Monitoring and Evaluation of Climate-Smart Agriculture

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Abstract

This paper addresses the concept of Climate-Smart Agriculture (CSA), which aims at reducing agriculture's negative contributions to climate change, rendering more resilient farming practices in changing conditions, while sustainably increasing its productivity to face the increasing demand of agricultural products of a growing world population. The aim of the paper is to give recommendations for improving the monitoring and evaluation (M&E) guidelines already created by the Food and Agriculture Organization (FAO) for evaluating the performance of CSA, and additionally, to give recommendations on how this framework could be linked to the monitoring of progress towards the Sustainable Development Goals (SDGs) for use by national governments. Therefore, we conducted qualitative interviews with farmers in Austria and Italy as well as with two experts, resulting in several main findings and recommendations regarding M&E of CSA and the agricultural sector in general.

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by Alice Piccolo & Kathrin Raunig

1 Introduction

We are witnessing a time when access to healthy food is still not a universal condition, and the effects of human-induced environmental changes have become very frequent; paradoxically, the waste of resources due to inefficient production and consumption of food products seems unstoppable. Currently, 821 million people are hungry (FAO et al., 2019), and the demand for food is expected to grow in relative and absolute terms, as the global population is expected to reach 9 billion people by 2050 (Godfray et al., 2010), and middle income countries are experiencing an unprecedented growth in pro capita income and are therefore consuming more resource-intensive food (Zhou, 2012). As a consequence, by the middle of this century, the world will need between 70% to 100% more food (Godfray et al., 2010).

Agriculture is the most land-intensive sector across the globe, as between 1,2–1,5 billion hectares are under crops, 3,5 billion hectares for grazing, and an additional 4 billion hectares of forests are used for human subsistence (Howden e al., 2007). Above all, agriculture "[…] in its many different forms and locations remains highly sensitive to climate variations, the dominant source of the overall interannual variability of production in many regions and a continuing source of disruption to ecosystem services" (Howden e al., 2007). Because of this tight dependence, a changing climate can have serious impacts on agricultural production, and everything related to it (Howden e al., 2007). Thus, it is essential to find ways to enable this sector to reduce its negative contributions to climate change, to render more resilient adaptation conditions, while sustainably increasing its productivity to face the growing population. The latter are the main features characterizing the concept of Climate-Smart Agriculture (CSA), which is the focus of this research. The aim of the paper is to give recommendations for improving the monitoring and evaluation (M&E) guidelines already created by the Food and Agriculture organization (FAO) for evaluating the performance of CSA, and additionally, to give recommendations on how this framework

could be linked to the monitoring of progress towards the Sustainable Development Goals (SDGs) for use by national governments.

1.1 Climate Smart Agriculture

The CSA concept includes three goals, or 'pillars': (1) sustainably increase agricultural productivity and income as well as ensure food security; (2) adapt to climate change and foster resilience to natural resources pressure; and (3) contribute to the reduction or removal of greenhouse gas (GHG) emissions of agriculture, forestry, fisheries and aquaculture (FAO, 2017). Especially in developing countries, agriculture still often accounts for more than 30% of GDP (World Bank, 2019). Consequently, because of the many implications it has in different socio-economic and ecological spheres, it can play a pivotal role in achieving the 2030 Agenda for Sustainable Development (FAO, 2016). A multitude of disciplines have implications with the agriculture sector (Wiek et al., 2011), and obviously benefit from a general societal increasing concern regarding social and environmental sustainability, as this can translate into commitments both in the public and private sectors supporting their fields of expertise. Given the interlinkages between CSA and the Sustainable Development Goals (SDGs), it is important to assess the contribution of CSA to achieve the SDGs in order to inform decision-makers on the synergies or potential trade-offs of investments in CSA. Implementing the three pillars of CSA entails different consequences on different SDGs (FAO, 2019a). Clearly, improving agricultural production qualitatively and quantitatively (SDG 2) can bring about positive impacts on multiple SDGs, for instance, alleviating poverty (SDG 1) and hunger (SDG 2). Farmer families could afford a more nutritious diet and have enough income for sanitary treatment when necessary (SDG 3). Moreover, when a process becomes more efficient it often requires less farm operations, which might mean less labor-intensive jobs (SDG 8) and shorter working times resulting in more time for other educational (SDG 4), economic and/or social activities, especially for more vulnerable individuals like children and women (SDG 5 and SDG 10). Additionally, there are environmental benefits ensuing more efficient resource use in the production and consumption phases of the supply chain (SDG 12), e.g. a lower impact on water resources (SDG 6), the marine (SDG 14) and terrestrial ecosystems (SDG 15), a reduction in greenhouse gas emissions overall (SDG 13), and mitigation of international conflicts for

resources (SDG 16)[1]. On the other hand, it is possible that the SDGs and the CSA goals may conflict and lead to an increase in the use of resources. For example, if a farmer notices that by adopting a more efficient method with the same resources s/he could cultivate a wider piece of land, s/he might do so, which is positive for his/her own family well-being in the short run, but detrimental for the environment. This so-called "rebound effect" (Hertwich, 2008) is a common phenomenon and can be identified by considering the three dimensions of sustainability (economic, social and environmental). These trade-offs are often unavoidable, and policymakers are confronted with the challenge of finding a compromise (FAO, 2017), which is one of the reasons why it is important to have suitable and accurate guidelines to measure and monitor CSA and its effects on the SDGs.

1.2 Aim of Research and Research Questions

Scientific research into M&E of CSA as well as the interlinkages between CSA and the SDGs is still at a preliminary stage. The aim of our research project is to understand which indicators are already used by farms and how they could contribute to developing a useful M&E framework to evaluate the performance of CSA projects. M&E indicators are important in order to inform decision-makers and sponsors on required policies as well as the benefits or potential trade-offs that investing in CSA could bring about. In our research we assume that some existing farms or projects are already implementing actions and measuring progress regarding at least one of the three pillars of CSA, but do not label them as such. By identifying these actors, our research hopefully does not only add to the existing CSA-projects database, but also may contribute to the improvement of the current M&E guidelines of FAO (FAO, 2019b) by recommending lessons learned from the M&E processes of the identified farms. Furthermore, the interviewed farmers may have already linked their CSA-activities to the SDGs and, consequently, could contribute to the methods and the framework for linking CSA-activities to the SDGs.

Research questions:

- Which practices do sustainable, agricultural projects or farms follow, that also align to the three pillars of CSA?

[1] See also: UN Environment on CSA-initiatives in Uganda and Cameroon to SDG 17; UN Women on projects in Mali and Malawi to empower women thanks to sustainable agriculture; World Bank Group's support countries in developing metrics and indicators to monitor and evaluate CSA and its contribution to the SDGs.

    - Which indicators relevant to the three pillars of CSA do these farms or projects measure?
- Which lessons can be learned from these farms for the development of an M&E framework for CSA by FAO?
- Which lessons can be learned from these farms for linking CSA to the SDGs and how can they contribute to measuring a country's performance on the SDGs?
    - How do the projects or farms link their indicators to the SDGs or, in case they do not, how could they be linked to the SDGs?
    - How could data collected through M&E of CSA be aggregated so it can be used for the M&E of progress in reaching the SDGs?

Before answering our research questions in chapter 4 *Results* and giving recommendations to FAO in Chapter 5 *Main Findings and Recommendations*, the status quo of scientific research regarding CSA will be dealt with in chapter 2 *Literature Review*. In chapter 3 *Methodology: Data Collection and Analysis*, we present the methods used for data collection and analysis. Our research is concluded in chapter 6 *Final Remarks*.

2 Literature Review

CSA is a recent concept and, although a lot of research has already been undertaken, more effort should be placed on investigating CSA measures, including their benefits, trade-offs, and significance for achieving the SDGs. A summary of the most promising work on CSA measures, their monitoring and evaluation, as well as their interlinkages to the SDGs, is presented in this chapter.

In general, in order to develop appropriate measures and define a baseline for M&E, data on local and regional conditions must be obtained through field surveys, focus group discussions, biophysical experiments (Shirsath et al., 2017), geoinformation, Earth observations, climate models, economic assessments and models. All CSA measures should align to the three pillars of CSA, although it is acknowledged that 'triple wins' for all three pillars at the same time are not always possible and trade-offs have to be accepted. Mitigation measures include greenhouse gas (GHG) emission reductions, carbon sink enhancements and fossil fuel offsets. Fossil fuel offsets encompass that farmers buy carbon credits to compensate emissions from their production systems or replace fossil fuels with energy from renewable sources. Adaptation measures include technological advancements, adaptive

farming practices and financial management. It is necessary to consider both supply- and demand-side measures of CSA when assessing the contribution of practices to the three pillars of CSA. On the supply side are measures occurring on the farms themselves, while measures on the demand-side of agricultural production correspond to the demand of retailers and consumers of agricultural products. However, the benefits of these measures are often site-dependent and differ according to agricultural practices, environmental conditions, or the production and consumption of specific products. Furthermore, CSA measures are doubtlessly more effective if accompanied by changes in consumer behavior. Therefore, interdisciplinary cooperation is necessary to develop simultaneous policy and market incentives to link supply and demand side (Scherer and Verburg, 2017).

Although CSA promises potential benefits for climate change adaptation and mitigation as well as a sustainable increase in productivity, the adoption of CSA has been limited. The main reasons for the lack of adoption include socio-demographic and economic conditions, agro-ecological scales and the nature of the practices.[2] Putting aside the challenge to push CSA adoption, the potential trade-offs among diverse goals is one of the reasons it is important to have suitable and accurate guidelines to measure and monitor CSA and its effects on the SDGs. The Climate-Smart Agriculture Sourcebook (FAO, 2017) provides some guidelines on the steps to monitor and evaluate CSA projects. Measuring the multiple effects of CSA is not easy, and there is no agreed set of indicators. Nonetheless, there are three indices which are used frequently, for instance by the World Bank for their CSA projects: The Policy Index, the Technology Index, and the Results Index (World Bank Group, 2016). They are used respectively to measure a country's institutional readiness to support CSA interventions, as an ex ante measure of the ability of CSA interventions to reach CSA's three objectives, and to measure a project's success to reach CSA's objectives (FAO, 2017). As a matter of fact, there are some aspects, such as adaptation and resilience to climate change that are scarcely measurable quantitatively. In order to find qualitative indicators for them (and thus, for pillar 2), it is fundamental to have a holistic perspective of the impacts of climate change on men and women's livelihoods and food security, and a solid understanding of what is meant by 'resilience' in a particular context.

[2] See e.g. Lan et al. (2018) for adoption barriers on different scales; see e.g. Glemarec (2017) for gender-specific barriers;

In addition to measuring the effects of actions taken on a project level to provide policymakers with recommendations, a national or international M&E framework is also needed to assess global progress in reaching the UN's SDGs. The ways in which sustainable agriculture is embedded in the SDGs and the status quo of monitoring standards such as certification and labelling, self-assessment tools, etc. – are highly fragmented between countries but also within the agricultural system. They exist e.g. only in specific parts of value chains of 'sustainable' products, especially where retailers and processors are requiring certified products from the farmers for market entry. In addition, there are contrasting visions of sustainable agriculture: one, which focuses on eco-efficiencies, and another, which focuses on the functional integrity and maintenance of resilient agricultural and ecological systems. Thus, different forms of policies exist globally, and the UN's Forum on Sustainability Standards tries to find common standards through the facilitation of multi-stakeholder platforms on voluntary sustainability standards. Furthermore, global trends such as urbanization, peri-urban and urban agriculture are expected to play a significant role in the future. Answers to questions regarding the politics of data generation and investments for indicator measurement, monitoring and evaluating SDG achievement are needed (Williams et al., 2018).

There are different local or regional frameworks for monitoring and evaluating CSA in different ecosystems and contexts.[3] These M&E frameworks are mostly developed according to the prevalent conditions and CSA-projects, which is why integration on a national level and embedding into SDGs are challenging. To develop a general M&E framework for CSA, lessons learned on M&E frameworks from other sectors might be helpful.[4] The Research Program on Climate Change, Agriculture and Food Security (CCAFS) has developed a very thorough set of indicators for every CSA goal, albeit not related to the SDGs (CCAFS, 2019). Furthermore, the International Fund for Agricultural Development (IFAD)'s adaptation

[3] see e.g. on CSA in Kenya: Berre et al., 2016; on biodiversity: Burton et al., 2014; on climate change adaptation by smallholder farms in Timor-Leste: Chandra et al., 2016; on terrestrial ecosystem resilience: De Bremond and Engle, 2014; on dry beans in Central America and dry beans and maize in east Africa: Eitzinger, 2018; on electronic governance for sustainable development: Estevez et al., 2013; on cropping systems: Khatri-Chhetri et al., 2019; on M&E of Multi-Stakeholder Platforms: Kusters et al., 2018; on integrated coastal management in the Netherlands: Vugteveen et al., 2014; on coral reefs in the U.S. see e.g. West et al., 2017; on Ethiopia: Woolf et al., 2018;

[4] see e.g. on energy development projects in Ethiopia: Colombo et al., 2018; on energy in Italy: Delponte et al., 2017; on a resilience indicator framework: Engle et al., 2014; on city sustainability indicators: Gibberd, 2017; on the integration of climate change adaptation and disaster risk reduction: Pilli-Sihvola and Väätäinen-Chimpuku, 2016; on indicators for SDG 14: Recuero Virto, 2018;

program for small farmers developed a set of indicators that is slated for adaptation to the SDGs (IFAD, 2012). Also, Syngenta has built a Good Growth Plan formed by a 6 commitments scheme, including different indicators linked to different SDGs (SYNGENTA, 2018). Rodríguez (2018) identified the contributions of sustainable agriculture to the SDGs, in a set of SDG targets and indicators related to CSA (Rodríguez, 2018).

An integrated M&E framework, with which organizations and countries can track their progress in CSA and its contribution to reaching the SDGs, is still missing. Furthermore, the low adoption rate of the concept of CSA itself might be a reason for the lack of scientific research on the interlinkages between CSA and the SDGs. However, every country and its policymakers require a solid M&E framework to track their progress concerning CSA and its contribution to the SDGs to set conducive measures. Therefore, FAO is looking into how M&E frameworks for CSA can be linked to the SDGs in order to support countries in measuring and reporting progress on both CSA and SDGs.

3 Methodology: Data Collection and Analysis

After a thorough review of the existing literature, it is clear that the concept of CSA is still not widespread in the agriculture sector, especially among small or medium farms. Yet, it has a lot of commonalities with other already-established practices generally defined as "green", "sustainable", and "organic". For the purpose of this project it was assumed that sustainable, green or organic farms, apart from development programs in the field of sustainable agriculture or CSA, might have implemented actions and measured their progress aligning with at least two of the three pillars of CSA, even if not labelling them as such.

Indicators are in fact the foundations of any monitoring and evaluation approach. Hence, before building a methodological structure for our paper we needed to verify what different tasks indicators can accomplish. An 'impact indicator' measures any kind of effects produced by a development intervention, directly or indirectly, intended or not intended. An example is the percentage of population that is food insecure (FAO, 2017). Instead, an 'outcome indicator' measures the quantity of goods and/or services provided, and their efficiency (Horsch, 1997). In the case of CSA an example could be fewer greenhouse gas emissions in the production process (FAO, 2017). Finally, a 'process indicator' measures how services and goods are produced (GIZ, 2013), and it is often needed to evaluate climate change interventions to track e.g. technologies dissemination (FAO, 2017). To be efficient, indicators must have some characteristics that can be summarized with the acronym SMART:

Simple, Measurable, Attributable, Reliable and Time bound (FAO, 2017). Besides, there are four typologies of indicators relevant for climate change interventions; i.e. quantitative (e.g. the number of men and women with increased income); qualitative (e.g. beneficiary perception of a service); proxy indicators "that give an approximation of a desired measure in situations where a direct indicator is difficult to assess"; and indices, "composed from other indicators to provide a more simplified aggregate measure of change" (FAO, 2017).

Since our objective is to understand how sustainable farms are trying to monitor and evaluate their work, we believe that a qualitative approach fits our purpose better. Therefore, qualitative interviews were conducted with three farmers in Austria and two in Italy. In addition, we conducted two expert interviews to add on to our findings. Qualitative analysis is more accurate to assess the process and reasoning behind a phenomenon. In this case, it helped us to understand why a farm has selected a set of indicators over another to monitor an aspect of sustainability, or why it has chosen to commit more to one sphere of sustainability and less to others. Such decisions are case specific, and depend on the characteristics of the individual farm, in terms of history, environmental and human resources, financial capabilities and so on. To draw conclusions applicable at farm as well as country level, we must find the underlying common patterns among the interviewed parties. To do so, after collecting and transcribing our field data we analyzed it by performing a 'codification'. Codification here means that we selected a set of variables and reread all the scripts while verifying if and how these variables are mentioned. Consequently, we report interesting variables found in the results chapter and try to draw patterns between the answers given in a more concise format, remaining aware of the differences between the farms (for more clarity on all variables and the coding table, consult Annex 1 – Coding Table). A similar procedure was performed for the expert interviews. In this case, we coded comparing expert interviews, but also expert interviews with farm interviews. Once the interview data was analyzed, we looked at the results to develop recommendations for FAO and specify our most important findings. As soon as all the farms were interviewed, we realized that we had to revise our initial objective of linking the indicators used to measure CSA at farm level with the SDGs to monitor a country's performance. This was due to the fact that most of the farms interviewed barely knew the SDGs and have until now not aligned their practices and/or measurement practices to them. Therefore, we could only ask them which SDGs the farmers would link to their practices. Additionally, even the expert's interview with Professor Centofanti did not

allow us to gain more useful insights, as in her opinion, given the great diversity among countries it would be difficult to find some harmonized M&E guidelines capable of respecting this diversity.

We selected and contacted farms based on the information provided by their websites. The farms had to be engaged in at least 2 of the 3 pillars of CSA in order to be considered. Regarding the size of the sustainable farms we chose small or medium ones.

Before the interviews, a questionnaire was developed (visible in Annex 2). The first set of questions asks for general information about the farms such as size, number of employees, sources of income, agricultural products produced on the farm, etc. The second set contains specific questions on the M&E conducted by the farms which involves e.g. questions about which data is collected and how, if and how it is evaluated, if they use indicators and if the evaluation has consequences for their further activities. Notably, the second part of the questionnaire is divided into three subsections according to the three pillars of CSA. The final questions relate to the linking of CSA indicators to the SDGs and the farms' knowledge, experiences and opinions in this field. The questionnaire is a combination of open-ended, closed-ended, and multiple-choice questions. The interviews are semi-structured, meaning that we have established a scheme to follow, but we also draw on the answers given to ask some follow-up questions, to deepen or broaden a topic. The interviews were conducted in German and Italian, depending on the mother tongue of the interviewee.

One last point is that throughout the interview many specific terms and phrases are introduced, such as "Climate-Smart Agriculture", "sustainable", "resilience", "climate change mitigation", "monitoring and evaluation", "indicator", "Sustainable Development Goals", and so on (visible in Annex 2). To collect accurate and consistent data, it is important that the participants and we have a common understanding of them. Therefore, we always give definitions or ask for the interviewee's definition of the terms. In particular, for the CSA concept and pillars we provide the definitions previously reported in the literature review section. For the term 'sustainable' we ask the interviewees about their interpretation, whereas when necessary we clarify other concepts. Regarding the SDGs, to facilitate the participant's task to tell us how and which ones s/he contributes to achieve, we decided to make this visually easier by showing him/her the SDGs table and asking to cross the relevant ones.

4 Results

4.1 Farm Profiles

Given the quantity of general information gathered on the farm profiles, we included and summarized everything in Table 1 visible below. For the sake of clarity, the Austrian farms' names are: ADAMAH Biohof located near Vienna, FarmAUT1[5], located in the West of Vienna and FarmAUT2[6], located in the Northeast of Vienna. On the other hand, the Italian farms are in northeastern Italy and are called Azienda Agricola Venica & Venica and Azienda Agricola Principi di Porcia e Brugnera and they are both located in the Friuli Venezia Giulia region. They both participate in a project launched by the Italian Ministry for the Environment called VIVA to promote sustainable viticulture. In order to take part in VIVA, the businesses need to measure and respect some established thresholds of four main groups of indicators: 'air', 'water', 'vineyard' and 'territory'.

[5] The interviewee chose to be anonymous.

[6] The interviewee chose to be anonymous.

Table 1: Farm Profiles (own research).

	Austria			Italy	
Name	**ADAMAH Biohof**	**FarmAUT1**	**FarmAUT2**	**Principi di Porcia e Brugnera**	**Venica&Venica**
Position of Interviewee	Managing Director & Founder	Managing Director & Founder	Managing Director & Founder	Managing Director + Vice Director	Responsible for external communications/ events
Founding Year	1997	2006	2000	1181	1930
Organic Farming since	1997	2006	2000	Not Organic	Not Organic
Agricultural Focus	Crop Production	Mix of crop & livestock production	Crop Production	Mix of crop & livestock production	Crop Production
Production for	Producing primarily for sale	Producing primarily for sale	Producing primarily for sale	Producing mainly for sale, with some own consumption	Producing primarily for sale
Number of Employees	130	4	6 (seasonally variable)	36	29 (seasonally variable)
Average Level of Education Employees	middle (academics and unskilled workers)	skilled workers	compulsory education	middle school/high school	high school
Ownership Structure	Owned with written documentation & rented-in, leased or sharecropped with written agreement	Owned with written documentation & rented-in, leased or sharecropped with written agreement	Mainly rented-in, leased or sharecropped with written agreement & very little land owned with written documentation	Owned with written documentation & rented-in, leased or sharecropped with written agreement	Owned with written documentation & rented-in, leased or sharecropped with written agreement
Additional Income	Processing of own products, on-farm teaching, on-farm sale	Processing of own products, on-farm teaching, on-farm sale	Trading Company (for sale of products) & wind power plant (feed-in to the public grid)	Electricity from the biogas plant (feed-in to the public grid)	Agriturism/ holiday farm
Receipt of public subsidies	Yes	Yes	Yes	Yes	Yes
Viable without Subsidies?	Yes	No	Yes	No	No

4.2 Backgrounds of the Experts

Harald Grabher from Caritas is responsible for managing the development program 'sustainable land-use' and facilitating the program's projects in Ethiopia and Mozambique. They are using a landscape approach; hence, they include all villages and people within a watershed. Beside the focus on projects regarding on-farm agricultural practices and carbon offset projects, the whole landscape system and its stakeholders are included in developing, setting and evaluating practices to reach economic, social and ecological sustainability. All the projects perform M&E. Data are collected and reported by Caritas experts who are directly working in the field. At the program-level, the data are collected and aggregated, and the indicators are used to measure and evaluate their success.

Professor Tiziana Centofanti has the position of Visiting Professor at the Central European University of Budapest teaching courses on Environmental Pollution and Bioremediation Methods, Environmental Health, Agroecology, and Food Policy. She is an environmental scientist with a Ph.D. in Environmental Sciences and an M.Sc. in Agricultural Sciences. Consequently, broadly speaking she researches on agricultural and environmental sustainability issues, which specify in restoration ecology of degraded land, local institutions, and human drivers for the conservation of natural resources.

4.3 Sustainability, Climate Change and Measures Aligning to CSA

4.3.1 Definitions of and Motivation for Sustainable Farming

From the three Austrian interviewees we received three different but overlapping definitions of sustainable farming. The founder and managing director of ADAMAH defined sustainable farming as thinking and acting in cycles. The idea is, that every output should be used again in the same or another system, namely as much resources as possible should be re-used. Another important aspect of sustainable farming for him is considering next generations, namely his children and grandchildren. For the managing director of FarmAUT1 sustainable farming is done by thinking thoroughly about every work step's usefulness and consequences. The managing director of FarmAUT2 focuses on ecological, economic and social sustainability when defining sustainable farming. Sustainable farming for him means the preservation of limited ecological resources for agricultural prosperity and providing social benefits to employees. All Austrian farmers mentioned to practice organic farming by conviction. The managing director of ADAMAH acts according to the principle "be the

change you want to see in the world" and out of the responsibility he feels towards future generations. The interviewee of FarmAUT1 additionally stated to practice organic farming due to economic reasons.

The Italian interviewees answered very similarly. Principi di Porcia e Brugnera referred to circularity in production as the main strategy for sustainable farming. They explained that by reducing as much as possible what exits the production circle, it is possible to reduce the inputs because of higher efficiency, and this is what makes a farm economically, environmentally and socially sustainable. For this reason, throughout more than eight centuries of history of their business there was never a day in which they decided to become sustainable or green. Venica & Venica stressed the importance of "caring and respecting", in fact, "a sustainable farm is one that cares and respects nature and people" (O. Venica, Azienda Agricola Venica & Venica). They have also never decided to be sustainable; it is just a normal practice considering that this is a family farm and both the parents and the children of the interviewee are involved in its activities and it is in everyone's interest to preserve nature and healthy people.

In the development programs of Caritas, sustainability is defined according to the three spheres of sustainability: environment, economy and society/culture. Although the three spheres are weighted differently in the projects, they try to balance them in their projects. Harald Grabher finds the involvement and participation of all stakeholders and clients as most important for ensuring sustainability. To reach environmental sustainability, the projects only implement ecologically sustainable agricultural practices and try to reduce external inputs to e.g. gain independence from multinational corporations for seeds. Agricultural production inputs should be purchased regionally. An ecologically sustainable practice has positive effects on nature, which is defined by science. In addition, a project is considered economically sustainable, if the farmers continue the implemented practices beyond project duration and independent of financial technical support. Such practices are e.g. farming independently from chemical fertilizers, pesticides and hybrid seeds. Cultural or social sustainability is reached by working and learning together with all stakeholders. In general, the projects aim to reach the SDGs.

Professor Centofanti admitted the difficulty to define "sustainable farming" because of the complexity and numerous points of view that can be considered. However, a general definition can be that sustainable farming is a set of "practices that do not deplete social and

environmental resources." She highlights that looking at the community and at the workers and their quality of life is very important, because when people are affected negatively by their work, a farm could never be sustainable. Then, the environmental resources that should be used sensibly are soil and water, because a misuse of these two can cause great damage to the environment, to the farm's production and to the community.

4.3.2 Awareness of Climate Change and Strategies to Limit Its Effects

Regarding awareness and perception of climate change, all farmers mentioned to be aware of and perceive effects of climate change. The Austrian farmers stated phenomena such as change of parasites, damage of cultivated plants due to heat, heavier and longer periods of drought, increased frequency of hail, frost, stronger storms, temperatures over 30 degrees Celsius and a higher water demand. The Italian farmers mentioned similar observations, and some specific problems they reported were higher body temperature of cattle in summer and shorter harvesting times for the grapes. Nevertheless, Venica & Venica pointed out that it is not always possible to attribute the causes to climate change. In the case of the grapes, she said that indeed the harvesting period is shorter, but it may be due to different issues, such as the genetical developments of the plant, and reduced use of chemical products that were delaying the natural maturation of the grapes. Harald Grabher mentioned that the farmers in Ethiopia and Mozambique observe droughts in higher frequencies, longer dry spells and more difficult cultivation situations due to water shortage, soil degradation.

To cope with environmental as well as financial problems, the interviewed farmers and Harald Grabher reported some risk mitigation strategies that can be adopted by farmers, such as: information and experience exchange with farmers and experts; ownership of land - possibility of taking out a loan; insurances against natural hazards such as lightning, storms, heavy rain, etc.; expeditions for learning from other areas; producing feed reserves; being member of an interest group; sharing of machinery with other farmers; maintaining soil health; irrigation provided with renewable energy; biodiversity through avoiding monocultures, crop rotation, building soil mounds on the fields with diverse vegetation for diverse animals and reforestation, promoting bees; promotion and support of cooperatives; development and implementation of alternative practices; participation in seminars and educational activities; diversifying the production and therefore risk.

Additionally, some focused on the adoption of climate-resistant crops or livestock. Although not using them yet, the Austrian farmers do not exclude them for the future, if climate change effects will be more severe. Similarly, Venica & Venica has participated in a study performed by the University of Udine on climate-resistant vine and is considering their adoption. Instead, Principi di Porcia e Brugnera has already taken a first step, by replacing their Fresian cattle, with a mixed breed, which is more resistant to temperature shocks, produces more milk, and emits less methane. In general, the Austrian farms and Harald Grabher have a negative opinion of hybrid seeds offered by multinational corporations and the legal directives for authorization of new seeds as they are developed and tested growing in ideal conditions, whereas conditions in farmer's fields are changing from day to day. They all wish for seeds that can cope with variable conditions.

Furthermore, all farms perform daily activities to reduce or remove GHG-emissions. ADAMAH uses photovoltaic plants (PV-plants) for cooling their storage facilities and plan to use electric vehicles for delivering their products to consumers. FarmAUT1 mentioned planting trees, using renewable energies from a PV- and a solar plant as well as using wood for heating. He also considers thoughtful manure and feed management as contributing to CSA pillar 3. He argued that hay has a better carbon footprint than silage and uses a drag hose for fertilizing so that less liquid manure and ammonia is lost on the field as it is put closer on the ground. FarmAUT2 operates a wind power station and uses PV- and solar plants. However, the managing director of ADAMAH mentioned that it is often difficult to set actions contributing to CSA pillar 3 due to law. For example, he cannot plant as many trees on his land as he wishes, because it would be then considered a forest, which would have an impact on his possibilities to set future actions and receive subsidies. Both Italian farms have installed systems to harness renewable energies such as solar panels, biogas plants, biomass heater, charger stations for electric vehicles, different technologies to reduce the use of tractors and machines (functioning with fossil fuels). Additionally, as said, more than half of the land of Venica & Venica is covered by woods sequestering a great amount of carbon. The two farms are not paying for carbon offset programs off their own farms, even if they are committed in spreading their message to have more sustainable farms aiming at reducing their environmental impacts. ADAMAH is the only Austrian farm involved in carbon offset programs. They compensate the GHG-emission of their delivery vehicles and flights. The

managing director of FarmAUT2 would be interested in offering a carbon offset program himself. Caritas already offers carbon offset opportunities.

4.3.3 Co-benefits and Trade-offs between Measures Regarding the Three Pillars of CSA

All the farmers see synergies on their farms regarding the three pillars of CSA. The managing director of ADAMAH mentioned that their direct marketing, which includes thorough planning of their delivery routes, is more economic for them and their customers and also is more ecological as a diploma thesis conducted on their work demonstrated that only visiting a farmer's market by foot would cause fewer GHG-emissions than their way of direct selling. Furthermore, through their close contact to customers and interested parties they can inform them about organic agriculture, resilience and other topics and therefore influence their customers' opinion about agriculture. The customers not only benefit from healthy food but also support a healthy environment by buying their products. However, again he finds certain laws obstructive for many useful measures, which contribute to synergies. In his opinion, policies often even lead to trade-offs between the three pillars of CSA. Also, the managing director of FarmAUT1 mentioned the same benefits of their direct selling. In addition, by allowing students to visit their farms they raise awareness on environmental issues, but also benefit from drawing attention to their products. Also, cultivating different varieties of grass, which are easily digestible for their cows, enhances biodiversity, but also increases productivity and therefore income. Flexible use of fields in cooperation with a neighbor enhances the ecological condition as well as productivity and income. In his opinion, also the use of renewable energy contributes to all three pillars of CSA. Finally, through trying to only use fields near the farm leads to increased income, productivity and to fewer emissions. In the opinion of the managing director of FarmAUT2, his healthy soil leads to higher profitability, productivity, resilience and captures carbon. All in all, the Italian farms relate to what reported by ADAMAH regarding the synergies between the three pillars resulting from their commitment of communicating their sustainable practices to their customers, colleagues of the sector, politicians, students by participating in research projects, and the community as a whole. As an example, Venica & Venica in 2019 started publishing a sustainability report, to communicate their message better, and additionally said that they are trying to involve as many other farms as possible in the VIVA project, to reach more consumers and have more farms that choose to work in a cleaner way. Principi di Porcia e Brugnera repeated multiple times that to them "efficiency has become resilience" (A.

Quellerba, Principi di Porcia e Brugnera) connecting the first and the second pillar, and to them efficiency is a consequence of "closing the circle". That is, when an economic actor is able to effectively use and reuse the resources available, and to revalorize the discards of a process and reinsert them in the latter, s/he becomes stronger and more ready to face any potential risk, i.e. more resilient. One of their ways of closing the circle is using the manure of the cattle in the biogas plant to produce clean electricity for them and for other users, and finally using the material resulting from the anaerobic digestion to fertilize the fields. Consequently, their way of being efficient (pillar 1) and closing the circle, allows them to greatly reduce GHG-emissions (pillar 3). Yet, the managing director of Principi di Porcia e Brugnera expressed his frustration regarding some political decisions on sustainable farming that they consider too demanding and which would not allow them to produce enough and survive as a business, especially since consumers still demand perfectly looking products. This is a typical example of a trade-off between pillar 1 (productivity) and pillar 2 (resilience), in other words, a lack of a harmonious relationship between decision-makers and the farmers, who are the ones directly facing risks of the agricultural sector. Harald Grabher stated that many practices are contributing to all three pillars of CSA. As examples, he mentioned that using regional seeds and implementing tree nurseries leads to higher productivity, more income, resilience and other livelihoods. Furthermore, by using regional seeds long delivery routes from abroad can be avoided and therefore contribute to reducing GHG-emissions. However, he finds M&E of synergies or trade-offs too complicated.

4.4 M&E Activities Regarding the Three Pillars of CSA

4.4.1 Data Collection and Indicators Regarding CSA Pillar 1

In general, some data and indicators aligning to CSA pillar 1 – sustainably increase agricultural productivity and income as well as ensure food security - must be collected and reported by the farmers by law or because of agreements with food retailers. Besides, the Austrian and Italian farmers mentioned using additional indicators for supporting their daily farm work, and from every kind of produce different indicators are derived. Table 2 shows the mentioned data and indicators, which can be used for M&E of CSA pillar 1.

Table 2: Data Collection and Indicators regarding CSA Pillar 1 (own research).

	Austria			**Italy**		**Experts**
Interviewee	**ADAMAH Biohof**	**FarmAUT1**	**FarmAUT2**	**Principi di Porcia e Brugnera**	**Venica& Venica**	**Harald Grabher**
Data collection and Indicators regarding CSA pillar 1	Bookkeeping of harvest per field section Double bookkeeping of financial records Estimations on sales volumes of the different products Price per unit of product to estimate production costs (considered difficult) Estimation of needed seeds in kilos for purchasing them Fertilizer input per hectare Working hours of employees per activity; overtime Use of fuels for agricultural machines and delivery vehicles Amortization of machines Weather and market prices of specific years for comparison Humus substance and health – nitrogen content Manure production and management Use of pesticides Fruit rotation Water usage for irrigation Animal husbandry – stock of animals, animals' health Records of nature conservation programs for subsidies Inputs and outputs of biogas plant Obligatory data for the quality control by supermarkets (variable)					**Increase of income** – if an Area under sustainable cu relation to total program a indicators) split in practice measures such as push-pu rotation, soil mounds, etc **Adoption rate of sustaina** **agricultural practices** – ho farmers continue with sus agricultural practices after time? **Production per piece** (e.g. **Estimates** of amount of co up per household **Food diversity score** – nut did nutrition of the farmer more diverse because the different kinds of vegetabl **Change** of overall situation wellbeing of farmers

Furthermore, the Austrian farmers mentioned that they do not measure harvest residues, materials sorted out and records of machine use. Many other aspects are "not recorded on paper but known by heart or seen during daily work". Caritas does not measure water usage or work hours as it is too complicated to collect this kind of data, although Harald Grabher would find it interesting.

4.4.2 Data Collection and Indicators Regarding CSA Pillar 2

Table 3 shows the mentioned data and indicators collected regarding CSA pillar 2.

Table 3: Data Collection and Indicators regarding CSA Pillar 2 (own research).

	Austria			**Italy**		**Experts**	
Interviewee	**ADAMAH Biohof**	**FarmAUT1**	**FarmAUT2**	**Principi di Porcia e Brugnera**	**Venica& Venica**	**Harald Grabher**	**Tiziana Centofanti**
Data collection and Indicators regarding CSA Pillar 2	No data collection, only relying on experience.		Soil samples and analysis of its nutrient ratios and microbiological life	water inputs soil health, and soil biological biodiversity biodiversity of animals in the ecosystem (is not strictly monitored, but rather observed in their work) fertilizers and pesticides-lower quantities make the plants naturally stronger weather forecasts temperature production-in relation to all the other indicators mentioned		watershed cooperations' viability, strength, structural components and way of organization; adoption rate of sustainable agricultural practices	Before measuring resilience, having tools and skills to measure shocks is necessary

4.4.3 Data Collection and Indicators Regarding CSA Pillar 3

ADAMAH is compensating the GHG-emissions of their delivery vehicles off-farm and therefore monitors the emissions of them. Apart from that they do not monitor the farm's emissions but try to set actions to reduce or remove them. The interviewee of FarmAUT1 does not collect data on GHG-emissions and does not think that it makes sense to e.g. monitor the emissions of his cows. However, he finds national estimates based on emission factors per cow useful. For that, the number of cows or other livestock must be known by the respective national institution, which is the case for Austria, but not for countries such as Ethiopia as Harald Grabher mentioned. FarmAUT2 estimates the carbon captured by its healthy soil.

Both Italian farms calculate their carbon footprint in wine making as a prerequisite of the VIVA project. Precisely it is divided in 3 sub-indicators, namely "direct emissions" generated directly by the farm in the farm property, "indirect emissions" generated by the farm's energy use, and "other indirect emissions" generated by other kinds of goods and services purchased and used by the farm in their activities. In doing so, they can track the emissions from the vineyards to the disposal of the wine bottle. Both farms have reported to use machineries that can do more than one task at the same time, which reduces the use of fossil fuels, and have installed solar panels to have clean electricity. Moreover, Venica & Venica as part of its property owns 40.3 hectares of vineyards and 42.5 hectares of woods, and with the guidelines of the Italian Ministry for Environment, it is able to calculate the carbon footprint of its products' lifecycle, and estimate the carbon sequestration of their woods, which allows them to confirm that they are able to sequester the emissions generated. In the same way, Principi di Porcia e Brugnera tries to measure as much as possible its other productions, especially the cattle husbandry. For instance, they replaced their pure breed cattle with a mixed breed, which on the one hand emits less methane, and on the other, is more resistant, and in the same conditions produces more milk. Finally, thanks to their biogas plants they can produce six times the electricity that they use, providing clean electricity also to other citizens.

In the carbon offset projects of Caritas the focus lies on reforestation, fuel efficient stoves, solar lights and water use. For M&E purposes, they first measure the typical fuel consumption of a household. Then they bring new technologies into the households and look at the adoption rate. They collect data on how many stoves or solar lights were deployed; how many of them were really used; when and how long they were used; and if they are damaged or still intact. The results are output indicators. With the adoption rate they can then estimate the reduction of GHG-emissions compared to the baseline value. Regarding reforestation, they measure the survival rate of planted trees and collect data on the extent and height of trees or shrubs to calculate their biomass index on the area and the bound CO_2-equivalents. However, estimating or calculating the reduction or removal of GHG-emissions in projects with an agricultural focus would be too complex and time and cost intensive according to Harald Grabher. Regarding the M&E of pillar 3, Professor Centofanti expresses her concern about the fact that it is a highly complicated task which should not encumber farmers yet

should be performed by external entities with more skills on the matter. This would also make broader comparisons and evaluations scientifically sounder.

4.4.4 Evaluation and Consequences of M&E Activities

For the Austrian farmers, it is especially important to fulfil the legal directives for organic farming, subsidies or other legal obligations and the agreements with food retailers. If requirements are not fulfilled, they need to change their practices. The M&E officer of ADAMAH observes changes and develops measures for fulfilling their obligations. For them, it is important to always identify the reasons for setbacks to set the right measures. However, they mention that some factors such as weather cannot be influenced. The managing director of FarmAUT1 mentions to compare their farm with other farms as well as with the Green Report of the Austrian Federal Ministry of Sustainability and Tourism, to set their results in context and to relativize their own progress. He mentions to usually know the reasons for something not working out but can influence only a few factors. According to him, there exists only a potential of 10% for experiments and changes as 90% are fixed due to location, geography, climate, soil condition and weather. Also, he finds it important to base decisions of change on long-term observations and not on year to year evaluations. Furthermore, they set changes very often based on external factors such as available subsidies and market prices and less on ecological or social factors, which indicates the steering power of policies. The managing director of FarmAUT2 compares the annual results with previous years e.g. harvest per hectares. He also relates them to weather conditions and market prices of the respective years. He mentioned to set changes based more on market prices than on productivity. Hence, the market and market prices determine profitable varieties and therefore what he cultivates. Furthermore, he tries to balance the soil nutrients on his fields based on the soil analysis. Harald Grabher and his team try to find the reasons and adjust to them together with the relevant stakeholders, especially when adoption rates are low, feedback of the farmers negative or the aims are not reached.

Generally, the Italian farms both reported that the outcome of their monitoring practices are attempts to improve their performance. As previously stated, the managing director of Principi di Porcia e Brugnera said that it would be impossible for them to draft a business plan for the next year without consulting the whole data framework gathered for the preceding one, to set new goals, spot problems and their causes and correct inefficiencies. Then, it is highly important to assess and verify their performance based on the previous data.

Additionally, it is thanks to the data gathered since the beginnings of the 1990s that they were able to take important decisions that have improved their social, environmental and economical sustainability. For instance, it was noticed that since 2005 the milk production in summer was drastically decreasing, which could be explained by higher temperatures, as a consequence, a refrigerating system was installed, which improved the animals wellbeing, and greatly increased the milk production, to the point that now the summer production is higher than the winter one (it is normally the opposite), and also a more resistant mixed breed of cattle was adopted. Venica & Venica instead reported that as a consequence of their monitoring, they try to improve as much as possible the quality of their product and production practices, in terms of sustainability. The interviewee said that given the land they own, they are not interested any more in increasing the production, but only increasing the quality, and improving their environmental performance.

4.4.5 Overall Opinion on M&E

All the Austrian farmers mentioned that they monitor and evaluate processes and outcomes beyond the legally obligated data they have to report to the Austrian Federal Ministry for Sustainability and Tourism. All of them find M&E of resilience most difficult. All of them find the obligatory reporting to the Ministry cumbersome and consider only few of the reported data necessary and interesting for their own practices. Often it is challenging to have the resources to autonomously perform M&E activities. Although ADAMAH Biohof has its own M&E officer, the managing director finds experience and knowledge more important than measurements. M&E, for him, is too much of a workload and also insecure if thinking about forecasts based on the results of measurements. He finds it more important to set farming actions, which are considered sustainable and ecological by nature, and raise awareness in society for organic farming. The managing director of FarmAUT2 mentioned that M&E is extremely burdensome for him, because by being very time-consuming, he has the impression of investing a long time monitoring the indicators required by the government and not having enough to dedicate to the M&E that he considers useful.

The managing director of Principi di Porcia e Brugnera has advocated multiple times that M&E is fundamental in the well-functioning of any business, because only by monitoring they are able to take grounded decisions for the following year. Additionally, thanks to M&E in any moment it is possible to go back to the data of the previous year to make sure that the production activities are on track to reach the established goals. Without past data it is

impossible to make forecasts or evaluation. Instead, Venica & Venica reported that M&E is important to them especially because it allows them to keep under control their achievements in sustainability and improve their performances. As mentioned before, the wines of both farms participate in the VIVA project, and M&E of wine production is mandatory for their participation, which probably explains the answer of Venica & Venica.

Harald Grabher argues that indicators should be SMART[7]. Too detailed measuring is too cost and time intensive. He argues for implementing sustainable practices and measures that are the most spontaneous, immediate and useful to the farmers and monitoring and evaluating them with simple indicators. Many existing indicators are too difficult or too complex to be estimated for their purposes, which is why he considers the simplification of indicators an important precondition before they can be used in their programs or even by farmers themselves. In general, he sees the collecting of data and estimating indicators as a responsibility of the local government, which can report the results to the public authorities at a higher level. Therefore, especially in a country like Ethiopia, he considers the installation of administrative institutions as precondition for M&E on CSA and SDGs on a national basis.

Tiziana Centofanti agrees that M&E is very important in farming, but also admits that it is very costly especially for Small and Medium Enterprises, which in the agricultural sector are the ones that should be supported if an ecological transformation is desired, because of their natural attitude to care for nature and community. She laments limited availability of consistent data at European Union level, and currently only very few municipalities are conducting M&E at farm level. This is a major obstacle to sustainable farming in Europe.

4.5 CSA and the SDGs

None of the farmers aligns their activities or M&E to the SDGs, because they were mostly unfamiliar with the SDGs. Although the interviewee of the Italian farm Venica & Venica reported that they know the SDGs and would like to include them in next year's sustainability report, their practices do not result from the SDGs. Harald Grabher mentions that they develop their projects according to the SDGs and also try to use indicators which are usable for measuring progress in reaching the SDGs. He thinks that the SDGs are very useful for orienting their work. Especially, he finds it important to think globally and to see problems in one country not only as problems of it but as problems of mankind. Furthermore, Harald

[7] See chapter "Methodology: Data Collection and Analysis" for an explanation.

Grabher states that as a requirement by Caritas, they have to align their M&E to the SDGs in the beginning of a project. However, after presenting them the SDGs, all the farms concluded that their practices not only have positive impacts on their surroundings, but also contribute to reaching the SDGs (see Table 4).

Table 4: Contribution of Sustainable Farming to the SDGs (own research).

	Austria			Italy		Experts	
SDG	**ADAMAH Biohof**	**FarmAUT1**	**FarmAUT2**	**Principi di Porcia e Brugnera**	**Venica & Venica**	**Harald Grabher**	**Tiziana Centofanti**
1	X	X	X	X	X	X	
2	X	X	X	X	X	X	X
3	X	X	X	X	X		X
4	X	X	X	X	X		
5	X	X			X		
6	X	X	X		X		X
7	X	X	X	X	X		
8	X	X		X	X		
9	X			X	X		
10	X	X		X	X		
11	X	X	X	X	X		
12	X	X	X	X	X		X
13	X	X	X	X	X	X	X
14	X	X		X	X		X
15	X	X	X	X	X		X
16	X	X	X	X	X		
17	X	X		X	X	X	

Concerning specifically linking CSA indicators to the SDGs, Harald Grabher suggests to base CSA indicators for measuring the progress in reaching the SDGs on estimates. They should be done based on official numbers and the help of GIS by public authorities on the national level. Instead, when thinking about developing and implementing official structures for M&E of CSA, (which is what mostly concerns farmers directly), he argues for developing them bottom-up in developing countries such as Ethiopia, because then not only the public authorities know the numbers, but also the farmers would know about all the relevant information of their farms. Certain data should be collected on farm level and then aggregated from the local administrative level to the next level.

5 Main Findings and Recommendations

5.1 Main Findings

All the interviewed farmers consider M&E as an important tool for enhancing their practices, especially the Italian farms. They consider it an unavoidable process of their work methodology, yet they often lack time and financial resources to implement thorough M&E practices. What was an encouraging result for us is that our interviewees confirmed our expectations on the indicators used for every pillar of CSA, which all in all correspond to those we found while doing our literature review, such as those indicated in CCAFS (2019). Moreover, both Italian farms lamented a lack of support from local and national government institutions that do not help in translating the farms' efforts to be socially, environmentally and economically sustainable in a real added value to consumers' eyes. As a matter of fact, regardless of the VIVA certification they have, currently on the supermarket shelves their products are the same as the others, but with higher prices. The farmers would like to find a way to communicate not only the quality of the product, but also the quality of their practices. In addition, they wish sustainable farming to be not only supported by subsidies, but also by policies that ease their daily work and allow for a way of farming that aligns to the three pillars of CSA. In particular, some of the farmers mentioned that laws or policies often impede agricultural practices, which contribute to all three pillars of CSA. One last point that we dealt with in the literature review (FAO, 2019) and for which we found a confirmation during our work in the field with Professor Centofanti, is that the aspects of adaptation and resilience (pillar 2) are quite challenging to be monitored. As matter of fact, our expert reported that before even attempting to measure them, it is necessary to have precise indicators and data on the hazard and shock that can hit a farm. Only after this it is possible to verify its resilience and adaptation, for instance by assessing which practices have changed after the shock. Additionally, Heather Jacobs one of our mentors for this project from the Climate and Environment Division of FAO, argues that it is also essential to determine the exact aspects to measure regarding adaptation and resilience, and to define these terms for the specific practice or organization concerned.

5.2 Recommendations

Based on our findings we propose the following recommendations when considering M&E of CSA and the SDGs. **Firstly**, policies in the field of agriculture should be reviewed and formulated in a way that allows agricultural measures contributing to the pillars of CSA

and co-benefits. **Secondly**, taking into account that every situation is different and must be singularly assessed, prerequisites and performance indicators that define minimum standards of social, economic and ecological sustainability should be predefined, so that all agricultural practices contribute to the three pillars of CSA. As the projects of Caritas show, such 'sustainable' prerequisites and performance indicators also ease the M&E of agricultural practices as the question if certain practices are sustainable or not must not be answered and one can focus on the performance of the set measures. However, this would demand a change of the overall orientation of the agricultural system from industrial farming, often including ecological and social detrimental practices, to social, economic and ecological sustainable practices. **Thirdly**, M&E of CSA practices and its linkage to the SDGs is too time- and cost-intensive for farmers themselves, this should be performed by public authorities on different scales. Harald Grabher suggests to base CSA indicators for measuring the progress in reaching the SDGs on estimates. They should be done based on official numbers and the help of GIS by public authorities on the national level. When thinking about developing and implementing official structures for M&E of CSA and their contribution to reaching the SDGs, he argues for developing them bottom-up in developing countries such as Ethiopia, because then not only the public authorities know the numbers, but also the farmers would benefit from knowing relevant information of their farms. Certain data should be collected on farm level and then aggregated from the local administrative level to the next level. In particular, Professor Centofanti reported that in her opinion, the most important aspects that should be monitored at farm and local (regional and/or town) level are the farmers' life quality, the productivity - also in terms of what and how natural resources are used - and food security. Instead, other aspects regarding environmental and production changes due to climate change at macro level should be monitored at national level by governments, NGOs, or international organizations, especially if it is wished to link them to the SDGs. She adds that with the first effects of climate change, it has become urgent to gather these data, yet even in the European Union, research is very much behind and strongly relies on locally gathered data. Nonetheless, Heather Jacobs (FAO) states that also national authorities should monitor the indicators from every pillar of CSA. **Fourth**, both experts claimed that when performing M&E at any level, focusing exclusively on quantity of output and efficiency is outdated, the latter are indeed, useful indicators, but measuring the quality of human and natural resources is fundamental. A few examples mentioned by the experts are the soil quality, nutritional

quality and variety and water quality. **Fifth**, many CSA practices contribute to more than one pillar of CSA, however, M&E of synergies or trade-offs between different measures set is considered too complicated. Therefore, indicators should be always kept SMART, namely Simple, Measurable, Attributable, Reliable and Time bound. **Finally**, we also found that a structural transformation needs to take place in the relationship producer-consumer and supply-demand. As Scherer and Verburg (2017) argue, CSA measures are more effective if accompanied by changes in consumer behavior, wherefore interdisciplinary cooperation is necessary to develop simultaneous policy and market incentives to link supply- and demand-side. As a matter of fact, according to the Managing Director of Principi di Porcia e Brugnera, sustainable farming practices can only be implemented when consumers are aware and/or accommodating towards them, and policymakers must consider this when enforcing new regulations on farmers. In fact, different practices imply different final products and different prices. A policymaker cannot oblige a farm to drastically reduce the use of some rather harmless chemical products, and then expect that the same farm can produce the same quantity and the same perfect-looking products at the same price. And consequently, consumers cannot require having healthy, fresh and local products, that also look perfect and are cheap. This is simply not feasible. As Professor Centofanti said, if a country wants to promote small and medium sustainable farms, which take care of the environment and the community, it is necessary to cut the subsidies to big agricultural businesses that carelessly take advantage of the resources, and divert them towards the former. It is detrimental to leave small farmers the whole responsibility of saving the environment without support from the state, because in so doing, countries like Austria and Italy run the risk of losing them.

6 Final Remarks

To conclude, by being in direct contact with farmers this study allowed us to dive deeper into the sector of sustainable agriculture, and at the same time provided us with useful information that could be applied to the concept of CSA. Since there is no example for applied CSA in Italy or Austria, we could not investigate farms practicing CSA. This might be seen as a shortcoming of our research, yet we preferred to consider it as an approach to sustainable agriculture closer to the perspective of farmers trying to work respectfully with the environment and people. Nonetheless, a limit of this research is that we failed in creating an indicators framework for the three pillars of CSA, and in linking M&E of CSA with the SDGs. This was a consequence of the nature of the farms interviewed, as some of them do not

perform very elaborated M&E practices. Still we were able to deduct numerous other insights for practicing sustainable farming and M&E of CSA.

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Annex 1 – Coding Table

Interview Topic	Number	Categories
General Information	C1	Definition of sustainable farm
	C2	Motivation for biological/sustainable/organic farming
	C3	Technologies for data gathering
	C4	Overall opinion about M&E
Pillar 1 - sustainably increasing agricultural productivity and incomes	C5	Data collection and Indicators regarding objective 1
	C6	Evaluation and consequences of evaluation regarding objective 1
Pillar 2 - adapting and building resilience to climate change	C7	Awareness and perception of climate change
	C8	Climate-resistant crops or livestock
	C9	Risk mitigation strategies (insurances, information exchange, group of collectives, etc.)
	C10	Data collection and indicators regarding objective 2
	C11	Evaluation and consequences of evaluation regarding objective 2
Pillar 3 - reducing and/or removing GHG-emissions	C12	Data collection and indicators regarding objective 3
	C13	Evaluation and consequences of evaluation regarding objective 3
	C14	On-farm activities to reduce or remove GHG-emissions
	C15	Involvement in off-farm programs
	C16	Synergies/co-benefits and trade-offs between the three objectives
Conclusion	C17	Farm's social, ecological and economic impact on the surroundings
	C18	Influence of SDGs on own activities
	C19	Linkages between sustainable farming and SDGs
	C20	M&E related to SDGs
Additional Expert Categories	C21	Measuring synergies
	C22	Recommendations for national tracking of progress regarding CSA and SDGs
	C23	Projects' social, ecological and economic impact on the surroundings

Annex 2 – Questionnaire

Interview Guide – Semi-Structured Interview: Monitoring and Evaluation practices for linking Climate-Smart Agriculture to the Sustainable Development Goals

INTRODUCTORY TEXT

We express our gratitude for your participation in this survey in advance.

We are here as participants of the Regional Academy for the United Nations (RAUN) program, which is an educational program of the UN Vienna for young researchers. This year's RAUN research topic is "Environmental and socioeconomic sustainability. How to create lasting impacts". In particular, our research focuses on the topic of Monitoring and Evaluation (M&E) practices for linking Climate-Smart Agriculture (CSA) to the Sustainable Development Goals (SDGs). The Food and Agriculture Organization of the UN (FAO) is supervising our research. We contacted you as interview partners because we believe that, given the sustainable practices you apply, the M&E procedures of your business could inform our research.

Your answers are extremely valuable for the success of our research, so we hope you can be as precise and thorough as possible. We assure you that you can decide to what extent you wish your information to be shared with our partner organization. We will record the interview to prove the reliability of the data gathered, we hope you agree. Obviously, you can receive the final draft of our research if you wish so. The interview will last about 1 hour, and it will consist of two parts, one more focused on general information about your company and the other will be specific on M&E.

Do you have any questions before we start?

Definition CSA by FAO:

Climate-smart agriculture (CSA) is an approach that helps to guide actions needed to transform and reorient agricultural systems to effectively support development and ensure food security in a changing climate. CSA aims to tackle three main objectives: sustainably increasing agricultural productivity and incomes; adapting and building resilience to climate change; and reducing and/or removing greenhouse gas emissions, where possible.
CSA is an approach for developing agricultural strategies to secure sustainable food security under climate change. CSA provides the means to help stakeholders from local to national and international levels identify agricultural strategies suitable to their local conditions. CSA is one of the 11 Corporate Areas for Resource Mobilization under the FAO's Strategic Objectives. It is in line with FAO's vision for Sustainable Food and Agriculture and supports FAO's goal to make agriculture, forestry and fisheries more productive and more sustainable".

A: GENERAL INFORMATION (to be filled in by the interviewee? or shall we ask them?)

1. **Shall we anonymize you and your farm in our paper?**
2. **What is your function on the agricultural holding?**
3. **When was the company founded?**

4. **How would you define a farm that works sustainably?**
5. **Since when is this SUSTAINABLE?**
6. **Why did it turn into a sustainable business?**
7. **From an economic perspective, what is the holding's main agricultural focus? Answer based on the economic value of your activities. Please specify the products.**

◯ Mainly crop production

Products:

_____

◯ Mainly livestock production

Products:

_____

◯ A mix of crop and livestock production

Products:

_____

◯ Aquaculture

Products:

_____

◯ Wood production

Products:

_____

◯ Other

Products:

_____

8. **What is the main intended destination of your agricultural production? Please fill in one circle only.**

◯ Producing primarily for sale (selling 90% or more)

◯ Producing mainly for sale, with some own consumption (selling more than 50% and up to 90%)

◯ Producing mainly for own consumption, with some sales (selling more than 10% and up to 50%)

◯ Producing primarily for own consumption (selling 10% or less)

9. **How many employees are working on the farm? Equivalent in full-time jobs.**
    a. How many female/male?
10. **Are people with disabilities working on the farm?**
11. **What is the average education level of the employees?**

12. **What is the tenure of the agricultural land used by the farm? If more than 1 answer is selected, please indicate the approx. percentage of the total land used.**

◯ Owned with written documentation (includes a title deed, a will, a purchase agreement, etc.)

◯ Owned without written documentation

◯ Rented-in, leased or sharecropped with written agreement

◯ Rented-in, leased or sharecropped without written agreement

◯ State or communal land used with written agreement (certified use rights)

◯ State or communal land used without written agreement (uncertified use rights)

◯ Occupied/squatted without any permission

◯ No agricultural land

13. **How do you generate your income? Just by cultivating the farm or are there incomes from additional activities/ side jobs? Please sort in order of importance. 1st = highest**
14. **Do you receive any public funding? Do you think the farm could run/function without it?**

B: QUESTIONS REGARDING THE THREE MAIN OBJECTIVES OF CSA

Objective 1: sustainably increasing agricultural productivity and incomes

1. **What information is systematically registered on the farm regarding agricultural productivity, incomes and sustainability? Which data are collected? Which data could be collected additionally?**

Elements for further inquiry if not mentioned by the interviewee:

Area cultivated/harvested

Crop production

Livestock production/aquaculture/wood production

Unit prices, amounts sold and total sales by product

Input quantities used (seeds, fertilizers, plant protection products, etc.)

Detailed quantities and prices of inputs bought

Workers' time

Workers' payment

Tractor hours per hectare or fuel per hectare

Soil health

Manure Management

Other (specify)

2. **Do you use any indicators? Which ones? How do you use them?**
    a. How do you monitor the productivity of the farm? e.g. product per unit of land, water, energy, nutrients, labour
    b. How do you monitor the profitability of the farm?
    c. How do you monitor if the productivity and income of your farm is sustainably increasing?
    d. Do you use the monitored data and indicators for evaluation? And if so, what are the consequences of the evaluation? Do you change your practices accordingly?

Objective 2: Adapting and building resilience to climate change

Resilience encompasses absorptive, anticipatory and adaptive capacities and refers to the properties of a system, in this case your farm. Resilience allows a farm to deal with shocks and stresses, to persist and to continue to be well functioning (in the sense of providing stability, predictable rules, security and other benefits to its members).

Concretely, some examples are:

-having insurance, enhancing biodiversity, being member of a cooperation (collaborating with other farms), reduction of soil fertility monitoring, use of less hazardous pesticides/fertilizers or natural remedies....

1. **Have you noticed any effects of climate change on your agricultural activities so far? How did you notice?**
    a. If yes, did you take any measures to adapt to it?
2. **Do you use climate-resistant crops or livestock?**
    a. Are you using plants/livestock of the same species and just different varieties or are you changing species?
    b. If not, are you planning to use climate-resistant crops or livestock? When?
3. **Do you use risk mitigation strategies such as crop insurance, (on-farm or off-farm), diversification, ...**
4. **What information is systematically registered? What data is collected on your farm regarding resilience in the sense of the mentioned definition? Which data could be collected, additionally?**

E. g. water, soil, biodiversity, fertilizers, pesticides, meteorological data, production

5. **Do you use any indicators? Which ones? How do you use them?**
6. **Do you inform yourself about climate change resilience and adaptation? If yes, how?**

Examples of "information methods":

use of seasonal forecasts

tools to determine water/fertilizers quantities

7. **How do technologies help you in gathering information?**

(if they do not own the land>>>do they think that owning the land would make them more resilient or are they more flexible because they rent?)

Objective 3: Reducing and/or removing greenhouse gas emissions

1. **What information is systematically registered? What data is collected on your farm regarding GHG-emissions? Which data could be collected?**
2. **Do you use any indicators? Which ones? How do you use them?**
3. **Do you perform any on-farm practices specifically to reduce or remove GHG emissions?**

e.g. Planting trees, using renewable energies or … manure management (to reduce emissions from storage and application of manure), feed management (to reduce emissions from enteric fermentation in ruminant livestock species), energy/fuel saving technologies, soil management/tillage practices (to increase carbon sequestration in the soil),

4. **Are you involved in any off-farms programs to reduce or remove GHG emissions? E.g. payments to projects in the field of reducing carbon (voluntary offset)**
5. **Do you perform any activities with the aim to sustainably increase productivity or resilience but which also achieve mitigation co-benefits?**
6. **Do you use the monitored data and indicators for evaluation? And if so, what are the consequences of the evaluation? Do you change your practices accordingly?**

C: CONCLUDING QUESTIONS:

1. **What positive and/or negative impacts do you think you have on the surroundings, environmentally, socially and economically speaking?**
2. **Do the SDGs somehow influence your practices?**
3. **What are in your opinion the most important linkages between sustainable farming and the SDGs?**
4. **Do you register any information/monitor any indicators related to the SDGs/aspects of sustainability identified through the previous question?**
5. **Would you like to add anything?**