Case Study

Italian synergies and innovations for scaling-up CSA

Germana Borsetta, Camilla Chieco, Carlo Malavolta, Cristiano Piacente, Danilo Marandola, Elisabetta Colaiacomo, Federica Rossi, Francesca Ponti, Mario Montanari, Nicola Dall'Olio and Teodoro Georgiadis

Case Study:
Italian synergies and innovations for scaling-up CSA

Leading author:
[1] Germana Borsetta

Contributing authors:
[3] Camilla Chieco, [5] Carlo Malavolta, [6] Cristiano Piacente, [4] Danilo Marandola, [6] Elisabetta Colaiacomo, [3] Federica Rossi, [5] Francesca Ponti, [5] Mario Montanari, [5] Nicola Dall'Olio, [3] Teodoro Georgiadis

Focal points
[2] Davide Liberati
[1] Federica Matteoli

([1] Food and Agriculture Organization of the United Nations, [2] Ministry of Agricultural Food and Forestry Policies, [3] IBIMET-CNR, [4] CREA, [5] Emilia-Romagna Region,[6] Sogesid S.P.A. c/o Ministry for the Environment, Land and Sea)

Publishing date: January (expected)
Published by:
Food and Agriculture Organization of the United Nations (FAO)
Contact:
Food and Agriculture Organization of the United Nations (FAO)
Viale delle Terme di Caracalla
00153 Rome, Italy
Tel: +39 06 57051
Email : FAO-HQ@fao.org

More information about the Global Alliance for Climate-Smart Agriculture at http://www.fao.org/gacsa/

Contents

Summary
Since last decades, climate change has become one of the major leading driver of global and national challenges for the protection of the environment and the human health, putting massive pressure on food production and in particular on food security. Developing efficient adaptation and mitigation strategies at the national and local level is essential to building resilience to climate change throughout the food system. Italy is at the forefront of promoting research and developing policies related to climate change adaptation and mitigation measures, including the promotion and application of the principles of Climate-Smart Agriculture, since the transition is occurring dynamically in the region, on the ground.
The development of adaptation and mitigation policies is a national challenge requiring cohesion among the various actors and sectors involved, and enabling management responses, participation and decision-making systems through vertical and horizontal governance models. Diverse, transversal and complementary projects are advancing in the territory, with the aim of integrating approaches and enhancing the national potential in responding to climate and socio-economic challenges. Conservation Agriculture is one of the core policies adopted by the agricultural actors and promoted by national institutions, and when practiced in conjunction with other pivotal local activities and projects may have increased potential. Italy's national agricultural production system plays a key role in the adaptation of ecosystems to climate change, and a wise management of natural resources, including land, water, biodiversity and genetic resources is envisaged and pursued. As a result, agriculture can make a significant contribution to climate change adaptation and mitigation at the national level.

Key words: *Conservation Agriculture, mitigation, adaptation, climate resilience, cost effective benefices, sustainability, social inclusiveness, governance, best-practices.*

1. General overview; agriculture and climate in context of national economy

The country of Italy is composed of heterogeneous climatic and soil conditions, with significant variation and peculiarities in territories traditionally distributed in the North, Center and South areas. The territory likewise other Mediterranean countries, is constantly experimenting increasing inauspicious phenomena such as soil loss[1], desertification, erosion and more in general degradation of ecosystems and escalation of extreme events. Thus, Italy is one of the richest country in Europe for biodiversity intensity, having almost half of the vegetal species in Europe and owning one of the most valuable presence of animal species (more than 58 000).[2] Differences and common traits are evident while evaluating the national agricultural sector, which through the last few decades has experienced significant changes as a result of regional and national policies aimed at developing and supporting both production and sustainability. Analogous characteristics are also reflected in the governance system, as institutions have distinct portfolios and separately sustain national and local actions, especially while dealing with climate change and agriculture. Dialogue and participation among institutions, regional bodies and stakeholders is still an ongoing process and requires the promotion of cohesive policies, technical panels and capitalisation of experiences.

[1] Italy has the highest mean annual soil loss rate 8.46 tonnes/ha/year, Source: RUSLE2015
[2] Source, MiPAAF 2016.

The enhancement of national rural policies has been developed starting from 1996 with the adoption of the European Rural Chart,[3] which linked the usage of agricultural land, strictly connected to the orography and non-agricultural land-use, to environmental and socio-economic dimensions.
Further regional and national actions to implement sustainability along the agricultural sector have been reinforced throughout European Directives and Regulations, such as the Directive 2009/128/CE (Sustainable use of plant protection products), and especially with the adoption of the European Development Strategy (2006). More recently, the reform of the Common Agricultural Policy (CAP) started in 2013, during the last decade has produced in Italy the enlargement of the business farm size, so that larger companies have started to be considered to be more efficient and competitive, while adapting to production changes and needs. On the other hand, livestock production has experimented with varied territorial trends, with important phenomena of concentration in some territories, requiring a crescent need to focus on the sustainable management of animals and related waste production treatments.

The Italian socio-economic framework is still characterised by a structural weakness as a result of the current general global financial crisis, resulting in a low growth performance and an economic contraction estimated at 0.9% of GDP annually (ISTAT, 2016), although it is remarkable that the agricultural sector supports Italian GDP with + 1.8% of added value.[4] Therefore, a reduction of agricultural incomes remain significant, with a contraction in the last ten years of around 6% compared to other EU countries (MiPAAF, 2016). Italy is still a leader in the number of products of agricultural excellence, which are labelled in the Italian system as PDO and PGI.[5]

In addition, the employment rate is experiencing a decline, and a gender gap remains steady with a significant regional dimension (e.g. North/South). Disparity among regions remains significant, and the need for modernisation of services and infrastructure exists along with an urgent demand for efficiency and innovation. According to the Global Innovation Index, Italy is the 26th most innovative country of 128 word nations (2016), but research, development and innovation still need to be enhanced. Moreover, competition and preparedness, to be used further in responding to European calls and funds, need to be enforced and capitalised.

Italy is actively involved in undertaking actions and promoting ad hoc policies to face climate change, and has ratified The Paris Agreement (COP21) with national Law 204/2016. In addition, the Italian Ministry for Environment, Land And Sea (IMELS) has approved in 2015 the national strategic document for adaptation to climate change "*Strategia Nazionale di Adattamento ai Cambiamenti Climatici*" (SNAC), through a national participatory approach that involved regions and stakeholders and which was derived from the European strategy COM (2013).[6] The SNAC recognizes that agriculture and food production are heavily dependent upon the condition of natural resources, and that they are particularly sensitive to the effects of climate change. Knowledge of the state, impacts and vulnerabilities of climate change on the agricultural sector at the local level is essential for defining and implementing the most appropriate adaptation measures. Many agricultural areas in Italy are considered vulnerable to climate change. The introduction of appropriate adaptation strategies intends to minimize or reduce their vulnerability, increasing the food production and contributing to the mitigation of climate change. Within the national Strategy SNAC a Forum to promote information, knowledge and citizens participation has been established in addition to a permanent observatory "*Osservatorio Nazionale*" composed of representative of

[3] The resolution on the European rural policy and the creation of a European Rural Chart dates back to 1996. UG C 347, 18.11.1996, pag. 458.

[4] Data have been processed by Coldiretti (leading organization of agricultural entrepreneurs at national and EU level) on the ISTAT Annual Report, 2016.

[5] Protected denomination of origin and Protected geographical identification.

[6] https://ec.europa.eu/clima/sites/clima/files/docs/eu_strategy_en.pdf

regional and local institutions and stakeholders, in order to identify priorities, support decision-making and monitor the effectiveness of actions and policies.

The National Plan for Adaptation to Climate Change will identify priority actions for key areas identified in the SNAC. In this regard, several best practices realized through EU funded projects within different programmes are available (e.g. LIFE, CIP Eco Innovation, CIP Intelligent Energy Europe - IEE, the Seventh Framework Programme for Research and Technological Development - FP7). The Knowledge Platform website (Piattaforma delle Conoscenze) was set to share these best practices and to facilitate the access to them, stimulating networking activities between relevant actors.

Data from the agriculture sector show an employment rate of 429 000 units in agriculture with an added value of 3.3% in agriculture, forestry and fisheries sectors, with a production estimated in 54,438 billion Euro (ISTAT, 2015). Agricultural area accounts for a total of 12,856,000 ha[7], and during the last several years, the total agricultural area accounted for a soil loss of 2.4%, although the firm trend demonstrated an increase in the average size from 7.9 to 8.4 hectares (ha). It is relevant that the number of multifunctional farms operating in agriculture has recently increased (+ 48.4%) due to the rise of farms producing renewable energy (21 000 farms) and converting their products (+ 97.8%). On the other hand, the livestock sector is in decline for pigs (-7.8%) and cattle (-4.5%), while poultry and sheep farms remain steady (respectively -1.5% and +0.5%). There has also been a significant increase in certified organic production (+ 7.7%) and a decrease in the use of pesticides. More than 9% of Italian agricultural land is allocated to organic production, positioning it fourth in Europe and sixth at the global level.[8]

2. Climate-Smart Agriculture intervention

2.1 Country level policies/enabling environment for CSA, goals/targets, institutions, etc.

The national dimension is positively interconnected to the regional and local levels, especially while dealing with policies and programs focusing broadly on climate change adaptation and specifically to Climate-Smart Agriculture (CSA). The national framework, jointly connected to the legal structure, encourages the institutionalisation of priorities, while promoting an enabling environment, participation and decision-making, and secures socio-economic and environmental priorities and local resilience. Ad hoc national policies play a substantial role in promoting the operational adoption of CSA solutions on the ground, integrated and laid down in European Directives and Regulations. In particular, CSA solutions may be profit-positive, neutral or profit-negative for farmers: profit-positive and neutral solutions may need social policies for removing barriers, or fiscal measures, such as carbon credit mechanisms, while profit-negative solutions may need additional subsidies and financial help to reduce their cost of adoption.
Within the national framework, the major policy and financial instruments contributing to climate change mitigation arose mainly from the CAP, and particularly from the pillar devoted to rural development measures. Agriculture is directly connected to these mitigation efforts, accounting for 24%[9] of GHG emissions and also acting as a potential reservoir for carbon storage. The second

[7] Type of crops: common wheat, durum wheat, corn, barley, oats, potatoes, oilseeds, legumes, orchards and citrus fruits, vine and olive trees, forage, vegetable. ISTAT data 2015.
[8] EUROSTAT elaboration, 2010.
[9] IPCC, 2014 Data for Agriculture, Forestry and other land use.

pillar of the CAP is funded by the European Agricultural Fund for Rural Development (EAFRD). In Italy, it is implemented by 21 regional Rural Development Programmes (RDPs), which envisage a set of support measures aiming at helping farmers in adopting agricultural practices beneficial for the climate and the environment.

The major national entities enabling and supporting CSA policies with a distinct portfolio along the territory are, at the institutional level, the Ministry of Agricultural Food and Forestry Policies (MiPAAF) and the Ministry of Environment and Protection of Land and Sea (IMELS), major national research agencies, such as the Institute for Protection and Environmental Research (ISPRA), the National Research Council of Italy (CNR), the Council for Agricultural Research and Economics (CREA), and regions and autonomous provinces at the local level.[10] It should also be noted that MiPAAF is managing a multiannual programme, the 2014-2020 National Rural Network Programme (NRN), which is implemented by CREA, which aims to support national and regional authorities in the implementation of EAFRD policies with specific incorporation of the RDP's CSA themes.

In addition, other important actors and stakeholders involved in the participatory approach to agriculture and sector-specific policies are the Operating Groups (EC regulation 1305/2014 art. 35), public and private service providers, agricultural and forestry enterprises, as well as other representatives of the agribusiness sectors, innovation brokers and facilitators.

In Italy, the leading projects, programs and funds foster CSA at different policy and technical levels, while creating effectual synergies and complementarities among diverse actors and drivers. Specifically, research and innovation policies are implemented at both national and regional levels, through the preparation of policy documents and the management of dedicated funds. Nationally, the Italian Ministries for the Agriculture and Environment (MiPAAF and IMELS), the Ministry of Economy and Finance (MEF) and the Ministry of Education and Research (MIUR) are the main institutions dealing with agri-food research, as well as interfacing with the European Union. Regionally, agricultural research is regulated by specific rules, while an important role is played by the coordination of an interregional network of agricultural research, forestry, aquaculture and fisheries. In the field of development services and innovation transfer, the regional administrations have full autonomy of action.

The "Strategic Plan for innovation and research in agriculture, food and forestry" describes MiPAAF and Italian regions strategy to meet the dictates of the first of the six priorities envisaged by the EU Regulations for the 2014-2020 programming period of the CAP, in order to "promote the transfer of knowledge and innovation in agriculture and forestry in rural areas", within the framework of the rural development policy scheme.

The concrete realisation of the European Innovation Partnership (EIP) takes profit from the opportunities offered by different areas of intervention: the CAP (second pillar) in particular, but also the Research and Innovation Policy (Horizon 2020) and the National Cohesion Policy, as well as the policy for the environment and climate change, the policy on consumers and health, the education and training policy, the industrial and information policy.

The main goals for the agricultural sectors require tackling challenges and promoting research, innovation and training at the national and local levels. In line with European programming for (2014-2020), Italian policies focus on thematic goals and, in particular, aim to: "Strengthen research, technological development and innovation", "promoting the competitiveness of small and medium-sized enterprises in the agricultural sector and in the fisheries and aquaculture sector",

[10] Total number of geographical regions and autonomous provinces in Italy: 21

"promoting adaptation to climate change prevention and risk management", and "protecting the environment and promoting the efficient use of resources".[11]

At the national level, several plans and projects are currently in place and act jointly to respond to sustainability priorities. One of the major themes focused by Italian Ministry of Agriculture (MiPAAF) and supported by regional RDPs relates to the role of Conservation Agriculture (CA) as a concrete instrument of CSA practices. The spread of CA practices on the Italian territory is promoted through dedicated support measures envisioned by the regional RDPs, and devoted to farmers that decide on a voluntary basis to shift towards conservation farming practices. CA practices are proposed as a valuable mitigation strategy towards phenomena of excessive soil and resource depletion, while positively maintaining soil fertility and biodiversity. The promotion of CA within the territory contributes to the maintenance of cultivated land, while optimizing production, social sustainability and resource use in conjunction with external inputs.

The major components of CA consist of technical interventions such as sod seeding and zero tillage, removing plowing systems, using cover crops between two consecutive plantings and leaving residues in the fields as similar mulch. Minimum tillage and strip tillage require processing of the first 15 centimeters of soil, while in addition the vertical tillage (e.g. cut without soil re-mixing) at depths of 5 and 8 centimeters. Through a dedicated project scheduled by the NRN 2014-2020 programme, MiPAAF provides regions and stakeholders with committed support aimed at facilitating the adoption and spread of CA under the umbrella of the EAFRD.

2.2 The investment climate including the flow of public and private investments

The sustainable growth path is emphasized in Europe with the scope or restoring sound public finances and support investment in sustainable development, particularly with regard to facing emerging challenges resulting from climate change. The Common Strategic Framework (CSF)[12] was conceived to provide long lasting socio-economic and environmental assistance for the period 2014 - 2010. In particular, European priorities have been harmonized with country and sector-specific needs, guaranteeing cooperation, convergence and competitiveness. Research and innovation, together with education and social cohesion, have been reinforced shifting to a resource-efficient, low carbon economy.
The European Union EAFRD budget amounts to EUR 99.6 billion. This represents roughly 24 % of the CAP budget. The expected total public spending (EU + national and/or regional) on rural development policy in the period 2014-2020 is EUR 161 billion. At the EU level, EAFRD budget devoted to environmental and climate priorities accounts for 52% of public funds, roughly EUR 80 billion. Agri-environment-climate payments (AECP)[13] established by measure n.10 of the RDPs, broadly represent 17% of the EAFRD budget in the EU. Italy's budget for 2014-2020 RDPs is approximately EUR 21 billion[14]. In Italy specifically, the 21 RDPs devote roughly 41% of their budgets to environmental and climate priorities. In particular the sole Measure n.10 accounts for a budget of 12% of the entire planned spending (EUR 2.3 billion for 2014-2020, which is the planned

[11] https://www.politicheagricole.it/flex/files/1/d/e/D.d52be58532a23d880371/brochure_Piano_10_luglio.pdf
[12] CSF funds include: European Regional Development Fund (ERDF), European Social Fund (ESF), Cohesion Fund (CF), European Agricultural Fund for Rural Development (EAFRD) and the European Maritime and Fisheries Fund (EMFF).
[13] AECP is area-related payment (euros/hectare/year) and supports farmers who shift on voluntary basis to acknowledge more sustainable farming practices.
[14] RDPs have been adopted by 21 Italian Regions at the end of 2015 and are co-financed by the EAFRD within the CAP

quota estimated to be allocated in seven years),[15] with availability of funds aiming at incentivizing sustaining farmers and other land managers for the preservation of natural resources, genetic patrimony, the delivery of ecosystem services and climate change mitigation/adaptation actions[16].

According to National Rural Network analysis, the impact of the public spending on RDP structural measures for innovation has considerably increased between 2007 and 2015 on the value of gross fixed investment in the agricultural sector, rising from 8% to 12.1% (Ismea, 2016). As previously mentioned, in addition to the European Programme Horizon 2020, which allocates more than EUR 3.8 billion to "Food security, sustainable agriculture, marine and maritime research and bioeconomy", the major funds devoted to CSA derive from the CAP and especially from the second pillar, funded by the European Agricultural Fund for Rural Development (EAFRD).

Private investments are also a supportive instrument of national funds. One example of this is the Multiregional Guarantee Platform that supports Italian companies in the agricultural sector, with availability of funds totaling EUR 465 billion beginning in 2017. This is the first experimental example of private national funds supported by MiPAAF and involving cooperation between regional administrations, national agencies and European financial institutions. This multilateral portfolio was conceived to protect and finance loans and investments linked to RDPs, while taking advantage of EAFRD support, and to insure small and medium-sized enterprises not only in their production, processing and distribution, but also in the transition process to CSA adoption.

Additional resources arose form cohesion policy funds, such as the Development and Cohesion Fund (FSC), National Operational Programs (PON) and other funds issued throughout international Calls, such as ERANET and the EU Joint Programming Initiative (JPI).[17] Further resources at the national level are related to the funds for interventions in the agricultural sector as per Italian Law 499/199. Concerning the promotion of CSA practices at the regional level, 15 out of Italy's 21 RDPs have envisaged a number of support measures adapting them to pedoclimatic territorial characteristics. Among these measures, one of the most important is a specific support operation of Measure n.10, aimed at helping farmers in the shift towards Conservation Agriculture practices such as No Tillage or Minimum Tillage, and other sustainable farming practices for promoting soil health. In fact, the shift of the agronomic paradigm toward zero tillage weighs the increased cost related to the adoption of new farming techniques with agronomic management. In Italy for the 2014-2020 period, the resources allocated for this typology of interventions account for EUR 500 million, with a target intervention area of 330.000 ha through the seven-year programming[18].
Moreover, in order to avoid double payments, and to hasten the transition period, regions have simplified the procedures and strictly defined the commitments and related allocation of funds, detailing the minimum eligibility criteria (e.g. no tillage, crop rotation, and minimum area of 0.5 ha for collective subscriptions and 4 ha for individuals) and defining additional commitments (e.g. cover crops, plant residues, etc.).[19] Eligibility criteria are specific to the applicant, and preferences are given to farmers operating in Natura2000 areas, zones vulnerable to Nitrate, and other significant ecologically valued areas.

[15] Fact sheet on EAFRD supports in Italy devoted to agr-env-clima priorities http://www.reterurale.it/flex/cm/pages/ServeAttachment.php/L/IT/D/f%252Fa%252F1%252FD.321082b793891b3e405c/P/BLOB%3AID%3D16639/E/pdf

[16] Source: Marandola D., Monteleone A., I PSR 2014-2020 puntano sulla semina su sodo, Edizioni l'Informatore Agrario, 2/2016

[17] ERA-NET is an EU instrument designed to support public-public partnerships in their preparation, establishment of networking structures, design, implementation and coordination of joint activities. JPI

[18] Source: Marandola D. Semina su sodo come strumento di competitività aziendale. L'Informatore Agrario 39/2016

[19] Funds allocated in PSR measure n.10 for zero tillage can be cumulated with others in PSR but they must be complementary and compatible, according to Regulation CE n.808/2014 article n.11

In addition, not only can commitments be up-scaled, but eligible funds can be combined. One example has been the Tuscany Region leader in experimenting the combination of RDP measures 10 and 11, respectively zero tillage combined with organic farming. Controls and sanctions are endorsed after strict administrative and *in situ* controls.

2.3 Technologies, practices, and services relevant to the country (link with practice briefs)

During recent years, Italy has enforced policies and services in the agricultural framework referred to as "Blue Agriculture". This comprises several projects that with their peculiarities exponentially contribute to the common goal of responding to climate change vulnerabilities, while stitching together national actors in a sort of "Glue Agriculture".

Within the actions of the NRN Programme managed by MiPAAF, the Research Center for Agricultural Policies and Bioeconomy of CREA (CREA - PB), in partnership with IMELS, regions and some national environmental organizations (NGOs), is particularly effective in the development of activities aimed at supporting CSA priorities within the RDP, as well as improving the efficient use of resources arising from EAFRD. In particular, the ongoing Project NRN CREA 5.1, "Actions in support of agro-climate environmental priorities of RDP" (2016-2018), focuses on Conservation Agriculture within the scope of achieving sustainability and cost-effective benefits. The project also aims to improve the livelihood of farmers through the application of the three main CA principles (minimal soil disturbance, permanent soil cover and crop rotations), and encourage the creation of networks enhancing knowledge sharing on techniques and policies fostering rural development and stakeholder engagement.

In particular, the promotion of information and communication networking activities among various national stakeholders, supported by research and innovation actors, is fundamental in encouraging the sharing of best-practices and know how not only on CA and CSA but also with regard to Land and Degradation Neutrality, which is one of the crucial topic of the sustainable development objectives to 2030. Moreover, at the national level, the project is particularly useful in the analysis of the complementarities and limits of rural development policies, not only within the Italian territory, but also in other regional and European actions on crucial themes, such as Land Degradation, Land Use Change, Climate Change Adaptation and Mitigation, Biodiversity and Sustainability. Complementarity and coordination on CSA goals are reinforced through the cooperation of other institutions and international organizations such as FAO, OECD and Ministries, as well as via participatory activities, communication and advocacy.

Thus, in the project, actors are involved at cross-cutting levels and are proactively committed to the process, both as end-user beneficiaries and operating partners. The activities supported are especially important in achieving long-term sustainability of multiple ecosystem services and promoting local innovation and participatory research, while contributing to respond to the modern challenges of ecological intensification,[20] while ensuring sustainability of landscape management and securing farmers' modernization and engagement. Hence, the engagement process is assured through the National Rural Network[21], regional and local committees, focus groups and other stakeholders, as well as with the development of specific activities aimed at sharing the experience of ongoing practices (i.e. the best practices of 15 Italian Rural Development Programmes for CA).

[20] Bommarco, Kleijn & Potts, 2013

[21] http://www.reterurale.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/1

Conservation Agriculture is a crucial practice for soil preservation, and practices such as zero and minimum tillage are also envisaged as compulsory commitments to be adopted within the broad Integrated Production (IP) certification scheme. This production scheme is one of the major target policies in the RDP measure n. 10. In fact, around 700 000 ha are engaged in integrated production and funds have been allocated in order to sustain farmers in the transition and adoption of such conservation techniques in the cultivation of herbaceous and arboreal crops.[22, 23]

Other significant national initiatives are presented below:

Institute of Biometeorology of the National Research Council of Italy (CNR-IBIMET)

Climate Smart Agriculture Booster. A Flagship Project of Climate Kic

Since 2015, the European Institute of Technology (EIT) has been co-funding with Climate Kic (Theme: Sustainable Land Use) the Flagship project Climate-Smart Agriculture Booster (CSAb). The mission of CSAb is to be the leading European Climate Smart Agriculture innovation platform, knowledge portal and marketplace, incubating scientifically-validated innovations, accelerating the adoption and the scaling of solutions, and facilitating transition to a climate-sustainable agricultural sector across Europe and beyond.

The Institute of Biometeorology of CNR, as the Italian partner of a restricted CSAb core group, is active at country level in CSA boosting activities.
The implementation of CSAb at the national level operates at different scales, spanning from the construction of an innovation platform to build and manage the users' community, to the definition of CSA solutions and services, as well as the development of a regional CSA Hub for the engagement of national stakeholders and partners.

Development of a National CSA "Hub"- activities and lessons learned
This action is devoted to the development of an Italian-based community of practice to provide a local platform for a climate-smart transformation of the regional and national agricultural sector.
As stated by IPCC, the effectiveness of adaptation (agronomic and economic) in ameliorating the impacts of climate change varies regionally, depending significantly on regional resource endowments, including stable and effective institutions.

In 2015, the CSA booster opened a local service in the Emilia-Romagna region. This service is the first national hub experiment, real and virtual, where CSA boosting becomes an active, dynamic network virtually connecting members willing to change and to innovate, and with a regional/national dimension. Current actions are: to work on the hub reputation, to enforce its institutional accreditation, to develop tests regarding climate-smart agriculture knowledge and acceptance, and to act as an intermediary organization between the regional and the European level.

In general, the local, tailor-made business model is effectively providing opportunities to engage political and corporate stakeholders, creating adequate opportunities for advising and consultation through intense cooperation between international CSAb partners. Future goals are to generate new partnerships with leading stakeholders and foremost actors in specific value chains, since the hub is prepared to engage many more actors including primary business consultants, representatives of multinational companies and national associations, international media partners, local financial institutions and professionals in the field of agronomy, economy,

[22] Product Specification for Integrated Production (Dpi)
[23] Source: Marandola D., Agricoltura Conservativa, la situazione in Pianura Padana, Edizioni l'Informatore Agrario, 2016

finance and law.

What is mostly remarkable and recommended, as emerged from the meetings organized, mostly from those with farmers associations, is the expectance that CSAb will-provide a large portfolio of CSA technologies scientifically guaranteed by the CSA booster itself, to be shown and ready to be adopted, with a solution finder. Moreover, it will represent a coherence point against fragmentation, also of policies, and promote the development of a CSA branding or voluntary certification. This last point has emerged at different levels and from most of the discussions on supporting policies and institutional actions, in introducing resilience and mitigation concepts into farms management.

Many challenges in boosting CSA have been identified. Interviews with direct and indirect contacts revealed that many barriers are present on both the supply and demand sides of the agricultural sector. This means that any measures designed to enhance and boost the diffusion and adoption of CSA technological innovations will need to target both sides of the adoption and diffusion equation in order to be effective.[24]

Goals and targets are set not only at the national or regional levels, but also at the international level with a series of CSA interventions. In particular, knowledge sharing and a clear focus on problems that need policy solutions are the pillars on which the hub-ecosystem is based.

For more updates: http://www.ibimet.cnr.it/?set_language=en

Italian Ministry for Environment, Land and Sea (IMELS)

International Alliance on Climate-Smart Agriculture (IACSA)

Recognition of the importance of the development of best practices is evident not only within national boundaries, but also outside the territory through international cooperative activities on CSA boosting.

In 2014, IMELS and FAO launched a project to strengthen international coordination and collaboration on climate-smart agriculture, and to build a global positive environment between different stakeholders, including countries, international organizations, NGOs and farmers, through the signature of a Memorandum of Understanding and the establishment of a bilateral Trust Fund.[25]

The project enables to support the development of concrete activities for the identification of CSA knowledge needs and actions to be implemented, building upon the advancement of the scientific environment surrounding CSA. In particular, it aims to strengthen livelihoods and food security, especially of smallholders, by developing the management and use of natural resources and adopting appropriate methods and technologies for the production, processing and marketing of agricultural goods. Farmers and their knowledge should be consider as pivotal custodians and managers of natural resource heritage and can therefore contribute to improving landscape adaptive approaches, while building resilience of ecosystems and communities.

[24] Long, Blok & Coninx (2016) Barriers to the adoption and diffusion of technological innovations for climate-smart agriculture in Europe: evidence from the Netherlands, France, Switzerland and Italy. In Journal of Cleaner Production, 112, 9-21

[25] GACSA- FAO 25th March 2014. More info at: http://www.minambiente.it/sites/default/files/archivio/allegati/sviluppo_sostenibile/MOU_establishment_international_alliance_climate-smart-agricolture.pdf

The main outputs of the project include the support of information and knowledge sharing through a number of communication pathways, capacity building and extension channels, and through the production and dissemination of FAO knowledge products for CSA. Stakeholders' consultation, sharing lessons learned, and information sharing are additional core elements of the project enhancement. Further developments have been realized through the presentation of three pre-feasibility studies for an active bilateral cooperation in Botswana, Ecuador and Ethiopia in order to explore the possibility of establishing CSA projects in developing countries to build or reinforce national capacity building and scientific agricultural expertise in the field of climate change. The project is particularly keen on taking into consideration local expertise and traditional knowledge in agriculture for adaptation and mitigation strategies to reduce climate change impacts, while providing policy support, technical assistance and assisting with financial opportunities. Assessment of local potential and limits is conducted to better address solutions for adaptation and mitigation issues. Beneficiaries are not only policy makers, technical advisers and researchers, but also, indirectly, rural communities and producers vulnerable to climate change.

In Botswana in particular, the project aims to integrate CSA into local harvesting and farming activities practices. In Ethiopia, the focus is on improving agricultural productivity as a measure to encourage adaptation to climate change, while increasing the marketing of durum wheat by smallholder farmers. In Ecuador, the main scope is to promote sustainable production and transformation of cocoa with the adoption of agroforestry strategies and supporting local economies and indigenous peoples.
For more updates: www.minambiente.it

2.4 Status of extension services

One of the key elements in capitalisation and diffusion of innovations and best practices aiming at cementing sustainability is the awareness and knowledge of farmers, since the success of CA and other climate-smart practices depends on the appropriation from the whole actors and their active participation. Programs, activities of lifelong learning (LLL) and training, as well as communication campaigns on sustainable production techniques and on consumer trends evaluation have been implemented.

Young farmers are significantly represented in Italy, accounting for 23% of managers of farms and having an important economic contribution (EUR 50 000 or more).[26] According to Coldiretti, from 2010 onwards, a new trend has emerged in the Italian countryside, the return of young people who decided to engage in agriculture after university studies. If compared to previous generations, these "young peasants" possess expertise and knowledge (i.e. some of them are agronomists) and are more innovative in terms of new technologies, thus they have a high economic potential which has been estimated at 40% more than their senior colleagues (Istituto Tecnico Agrario Paritario Europa Unita, 2016). Hence, in 2017, in order to respond to this crescent trend MiPAAF presented the portal "Banca delle Terre", with the scope of promoting public land heritage and enhancing youth entrepreneurship and generational replacement by providing access to simplified credit and reduced land prices. ISMEA has collaborated on the project and showcased the mapping of the first 8 000 acres of land on its website.

[26] Coldiretti, 2014

Under the Partnership Agreement 2014-2020, with the availability of EUR 42 billion from EU in addition to EUR 10.4 billion from EAFRD, funds for training are made available to Italy which cofinance rural development measures up to additional EUR 21 billion. Thus, Measures 1 and 2 of RDP "Transfer of Knowledge and Information Actions" and "Consultancy, Replacement and Assistance Services for Management of Farms", are particularly encouraged throughout calls and programs. Such funds are particularly effective at the regional level, since regions promote education through professional training courses, some of which are free of charge, in order to promote education and create added value. Some of the major themes are related to business creation and development, supply chains and agri-food marketing, accounting and access to credit, business management, financing for agricultural enterprise, EU regulations and funds, social dimension and organic agriculture. In 2015, the training programme "Impresaduepuntoterra" launched, available for both young and senior graduates, through the collaboration between Coldiretti Giovani Impresa and INIPA. These training activities have been promoted by ISMEA and funded by MiPAAF (under Law 296/2006 on Measure "Promoting the spirit and the culture of enterprise").

Additional master and lifelong trainings are regularly promoted within regions, and through the collaboration among universities (e.g. the Food Innovation Programme of the Emilia-Romagna region). These national activities and programs are inscribed within the European framework, since Italy as a Member State has the obligation to establish a system for advising farmers on land and farm management via the Farm Advisory System (FAS), which was introduced in 2007 as one of the major components of the CAP as envisaged by the EU Regulation 1306/2013. The objective of the FAS is to enhance farmers' awareness, on a voluntary basis, on material flows and on-farm processes related to the environment, food safety and animal health and welfare, helping also in fulfilling compliance requirements and avoiding financial penalties.

2.5 Metrics and methodologies in place to measure success and delivery

Climate-Smart Agriculture and specifically zero tillage practices, as demonstrated in the scientific literature, are particularly useful in reducing the cost of mechanical soil treatments and other related costs (e.g. energy consumption, usury of machines, working hours), and can be labour-saving compared to other techniques typical of conventional agriculture. Not only can the cost and benefits be measured, but the improvement of farms' efficiency and productivity can be assessed. Thus, within the Agricultural Accounting Information Network (RICA)[27], the Italian Farm Accountancy Data Network (FADN) has been implemented, a community tool designed to evaluate the economic situation of European agriculture and to plan and evaluate the CAP in a given territory and on microeconomic agricultural level. This is a software tool called "GAIA", which has been developed by CREA-PB for users within the RICA network, agricultural entrepreneurs, consultancy services and the world of agricultural training. The software analyses the farm business budget as a starting point through the use of specific indicators, including efficiency ones, in order to compare the technical and economic structure of a given farm to similar others. The software allows data collection and validation in the form of technical and economic indexes that can be further proceed and compared. Analysis of such data has demonstrated that CSA practices, particularly no tillage, attenuate the workload per surface units, granting for maximize working hours, giving the opportunity to cultivate larger areas using the same facilities. Considering the workforce the indicator "index of labor intensity", increased on 75% for zero tillage if compared to other sample farms not using such technique. Another important indicator used is the "Net soil productivity

[27] http://www.rica.inea.it/public/it/index.php

index", which demonstrated a net increase of approximately 14% compared to other farming systems not using CA.[28] The Rica database used by MiPAAF and other research bodies represents a valid instrument in the decision-making process and in the evaluation *ex ante* and *ex post* of agricultural policies and rural development at the national level.

In addition, within the CSA Flagship Project, another sector-specific database has been elaborated as a classification system linking policy incentives with specific national CSA solutions, and focused on Emilia-Romagna as a case study. Similar dynamic policy-knowledge database, which includes financial instruments and policies, is intended to be an instrument for consultation by technology providers, food and beverage companies and farmers, and represents a source of information for policymakers and for comparing policies to identify gaps on climatic threats.
Technology providers may couple their solutions with tools for reducing their cost to farmers, and farmers may access the database to find subsidies and support for the submission procedures. Thus, subsidy advisers and consultants may obtain information on available supports through the database.
Innovation policies are of high relevance in the database, such as Horizon2020, RDPs, EIP initiatives, water and soil regulations, national climate action plans and regional development programs. The structure of the database is organised to couple main barriers and relative policies.

2.6 Planning and priority-setting for strengthening climate-smart food production systems

In Italy, permanent crops play a significant role in contributing to the absorption of CO2, soil and landscape conservation, and erosion curbing. Recent national planning policies focused also on Statutory Management Requirements (SMR)[29] as environmental priorities in addition to food security, animal welfare and health, while maintaining Good Agricultural and Environmental Conditions (GAEC). National priorities are constructed with participatory approaches aiming at reinforcing existing tools, improving competitiveness and increasing the ability to adapt also to market turmoil. Further priorities envisage the valorization of Common Market Organizations (CMOs) as the third pillar of the PAC[30], while preventing the adoption of rural development programs from bureaucracy and reinforcing risk management actions. In addition, Italy foresees the generational replacement within the agricultural and related sectors, the enhancement of investments in R&I (Research and Innovation) and the evolution of remote areas in response to land abandonment.

As for the production system development, CMOs have resulted in effectively supporting the transition and reorganization processes in a long-term perspective, as they are based on innovation, being market-oriented and enable positive responses to market crisis. Such positive policies and activities are particularly effective within the wine sector in terms of structural advancement and sector aggregations. In Italy, the wine sector is still one of the driving pillars of production systems and food exports in terms of economic value and cultural capital of the territory. Sustainability and integrated assessment of wine production is crucial at different levels of the supply chain, and need public and private cooperation, since the management of the agrarian landscape demands

[28] Sample farms are identified at the Member State level to represent different typologies both for dimension than type of productions. Data refer to surveys carried on in 2012 on sample farms. Source: Marandola D., Marongiu S. Più efficienza al Centro-sud con la semina su sodo. L'Informatore Agrario 40/2012.

[29] "The statutory management requirements form part of cross-compliance and are laid down in a number of European Union directives and regulations. They concern public health, animal and plant health, identification and registration of animals, environment and animal welfare. These requirements apply independently of cross compliance (which only establishes the link between the full payment and the respect of such requirements)". Source, EC, 2017

[30] This is a proposed reform for the new CAP after 2020, suggested by MiPAAF.

environmental sustainability requirements (e.g. water resource, soil conservation, fertiliser reduction, etc.). In particular, companies as specified by EU and national regulations,[31] commit on a voluntary basis to reduce GHG emissions, and in Italy have the ability to benefit from tax reductions, such as firms registered with Emas/Ecolabel or that use LCA within production. [32]

In this field, the IMELS launched in 2011 the V.I.V.A. Sustainability and Culture Project, an initiative to strengthen climate-smart production systems in the wine sector and to measure sustainability performance and reduce impacts of the viticultural chain through the analysis of four indicators named: Air, Water, Territory and Vineyard. The pilot phase, concluded in 2014, endorsed the participation of important Italian wine producers that have been selected on the basis of geographical criteria and product characteristics, with the scientific collaboration of the OPERA Research Center for Sustainable Agriculture of the University "Università Cattolica del Sacro Cuore" and Agroinnova Competence Center of the University of Turin, resulting in a second phase of the project open to 40 other national companies.[33] The wine sector in Italy contributes for a total production of 50 261 hectoliters[34] and represents an important economic added value; the V.I.V.A. project sustains the creation of a low-impact model of production aimed at preserving Italian landscapes and improving quality, fairness and traceability within and outside the country. The first phase led to the determination of technical requirements for evaluating sustainability performance and impacts throughout the creation of an innovative and environmental value-associated label for companies willing to improve awareness,[35] identify sustainable strategies and measure their future improvements, while providing consumers with transparency and sustainable engagement. The methodology applied is based on scientific indicators validated every two years by an independent entity and tends to harmonize results and achievements in line with EU regulations and standard issues. The project also contributes in training and knowledge transfer, encouraging professionalism and awareness in the agri-food system, while sustaining local social capital and enhancing stakeholder participation and decision-making. The four indicators are conceived as easy-to-use instruments and, in particular, the "Air" indicator measures the impact on climate change inherent to the production of a specific bottle of wine (Product Carbon Footprint) and/or to whole firm's activities (GHG Inventory).[36] The "Water" indicator measures the fresh water consumption related to the production of a specific bottle of wine and/or related to the whole firm's activities (consumed and contaminated water in vineyards and winery). This indicator is related to water footprint and analyses the Blue Water, Green Water and Gray Water.[37] The "Vineyard" indicator measures the environmental impact of the agronomic techniques, including vineyard fertilisation and defense. It also assesses those aspects concerning biodiversity, soil management and fertility. Lastly, the "Territory" indicator is an aggregated indicator, based on quantitative and qualitative assessment. It indicates the connection between wine and its territory intended as: community (social and economic effects on workers, producers and consumers); environment (biodiversity, landscape

[31] Climate-Energy Package" adopted by the Council of the European Union in 2008

[32] Law of Stability Art. 10 and Art. 11

[33] Pilot companies involved in the project: Castello Monte Vibiano Vecchio, F.lli Gancia & Co, Marchesi Antinori, Masi Agricola, Mastroberardino, Michele Chiarlo, Planeta, Tasca d'Almerita, Venica&Venica

[34] Data 2016-2017. Source: Member State communication following Art. 19 of Regulation (EU) 2009/436 elaborated by DG Agri G2.

[35] The VIVA label for the international market is composed by the Label and the QR Code while for the national market by the Product label and the Organizational Label. These digital labels placed on the back of the wine bottle help consumers to understand results and improvements.

[36] PCF is a life cycle analysis referring to a standard wine bottle of 0.75 liters from cradle to grave. GHG Inventory refers to a wine firm and measures emissions related to the company activities.

[37] Blue Water: volume of fresh surface water and groundwater directly consumed of incorporated in the product and not returning to the same catchment area or returning in a different time period; Green Water: volume of rainwater, evapotranspired during the grapevine crop cycle; Grey Water: level of pollution of the water calculated on water quality standards.
Source: Water Footprint Network, Lamatra L., Suciu N.A., Novelli E., Trevisan M., A new approach to assessing the water footprint of wine: An Italian case study. Science of the Total Environment. 490 pag. 748-756

safeguard); and culture (artistic heritage and cultural inheritance protection, sights enhancement). The project is particularly effective in calculating the water flow in agriculture, which is the largest freshwater consuming sector, accounting for 44.07% of withdrawals in Italy (Word Bank, 2014)[38]. In the wine sector in particular, rising demand for water resources (Iacchelli *et al*., 2010) accounts for 69.9% of GW, 15.9% of BW and 14.3% of GW (Lamastra *et al.*, 2014). Thus according to the literature, V.I.V.A.'s first phase showed some important results, such as differences in pesticide application and water body distance allocating Water Flow (WF) values related to farm conditions, that in combination with the other multi-dimensional indicators and the use of Web GIS software, help in estimating the agronomic sustainability of the vineyard management.

2.7 Examples of ongoing action by Civil Society organizations and the private sector

In order to promote and improve agricultural technologies, the Ministry of Economics and Finance in collaboration with the Ministry of Agriculture, Confindustria[39], and major national research centers, have recently launched the Industria 4.0 Plan. It consists of actions aiming at fostering easy access for enterprises to dedicated credit lines and a number of services, broadband included. The aim is to strengthen agricultural and agri-food research and to increase the use of precision technologies in the agricultural sectors by 2021.

Alongside the Industria 4.0 Plan, the Technological Cluster CL.A.N. is another important initiative aimed at promoting a partnership between companies, research centers, local representatives and relevant stakeholders in the food chain. Established by Federalimentare to provide continuity to the work of the Italian Technology Platform Food for Life, the mission of CL.A.N. is to defend and increase competitiveness of the national economic system, from agricultural production and processing, to packaging and logistics. Its core activities are innovation, access and communication of the results of scientific research, collaboration between research organizations, companies, institutions and public administration.

The relationship between Italian agri-food industries and technological innovation is an additional asset in CSA implementation. The consultation of the National Observatory of Italian Districts allowed for mapping of the entire Italian agri-food sector, and has identified 40 industrial districts in Italy, of which 30 are in the manufacturing industry, food and beverage and 10 in agriculture.[40] The Italian Food Industry, represented by Federalimentare (Italian Federation of Food Industries) consists of 6 845 companies (404 000 employees), of which about 40 are big industries, 305 are medium-sized and the remaining 6 500 are small or very small (up to 10 workers). Along with agriculture and distribution, the food industry is central to the economic sector of the country, with EUR 132 billion turnover, a positive trade balance of EUR 7 billion and exports at a value of EUR 27 billion; one food product out of five is exported. More than a third of all food companies (35.1%) have introduced at least one innovation system in production or processing. Moreover, it is evident that 36.1% of innovative agri-food enterprises, while not devoting themselves entirely to the development of new products, have chosen to adopt the most technologically advanced production systems and highly innovative machinery.[41]

[38] Italy - Water Withdrawal - Agricultural water withdrawal as a share of total water withdrawal

[39] Confindustria is the main association representing manufacturing service companies in Italy, with a voluntary membership of more than 150,000 companies of all sizes, employing a total of 5,440,125 people.

[40] Osservatorio nazionale distretti italiani. Il nuovo respiro dei distretti tra ripresa e riposizionamento. Rapporto 2015.

[41] Green Entrepreneurship in Italy. Regional Activity Centre for Cleaner Production (CAR/PL), December 2011

The Italian agri-food industry has always shown interest in environmental sustainability issues. In 2015, according to the study carried out within the CASI Project, 40.1% of companies have implemented innovative measures to reduce pollution with investments oriented to reuse processing waste, recycle water and improve waste management, while over a quarter of innovative enterprises adopted innovative practices to improve energy efficiency and reduce industrial CO2 emissions.[42]

The Emilia-Romagna Region Project, approved within the European Life+ Project: "CLIMATE CHANGE-R" (Life12 ENV/it/000404)[43], is a competitive and brilliant initiative gathering together national partners from the most important companies in the agri-food and distribution sectors and research institutions.

The Emilia-Romagna regional administration has been the leading body of this three-year project, developing best practices in the farming and livestock sectors with the goal of enhancing sustainability and consumer awareness, and reducing GHG emissions from the sector, while preserving product quality and productivity yield. Industries, operators and chain representatives have been fully involved in the process of crop and livestock production practices for key products in the region (i.e. durum wheat, pear and peach trees, green beans, tomatoes, beef cattle and dairy cattle, of which 44 are DOP and IGP products) and participating in partnerships for 30% of regional farms and around eight million consumers. The Emilia-Romagna region, in line with EU 2020 Strategy, is the forefront of developing a form of agriculture with low carbon footprint and commitment to the use of organic and integrated production within its territory (117 000 ha organic- around 11% of total regional Utilized Agricultural Area, and 124 000 ha integrated- around 12% UAA).[44] The main goals of the project reside in the significant reduction of GHG emissions at the farming and livestock-raising stage also through water management, energy saving, limitation of pesticides and fertilisers and the use of advanced techniques in manure management. During the three-years project the reduction of agriculturally originating GHG emissions have been estimated to be 200,000 tonnes of CO2, in line with EU Strategy 2020 goals.

In addition, the ambition of the project is to involve a great number of firms and production chains to increase sustainability at the production stage using integrated approaches, while promoting awareness and consumers consciousness. In particular, consumer participation is enhanced through interactive methods, such as the design of an "App" for smartphones allowing the calculation of "carbon shopping"[45]. Climate change understanding among the local population is also promoted via educational activities and information sharing (e.g. Emilia-Romagna online platform for participation).[46] In addition, field visits to sample farms are planned for farmers and experts for knowledge transfer purposes.

The private sector is proactive and involved in the project, and constitutes an added value. The main national and international groups of agri-food and large-scale distribution that aim to adopt new procedural guidelines are: Barilla, Coop, Granarolo, Parmareggio, Centro servizi ortofrutticoli, Apo Conerpo, Unipeg, and The Parmigiano-Reggiano Consortium (participating in the project as a sponsor).

---

[42] Public Participation in Developing a Common Framework for Assessment and Management of Sustainable Innovation" (CASI Project) SUSTAINABILITY AND INNOVATION IN THE ITALIAN AGRI-FOOD CLUSTER, 2016. http://www.casi2020.eu/blog/posts/sustainability-and-innovation-n-the-italian-agri-food-cluster/

[43] Life+ is one of the major financial tool for promoting environmental protection and sustainable development via targeted projects. The overall project costs 1.8 million euros, 50% cofinanced by EC. More info at: http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=4564&docType=pdf

[44] Source of data: Emilia-Romagna Statistics

[45] The App has been created in collaboration with COOP Italy

[46] http://partecipazione.regione.emilia-romagna.it/

In addition to the private sector, two research bodies contribute to the project, the Cesena's Plant Production Research Center (CRPV) and the Animal Production Research Center (CRPA).

The project includes the capitalisation of a best practices system, aiming at settle production regulations in order to be further applied and adopted throughout the entire region. Financial instruments, such as funds available within the Rural Development Programme 2014-2020, will be broadly allocated for pursuing sustainability within the project. Moreover, a system of open source databases,[47] is conceived for end-users interested in developing Life Cycle Assessment (LCA) analyses and willing to improve their knowledge. Analysis of emissions are calculated at three different levels of environmental impact, and specifically LAA1 (cross compliance rules), LAA2 (integrated production) and LAA3 (integrated production and agronomic and plant protection advanced techniques).[48] Also, data are especially important for the awarding of the environmental certification. LCA remains a key element in the project methodology for the calculation of carbon footprints, estimated on the main agricultural systems present in the region. This integrated approach is central along all stages of the project, horizontally involving different sectors (e.g. food industry production and distribution) and crop/plant and livestock/animal sectors. The methodology is based on testing cultivation and breeding techniques with the same manufacturing yield, and comparisons have been made using the Environmental Risk Levels (LAA) assessment. LCA estimations take into account the following criteria: "production of the technical means employed during plant and cultivation (plant infrastructure, irrigation system, fertilizers, agrochemicals, pheromones and water), plant and cultivation operations (fuels' production and combustion, electricity), direct and indirect N_2O emissions; transport of technical means in the farm and waste disposal".

In the three years since the inception of the project, it is interesting to observe significant reduction in carbon footprint, such as -50% in tomato cultivation and -20% in durum wheat. In the livestock sector, some measures were identified that make it possible to:

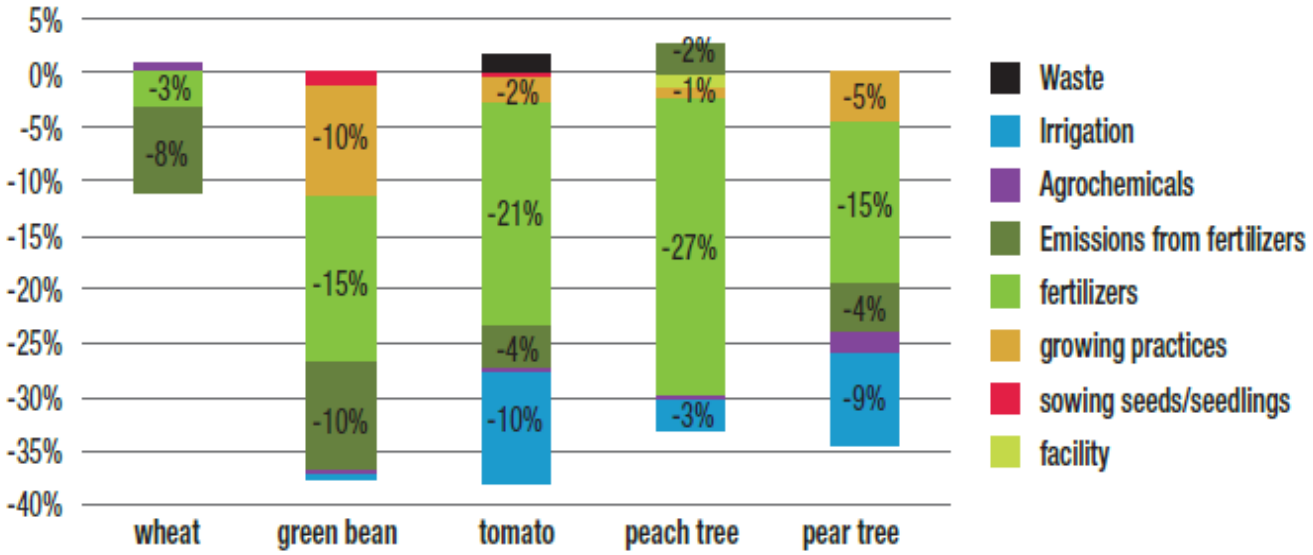
- Increase the digestibility of the cattle feed ration;
- improve nitrogen efficiency in the barn and in the field;
- improve agronomic management of livestock manure;
- reduce the use of synthetic fertilizers.

[47] Database Ecoinvent vers. 2.2, more info at : http://agricolture.regione.emilia-romagna.it/climatechanger/temi/database

[48] Software for calculation SimaPro vers. 7.3.3

Figure 1: Carbon Footprint reduction in the Emilia-Romagna Region, crops sector

(Source: Project Monitoring Report)

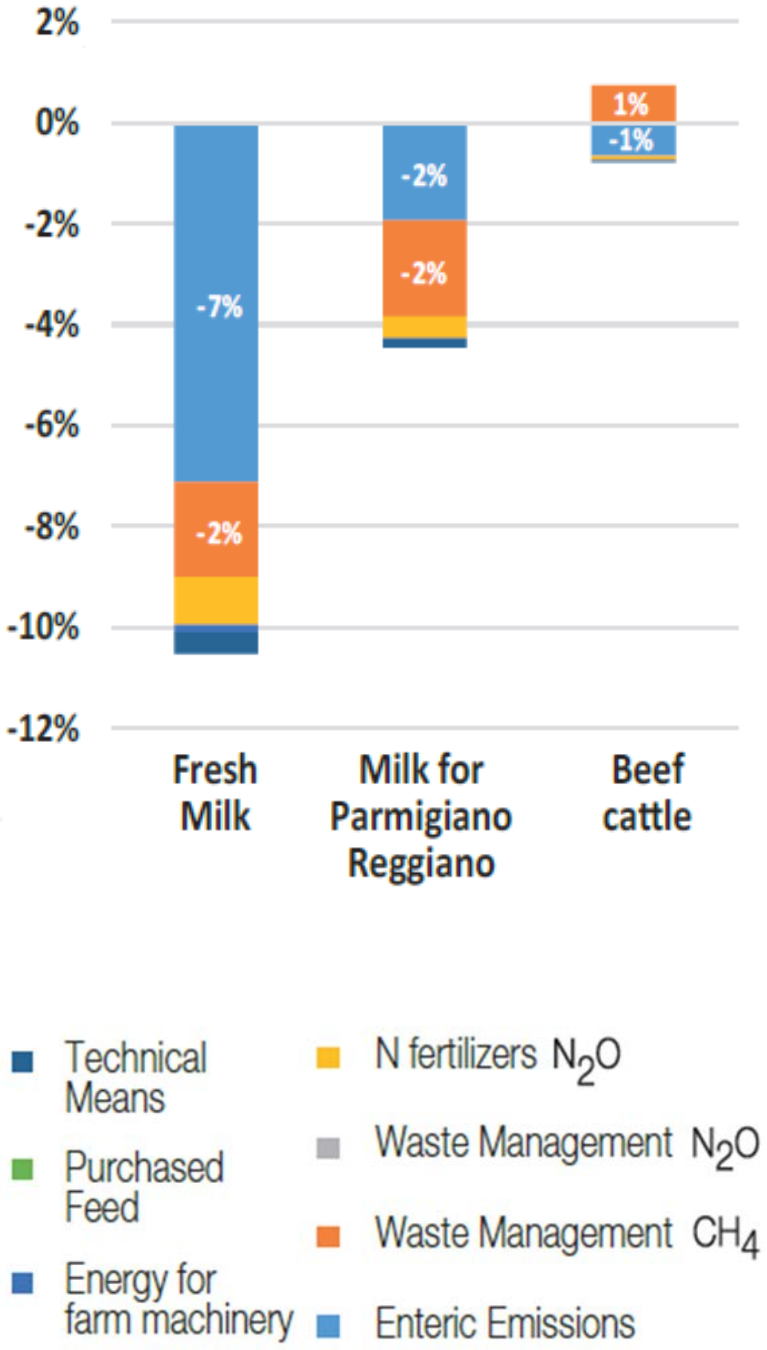


The results obtained with the application of the Good Practices and estimated with LCA analysis are positive, with the percentage of carbon reductions ranging from a few percent up to over 30%, compared to the average impact of the individual chains. The average impact of individual sectors has been calculated as:

- 1.2 kg CO2 eq/kg milk for fresh milk;
- 1.3 kg CO2 eq/kg milk for production of Parmigiano-Reggiano cheese;
- 11.1 kg CO2 eq/kg live weight for beef.

Figure 2: Carbon Footprint reduction in Emilia-Romagna Region husbandry sector (milk, Parmigiano Reggiano cheese, and beef cattle)

(Source: Project Monitoring Report)



3. Projected impacts of existing CSA interventions

3.1 Effects on productivity and income and implications for food security

National policies in alliance with regional and locally oriented projects, some herein presented, should be still analysed as in their beginning stages when considering their impacts. Italian climate-smart-oriented actions are significantly contributing to strengthening food security and developing food sovereignty,[49] and estimation on productivity is an ongoing process.

Inter alia, experts focus calculations on the principles of climate-smart agriculture and the related impacts on soil health and crop productivity, as well as on CA, organic agriculture and agroecology and on the importance of seed use and conservation. Notably, recent studies focused particularly on CA and its environmental and economic benefits, as a holistic approach oriented in limiting GHG emissions through sequestration of CO2, as well as supporting the reduction of ammonia emissions from agriculture in areas of intensive agriculture.

A part from environmental gains, important cost-related benefits are achieved thanks to the reduction in number of processing surface areas and longing engine energy with fuel cuts around 80/100 litres diesel per hectare (ENEA, 2017). Further significant profits relate to economic efficiency, with an overall economic saving of EUR 250-300 per hectare, and a reduction in crop costs, with greater yields of cereals than the soil worked in droughty vintage. Economic and social related capitals are also enhanced, since soil conservation, erosion prevention, water saving and GES contribute to biodiversity richness and fertility increase, committing especially to Sustainable Development Goals (SDGs) no. 2 and 15. The balance between productivity and cost is quite positive, with yields of 5.24 tonnes/ha at 13% of humidity if compared to conventional agriculture (i.e. 5.76 tonnes/ha and 13% humidity), but with cultivation costs in 2016 estimated around EUR 871/ha, when in conventional agriculture these are EUR 1,016/ha. Although a slight reduction in production yield persists, the numerous benefits of cost reduction, soil conservation, ecosystems and fertility enhancement are of invaluable importance for national food security and socio-economic values.[50]

3.2 Adaptation potential achieved

Adaptation policies (e.g. preventative, reactive, planned, autonomous, private and public adaptation), are an evolving process requiring a constant adjustment to changing impact scenarios, while taking appropriate actions to respond to climate change effects. One must also consider agricultural activities affected by rising climate variability and therefore uncertainty of incomes. Thus, the literature on adaptation costs in agriculture is still limited partly due to adaptation action being translated into ad hoc farm-level adjustments, partly because there is often no clear distinction between public and private responsibility in undertaking such actions (OECD, 2010).

National adaptation strategies are still in line with principles contained in the White Paper "Adapting to Climate Change: Towards a European Action Framework" (European Commission, 2009), and declined at the local level through Regional Adaptation Strategies (RAS). Perspectives on adaptation in agriculture are divided into short-term (i.e. at farm level) and long-term (i.e. at local level) actions. Adaptation process and actions are complex systems and require high degrees

[49] According to la Via Campesina, the term “food sovereignty” is used when a community has the full control over the way food is produced, traded and consumed.

[50] CIA, 2016.

of governance and dialogue between public and private sectors, and their center of responsibility in nationally applying adaptation plans. In addition, the agricultural insurance system is an important economic tool since applied *ex ante* and no longer *ex post* when damages have already occurred; the major instrument derives from the National Solidarity Fund.[51]
According to the White Book for national climate change challenges, progress and main potential lie in technology evolution, adoption of innovations in agricultural systems, governance, and financial management of agricultural companies (MiPAAF, 2011). In particular, according to CREA, while dealing with water management, CA improves resilience in soil erosion and drought risk, while limiting nitrate pressure with the use of technical improvements in limiting water use in agriculture, also by planting less water intensive varieties of crops, and helping to prevent farmers from climate variability.
A sustainable and diversified use of forage crops adapted to the climatic conditions is another adaptation instrument increasing on-farm added value. Moreover, due to rising temperatures and considering the Temperature Humidity Index (THI), other adaptation practices may become increasingly necessary, such as shading, aeration and insulation systems. In addition, forecasting tools and applications for irrigation designed for end-user consultation (i.e. for farmers), are currently being used in order to face water scarcity or prevent floods, while securing good interventions on water volumes to be used to obtain quality products and saving water resources (Irrinet, Canale Emiliano Romagnolo).[52]

3.3 Mitigation benefits achieved

In the agricultural sector, mitigation is a dispute that has a broad spectrum of solutions, some of which have been consolidated and globally recognized by the scientific community. At the national level, the primary mitigation solutions derive from European policies oriented toward programmes reducing emissions in the agricultural sector, such as the EU climate and energy package adopted in 2009.[53] In addition, Italy must achieve binding national limitation targets for GHG emissions, as well as for the "Effort Sharing Decision" from sectors not covered by the EU Emissions Trading System (ETS).[54]
According to IPCC, agriculture has a higher potential if compared to other economic activities due to the unique potential to act as a sink for carbon storage in the soils and forests, accounting for a significant mitigation potential estimated at 5.5-6 Gigatons of CO2 equivalent by 2030 (IPCC, data estimation started in 2007). Currently, analyzing the EU system of "Monitoring, Reporting and Verification (MRV)", it remains difficult to make a correct estimation of mitigation potential, as carbon sequestration and emission balances have a large number of variables (Paustian et al., 2004). Nonetheless, the scientific community agrees that in unprotected soils, the loss in organic substance is higher than that accumulated. Conservation Agriculture, while consolidating and increasing the stock of organic matter, can significantly reduce CO_2 emissions and contribute to sequestration of the organic substance (López-Bellido *et al.*, 2010).

[51] Legislative Decree 102/2004
[52] http://www.irriframe.it/irriframe/home/Index_er
[53] The EU climate and energy package has been adopted in 2009 to implement the 20-20-20 targets endorsed by EU leaders in 2007. Compared to 1990 by 2020 there should be a 20 % reduction of GHG emissions, a 20 % share of renewables in EU energy consumption, and energy improvement by 20 %.
[54] https://ec.europa.eu/clima/policies/ets_en

Thus, mitigation barriers persist at the socio-economic levels not only in consumer awareness (e.g. choice of products with higher environmental impact) or etic consideration on economic growth, but also in loss of competitiveness and large economic costs for sustainable techniques.
As presented mitigation policies and tools are diversified according to the principle that the mitigation measure-adapted strategies influence the choice of instruments for reaching prefixed objectives. Incentives and commitments contribute to benefit achievements particularly for voluntary agreements, such as information campaigns, labelling, use of economic subsidies and agri-environmental payments.

3.4 Other co-benefits achieved (economic growth, jobs etc.)

According to recent studies multiple benefits arose from climate-smart agriculture practices, in addition to the development of resilience to climate change ravages, reduction of anthropic pressures and enhancement of best practices. The global restoration and amelioration of natural habitats around exploitations and farms, contributes to the valorization of landscapes and natural resources, with consequent socio-economic development. In addition to the environmental benefits of reduced pollutant presence and persistence and consequent increase in biodiversity, the local economy of many Italian regions benefit from CSA through rural tourism development and education to heritage.[55]

Through this lens, the multifunctionality of the farm plays a prominent role in society; according to CAP, "agriculture plays complementarily within society beyond its role as food producer, including the supply of public goods such as food security, sustainable development, environmental protection, vitality of the development of rural areas and the maintenance of a general balance within society between farmers' incomes and incomes of people in other occupations".
Globally, analysis of agricultural sub-sectors revealed a growth of 47% in conservation tillage in the five-year period 2008-2013. At the national level, conservation practices are employed on 0.38 million hectares, which is a noteworthy achievement considering that it indicates a growth of 450% in five years (FAO, 2016). Data on CA adoption in Italy are not officially reported. The unique source of information is represented by the Agricultural Census who in 2010 surveyed the adoption of No Tillage (NT) practices in 52,128 holdings over a surface of approximately 290 hectares of arable land. Available data, however, are not clear as to whether these NT practices are adopted as part of continuous CA farming systems, or merely as a sporadic alternative to conventional tillage practices[56].
Fuel savings, around 80/100 liters of diesel per hectare, result in additional economic efficiency, with economic savings of EUR 250-300 per hectare (Aigacos, 2017), while estimations on job rate show that NT farms in Italy employ around 210,000 operators (average 4.1/farm vs 3.8/farm under conventional tillage practices) for a total of approximately 28.5 million working days per year.[57]

[55] Climate-Smart Agriculture Sourcebook, FAO 2013

[56] Source: Belliggiano A., Levoli C., Marandola D., Romagnoli L. Cooperating for sustainability: the role of farmers' networks in spreading Conservation Agriculture practices beyond No-Till in Italy. Proceedings of the LIV SIDEA Congress (2017).

[57] Elaboration on 2010 Census Dataset provided by Dr. Concetta Cardillo (CREA).

4. Challenges and opportunities for further implementation of CSA

The section identifies opportunities for further CSA activity in each country beyond what currently exists.

4.1 Challenges to implementation or adoption

Climate-smart agriculture practices in Italy are still recent and need time and effort to be capitalised upon, and to enter into use throughout the country, especially at the local level. In particular, time issue is a sensitive element particularly while analysing the adoption of such sustainable techniques. For example, in order to obtain agricultural productions by conservative methods, as in arable field-scale crops, it is necessary to wait for a period of soil adaptation of about 6-8 years, during which period the soil must not be turned. Although recent studies have shown the environmental and economic values of aforesaid practices and policies, the use of consolidated systems, such as conventional agriculture, require less efforts from the agricultural sectors.[58]
Cost-related challenges are particularly evident in more remote and rural areas, where transition is happening but require more assistance in facing related risks. Analysis and monitoring of ongoing projects, such as 2016 financed projects in the Emilia-Romagna region (RDP 2014-2010, Measure 16.01.01), present concrete examples of capitalization of experience, supporting knowledge sharing and best practices, while developing new solutions and strategies.
Entrepreneurial training proposals and calls are continuously available as well, thanks to the support of public resources both at national and local levels (some of which of up to 90%). Access to funds, technical assistance in the transition, as well as in structural adjustments and innovation adoption, are crucial in increasing the development of CSA. It remains important to support initiatives other novel projects of the current national programming, such as the Operational Innovation Operations (GOIs), keen on developing participation of farms in establishing best practices, products, processes and innovative technologies.

Training and mobility should be enhanced among agricultural companies, agro-industry, associations and the scientific community in order to overcome critical issues and develop participatory approaches which include farmers in decision making and strategizing.

Lastly, notice should be paid to risk management, as the full adoption of new techniques is often perceived as an economic threat to overcome, which is also linked to criticism and concerns about CSA that leads to limited willingness to build partnerships and collaboration. It is important to overcome the possibility of scarce interest, especially at the local level, and to establish mechanisms promoting stakeholder engagement and enhance dialogue among different actors.

4.2 Lessons from evidence uncovered in the case study

The major achievements are related to carbon footprint reduction and particularly:

- Increasing production efficiency with sustainable intensification that increments production through a more efficient use of inputs;
- reducing emissions by optimising nitrogen fertilisation (e.g. amount, timing, precision technologies, model of distribution especially for livestock manure), and the use of agrochemicals and water;

[58] http://agricoltura.regione.emilia-romagna.it/archivio-agricoltura/2016/dicembre-2016/supplemento-n-63-dicembre-2016

- producing and saving energy while increasing the energy efficiency of machines used, as well as installation of power plants from renewable sources, such as solar;
- carbon sequestration from the atmosphere through agricultural practices that preserve soil fertility and increase organic matter content (e.g. conservation agriculture).

Land management should aim at restoring biomass and biodiversity, particularly by decreasing the intensity of soil tillage, adopting combined and multi-stratification cultivation of fields. Thus, minimum and zero tillage and other sustainable techniques that together with the use of differentiated mechanical technologies for each type of agriculture and farming activity, constitute the necessary support to the correct and viable development of CSA. Support of knowledge transfer and communication, in addition to good governance, remain the core instruments to local preparedness and awareness.

4.3 Harmful practices or gaps in implementation that could be improved by specific interventions of climate-smart/sustainable practices

The analysed practices and policies have underlined the requirement of consultation and transversal and multilayered action for attaining results and overcoming barriers. Some of the major limits are still encountered in technology gaps in regional areas willing to continuously adopting conservation agriculture. Some of the envisioned solutions are feasible for vertical tillage (e.g. processing of first 5 centimeters of arable soil) when applied in pre-sowing, and would be helpful in continuing use of conventional seed drills instead of providing additional specific equipment. Moreover, a portion of cover crops could be allocated to markets, while sub-irrigation can be particularly convenient.

Damaging techniques put excessive pressure on production within specific sectors, so climate-smart intervention should aim at reinforcing resilience. Also, from an economic perspective, some eligible funds are not often fully utilized due to a certain degree of a lack of preparedness and expertise. Moreover, regions face problems in trying to avoid the risk of allocating or receiving a double payment (double funding) for different measures of commitments in the same agricultural area or to the same beneficiaries for the same measures or same measures for different funds. The definition of land area, funds and beneficiaries eligible for payment requires specific mapping, attention and rapid response.

In addition, the inadequacy of ad hoc credit turns into a lack of investment, or perfunctory maintenance of ongoing activities. The phenomenon of "Credit Crunch" began to plunge Italy into increasing internal vulnerability. Recent investment initiatives are sustaining business self-financing, and in some cases direct access to capital and markets. The redesign of systems is also important in preventing consumer vice, and in encouraging sustainable purchases with consequent increase of awareness.

The fragmentation of policies, rules and access to correct information hampers the adoption of CSA technologies. Moreover, policymakers are not entirely integrating CSA challenges into their local policy development, and specifically, financial policy tools are not currently connected to solutions. Hence, the problem of availability and time series data should be overcome with ad hoc data collection and harmonization in order to avoid data inadequacy. An example of this occured in 2008-2012, when despite the potential positive role of climate change mitigation policies for

agriculture, Italy decided not to count on this sector, due to the lack of data required for the calculation (according to the Kyoto Protocol methodologies).[59]

5. Outlook/conclusion

5.1 Proposed next steps for Knowledge Action Group to address specific challenges/gaps related to knowledge sharing, capacity building, and extension.

The heterogeneity of multifacing policies and multilevel projects characterizing the Italian framework on CSA often lead to a lack of cohesion among drivers and actors. In particular, it is important to support and secure the know-how in order to avoid short circuits in the adoption of best practices pathways. In fact, there is very often consistent presence and abundance of innovation, availability of funds and means, but the adoption is not pursued because of a mistrust of local entities (i.e. farmers). Good quality and availability of knowledge is crucial in helping in the transition, thus ad hoc actions and initiatives aiming at increasing knowledge and promoting research and development should be solicited.

In this regard, actions in support of knowledge development on the field, aiming also at valorizing existing local knowledge, while reinforcing the collaboration with researchers and experts, should be pursued. Innovation in networking and cooperation activities could represent a valid support in the transition to CSA, creating trust and securing best practices. Hence, renewal and transformation would aim at capitalizing on best practices via vocational training.

5.2. Proposed next steps for Enabling Environment Action Group to address specific challenges/gaps related to policy creation and 'whole of governments' buy-in

According to similar traits and results of the presented policies and activities, a range of potential solutions were proposed:

- A greater engagement with potential users earlier in the innovation process, as well as ensuring sharing of information via extension channels and communication activities, in particular by linking with universities, technical bodies and national institutions.
- Policymakers also have a role to play in climate-smart agro-technological innovation; the researchers suggest traditional supply-side measures (such as state support for start-ups) and equivalent demand-side measures (such as tax breaks) could reduce cost and increase return on investment for users.
- Policies at the regional and national level need to be compatible with CSA objectives and their ability to boost the development and adoption of CSA technological innovation. More generally, to facilitate the selection and adoption of CSA technologies, awareness of CSA needs to be increased, as well as the collaboration between farmers, industry and technology providers.
- Appropriate education programmes and awareness raising campaigns would better prepare technology providers to address the market needs of their customers and end-users for the adoption of these technologies. The identification of knowledge needs for CSA and priority areas of intervention should be enhanced through consultative and

[59] White Book, MiPAAF, August 2011.

participatory approaches, as well as promotion of data and results (e.g. knowledge products, workshops).

5.3 Proposed next steps for Investment Action Group to address specific challenges/gaps related to investment and financial flows

Providers should be accompanied and assisted in developing business models and in demonstrating the benefits of their technologies, potentially with a branding/labelling scheme, to provide reassurance to end-users. Some suggested next steps for the Investment Action Group are as follow:

- A better balance between costs and benefits of technology adoption throughout the supply chain should be estimated.
- Capacity building and fair access to funds should be guaranteed through ad hoc instruments, so information sharing and consultation will be essential.
- The validation of a risk management index could be relevant in assessing economic risks and benefits and preventing criticism.
- The possibility of limited financial support often leads to a deficiency in finalizing projects and activities, so a correct mapping of financial instruments and possibilities will guarantee a higher success rate.

5.4 Proposed next steps for GACSA and how it can support addressing the challenges and gaps uncovered in the case study

Partnership and governance with GASCA is essential for networking and reputation-building, with the scope of enhancing knowledge, investment and financing opportunities, while providing specific policy support and general assessment for better development. Moreover, it will crucial to improve the adoption of tools and methodologies in order to allow national and local stakeholders and decision-makers to identify and further adopt appropriate practices, technologies and innovative farming systems addressing food security and climate change related issues. In particular, the support of cooperative activities, such as consultations, workshops and specific engagement of groups (e.g. Farmers, NGOs, civil society, private sector, etc.) in alliance with technical expertise, remain a valid support in ensuring ownership and enhancing knowledge.

6. Further reading and information (annex methodology)

Methodology

The case study has been elaborated from a consultation process begun in January 2017 and involving different stakeholders and representatives of international and national institutions, regional entities, researchers, private sector and civil society.

The main objective of this study was to present current policies in the Italian framework and focusing on Climate-Smart Agriculture (CSA). In particular, the scope was not only to showcase current national policies but to present a critical evaluation with the additional aim of overcoming barriers and focusing on challenges and areas of improvement.

This study is the result of a qualitative and quantitative methodology herein used to describe the process of transition, adoption and scaling-up of CSA in the Italian territory. The main challenges resided in the harmonization of the different contributions from different entities and the need to find clear common goals. The complexity of methodologies and activities presented throughout this study fully reflected the variety and specificity of the Italian policy landscape. Thus, the study presented a multitude of elaborated funding systems and projects that required an intensive process of research.

Quantitative and qualitative data have been validated before use, and are mainly derived from national and international statistics. The most recent time series at the time of finalization have been consulted. Nevertheless, some data and results are derived from grey literature, since some projects are still in process and require *ex post* analysis.

Along with the presentation of pilot projects and best practices from research institutions and regions, emphasis has been given to Conservation Agriculture as the current main national focus, with regard to CSA objectives. The additional value of the study was not only to harmonize, highlight and capitalise national projects and policies, but also to link them via a capacity-building process to the international stage.

7. Bibliography

Online consultations

http://www.crea.gov.it/wp-content/uploads/2016/02/Itaconta-2015-def-WEB-2.pdf, June 2017.

https://ec.europa.eu/clima/sites/clima/files/docs/eu_strategy_en.pdf, March 2017.

https://ec.europa.eu/agriculture/rural-development-2014-2020_en, July 2017.

http://www.reterurale.it/flex/cm/pages/ServeBLOB.php/L/EN/IDPagina/3490, May 2017.

http://ec.europa.eu/research/era/era-net-in-horizon-2020_en.html, July 2017.

http://www.minambiente.it/sites/default/files/archivio/allegati/sviluppo_sostenibile/MOU_establishment international_alliance_climate-smart-agricolture.pdf, July 2017.

http://giovanimpresa.coldiretti.it/, June 2017.

http://www.rica.inea.it/public/it/index.php, March 2017.

https://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/5090, July 2017.

https://ec.europa.eu/agriculture/direct-support/cross-compliance_en, June 2017.

http://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:legge:2015-12-28;221, July, 2017.

http://www.casi2020.eu/blog/posts/sustainability-and-innovation-in-the-italian-agri-food-cluster, May 2016.

http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=4564&docType=pdf, June 2017.

http://partecipazione.regione.emilia-romagna.it/, March 2017.

http://agricolture.regione.emilia-romagna.it/climatechanger/temi/database, June 2017.

http://www.cia.it/approfondimenti-ufficio-studi, June 2017.

https://ec.europa.eu/clima/policies/ets_en, May 2017.

http://agricoltura.regione.emilia-romagna.it/archivio-agricoltura/2016/dicembre-2016/supplemento-n-63-dicembre-2016, March 2017.

http://esdac.jrc.ec.europa.eu, June 2017.

https://www.itaeuropaunita.com, May 2017.

http://www.enea.it/en/home-luglio-2015?set_language=en&cl=en, March 2017.

http://goi.crpa.it/nqcontent.cfm?a_id=14990, June 2017.

http://www.irriframe.it/irriframe/home/Index_er, September 2017.

https://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/202,September 2017.

http://www.ibimet.cnr.it/?set_language=en, September 2017.

http://agricoltura.regione.emilia-romagna.it/climatechanger, September, 2017

References

1. Belligiano A., Levoli C., Marandola D., Romagnoli L., 2017, Coopearting for sustainability: the role of farmers'network in spreading Conservation Agriculture practices beyond No-Till in Italy. Proceedigs of the LIV SIDEA Congress.

2. Bommarco, R., Kleijn, D. and Potts, S.G. (2013) Ecological Intensification: Harnessing Ecosystem Services for Food Security. Trends in Ecology & Evolution, 28, 230-238.
3. INEA, 2012, L'agricoltura italiana conta, Rapporto INEA.

4. Standard Arjen Y. Hoekstra A.Y., Chapagain A.k., Aldaya M.M., Mekonnen M.M., 2011, The Water Footprint Assessment Manual Setting the Global Standard, Earthscan.

5. Lamatra L., Suciu N.A., Novelli E., Trevisan M., 2014, A new approach to assessing the water footprint of wine: An Italian case study. Science of the Total Environment. Water Footprint Network. 490 pag. 748-756.

6. Long, Blok & Coninx (2016) Barriers to the adoption and diffusion of technological innovations for climate-smart agriculture in Europe: evidence from the Netherlands, France, Switzerland and Italy. In Journal of Cleaner Production, 112, 9-21.

7. López-Bellido *et al*., 2001, Effects of crop rotation and nitrogen fertilization on soil nitrate and wheat yield under rainfed Mediterranean conditions, INRA, EDP Sciences.

8. Marandola D., Monteleone A., 2016, PSR 2014-2020 puntano sulla semina su sodo, Edizioni l'Informatore Agrario.

9. Marandola D., 2016, Agricoltura Conservativa, la situazione in Pianura Padana, Edizioni l'Informatore Agrario.

10. Marandola D., Marongiu S., 2012, Più efficienza al Centro-sud con la semina su sodo. L'Informatore Agrario 40/2012.

11. Member State communication following Art. 19 of Regulation (EU) 2009/436 elaborated by DG Agri G2.

12. MiPAAF, La Strategia per L'innovazione e la Ricerca nel Settore Agricolo Alimentare e Forestale 2014-2020. Adopted on 2015 by D.Lgs n. 7139 on 1 Aprile 2015.

13. MiPAAF, August 2011, Sfide e opportunità dello sviluppo rurale per la mitigazione e l'adattamento ai cambiamenti climatici, Libro Bianco.

14. Panagos, P., Borrelli, P., Robinson, D.A. Common Agricultural Policy: Tackling soil loss across Europe. Nature 526, 195 (07 October 2015), doi:10.1038/526195d.

15. Panagos P., Van Liedekerke M., Jones A., Montanarella L., “European Soil Data Centre: Response to European policy support and public data requirements”; (2012) Land Use Policy, 29 (2), pp. 329-338. doi:10.1016/j.landusepol.2011.07.003.

16. Paustian K. *et al*., Climate-smart soils, Nature 532, 49–57 (07 April 2016).

17. European Charter for Rural Areas, Doc. 7507, 20 March 1996.

18. Food and Agriculture Organization of the United Nations, Climate-Smart Agriculture Sourcebook, ISBN 978-92-5-107720-7 (print) E-ISBN 978-92-5-107721-4 (PDF), FAO 2013.

19. Green Entrepreneurship in Italy. Regional Activity Centre for Cleaner Production (CAR/PL), December 2011.

20. IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

21. ISTAT Annual Report, 2016

22. ISTAT Annual Report, 2017

23. Osservatorio nazionale distretti italiani. Il nuovo respiro dei distretti tra ripresa e riposizionamento. Rapporto 2015.

24. 2020 Climate and Energy Package – Directive 2009/29/EC, Directive 2009/28/EC, Directive 2009/31/EC and Decision No. 406/2009/EC of the Parliament and the Council.