IA tools applied to impact assessment of EU policies in agriculture and environment

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Abstract: Demand for impact assessment (IA) tools by public administrations has increased significantly in the last decades, when the European Union has also increased its efforts to measure the impact of its agricultural and environmental policies. Different IA tools have been applied to assess EU policies in agriculture and environment, like the Common Agricultural Policy reform, decoupling, the Water Framework Directive, agri-environmental schemes, the Nitrates Directive, etc. This paper considers impact assessment tools that are commonly used in Europe and the rest of the world for carrying out assessments initiated by policymakers. The aim of the paper is to provide a review of the IA tools applied for the assessment of the EU policies in agriculture and environment, to analyse them and to classify them by different criteria according to the policy that they have been applied to and by the impacts that they have been measured. This paper reviews 116 published studies for impact assessment carried out in European countries.

Keywords: impact assessment; agriculture; environment; impact assessment tools.

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1 Introduction

Agricultural and environmental issues are affected by a wide set of regulations and laws due to national and European Union agricultural policies. European Union has made increased efforts to measure the impact of its policies (Midmore, 1993). The importance of impact assessment (IA) has significantly increased in the last decades, and it is now common to have IA reports attached to policy making processes. In this context, the European Commission (EC)'s Directorates-Generals (DGs) have increased funds for both research and consultancy aimed at providing the IA of agricultural and environmental policies.

The main available tools according to van Herwijnen and de Ridder (2007) are: physical assessment tools, monetary assessment tools, modelling tools, scenario analysis, multi-criteria analysis (MCA), simple tools, stakeholder analysis tools.

In many cases, the policy IA results provided by the available tools are not completely satisfactory (Finn et al., 2009). According to Bartolini and Viaggi (2010), there are at least three reasons for it. Firstly, they argue that the representation of a complex system implies considering only partial components of the system itself (Funtowicz et al., 1999; Munda, 2000). Secondly, they support that evaluations imply an operational definition of 'value' that is a representation of the importance placed on different elements by different social actors (Munda, 2004). Finally, the limited knowledge about future states of conditions and the temporal distance between policy implementation and policy impact, results in IA exercises being characterised by a high degree of uncertainty (Stirling, 1998). In order to analyse these tools, a number of studies have taken up the challenge of reviewing the tools that researchers use in order to assess the impacts of policies in agriculture and environment (Cashmore et al., 2008; Payraudeau and van der Werf, 2005; Andreoli and Tellarini, 2000; Bina, 2007; Ness et al., 2007).

This paper provides an analysis of IA tools policies, types and impact areas. The article presents the findings of a literature review for the assessment of EU policies in agriculture and environment, analyses and classifies them by different criteria according to the policy that they have been applied to, the tool types and the impacts that they have been measured. It covers literature on policy level appraisal, on types and methods of tools used and on impact areas. In total, this paper considers a literature comprising over 116 references. We have searched five academic databases: Science Direct; Web of Science/Web of Knowledge; Wiley Online Library; SCOPUS; and Google Scholar, identifying over 1,000 articles (including duplicates) published until 31 October 2011. The articles were selected at first according to their titles, subtitles and abstracts but their final inclusion to the literature review was made at the articles review stage (i.e., by a full read). The selection criteria were the focus of articles on: IA in agriculture; IA in environment; IA tools; IA methods.

2 EU policies in agriculture and environment

In this section, we describe some basic EU policies in agriculture and environment [revised CAP, decoupling (Bonfiglio, 2011), Water Framework Directive (WFD), agri-environmental schemes, Nitrates Directive (ND), etc.]. As described in the introduction, IA is a topic of growing importance in social sciences, as well as in economics and agricultural economics literature. van Ittersum et al. (2008) argue that in order to measure the impacts of policies in agriculture and environment, agricultural, environmental and rural development policies must achieve their objectives, in a cost-effective and efficient manner. The EC, since 2003, in order to develop and introduce new policies has introduced IA as an obligation (van Ittersum et al., 2008). The Common Agricultural Policy (CAP) reform in 2003 introduced two pillars of policy measures. The first pillar consists of direct payments to EU farmers based solely on historical information. The direct payments enhance ongoing reforms of the CAP by allowing farmers to make their decisions based more on market-oriented and demand-driven issues than on interventions (Kelch and Normile, 2004). CAP used IA as ex-post and mid-term evaluation of first pillar actions (Kelch and Normile, 2004; Serra et al., 2006; Kantelhardt, 2006; Papri and Henning, 1999; Kempen et al., 2010; Gotor and Tsigas, 2010; Gohin, 2006; Manos et al., 2011; Gocht and Britz, 2010). Pillar II aims at

supporting broader rural development and environmental objectives. Rural Development Plans (RDPs) is the main policy of the CAP second pillar. This rural development policy is focused on three thematic axes under which 26 measures that attempt to tackle the challenges facing rural areas (Salvioni and Sciulli, 2011). IA of these measures contributed to the preparations for the new rural development regulation post-2006 (Lowe et al., 2002; Psaltopoulos et al., 2010; Knickel et al., 2009; Bradley et al., 2010; Hill and Blandford, 2008; Banks and Mardsen, 2000).

One of the main EU environmental policies is WFD which was enacted in the first half of 2000 for water policy of EU (Bazzani, 2005). WFD, provides a managerial framework for the whole range of water protection policy and legislation. The ND is also an EU policy that preserves environment. The actions identified by the ND tie in with the river basin management approach taken in the WFD to improve water quality (Fassio et al., 2005). These two directives were the most important fields of environmental IA research in the last decade (Arriaza and Gomez-Limon, 2006; Bazzani et al., 2005; Bartolini et al., 2007; Berbel and Gomez-Limon, 2000; Janssen et al., 2005).

Policy can play an important role to balance the multiple functions of agriculture and support sustainable development (Reilly and Schimmelpfennig, 1999). From 2013, any further agricultural and environmental policy changes are expected to change the rural landscapes and their socio-economic conditions drastically (Piorr et al., 2009; Pokrivcak et al., 2006). The effectiveness of policy design and implementation could be improved if the potential impacts of policies on agriculture and through agriculture on sustainable development are better interpreted.

Table 1 Impact assessment literature for EU policies in agriculture and environment

Policies	*Number of papers*	*%*
WFD	12	10.3
EU ND	5	4.3
CAP	18	15.5
RDP	8	6.9
Agri-environmental schemes	8	6.9
Other policies	46	39.7
WFD-EU ND	1	0.9
Non-EU policies	18	15.5
Total	*116*	*100.0*

In Table 1, the 116 articles reviewed are classified according to the agricultural and environmental policies that they are trying to assess. Table 1 includes the number and the frequency of appearance of the EU and non-EU policies in the 116 articles. The CAP and non-EU policies is the 15.5%, the WFD the 10.3%, while the EU ND, RDP, agri-environmental schemes present under 10%. It is important to note that the majority of the articles (39.7%) refers to other policies (national policies in the fields of agriculture and environment). We also found 18 IA researches carried out for non-European agricultural and environmental policies (Pereira et al., 2002; Biao et al., 2003; Holmer et al., 2008; Levitan et al., 1995; Hacking and Guthrie, 2008; Ijäs et al., 2010; de Jesus-Hitzschky and da Silveira, 2009; Fitzpatrick and Sinclair, 2009; Toro et al., 2010; García-Montero et al., 2010; Clausen et al., 2010).

3 Policy assessment tools

This section draws on the typology which classifies tool types, developed by Nilsson et al. (2008). The term policy assessment tool has attracted a large number of definitions (de Ridder et al., 2007; Jordan et al., 2003; Lascoumes and le Gales, 2007; Radaelli and de Francesco, 2007; Jacobs, 2004). In this paper, the main policy assessment tools have been subdivided into three main groups. Nilsson et al. (2008) argues that there are simple tools (checklists, questionnaires, impact tables, process steps or similar techniques) there are more formal tools [scenario techniques, cost-benefit analysis (CBA), risk assessment and MCA] and finally there are more advanced tools that attempt to capture the more dynamic and complex issues. Table 2 shows the classification of the 116 articles based on Nilsson et al. (2008) three main tool types, i.e., simple-formal-advanced tools. We can observe that the majority of the articles use formal tools (46.6%) and advanced tools (43.1%) while 10.3% use simple tools.

Table 2 Literature review papers according to the tool type categories proposed by Nilsson et al. (2008)

Tools	*Number*	*%*
Simple	12	10.3
Formal	54	46.6
Advanced	50	43.1
Total	116	100.0

4 IA tools

According to van Herwijnen and de Ridder (2007), the following tool groups are distinguished for IA:

1 physical assessment tools

2 monetary assessment tools

3 modelling tools

4 scenario analysis

5 MCA

6 simple tools

7 stakeholder analysis tools.

A wide body of literature exists on the IAs of EU agricultural and environmental policies (Funtowicz et al., 1999). IA tools are usually targeted towards one of the three stools of sustainability (economic, social and environmental). In our literature review, we examine the main families of assessment tools applied (Gabbert et al., 2010). The results are reported in Table 3.

5 Physical assessment tools

According to de Ridder et al. (2007) the tools within the group of physical assessments tools relate human activities to environmental pressures. In this category of tools, life cycle analysis (LCA), material flow analysis, etc., are included. One of the most important physical assessment tools is LCA. The results of our literature review show that the LCA is used by seven authors when analysing the impacts of EU agricultural and environmental policies (Blengini and Busto, 2009; Brentrup et al., 2001; Cederberg and Mattsson, 2000; Welz et al., 2010; Hanegraaf et al., 1998; Haas et al., 2000, 2001).

6 Monetary assessment tools

The monetary assessment tools category focuses on the theory and practice of the CBA, cost-effectiveness analysis, and environmental accounting. Each monetary assessment tool builds on the monetisation of impacts. Monetisation of impacts is therefore generally used in IA of EU agricultural and environmental policies (Hodgson et al., 2005; Bateman et al., 2007; Hulme, 2000). The most common monetary assessment tool is CBA. CBA is a technique of sustainability IA by using accounting for economic, social and environmental impacts. CBA is often used with other techniques and also uses more participatory techniques (e.g., community impact analysis) (Atkinson and Mourato, 2008; Franz and Kirkpatrick, 2006; Pearce; 1998; Hanley, 2001).

7 Modelling tools

According to Lotze-Campen (2008), modelling tools "help to structure scientific thinking, focus on the most relevant processes, analyse important trade-offs between conflicting goals, define scenarios, and, to a certain extent, make predictions of likely future developments". For this reason, modelling tools have relevance to the actual policy-making process with regard to sustainability questions (Giupponi and Vladimirova, 2006; Granlund et al., 2000; Louhichi et al., 2010; Sterk et al., 2010; Boorman, 2003; Trnka et al., 2007; Stigter et al., 2006; Kunkel et al., 2008; Rasanen et al., 2006; Belhouchette et al., 2010). Our analysis found a variety of modelling tools that have been applied to IAs in agriculture and environment and have been used for policies relevant to sustainability issues (Bournaris et al., 2009; Peche and Rodríguez, 2009, 2010; Schade and Wiesenthal, 2010; Thiel, 2009; Viaggi et al., 2010; Cardenete and Sancho, 2004; Fragoulis et al., 2009; Zimmermann et al., 2009).

8 Scenario analysis tools

Scenario analysis tries to analyse possible future events by considering alternative possible outcomes. Scenario analysis is commonly used in IA researches in combination with other IA tools (Abildtrup et al., 2006; Thornton and Herrero, 2001; Berkhout et al., 2002; Kramer et al., 2008; Orlandini et al., 2008).

9 MCA tools

MCA is a tool that considers multiple criteria simultaneously in a wide range of concerns in complex decision-making processes by taking into account multiple conflicting criteria. MCA also takes into account a wide range of concerns that are usually being expressed by one or more criteria which can be assessed at the same time (Hayashi, 2000). In recent years, several IAs have been carried out with the use of MCA in various fields. Hajkowicz and Collins (2007) elaborate on the application of MCA to water planning with a comparison of 110 studies. Pohekar and Ramachandran (2004) found over 90 articles on MCA studies for energy management. Hayashi (2000) found over 80 studies on the application of MCA to agriculture. However, no specific review was found on the assessment of agriculture policy changes (Manos et al., 2006, 2009, 2010a, 2010b; Benedetti et al., 2010).

10 Simple tools

By simple IA tools we mean tools that can give answers in measuring impacts in a simple way, e.g., causal model, qualitative assessment, impact matrix, checklists, indicators, etc. The fundamental tool of this category is indicators. Indicators are used frequently to the estimation of the IA of a policy. Many IA studies use indicators as simple tools for measuring sustainability impacts (Braband et al., 2003; Halberg et al., 2005; Juraske et al., 2007; Binder et al., 2010; Andersen et al., 2007; Manos et al., 2008; Karjalainen and Järvikoski, 2010; van der Werf and Petit, 2002).

11 Stakeholder analysis tools

Stakeholders and participatory methods can be defined as: "methods to structure group processes in which stakeholders play an active role in order to articulate their knowledge, values and preferences" (Hare et al., 2003). Depending on the objectives of a specific IA research, a participatory method is often used in combination with other methods (Marsden, 2010; Song and Glasson, 2010; Nykvist and Nilsson, 2009; Rodrigues et al., 2003; O'Faircheallaigh, 2010; Cashmore et al., 2010; Walker, 2010; Ahmadvand et al., 2009; Lovell et al., 2010; Dwyer et al., 2008; Marttunen and Hamalainen, 1995).

12 Analysis of IA tools applied to assess the impacts of EU policies in agriculture and environment

This part contains the analysis of results of our literature review from searching in journals and other relevant publications. For our purposes, we have used the following five academic databases: Science Direct; Web of Science/Web of Knowledge; Wiley Online Library; SCOPUS; and Google Scholar. The searches identified over 1,000 articles (including duplicates) published up to 31 October 2011. The articles included in the literature review were selected by comparing titles and subtitles as well as reading the abstracts. A final decision was only made at the review stage (i.e., by a full read). The articles were selected if they focused on:

- IA in agriculture
- IA in environment
- IA tools
- IA methods.

Table 3 IA tools applied to assess policies in agriculture and environment

Tools	*%*
Decision support systems	2.6
Indicators	10.3
LCA	6.0
Participatory tools	6.9
Modelling tools	31.9
MCA	8.6
Linear programming	3.4
Decision support systems-MCA	1.7
MCA-scenario analysis	1.7
Indicators-modelling	.9
Modelling-scenario analysis	1.7
Scenario analysis	4.3
Cost-benefit analysis	3.4
Stakeholder analysis	14.7
Monetary	1.7
Total	100.0

The total number of resulting articles to be included in the literature review was 116. There is a huge amount of literature on tools and methods used for policy assessment in agriculture and environment (Hajkowicz and Collins, 2007; Addink, 1999; Rodrigues et al., 2010). Table 3 shows the frequency of appearance of the different IA tools that have been applied to assess EU policies in agriculture and environment, as extracted by the available literature. We can conclude from this table that modelling tools, stakeholders' analysis, indicators and MCA are commonly used by the researchers in the majority of IA of EU policies in agriculture and environment. For a more detailed processing of our search results, we classified the examined publications according to the IA tools that have been used, the impact areas and the policy that they assess. Table 3 presents the frequency of appearance of the IA tools in the 116 articles, sorted by the tool applied to assess the policies in agriculture and environment. The majority of the studies (31.9%) use modelling tools, 14.7% uses the stakeholder analysis, while 10.3% use indicators in order to measure the impacts of policies in agriculture and environment.

13 Impact areas

The identification of relevant impact areas addresses the economic, social and environmental dimension for each option, as well as the potential trade-offs and synergies. Impact areas are derived from the IA guidelines of the EC (SEC, 2009).

Table 4 Impact areas according to the EU IA guidelines (SEC, 2009)

Economic impact areas	*Environmental impact areas*	*Social impact areas*
• Competitiveness, trade and investment flows • Competition in the internal market/functioning of the internal market and competition • Operating costs and conduct of business/operating costs and conduct of business/small and medium enterprises • Administrative costs on business/administrative burdens on businesses • Property rights • Innovation and research • Consumers and households • Specific regions or sectors • Third countries and international relations • Public authorities • The macroeconomic environment	• Air quality • Water quality and resources • Soil quality and resources • Climate • Renewable or non-renewable resources • Biodiversity, flora and fauna and landscape • Land use • Waste production/ generation/recycling • The likelihood or scale of environmental risks • Transport and the use of energy • The environmental consequences of firms and consumers • Animal and plant health, food and feed safety/ animal welfare • International environmental impacts	• Employment and labour markets • Standards and rights related to job quality • Social inclusion and protection of particular groups • Equality of treatment and opportunities, non-discrimination/gender equality, equality treatment and opportunities, non-discrimination • Private and family life, personal data/individuals, private and family life, personal data • Governance, participation, good administration, access to justice, media and ethics • Public health and safety • Crime, terrorism and security • Access to and effects on social protection, health and educational systems • Culture • Social impacts in third countries

As regards the impact areas, an effort was made to divide the literature into three main impact areas types (Ahmadvand and Karami, 2009; Lockie et al., 2009). Table 4 shows the different impact areas as they are referred in the EC guidelines of 2009 (SEC, 2009) and as found in the available literature. Table 5 indicates that the environmental impacts are assessed in the majority of the articles (39.7%) found in the literature review. The combination of economic, environmental and social impacts is the second most important (24.1%) impact area that is being assessed by the researchers. On the other hand, economic (12.9) and economic-environmental (8.6%) impact areas are the third most important impact areas that the researchers use in their articles.

Table 5 Impact assessment literature according to impact area

Impact areas	*%*
Economic	12.9
Environmental	39.7
Social	5.2
Economic-environmental	8.6
Economic-social	7.8
Environmental-social	1.7
Economic-environmental-social	24.1
Total	100.0

In Table 6 and Table 7, we use cross tabulation as the process of creating a contingency table from the multivariate frequency distribution of IA tools and impact areas that are used in several EU agricultural and environmental policies. The policies that we have used for this classification is the WFD (Salgot, 2008; Bartolini et al., 2010; van Dijk et al., 2010), agri-environmental schemes (Paar et al., 2008; Olsson et al., 2009; Primdahl et al., 2003; Onate et al., 2000; Bartolini et al., 2005), the ND (Bouraoui et al., 2008), other EU environmental policies (Therivel, 2009; Heinma and Põder, 2010; Meissner et al., 2008; Martínez et al., 2007; Rosenberg et al., 1986; Uthes et al., 2010).

In order to assess the impacts of the WFD, MCA tools use the 25% of researchers. Both modelling and a combination of decision support systems with MCA tools are used by the 16.7%. Modelling tools are also used by the majority of the researchers (60.0%) for assessing the impacts of the ND. Both decision support systems and the combination of modelling with scenario analysis are used by the 20%. Modelling tools (44.4%) and MCA tools (22.2%) are also used in CAP reform assessment, together with indicators, participatory tools, scenario analysis and stakeholder opinions. Modelling tools are also the main tool category used in the assessment of agri-environmental schemes (37.5%), RDPs (50.0%) and in the WFD combined with the ND (100%).

Table 7 shows the distribution of EU agricultural and environmental policies according to the impact areas that they are researched for. The WFD researchers are interested in assessing a combination of environmental-social-economic impacts (50.0%), while 41.7% of them are interested only in the environmental impacts of the WFD. The published studies on the ND are only concerned for the environmental impacts (100.0%). The distribution of impacts researched for the CAP is divided between all the impact areas. The CAP researchers are interested in assessing the economic impacts (33.3%) while a combination of environmental-social-economic impacts and a combination of economic-social impacts is the same (22.2%). On the other hand RDP researchers are mainly concerned for economic (37.5%) and economic-social-environmental impacts (37.5%) followed by economic-social (25%). The agri-environmental schemes researchers are interested in assessing the Environmental impacts (37.5%) and the combination of environmental-social-economic impacts (37.5%), while the combination of economic-environmental and economic-social impacts is the same (12.5%). The published studies on the combination of WFD-ND are only concerned for the environmental impacts (100.0%).

Table 6 IA tools and policies

Tools	*Policies*						
	WFD %	*Nitrates %*	*CAP %*	*RDP %*	*Agri-environmental schemes %*	*Other*	*WFD-nitrates*
DSS	0.0%	20.0%	0.0%	0.0%	12.5%	2.2%	0.0%
Indicators	0.0%	0.0%	5.6%	12.5%	25.0%	8.7%	0.0%
LCA	0.0%	0.0%	0.0%	0.0%	0.0%	15.2%	0.0%
Participatory	8.3%	0.0%	5.6%	0.0%	0.0%	6.5%	0.0%
Modelling	16.7%	60.0%	44.4%	50.0%	37.5%	32.6%	100.0%
MCA	25.0%	0.0%	22.2%	0.0%	0.0%	4.3%	0.0%
LP models	8.3%	0.0%	11.1%	0.0%	0.0%	.0%	0.0%
DSS-MCA	16.7%	0.0%	0.0%	0.0%	0.0%	.0%	0.0%
Models-MCA	0.0%	0.0%	0.0%	0.0%	0.0%	.0%	0.0%
MCA-scenario	8.3%	0.0%	0.0%	0.0%	0.0%	2.2%	0.0%
LCA-DSS	0.0%	0.0%	0.0%	0.0%	0.0%	.0%	0.0%
Indicators-models	0.0%	0.0%	0.0%	0.0%	0.0%	2.2%	0.0%
Models-scenario	0.0%	20.0%	0.0%	0.0%	0.0%	2.2%	0.0%
Scenario analysis	0.0%	0.0%	5.6%	0.0%	12.5%	4.3%	0.0%
Cost benefit analysis	0.0%	0.0%	0.0%	0.0%	0.0%	8.7%	0.0%
Stakeholder	8.3%	0.0%	5.6%	37.5%	0.0%	10.9%	0.0%
Monetary	8.3%	0.0%	0.0%	0.0%	12.5%	.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 7 Impact areas and policies

	Policies						
	WFD %	*Nitrates %*	*CAP %*	*RDP %*	*Agri-environmental schemes*	*Other policies*	*WFD-nitrates*
Economic	0.0%	0.0%	33.3%	37.5%	0.0%	8.7%	0.0%
Environmental	41.7%	100.0%	5.6%	0.0%	37.5%	50.0%	100.0%
Social	0.0%	0.0%	5.6%	0.0%	0.0%	4.3%	0.0%
Economic-environmental	8.3%	0.0%	11.1%	0.0%	12.5%	10.9%	0.0%
Economic-social	0.0%	0.0%	22.2%	25.0%	12.5%	4.3%	0.0%
Environmental-social	0.0%	0.0%	.0%	0.0%	0.0%	2.2%	0.0%
All	50.0%	0.0%	22.2%	37.5%	37.5%	19.6%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

14 Concluding remarks

This paper presented a framework for the classification of IA tools with the objective of contributing to the overview and discussion on IA tools. The suggested framework is primarily based on a combination of the tools' use, the policy focus of the IA tool, and the impact areas of the assessment. The literature review revealed a number of important findings. Results show that IA tools have a wide application in the IA process in relation to agricultural and environmental policies. The analysis of IA tools reveals a wide diversity of policies, impact areas, and tool types involved. Several key points have been identified in the implementation of the IA tools. Firstly, it is shown that CAP and the WFD are the main policies whose impacts are studied by researchers. Secondly, the researchers are mainly using formal and advanced tools. Regarding the types of tools used, modelling tools and a combination of modelling and MCA are the main tools applied by researchers. Finally, researchers mainly focus on assessing environmental impacts and a combination of economic-environmental-social impacts.

The most important challenge for IA, however, will be to further develop methods and approaches that are capable of translating model results into understandable outputs, so that appropriate recommendations for action can be formulated. Our approach to review and classifying existing literature allows to devise a future research agenda which aims to encourage interaction between researchers and policy makers. Although, IA provides a wide set of tools and variants of very high interest for policy analysis, their application still requires a wide range of improvements. Improving the structured interaction of these tools with the contribution of stakeholders is also a key issue. In particular, an improved ability to support the IA process can be expected if IA tools use reliable data, and both IA tools data are developed and gathered in such a way as to provide integration between IA process and policy concepts.

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