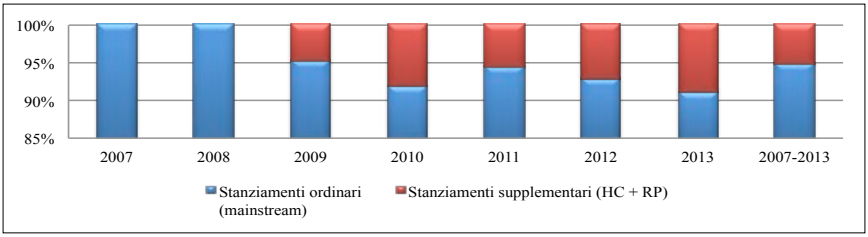
Per la programmazione 2007-2013, in Italia sono stati predisposti 22 Programmi, di cui 21 Programmi Regionali (PSR) e un Programma Nazionale (Rete Rurale Nazionale). La Politica di Sviluppo Rurale 2007-2013 in Italia presentava inizialmente una dotazione finanziaria pari a circa 9 miliardi di euro di risorse comunitarie (FEASR) e un totale di 17,6 miliardi di euro di spesa pubblica complessiva (FEASR e cofinanziamento nazionale). A fronte di questa spesa pubblica programmata, alla data del 31 dicembre 2013 l'Italia ha sostenuto una spesa complessiva pari a circa 11,6 miliardi di euro a sostegno dello sviluppo rurale (Fig. 1), mostrando un'efficienza di spesa pari al 66%. Tale quota sostenuta, attivabile attraverso i PSR, si compone per buona parte di un

Fig. 1. Confronto tra spesa pubblica totale (FEASR + cofin. Italia) programmata e sostenuta in Italia – programmazione 2007-2013 (€) (dati al 31/12/2013)



Fonte: ns. elaborazioni su dati RRN (Ottaviani, Lafiandra, 2014).

Fig. 2. Ripartizione per anni del finanziamento programmato FEASR (ordinario + supplementare) – programmazione 2007-2013 (€) (dati al 31/12/2013)

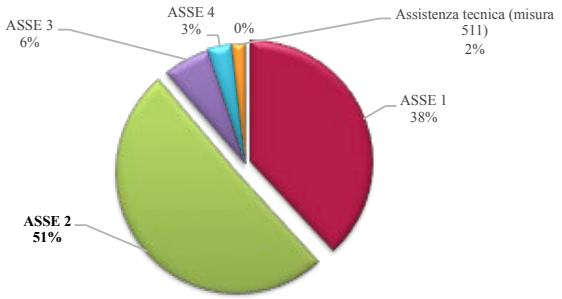


Fonte: ns. elaborazioni su dati RRN (Ottaviani, Lafiandra, 2014).

cofinanziamento nazionale (risorse statali e regionali) mentre, per circa il 51%, deriva dal sostegno comunitario allo sviluppo rurale, messo a disposizione dall'UE attraverso il FEASR. La dotazione di quest'ultimo (Fig. 2) va distinta in quota ordinaria (*mainstream*) e quota supplementare (Health Check – HC e Recovery Plan – RP) a partire dal 2009, a seguito del passaggio di risorse comunitarie dal I al II pilastro. Le risorse comunitarie erogate all'Italia da inizio programmazione alla data del 31 dicembre 2013 ammontano a circa 6 miliardi di euro complessivamente, quota quest'ultima di molto inferiore a quella inizialmente programmata dall'UE.

Come già ricordato, la politica di sviluppo rurale comunitaria si articola in 4 Assi tematici, comprendenti un totale di 43 misure, e nella misura 511-"Assistenza tecnica". Procedendo a una ripartizione nei sopracitati Assi della spesa pubblica totale (cofinanziamento nazionale + FEASR) sostenuta in Italia per il II pilastro, si nota un andamento estremamente polarizzato: infatti, è possibile evidenziare (Fig. 3) che nel complesso la maggior parte delle risorse pub-

Fig. 3. Ripartizione per Assi spesa pubblica totale sostenuta in Italia – programmazione 2007-2013 (%) (dati al 31/12/2013)



Fonte: ns. elaborazioni su dati RRN (Ottaviani, Lafiandra, 2014).

bliche (51%) è stata assegnata all'Asse 2-"Miglioramento dell'ambiente e dello spazio rurale", con un valore pari a circa 4,4 miliardi di euro (Tab. 1). Con allocazioni decrescenti seguono poi l'Asse 1-"Miglioramento della competitività del settore agricolo e forestale" (38,2%) e, a distanza, l'Asse 3-"Miglioramento della qualità della vita e diversificazione dell'economia rurale" (6,4%), l'Asse 4-"Attuazione dell'approccio LEADER" (3,2%) e infine la misura 511 (1,6%). La distribuzione finanziaria per Asse mostra come l'allocazione delle risorse per gli interventi rivolti all'innalzamento della competitività del settore agricolo e forestale (Asse 1) e a favore della tutela dell'ambiente e dello spazio rurale (Asse 2) sia del tutto preponderante (complessivamente circa l'89% del finanziamento totale allo sviluppo rurale) rispetto agli interventi relativi ai restanti due Assi; questi ultimi due, infatti, non rappresentano che un fanalino di coda (circa il 9,5%) nella dotazione pubblica allo sviluppo rurale. In particolare, il LEADER ha ricevuto risorse corrispondenti al 3,2% (circa 370 milioni di euro) sul totale delle assegnazioni allo sviluppo rurale e tale quota appare notevolmente inferiore rispetto alla percentuale di finanziamento inizialmente ipotizzata (7,5%). Tuttavia, se si considera il totale della contribuzione FEASR (pari a circa 5,9 miliardi di euro) al II pilastro, appare chiaramente come la quota spesa in Italia per il LEADER (6,3%) sia perfettamente in linea con il dato UE-27 (EU, 2013a); vale la pena precisare che Paesi più virtuosi quali la Danimarca o la Spagna hanno attribuito maggiore importanza all'approccio bottom-up, posizionandosi ai primi posti nella classifica europea, con una quota pari all'11%.

Procedendo con l'analisi della dotazione finanziaria dei PSR italiani, nei quattro grafici che seguono (Fig. 4) è possibile vedere l'importanza relativa di ciascuna misura all'interno del rispettivo Asse. Con riguardo all'Asse 1, risulta

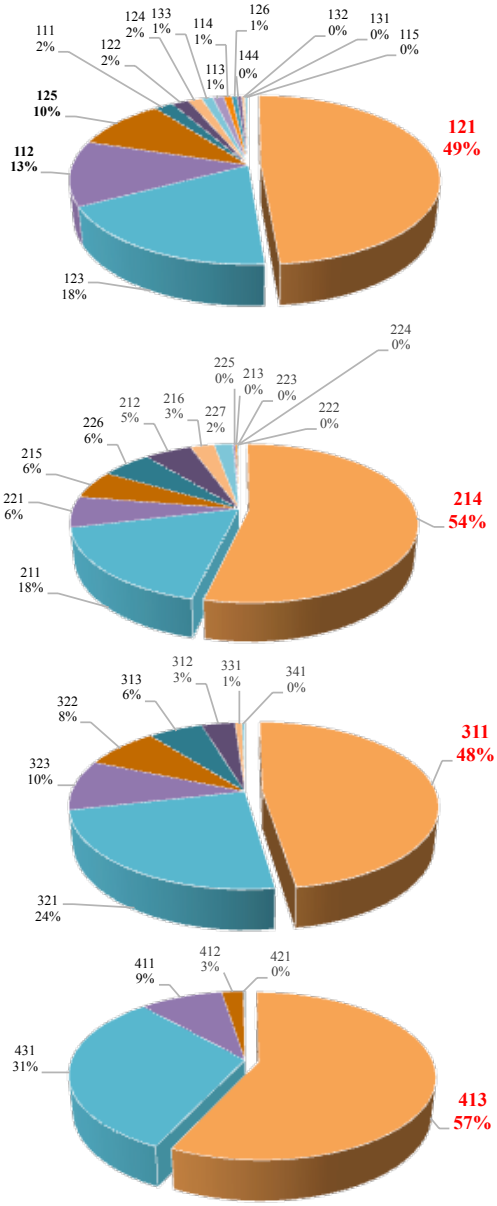
Tab. 1. Ripartizione per assi spesa pubblica totale (programmata e sostenuta) – programmazione 2007-2013 (€) (dati al 31/12/2013)

ITALIA	Spesa pubblica totale programmata (€)	% Spesa pub. tot. prog./tot. spesa prog. finanziata	Spesa pubblica totale sostenuta (€)	% Spesa pub. tot. sost./tot. spesa sost. finanziata
ASSE 1	7.032.018.026	*39,8*	4.438.994.297	*38,2*
ASSE 2	7.335.132.851	*41,6*	5.893.927.594	*50,7*
ASSE 3	1.596.978.861	*9,0*	741.706.526	*6,4*
ASSE 4	1.316.228.116	*7,5*	369.051.186	*3,2*
Assistenza tecnica (misura 511)	371.353.297	*2,1*	190.281.318	*1,6*
TOTALE	**17.651.711.151**		**11.633.960.920**	
di cui FEASR	8.985.781.883		5.885.878.011	
% FEASR sul Totale	*51*		*51*	

Fonte: ns. elaborazioni su dati RRN (Ottaviani, Lafiandra, 2014).

forte l'incidenza delle misure settoriali più tradizionali, quali quelle per l'ammodernamento delle imprese agricole, l'accrescimento del valore aggiunto dei prodotti agricoli e forestali e gli interventi a favore dell'insediamento dei giovani agricoltori. In accordo con quanto appena espresso, infatti, il 49% della spesa sostenuta (circa 2,2 miliardi di euro) si concentra nella misura 121-"Ammodernamento delle aziende agricole", seguono poi le misure 123-"Accrescimento del valore aggiunto dei prodotti agricoli e forestali" (18%) e 112-"Insediamento di giovani agricoltori" (13%). Con riguardo all'Asse 2, appare evidente come ad essere privilegiati siano soprattutto i pagamenti agro-ambientali, seguiti dalle indennità compensative per le zone svantaggiate: la misura 214-"Pagamenti agro-ambientali" vanta, infatti, la maggiore dotazione finanziaria corrispondente al 54% del totale (pari a 3,1 miliardi di euro), seguita dalla misura 211-"Indennità per svantaggi naturali a favore degli agricoltori" (18%). Nell'ambito dell'Asse 3, contenente le azioni finalizzate al miglioramento delle condizioni di vita delle popolazioni rurali e alla diversificazione, gli interventi più importanti riguardano prevalentemente la misura 311-"Diversificazione in attività non agricole, la quale presenta la maggiore dotazione finanziaria" (48%) vantando allocazioni pari a quasi 354 milioni di euro; essa è seguita rispettivamente dalle misure 321-"Servizi essenziali per l'economia e la popolazione rurale" (24%) e 323-"Tutela e riqualificazione del patrimonio rurale" (10%). Infine, nell'ambito dell'Asse 4, la misura 413-"Attuare strategie di

Fig. 4. Ripartizione per misure spesa pubblica totale sostenuta in Italia - programmazione 2007-2013 (€) (dati al 31/12/2013)

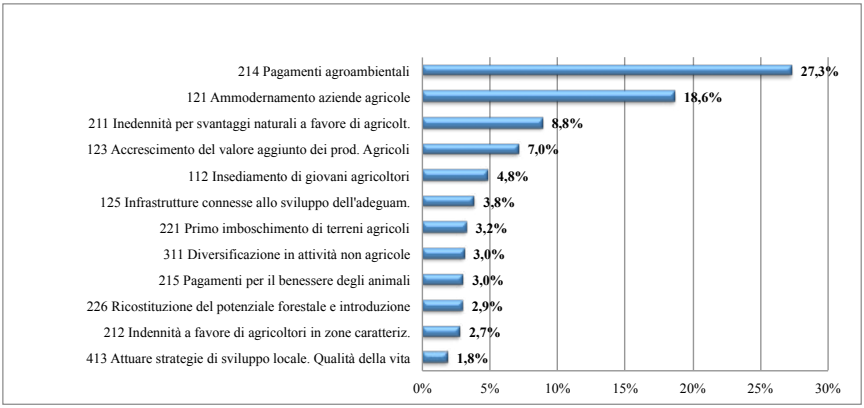


Fonte: ns. elaborazioni su dati RRN (Ottaviani, Lafiandra, 2014).

sviluppo locale. Qualità della vita e diversificazione" si aggiudica oltre la metà (57%) della dotazione totale con ben 210 milioni di euro assegnati; essa è poi seguita, con la quota del 31%, dalla misura 431-"Gestione del gruppo di azione locale, acquisizione di competenze, animazione".

Tali risultanze italiane appaiono in perfetta sintonia con quanto emerso da un'analoga analisi europea relativa alla spesa pubblica sostenuta alla data del 31 agosto 2013 (EU, 2013a), fatta eccezione per il terzo Asse. Nel panorama europeo EU-27 emerge, infatti, che è la misura 321-"Servizi di base per la popolazione rurale a mostrare la maggiore dotazione finanziaria" (con il 28%), seguita dalla misura 322-"Rinnovamento e sviluppo dei villaggi" (26%). In Italia la misura che ha registrato maggiore successo è stata la 311-"Diversificazione in attività non agricole", intendendo con questa azioni dedicate per lo più a impianti agro-energetici e servizi agrituristici. Nel complesso dei 21 PSR italiani, è chiaramente evidente la maggiore concentrazione di risorse intorno a un numero molto selezionato di misure (Fig. 5). La misura "Pagamenti agro-ambientali" (214) assorbe, infatti, oltre un quarto (27,3%) dell'intera dotazione finanziaria per il II pilastro, seguita dalla misura 121-"Ammodernamento" (18,6%); con dotazioni decrescenti seguono poi le misure 211-"Indennità a favore degli agricoltori delle zone montane" e 123-"Accrescimento del valore aggiunto dei prodotti agricoli e forestali", cui sono riservati rispettivamente l'8,8% e il 7% della spesa pubblica complessivamente sostenuta in Italia. Questo avvalora ulteriormente quanto già esposto, ossia che complessivamente la maggior parte della spesa pubblica destinata al II pilastro in Italia ha inte-

Fig. 5. Principali misure finanziate sul totale (FEASR + cofin. Italia) della spesa pubblica sostenuta in Italia – programmazione 2007-2013 (%) (dati al 31/12/2013)



Fonte: ns. elaborazioni su dati RRN (Ottaviani, Lafiandra, 2014).

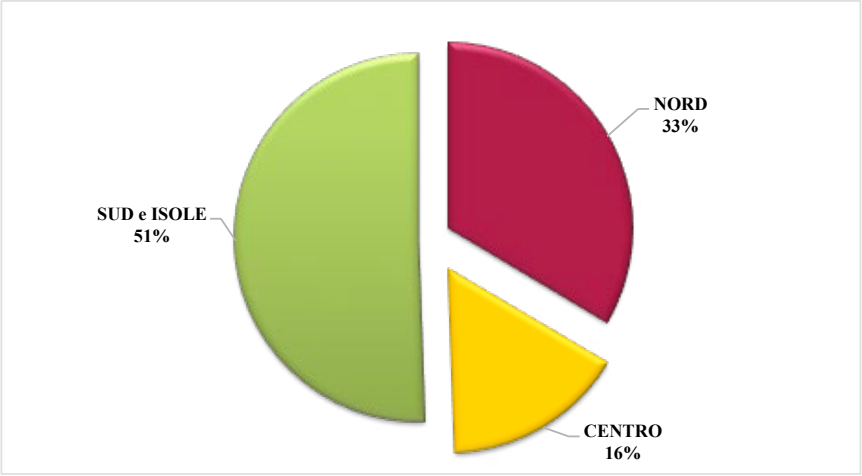
ressato le misure inerenti alla competitività e all'ambiente rurale (Assi 1 e 2). In particolar modo, la misura 214, attraverso le azioni agro-ambientali in cui si articola, concorre al raggiungimento dei seguenti obiettivi specifici, caratterizzanti la strategia dell'Asse 2: salvaguardia della biodiversità; tutela e miglioramento quali-quantitativo delle risorse idriche; sviluppo di pratiche agricole favorevoli all'attenuazione dei cambiamenti climatici e al miglioramento della qualità dell'aria; promozione della permanenza dell'attività agricola nelle aree svantaggiate; conservazione del paesaggio rurale; miglioramento della gestione del suolo (terreni agricoli e forestali). Diversamente, finanziando gli investimenti atti ad ammodernare le aziende agricole al fine di promuovere l'innovazione di processo e di prodotto e la riconversione produttiva delle aziende, la misura 121 concorre al raggiungimento dei seguenti obiettivi: incremento della competitività e dell'efficienza delle aziende; miglioramento del capitale fisico; riconversione e diversificazione dell'attività produttiva agricola; sviluppo di nuovi prodotti; incremento dell'occupazione e del ricambio generazionale; conservazione e miglioramento dell'ambiente e del paesaggio.

Procedendo nell'analisi finanziaria, interessante può risultare una valutazione della spesa pubblica sostenuta dalle singole Regioni e Province Autonome. In primo luogo si è scelto di ripartire queste ultime in tre macro-aree geografiche, ossia il Nord (Alto-Adige, Emilia-Romagna, Friuli, Liguria, Lombardia, Piemonte, Trentino, Veneto, Valle D'Aosta), il Centro (Lazio, Marche, Toscana, Umbria) e il Sud (Abruzzo, Basilicata, Calabria, Campania, Molise, Puglia, Sicilia, Sardegna). A conti fatti, appare evidente che all'incirca la metà (51%) della spesa pubblica totale erogata in Italia nella programmazione 2007-2013 è stata sostenuta al Sud, con una quota pari a circa 5,9 miliardi di euro (Fig. 6); seguono poi rispettivamente il Nord (33,5%) con circa 3,9 miliardi di euro e, infine, il Centro (15,9%) con 1,8 miliardi di euro.

Entrando più nel dettaglio, si è proceduto all'analisi delle scelte di riparto delle risorse assegnate alle singole Regioni e Province Autonome, non trascurando anche la dotazione destinata alla RRN. Dalla figura 7 risulta che la regione maggiormente finanziata nel periodo in esame è la Sicilia (12%), seguita dalla Campania (9,3%) e dalla Puglia (8,9%). Le tre regioni meridionali anzidette complessivamente assommano circa il 30% della dotazione pubblica italiana al II pilastro.

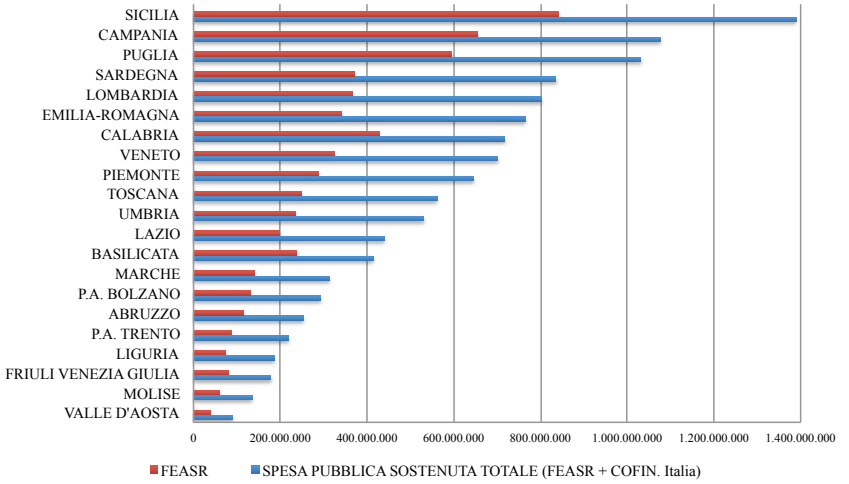
Operando un rapido confronto tra la spesa pubblica programmata e quella realmente sostenuta per ciascuna Regione e Provincia Autonoma al 31 dicembre 2013 (Tab. 2), è possibile vedere che la maggiore efficienza di spesa spetta principalmente alle due Province Autonome di Bolzano (88,8%) e Trento (78,4%), seguite dalle Regioni amministrative Lombardia (78,2%), Valle D'Aosta (72,1%), Umbria e Veneto (entrambe 67,3%). Emerge quindi come le regioni maggiormente finanziate (la Sicilia, la Campania e la Puglia) siano in realtà

Fig. 6. Ripartizione per macro-aree geografiche Nord-Centro-Sud Italia del finanziamento pubblico totale – programmazione 2007-2013 (%) (dati al 31/12/2013)



Fonte: ns. elaborazioni su dati RRN (Ottaviani, Lafiandra, 2014).

Fig. 7. Ripartizione per regioni FEASR e spesa pubblica totale (FEASR + cofin. Italia) sostenuta – programmazione 2007-2013 (%) (dati al 31/12/2013)



Fonte: ns. elaborazioni su dati RRN (Ottaviani, Lafiandra, 2014).

Tab. 2. Ripartizione per regioni della spesa pubblica totale (FEASR + cofinanziamento Italia) programmata e sostenuta – programmazione 2007-2013 (€) (dati al 31/12/2013)

Regioni	Spesa pubblica programmata totale (€) a	Spesa pubblica sostenuta totale (€) b	% Spesa pubblica sostenuta/ Spesa pubblica programmata b/a	Numero aziende (ISTAT) c	Finanziamento per azienda (€) b/c	SAU - ha (ISTAT) d	Finanziamento a ettaro (€) b/d
Bolzano	330.192.026	293.309.944	*88,8*	20.247	14.487	240.535	1.219
Trento	278.764.791	218.587.923	*78,4*	16.446	13.291	137.219	1.593
Lombardia	1.026.568.657	802.710.023	*78,2*	54.333	14.774	986.826	813
Valle D'Aosta	123.649.759	89.166.741	*72,1*	3.554	25.089	55.596	1.604
Umbria	786.904.257	529.931.726	*67,3*	36.244	14.621	326.877	1.621
Veneto	1.042.158.575	701.036.745	*67,3*	119.384	5.872	811.440	864
Friuli Venezia Giulia	265.683.479	178.624.884	*67,2*	22.316	8.004	218.443	818
Piemonte	974.087.993	646.071.392	*66,3*	67.148	9.622	1.010.780	639
Emilia-Romagna	1.158.082.673	764.929.160	*66,1*	73.466	10.412	1.064.214	719
Calabria	1.087.508.918	717.533.070	*66,0*	137.790	5.207	549.254	1.306
Molise	206.582.326	135.105.183	*65,4*	26.272	5.143	197.517	684
Sardegna	1.284.746.987	835.810.417	*65,1*	60.812	13.744	1.153.691	724
Marche	482.282.568	312.817.931	*64,9*	44.866	6.972	471.828	663
Liguria	289.402.956	187.329.400	*64,7*	20.208	9.270	43.784	4.278
Puglia	1.595.085.914	1.031.132.668	*64,6*	271.754	3.794	1.285.290	802

(Continua a pagina 89)

(Continua da pagina 88)

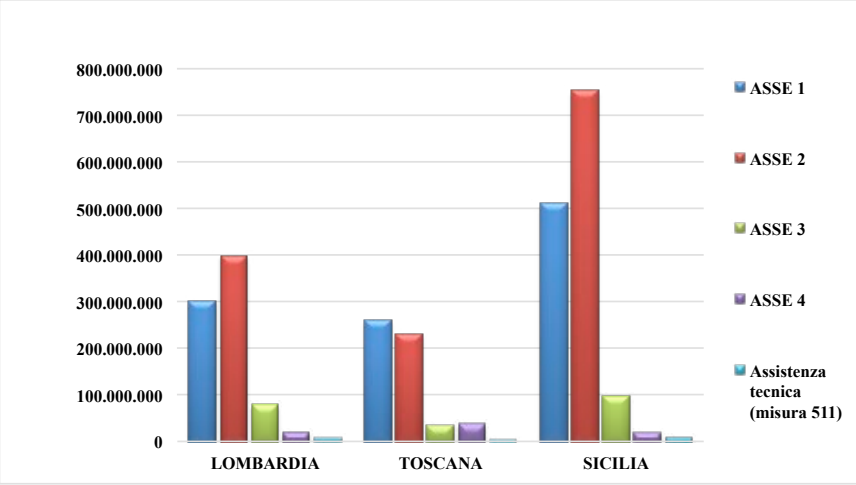
Regioni	Spesa pubblica programmata totale (€) a	Spesa pubblica sostenuta totale (€) b	% Spesa pubblica sostenuta/ Spesa pubblica programmata b/a	Numero aziende (ISTAT) c	Finanziamento per azienda (€) b/c	SAU - ha (ISTAT) d	Finanziamento a ettaro (€) b/d
Toscana	870.527.329	561.505.330	*64,5*	72.686	7.725	754.345	744
Sicilia	2.172.958.855	1.389.477.703	*63,9*	219.677	6.325	1.387.521	1.001
Basilicata	656.000.886	414.631.674	*63,2*	51.756	8.011	519.127	799
Lazio	700.434.557	439.699.883	*62,8*	98.216	4.477	638.602	689
Campania	1.810.840.262	1.077.691.344	*59,5*	136.872	7.874	549.532	1.961
Abruzzo	426.327.617	252.668.193	*59,3*	66.837	3.780	453.629	557
RRN	82.919.766	54.189.587	*65,4*				
Italia	**17.651.711.151**	**11.633.960.920**	***65,9***	**1.620.884**	**7.178**	**12.856.048**	**905**

Fonte: ns. elaborazioni su dati RRN (Ottaviani, Lafiandra, 2014) e VI Censimento Agricoltura ISTAT 2010.

scarsamente efficienti nella spesa pubblica, presentando valori compresi tra il 64,6% al 59,5%. A livello europeo, parallelamente, risulta che i paesi più efficienti nella spesa sono Irlanda, Lussemburgo, Belgio e Austria, mentre gli ultimi in classifica risultano essere la Grecia e la Bulgaria. Attraverso i dati del VI Censimento dell'agricoltura (ISTAT, 2014) e, più precisamente, facendo riferimento al dato relativo al numero di aziende e a quello relativo alla SAU (ha) per ciascuna Regione e Provincia Autonoma d'Italia, è stato possibile individuare, sia l'importo del finanziamento mediamente attribuito alla singola azienda regionale, sia il finanziamento a ettaro accordato dai PSR. Tenendo conto del primo indicatore, infatti, le evidenze mostrano che la Valle D'Aosta è la Regione con il più alto finanziamento per azienda (25.089 euro), seguita dalla Lombardia (14.774 euro), dall'Umbria (14.621 euro) e dalla Provincia Autonoma di Bolzano (14.487 euro). Invece, riguardo alla quota media di finanziamento per ettaro, risulta che sono le aziende della Liguria ad aver ricevuto la quota più cospicua (4.278 euro/ha), seguite da quelle della Campania (1.961 euro/ha), da quelle dell'Umbria (1.621 euro/ha) e della Valle D'Aosta (1.604 euro/ha). Per quanto riguarda il dato medio a livello italiano, si rileva un'efficienza di spesa pari a circa il 66% per il periodo di programmazione in esame, con un finanziamento medio per azienda pari a 7.178 euro e un finanziamento medio a ettaro pari a 905 euro. Infine, relativamente alla dotazione destinata alla RRN, emerge che essa rappresenta circa lo 0,5% dell'assegnazione pubblica totale, presentando un'efficienza di spesa pari a circa il 65%.

Si è proceduto, infine, ad analizzare la distribuzione della spesa pubblica sostenuta in ogni regione maggiormente finanziata all'interno di ciascuna macroarea geografica (Fig. 8), vale a dire la Lombardia (6,9% di spesa sostenuta sul totale nazionale) per il Nord, la Toscana per il Centro (4,8%) e la Sicilia per il Sud (11,9%). Pur prendendo in considerazione solo le tre regioni in questione, in rappresentanza dell'intero scenario dei 21 PSR, ciò ha aiutato a evidenziare se a livello regionale la situazione fosse analoga a quanto emerso a livello nazionale. In linea con ciò, sebbene il panorama sia complessivamente piuttosto omogeneo, emergono comunque delle differenze fra le regioni sopracitate in merito alla ripartizione della spesa pubblica sostenuta per assi. Complessivamente sono gli assi 1 e 2 ad aver ricevuto il maggior finanziamento pubblico, in conformità con i risultati emersi a livello italiano, ed è una scelta questa che accomuna tutte le tre regioni. Di contro, agli Assi 3 e 4 complessivamente è stato destinato in media circa l'11% del totale in ciascuna delle tre regioni. In particolar modo, in Lombardia e Sicilia (e quindi al Nord e Sud) è l'Asse 2, con una quota di spesa pubblica sostenuta che si aggira mediamente intorno al 52%, a dominare sull'Asse 1 (mediamente 37%). Questo è indice di una scelta decisa da parte di alcune regioni in favore della valorizzazione dell'ambiente e dello spazio rurale. Viceversa, in Toscana a predominare è l'Asse 1 (46,1%) seguito dall'Asse 2 (41% cir-

Fig. 8. Ripartizione per assi spesa pubblica totale (FEASR + cofin. Italia) sostenuta, regioni Lombardia, Toscana e Sicilia – programmazione 2007-2013 (%) (dati al 31/12/2013)



Fonte: ns. elaborazioni su dati RRN (Ottaviani, Lafiandra, 2014).

ca). Anche in relazione alla ripartizione del finanziamento nelle singole misure, a livello regionale (e più precisamente facendo riferimento alle tre regioni di cui sopra) i risultati appaiono in linea con la situazione a livello nazionale: emerge, infatti, che sia la Lombardia sia lo Toscana sia la Sicilia, rappresentative dei 21 PSR italiani in questa analisi, hanno attribuito un peso rilevante alle misure 121, 214, 311 e 413, con un valore medio percentuale rispettivamente del 51%, 62%, 75% e 63% sulla spesa totale relativa a ciascun Asse.

4. Considerazioni conclusive

L'analisi ha messo in luce alcune evidenze relative sia all'efficienza di spesa sia alla diversa allocazione delle risorse pubbliche destinate al II pilastro in Italia, nella programmazione appena conclusa. Ciò che a una prima analisi emerge con maggior evidenza è una scarsa efficienza di spesa (66%) riscontrata a livello sia nazionale sia regionale, alla data del 31 dicembre 2013. A questo proposito, non v'è dubbio che l'impatto socio-economico dell'attuale crisi e il clima di incertezza economica abbiano avuto un peso in tal senso, ostacolando l'accesso ad alcune misure strutturali del PSR. Un forte divario tra Nord e Sud chiaramente emerge, laddove la metà della spesa pubblica totale erogata in Italia è stata sostenuta nelle regioni meridionali (51%). Si segnala, inoltre,

che le regioni maggiormente finanziate (Sicilia, Campania e Puglia) sono in realtà scarsamente efficienti nella spesa pubblica. Per contro, non stupisce l'eccellenza espressa dalle Province Autonome di Trento e Bolzano, che identificano strategie oculate non solo dal punto di vista finanziario, rivelandosi anche esempi virtuosi di valorizzazione territoriale. Guardando agli Assi e alle misure dei 21 PSR, in Italia risulta che complessivamente la maggior parte della spesa pubblica destinata allo sviluppo rurale ha interessato le misure inerenti alla competitività (Asse 1) e all'ambiente rurale (Asse 2). È d'uopo riconoscere all'esperienza passata un ruolo fondamentale per gestire in maniera più efficiente lo sviluppo rurale futuro, incrementando tanto le performance politiche quanto le ricadute a livello territoriale. In tal modo, a tutti gli stakeholder (inclusi gli agricoltori, i loro rappresentanti e i governi dei singoli Stati Membri) giunge un potenziale insegnamento, tratto dall'esperienza, per disegnare al meglio le nuove misure e consegnare al territorio un supporto allo sviluppo che sia più adeguato agli obiettivi e più coerente con le riforme e le politiche. Al contempo, ai circoli accademici ciò consente di centrare quali siano i meccanismi e gli impatti dell'intervento pubblico sul territorio, cosi da sviluppare nuove e immediate questioni, rilevanti sul piano strategico, a supporto della politica di programmazione (Hodge, Midmore, 2008). Alla luce dei risultati emersi dall'elaborazione dei dati, appare dunque utile dar voce ad alcune riflessioni che possono essere preziose per l'applicazione delle future misure del II pilastro nella nuova programmazione. Sebbene l'architettura logica della nuova Politica di Sviluppo Rurale assuma una veste molto diversa, almeno all'apparenza, dalla precedente, poco in realtà cambia in relazione agli obiettivi. In merito ai contenuti, si sottolinea che la vera novità riguarda l'incentivazione dell'innovazione che, risultando trasversale sul piano strategico, prende forma attraverso la creazione di un Partenariato a livello europeo (PEI). Lo stesso vale per la gestione del rischio che, tuttavia, dal punto di vista operativo esula dallo schema prettamente legato al II pilastro ma resta appannaggio di una gestione centrale. Poiché l'innovazione (di prodotto, di processo ma anche di strategie economiche) non prescinde dalla ricerca, nella nuova programmazione risulta necessario che quest'ultima sia incorporata nel processo di sviluppo integrato del territorio rurale. La ricerca economico-agraria si rivela, infatti, fondamentale per lo sviluppo di nuovi mercati (Alternative Agri Food Networks), per l'organizzazione di filiera, per la competitività aziendale, ma anche relativamente agli aspetti sociali che sono parte integrante dello sviluppo. Al fine di migliorare l'efficienza di spesa per il futuro, uno strumento essenziale è la semplificazione, la quale comporta una minore burocratizzazione, una pianificazione adeguata dei tempi di attuazione dei bandi ma anche una selezione strategica delle azioni da intraprendere, al fine di evitare l'eccessiva frammentazione delle risorse a disposizione. Tale obiettivo, inoltre, non può

prescindere da un'efficace concertazione da intendersi a più livelli (tra organizzazioni e cooperative agricole, tra policy-maker e tessuto produttivo), da una maggiore informazione tra le parti interessate e da un'adeguata formazione degli agricoltori in merito alle misure e alle azioni da intraprendere. Ciononostante, una maggiore efficienza di spesa deriva anche da adeguate garanzie di accesso al credito, ritenuto da più parti un deterrente per il ricorso al finanziamento pubblico da parte degli imprenditori agricoli, nonché causa principale del gran numero di misure che, una volta intraprese, falliscono. In linea con ciò, un nuovo ruolo di CONFIDI è chiaramente auspicato, affinché questo non si limiti a fornire un mero sostegno di secondo livello, ma piuttosto assuma un ruolo maggiormente incisivo per le imprese. Nonostante il comprovato successo dell'Asse 2, i risultati raggiunti sembrano ancora scarsi o perlomeno lontani dagli obiettivi originali. A tal proposito, è utile ricordare che maggior impegno deve essere rivolto all'aggregazione di imprese ricadenti in un certo ambito territoriale e ambientale, attraverso la realizzazione di progetti di filiere, accordi agro-ambientali di area e progetti integrati territoriali. Un simile approccio corale amplificherebbe, finanche a migliorarle, le ricadute sul territorio (Finco *et al.*, in stampa). Sulla base di alcune evidenze empiriche è d'uopo notare che attuare progetti di filiera è risultato talvolta penalizzante per le imprese fino ad oggi, a causa sia della lunghezza delle procedure di approvazione delle domande, sia dei vincoli imposti dalla stessa filiera, sia dalle garanzie che le amministrazioni regionali reclamano in termini di piena operatività delle filiere. Dal nostro punto di vista, i progetti bottom-up trovano ragion d'essere anche nella nuova programmazione, in quanto efficace motore di sviluppo endogeno, tanto quanto lo sono i settori produttivi tradizionali, sebbene l'approccio LEADER vada necessariamente riconsiderato e valorizzato. A tal proposito, ci si auspica che ci sia una maggiore integrazione tra i GAL e le aziende agricole coinvolte nei progetti e che gli obiettivi dei progetti proposti si mantengano coerenti sia con la natura agricola e ambientale delle risorse da cui derivano i finanziamenti (FEASR), sia con le ricadute sociali nel territorio rurale. Infine, laddove il I pilastro si è dimostrato poco generoso verso i giovani agricoltori (destinando solo l'1% delle risorse), il II pilastro sembra voler, almeno nelle premesse, attenzionare con maggior interesse questa voce, inserendola tra i sottoprogrammi tematici. Tuttavia, riteniamo che occorra continuare a incoraggiare il ricambio generazionale non solo riproponendo il pacchetto giovani, ma incentivando anche la mobilità del mercato fondiario, specie nelle aree marginali. In conclusione, al fine di promuovere uno sviluppo rurale sempre più coerente con gli obiettivi sia economici sia strategici in Europa e in Italia, il ruolo più significativo va ricondotto necessariamente ai decisori politici. Questi ultimi sono chiamati ad applicare futuri criteri di governance che siano sempre più svincolati dalle logiche squisitamente politiche

e maggiormente fedeli agli obiettivi di efficienza tecnico-economica e di sviluppo territoriale.

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Mafalda Monda,
Roberto Henke

Council for Agricultural Research and Economics, Rome, Italy

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Public research in agricultural economics: organisation models, objects of investigation and targets[1]

Many changes affected rural society and economy in the last decades, requiring a rethinking of the whole system of public research in support of the policy making in agriculture and rural areas. In this context, INEA promoted a workshop with other research Institutes in order to discuss about the evolution, changes and perspectives in the public research for agriculture, the targets of the research activities and the new challenges for public research institutes in the economic, social and environmental analysis of agriculture. This paper summarizes the main results of the INEA's event that was a unique occasion to present and discuss the rationale of a public research system and its long-term perspectives and to create conditions for useful network for European research projects, allowing to develop and enhance the circulation of ideas and researchers.

Introduction

In Italy the debate about the role and the future of the public research system around and for agriculture is quite intense. Many changes affected rural society and economy in the last decades, requiring a rethinking of the whole system of public research in support of the policy making in agriculture and rural areas. These changes can be summarized as following:

- A change in the units of production. Farms nowadays are very different from the past, including new functions and activities and pursuing new strategies and goals. The spectrum of farm typologies is an issue that needs further investigation, also in order to better define and qualify the «model of European agriculture» that is at the base of all the new EU policies for agriculture and rural areas.

[1] Held in Rome, October 14, 2014, the event was financed by INEA within the activities of the Observatory of Structural Policies. The Observatory, launched in 1996 with the aim of supporting the Ministry of Agriculture, Food and Forestry and the Italian Regions for the evaluation of structural intervention programs, promotes research activities on issues relevant to the design of rural and agricultural policies.

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- A change in the relationships of the primary sector with the other actors of the agro-food *filiere* (processing, marketing, exports).
- A change of the role of agriculture in the socio-economic systems of the EU Member States. Agriculture is increasingly seen not only as an economic sector but also as a main actor providing environmental services, social and touristic services, and also featuring a residential function. At the same time, rural areas are not anymore seen just as production sites but also as a place for consumption and recreational activities. For these reasons, new research in agricultural economics need to take all these considerations on board and focus on the interrelationships between the "core" of the agricultural business and the role of agriculture in the environment, landscape, natural resources management, labour, markets, consumption, leisure.
- A change in rural society and economy. In recent years neo-liberal principles have called for the retreat of state intervention in rural development, the privatisation of public services and the application of commercial principles to utilities that remain under state control, leading to the dismantling of uneconomic services and facilities in rural communities. As a consequence, a problem of persistent rural poverty has emerged that cannot be addressed only by raising farm incomes, but rather securing the family farm as the key social unit of rural life and maintaining agricultural employment and population in rural areas.

In this context, INEA promoted a workshop with other research Institutes in order to discuss the following themes:

- The evolution, changes and perspectives in the public research for agriculture, with specific regards to the forms of organisation and management within the public research structures, the relationships with the public and private institutions governing the sector (EU institutions, Ministries, local institutions, stakeholders, professional organisations) and the possible forms of support supplied to institutions and other actors;
- The targets of the research activities, types of publications and ways to communicate the results of analyses.
- The new challenges for public research institutes in the economic, social and environmental analysis of agriculture as a consequence of the new topics emerged in agricultural economics (multifunctionality, sustainability, diversifications, small farms, green economy, blue economy).
- The ways and opportunities for public research to contribute to the diffusion of innovations and to address the results of the policy analyses to economic and social actors.

The event was divided into four panels linked to the above mentioned objectives. Each panel was introduced by an INEA staff member and discussed

by an expert (academic, professional…) who summarized the main results. Seven research Institutes/Agencies (of the EU area) joined the discussion: LEI Wageningen UR (Netherlands) with two participants – Mr. Krijn J. Poppe and Ms. Laan Van Staalduinen; The Irish Agriculture and Food Development Authority (Ireland) with Mr. Gerry Boyle; The Thünen-Institut of Market Analysis (Germany) with Mr. Martin Banse; the National Institute for Agricultural and Food Research and Technology (Spain) with Mr. Andres Montero Aparicio; the National Agricultural and Food Centre (Slovakia) with Mr. Ivan Masar; the Austrian Federal Institute of Agricultural Economics (Austria) with Mr. Thomas Resl; the Leibniz Centre for Agricultural Landscape Research with Ms. Annette Piorr. In addition to these participants, Ms. Elena Saraceno, Consultant at European Commission, Mr. José Maria García Alvarez Coque, professor at the Universitat Politecnica de Valencia and Mr. Gianluca Brunori, professor at University of Pisa participated at the Workshop.

Panel 1. Public research in agriculture: scope, organisation, institutions. Moderator: Francesco Mantino, Senior researcher at INEA. Discussant: Janet Dwyer, Director of Countryside and Community Research Institute (United Kingdom)

Object: The research system around agricultural economics is quite vast and features various organisational models. In most cases it lays on independent Institutes (Italy, Austria, Poland, Japan), in other cases it is part of a larger net of research institutes for agriculture (France), other times it is a component of the academic network (Netherlands) or it is a body of the Ministry of agriculture, in all its different definitions (USA, UK). This last feature is predominant in non EU countries (USA, Canada, Australia). It is a field in which changes occur quite quickly and at a fast pace, due mainly to budget reasons, the need to rationalising resources, or to better focusing on the main research topic. There are also many private or semi-private institutes and agencies that work in the field of agricultural economics and other fields that are contiguous to it (agricultural and rural policies, environment, food, etc.). They also have a crucial role in the sector analysis and in the institutional support, often interacting with the public institutes. The panel investigated different organisational models of public and private research in agriculture, with a specific focus on the sources of funding (especially EU funds), the research structure and the relationships with European and National Government Institutions and Universities. How the change in funding and research priorities is affecting organization?

Panel discussion

T. Resl (AWI, Austria) pointed out that in Austria public research in agricultural economics is fragmented among many different institutes, although there is a lot of shared work. AWI is an independent Institute, under the Ministry of Agriculture and funded by 90% by public national funds. However this is a very fluid situation, depending on access to European funds or projects of a different nature. The discussion about funding and budget constraints is always central and somehow affects the life and the production of the Institute. Coming to the issue of organisational change, there is always a trade-off between the search for funds and the topics, which are mainly defined with the Ministry. For this reason, it is very difficult to look for other sources of in-coming resources. In the recent past AWI got more autonomy from the Ministry, but then the Institute sorts of «returned home», so it is now more difficult to claim for access to resources and other funds. In the future, AWI could become a private company, so that it will have to hunt for funds totally on the market. This will make also employment policies easier, because AWI will be able to choose whom to employ and with what specific skills.

A. Montero Aparicio (INIA, Spain) highlighted how in Spain there is a downward trend of public budget for agricultural research, combined with a high level of instability. At the same time, private research has grown up, even though it does not fill in the gap. Budget constraints have affected highly the two main institutions dealing with public research in agriculture: INIA and the National Research Council (NCR). INIA has undergone many changes in the last few years, and at the moment it is both a funding institution and a research institute. Moreover, in 1982 the system of public research was decentralised, with the transfer of regional branches to the regions. They are financed by the local governments, while INIA depends on the National governments, and specifically on the Ministry of economy and competitiveness. On the other hand, the NCR deals with technical aspects of agriculture, in the domain of agricultural science, while agricultural economics is considered a social science, so it is not included in the interests of the NCR. A very interested case in Spain is that of IRTA in Cataluña. This is an interesting model because it switched from department organisation to a programme organisation, and one of that is on agricultural economics. So the research is actually organised along programmes rather than departments, allowing them a higher rate of multi-disciplinarity and better capacity to access to funds. In the last years funds coming from international sources are increasing.

A. Piorr (ZALF, Germany) described the process of global rethinking of the whole German Institutes after the reunification, the so-called "Blue List

Institutes" which gave rise to the Leibniz Association to whom ZALF is part of. Leibniz gathers about 70 Institutes that stems from social sciences to natural sciences, based on the idea of inter-disciplinarily and crossing boundaries of academic disciplines. In the case of ZALF, they try to merge rural areas with cultural aspects, land use and social issues, such as labour. Funds originate 50% from the federal government and 50% from the State of Brandenburg, where the Institute is located. In spite of the origin of funds, ZALF is totally free to organise and choose research issues and methods, included the possibility to bid for international projects. This brought also to a quite significant increase in the stuff, both scientific and support, which is, however, often tied to the specificity of the project and not permanent. One of the key point we try to address is the integration among Institutes, trying to favour cross-cutting instruments and methodologies that can become common and shared knowledge. This is not an easy task, since very often languages, backgrounds and approaches are quite distant. Another relevant and complicated issue is the institutional level to deal with, given the federal structure of Germany and the different origin of funds, but also the increasing share of European and International funds. The main topics now are land use change, structural change and multi-functionality and climate change.

L. Van Staalduinen (LEI, Netherlands) recalled how LEI is part of the Social Science Group of the Wageningen University and Research Centre since 2012. It was born as an independent private institute in 1940 and then became part of Ministry of Agriculture, but in 2000 it was transferred to the Wageningen University. Most funds come from the Ministry of Economic Affairs, but an increasing share comes from the EU (research projects) and a little but significant share from private subjects. It is worth to underline that in the Netherlands there isn't a Ministry of Agriculture, which merged few years ago with the Ministry of Economic Affairs. After this merge the Institute became less vulnerable to budget cuts so that now it is seen as a more reliable partners also by the private sector. Being part of the University affects a bit the topics on which the Institute works: food, feeds, bio-based production, and LEI specialises in the economic analysis and also on land use, bio-based economics and resource economics. The approach is mixed: from micro to macro, from producers to consumers. Some researchers are highly specialised and work on specific topics but their goal is to improve multi-disciplinarity and the team work becomes key in order to better focus on the client's demand and translate that into useful and high quality scientific work. Food security and sustainable food with respect to water, climate and energy are the subjects where LEI wants to be leading in the next years. With regard to the organization, people working at LEI want to specialize on different tasks: research, fundrais-

ing, communication, development of new products and services. These functions require different skills and specialization.

M. Banse (VTI, Germany) added a few elements to the presentation of A. Piorr about the German system of public research in agriculture. The van Thünen Institute is fully financed by the Federal government, through the Ministry of agriculture, which funds the Institute but the Institute is fully independent. Actually, within the VTI are fourteen Institutes dealing with agriculture, forestry and fisheries with a focus on three aspects: economics, technology and ecology. So it is like a matrix system: fourteen Institutes by three broad topics, and according to the specific issues the team is built as the combination of the two dimensions. With regards to funds, they are provided in different ways: at the federal level, through three main sources: the Research Association, which is an agency that funds general projects on agriculture, forestry and fisheries; the Ministry of Science and Research, concentrating resources especially on climate change and crop science; and the Ministry of Agriculture, which at the moment is focusing especially on renewable resources. In terms of sectors, it is especially livestock the challenge in Germany, because it involves topics that are considered society-sensitive for environmental, landscape, ethical, nutritional and economic reasons.

I. Masar (NPPC, Slovakia) brought at the table the experience of the Slovak Republic in public research in agriculture. Also in Slovakia, like in many other European countries, the NPPC merged with other specialised institutes into one large research centre, dealing with food and agriculture. This new centre merges nine institutes, with the aim to cut costs and make research projects more efficient, creating linkages and synergies among fields of activities and researchers. It could be stressed that the merging involves institutes quite different both in size and topic: some of them are highly specialised, such as the Research Institute of Viticulture and Enology, the Food Research Institute and the Grassland and Mountain Agriculture Research Institute. The new Institute is financed mostly from public funds via Ministry of Agriculture and Rural Development and Ministry of Education, Science, Research and Sport but also by a specific Slovak Research and Development Agency for science and research support. However, it must be said that the new Institute still faces serious budget problems with dramatic consequences on the level of employment and quality of research.

J. Boyle (TEAGASC, Ireland) pointed out that his Institute is an autonomous, non-commercial State agency funded for the highest part by the government and by the research market (EU and national funds for research).

Interestingly enough, the Agency hosts many Ph. D students, who are integrated in the research projects. The Institute works on the fields of agriculture, food processing and rural economy, with an applied focus. The Institute covers also the fields of agricultural extension and agricultural education. The influence of the funding institutions is rather limited on the day-to-day business. However, there are continuous informal exchanges of opinions and point of views on most topics TEAGASC deals with, and especially on CAP design and implementation, water quality and climate change issues. TEAGASC features also regular relationships with two public national universities and some international ones. The main task is to create joint programmes, so that we can host students and collaborate in two projects. This is quite challenging because TEAGASC is very mission focused, while Universities are more theory oriented and the research approach is more individualistic. The Agency has also extended relationship with the private sectors and, in particular, with processing food companies and multinational companies. As many other Institute participating in this workshop, we face a serious problem of employment, which is in decline since 2008. The other tricky issue TEAGASC daily faces is to find the right balance between strategic objectives, that are nationally oriented, we pursue and the need of some of our funders, especially in the case of the private sector.

J. Dwyer (Concluding Discussant) A few common themes emerged from the discussion. The first issue is the process of change that is affecting, in one way or another, all the research Institutes dealing with agriculture and close themes. Reorganisation and merging respond mainly to the logic of budget cuts and expenditure efficiency, less common is the case of a rationalisation of the topics and the tasks of research projects. The second theme is represented by the issue of funds. The common problem of the shrinkage of the public funds forced research organizations to look for different sources of finance to sustain themselves and to generate more stability, considering that traditional funding sources are becoming less stable or narrower in what they are willing to support. As a consequence, many organizations are moving away from what had been a traditional relationship with the central ministries, working more intensely with the private sector and mixing several sources of funding. The variety of sources of funds (national, European, regional or local) has an impact on the agendas and on the organization of research Institutes because these have to be responsive to external political agendas and financial rules. In this sense, the diversification of income sources might give more stability to research organizations, but it might also make them more vulnerable. Furthermore, research Institutes that work close with governments get very affected by political changes. Changes of government mean changes in respect of governance and in respect of public spend-

ing in order to deal with the economic challenges. The discussion has shown very different organization typologies with regard to the nexus with other disciplines. In relation to research fields, some Institutions operate as separate social science institutes and others carry on agronomical or technological research. In some countries, these two functions seem to be separate while in others they are brought much more together, so that agricultural economics and sociology work very closely with the natural sciences. Finally, the other relationship which came out from the discussion concerned the role of extension. Traditionally, there were models of agricultural research where the research was directly linked to the extension which meant that government funding went directly to farmers. However, extension services across Europe changed and now the relationship between research and extension is not so clear. Finally, in relation to priorities, it is very clear that research organizations are addressing four or five main topics: structural change, farm accountancy, the environmental agenda and the community's agenda, the rural economy agenda that lead automatically into multi-disciplinarity or trans-disciplinarity. Multi-disciplinarity and trans-disciplinarity require to develop methodologies which work across the boundaries of traditional scientific disciplines.

Panel 2. Whom do we talk to? Dissemination of results and publishing in public research institutes, Moderator: Annalisa Zezza, Senior researcher at INEA, Discussion: Piero Conforti, Senior statistician at FAO

Object: The theme of this panel can be summarized as follows: what are the major challenges in generating and disseminating scientific results of research work? One of the key points in the activities of public research institutes (and more in general about research) is how to combine the quality of work done on the matter and the communication and dissemination of results to a wider audience. By definition research does not reach a wide public because the main users of the immediate results are experts, institutions, stakeholders. In agriculture, the audience is even more restricted due to the apparently small contribute of the primary sector to the overall economy. Since public research relies mainly on public funds, it is increasingly "under the spot", especially in a context of reduction of financial resources and increasing competition among different possible utilisations. As a consequence, trying to reach a wider audience with simple but effective messages is currently a priority. There seems to be an apparent trade-off between publishing on high-rated scientific journals and having an impact on society. Moreover, a lot of work we do and papers we produce are in the grey area of supporting documents for the Institutions and they often do not fully meet requirements for peer-review scientific publications.

This panel focuses on the crucial issues of the beneficiaries of the research work in public and private Institutes: what, where and how to disseminate results, what publishing policies should be adopted in order to ensure and enhance quality research products, at the same time realizing results that are useful for technical support to National and European Government Institutions. Also, there are technical relevant issues that add on to the difficulties to disseminate research work in a affective and efficient way: is a good executive summary useful? Is the language a barrier? Are websites a good and feasible way to disseminate results? All that has clearly a cost, in terms of financial resources but also of human capital and time.

Panel Discussion

T. Resl (AWI, Austria) opened the discussion pointing out how public Institutes often bridge between scientific research and economic and political practises in support of different institutional levels. With this regards, the relationship with the Universities is very important. In Austria AWI collects data from farmers, in various ways, then it builds together with the Universities a valid methodology in order to analyse them properly and infer from them behaviours and support policy. Another relevant issue is the transdisciplinarity: economy has to be looked at together with ecology, animal welfare and so on. A cooperative approach is necessary and welcome, both on the scientific side and on the practices. The size of the Institutes is also an issue for the right balance between the two approaches: AWI is a small Institute and it would be more difficult and costly to develop methodologies on its own. So working together with Universities and other Institutes is not only encouraged for scientific reasons, but also for the efficiency of the expenses. The second issue has to do with generating an impact of our works and evaluating it. Generally speaking, what AWI does has to have an impact on farmers and society but it is delivered as a first and crucial step to politicians and Ministries. AWI does not talk directly to farmers because it does not cover the extension service. This job is done by the Chamber of Agriculture, with which AWI cooperates. So a flow of information and results transmission is progressively built although sometimes is not easy to make it work properly. Furthermore, the media have a key role in it, because it is in their responsibility how results are delivered to the whole society and transmit the sense of whether and to what extent our job is useful. Finally, the language is an issue, especially in the effort to collaborate at the international level, so AWI tries to have at least some of its published works and the website in English.

J. Dwyer (CCRI, United Kingdom) brought the point of view of a British research Institute based within a University. This is a rather unusual combination because the University is relatively small and CCRI is by far the largest research entity within the University. As often is the case in the UK, CCRI is on the market for project financing, so the issue of dissemination is absolutely critical. The Institute has its own marketing team in order to publicise its works. Policy makers are a very important audience because the ultimate goal is having an impact on policy design and implementation. Also the general public is very important in order to "build a reputation". Another relevant issue is how to enlarge the spectrum of the audience, trying to reach and involve other actors such as the agri-food industry, the third sector, the local communities. The challenge is to find a common language with them, which can be different to the language CCRI is used to. Trying to have an impact is what really characterises and drives the job of public research institutes compared to Universities, which tend to be less demand-driven. The other big challenge is to build and defend a credibility, with applied research, in academic and scientific circles, given also the specific histories and paths: agricultural economists, development economists, policy analysts, sociologists, and so on.

E. Saraceno (ENRD, Belgium) pointed out how the system of knowledge for agriculture or rural development and environmental practises are very different. The former has been highly codified, like an academic discipline that is the transmitted to the final beneficiaries through the extension service. The latter cannot rely on the same type of organisation, since the body of knowledge has not been codified in the same way. For this reason the marriage of these two subjects in the research institutes is always a bit difficult and each Institute has dealt with that in different ways. Linkages between agriculture and rural areas, between farmers and rural population need to be further explored and so must linkages between policies be. This is the real challenge for public research in agriculture and in rural development because, in the end, the main goal is that of making it clear what policies are meant for and who has access to the body of policies and for what. Farmers often do not understand the policies they are forced to follow and sometimes they do not understand whether and to what extent there are benefits for them in those policies. It becomes then paradoxical that you have a supply of knowledge that is not relevant for farmers (or it seems to them not relevant) and a demand of knowledge form farmers that is not satisfied by extension services and research Institutes.

A. Montero Aparicio (INIA, Spain) underlined the relationships of the activities within the European research Institutes and the network of European

research such as Horizon 2020. How to combine the research excellence and the perception of a relevant service for farmers and rural areas? On this matter the debate in a large part of the research Institutes is quite intense because it is not an easy task to get the right balance between these two aspects. Of course on a daily base research Institutes do not talk directly to farmers because that is not their job and it requires skills and a specific language that is not part of the research job, but what you do as a researcher should, in the end, be useful or perceived as useful by farmers and actors of rural areas. One of the successful words for that is "co-ownership". This will allow to go beyond the traditional line of the knowledge transfer: getting all the subjects involved and make them co-owner of the ideas. That means to participate since the very beginning in the conceptualisation of the ideas of the projects, of the development process, so that in the end relevant solutions will come up and everybody will feel part of the same common experience.

A. Piorr (ZALF, Germany) highlighted how the support work that is done in favour of national and European institutions is very often short-time, and it becomes outdated even before any possibility to reach peer-review journals. However, even projects where work on methodologies and policy tools is conducted sometime the end up in the institutions drawers or on websites where they disappear from after a few years. Scientific paper publication is still at the top of the criteria for evaluation also in the case of public research institutes and so that becomes a priority for each individual researcher. To that end, a single researcher has to find a sort of balance between proper research and support, between policy analysis and methodological work, but also between consolidate research patterns and new frontier topics, which are more interesting for publication on international peer review journals. Language is also a key issue, and from that point of view it is often the case that researchers work in English for European projects and then they must translate their work in their mother language because that is the only way to disseminate the work at the domestic level. So this becomes also a time issue, a cost issue and, after all, an issue of scale economies and sizes of the Institutes.

K.J. Poppe (LEI, Netherlands) pointed out that the main targets of research output are represented by policy-makers (the Ministry of Agriculture, the Parliament and the Ministry of Environment) and farmers. This is for two reasons: a) a lot of research institutes get data from farmers in the FADN; b) the second reason consists on the fact that it's important to give to farmers relevant information about their business. In this context, scientific papers are not the main objective of research institutes but they are important in order to build their scientific credibility and to play well in competitive bidding within

the European system. But LEI publishes also practical abstracts for farmers and citizens. LEI has a policy of making available for the general public the results of its research but this may not be always possible when working with the private sector.

M. Banse (VTI, Germany) underlined that working mainly for the government but being evaluated by researchers is a challenge. Generally research evaluation criteria are based on scientific outcomes, papers, peer reviewed articles. On the other hand, working for the government implies to process complex requests on a short-term base and to adopt a different communication style. In this sense, evaluation criteria applied to policy reports should be based more on the political impact that they have. The second challenge that researchers in agricultural economics have to face is to translate research outcomes to farmers that requires the ability to communicate with them. The Von Thünen Institute decided to hire two journalists in order to write good executive summaries and to translate research results into «normal people's language». In this way it was possible to integrate scientific excellence with a communication strategy. In addition, the communication of scientific results in a way that is understandable to the broader public helps research activity to continue in the future because taxpayers are guarantees of continuous work in governmental support.

I. Masar (NPPC, Slovakia) remarked the importance of involving different parties such as advisory services, companies, consumers, the civil society and policy-makers in a joint preparation of research, research tasks and research fields. The application of a transdisciplinary approach in research tasks is also a specific requirement of the European Union and European Commission in Horizon 2020 that try to involve different parties from various countries and research fields. Cooperation between research institutes helps to create synergies, avoiding duplication of efforts, and to maximize benefits from public research that are mostly funded from the State money or State budgets. However, the research outcomes should be communicated in a concise and understandable way and in English that is becoming the world language. This could allow agricultural institutions, policy-makers and farmers to know more about research activities in other countries.

J. Boyle (TEAGASC, Ireland) pointed out that research institutes are facing the same challenges with different funding sources. For this, TEAGASC tried to harmonize the project selection by establishing some common elements between funding agencies with the objective of emphasizing the impact and the scientific excellence of research. These criteria -impact and scientific excel-

lence- are particularly stressed by the major science funding entity in Ireland that requires projects to be first acceptable in impact sense. The impact also represents the third stage of the research internal evaluation process adopted by TEAGASC that is based on a three step system where the first stage is represented by the KPI based on scientific publications while the second is the practice adoption. TEAGASC disseminates research outcomes taking into consideration the differences in processes and ultimate users in agriculture and food research. For agricultural research, TEAGASC generally produces "technology updates" that are a joint production between researchers and extension specialists. The extension service transmits this to farmers. For research in the food sector, the end user is a company. For this, TEAGASC has established a series of customer relationship through expos in which they can engage a dialogue with researchers.

G. Brunori (University of Pisa) emphasized that it is not possible to escape from the combination between impact and scientific rigor. However, the trade-off between solving real problems and having good science is apparent. Some examples of that are shown by scientific journals (e.g.: Nature, Science) that publish articles easy to read which have a huge impact factor. Open access is changing the way to communicate scientific results. Often researchers belong to multi-disciplinary groups so they try to address a problem from different perspectives, bringing their specific body of knowledge. Since it is a collective endeavour, building networks is an investment that requires researchers to travel, to build infrastructures, to integrate different laboratories, to produce research and disseminate it. All this requires different skills and approaches and the capacity to see forward, to reflect on the processes and try to organize them. This can be done with institutions that are nearer to the societal challenges. Research institutes can help to identify these challenges and, to a certain extent, give an idea of how science can be related to them.

P. Conforti (Concluding discussant): The first element emerged from the discussion was that communication is a difficult task for researchers because it's something that forces to see things in a different way and to deal with different types of expertise. People who are expert in communication know nothing about research, but they still have a say on what researchers are supposed or not supposed to be saying. In addition to this, there is a need to work by problem and across disciplines, that is something which communication can highlight. Trans-disciplines is an effort in trying to combine specialization, which is typical of research, and, at the same time, the need to addressing problems. This highlights the problem of resources because hiring journalists or people specialized in communication demands resources that,

on the other hand, require to develop partnerships and join forces across the work to do. Finally, the discussion about communication also highlighted the need for feedbacks. The research system has to be oriented by some feedbacks that tell whether it is doing right or wrong in the direction it is moving. In this sense, indicators could be useful.

Panel 3. Agriculture and beyond: what is moving in Europe? Moderator: Roberto Henke, Head of Macroeconomic and Short-Term Economic Analysis Unit at INEA. Discussion: José María García Álvarez-Coque, Professor at the Universitat Politecnica de Valencia

Object: Agriculture itself is becoming something very different from the past. Now, agriculture is not only an economic sector because it provides environmental, social and touristic services. As a consequence, agricultural economics institutes started to look beyond agriculture, also to address the budget problem and to be more competitive or more interesting for the public and other institutions. However, the new role of agriculture requires to develop a more comprehensive approach in conducting research in this field, to hire people with different skills and to change criteria of recruitment. The new role and concept of agriculture need to build relationships with new actors (Ministries, rural entrepreneurs, new professions in agriculture…). The Ministry of Agriculture is, traditionally, the institution to whom the agricultural economics institutes turn to, but other institutions such as the Ministry of Environment and the Ministry of Health are also involved in this process. The panel investigated these new topics arising in the broad fields of agriculture and agri-food systems, paying particular attention to the transformation of the role of agriculture in Member States and the new functions of agriculture in contemporary societies, as well as the links and nodal points of the agro-food systems.

Panel Discussion

T. Resl (AWI, Austria) illustrated how the Agricultural Economics Institute is shifting from agriculture to rural development research. AWI is still negotiating with the Ministry of Agriculture the whole responsibility for the evaluation of the rural development – two of the European programs in Austria – as consequence of the European Commission request for an independent evaluation of rural development policy in Austria. This process is leading this institute to be more independent from the Ministry of Agriculture. In ad-

dition, the Agricultural Economics Institute is developing new programs that allow to use economic resources of the Pillar 2 for activities that are not only related to agriculture, launching new projects to boost regional tourism in order to diversify the farm income. From the Austrian Institute point of view, food security will be one of the main challenges in the future. AWI wants to form with other institutions a sort of Agency for Food Security with the responsibility of whole food security. However, food security is a challenge that calls for global solutions, requiring to find partners on European and international levels. The second challenge for research in agriculture that needs to work with international partners is represented by the food supply change and the economics of food supply change because the cost of foodstuffs is, continuously, rising with negative consequences for farmers. In the future, the Institute wants to support farmers to find the good way to produce, taking into consideration the economic and ecological aspects of the food production.

J. Dwyer (CCRI, United Kingdom) pointed out the importance of interdisciplinary in order to analyse economic problems. CCRI is inter-disciplinary within the social sciences having sociological, anthropological and geographical expertise. Also effective partnerships across disciplinary boundaries with institutions of different research areas are very important. CCRI, for example, worked with ecologists of the Food and Environment Research Agency or with soil scientists on projects in the FP7.

E. Saraceno (ENRD, Belgium) highlighted that the new role of agriculture has added a whole different range of issues besides the traditional modernization of farming strategies, including part-time farming and multiple activities. In this context, it is becoming important to understand these linkages that have completely changed the way in which farmers think about their business. This represents a difficult task especially for small research centres. However, establishing networks with people in other disciplines is very important as well as doing field work in order to be in contact with a specific community or specific types of farmers and understand how they work. Multi-disciplinarity has added new dimensions in governance arena with the need to talk with more than one autorithy.

A. Montero Aparicio (INIA, Spain): pointed out that changes in agriculture affected farmers and research. In Spain, for example, the number of farmers reduced but their capacities increased as well as their activities that are more related to environment. Changes in agriculture research become clear looking at the case of IRTA, the regional research centre in Catalunya. IRTA moved from departmental organization to programs organization in order

to develop a more transdisciplinary research. This represents a challenge because the interdisciplinary relations between different programs is difficult to put into practice considering that each program has its objectives and problem solutions. However, as a consequence of changes in agriculture research Institutes should provide resources to our end users in order to adopt the technology and to face future trends.

A. Piorr (ZALF, Germany) emphasized the idea that research Institutions are facing main challenges for agriculture such as: food security, climate change, rural development etc. What is needed is to understand the linkages by identifying the cause-effect relationship. In order to cover this broad complexity, that represents a challenge, institutions have to broaden the disciplinary composition of their staff. ZALF staff, for example, is currently composed by: planners, geo-ecologists, policy scientists, agronomists and economists. The collaboration between them is generally fruitful but difficult as a consequence of different approaches adopted by each discipline. Research needs a new approach beyond themes and territories, some communalities and some kind of middle level research.

L. van Staalduinen (LEI, Netherlands): highlighted that sustainability, risk management, food safety, food management and the credibility of the food chain are some of topics that LEI wants to develop in next years. In addition, there are topics such as health, food and consumers (healthy foods, consumer choices, the consumer behaviour) that need to further develop. The relation between food and health became important in the last 20 years and several joint program initiatives – such as Healthy Diet for a Healthy Life – are ongoing in Europe. This relation will probably be more important in the next 10–15 years with an impact on public policies in agriculture on national level. In Wageningen social scientists try every year to build scenario analysis to meta-analysis that can help colleagues from the technical divisions to understand which are the main areas of research to invest in. Important research issues regard finance, succession issues, risk management and the circular economy that closes the resources circle.

M. Banse (VTI, Germany): stressed that research in agriculture has to look beyond the agricultural production taking into consideration societal and health aspects. In this sense, agricultural economists and experts in social economic science can built a bridge between the more production oriented sciences and sociology. Talking about food and health allows researchers to inform a large arena about what is happening in agriculture going beyond the traditional farming system.

I. Masar (NPPC, Slovakia) highlighted some of the main challenges of agricultural economics beyond 2020. In particular, environmental issues and the sustainable use of natural resources will be probably on the top priorities of the EU agenda. Another issue is the distributional value and equity along the food chain. New challenges for agricultural research will be food standards and labelling of food products, the elimination of food waste and food security. Finally, scarcity of raw materials and rising cost of inputs will probably result in high volatility that will assume an increasing importance for research in agriculture. Beyond 2020 period, changing tastes and preferences of consumers will be other important topics as well as the fair price formation and the transmission along food supply chains.

J. Boyle (TEAGASC, Ireland) highlighted the partial view that often is applied to the arising challenges in agriculture. Research specialization has definitely narrowed the scope of the issues that are the subject of most research requiring to have appropriate skills. TEAGASC focuses on the improvement of rural communities livelihood, mainly farmers, applying two strategies: maximizing the utilization of resources on the farms and facilitating diversification on farm and off farm. Regarding to this, TEAGASC had a very large program on diversification and, in this context, it hired a series of technical specialists but these did not work. In this case it could be that a business school people that could have been better in order to assist farmers to think strategically and plan strategically. The multi-disciplinarity approach can work when research is problem driven that is happened often in the environmental area.

G. Brunori (University of Pisa) highlighted how boundaries are set by problems suggesting to look for problems instead that for boundaries. Boundaries need to be crossed understanding our limits to see how is possible to go beyond them. With regard to policies, our research should be aimed at anticipating policies more than analyse the implications of the policies already in place.

J.M. Garcia Alvarez Coque (Concluding discussant): The discussion focused on priorities of research in agricultural economics in the next future and the applicable approach addressing many subjects as water, climate change, low carbon economy. In this context, governance and asymmetries in the food chain represent important topics. However, there is the need to help organizations to be more efficient, effective and participatory taking into consideration that there is a separation between the leadership and the base in the organizations. Other challenge for research in agricultural economics is to overcome the trade-offs between sustainability and competitiveness, to change the style of life of society, the way people consume and treat food,

the education of people. Innovation is also useful in order to enhance capacities of the farming sector but it requires to adopt the participatory approach to make knowledge more effective for farmers. The approach to apply in research should be inter-disciplinarity and networking oriented. In this way, research institutions can use new methodologies applied in other countries by working with partners of other parts of the planet. This is useful not only for farmers across the European Union but for all social actors in the society. It was also highlighted how some foresight exercises on priorities in agricultural research have taken place and are going on in the EU but often they are moved by interests in specific fields so independent exercises are needed.

Panel 4. Innovation, research and partnerships: what role for public Institutes? Moderator: Guido Bonati, Senior researcher at INEA, Discussion: Gianluca Brunori, Professor at University of Pisa

Object: Public institutes can play a crucial role as a "transmission belt" between research and analytical work and the production world, including the downstream components of processing, distribution and consumption. This specific role can become very relevant also in the international research and policy analysis arena, such as Horizon 2020 and the OECD working tables. This panel investigated ways and opportunities for public research to contribute to the diffusion of innovations and to address the results of the policy analyses to economic and social actors and the main challenges to face in participating in international projects and partnerships with the private sector, including the establishment of research economic institutes. In addition, it wants to analyse ways and room for collaboration with private sector in response to its specific demand.

Panel Discussion

M. Banse (VTI, Germany) underlined that the interaction between the Federal Research Institute and the private sector is becoming more important in last few years and this is encouraged by Horizon 2020. Besides, the private sector approached the Institute in many areas. One of the most important initiative of the Institute was represented by the *Agribenchmark*, an international farm comparison network that allows to compare farm costs related to different agricultural activities (organic farming, vegetable production, beef) and farms of all over the world. Private companies that finance the *Agribenchmark* network project have an exclusive access to the current work of the Institute in

this area. Regarding the establishment of networks he recalled the initiative of the global club of directors and announced that there is some work to do for re-launching it in the next months.

I. Masar (NPPC, Slovakia) pointed out that agricultural research has to find a balance between providing public goods and producing research for the private sector (agriculture and food industry). However, in the Slovak Republic the farmers demand for research and innovation is low because the industry provides them good extension services. In addition, Slovak farmers don't have financial resources to cover research projects. In this context, the establishment of an intermediate broker who connects farmers or companies of the food industry and research institutions could be an option to optimize their interactions and strengthen cooperation. This broker could also support farmers to find out the financing to transmit to research institutes. At European level, innovation could be improved by the establishment of a centralized database of research projects, considering there is not a real interconnection within the European countries and there are many project databases owned by separated Institutions (e.g.: libraries, ministries and universities).

J. Boyle (TEAGASC, Ireland) stressed the difficulties to gain adequate economic resources by working for the private sector. In particular, TEAGASC tried to persuade farmers to contribute to research activities by the way of levy. The Institute currently has small levies in dairy, pigs and cereals. TEAGASC has also public-private partnerships with processing companies -meat companies and dairy companies. These companies are interested in working with TEAGASC and farmers because their primary interest is in facilitating or encouraging greater efficiency in the production of primary products. In this context, an important partnership example is represented by the triangular relationship between TEAGASC, the beef processor and the major farming newspaper in Ireland. This collaboration has an important dissemination component because they weekly publish the results of the on-farm activity. TEAGASC is also involved in pre-competitive research activities financed by private companies and the State in the areas of food for health, human gut microbiota and some initiatives in dairy and meat. The relationship with the private sector, although not relevant in final terms, can be important for a political point of view in order to gain visibility and credibility at societal level. Our role is also justified by the prevalence of SME in the food sector, that are not big enough to pursue their own research.

J.M. Garcia Alvarez Coque (Universitat Politecnica de Valencia) brought the point of view of the University at Valencia where the collaboration with

technological platforms represents an opportunity to have contact with the private sector - such as Food for Life and other technological platforms- and work close with the stakeholders in the food chain. However, these activities are not necessarily profitable as a consequence of the fact that the agri-food sector is fragmented with a prevalence of small and medium enterprises. This represents a limit for research demand coming from the private sector. However, cooperation with the private sector could be a way to have money for marginal activities that are not funded by public sources. This is the reason why the Universitat Politecnica de Valencia collaborates with inter-professional organizations and farming organizations, cooperatives, organization of cooperative federations and foundations. Especially foundations are increasingly linking universities with farmers.

T. Resl (AWI, Austria) underlined the importance of cooperation between research institutes of public and private sectors, on national and international levels, in order to overcome the lack of economic resources and have good research outcomes. Cooperation is particularly useful in order to apply for international tenders such as Horizon 2020 and to exchange experiences and information. An example that shows the importance of cooperation is represented by the AWI research on taxation systems of agro-fuel in response to a specific question from the Ministry of Agriculture. In this context, AWI had a lot of difficulties to get information on mineral tax or energy tax in force in other countries that could be avoided by cooperating with institutions of these countries.

J. Dwyer (CCRI, United Kingdom) focused on the third sector as possible partner of research institutes. Non-profit organizations are increasing their centrality in the society as a consequence of the government institutions failure. The limited amount that the third sector can invest in to research is of minor importance with respect to the knowledge on rural development that it owns. That's why collaborating with non-profit organizations represents an important opportunity of learning for research institutions.

E. Saraceno (ENRD, Belgium) underlined that the private sector is a reality composed by many figures: farmers, SMEs, large business, NGOs that ask for different types of research and services that do not find an adequate supply. An example is the technical assistance for burocratic activity which doesn't get supplied by the public sector but also the financial aspects of prefinancing projects that generally require the involvement of banks. The role and answers to private sector demand depend on the type of circuit of the agri-food chain -national or international- and its length. Indeed, the type of

support needed when the production and transformation processing and marketing take place within a relatively small area is very different than that demanded in longer circuits.

A. Montero Aparicio (INIA, Spain) highlighted the role of European Innovation partnerships (PEI) in connecting with demand of innovation. The agri-food sector is fragmented because the majority of farms are small and medium size. This represents a limit for the demand for research and innovation that comes from the private sector. However, initiatives funded by the rural development program and Horizon 2020 could help to create a better environment for innovation in the agri-food sector in EU, increasing the demand for innovative activities. For this, it is important to incentivize the participation in Horizon 2020 by creating networks for researchers that represent the main issues in order to develop new ideas.

A. Piorr (ZALF, Germany) underlined that innovation in terms of technological or social innovation, management and governance is one of the most important activities that research institutions offer to the private sector. Research institutions help to analyse processes taking the role of brokers of knowledge. In particular, the ZALF takes part in several technological platforms, creating new models like crowdfunding. However, cooperation on international level is a key issue in order to have knowledge advantages. In this sense, networks play an important role to respond to calls and to be active in setting the political agenda.

Krijn J. Poppe (LEI, Netherlands) put in evidence that working with the private sector represents an opportunity to finance research but could create tensions between public and private goals of research institutes that have to give political advices and to support the private sector. For this, innovation is part of policy research that has to be done in public-private partnership. There are opportunities of public-private partnerships in particular in the food supply chain. One example is the development of sustainability indicators within a sustainability consortium. In addition, opportunities for European research institutes come from countries extra Europe: for example in developing FADN in other countries.

G. Brunori (Concluding discussant): The relation between public and private sectors changed in the last few years. Before, agricultural research was strongly embedded in agricultural social welfare state and, as a consequence, had objectives defined by the State, in a top-down approach, such as: promoting agriculture, avoiding fluctuations, volatility and ensuring to farmers

a level of income equals to that of other sectors. This model was replaced by a new model where the public sector lost its centrality and the private sector becomes more important. But the private sector is not always able to express its demand for innovation. The private sector has to face short-term problems while research is, generally, related to middle-term or long-term problems. In this context, partnerships between public and private sectors can help to fund long-term research in order to face common challenges and respond to the need of innovation. The relationship between public and private sectors is also beneficial to public research institutes that have the opportunity to learn from various actors – corporations, farmers and third sector. These forms of collaboration public – private give also benefits to private companies that want to develop new concepts and products or to anticipate change because they have the opportunity to influence the process of regulation-making and innovate before the regulation enters in place. Indeed research activity can influence or generate dialectic between policy-makers and companies, the third sector, etc.. helping to develop concepts and to address emerging social challenges. In this sense, research innovation is not good by itself e but only if is able to address what is relevant to society. In Horizon 2020 research is related to societal challenge and not only productivity gain but these challenges do not match short term needs of the private sector. The establishment of a network is a key issue in order to participate to international calls but it requires a lot of preparatory work starting from the mobility of researchers, the exchange of Ph. Ds or stages.

Conclusions (prof. Giovanni Cannata)

The event was a unique occasion to present and discuss the rationale of a public research system and its long-term perspectives but also to discuss and compare the relationships with the wider research system inside the single countries and also outside them (Academic research, International agencies, and so on). However, the event represented also an opportunity to discuss about some common problems that research institutes have to face in next years that seem to be related to the research budget, topics and the way of disseminating results. To this regard, the discussion has shown the existence of a trade-off between scientific and educational approaches in research and difficulties to disseminate research outcomes to specialized and not specialized audience, especially considering the scarcity of resources. Indeed, research institutes are facing budget constraints in several European countries that ask for more efficiency in the way in which public or private resources are used and to collect more resources from the private sectors. The development of

new themes represents in this context an opportunity and a challenge for research in support of the private sector that requires more attention to interdisciplinarity and a switch from short-term problems to longer-term problems. That's why, research institutes have to be able to anticipate change and to give to stakeholders the opportunity of understanding the change. Cooperation within research institutions, at national and international level, is a key factor because it could help to keep changes, manage inter-disciplinarity, having research funds and spread research results. The workshop helped to create conditions for an useful network for European research projects, allowing to develop and enhance the circulation of ideas and researchers, sharing projects, exchanging young professionals and senior researchers.

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