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FATIMA

FArming Tools for external nutrient Inputs and water MAnagement

D1.2.1: Socio-economic analysis framework

WP1.2 – Socio-Economic Analysis/ Prosperous farming communities

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Executive summary

This documents provides an overview of the fundamental concepts and methods for the socio-economic analysis in the various pilot areas during the whole running of FATIMA. We define a **common framework** for the socio-economic assessment of agricultural technologies (e.g. precision farming) and their role as drivers for transitions towards prosperous, resource efficient agricultural communities in pilot areas. As a first step towards implementation of the framework, and in close coordination with WP4.2 and WP5, the baseline conditions in the various pilot studies will be characterized, including:

(1) identification of the main types of farms to be analyzed;

(2) detailed information on crop systems, existing technologies and associated input-output balances.

Furthermore, the socio-economic analysis will involve the following activities:

- a meta-analysis & value transfer of positive and negative externalities of the relevant farming practices;
- a farmer survey with choice experiment in three pilot areas;
- a detailed financial & social cost benefit analysis for three pilot areas; and
- the integration of socio-economic and policy analysis.

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Table of Contents

List of Figures

1 Context, objectives, scope

The overall objective of FATIMA Workpackage WP1.2 («**Socio-economic analysis / Prosperous farming communities»)** is

> 1- To develop and implement a **common analytical framework** for the **socio-economic assessment of innovative farming tools and agri-environmental capacities** that help optimize the management of external inputs (nutrients and water) and the delivery of ecosystem services in agricultural landscapes.
>
> 2- To design and develop a **shared vision for prosperous farming communities** in each pilot area making use of socio-economic tools and methods and the multi-actor community platform.

For this purpose WP1.2 focuses on the evaluation of the economic impact of the adoption of different precision farming technologies and soil restoration measures on farm prosperity and provision of agricultural ecosystem services. It is conducted in close coordination with WP4.2, which focuses on the enabling environment and design of novel policy instruments. The socio-economic assessment and impact analysis will be coordinated across the different pilot areas based on the development of a joint common research design, focusing on key issues in the transition towards prosperous, resource efficient farming communities. In the assessment procedure we take into account aspects such as household vulnerability, dependence on subsidies, diversification of crops and resources, as well as crop productivity and economic efficiency concerns (such as crop yield and value of production, total production cost, energy, water and fertilizer input cost).

The document aims at establishing the fundamental concepts and methods for the socio-economic analysis in the various pilot areas during the whole running of FATIMA. We define a **common framework** for the socio-economic assessment of agricultural technologies (e.g. precision farming) and their role as drivers for transitions towards prosperous, resource efficient agricultural communities in pilot areas. As a first step towards implementation of the framework, and in close coordination with WP4.2 and WP5, the baseline conditions in the various pilot studies will be characterized, including:

(1) identification of the main types of farms to be analyzed;

(2) detailed information on crop systems, existing technologies and associated input-output balances.

In order to analyze the baseline conditions, use will be made, for example, of the available data from the Farm Accountancy Data Network (FADN), integrated with other information sources (e.g. national agricultural census data). Where necessary, additional key informant interviews will be carried out with relevant stakeholders (farmers, technicians, managers of agribusiness companies etc.).

In order to accomodate a major change in the IVM (Institute for Environmental Studies, VU University) team (see Periodic Report), the timeline for the initial WP1.2 activities has been slightly modified. Consequently, this document gives a top-level overview of the common framework, with details of methodology to be added by month 12 in a subsequent version.

2 Analytical framework: overview and definitions

In close consultation with other consortium members, an analytical framework was developed with the purpose of structuring the main elements that are relevant to arrive at an extended cost benefit analysis (CBA) of innovative farming practices (see Figure 1).

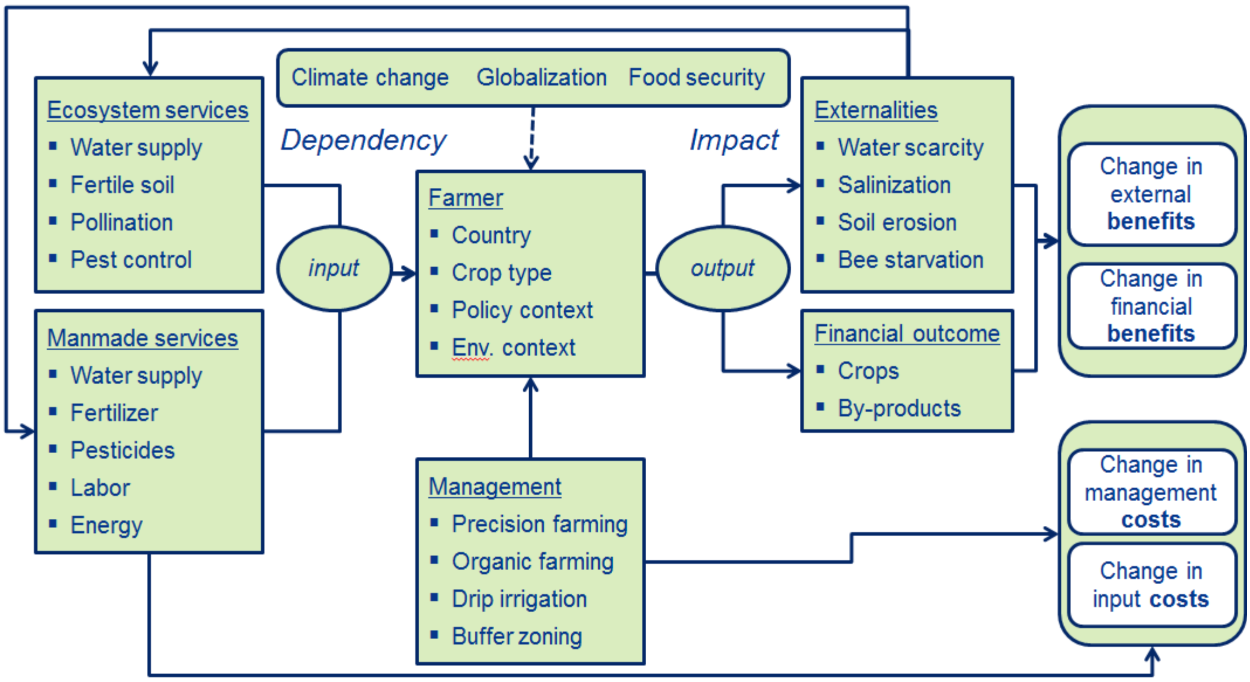

Figure 1. Analytical framework for FATIMA WP1.2

As shown in Figure 1 above, the main elements of the proposed analytical framework for the economic analysis include:

The farmer: central in the analysis is the farmer that, on the one hand, is dependent on natural and artificial inputs, and on the other hand, generates the intended agricultural outputs as well as unintended externalities. Farmers across Europe differ in many ways. These differences need to be taken into account, when analyzing the appropriateness of various management improvements. Similarly, farmers may also be exposed to various exogenous influences that influence their performance.

Ecosystem services: Various natural functions provided by ecosystems free of costs are crucial for the performance of the agricultural sector. Among others, these include water supply, soil fertility, pollinating services, as well as pest control. These ecosystem services are often unaccounted for in monetary terms and therefore are too easily taken for granted. At the same time, in many parts of Europe the provision of ecosystem services is jeopardized, therefore indirectly threatening the performance of the farmer.

Human-made services: Besides ecosystem services, the farmer uses human-made services to optimize their operations. In general, one can claim that human-made and ecosystem services are substitutes: the less ecosystem services are provided, the more human-made inputs need to be used. Such human-made inputs include among others labor, human capital, fertilizers, pesticides, and artificial water inputs. Human-made inputs are generally more costly for the farmer than the ecosystem services (provided freely under the current policies).

Financial outcome: The main purpose of the farmer is to maximize their economic benefits while minimizing negative externalities. This means optimizing agricultural production cost (inputs) and yields (outputs in terms of crops and by-products). The valuation of these products is often straightforward through the use of market prices. However, many agricultural products prices are distorted because of the presence of subsidies. Therefore, the analysis should correct for the presence of these market distortions.

Externalities: Agricultural activities go hand in hand with positive and negative externalities such as water pollution, groundwater depletion, salinization and soil erosion. Examples of positive externalities include the creation of attractive rural landscapes and fodder for wildlife. Most of these externalities are not accounted for in the agricultural operations, yet they do represent societal and economic consequences and therefore should be taken into account in the extended CBA through the use of economic valuation techniques.

Management: The farmers can improve their environmental and economic performance by adopting various innovative farming practices or technologies or by transition to more sustainable farming systems that can lead to increases in productivity while reducing environmental externalities. Examples are precision farming, drip irrigation, or organic farming. The extent to which such practices are adopted depends on internal farmer specific characteristics as well as external contextual factors.

Exogenous drivers of change: The farmer and their land and technologies do not work in isolation in a static environment. The farmer is faced with a rapidly changing world such as globalization, climate change, reduced government interventions, and increasing issues of food security. These changes affect the farmers performance and therefore call for more innovative and pro-active responses.

3 Tasks and activities

On the basis of the above analytical framework, a number of tasks are identified which will help us to arrive at an extended CBA for various innovative farming practices. As shown in Figure 2 below, each of these tasks addresses a specific element in the framework thereby gradually completing the socio-economic analysis. These tasks are briefly described below.

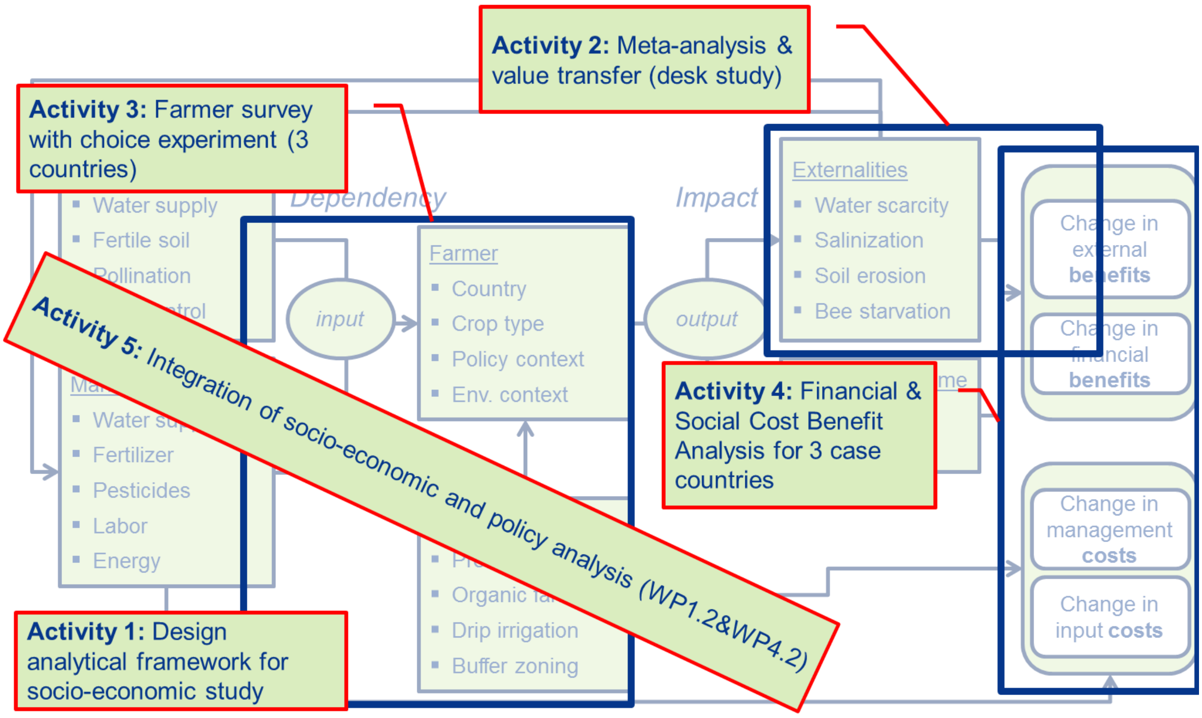

Figure 2. Tasks and activities in the socio-economic analysis of FATIMA (WP1.2)

3.1 Activity 1: Design analytical framework for socio-economic study

This activity involves the setting of the boundaries and the agreement of definitions used in the study. On such definition is the term "precision farming". This definition will be agreed upon at the level of the FATIMA programme in general. To make sure that previous economic studies on precision farming are accounted for, a literature study will be conducted.

3.2 Activity 2: Meta-analysis and value transfer

Because it will be impossible to measure all environmental effects of agriculture in the field, as well as the impact of innovative farming techniques on these effects, a meta-analysis will be conducted on the externalities of farming in general as well as the effectiveness (i.e. costs and benefits) of precision farming. This activity will also involve the establishment of dose-response functions of various innovative farming practices.

Meta-analysis starts with a thorough literature review to identify valuation data relating to the specific good(s)/ service(s). The review involves checking available studies for quality and applicability. Assess the relevance (suitability) of the study site values for transfer to the policy site, considering the similarity of the policy site to the study site, the similarity of impacts considered, baseline environmental quality, the affected populations, etc. The quality of the collected primary valuation literature should also be reviewed. Indicators of quality will generally depend on the method used. The analyst should also determine whether adjustments can be made for important differences between the policy case and the study case.

Value transfer involves borrowing an estimate of Willingness To Pay (WTP) from one site (the study site) and applying it to another (the policy site). What is borrowed is a mean value that is unadjusted or a mean value that has been modified to 'suit' the new site. The attraction of value transfer is that it avoids the cost and time involved in conducting primary valuation studies. The value transfer approach to environmental valuation was developed for situations in which the time and/or money costs of primary data collection for original direct and indirect studies are prohibitive. With value transfer, environmental benefit estimates from existing case studies (i.e., the study sites) are transferred to a new, policy case study (i.e., the policy site). Given the limited resources that may be available for conducting valuation studies on small islands, under certain circumstances (see below) value transfer can provide a fast and affordable process to estimate values for environmental services.

3.3 Activity 3: Farmer survey with choice experiment in three pilot areas

Choice experimenting & modelling is also a stated preference method which can be used to estimate economic values for virtually any ecosystem good or service. It is a hypothetical method – it asks people (i.e. farmers in our case) to make choices based on a hypothetical scenario. Choice modelling is based around the idea that any good can be described in terms of its attributes or characteristics. Changes in attribute levels essentially result in a different good, and choice modelling focuses on the value of such changes in attributes. Values are inferred from the hypothetical choices or tradeoffs that people make between different combinations of attributes.

Because it focuses on tradeoffs among alternatives with different characteristics, contingent choice is especially suited to policy decisions where a set of possible actions might result in different impacts on natural resources or environmental services. For example, a better managed or restored agricultural land will potentially improve the quality of several services, such as drinking water supply, on-site recreation, and biodiversity.

Choice modelling is an efficient means of collecting information, since choice tasks require respondents to evaluate multi-attribute profiles simultaneously. In addition, economic values are not elicited directly but are inferred by the trade-offs respondents make between monetary and non-monetary attributes. As a result, it is less likely that Willingness to Pay (WTP) information gathered using this method will be biased by strategic response behaviour. A further advantage of the choice model approach is that research is not limited by pre-existing market conditions, since the levels used in a choice experiment can be set to any reasonable range of values. As such, the choice modelling is useful to use as a policy tool for exploring proposed or hypothetical futures or options (for example, in a decision support tool based on the results). Finally, and perhaps most importantly in the context of non-market valuation, choice experiments allow individuals to evaluate non-market benefits described in an intuitive and meaningful way, without being asked to complete the potentially objectionable task of directly assigning Euro figures to important values such as culture.

A disadvantage is that choice modelling requires advanced statistical analytical skill and a rather large sample size of at least 300 to 400 respondents.

The farmer survey with the choice experiment will be the most important activity of this work package. The first step will be to select case study pilot areas in which surveys can be conducted among farming communities that have experience with innovative farming practices versus those that have not. A mixed approach can be applied in the field survey. In pilot areas with ample precision farmers, a (quantitative) full farmer survey will be conducted. In pilot areas where the sample of precision farmers is small, we are will conduct a qualitative survey through key informant interviews and focus group discussions. Specific attention will have to paid to the unit of analysis (i.e. farm household, unit of production, per hectare).

On the basis of the current knowledge, the following pilot areas seem to be most suitable for survey implementation: Austria, Spain, Italy and the Czech Republic. This preliminary list is based on willingness to cooperate, scale of innovative farming practices, and variation in climatic conditions. This list is not definite, yet a good first impression of the appropriateness of the cases. The next step in the survey is to prepare a one-page brief for the pilot areas in which the activity and its added value is explained in more detail.

3.4 Activity 4: Financial & social cost benefit analysis for three pilot areas

Using the information collected through the meta-analysis and the farmer survey, sufficient information should be available to conduct a financial and social CBA for three case studies. These CBAs will demonstrate under which conditions innovative farming techniques are economically feasible. The nuances of the CBA are explained below. It will also be the teams aim to standardize the CBA information with the purpose of allowing a more generic analysis for the other cases in the FATIMA project, as well as potential other users. This tool will probably be developed in a user friendly interface in excel.

This activity aims to identify from the perspective of farmers and farming communities the most efficient way to reach prosperous, resource efficient agricultural communities and financially most profitable precision technology, focusing on different process and crop systems in relation to different types of farms. Different technological solutions are tested in WP2 & WP3, resulting in possibly 3 scenarios:

(1) very-high-precision VRT (variable rate N application) at meter scale from in-field (on tractor) heterogeneity mapping;

(2) still-very-high-precision VRT at 1-5m scale using EO images (WV-2, Rapideye),

(3) very-high-precision VRT at 10-30m scale using EO (Sentinel-2 & others).

The economic feasibility study will utilize partial budgeting and break-even techniques to evaluate the potential costs and benefits of real-time VRT nitrogen management for each cropping system. Partial budgeting is particularly useful for analysing the addition of equipment to a farm enterprise or switching among different production technologies. On the contrary, break-even analysis is often used to calculate the level of input needed to obtain a desired level of profit. Combining break-even analysis and partial budgeting can provide useful insight concerning the feasibility of these new N management technologies. A similar approach is currently used by the University of Tennessee under the Cotton Yield Monitor Investment Decision Aid (CYMIDA) project (http://economics.ag.utk.edu/cymida.html).

3.5 Activity 5: Integration of socio-economic and policy analysis

In close collaboration with partners 2eco and CRA-INEA an integrated analysis will be completed in which the socio-economic and the policy analysis are combined. For this integration step to be successful it is preferred to select the same case study countries so that the resolution of the collected information matches between both activities. This integrative activity will generate comprehensive recommendations on how to promote and diffuse innovative farming practices in an effective manner in Europe.

4 Planning

The planning of the first part of the socio-economic activity will be as follows:

- November-December 2015 – Complete analytical framework
- January-February 2016 – Draft first ideas on the choice experiment to be implemented in the farmer survey
- March 2016 – Decisions on case studies and first sampling of innovative farming practices and completion of survey questionnaire
- April-May 2016 – Start preparation for survey implementation in pilot areas
- December 2016 – First case studies should be completed and data should be analyzed.