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FLINT – Farm-level Indicators for New Topics in policy evaluation: an introduction

Societal expectations about agricultural production are changing. There are increased demands on issues such as food safety, animal welfare and the impact of agriculture on the environment (land, water and air). These changes have been reflected in the European Union's (EU) Common Agricultural Policy (CAP), but information on these issues is lacking and this complicates the required evaluation of policies. The EU Framework 7 project FLINT tries to close this gap by analysing the feasibility of collecting data on these new topics. FLINT has established a data infrastructure with up-to-date farm-level indicators for the monitoring and evaluation of the CAP. The project created a pilot network of more than 1,000 farms to collect a set of sustainability indicators at farm level. The pilot represents farm diversity at EU level, including the different administrative environments in the Member States. This paper sets out the context and the main contributions of the project.

Keywords: policy analysis, data needs, farm performance, sustainability

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Introduction

The grand challenge for agriculture is to attain higher levels of production of safe and good quality food, while preserving the natural resources upon which agricultural productivity depends (Folke *et al*., 2002; Robertson and Swinton, 2005; Tscharntke *et al*., 2012; Ringler *et al*., 2013). Individual farmers play a crucial role in the agri-food supply chain which connects input industries, food industry and retail, and is governed by both markets and policies (Tilman *et al*., 2002). The changing societal expectations towards agriculture in Europe are reflected in the evolution of the European Union's (EU) Common Agricultural Policy (CAP) (EU, 2012; EC, 2013).

According to Article 39 of the Treaty of Rome (1957)[4], the objectives of the CAP are to increase agricultural productivity, to ensure a fair standard of living for the agricultural community, to stabilise markets, to assure the availability of supplies and to ensure that supplies reach consumers at reasonable prices. In the early period of the CAP, most attention was devoted to market and price policies with the central objective of fostering a reasonable level of income in agriculture. However, over recent decades, several changes have been made to the CAP, mainly in response to production surpluses, budgetary problems, market disruption for third countries and pressures on the environment. Starting in 1992, the CAP has been through successive reforms, which have increased the market orientation for agriculture, while providing income support and safety net mechanisms for producers, improved the integration of environmental requirements, and reinforced support for rural development across the EU.

The policy for 2014-2020 continues along this reform path, moving from product to producer support and increasingly to a more land-based approach. The European Commission (EC) has identified three challenges for the CAP for this time period (EC, 2013). Firstly, an *economic challenge* including concerns over food security and globalisation, a declining rate of productivity growth, price volatility, pressures on production costs due to high input prices, and the deteriorating position of farmers in the food supply chain. Secondly, an *environmental challenge* that relates to concerns on resource use efficiency, soil and water quality, and threats to habitats and biodiversity, and thirdly, a *territorial challenge*, where rural areas are faced with inadvertent demographic, economic and social developments, including depopulation and relocation of businesses.

The role of the current CAP is to provide a policy framework that supports and encourages producers to address these challenges while remaining coherent with other EU policies. This translates into three long-term CAP objectives, namely viable food production, sustainable management of natural resources and climate action, and balanced territorial development (EC, 2013). To achieve these goals, the CAP instruments have been adapted. The reform for the period 2014-2020 focused on the operational objectives of delivering more effective policy instruments, designed to improve the competitiveness of the agricultural sector and its sustainability over the long term.

These changes in the societal expectations of agriculture, as well as the reforms of the CAP, have created a demand for new information. The role of evidence-based policy making and evaluation has been strengthened to improve the effectiveness of policies, and especially to improve the targeting of measures and prevent perverse effects (EC, 2009). To enable the effective management of a change programme, such impact assessments and monitoring and evaluation efforts are ideally based on empirical data. This requires a monitoring tool that empirically documents important trends in a way that developments can be attributed to the relevant policies and separated from other influences.

Data needs and data provision

Changing data needs

The availability of information has been criticised by different stakeholders at different moments in time. In 2002, the European Court of Auditors (ECA, 2003) asked the EC to expand its view on the income of farmers and not only focus

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[4] Copied in the Treaty on the Functioning of the European Union as Article 33.

on the income from agricultural production. In response, the Farm Accountancy Data Network (FADN) started to collect and include data on other gainful activities (such as farm tourism, processing of products, farm sales). Evaluators of rural development programmes (applying the Common Monitoring and Evaluation Framework, CMEF) found a lack of adequate micro-economic data for policy evaluation (Ahner, 2004). Also, researchers identified information gaps. Several EU-funded research projects recommended to improve measurement and data collection for (policy) research, either in general (SEAMLESS; van Ittersum *et al*., 2008), or on specific topics such as organic farming (EISfOM; Recke *et al*., 2004) or sustainability (SVAPPAS; Van Passel, 2008). In a more recent report (ECA, 2016), the European Court of Auditors addresses the difficulties of monitoring the CAP objectives and the limitations of the available data.

In the current situation the availability of relevant data is a bottleneck for the monitoring and evaluation of these new topics. Although a set of well-established agricultural statistics is available for policy analysis, these are very much focused on structure (Eurostat, Farm Structure Survey; EC, 2008) and monetary economic results of farms (FADN system; EC, 2009). Some changes in data collection have been made in the last few years (new FADN Farm Return including N, P and K use and SAPM survey by Eurostat[5]) but, in general, the official statistics are not sufficiently adapted to new information needs.

Current initiatives

As a response to this lack of data on sustainability issues, many international indicator frameworks have been developed that especially focus on environmental indicators (e.g. EAA (EAA, 2003), Eurostat (EC, 2006), FAO (FAO, 2010), OECD (OECD, 2013)). The Millennium Development Goals and Sustainable Development Goals[6] take a wider perspective and present a set of indicators measuring different dimensions of sustainability. Although very appropriate for identifying relevant topics and the definition of these topics, most of these frameworks do not allow for farm-level policy analysis. The indicators are often specified at more aggregated levels (regional or national) and not at farm level.

Also the agri-food sector responds to these new needs. The UN Global Compact[7] principles and the Sustainable Development Goals highlight directions to pursue on sustainable development that relate to, among others, food security, resource efficiency and environmental impacts in agriculture (Griggs *et al*., 2013). Food and beverages processing companies often express their commitment to improve on these internationally-recognised goals and principles in their corporate social responsibility reports. Reporting guidelines set by organisations such as the Global Reporting Initiative provide direction to what indicators could be included, and which data are needed to report against these indicators (Vigneau *et al*., 2015). Another example where there is a farm-level data need is for certifications schemes such as Global G.A.P.[8] or the Irish *Bord Bia* Quality Assurance Schemes[9]. Data assembling is often in place, or linked with farm management systems. Alongside standards and certifications that are being developed to measure sustainability performance, there are also sector-based initiatives that pursue alignment across initiatives such as the Sustainable Agriculture Initiative (SAI) Platform[10]. The SAI Platform works on tools and guidance that enhance the support for both global and local sustainable practices and sourcing. Another more sector-specific example is the Dairy Sustainability Framework (DSF)[11]. The DSF is a programme of the Global Dairy Agenda for Action (GDAA) that aims to align and connect sustainability initiatives in the dairy supply chain.

At a national level, there are several initiatives on the development of empirical indicator frameworks which are directly linked to data collection to capture the sustainability performance of farms at farm level (Boone and Dolman, 2010; Dillon *et al*., 2010; Platteau *et al*., 2014). Although these initiatives are successful in measuring (certain aspects of) farm-level sustainability, a current limitation is that the measurement and data collection are not harmonised among countries. This lack of harmonisation and especially the fact that this information is only available for a limited set of countries hampers its use in EU policy evaluation.

Data collection

The collection of sustainability data at farm level for policy evaluation purposes is still in its infancy. Although the FADN system was renewed in recent years, and a new data collection form ('Farm Return') with some new environmental indicators was introduced in 2014, it has been difficult to adjust the FADN system to the new policy realities in the CAP. Some progress with data collection on new farm-level indicators has taken place in some Member States. The Dutch FADN has for many years included an extended set of sustainability indicators (Boone and Dolman, 2010), as well as data on innovation by farmers (Van Galen and Poppe, 2013), and several countries have collected and analysed data on knowledge transfer in the farming sector (Floriańczyk *et al*., 2012; Läpple and Hennessy, 2015; Dillon *et al*., 2016). The Irish FADN has also collected Triple P sustainability data for policy analysis (Dillon *et al*., 2010). The Irish dataset is currently being further developed to arrive at estimates of the carbon footprints of farms using methodologies approved by the Carbon Trust. The FADN in Vlaanderen, Belgium gathers information for a barometer on farm managers' business confidence. At recent Pacioli meetings, successful developments in sustainability indicators at national level were presented (Vrolijk, 2013). Van Calker *et al*. (2007) distinguished several indicators relevant for rural sociology.

There are several reasons why this progress could not be achieved at EU level yet. An important reason is the divergence in data collection systems among EU Member States (Vrolijk *et al*., 2016). Some systems are easier to adapt than

[5] http://ec.europa.eu/eurostat/statistics-explained/index.php/Survey_on_agricultural_production_methods
[6] https://sustainabledevelopment.un.org/?menu=1300
[7] https://www.unglobalcompact.org/
[8] http://www.globalgap.org/uk_en/
[9] http://www.bordbia.ie/industry/farmers/quality/pages/qualityassuranceschemes.aspx
[10] http://www.saiplatform.org/
[11] http://dairysustainabilityframework.org/

others. The development of new indicators has been further complicated by the challenge for DG AGRI to include the 'new' Member States into the FADN system. Furthermore, the decision making is influenced by expectations about the feasibility and willingness of farmers to participate, which have never been tested in practice.

Future data infrastructure at EU level

The existing initiatives to improve data provision differ in level of measurement (farm, regional or national level), empirical implementation (some frameworks exist on paper but it is unclear how data should be collected), or are not harmonised across countries. Therefore, enhanced efficiency, coherence and synergies require further development of the FADN farm-level dataset, with a view to monitoring the full behaviour of farmers and how they integrate the different policy incentives in their decision-making processes and how that affects their sustainability performance. However, this has raised concerns vis-a-vis the voluntary participation of the farmers in the network and the feasibility of collecting this type of data. Any extension of the data collection will be limited by (a) the current data collection methods in each Member State, (b) the willingness of farmers to voluntarily supply additional data, and (c) the cost of collecting additional data.

There are several ways to address these challenges. The crucial thing is not to separate information needs for policy making and research from what is happening in the agricultural sector. Considering the trends of big data, internet of things and precision agriculture, the availability of information will only further increase. Also, the need for information in the agri-food sector increases continuously. Agricultural statistics should be an integral part of the whole system of information needs and information flows throughout the agricultural sector (Vrolijk and Poppe, 2016). Two aspects are important, increased use of registrations and information flows which already take place in the agricultural sector and maximum use of modern information technologies for data exchange.

Increased use of existing data concerns for example the use of other sources such as administrative data, the agricultural census, data from the paying agencies on direct payments (the IACS system), remote sensing data and Geographic Information Systems (GIS). Solutions can also be found in connecting with private sector developments. At farm level, farmers are already asked to collect and provide data on sustainability and food safety issues for schemes such as Global G.A.P. and the British Retail Consortium (BRC). Leading management tools are the Keystone Field to Market, the BASF Ag Balance tool, the Cool Farm Tool, RISE and the Stewardship Index for Specialty Crops, as well as farm software packages with a regional installed base. This plurality of tools also poses a challenge, an initiative such as SAI tries to harmonise the indicators to allow the exchange of information between these schemes.

Also the information technologies for data exchange support the re-use of data. The construction of data infrastructures for farm-level indicators may benefit from developments in this field. EDI standards (promoted by, for example, GS1 and UN/CEFACT[12]) have been developed that facilitate information exchange between companies. SDMX[13] is a standard for the exchange of statistical data. Standard Business Reporting defines XBRL standards to exchange information between banks, businesses and the government. These initiatives facilitate the efficient exchange of information and thus allow the re-use of information.

Contributions and approach of FLINT

The EU Framework 7 project FLINT (Farm-Level Indicators on New Topics in policy evaluation) was created to address the gap between the data needs for policy evaluation and research and the currently-available agricultural statistics. The monitoring and evaluation of the CAP requires data (preferably at farm level) which are not available at the moment in the EU information systems. Attempts have been made to modernise these systems but decisions were strongly influenced by expectations about the feasibility of data collection and the willingness of farmers to participate. FLINT provides an opportunity to test the feasibility and to show the added value of having a wider set of sustainability indicators to monitor and evaluate the agricultural policies and design more targeted policy measures.

Main contribution and research questions

The foregoing leads to the two key objectives of FLINT: (a) to demonstrate the feasibility of collecting policy-relevant data in different administrative environments with newly-developed farm-level indicators on economic, environmental and social issues, and (b) to demonstrate how the new farm-level indicators can be used to evaluate policy and improve the targeting of policy initiatives in such a convincing way that the EC can establish an operational EU-wide system to collect the extended set of farm-level indicators.

To achieve these contributions, the FLINT project formulated five key questions:

- What data are desirable? What farm-level data are needed for the CAP evaluation?
- What data can be feasibly collected in the value chain? Data collection is costly and depends on the collaboration of farmers. What is the farmers' level of awareness and what is their willingness to share this information? What information do farmers already share with the food industry?
- What is a feasible pilot network? What and how do we test in a pilot network and how can up-to-date ICT support such a European infrastructure?
- What data are useful? Are the newly-collected farm-level data really essential in policy evaluation? To which extent could proxies be used? Is it really necessary to gather all data in an integrated way at individual farm level?
- What level of ambition is acceptable? The usefulness of data in policy monitoring does not guarantee that

[12] http://www.gs1.org/edi
[13] https://sdmx.org/

stakeholders and data collectors will collect them. So, what are acceptable scenarios for the future data infrastructure in an era of tight budgets?

Approach of FLINT

FLINT evaluated existing policy measures and accompanying methodologies, such as agri-environmental indicators and the CMEF covering the CAP as a whole. The contribution of other sources, such as the OECD, or other initiatives, such as EU strategies or Member State schemes, which are related to farm-level practice and outcomes, were taken into account. Following this analysis of policy evaluation needs, FLINT reviewed the data and indicators currently available through FADN sources and identified gaps and deficiencies in the current data availability. The stock of variables available in the various Member State FADN datasets varies and the capacity/willingness of the various countries to collect additional data is also variable. Hence a pilot in a number of countries with different data collection methods and coming from different starting points was set up.

FLINT established a pilot network of more than 1,000 farms (representative of farm diversity at EU level, including the administrative environment in the different Member States) that is well suited for gathering data on the basis of farm-level indicators to test indicators and methodologies. Testing the data infrastructure required that the identified farm-level indicators are defined, standardised and decomposed into data items that can be collected at farm level (including data from other sources such as administrative data, farm structure survey, commercial data). Software was developed and/or adapted to collect these data, test the data and calculate the indicators. In this way, the pilot provided invaluable information about the operational structure, the feasibility and the time-frame required to collect such data and develop such indicators.

The value added of the newly-developed indicators is tested in the analysis of a number of policy-relevant analyses. The lessons learned from the project are used to advise the EC on upgrading the data collection and indicator development to an operational EU-wide system.

Identification of indicators

At the start of the project, FLINT analysed the developments in the CAP and related environmental policies to determine the impact on information needs. Furthermore, an extensive review of the literature and national initiatives in all nine partner countries produced an inventory of relevant indicators already developed or applied (Latruffe *et al*., 2016). A comparison of the policy needs and the identified indicators has resulted in the identification of 33 sustainability themes to be included in the FLINT project. The themes cover the three sustainability dimensions of people, planet and profit (see Hererra *et al*., 2016) for a description of the indicators). The list of environmental indicators themes is the longest, indicating the serious lack of data at farm level on these issues. The environmental indicators cover important topics such as use of pesticides, nitrogen balances, water consumption, greenhouse gas emissions, farm practices with respect to soil erosion, nitrate leaching and soil organic matter. There are fewer economic indicators but these refer exclusively to those not yet included in FADN. They cover topics such as risk management, innovation, sales channels, farm succession and the use of contracts. The social indicators are the most qualitative by nature and involve issues such as education and training (use of advisory services), engagement in the farming sector and rural society, quality of life and working conditions.

To align the information needs from the sector with the information needs of policy makers, the selection of indicator themes also included a stakeholder analysis. The underlying idea is that collection of data is more feasible if the information is also relevant for the farmers themselves. If information needs overlap, this would improve the availability of data, the quality of the data and the farmers' interest. In the stakeholder analyses, the indicators were assessed by stakeholders from the agricultural sector (Herrera *et al*., 2016).

Pilot data collection

The pilot data collection required the development of an appropriate IT structure and the implementation of data collection and data management processes.

The indicators are not directly measurable at farm level because of the level of aggregation (for example N balance or greenhouse gas emissions). Therefore, each of the themes was translated into a well-defined set of variables with a detailed explanation and instruction for data collection[14]. In theory, around 1,000 new data items were added to the existing dataset, in practice (owing to the fact that only a subset of items is relevant for a specific farm) about 300-400 items were added at farm level.

The FLINT variables were collected in addition to the regular FADN variables. For each country a practical approach for data gathering at farm level was designed. This was necessary because the systems and processes of FADN data collection differ strongly between countries (Vrolijk *et al*., 2016). The objective of FLINT was not to harmonise FADN data collection across Europe, but to find ways to collect sustainability data that fit the local situation and make use of the local infrastructure and already existing data sources.

An IT infrastructure was developed to collect data, to upload the data to a central FLINT database, to check the data using the test engine for the regular FADN data of DG-Agri, and to disseminate the data to the users of the FLINT database. Owing to the differences between countries, the data collection tools were not fully harmonised. Some countries used a data entry form developed for FLINT, while others integrated the data collection into their normal FADN data collection systems and processes. The testing was done in a similar way as the FADN data is tested. FLINT specified a number of testing rules (especially to test the magnitude of the values and the consistency between different data elements). These testing rules were implemented in the FADN test engine of the EC in Brussel. This approach also made it possible to test the consistency between the FLINT and the FADN variables.

[14] See FLINT farm return at www.fp7-flint.eu.

Use of sustainability

Besides evaluating the feasibility of the data collection, another important objective of FLINT is to demonstrate the added value of having a wider set of data at farm level on the measurement of the sustainability performance. FLINT has defined a set of cases to evaluate and illustrate the added value. The cases are linked to the policy priorities described above and aim to cover the main themes of data collected in FLINT. In principle, three categories of applications can be distinguished:

- Establishing the impact of existing policy measures on other sustainability issues. FLINT can better help to assess if the CAP can reach its long-term goals of viable food production, sustainable management of natural resources and balanced territorial development. FLINT allows for the integrated evaluation of the current policies by also taking into account the performance on other sustainability indicators;
- Evaluating the usefulness of other instruments of the current CAP. For example, FLINT can assess the impact of risk management strategies or innovation on the sustainability performance of farms;
- Simulations that can help design a new CAP. For example, whether farmers are currently far from the new requirement levels or evaluate new target indicators that are not covered by the current CAP such as pesticide use, or assessments of how measures affect the economic performance of farms.

A list of cases has been defined, including topics such as: impact of innovation on productivity and sustainability, impact of subsidies on technical efficiency (excluding and including environmental outputs), impact of young farmers on sustainability and productivity, market outlets, risk management and farm income, energy use and sustainability, greenhouse gas emissions and productivity (dairy), fragmentation and sustainability and general trade-offs between economic, social and environmental dimensions.

Discussion and conclusions

Owing to the changing societal concerns about agricultural production and its impact on agricultural policies, the present data infrastructure for policy evaluation is outdated on some relevant issues. There is an increased demand to measure the sustainability performance of farms. The current set of agricultural statistics provides only very limited information on these issues.

In the project, lessons have been learned from previous work on international sustainability frameworks and national initiatives on sustainability measurement. These frameworks have been important in defining the concepts of sustainability (especially environmental) but often do not have a link with farm-level data collection. Some national initiatives have proven beneficial because they have tested the collection of farm-level data, but these have the drawback that they are not harmonised and have a different focus in sustainability issues.

The FLINT project has developed a new data infrastructure for the collection and use of a broader set of sustainability indicators at farm level. It has tested the feasibility of collecting farm-level data and experiences of farmer participation and has tested the feasibility in different administrative environments in the partner countries. An integrated data assembly at the micro level has several benefits. Extending FADN with environmental and social performance indicators allows for the integrated analysis of policy questions. The trade-offs between sustainability indicators can be analysed, for example the economic impacts of specific environmental or social policy measures, evaluation of the cost-effectiveness of environmental or animal welfare measures, and the trade-off or jointness between the environmental and economic performance of farms (e.g. Dolman *et al*., 2012). This enables better policy analysis and the design of more targeted policy measures. It also provides benefits for the farming sector. Reporting sustainability performance to farmers allows for increased understanding and identification of improvement options. The harmonised approach followed in FLINT facilitates an international comparison of sustainability performance.

The project will conclude with recommendations for the future. The project findings have been discussed at the FADN committee meeting, Pacioli workshop and FLINT advisory board meeting. The most promising scenarios have been selected, and further developed and quantified. These most promising scenarios range from a follow-up to the FLINT project (but then including all Member States) to a full integration into FADN. In such a full integration, options range from collecting FLINT data on a subsample of farms to reducing the full FADN sample to compensate for the additional work of collecting FLINT data. The impacts on costs, quality of the estimates and the sampling plans are being quantified. Even so, some recommendations are already clear. Data collection should become more efficient. All stakeholders agree that re-use of existing data should be stimulated. This not only requires that projects experiment with this sharing of experiences among Member States but also the development of legal frameworks to facilitate this. Furthermore, there is a strong interest in international cooperation for the development of software and systems for data collection.

A positive impact of FLINT is that several of the participating countries have indicated a wish to continue with part of the FLINT data collection for national purposes.

Looking to the future, there are opportunities for further integration of sector and policy initiatives. The FLINT project objective is to provide quantitative information that helps policy makers to make decisions or to evaluate the impact of decisions for a country or farm type. There are many initiatives that measure sustainability performance in agricultural systems. The goal of the initiative determines what data should be assembled and which tools and indicators could be used to measure processes and practices. Despite the differences in goal and scope, there are opportunities for harmonisation and alignment between measurement frameworks, tools and data assembling systems. At product level, for example, the EC initiated the Product Environmental Footprint (PEF). The PEF is a multi-criteria measurement

framework for the environmental performance based on a life cycle approach (Lehmann *et al*., 2015). Within the PEF, primary and secondary data needs are identified. Primary data need to be provided by a company, whereas secondary data are data from PEF-designated data sources. Data from the FLINT project could strengthen these secondary data sources, and might even provide primary data for a food producing company. Another product-level example is The Sustainability Consortium (TSC). TSC convenes stakeholders in consumer good supply chains and develops science-based key performance indicators (KPI) that measure environmental and societal performance per product category based on a life cycle approach. Quantifying KPIs often requires farm-level data or regional estimates from a sub-country area or agricultural zone, which FLINT could provide.

Acknowledgements

This work was partly funded by the EU Seventh Framework Programme grant number 613800. The opinions expressed in this paper are not necessarily those of the EU.

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