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FATIMA

FArming Tools for external nutrient Inputs and water MAnagement

D4.2.2 - Catalogue of Best Practices to Promote Sustainable Crop Production Systems and Building Blocks for the Institutional-Economic Design of Sustainable Farming Systems

WP4.2 – Policy analysis and indicator framework

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Executive summary

The aim of FATIMA is to encourage optimized yield with minimum inputs (mainly water and nutrients), while preserving natural capital and moving towards socially and economically viable rural farming communities. Therefore, the analysis of current policies in the pilot areas is important to understand their influence in the strategies and practices adopted by the rural communities, as they play a crucial role in shaping farmers and other actors' decisions that influence the sustainability of these communities. Last but not least, the understanding and knowledge of successful policies being implemented around the world is also important by learning with those examples.

The purpose of this document is to present a synthesis of relevant policies and incentives, with a particular focus on the European Union (EU) experience, regarding water-nutrient-energy-soil management in intensive agricultural systems, as well as in other models of agriculture like organic farming and conservation agriculture, and an analysis of their implications for FATIMA activities. Further, it presents a portfolio of successful/relevant cases of application of policy instruments to promote sustainable crop production, covering different problems, farming systems, institutional contexts and associated socio-ecological systems. Examples are collected from all over the world, including instruments like, for instance, sustainable financing, certification schemes, payments for ecosystem services, agri-environmental measures and conservation agreements. Thus, the document provides a review of existing policies and instruments. The development of new, innovative policies, instruments, and practices will be discussed in the forthcoming deliverable on policy recommendations.

Agriculture has major impacts on natural resources and a coordination of different policies is most of the time crucial to a successful implementation of the policies. It is important that agricultural and environmental policies are closely coordinated and mutually supporting. Moreover, the degree of the environmental impacts associated with agriculture vary widely between and across countries. The socio-cultural background also varies, which can influence the successful of a policy. Then, it is important when developing new policies or looking for some of the cases presented in this document to evaluate the context and analyse which are most appropriate to each country and specific goal. Finally, it is clear that sustainable alternatives to industrial crop production are the focus of several policies.

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1 Purpose of the Document

The aim of FATIMA is to establish innovative and new farm tools and service capacities that help the intensive farm sector optimize its external input management (mainly nutrients and water) and productivity, with the vision of bridging sustainable crop production with fair economic competitiveness. Moreover, FATIMA intends to demonstrate how improved, highly efficient technology (e.g. EO, sensors, VRT N management) may contribute to promote agricultural sustainability. However, it is also acknowledged that technology alone may not be sufficient to ensure sustainable crop production, even if combined with increased awareness and adoption of improved management practices by farmers and other stakeholders.

Public policies are a central element in the development of a pathway towards sustainable crop production as they play a crucial role in shaping farmers and other actors' decisions that influence the sustainability of rural communities. Therefore, a policy analysis is a key contribution to achieve FATIMA objectives.

The purpose of this document is to present the synthesis of results from a review conducted on relevant policies and incentives (see Box 1 with the adopted definition of policy instruments) regarding water-nutrient-energy-soil management in intensive agricultural systems, as well as in other models of agriculture like organic farming and conservation agriculture. The potential relation of these policies with FATIMA objectives and activities is briefly described.

Therefore, a review of successful or relevant application of policy instruments from around the world is helpful to understand it and to learn with them for future policies development. The objective is to identify which type of policies and incentives shall be considered as options for application in the pilot areas to enable the paradigm shift to a sustainable, resource efficient crop production system, i.e. to achieve optimized yield with minimum inputs, while preserving the environment and moving towards socially viable rural farming communities.

BOX 1: WHAT ARE POLICY INSTRUMENTS?

Policy instrument is the term used to describe tools/mechanisms used by governments/authorities to achieve a desired effect/policy objective. We can distinguish three basic types of policy instruments: (1) regulatory/command and control, (2) economic/market-based and (3) voluntary/decentralized approaches.

The relevant policies will not always originate from agricultural or environmental policies only, but might stem from different sectoral policies (e.g. energy or trade policies). Some examples of potential relevant policy instruments:

- EU CAP agri-environmental payments;
- payments for environmental/ecosystem services;
- conservation agreements;
- other agricultural subsidies and voluntary funding schemes;
- water tariffs/taxes;

- energy tariffs/taxes;
- taxes on fertilizers/nitrogen taxation;
- nitrate regulations;
- certification schemes and labelling;
- climate policies/carbon taxes;
- sustainable financing.

It is important to choose the most appropriate instrument or mix of instruments, as certain instruments are more effective than others to achieve the desired end (IISD, 1995). In order to ensure success, care must be exercised in the instruments application. Several factors should be taken into account when determining the most suitable instrument in a particular situation and also when design it. Among the relevant factors (evaluation criteria) which should be considered, are:

- environmental effectiveness;
- realization of economic benefits and efficient allocation of resources (economic efficiency);
- international/national/regional competitiveness;
- distribution impacts;
- transition and adjustment costs;
- administration and compliance costs;
- jurisdiction;
- consistency with other government policies;
- and industry and public acceptability.

Each of these factors has direct application when designing agricultural policy which is expressed through instruments (IISD, 1995).

In synthesis, this document presents a brief catalogue of good practices in instruments to promote sustainable crop production, collected from all over the world, but with particular attention to the current EU policy. The focus is on instruments targeted towards sustainable nutrient-water-energy-soil management in intensive agricultural systems, but can also include examples of successful cases of adoption of sustainable agriculture practices in a more general way, covering different problems, farming systems, institutional contexts and associated socio-ecological systems.

The description of each instrument includes, whenever possible with the information available, the following aspects:

- Name of the instrument;
- Rationale and objectives of the instrument: brief explanation to justify the need for the instrument, its objectives and how it is expected to address the problem; is the instrument applied in a wider context or is it only applied in a particular case?
- Baseline for the implementation of the instrument: The baseline describes how property rights are assigned. For instance, on what basis are payments granted or taxes relieved? How is the obligation to offset impacts determined?;
- Link to FATIMA approach and objectives;
- Spatial scope (e.g. EU, national, regional, local, pilot area);
- Current status and time horizon: in place from... to…;

- Targeted actors (who is targeted by the instrument?). Distinguish between public and private actors/activities/products/emissions/resources;
- Governance issues: includes relevant governance levels of instrument application - often governmental level, but not necessarily (e.g. public agency responsible for its proposal and application); the governance levels can be: international (e.g. European), national, regional (e.g., state level, provinces, in any case between "local" and "national"), local (community, municipality, district level);
- Financial issues: required funding/funding sources/revenues generated;
- Links to other relevant instruments: Does the instrument typically operate independently or within a policy mix?

2 Objectives and scope of WP 4.2

The main objective of WP4.2 is to perform a policy analysis and provide recommendations for tailored policy instruments to promote sustainable crop production and the provision of ecosystem services by agriculture. From this analysis we aim to obtain general policy lessons as well as pilot area-specific recommendations.

To achieve these objectives it is relevant to evaluate the performance of current policies, including their strengths and weaknesses, identify policy gaps, and understand which policies and incentives are needed to enable a paradigm shift to a sustainable, resource efficient crop production system, i.e. to achieve optimized yield with minimum inputs, while preserving natural capital and moving towards socially and economically viable rural farming communities. This knowledge is used to identify opportunities for the proposal of improved (revised or new) policy instruments and innovative financial arrangements, based on extended stakeholder involvement in the process.

The strategy in WP4.2 is to direct the fine grain analysis in each pilot area to those policy instruments that have a higher potential to contribute to develop an enabling policy environment for the uptake of FATIMA results. In this way, we ensure an efficient allocation of available project resources and avoid diverting our effort to the analysis of other instruments that, although relevant, do not have a very strong link with FATIMA objectives. Examples of relevant instruments include: (i) water-pricing schemes, designed to increase agricultural water productivity; (ii) nitrate regulations that promote efficient use of fertilizers; or (iii) payments for ecosystem services that promote agro-forest/crop systems and farming practices that reduce the need for herbicides, pesticides, fertilizer, as well as energy and water consumption.

3 European Policies

3.1. Synthesis of relevant policies and organizations in the European Union

The most relevant policy instruments and incentives throughout Europe with influence in FATIMA pilot areas are presented in Table 1. A more detailed analysis of a subset of pre-selected policy instruments is developed, elaborating the main purpose of each policy and its implications on FATIMA.

Table 1 – Synthesis of main EU Policies relevant to FATIMA

EU Policies		Main Objectives/Scope
Common Agriculture Policy (CAP), since 1962 (last reform in 2013)		CAP is a key EU policy in a strategic sector in terms of food security, environment preservation and economic growth in rural areas.
Rural Development Regulation (Regulation (EU) No. 1305/2013), of 17 December 2013		Rural development policy is a key part of the EU's common agricultural policy. The EU's priority in this area for 2014-20 is to make agriculture fairer, greener and more efficient. This regulation sets out how the European Agricultural Fund for Rural Development (EAFRD) will work towards achieving this goal.
Regulation on the Financing, Management and Monitoring of the CAP (Regulation (EU) No 1306/2013), of 17 December 2013	**European Agricultural Fund for Rural Development (EAFRD)**	The EAFRD is a funding mechanism under the CAP. The objective is to contribute to the competitiveness of agriculture, the sustainable management of natural resources and climate action, as well as to the balanced territorial development of rural areas.
	European Agricultural Guarantee Fund (EAGF)	The EAGF primarily finances direct payments to farmers under the CAP and measures regulating or supporting agricultural markets.
Nitrate Directive (Directive 91/676/EEC), of 12 December 1991		The Nitrates Directive aims to protect water quality across Europe by preventing nitrates from agricultural sources polluting ground and surface waters and by promoting the use of good farming practices.
Fertiliser Regulation (Regulation (EC) No 2003/2003), of 13 October 2003		This regulation was adopted in order to gather all rules applying to fertilisers into a single piece of legislation and to ensure the uniform application of a package of very technical provisions. It only applies to mineral fertilisers made up of one or more plant nutrients (or fertilising elements).
Pesticides Directive (Directive 2009/128/CE), of 21 October 2009		The Directive establishes a framework for Community action to achieve a sustainable use of pesticides. The proposed measures concern in particular closer monitoring, increased training and information of users

EU Policies	Main Objectives/Scope
	as well as specific measures for the use of these substances.
Plant Protection Products Directive (Directive 91/414 /EEC), of 15 July 1991	The Directive concerns the authorization, placing on the market, use and control within the EU of commercial plant protection products (pesticides). Regarding groundwater, authorization is only granted if plant protection products have no harmful effect on human health or on groundwater and that do not have undesirable effects on the environment, particularly on the contamination of water, including drinking water and groundwater.
Sewage Sludge Directive (Directive 86/278/EEC), of 12 June 1986	The Directive sets rules on how farmers can use sewage sludge as a fertiliser, to prevent it harming the environment and human health, by compromising in particular the quality of the soil but also the quality of surface and ground water.
Soil Thematic Strategy (COM (2006) 231), of 22 September 2006	The main objective of the Soil Strategy is to protect soils across the EU, by preventing the continued unsustainable use of soils and to achieve biodiversity and climate change goals.
Water Framework Directive (WFD) (Directive 2000/60/EC), of 23 October 2000	The WFD aims to achieve a good qualitative and quantitative status of all water bodies in the EU. It intends to contribute to preserve, protect and improve environmental quality and also the prudent and rational use of natural resources, introducing several new ecological, economic and social approaches and concepts in the EU water management (e.g. good ecological status, full cost recovery, public participation).
Communication on Water Scarcity and Droughts (COM (2007) 414), of 18 July 2007	The Communication recognises the major challenges caused by water scarcity, and medium - or long-term droughts in the EU, and provides guidelines for addressing them. These deal with: water pricing; water allocation; drought prevention and drought responses; water supply alternatives; and high-quality information and technological solutions tackling water scarcity and droughts.
Protection of the Aquatic Environment Directive (Directive 2006/11/EC), of 15 February 2006	This Directive lays down rules for protection against, and prevention of, pollution resulting from the discharge of certain substances into the aquatic environment. It applies to inland surface water, territorial waters and internal coastal waters.
Groundwater Directive (Directive 2006/118/EC), of 12 December 2006	The Groundwater Directive aims to protect groundwater against pollution and deterioration. This includes procedures for assessing the chemical status of groundwater and measures to reduce levels of pollutants.
Urban Waste Water Directive (Directive 91/271/EEC), of 21 May 1991	The Directive objective is to protect the environment from the adverse effects of urban waste, water discharges and discharges from certain industrial

EU Policies	Main Objectives/Scope
	sectors, and concerns the collection, treatment and discharge of: Domestic waste water; Mixture of waste water; Waste water from certain industrial sectors. In areas where water is scarce, treated wastewater provides an alternative source of water for irrigating crops.
Habitats Directive (Directive 92/43/EEC), of 21 May 1992	The main aim of the Directive is to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements. It makes a contribution to the general objective of sustainable development, whereas the maintenance of such biodiversity may in certain cases require the maintenance, or indeed the encouragement, of human activities. Creates the Natura 2000 network.
Birds Directive (Directive 79/409/EEC, of 2 April 1979 codified by Directive 2009/147/EC, 30 November 2009)	The Directive aims essentially to ensure the conservation of birds and their habitats, contributing to the maintenance of biodiversity.
The EU Biodiversity Strategy to 2020 (COM(2011)244), of 3 May 2011	The EU Biodiversity Strategy to 2020 includes a specific target that addresses the role of agriculture and forestry as regards biodiversity in Europe and links directly with the reformed CAP and its greening measures. These will reward farmers for respecting three obligatory greening measures: maintenance of permanent grassland, ecological focus areas and crop diversification.

A synthesis of relevant organizations in the agriculture sector, and their key objectives/scope, is presented in Table 2.

Table 2 – Main Institutions in the Agriculture Sector in EU

Main Institutions	Main Objectives/Scope
International Agricultural Trade Research Consortium (IATRC)	The IATRC is a unique international association of agricultural trade researchers and policy practitioners.
Food and Agriculture Organization of the United Nations (FAO)	Achieving food security for all is at the heart of FAO's efforts – to make sure people have regular access to enough high-quality food to lead active, healthy lives. Three main goals of FAO: eradication of hunger, food insecurity and malnutrition; elimination of poverty and the driving forward of economic and social progress for all; and, the sustainable management and use of natural resources, including land, water, air, climate and genetic resources for the benefit of present and future generations.
European Conservation Agriculture Federation (EFAC)	ECAF brings together fourteen national associations which promote among Europe's farmers the soil management "best practice" aspects of Conservation Agriculture. With member associations in Denmark, Finland, France, Germany, Greece,

Main Institutions	Main Objectives/Scope
	Ireland, Italy, Moldova, Portugal, Russia, Slovakia, Spain, Switzerland and United Kingdom, ECAF represents the interests of the majority of the European Union's cropped farmland. The aims of ECAF are: - to promote information to farmers, agrarian technicians and society in general, about the techniques that make it possible to conserve agrarian soil and its biodiversity, in the context of sustainable agriculture; - to encourage the development, teaching and investigation on any aspect related to Conservation Agriculture and the biodiversity of agrarian soil; - to develop all kinds of activities and programs addressed to the achievement of the previous aims.
European Environment Agency (EEA)	EEA is the agency of the European Union (EU) that provides independent information on the environment for those involved in developing, adopting, implementing and evaluating environmental policy, and also the general public. In close collaboration with European Environmental Information and Observation Network and its 33 member countries, the EEA gathers data and produces assessments on a wide range of topics related to the environment. The agency is governed by a management board composed of representatives of the governments of its 33 member states, a European Commission representative and two scientists appointed by the European Parliament, assisted by a committee of scientists.
European Association for Agricultural Economists (EAAE)	EAAE brings together agricultural economists and others interested in the problems of the agricultural and food industries and rural development in Europe. The main objectives are: the furtherance of knowledge and understanding of agricultural economics, especially in the European context; the exchange of experience, ideas and information between agricultural economists.

3.2. Description of the most relevant policies

A brief description of some of the most relevant instruments identified in the previous section is presented. A detailed characterization of instruments will only be made for those selected as the most relevant for each pilot area.

3.2.1. Nitrate Directive

The agricultural use of nitrates is the main diffuse pollution source affecting the waters in EU. It is therefore necessary, in order to protect human health, living resources, aquatic ecosystems and to safeguard other legitimate uses of water, to reduce water pollution caused or induced by nitrates from agricultural sources and to prevent further such pollution.

BOX 2: Nitrates Directive implemented in 1991

- **Name of the instrument:** Nitrate Directive (Directive 91/676/EEC) of 12 December 1991.
- **Rationale:** The Nitrates Directive was created in response to the need of a common action to control the problem arising from intensive agricultural production. While nitrogen is a vital nutrient that helps plants and crops to grow, high concentrations are harmful to people and nature. The agricultural use of nitrates in organic and chemical fertilisers has been a major source of water pollution in Europe. The Directive aims to protect water quality across Europe by preventing nitrates from agricultural sources polluting ground and surface waters and by promoting the use of good farming practices. As water sources are not restricted within national boundaries, an EU wide approach was crucial to tackling the problem of pollution. The Nitrates Directive obliges Member States to designate Nitrate Vulnerable Zones (NVZ) of all known areas in Member States whose waters – including groundwater – are or are likely to be affected by nitrate pollution. Vulnerable zones are defined as those waters which contain a nitrates concentration of more than 50 mg/l or are susceptible to contain such nitrates concentration if measures are not taken.
- **Link to FATIMA approach and objectives:** This Directive is directly related with FATIMA objectives. The Nitrate Directive aims to prevent and protect ground and surface waters against pollution caused by nitrate leaching from agricultural sources. The Directive has imposed a maximum nitrate concentration level of 50 mg/l in water, and by establishing this limit it implies that farmers need to change farming practices and adopt new technologies in order to reduce the nitrate input. FATIMA technologies and solutions aim to contribute to this objective.
- **Spatial scope:** applied at European level and then transposed to national law by Member States.
- **Current status and time horizon**: In place from 19 December 1991. The successive amendments and corrigenda to the Directive have been incorporated into the original text (Regulation (EC) No 1882/2003 and Regulation (EC) No 1137/2008).
- **Target uses and users:** Under the Directive, all Member States have to: (1) designate as vulnerable zones all those draining into waters which are or could be affected by high nitrate levels and eutrophication. The designation is reviewed and possibly revised at least every 4 years to take account of any changes that occur; (2) establish mandatory action programmes for these areas, taking into account available scientific and technical data and overall environmental conditions; (3) monitor the effectiveness of the action programmes; (4) test the nitrate concentration in fresh ground and surface water at sampling stations, at least monthly and more frequently during flooding; (5) carry out a comprehensive monitoring programme and submit every 4 years, a comprehensive report on the implementation of the Directive. The report includes information on nitrate-vulnerable zones, results of water monitoring, and a summary of the relevant aspects of codes of good agricultural practices and action programmes; (6) draw up a code of good agricultural practice which farmers apply on a voluntary basis. It sets out various good practices, such as when fertiliser use is inappropriate; (7) provide training and information for farmers, where appropriate.
- **Governance structure:** Member States should establish and present to the European

Commission reports every 4 years on the implementation of this Directive and the Commission should report regularly on the implementation of this Directive by the Member States.

- **Links to other relevant instruments:** The measures for action of the Nitrates Directive are also listed in the Water Framework Directive (Directive 2000/60/EC, Annex VI) and the Groundwater Directive (Directive 2006/118/EC, Annex IV, part B).

3.2.2. Common Agricultural Policy (CAP)

For the last 50 years the Common Agricultural Policy (CAP) has been the EU's most important common policy. This explains why traditionally it has taken a large part of the EU's budget, although the percentage has steadily declined over recent years. Over the past five decades, the CAP has encouraged the sector to become rapidly modernised and to increase the intensification of agricultural production, although adopting also some measures to reflect environmental concerns.

BOX 3: Common Agricultural Policy (CAP) launched in 1962, last reform in 2013

- **Name of the instrument:** Common Agricultural Policy (CAP) reform 2014-2020.
- **Rationale:** The CAP is a link between the expectations of EU citizens for agriculture, and the needs of EU farmers facing economic and environmental challenges. It translates an investment of the EU in a strategic sector in terms of food, environment and economic growth in rural areas. Since its launch in 1962, the CAP has evolved to address global challenges and has been through successive reforms. These reforms have increased 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 current challenges facing the sector, many of which are driven by factors that are external to agriculture, have been identified as:
  - Economic: food security and globalisation; a declining rate of productivity growth; price volatility; pressures on production costs due to high input prices, and; deteriorating position of farmers in the food supply chain.
  - Environmental: resource efficiency; soil and water quality, and; threats to habitats and biodiversity.
  - Territorial: where rural areas are faced with demographic, economic and social developments including depopulation and relocation of businesses.

  The recent CAP reform for the 2014-2020 period aims to respond to these three main challenges facing the sector, moving from product to producer support and now to a more land-based approach. The policy objectives are to have (1) a viable food production, (2) a sustainable management of natural resources and climate action and (3) a balanced territorial development. The reform may be broadly summarised as guaranteeing food security and improving environmental performance in rural areas which are faced with large-scale competition for land, reflecting rapid changes in the socio-economic situation. An important feature of the new CAP is the recognition that farmers should be rewarded for the services they provide to the public even though they might not have a market value (e.g. biodiversity conservation). This reform intends to strength the competitiveness of the sector, promote sustainable farming, innovation and

greater effectiveness and support jobs and growth in rural areas.

- **Link to FATIMA approach and objectives:** The successive reforms of the CAP intend to make farming methods more environmentally friendly and efficient (more sustainable) by encouraging better use of natural resources, which is fully aligned with FATIMA objectives. This modernisation of agriculture is a result of the continuous allocation of funding into research and new technology. Greening the CAP is intended to slow down the decline in farmland biodiversity, most notably in intensive farming areas. The new CAP, as FATIMA technologies and solutions, supports all different types of farm and farming practices (big or small, family-run, conventional or organic).
- **Spatial scope:** Applied at an European level, with rural development programmes adjusted by each Member State to national and/or regional level;
- **Current status and time horizon:** CAP is in place since 1962 and over time has undergone different reforms in order to face the challenges of the sector. The most recent reform of CAP was in June 2013 and established priorities to the period 2014 to 2020.

  Target uses and users: The CAP is a common policy for all the Member States of the European Union. It helps farmers to be more productive and to improve their technical skills, where research and innovation are crucial for farmers to produce more from less. In its early years, the CAP encouraged farmers to use modern machinery and new techniques, including chemical fertilisers and plant protection products, resulting in food surpluses. Nowadays, the emphasis has changed and CAP helps farmers to: (1) farm in a manner that reduces emissions of greenhouse gases; (2) use eco-friendly farming techniques; (3) meet public health, environmental and animal welfare standards; (4) produce and market the food specialities of their region; (5) make more productive use of forests and woodland; (6) develop new uses for farm products in sectors like cosmetics, medicine and handicrafts.

  The new CAP provides farmers with financial assistance, however, in order to receive their full entitlement of income support payments, farmers have to adopt environmentally-sustainable farming methods. The CAP introduces a new policy instrument the Green Direct Payment, this accounts for 30% of the national direct payment envelope and rewards farmers for respecting three obligatory agricultural practices: (1) maintenance of permanent grassland areas (grass is good at absorbing carbon dioxide, which helps in the fight against climate change); crop diversification (grow a minimum number of crops) and; (3) protection of ecological focus areas (must farm 5 % of their arable area in a manner that promotes biodiversity). As the green direct payment is compulsory it has the advantage of introducing practices that are beneficial for the environment and climate on most of the used agricultural area.

  Farmers may also receive additional support if they adopt more strict agri-environmental farming practices. At least 30% of the budget of each Rural Development programme must be reserved for voluntary measures that are beneficial for the environment and climate change. These include agri–environmental climate measures, organic farming, Areas of Natural Constraints (ANC), Natura 2000 areas, forestry measures and investments which are beneficial for the environment or climate.
- **Governance structure:** The CAP is managed and funded at European level. The European Commission collaborates with the full range of stakeholders (mainly through its many advisory groups) before drawing up proposals. Then each Member State is responsible for composing and running their rural development programmes. Those are composed from the same list of

measures, however, Member States have the flexibility to address the issues of most concern within their respective territory reflecting their specific economic, natural and structural conditions. On law making, the Commission's proposals are decided on by the Council of agriculture ministers of the 27 EU countries, together with the European Parliament. The EU's Court of Auditors also plays a major role in supervising expenditure.

- **Financial issues:** The CAP can be described as having three dimensions: market support, income support and rural development. The first two dimensions - market and income support - are solely funded by the EU budget, whilst the rural development dimension is based on multiannual programming and is co-financed by Member States. The CAP is financed by two funds: the European Agricultural Guarantee Fund (EAGF) - primarily finances direct payments to farmers and measures regulating or supporting agricultural markets; and the European Agricultural Fund for Rural Development (EAFRD) - finances the EU's contribution to rural development programmes. A total amount of EUR 408 billion for 2014-2020 is available, of which EUR 313 billion is foreseen for direct payments and market-related expenditure and EUR 95 billion for rural development. The budget is decided every year by the Council of the EU and the European Parliament.
- **Links to other relevant instruments:** There are four basic EU regulations of the new CAP. These four legislative texts reflect the political agreement between the European Commission, EU Member States Agriculture Ministers (in the Council) and the European Parliament. The vast majority of CAP legislation will be defined under four consecutive Regulations covering: Rural Development, Regulation 1305/2013; "Horizontal" issues such as funding and controls, Regulation 1306/2013; Direct payments for farmers, Regulation 1307/2013; and Market measures, Regulation 1308/2013.

3.2.3. European Agricultural Fund for Rural Development (EAFRD) and European Agricultural Guarantee Fund (EAGF)

In order to achieve the objectives of the CAP, the financing of the various measures falling under that policy shall be made by: (1) the European Agricultural Guarantee Fund (EAGF); (2) the European Agricultural Fund for Rural Development (EAFRD). These agricultural funding mechanisms are addressed in the Regulation on the Financing, Management and Monitoring of the CAP (Regulation (EU) No 1306/2013), of 17 December 2013.

BOX 5: Regulation on the Financing and Management of UE agricultural policy

- **Name of the instrument:** Regulation on the Financing, Management and Monitoring of the CAP (Regulation (EU) No 1306/2013), of 17 December 2013.
  Rationale: This Regulation is part of a reform package for the CAP and lays down the rules on: (a) the financing of expenditure under the CAP, including expenditure on rural development; (b) the farm advisory system (requires EU countries to set up a farm advisory system to help farmers understand, in particular, the CAP's cross-compliance and greening obligations); (c) the management and control systems to be put in place by the Member States; (d) the cross-

compliance system (a system which requires farmers to meet standards on aspects like environment, public health and animal welfare in return for support payments); (e) clearance of accounts. Moreover, where farmers do not comply with eligibility conditions or other obligations, the aid can be withdrawn (if unduly paid) and penalties imposed; permits names of CAP fund recipients to be published, to discourage irregular behaviour; sets up a monitoring and evaluation framework to measure the CAP's performance; sets up a reserve to support the farming sector in the event of major crises affecting production or distribution. The regulation is under the two main CAP funds: (1) European Agricultural Guarantee Fund (EAGF) - mainly finances direct payments to farmers and agricultural market support measures, and; (2) European Agricultural Fund for Rural Development (EAFRD) - co-finances national rural development programmes.

- **Link to FATIMA approach and objectives:** One of the priorities of the EAFRD is the promotion of resource efficiency and support of the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors. Within this priority, the EAFRD will cover basic services and village renewal in rural areas including: (1) investments in the creation, improvement or expansion of all types of small scale infrastructure, including investments in renewable energy; (2) studies and investments related to maintenance, restoration and upgrading of the cultural and natural heritage of villages and rural landscapes, including related socio-economic aspects; (3) investments targeting the relocation of activities and conversion of buildings or other facilities located close to rural settlements, with a view to improving the quality of life or increasing the environmental performance of the settlement. The EAFRD will also cover investments in physical assets which concern infrastructure related to the development and adaptation of agriculture, including access to farm and forest land, land consolidation and improvement, energy supply and, water management. In other words, the EAFRD aims to: foster the competitiveness of agriculture; ensure that natural resources are managed sustainably and that measures to tackle climate change are implemented effectively; ensure that rural areas across the EU receive support for development, in particular by creating new jobs and protecting existing ones.
- **Spatial scope:** applied at European level.
- **Current status and time horizon:** Applied from 1 January 2014.
- **Target uses and users:** The EAFRD finance the rural development programmes implemented in accordance with the Union law on support for rural development, while the EAGF finance the following type of expenditures: (a) measures regulating or supporting agricultural markets; (b) direct payments to farmers under the CAP; (c) the Union's financial contribution to information and promotion measures for agricultural products on the internal market of the Union and in third countries, undertaken by Member States on the basis of programmes other than those referred to in Article 5 and which are selected by the Commission; (d) the Union's financial contribution to the Union School Fruit and Vegetables Scheme as referred to in Article 23 of Regulation (EU) No 1308/2013 and to the measures related to animal diseases and loss of consumer confidence as referred to in Article 155 of that Regulation. The EAGF shall finance the following expenditure in a direct manner and in accordance with Union law: (a) promotion of agricultural products, undertaken either directly by the Commission or through international organisations; (b) measures, taken in accordance with Union law, to ensure the conservation, characterisation, collection and utilisation of genetic resources in agriculture; c) the

establishment and maintenance of agricultural accounting information systems; (d) agricultural survey systems, including surveys on the structure of agricultural holdings. The Funds may each, finance, in a direct manner, on the initiative of the Commission and/or on its behalf, the preparatory, monitoring, administrative and technical support activities, as well as evaluation, audit and inspection measures required to implement the CAP.

- **Governance structure:** The EAGF and EAFRD are implemented in shared management between the Member States and the Union**.** This means that the Commission does not make payments directly to the beneficiaries of aid, being this task delegated to the Member States**.** Funds for rural development are disbursed through programmes run by national governments: the government appoints the Managing Authority whose task is to inform potential beneficiaries of the support that is available, the rules that apply and the level of the EU contribution. By 1 September of each year the Commission draws up a financial report on the administration of the EAGF and of the EAFRD during the previous budget year and submits it to the European Parliament and the Council.
- **Financial issues**: The EAGF and the EAFRD come under the general budget of the EU. A total amount of EUR 408 billion for 2014-2020 is available, of which EUR 313 billion is foreseen for direct payments to farmers and measures regulating or supporting agricultural markets (funded by EAGF) and EUR 95 billion for rural development programmes (funded by EAFRD). The minimum EAFRD contribution rate shall be 20%. Nevertheless, at least 30% of funding for each rural development programme must be dedicated to measures relevant for the environment and climate change.
- **Links to other relevant instruments:** Mainly with the Common Agricultural Policy (CAP) reform 2014-2020.

3.2.4. Water Framework Directive (WFD)

Pollution from agriculture is a major pressure on the quality of ground and surface waters in the EU. In the past few years, there has been an increasing pressure on water due to the continuous growth in demand for sufficient quantities of good-quality water for a whole range of uses. The Water Framework Directive (WFD) aims to protect and improve the quality of water in Europe.

BOX 4: Water Framework Directive (WFD) adopted in 2000

- **Name of the instrument:** Water Framework Directive (Directive 2000/60/EC), of 23 October of 2000.
- **Rationale:** The WFD relates to the quality of fresh and coastal waters in EU, aiming to attain good ecological and chemical status of Europe's fresh and coastal waters. Specifically, this includes: protecting all forms of water (inland, surface, transitional, coastal and ground); restoring the ecosystems in and around these bodies of water; reducing pollution in water bodies, and; guaranteeing sustainable water usage by individuals and businesses.
- **Link to FATIMA approach and objectives**: Agriculture is responsible for 44 % of total water abstraction in Europe (EEA, 2008), being irrigation the most significant use of water. The WFD

contributes to preserving, protecting and improving the environmental quality and also the prudent and rational utilization of natural resources, introducing the concept of the "full cost recovery" for water services. Full cost recovery not only encompasses the cost of water supply, maintenance and new infrastructure but also environmental and resource costs. As such it reflects the "water user pays" principle. The WFD recognises that water pricing is critical to achieve sustainable water use, requiring that pricing provide adequate incentives to use water resources efficiently.

- **Spatial scope:** applied at an European level and transposed to national level by each Member State.
- **Current status and time horizon:** In place since 2000 until 2027 (final deadline for meeting objectives).
- **Target uses and users:** The WFD requires all Member States to protect and improve water quality in all waters in order to achieve good ecological status. The legislation places clear responsibilities on national authorities. They have to:
  - identify the individual river basins on their territory - that is, the surrounding land areas that drain into particular river systems;
  - designate authorities to manage these basins in line with the EU rules;
  - analyse the features of each river basin, including the impact of human activity and an economic assessment of water use**;**
  - monitor the status of the water in each basin;
  - register protected areas, such as those used for drinking water, which require special attention;
  - develop and implement "river-basin management plans" (RBMP) to prevent deterioration of surface water, protect and enhance groundwater and preserve protected areas. RBMP include a programme of measures to be implemented in the plan horizon, that shall correspond to a cost-effective approach to achieve established objectives;
  - ensure the cost of water services is recovered so that the resources are used efficiently and polluters pay;
  - provide public information and consultation on their river-basin management plans.
- **Governance structure:** Each member states through its environmental agencies or other authorities took the responsibility to implement the Directive. Then, they must report to the European Commission and to the European Environment Agency (EEA) on implementation of WFD tasks.
- **Links to other relevant instruments:** The WFD is linked to a number of other EU directives some of the most relevant are: directives relating to the protection of biodiversity - Birds and Habitats Directives; directives related to specific uses of waters - Drinking Water, Bathing Waters and Urban Waste Water Directives; directives on topics such as Floods and the Marine Strategy Framework (supplemented by the Priority Substances Directive and the Groundwater Directive); Nitrates Directive - forms an integral part of the WFD, and; the Sustainable Use of Pesticides and the Sewage Sludge Directives also provide for the control of materials applied to land.

Several of the WFD requirements were not yet achieved in the EU member states. For instance, very recently the European Parliament and the European Commission have required that Spanish authorities revise water management in the country, namely in the scope of the implementation of

the second generation of RBMP in Tagus and Ebro basins, according to the WFD principles and objectives.

3.2.5. Soil Thematic Strategy

Soil has a key role as a habitat and gene pool, serves as a platform for human activities, landscape and heritage and acts as a provider of raw materials. In the interface between the earth, the air and the water, the soil performs many vital functions: food and other biomass production, storage, filtration and transformation of many substances including water, carbon and nitrogen. Soil functions are extremely important for environment as well as in a socio-economic level. Intensive agriculture practices can contribute to damage and deplete this valuable natural resource. While intensive plowing and monocrop agriculture systems have caused nutrient depletion and wide scale soil erosion, over application of fertilizers and pesticides has contaminated soils and polluted waterways.

BOX 6: Soil Thematic Strategy of 2006

- **Name of the instrument:** Soil Thematic Strategy (COM(2006) 231), of 22 September 2006.
- **Rationale:** The Soil Thematic Strategy Communication from the Commission is a proposal for a Framework Directive (a European law), and an Impact Assessment. It sets the frame, explains why further action is needed to ensure a high level of soil protection, sets the overall objective of the Strategy and explains what kind of measures must be taken. The Strategy was created in order to stop the continued unsustainable use of soils from compromising the Union's domestic and international biodiversity and climate change objectives. While using it sustainably, through the prevention of further degradation, the preservation of soil function and the restoration of degraded soils.
- **Link to FATIMA approach and objectives**: The proposal for a Framework Directive sets out common principles for protecting soils across the EU. Within this common framework, the EU Member States will be in a position to decide how best to protect soil and how use it in a sustainable way on their territory. Only a few Member States have specific legislation on soil protection. Soil is not subject to a comprehensive and coherent set of rules in the Union. Existing EU policies in areas such as agriculture, water, waste, chemicals, and prevention of industrial pollution do indirectly contribute to the protection of soils. But as these policies have other aims and scope of action, they are not sufficient to ensure an adequate level of protection for all soils in Europe. Furthermore, the Strategy pretend to promote the integration of policies, mentioning that Member States and EU institutions must integrate soil concerns into sectoral policies that have a significant impact on soil, especially agriculture, regional development, transport and research.
- **Spatial scope:** applied at European level and then possibly applied by Member States to national level.
- **Current status and time horizon:** In place since 2006, it establishes a ten-year work program for the European Commission.
- **Links to other relevant instruments:** Before the Communication COM(2006) 231 there was

other Commission's Communication entitled “Towards a Thematic Strategy for Soil Protection” (COM (2002) 179), of 16 April 2002. Some years after the adoption of the Soil Thematic Strategy, the European Commission published a policy report on the implementation of the Strategy and ongoing activities (COM(2012) 46), of 13 February 2012. All those instruments come from the Sixth Environment Action Programme.

3.2.6. Habitats and Birds Directives

The Habitats Directive and the Birds Directive are two key pieces of the EU nature conservation policy and together establish the Natura 2000 network. This is a network of some 25 000 sites, covering about one-fifth of the territory of the EU, and is aimed at protecting Europe’s biodiversity. The sites are not “fenced-off” protected areas but are open and are often dependent on sustainable human activities and land-use, mainly agriculture, that have shaped and maintained them over the years. Many sites are on farmland and the farmers undertake to manage the land in a specific manner so that the biodiversity is maintained. In this regard, the EU’s Natura 2000 programme is relevant.

BOX 7: Habitats Directive adopted in 1992

- **Name of the instrument:** Habitats Directive (Directive 92/43/EEC), of 21 May 1992.
- **Rationale:** The Habitats Directive ensures the conservation of a wide range of rare, threatened or endemic animal and plant species. Some 200 rare and characteristic habitat types are also targeted for conservation in their own right. Adopted on the conservation of natural habitats and of wild fauna and flora it aims to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements. It forms the cornerstone of Europe's nature conservation policy with the Birds Directive and establishes the EU wide Natura 2000 ecological network of protected areas, safeguarded against potentially damaging developments.
- **Link to FATIMA approach and objectives:** Biodiversity is inextricably linked to farming models and practices, existing valuable agro-ecosystems across whole of Europe. A large number of highly valuated wildlife species and semi-natural habitats types in Europe are dependent on continuing low-intensity agricultural practices. Areas where farming practices are associated with high biodiversity value are qualified as High Nature Value (HNV) farmland. Of the 231 habitat types of European interest targeted by Annex I of the EU Habitats Directive, 55 depend on extensive agricultural practices or can benefit from them.
- **Spatial scope:** Applied at European level.
- **Current status and time horizon:** Adopted on May 1992.
- **Target uses and users:** Over 1.000 animal and plant species, as well as 200 habitat types, listed in the directive's annexes are protected in various ways:
  - Annex II species (about 900): core areas of their habitat are designated as sites of Community importance (SCIs) and included in the Natura 2000 network. These sites must be managed in accordance with the ecological needs of the species.
  - Annex IV species (over 400, including many annex II species): a strict protection regime must

be applied across their entire natural range within the EU, both within and outside Natura 2000 sites.
  - Annex V species (over 90): Member States must ensure that their exploitation and taking in the wild is compatible with maintaining them in a favourable conservation status.
- **Governance structure:** The Habitats Committee assists the European Commission (EC) in the implementation of the Habitats Directive and delivers an opinion on the draft list of LIFE-Nature projects to be financed each year. Member States implement the directive and report to EC on the conservation status of habitats and species, on compensation measures taken for projects having a negative impact on Natura 2000 sites or on derogations they may have applied to the strict protection measures.
- **Links to other relevant instruments:** Birds Directive (Directive 2009/147/EC) of 30 November 2009.

BOX 8: Birds Directive of 1979 codified in 2009

- **Name of the instrument:** Birds Directive (Directive 2009/147/EC) of 30 November 2009.
- **Rationale:** The Birds Directive aims to conserve all wild birds in the EU by setting out rules for their protection, management and control. It covers birds, their eggs, nests and habitats. Wild bird species are often migratory and for that reason can only be protected by across borders cooperation. The Directive places great emphasis on the protection of habitats for endangered and migratory species. It establishes a network of Special Protection Areas (SPAs) including all the most suitable territories for these species. Since 1994, all SPAs are included in the Natura 2000 ecological network, set up under the Habitats Directive 92/43/EEC.
- **Link to FATIMA approach and objectives:** Valuable agro-ecosystems across whole of Europe are a proof of the potential to make compatible biodiversity conservation and farming models and practices. A large number of highly valuated wildlife species in Europe are dependent on continuing low-intensity agricultural practices. Urban sprawl and transport networks have fragmented and reduced their habitats, intensive agriculture, forestry, fisheries and the use of pesticides have diminished their food supplies, and hunting needed to be regulated in order not to damage populations. Habitat loss and degradation are the most serious threats to the conservation of wild birds.
- **Spatial scope:** Applied at European level.
- **Current status and time horizon:** Adopted on April 1979, the Directive 79/409/EEC was amended in 2009 and it became the Directive 2009/147/EC.
- **Target uses and users:** The 500 wild bird species naturally occurring in the European Union are protected under the Birds Directive in various ways:
  - Annex 1: 194 species and sub-species are particularly threatened. Member States must designate Special Protection Areas (SPAs) for their survival and all migratory bird species.
  - Annex 2: 82 bird species can be hunted. However, the hunting periods are limited and hunting is forbidden when birds are at their most vulnerable: during their return migration to nesting areas, reproduction and the raising of their chicks.
  - Annex 3: overall, activities that directly threaten birds, such as their deliberate killing, capture or trade, or the destruction of their nests, are banned. With certain restrictions, Member States can allow some of these activities for 26 species listed here.

- Annex 4: the directive provides for the sustainable management of hunting but Member States must outlaw all forms of non-selective and large scale killing of birds, especially the methods listed in this annex.
- Annex 5: the directive promotes research to underpin the protection, management and use of all species of birds covered by the Directive, which are listed in this annex.

- **Governance structure:** The European Commission is responsible for implementing the Birds Directive and it is assisted by the Ornis Committee. The Commission provides guidance on hunting practices, some of the key concepts of the Directive and on the sustainable management of cormorant populations. All Member States have to submit reporting on the status and trend in bird populations as well as on derogations they may apply to the directive's obligations.
- **Financial issues:** The threatened birds species listed in the directive's annex 1 are a priority for funding under the LIFE programme or benefit from a Species Action Plans. Under the current LIFE+ programme, projects that focus on practical conservation measures for any of those bird species can benefit from a higher EU co-funding rate, up to 75 %.
- **Links to other relevant instruments:** Habitats Directive (Directive 92/43/EEC), of 21 May 1992.

In the areas of importance for the conservation of certain habitats and species, human activities should be compatible with the preservation of these values, aiming at an integrated sustainable management of ecological, economic and social aspects. Ensuring the achievement of these objectives necessarily requires an articulation of the nature conservation policy with other sectoral policies in particularly agriculture in order to find the mechanisms so that the spaces included in the Natura 2000 network are spaces lived and managed in a sustainable manner.

3.2.7. Sustainable Agriculture Policies in EU

Reducing agriculture's environmental impacts requires a transition towards innovative, low-input systems. Thus, organic production plays a role in increasing the efficiency of nutrient management and reducing pesticide use.

Organic farming appears suitable for identifying environment-friendly farming practices. There is no specific EU target on the share of organic farming area, but a considerable number of EU Member States have set targets for area under organic farming. EU agri-environment programmes and consumer demand are key factors for the above mentioned inclination as well as for this recent strong increase in trends (EEA, 2016).

Organic farming respects the natural life cycles of plants and animals. It is protected by stringent production requirements laid down in EU law. It also benefits from rules on labelling and traceability aimed at guaranteeing the quality and authenticity of organic produce, wherever it comes from in the world.

In this context, there is a special European logo for organically produced products which guarantees that European organic production standards have been complied with (Figure 1). Organic farmers and food producers must undergo a strict certification process before being entitled to use the logo.

The European logo for organically produced products.

Figure 1 – European logo for organic products

Furthermore, there are also some voluntary certifications systems for food quality that guarantee compliance with specifications which may include requirements on environmental protection, animal welfare, the odour and taste of a product and fair trade. The European Commission has developed guidelines to harmonise these systems, to limit the constraints on producers and to ensure that consumers are not misled.

In 2007, the European Council of Agricultural Ministers agreed on a new Council Regulation (Council Regulation (EC) No. 834/2007) setting out the principles, aims and overarching rules of organic production and defining how organic products were to be labelled.

Last but not least, under the CAP, Member States can offer specific support in their rural development programmes to conventional farmers wishing to make the switch to organic farming. There is the possibility of receiving aid for both converting to and maintaining organic farming.

4 Other policies promoting good practices beyond EU

4.1. Sustainable and organic agriculture

Global food production will have to increase dramatically over the coming decades to meet the needs of growing populations and developing economies. As intensive agriculture is currently unsustainable a different path is needed. The desire for a sustainable agriculture is universal, but an agreement on how to progress towards it remains indefinable.

Sustainable agriculture and organic farming are two concepts often seen as synonyms, however it is not consensual. Some authors argued that they should not be equated and regard them as separate concepts (Rigby & Cáceres, 2001). Generally, organic farming (or organic agriculture) falls within the accepted definition of sustainable agriculture. Nevertheless, it is important to distinguish between the two, since organic products can be produced on large industrial farms unsustainably, and farms that are not certified organic can produce food using sustainable methods.

BOX 10: DEFINITION OF SUSTAINABLE AGRICULTURE AND ORGANIC FARMING

Sustainable Agriculture is the efficient production of safe, high quality agricultural products, in a way that protects and improves the natural environment, the social and economic conditions of farmers, their employees and local communities, and safeguards the health and welfare of all farmed species (Sustainable Agriculture Initiative Platform, 2010).

Organic Farming is a farming system that has been explicitly developed to be environmentally sustainable, and is governed by clear, verifiable rules. It relies on a number of objectives and principles, as well as common practices designed to minimise the human impact on the environment, while ensuring the agricultural system operates as naturally as possible (EEA, 2016).

Organic Agriculture is a production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasises the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. Organic Agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved (FAO, 2016; IFOAM, 2005).

> Example based on "food miles" to distinguish both: *In organic farming the food can travel thousands of miles before reaching our houses, and certification does not take into consideration the use of fossil fuels used to truck food. While in the concept of sustainable agriculture the food is (preferable) distributed and sold as close to the farm as possible.*

Therefore, organic agriculture is just one of several approaches to sustainable agriculture and should not be automatically assumed as sustainable.

4.2. Policies to promote sustainable crop production

In this section it is presented a portfolio of some selected cases of application of policy instruments to promote sustainable crop production. These are reference cases instead of successful cases or policies since it is difficult to identify policies with proven success.

The following cases are from all over the world and cover different topics.

4.2.1. Australia - Policy for Sustainable Agriculture in NSW

In 1998, New South Wales (NSW), a state in the east coast of Australia, implemented a Policy for Sustainable Agriculture. The policy forms part of the process of incorporating principles and

objectives of ecologically sustainable development into the ethos of agricultural industries. It also aims to facilitate a change in agricultural production towards ecologically and economically sustainable practices and farming systems through a coordinated approach.

Agriculture has played a key role in the development of New South Wales and contributed to the character, culture and heritage value of the rural landscape. 75% of the State's land resources and extracted water are used by agriculture to produce more than $6 billion worth of high quality products, accounting for 30% of the total national agricultural output each year. As major users of natural resources in the State, agricultural industries and individual landholders have a significant role to play in managing the State's valuable resources. It is recognised that the development of successful, sustainable agricultural enterprises may require significant change, or adjustment, from existing practices (NSW Government, 1998).

The Policy provides an agreed goal for sustainable agriculture, common objectives, and strategies that should guide a wide range of stakeholders towards this goal. It also provides a framework within which individual agencies and interest groups can develop specific position statements and action plans (NSW Government, 1998). The Policy is divided in six key areas: Agricultural production; Land management; Water use and quality; Nature conservation on farms; Rural communities; and Integrated management. In Table 3 to Table 8 is briefly described the policy key issues (with relevance for FATIMA) that need to be addressed for each of these areas and then present a range of strategies to be adopted by stakeholders in order to meet the objectives.

Table 3 – Agricultural Production Key Area of the Sustainable Agriculture Policy in NSW

Agricultural Production	
Objective: Profitable agricultural industries producing high quality agricultural products in an ecologically sustainable manner that meets consumer needs, and based on a better understanding of the relationship between product prices and production costs, including environmental costs	
Issue	**Strategy**
▪ Development and adoption of best management practices, incentives, guidelines and training in farm business and risk management necessary to enhance farm profitability and promote the adoption of agricultural practices that are both sustainable and productive ▪ Alternative farming systems as a response to consumer demand for organically grown food ▪ Effective management of pests and weeds critical to agricultural productivity	▪ Develop and adopt best management practices for agricultural industries in line with Ecologically Sustainable Development principles ▪ Develop and adopt alternative farming systems that allow adaptation to suit the variable soil and climate conditions ▪ Define and measure quantifiable indicators of the state of the agricultural and related environment, to allow better decision making ▪ Better inform rural communities of the role and appropriate use of agricultural and veterinary chemicals and biological pest control in sustainable agriculture ▪ Reduce the reliance of industry on pesticides

Table 4 – Land Management Key Area of the Sustainable Agriculture Policy in NSW

Land Management	
Objective: Agricultural land protected and managed for sustainable agricultural use with agricultural activity contributing to its protection and enhancement	
Issue	**Strategy**
▪ Quality of land resource (loss of native vegetation; rising groundwater; erosion; dryland salinity; soil acidification) ▪ Management of soil and vegetation, the control of pests and weeds (effective soil management to minimise and reverse significant soil structural degradation, salinity and acidity problems) ▪ Sustainable farming systems replace soil nutrients harvested as pasture and crop products, with a view to long term on- and off-farm nutrient balance ▪ Native vegetation to protect land from soil erosion and salinity ▪ Management of fertilisers	▪ Encourage the protection, and promote the value of native vegetation and biodiversity in agricultural land management ▪ Develop and adopt management practices and farming systems that conserve and enhance the health of soil resources ▪ Use fertilisers to achieve maximum benefits in replacing nutrients used to produce agricultural products, with minimal adverse impact on the environment

Table 5 – Water Use and Quality Key Area of the Sustainable Agriculture Policy in NSW

Water Use and Quality	
Objective: Agriculture as an efficient and productive user of water contributing to the achievement of water quality and environmental flow objectives	
Issue	**Strategy**
▪ Irrigated agriculture affecting water quality ▪ Wetlands contribute to improved water quality by recycling nutrients and by absorbing and breaking down pollutants ▪ Groundwater systems important to agriculture and rural communities as a source of water for irrigation ▪ Groundwater quality and supply, and water table levels need greater protection and management to achieve sustainable development ▪ Efficient irrigation techniques	▪ Adopt efficient and effective water use practices (by irrigators, pastoralists, and other water users) that conserve and enhance the quality of the environment ▪ Develop and implement land and water management plans in irrigated agricultural areas including adoption of best farming practice, irrigation system designs and decision support systems that overcome water degradation and provide for long-term irrigation community viability ▪ Provide government incentive programs that improve the sustainable use of water by agriculture

Table 6 – Nature Conservation on Farms Key Area of the Sustainable Agriculture Policy in NSW

Nature Conservation on Farms	
Objective: Agriculture making a beneficial contribution to the protection and management of the State's natural heritage and biodiversity	
Issue	**Strategy**
▪ Australia's biodiversity is a significant National asset with recognised global significance (maintenance of biodiversity has significant benefits for agriculture, science and medicine) ▪ Agriculture both contributes to and benefits from the retention and management of native vegetation (vegetation protect soil and water resources and provide shelter for livestock and crops. It is also the habitat for natural predators of agricultural pests and can reduce the use of agricultural pesticides and create opportunities to conserve native flora and fauna)	▪ Adopt farming systems that conserve and enhance biodiversity ▪ Adopt management plans that integrate nature conservation on-farm with agricultural production systems ▪ Manage pest animals in ways that optimise agricultural and ecological benefits, and promote species conservation

Table 7 – Rural Communities Key Area of the Sustainable Agriculture Policy in NSW

Rural Communities	
Objective: Making a beneficial contribution to regional and State economies and contributing to the support of the State's rural people and communities	
Issue	**Strategy**
▪ Agriculture provides the economic base of many rural and regional towns and contributes to the development of rural communities by creating jobs and economic wealth ▪ Agricultural sector often depends upon many services provided by rural and regional centres	Improve the coordination and complementary nature of rural policies and services

Table 8 – Integrated Management Key Area of the Sustainable Agriculture Policy in NSW

Integrated Management	
Objective: Agricultural industries, communities and governments working together to achieve positive economic, environmental and social outcomes	
Issue	**Strategy**
For agriculture to operate in an ecologically sustainable manner while meeting economic and social goals, mechanisms are needed to facilitate consultation and cooperative action between industry, government, local authorities and community groups	▪ Implement policies and provide information to encourage the adoption of sustainable agricultural practices ▪ Ensure collaboration in the development, implementation and review of plans, policies and legislation relating to agriculture ▪ Coordinate monitoring and reporting of the state of the agricultural and related environment, using measurable indicators that contribute to decision making

The responsibility for implementing the Policy lies principally with: NSW Government agencies; farmers; local authorities; and environmental interest groups. The objectives and strategies outlined in the Policy for Sustainable Agriculture in NSW will be used both to guide stakeholders in the agricultural sector in decision-making with respect to agricultural activities, and to facilitate a coordinated approach to achieving an ecologically and economically sustainable agricultural sector in NSW (NSW Government, 1998).

Last but not least, the Policy for Sustainable Agriculture complements a broad range of State Government initiatives aimed at improving long-term productivity while protecting the environment, and supporting rural and regional communities NSW (NSW Government, 1998). These initiatives include:

- partnership programs between the community and government such as *Total Catchment Management*, land and water management planning, *Landcare and West 2000*;
- the requirement that rural community impact statements be prepared before making Cabinet decisions that may impact on rural communities;
- State natural resource policies such as *The NSW State Rivers and Estuaries Policy*, *The NSW Wetlands Management Policy* and the draft *NSW Biodiversity Strategy*;
- the State vegetation reform initiative, which focuses on the management and conservation of native vegetation through regional planning and clearing controls;
- the State water reform package which aims to improve the sustainability of NSW rivers through the establishment by community groups of river and ground water management plans, changes to licencing arrangements and incentives for the efficient use of irrigation water;
- the acid soil action program to correct problems of soil acidity in cropping, irrigation, horticultural and coastal areas;
- the Healthy Rivers Commission assessment process which examines, in consultation with the community, problems and possible solutions for individual catchments.

When developing strategies to achieve sustainable agricultural practices, it is necessary to take into account the complex and diverse nature of the agricultural sector. Each key area is important in its own right. However, for sustainable agriculture to be achieved, the challenges presented within these areas must be addressed in a coordinated way (NSW Government, 1998).

4.2.2. Austria – Organic Agriculture

Austria established the first organic farms in 1920s and later in 1979 was created the Foundation of *Ernte für das Leben*, the largest organic farming association at that time. In 1990s, the organic sector expanded as a result from the increasing ecological awareness, marketing via supermarket chains and the implementation of the Austrian agri-environment programme. Later in 2004 was created the Foundation of the Research Institute of Organic Agriculture (FiBL) and one year after the Foundation of Bio Austria (Austria's largest organic farmers organization).

According to FiBL (2014) 19.4 % of Austria agricultural land is organic, the second highest percentage only behind Liechtenstein with 30.9 %. The organic agricultural area covers 533 230 hectares,

existing 21 843 organic producers and a retail of EUR 1064.7 million (2011). Of the total organic area 63.1 % consists of permanent grassland and grazing area, 35.7 % arable land and 1.2 % permanent crops.

The organic market in Austria is dominated by conventional supermarket chains and discounters which account for about two-thirds of the annual turnover. Specialised organic shops also play an important role and are expanding and modernising their premises, while organic supermarkets are attracting new customers. Another important and growing marketing channel is catering, in both the public and private sectors. The top-selling products are: eggs (18.4 % of all eggs sold on the food market), milk (17.8 %), potatoes (17.2 %), fresh vegetables (11.6 %) and butter (11 %). The market channels used are: distribution comprises general retailers (78.9 %), organic retailers (15.1 %) and direct sales (6 %) (data are from Organic Retailers Association, 2011 in FiBL, 2014).

The most important legislations are the European Union (EU) legislation on organic farming, other regulations and Chapter A 8 of the *Codex Alimentarius Austriacus* (Austrian Food Codex) apply. In addition to the code number of the control agency and the logo of the EU, the AMA label for organic farming may be printed on the product. This label exists in two variations:

- The label Austria Bio-Zeichen with indication of origin - may be used by approved organic farmers, processors and trading companies. It guarantees that products showing this label originate from organic farming and that at least 70 % of all ingredients originate from domestic organic farming;
- The label Austria Bio-Zeichen without indication of origin - does not refer to the regional origin. Products with this label have been produced according to organic standards but less than 70% of the ingredients originate from Austrian organic production.

Additionally there are various organic logos of organic associations such as Bio Austria and from supermarket chains and discounters.

In terms of supporting policy Austria have a national action plan to support organic farming. The Organic Farming Action Plan of the Ministry of Life is intended to improve marketing strategies and to undertake public relations work to further increase the market share of organic products. The most recent Organic Farming Action Programme (2008 – 2013) (*Bio-Aktionsprogramm 2008 – 2013*) includes the following goals:

- All products produced according to organic farming criteria are marketed as organic products;
- Capacities are created enabling the demand for organic foods to be satisfied predominantly from Austria;
- The market share is increased further, especially for organic products for which there is less demand (for instance meat and meat products);
- The production of organic products which are not yet available in sufficient quantities (such as fruit and vegetables) is stimulated;
- The public are better informed about the environmental services provided by organic farming and students of agricultural schools are provided with more comprehensive knowledge about organic farming (FiBL, 2014).

Austria has also a support under EU rural development programmes the Austrian Agri-environmental Programme (*Österreichisches Programm zur Forderung einer umweltgerechten, extensiven und den natürlichen Lebensraum schützenden Landwirtschaft* - OPUL). It aims to ensure that the environmental impacts of domestic agriculture are taken into account. The OPUL 2007-2013 operates through approximately 30 measures. From the perspective of the Austrian government the Organic Farming measure is seen as important to maintain Austria's position as the leading country for organic farming, in terms of total share of organically managed agricultural land (FiBL, 2014).

In 2011, more than 20 000 organic farmers received compensatory payments under the national measure Organic Farm Management amounting to EUR 99.6 million. Altogether, some EUR 168 million, or 30 % of the total OPUL funds, were paid to organic farmers.

The main institutions engaging in research on organic agriculture are FiBL Austria, the University of Natural Resources and Applied Life Sciences in Vienna, the Agricultural Research and Education Centre Raumberg-Gumpenstein and the Organic Research Austria (Bio Forschung Austria). Advice, training courses, and technical information for practitioners are provided by Bio Austria, the regional chambers of agriculture, and FiBL Austria (FiBL, 2014).

Austria plays a leading role in organic agriculture, and experts predict a rising trend for the organic market. Nevertheless, in order to achieve the goal of maintaining the proportion of organic farms and organic area, and to expand organic agriculture in the long term, all relevant players, including policy-makers, market players, researchers, producers, and consumers need to cooperate (FiBL, 2014).

4.2.3. Brazil – Irrigation Policy

In January 2013, Brazil implemented its new National Irrigation Policy, which provides, among other things, that public and private irrigation projects may receive tax incentives, with priority given to areas with low indicators of social and economic development. Farmers who practice irrigated agriculture may have access to rural credit lines for the purchase of irrigation equipment and rural insurance (Soares, 2013).

Brazil's irrigation policy is governed by the following principles:

- sustainable use and management of land and water resources for irrigation;
- integration with specific policies on water, environment, energy, environmental sanitation, rural credit and insurance and their respective plans, with priority given to projects whose works allow multiple uses of water resources;
- the linking of the actions concerning irrigation in different instances and levels of government and between them and the actions of the private sector;
- democratic and participatory management of public irrigation projects with irrigation infrastructure in common use, through mechanisms to be defined by regulation;
- prevention of waterborne rural endemics.

The objectives of the irrigation policy are to:

- encourage the expansion of irrigated areas and increase productivity in an environmentally sustainable basis;
- reduce climate risks inherent in agricultural activities, especially in areas subject to low or irregular rainfall distribution;
- promote local and regional development, with priority given to regions with low social and economic indicators;
- contribute to increase the competitiveness of the country's agribusiness and the creation of jobs and income;
- contribute to the supply of the domestic market of food, fiber and renewable energy, as well as for generating agricultural surpluses for export;
- train human resources and foster the creation and transfer of technologies related to irrigation;
- encourage private irrigation projects, as defined by regulation.

The instruments to be used for the implementation of the irrigation policy, include:

- plan and irrigation projects;
- the National Information System on Irrigation;
- tax incentives, rural credit and insurance;
- training of human resources;
- scientific and technological research;
- technical assistance and rural extension; special rates for electricity for irrigation;
- certification of irrigation projects;
- Investment Fund in Infrastructure (FIP-IE);
- National Irrigation Council.

In 2011, the National Irrigation Secretariat (SENIR) was created by the government for the main purpose of setting up a management system for irrigated agriculture, establishing the various agencies that interact with the industry, supporting the private sector, and optimizing public areas as development tools for disadvantaged regions. SENIR also aims to promote irrigation as an instrument for efficient agricultural production and eradication of poverty by creating jobs and income. It is subordinated to the Ministry of National Integration and is divided into two sections: the Department of Public Irrigation and the Department of Irrigation Policy. Among other things, SENIR is in charge, of:

- promoting the creation, implementation, monitoring, and evaluation of the National Irrigation Policy and its instruments, which are integrated with the National Policy for Regional Development and other related policies;
- promoting the implementation of irrigation projects and agricultural drainage;
- promoting and regulating initiatives for the implementation, operation, and maintenance of public works related to irrigation projects.

The Department of Public Irrigation is mainly responsible for: promoting instruments to support public irrigation perimeters; monitoring, supervising, and inspecting the implementation of actions aimed at the use of water resources and land; and developing tools for the economic and environmental sustainability of public irrigation projects. Whereas the Department of Irrigation Policy is responsible for: leading the process of formulating the National Irrigation Policy and its instruments; evaluating the performance of the National Irrigation Policy; coordinating the

formulation of regional plans and programs for the development of irrigated agriculture; establishing the guidelines for the preparation and management of state development plans of irrigated agriculture; promoting studies, research, and dissemination of technologies for the development of irrigated agriculture; and promoting the optimization of the productivity chain in irrigated agriculture with the use of financing, dissemination of management practices, and implementation of certifications, among other things (Soares, 2013).

The implementation of an irrigation project depends upon the issuance of an environmental license whenever such license is required by a specific federal, state, municipal, or district law. When declared by the federal government as essential for social and economic development, the infrastructure works of irrigation projects, including the obstruction of watercourses that cause intervention or removal of vegetation in an area of permanent preservation, may be considered of public utility for the purposes of environmental licensing. The use of water resources for irrigation projects depends on the prior approval of the right to use water resources by the appropriate federal, state, or district entity. The institutions participating in the national system of rural credit may only finance the implementation, expansion, and payment of irrigation projects that have been approved to use water resources (Soares, 2013).

4.2.4. United States – Organic Food Production Act and Funds

In the United States (US), Congress passed the Organic Foods Production Act in 1990, requiring the United States Department of Agriculture (USDA) to develop standards for the production and management of organic products, which were developed under the USDA National Organic Program (NOP).

In October 2002, the production and marketing of organic food came under regulation by the US Department of Agriculture's (USDA) National Organic Program (NOP). The National Organic Program (NOP) is a regulatory program housed within the USDA Agricultural Marketing Service. They are responsible for developing national standards for organically-produced agricultural products. These standards assure consumers that products with the USDA organic seal meet consistent, uniform standards (USDA, 2016).

Certification is conducted by USDA-accredited certifying agents and, in the United States, is compulsory only for operations handling more than US$5 000 per year in organic products. Imported products can be exported to the United States as organic only if their compliance to the NOP regulations has been certified by accredited certifiers, of which several are located in countries outside the United States (USDA, 2016).

The history of the development of agri-environmental payments in the United States has been somewhat different from EU, with the majority of payments prior to 2002 being devoted to land retirement schemes that paid farmers to take environmentally-sensitive land out of crop production for specific periods (USDA, 2009). The 2002 Farm Security and Rural Investment Act substantially increased funding for agri-environmental measures on cropped and grazing lands. Further significant reform took place as part of the Food, Conservation and Energy Act of 2008, which expanded support for:

- **Working-land programmes** providing technical and financial assistance to farmers who install or maintain conservation practices on land in production, including assistance for conversion to organic production and specific support for limited resource, beginning and socially-disadvantaged producers;
- **Land retirement programmes** - including conservation and wetland reserves, which generally remove land from agricultural production for a long period (at least ten years) or, in some cases, permanently;
- **Agricultural land preservation programmes -** enabling purchasing of the rights to certain land uses, such as development, in order to maintain land in agricultural use;
- **Conservation technical assistance (cta) -** providing ongoing technical assistance to agricultural producers who seek to improve the ecological performance of their farms. Like the EU, the USA has baseline environmental compliance requirements for its mainstream commodity support programmes, emphasizing the use of additional financial support, supplemented by research and education, to address environmental problems where the effects are diffuse.

In such circumstances, it is difficult to attribute responsibility to an individual producer and to address the problem via regulation. However, conservation compliance programmes, aimed at reducing soil erosion and the protection of wetlands, have been successful and are being maintained (USDA, 2009).

USDA Technical and Financial Assistance Programs for Organic Producers

USDA has Technical and Financial Assistance Programs for Organic Producers:

- USDA Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP) Organic Initiative (NRCS' EQIP Organic Initiative) provides technical and financial assistance to producers who plan and implement conservation practices that support environmental sustainability. Certified or transitioning organic producers are eligible to receive up to $20,000 per fiscal year to use toward activities such as developing a conservation plan, improving soil quality, minimizing erosion, developing supportive livestock practices, improving irrigation efficiency, and enhancing cropping rotations (USDA in Sustainable Ag News, 2016).
- USDA NRCS Agricultural Management Assistance (AMA) Program (USDA NRCS' AMA program) provides technical and financial assistance to help producers incorporate conservation practices into their farming operations through activities such as water management, water quality improvement, and erosion control. The AMA program is available to organic, transitioning, and conventional producers in 16 states (USDA in Sustainable Ag News, 2016).
- In addition to the two programs listed above, General USDA NRCS Technical Assistance - provides free, general technical assistance to all agricultural producers, including certified organic and transitioning farmers. This includes direct technical assistance from NRCS conservationists, monthly webinars, and informational materials on organic practices. Organic and transitioning farmers are also eligible for all NRCS financial assistance programs (USDA in Sustainable Ag News, 2016).

- USDA National Agricultural Library (NAL) Alternative Farming Systems Information Center (AFSIC)— NAL's AFSIC houses resources on sustainable and alternative agricultural systems, crops, and livestock including information on organic agriculture. Librarians are available to help producers locate materials on all aspects of organic farming, including in the "Organic Roots" digital collection, an archive of historical USDA documents published before the common use of synthetic fertilizers and chemicals (USDA in Sustainable Ag News, 2016).
- USDA Economic Research Service (ERS), USDA's principal social science research agency, tracks and reports on economic trends in agriculture, food, the environment, and rural development. As part of this service, ERS publishes specific information on the organic market including organic price premiums, consumer demand for organic food, the adoption of organic farming systems, and other economic characteristics of organic agriculture (USDA in Sustainable Ag News, 2016).

Furthermore, USDA has several programs that offer purely financial assistance to organic producers. A list of these programs is presented in Table 9.

Table 9 - USDA Financial Assistance Program for Organic Producer (adapted from USDA in Sustainable Ag News, 2016)

USDA Financial Assistance Program for Organic Producer	
USDA Organic Certification Cost Share Programs	Reimburse eligible operations for up to 75 % of organic certification costs each fiscal year (administered by the NOP, AMA, and State departments of agriculture)
USDA NRCS Conservation Stewardship Program	Offers producers financial assistance of up to $200,000 per fiscal year to address resource concerns in a comprehensive manner by undertaking or continuing conservation activities including many critical components of organic production, such as crop rotation and integrated pest management
USDA FSA Transition Incentives Program	Provides incentives for retired or retiring owners and operators to transition land enrolled in FSA's Conservation Reserve Program to a beginning farmer or rancher or a socially disadvantaged farmer or rancher for production using sustainable methods

4.2.5. Norway – Pesticide Tax

Norway has a long history of environmental taxes and in the late 1980's and early 1990's a widespread use of environmental taxes could be seen. In 1988, taxes on pesticides, mineral fertilisers and lubricant oils were introduced (Ministry of Finance, 2007). In 1999, a new banded pesticide tax system was created, replacing the tax based on import value. The new system differentiates the pesticides based on their impact on the environment and human health and thus aims to reduce the usage of pesticide, especially the harmful ones. This innovative system together with an area-based approach is considered to be effective in encouraging a more conservative use of pesticides and reducing the use of harmful products (Withana, 2014).

The Norwegian pesticide tax was introduced first in 1988, based on a percentage of the import value of the pesticides, since then the tax has suffered some modifications (Withana, 2014). In the current system the pesticide tax consists of three components: a registration fee, a levy to fund the efficacy

and residue trials, inspections and the registration processes and the banded tax system (Spikkerud, 2006) which is further detailed below. In 2004, the levy was set at NOK 16 per hectare for all pesticides sold (Rorstad, 2005).

As a follow-up of the Norwegian Action Plan for Pesticide Risk Reduction (1998-2002) a new taxation system was developed and was implemented in 1999. The new system is area based and consists of seven tax bands based on the environmental and health related risks linked to the pesticides. The human health criteria is based on the intrinsic properties of the pesticide and the exposure during mixing, while the environmental criteria takes into account amongst others the toxicity of the pesticide in aquatic and terrestrial ecosystems and the leaching potential. In addition, tax bands are differentiated between pesticides used by the industry and domestic users, i.e. home gardens. Until 2004 there was also a separate category for microbiological and seed treatment products. The tax per kg or litre is calculated as follows: (base rate*factor)*1000/ standard area dose). The base rate is the same for all products and was initially fixed at NOK 20 (around EUR 2.4) per hectare and was increased to NOK 25 (around EUR 3.4) from January 2005. The factors correspond to the seven tax bands as shown in Table 10. The standard area dose is determined by the maximum application rate (in grams or millilitres per hectare) for the main crops for which the pesticide is used (Withana, 2014).

Table 10 - The different tax bands of the Norwegian pesticide tax since 2004

Tax band	Factor	Produce type
1	0.5	Products with low human health risk and low environmental risk
2	3	Products with low human health risk and medium environmental risk, or products with medium human health risk and low environmental risk
3	5	Products with low human health risk and high environmental risk, or products with medium human health risk and medium environmental risk, or products with high human health risk and low environmental risk
4	7	Products with medium human health risk and high environmental risk, or products with high human health risk and medium environmental risk
5	9	Products with high human health risk and high environmental risk
6	50	Concentrated home garden products
7	150	Ready-to-use home garden products

Source: OECD, 2010

Since the implementation of the tax in 1988 the main trend was a decrease in the sales of pesticides even if there had been significant variations throughout the years. Estimate the impact of the pesticide tax on the environment is very hard as many variables can influence the amount of pesticide sales but overall the banded tax system is considered to be effective as it not only encourages the more conservative use of pesticides but also provides an incentive to use less harmful products (OECD, 2010). The banded tax system is an important tool to incentivise farmers to use less pesticides and alternative methods.

When the tax was initially introduced in 1988, it was assumed that the tax was made not to influence the usage of pesticides but to raise revenues to finance a number of environmental initiatives (Andersen et al, 2000). However, the change to the tax in 1999 via the introduction of the banded tax system reflected a stronger objective to reduce the application of pesticide products, especially the most harmful ones which pose the highest risk to the environment and human health

(PAN Europe, 2005). In addition, the application of an area-based approach helped to link the pesticide tax more directly to pesticide use (Spikkerud, 2006). The Norwegian Action Plan for Pesticide Risk Reduction (1998-2002) indicated as its main targets to reduce the various risks related to pesticide use by 25 % and to promote the usage of biological pest management measures instead of chemical pest management (Andersen et al, 2000 and Rorstad, 2005).

Finally, about 40 % of farmers replied to a farmer survey conducted in 2002 as part of the evaluation taken place in 2003 indicated that the banded tax system incentivised them to use pesticides in the lower tax bands (PAN Europe, 2005). Nevertheless, the 2013 evaluation concluded that pesticide users are more concerned with efficacy of the pesticide products than their price but when alternative products are available in the different tax classes they also take price into consideration (Expert input, May 2014).

Spikkerude (2006) showed that the new tax system introduced in 1999 generally made harmful pesticides more expensive per hectare than other pesticides with lower risks to the environment and human health. Nevertheless, there are examples where the costs of the pesticides under different tax bands are similar. In addition, according to a farmer survey in 2002, more than 70 per cent of farmers said that the new pesticide tax scheme has resulted in higher costs (Spikkerude, 2006). Nevertheless, when the new banded tax system was introduced, one of the main preconditions was that the total tax burden should be the same as with the old system. This means that the new system should not have a negative impact on farmers' competitiveness and lead to higher costs in general, however this could be the case for some products (Expert input, May 2014). Pesticide companies in their responses indicated that they do not want a tax at all and that there are too few pesticides in Norway to effectively implement a banded tax system (Spikkerude, 2006). It is also interesting to note that it was estimated that the administrative cost of running the new banded tax system is very low counting for about 1 % of the tax revenue (Valborg Kakkerstad and Rorstad, 2002). Nevertheless, Norway does not have as many pesticide products as some other European countries and this might be the reason that the administrative costs of the banded tax system are not significant (OECD, 2010).

As part of the evaluation procedure the development in health and environmental risks were also assessed based on trade of pesticides and not on use. The average health and environmental risks for 2001-2002 have been reduced by approximately 35 per cent compared to the baseline years of 1996-1997 (Rorsatd, 2005). Nevertheless, the trend is not that clear when data from 2003 is included and it is also important to note that other policy measures also took place during the same time period thus the positive effects cannot be attributed solely to the new tax system.

In 1997-98 the annual income from the pesticide tax was around NOK 20 million (Rorstad, 2005). In recent years this has increased to about NOK 60 million (around EUR 7.2 million) a year (PAN Europe, 2005). Even though the revenues collected were not earmarked for environmental actions, the proportion of reimbursement between 1989 and 1994 was still around 90 per cent (Andersen et al, 2000).

4.2.6. The Netherlands - Taxes on Nutrient Surplus

Agricultural nutrients can be a significant source of surface and groundwater pollution. In 1998, The Netherlands implemented a system of nitrate surplus taxes for the agricultural sector to deal with the problem. The aim of the policy is then to control agricultural nutrient pollution problem in The Netherlands.

The system is called Mineral Accounting System (MINAS) and it is the Dutch approach to the Nitrates Directive. The system focusses on nutrient on individual farms, and taxes farms whose nutrient surplus exceeds a defined limit per hectare. The goal of the system is to reduce the mineral surpluses and to increase mineral efficiency. In order to do that, farmers keep records concerning the Nitrogen (N) and Phosphorus (P_2O_5) inputs in purchased feed, chemical fertiliser, and manure, and outputs in animal and plant products. In this way, a balance at farm level is set up. The Nitrogen and Phosphorus surplus per hectare are calculated as input per hectare minus output per hectare. Not all inputs are included in the system: N-fixing of leguminous crops and deposition (from the atmosphere) are not incorporated. Certain levels of phosphate and nitrogen surplus are allowed (the levy-free surplus), and these are lowered over time. For the surplus above this level the farmer has to pay a levy (ECOTEC, 2001). Standards related to levy-free surpluses were progressively lowered between 1998 and 2003 as showed in Table 11. For example, the P standard for arable crops was lowered from 40 kg/ha to 20 kg/ha, while the N standard was lowered from 175 to 100 kg/ha on clay soils (ECOTEC, 2001; Wright & Mallia, 2008).

Table 11 – Tax rates under MINAS System in the Netherlands in NLG/Kg (EUR/Kg)

	Levy-free N-surplus (Kg/ha)		Levy-free P_2O_5-surplus (Kg/ha)	Tax Rate Applied NLG/kg	
Year	Grass land	Arable land		Nitrogen	Phosphorus
1998	300	175	40	1.50 (0.7)	2.50 (1.1)
2000	250	125	35	1.50 (0.7)	5.00 (2.3)
2002	220	110	30	1.50 (0.7)	5.00 (2.2)
2003	180	100	20	5.00 (2.3)	20 (9.1)
2003 – sandy soils	140	60	20	5.00 (2.3)	20 (9.1)

Source: ECOTEC, 2001

According *to* ECOTEC (2001), the Dutch government expected to generate revenues from the levy of Dfl. 16 million (EUR 7.3 million). It is not (yet) clear what the real revenues of the levy were in the first years of Minas. The revenues are not earmarked. The revenues contribute to the total budget of the Ministry of Finance. However, the decisions on the available budgets that are available for other manure policies, are partly influenced by the magnitude of the revenues derived from Minas.

The Levies Bureau manages MINAS. This Bureau is responsible for implementation and the administration of the scheme. The administrative burden consists of the administrative costs of the Levies Bureau and the control costs of the General Inspection Service (AID).

Different modelling studies focus on the environmental effect of levies were done and all the studies show decreasing pollution after the implementation of MINAS. Most probably Minas has resulted in

more awareness of farmers regarding the effects of their management on pollution. MINAS is expected not to have any perverse incentives, because the tax is put on the pollution itself. This makes it hard to avoid the tax by use of substitutes, as can be the case with tax on products (fertiliser for instance) (ECOTEC, 2001).

Ondersteijn *et al*. (2002) investigated the implications of MINAS for individual farm performance by using detailed financial and nutrient bookkeeping data of 194 farms, distributed over five farm types and covering the years from 1997 through 1999. Their study shows, among other issues, that farm-specific nutrient surplus taxes can vary a lot, ranging from € 179/ha for arable farmers to € 404/ha for mixed dairy and intensive livestock producers. On average, these taxes would reduce gross margin by 8% and can threaten continuity on an individual farm level.

Despite the perceived advantages of a nutrient surplus tax over a uniform manure application standard or uniform fertilizer tax rate, the MINAS system failed and was replaced in 2006 (Lankoski & Ollikainen, 2013). Wright & Mallia (2008) examined reasons for this failure. First, the Dutch government thought that with the implementation of MINAS it was possible to avoid strict, and possibly costly, manure application standards mandated by the Nitrates Directive. However, the EU Commission was unsatisfied with the system and considered it insufficient to protect groundwater from nutrient pollution and took legal action against the Dutch government. Indeed, in 2003, the European Court of Justice ruled that the Dutch government had failed to fulfill obligations of the Nitrates Directive. Second, the MINAS was considered unfair towards intensive pig and poultry farms with very little arable land for the application of manure produced on the farms. These farmers had to bear the cost of transporting manure off the farms to crop farms. Moreover, the surplus levies were considered extremely high representing 5 to 10 times the price of nitrogen fertilizer and 50 times the price of phosphorus fertiliser.

In conclusion, taxing nitrates surplus (that is the proportion of nitrate applied which causes the pollution of surface and groundwaters) instead of a tax on the fertilisers is the best solution since nitrate is a diffuse pollution. In addition, a tax on mineral surplus is based on the “Polluter Pays Principle” which stimulates the efficient use of minerals (ECOTEC, 2001).

4.2.7. Indonesia – Payment for Ecosystem Services (PES) and multi-strata coffee Gardens in Sumberjaya

Sumberjaya is a sub-district (542 km^2), in the district of West Lampung, Indonesia, which has historically been the dramatic scene of massive deforestation escalating in social conflicts and poor households (FAO, 2011).

Since the 1970s, Sumberjaya recorded a rapid expansion in smallholder coffee cultivation. Although the government was aware of the consequent high uncontrolled deforestation rate, it was only in 1990, when a hydropower plant was planned in the upper watershed of the Way Besai River, that it took action, concerned about slope erosion and potentially high sediment discharge to the hydropower plant (USAID, 2007). Thus, 40 % of the land in Sumberjaya was declared as areas of restricted use and forest protection and, between 1991 and 1996, thousands of farmers were evicted from their lands. In 1998, a reconciliatory negotiation promoted by the World Agroforestry

Centre (ICRAF), the local NGO Watala, the Ford Foundation and the UK Government's Department for International Development (DFID) was initiated to resolve the huge social conflict and promote sound land-use management (FAO, 2011).

In 2000, as the farmer eviction was ultimately seen as ineffective, a legal decree established a community forestry programme, called *Hutan Kamasyarakatan* (HKm). The programme, equivalent to a public-led PES scheme, allowed groups of farmers jointly applying as a community to obtain legal permission to use the state-owned land. The permission was issued for a trial period of five years with the possibility of extension for a further 25 years. In return, the farmer community commits to protect native forest trees and convert coffee monocultures into multi-strata coffee gardens (FAO, 2011).

When a contract is signed an inventory of the existing trees on the contracted land is made and the composition of the agroforestry plots to be maintained is set. In addition, the community agrees to protect the natural forest from logging and forest, to adopt soil conservation practices and to plant additional trees — seedlings can be obtained from the local forestry office. Performance is evaluated on the overall land, thus, the whole subscribing community is responsible for compliance of PES requirements (FAO, 2011).

Establishment of a PES scheme - RUPES

The IFAD-funded RUPES (Rewarding Upland Poor for Environmental Services) initiative has been acting as a facilitating intermediary began in 2004 and this has helped to scale up the success of the *Hutan Kamasyarakatan* initiative. To date nearly 6 500 farmers have received conditional land tenure; this has doubled the local land value, reduced corruption, decreased bribing and consequently increased household income by about 30 %. Above all, land tenure has motivated farmers to protect the remnants of native forests. RUPES has also being involved in facilitating a privately-funded PES scheme by launching a pilot study, RiverCare, between the hydroelectric power plant set on the Way Besay River and a community of 70 households, living on 160 ha in the Way Lirikan subcatchment, which is the contributing to major sediment discharge in the Way Besay River. The Way Besay hydroelectric plant presently provides 60% of the electricity to the province of Lampung. The sediment load can be as high as 3 kg/m 3/s and this creates a reduction in turbine efficiency, damages the plant fitter and increases cleaning costs. Under the RiverCare initiative the community received a full payment of USD 1 000 in the first year to cover the implementation costs of digging sediment/litter pits, dead-end trenches, drainage ditches to reduce soil erosion in their coffee plantation, check dams in some rough sections of the river of slow its flow and sediment traps on public foot path and in gullies. In the subsequent years, the community has received payments according to the percentage of sediment reduction obtained (Table 12).

Table 12 – Conditional payment scheme based on the reduction percentage of the river sedimentation load

Percentage of sediment reduction	Annual payment received by the community (USD)
≥ 30	1000
20-29	700
10-19	500
≤ 10	250

Source: FAO, 2011

RUPES carried out an auction process in the villages of Mulya Indah and Wanasari to estimate the costs that farmers will face planting trees (a minimum of 400 trees/ha, which includes 70% fruit trees and 30 % timber trees) to reduce soil erosion. Particular attention was given to ensure that farmers understood the auction mechanism. Thus, the auction was held in two sessions, one in each village. Participants bid seven consecutive times to allow them to become familiar with the auction process. The bids submitted in the last round were considered as the real auction output. During previous rounds participants developed familiarity with the process and adjusted their estimated opportunity costs on the basis of the previous bidding outcomes. Although there was an expected certain variability in the estimate of the opportunity costs given by participants, there were 19 auction winners in Mulya Indah and 15 winners in Wasanari. In both cases, the contract price per hectare of land under the PES scheme was set close to the average opportunity value estimated by the auction (Table 13).

Table 13 – Results of the auction promoted by RUPES/IFAD to estimate opportunity costs of farmer planting trees to reduce soil erosion

		Mulya Indah	Wanasari
Number of participants		48	34
Number of auction winners		19	15
Contract price per hectare of land (USD)		178	167
Opportunity costs estimated by the participants (USD)	Minimum	100	67
	Average	311	269
	Maximum	2778	778

Source: FAO, 2011

Recently, the RUPES RiverCare pilot project has been extended to 25 households in Buluh Kapur village. In this case, the first year payment was conditional on a 30 % sediment reduction. Although the community did not meet this threshold, only being able to reach a 20% reduction, the Way Besay hydroelectric power plant delivered the first year's payment as a token of goodwill and effort made by the villagers (van Noordwijk and Beria, 2010). PES implementation in the Sumberjaya region gives an example on the critical role of the intermediary in facilitating and upscaling publically- and privately-funded PES initiatives. The key task was to re-establish people's basic levels of trust in the government's policy and programmes, which had been disrupted by a history of conflicts on land use and allocation. The intermediary was subsequently able to establish dialogue and mediate between the interests of a major hydroelectric power company in Sumatra and very poor local farmer communities (FAO, 2011).

4.2.8. Conservation Agreements: Solano County (in US) and Ontario (in Canada)

There have been some examples of implementation of Conservation Agreements in some areas as a measure to preserve biodiversity in farmlands.

BOX 11: WHAT IS A CONSERVATION AGREEMENT?

Conservation Agreement (or conservation easements) is a voluntary legal agreement between the landowner and a conservation agency. The landowner sells only the development rights of the property to the agency. The land continues to be used for agricultural purposes and is still owned by the farmer or rancher (Solano Land Trust, 2016).

Ontario – Canada

In Ontario, Canada, there is also the promotion of conservation agreements. It provides a way in which landowners may retain agricultural heritage and biodiversity on the future use of their land, while benefiting from specific tax credits.

Agriculture conservation agreements do not interfere with normal farming practices. The conservation body and landowner develop a working relationship to ensure agreements do not place undue restrictions on agricultural activities (Queen's Printer for Ontario, 2016).

Solano County - US

As in many areas of the United States, the conservation of farmlands in Solano County is a complicated topic. Preservation of open space and agriculture must be balanced against housing and industry development pressures. Farmers face increases in labor and water prices and competition from large scale and international farming. The prime conditions for growing in Solano County, however, render the land irreplaceable. Conservation agreements assist the agricultural sector of the economy to maintain vigor and grow in production. And, the existence of large farms and tracts of open space contribute directly to quality of life. In 2007, a local newspaper survey placed “rural atmosphere,” “small town feeling,” and “open space” among the top 10 best things about Solano County. In 2002, Solano Land Trust (conservation agency in Solano) completed an evaluation of the state of agriculture in Solano County and developed a plan for protecting this valuable resource by using conservation agreements. Funded by the Packard Foundation, the Agricultural Conservation Easement Plan proposes to protect lands with highly productive soils and adequate agricultural water. The plan identifies several subareas of the county— Dixon Ridge, Winters, and Vaca, Lagoon, Suisun and Green Valleys—as having high agricultural preservation priority. Solano Land Trust’s goal is to protect between 20,000 and 40,000 acres of agricultural lands with conservation agreements over the next 20 years (Solano Land Trust, 2016).

In Table 14 below is presented the benefits to landowners and to the public of a conservation agreement.

Table 14 – Benefits of a conservation agreement (adapted from Solano Land Trust, 2016)

Benefits Of A Conservation Agreement	
To Landowners	**To the Public**
Retain private property rights to land after selling or donating easement—keep the family farm	Safeguards the heritage and character of the area (e.g. Solano County)
Realize equity in land	Contributes to the quality of life
Can reduce property taxes and provide significant other tax benefits, such as favourable estate tax treatment	Protects topgrade Class I & II soils for food production
	Preserves agriculture as an economic mainstay
	Provides fresh, local and seasonal fruits and vegetables
	Supports local farmers and ranchers

4.2.9. Corporations voluntary strategies: the cases of Mondelez and Vittel

Mondelez and Vittel are some examples of big companies that understood the impacts and importance of sustainable agriculture to the success of their businesses.

Mondelez

Mondelez International is a global snacking powerhouse, with 2013 revenue of $35 billion, present in 165 countries. Mondelez is a world leader in biscuits, chocolate, gum, candy, coffee, and powdered beverages, with billion dollar brands such as Oreo, LU and Nabisco biscuits; Cadbury, Cadbury Dairy Milk and Milka chocolate; Trident gum; Jacobs coffee and Tang powdered beverages.

Mondelez depends on a steady, high-quality supply of agricultural crops like cocoa, wheat and many other commodities to create their snacks. As business grows, so do the challenges facing the farmers who grow their agricultural supplies (Mondelez International, n.d - a).

For many years, Mondelez have listened and worked with smallholder farmers to promote sustainable supply chains. With their partners Mondelez help increase the farmers' output, improve their livelihoods, build thriving communities and protect the environment. They are focus in those areas where they can have the greatest impact: sustainable agriculture and reducing the environmental footprint of their own operations. In order to reduce their environmental footprint by 2015, Mondelez set the following goals:

- Cut energy and water use in manufacturing by 15%;
- Reduce greenhouse gas emissions and waste from manufacturing by 15%;
- Make 60% of production in Zero Waste to Landfill sites;
- Eliminate 50 million pounds (22,500 tons) of packaging material.

Transforming their agricultural supply chains is an essential foundation for a sustainable future. They have launched innovative, industry-leading holistic programs in key commodities like cocoa (Cocoa

Life Program) and wheat (Harmony Program) (programs are presented in Table 15), giving a voice to farmers and empowering them to create thriving farms and communities. Beyond this, as the foundation for all their work in sustainable agriculture, they are embedding sustainability into their sourcing practices across their commodities (Mondelez International, n.d - b).

Table 15 - Mondelez signature programs in key commodities (adapted from Mondelez International, n.d – a; Mondelez International, n.d – b; Kraus, 2016).

Program	Main Scope
Cocoa Life	Cocoa Life is a holistic, verified program working to transform the lives and livelihoods of cocoa farmers, create thriving communities and inspire the next generation. Cocoa Life's $400 million, 10-year commitment aims to empower more than 200,000 farmers and more than 1 million people in cocoa farming communities in Cote d'Ivoire, Ghana, Indonesia, Brazil, the Dominican Republic and India. Mondelez also join with partners in a range of initiatives to support sustainable cocoa production.
Harmony	Mondelez European wheat program, which promotes biodiversity and good environmental practices in wheat production. Farmers commit to following a charter of best agricultural practices. It is a set of 49 agricultural practices that address issues such as wheat variety selection, soil rotation, farmers' safety, traceability, biodiversity and pesticides. Farmers become part of Harmony by signing up to the Charter, which is renewed and improved every year. Harmony is about: ▪ Partnering with farmers as close as possible to their factories; ▪ More sustainable agricultural practices; ▪ Making a positive impact on local biodiversity; ▪ Traceable wheat from grain to biscuit. The 3 key pillars of Harmony are: 1. Quality: - Rigorous and demanding proprietary charter; - Full traceability from grain to biscuit; - Selection of best wheat varieties; - Segregation of wheat; - External audit. 2. Environment: - Biodiversity preserved and enhanced; - Respectful agricultural practices (Resistant wheat varieties; Soil management; Less pesticide and fertilizer; Caring for water resources); - Farmers and millers close to factories to reduce carbon footprint. 3. Society: - Local communities; - Build know how with partners; - Farmers to learn and improve their practices with Harmony; - Safety and security. Today, about 75% of Mondelez West European biscuits are made with Harmony wheat and about 2100 farmers have partnered with Harmony across Europe. An assessment was done and Harmony proved its success in driving positive sales and image. Mondelez is leader on trust and quality, sustainability, biodiversity and partnership with farmers and local sourcing.

Furthermore, new sustainability goals were set for 2020, divided by four main areas (Kraus, 2016):

- Secure key raw material:
  - Lead creation of sustainable supply chains in critical raw materials with signature programs focused on impact at scale: Ultimately all cocoa to be sustainably sourced, mainly via Cocoa Life; Maintain 75% West EU biscuits made with Harmony wheat.
  - Continue AIM-Progress social and environmental compliance program: Close-to-100% audit compliance for Mondelez facilities and priority suppliers.
- Reduce end-to-end carbon footprint:
  - Reduce absolute manufacturing CO2 emissions in line with Science Based Target approach: -15% absolute manufacturing CO2 emissions.
  - Address deforestation and communicate resulting end-to-end carbon footprint impact: Implement Mondelez Palm Oil Action Plan; Drive down deforestation in cocoa via Cocoa Life program; Close-to-zero deforestation on soy, paper.
  - Support deforestation goals by using recycled paper or paper from verified non-deforested sources as the first choices for paper based packaging.
- Reduce end-to-end water footprint, focusing on priority locations:
  - Reduce absolute manufacturing incoming water focusing on priority water sites: -10% water use in priority water locations.
- Reduce end-to-end waste, including packaging:
  - Reduce total manufacturing waste by 20%.
  - Eliminate 65,000 tonnes of packaging.

Vittel

Vittel is a French brand of bottled water sold in many countries. In the early 80s, the owners of the Vittel brand, realised that the intensification of agriculture in the Vittel catchment posed a risk to the nitrate and pesticides level in Grande Source and consequently to the Vittel brand. The artesian spring for Vittel's Grande Source is located in the thermal park and all farms in the catchment are located upstream from the spring (Perrot-Maître, 2006).

In the Vittel catchment, as in many places in France and in Europe, the traditional hay-based cattle ranching system had been replaced by a maize-based system. Free range was limited while stocking rates increased. The increased nitrate rate was caused primarily by the heavy leaching of fertilizers from the maize fields in the winter when fields are barren, overstocking, and poor management of animal waste (Perrot-Maître, 2006).

In 1989 Vittel, in partnership with the French National Agronomic Institute (*Institut National de la Recherche Agronomique* – INRA), launched a four-year multidisciplinary action research programme called *Agriculture-Environnement-Vittel* (AGREV). The objective was threefold:

- Understand the relationship between actual farming practices and the nitrate rate in the aquifer;
- Identify and test the practices necessary to reduce and maintain the rate of nitrates at the desired level rate;
- Identify incentives necessary for farmers to change their practices.

Extensive hydro-geological modelling was conducted in the perimeter and showed that ensuring a nitrate rate of 4.5mg/l in Grande Source required maintaining nitrate levels at the root zone (up to 1.5 meters below the surface) at 10mg/l. The sub-catchment was modelled at sub-catchment, farm, and plot level to test the technical and economic feasibility of the proposed alternatives. A four step methodology was developed (Perrot-Maître, 2006):

- Understand the farming systems and why farmers do what they do.
- Analyse the conditions under which farmers would consider changing farming behaviour.
- Identify, test, and validate in farmers' fields the management practices necessary to reduce the nitrate threat.
- Provide financial and technical support to farmers willing to enter the programme.

Unlike conventional approaches in agriculture, which focus on the agronomic aspects of practices, the methodology focused initially on understanding the history, the geography, and the sociology of the area and its people. Scientific and economic research was only introduced later after a dialogue had been successfully established between Vittel and the farmers, compatibility between farmers' and Vittel's objectives had been demonstrated, and the idea of a mutually beneficial partnership accepted. The farm typology developed showed there was no such a thing as a "typical farmer" in the area. Instead there were four groups of farmers, each with a different set of livelihood strategies, objectives and constraints, as well as a varied willingness and capacity to adapt to change (Perrot-Maître, 2006).

4.3. Energy Policies

Energy Policy is an important issue when addressing sustainable agriculture. Biofuels production targets compete for land and water with agricultural food production. On the other hand, agriculture is an important contributor to global GHG emissions. For example, in US a congressional mandates now require the production of billions of gallons of ethanol, which is primarily derived from corn. Corn grown for ethanol takes land away from food production and, in states where corn is irrigated, uses a significant amount of water (Grace Communication Foundation, 2016).

The consequences of a lack of coordination between agriculture and energy policies could have significant impacts. For example, in July 2012 three of India's regional electric grids failed, letting more than 620 million people powerless. The cause was the strain of food production from a lack of water. Because of major drought, farmers plugged in more and more electric pumps to draw water from deeper and deeper belowground for irrigation. Those pumps, working furiously under the hot sun, increased the demand on power plants. At the same time, low water levels meant hydroelectric dams were generating less electricity than normal (Webber, 2015).

Today, industrial agriculture consumes fossil fuels for several purposes. Table 16 gives an overview of the main agricultural energy inputs.

FATIMA WP4.1 (WP9 in SyGMa notation) has been designed to assess more in detail the Water-Energy-Food (WEF) Nexus. Its deliverables provide a framework for this assessment and a baseline WEF analysis of all pilot areas.

Table 16 – Agricultural Energy Inputs (adapted from Grace Communication Foundation, 2016)

Agricultural Energy Inputs	
Fertilizer Production	Industrial farms use huge quantities of synthetic fertilizers, which are produced from fossil fuel and which also require significant energy inputs to be produced. Other fertilizing agents (e.g., potassium and phosphorus) are mined, consuming even more energy
Pesticides Production	Pesticides are produced from fossil resources (fuel and gas)
Water Consumption	Industrial agriculture is incredibly water intensive. The scarce resource is used for crop irrigation, waste management (i.e., for flushing manure out of industrial livestock facilities) and as drinking water for animals. This overuse of water has implications in the energy sector as well. Pumping, treating and moving such large volumes of water require a great deal of energy
Farm Equipment	Modern agriculture relies upon machinery that runs on gasoline and diesel fuel (e.g., tractors and combines), and equipment that uses electricity (e.g., lights, pumps, fans, etc.)
Processing, Packaging & Transportation	Much of the food produced today is highly processed and heavily packaged, which further increases its energy footprint. As a result of consolidation and centralization of production, foods are often transported long distances, requiring additional energy inputs

BOX 12: ENERGY AND AGRICULTURE IN US - RURAL ENERGY FOR AMERICA PROGRAM

According to Levine (2012), agriculture is one of the most important sectors in the U.S. economy. Since energy inputs are found in every stage of production, it represents significant energy consumption. This has left farmers vulnerable to high energy costs and volatile energy market fluctuations that impact fertilizer costs as well. The implementation of effectively, energy efficiency measures can help agricultural producers save energy without harming productivity. Moreover, effective policies, including educational training and incentives for energy efficiency improvements, can help farmers to enhance their operations.

The US created some programmes to address the problem, one of them was the Rural Energy for America Program (REAP). The popularity of REAP and the increasing number of state and private energy efficiency programs demonstrate the growing interest in energy improvements on farms. REAP has become a widely known program and has made farmers more aware of the benefits of energy efficiency. Agricultural producers had long been left out of the energy efficiency equation in some areas, even as they are increasingly subject to high and volatile energy costs. Fortunately, this is changing because of programs like REAP. REAP's success in promoting efficiency is a result of many factors, including good marketing and familiarity of Natural Resources Conservation Service and the state agriculture departments that administer it. Over the years, REAP has also gone through a number of modifications to overcome barriers applicants originally faced. It has stimulated installation of efficient equipment on farms. A growing number of farmers recognize the benefits of upgrading equipment. The exclusion of agricultural tillage equipment and vehicles represents a significant gap in REAP, but such equipment may be better addressed in other programs. While buying more efficient vehicles and machinery that can reduce oil consumption, the biggest changes can be made through reducing overall tillage and reducing fertilizer applications. These behavioural changes are difficult to implement under a grant and loan program, such as REAP, that mostly provides funds to cover equipment expenses. They may be better addressed as part of land conservation and sustainable farming programs, such as the Environmental Quality Incentives Program On-Farm Energy Initiative and its management plans. However, the energy components of these programs are underutilized (Levine, 2012).

Encouraging producers to become more efficient is good for farmers' bottom lines and is a step in the right direction. Federal and state programs are already helping move the market towards a more efficient use of energy, and many farmers are reaping the benefits (Levine, 2012).

4.4. Climate Change Adaptation

The impacts of climate change on agriculture have reason for concern. Climate change is a global phenomenon that is expected to modify agricultural productivity worldwide, decreasing global food production and increasing food prices and food insecurity. Climate change would modify agricultural productivity through five main factors changes in precipitation, temperature, carbon dioxide (CO2) fertilization, climate variability, and surface water runoff (Calzadilla *et al*., 2014).

Crop production is directly influenced by changes in precipitation and temperature. Precipitation is the main source of all freshwater resources and determines the level of soil moisture, which is a critical input for crop growth. Temperature and soil moisture determine the length of the growing season and control the crop development and water requirements (Calzadilla *et al*., 2014).

The climate changes impacts are different depending on the region (Calzadilla *et al*., 2014). Therefore, any adaptive response must have into considerations different criterions depending on the region characteristics.

BOX 13: ADAPTIVE RESPONSES TO CLIMATE CHANGE IN CHINA

In recent years, China's government has put climate change adaptation into the nation's top policy agenda. China has begun to formulate a set of plans to deal with adaptation issues by aiming at improving public access to information, stronger enforcement of laws, and higher accountability for emitters. In 2008, the Chinese government released "China National Plan for Coping with Climate Change" (NDRC 2007) and in 2011 "China's Policies and Actions for Addressing Climate Change" was also issued (SCIO 2011) (Wang *et al*., 2014).

According to Wang *et al*. (2014) in order to improve adaptation capacities in the agricultural sector, it is not only necessary for government to undertake actions such as improving irrigation infrastructure and adoption of improved technology or farm management, but also necessary for farmers to make appropriate responses (e.g., changing sowing date, cultivars or cropping patterns). In China, these two approaches were taken: adaptive responses from government and adaptive responses from farmers. Below are presented some of the measure undertaken in China.

Adaptive responses from government:

- **Improve agricultural infrastructure:** China's government considered accelerating the construction of supporting facilities in large-scale as water-saving irrigation projects. There are also efforts to build new smaller-scale irrigation and drainage projects in areas

currently not irrigated. Last but not least, there are also plans to accelerate the construction of water storage projects and projects that enhance water utilization, especially in mountainous and desert areas (Wang *et al*., 2014).

- **Strengthen research and development for new technologies:** One of the main roles of China's government has been investment in the research and development of agricultural technology, especially in systems that are dominated by smallholders and lack investment by large private agricultural seed and/or research companies. Specifically, the government should both continue and expand breeding programs to encourage research on seed varieties with traits that promote resistance to drought, water-logging, high temperature, diseases and pests. In addition to these programs, the government has pushed for research to better understand the magnitude, source and mechanisms of climate change and its consequences (Wang *et al*., 2014).

Adaptive responses from farmers:

- **Crop choice:** Across China, farmers in warmer places are more likely to produce cotton, wheat, oil crops and maize and less likely to grow rice, soybeans, vegetables, potatoes and sugar. These indicate that they are already beginning to make planting shifts according to local climatic conditions. In wetter locations, farmers are more likely to plant rice soybeans, oil crops, sugar, vegetables, and cotton and less likely to grow maize, potatoes, and wheat. Field studies in single provinces also find similar behaviour among farmers (Wang *et al*., 2014).
- **Irrigation:** Irrigation choice varies from place to place. Farmers in locations with more rainfall are less likely to irrigate. In part, this is because they are able to get sufficient moisture without the expense of irrigation. However, the marginal effects of climate change on irrigation choice depend on the distribution of seasonal rainfall and temperature. Over the past decades, individual farmer have been investing in irrigation infrastructure (Wang *et al*., 2014).
- **Adoption of water saving technologies:** By 2004 at least 42% of villages in China were using a number of different types of household-based water saving technologies such as plastic sheeting, drought resistant varieties, retaining stubble/employing low-till methods, and surface level plastic irrigation pipe (Wang *et al*., 2014).
- **Adopting new crop varieties to reduce weather related risk:** Farmers have already shown a willingness to plant crop varieties with better resilience to adverse weather. The 2007 GEF/SCCF (Global Environmental Fund/ The Special Climate Change Fund) project report of Hebei, observed that farmers in Cang County in Hebei Province selected drought-resistance crop varieties in response to decreased water availability. In addition, farmers planted productive and disease-resistant varieties in some parts of Jiangsu Province. Current development of heat tolerant and pest-resistant wheat varieties is at least in part a response to the early effects of climate change (Wang *et al*., 2014).

If governments and farmers are able to adapt adequately, it is possible that the agricultural sector can actually take advantage of changes in temperature and rainfall. Future agricultural production will depend on the ability of these actors to make effective responses.

5 Conclusions

The agricultural sector is one of the most important for the sustainability of our societies, with significant impacts on environment as well as at the socio-economic level. As a consequence, the policy instruments available are extremely important to regulate and minimize those impacts with the goal of a more sustainable agriculture culture.

Through the analysis of the different policy instruments in EU, the contribution and relevance of the new reform of the Common Agricultural Policy (CAP) to the objective of a more sustainable agriculture became clear by allocating more financial support to farmers with environmental friendly practices and methods. As a result, the CAP is an instrument of high importance to prosecute and develop FATIMA activities.

In addition, also the EU's Water Framework Directive (WFD) has contributed to achieve a resource-efficient economy through an encouragement of changes to agricultural practices that can improve both water quantity and quality in Europe. Nevertheless, a more efficient use of our water resources in agriculture is only one of the steps that it is needed to take in order to reduce the impact on the environment. The WFD recognises that introducing water pricing across all sectors will be critical to achieving sustainable water use, which has been implemented by some Member States. Water management in agriculture would certainly benefit from a stronger focus in the CAP on resource efficiency and ecosystem services. Moreover, the Nitrates Directive (under the WFD) is also one key instrument in the protection of waters against agricultural pressure. However, a sense of more regulation of the implementation of the measure is required.

Finally, two other important aspects are the maintenance of biodiversity and the reduction of pressure on soils due to agricultural practices. In these matters strong policies are required. For example, soil has not been subject to a specific protection policy at EU level. On 17 January 2014, the Seventh Environment Action Programme recognises soil degradation as a serious challenge. It provides that by 2020 land is managed sustainably in EU, soil is adequately protected and the remediation of contaminated sites is well underway and commits the EU and its Member States to increasing efforts to reduce soil erosion and increase soil organic matter and to remediate contaminated sites. However, in May 2014 the Commission decided to withdraw the proposal for a Soil Framework Directive.

All over the world there is a large number of policy instruments related to sustainable agriculture (directly or indirectly). However, evaluating a policy success is sometimes difficult since there are so many factors influencing it and therefore it is not always easy to identify and select best practices in instruments to promote sustainable crop production. As a result this document presented reference cases or policies around the world which can give a contribution to the design and implementation of improved policies in FATIMA pilot areas.

Table 17 below summarizes the main conclusions and the most relevant points to retain from each of the instruments/cases mentioned in the document.

Table 17 – Main Conclusions of the Instruments/Cases studied

Policy Instrument/Case	Main Conclusions
Policy for Sustainable Agriculture in NSW - Australia	The Policy recognises the shared goals of government, farmers and conservationists and the need for all stakeholders to work together to achieve sustainable agriculture. A good instrument to promote sustainable agriculture, involving all stakeholders and defining the main goals. A good guide for best practices.
The Organic Farming Action Plan of the Ministry of Life - Austria	The success of organic farming in Austria could be a consequence of the support from the government in its promotion near the communities.
Austrian Agri-environmental Programme	The programme aims to ensure that the environmental impacts of domestic agriculture are reduced by financial support to farmers.
National Irrigation Policy - Brazil	Farmers who practice irrigated agriculture may have access to rural funds in order to a more sustainable use and management of land and water resources.
National Irrigation Secretariat (SENIR) - Brazil	The main purpose of SENIR is setting up a management system for irrigated agriculture. It also aims to promote irrigation as an instrument for efficient agricultural production.
Organic Food Production Act/National Organic Program (NOP) - US	NOP is a regulatory program housed within the USDA Agricultural Marketing Service. They are responsible for developing national standards for organically-produced agricultural products.
USDA Technical and Financial Assistance Program for Organic Producer - US	Provides technical and financial assistance to producers who plan and implement conservation practices that support environmental sustainability.
Pesticide Tax - Norway	The pesticide tax helped to reduce the use of pesticides in Norway by incentivising farmers to use less pesticides and alternative methods. However, pesticides are not absolutely necessary for the cultivation of crops, while other sources of diffuse pollution from agriculture, such as the presence of nitrate in the soil is necessary for plant growth. So, the same approach to fertilizers may not have the same success.
Taxes on nutrients surplus - The Netherland	Instead of a tax on fertiliser, the Netherlands introduced a levy on mineral surpluses. Taxing nitrates surplus (that is the proportion of nitrate applied which causes the pollution of surface and groundwaters) instead of a tax on the fertilisers is the best solution since nitrate is a diffuse pollution. In addition, a tax on mineral surplus is based on the "Polluter Pays Principle" which stimulates the efficient use of minerals.

Payment for Ecosystem Services (PES) and Multi-strata coffee gardens - Indonesia	PES implementation in Sumberjaya is an example on the critical role of the intermediary in facilitating and upscaling publically- and privately-funded PES initiatives. The key task was to re-establish people's basic levels of trust in the government's policy and programmes, which had been disrupted by a history of conflicts on land use and allocation. By doing that was possible to implement soil conservation practice and protect the natural forest.
Conservation Agreements	Conservation Agreements are important to the conservation of biodiversity and benefits farmers. Conservation program payments actually encourage adoption of practices that farmers would not otherwise adopt.
Corporations and Sustainable Agriculture	Big companies have huge influence in the implementation of best practices for sustainable agriculture, being a strong influence to farmer behaviour. Mondelez and Vittel are good examples of that.

Agriculture has major impacts on natural resources and a coordination of different policies is most of the times crucial to a successful implementation of the policies. Moreover, it is important that agricultural and environmental policies are closely coordinated and mutually supporting.

Badly designed policies can cause enormous damage and waste massive amounts of public money, so special attention is required when designing them. Furthermore, the degree of the environmental problems associated with agriculture vary widely between and across countries and also the socio-cultural background varies which can influence the successful of a policy. It is important when developing new policies or looking for some of the cases presented in this document to evaluate the most appropriate to each country and specific goal.

Finally, it is clear that sustainable alternatives to industrial crop production exist. Conservation agriculture, (including no-till agricultural methods), organic fertilizer, innovative pest management approaches, concepts of agroecology and optimized water-management practices are all strategies being utilized as alternatives to industrial crop-growing method. Some examples of policies supporting that were presented in this document and can be use in the development of new policies.

The elements of this analysis will be further developed and used in the following deliverables of this WP ("Policy analysis of pilot areas" and "Policy brief/recommendations").

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