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Sustainable governance modes to increase the implementation of best management practices preventing erosion on arable land by farmers in Andalusia.

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The picture on the second page was taken near La Junquera, Spain. Its purpose is to illustrate the size of the erosion problem in Andalusia at a simple glance.

Keywords: Governance modes, erosion mitigation, conservation agriculture, Andalusia, policy instruments, drivers, barriers

Abstract

The traces of erosion are visible throughout the Spanish province of Andalusia, often carving out beautiful valleys and so providing a beautiful sight for tourists traveling the mountainous landscape. However, soil erosion threatens farmers' livelihoods, as they see their income decrease throughout the years, and the region watches its tax revenues partially disappear by cleaning local waterways of sediments and excessive nutrients. Andalusia suffers from one of the highest erosion rates throughout the EU, but is also the source of a large portion of agricultural produce grown within the Union. Suggesting policy instruments to address this common resource pool problem with governance solutions is one of the main goals of this thesis. Soil governance is a complex research field however. Instead of reviewing the literature on conservation agriculture governance to identify "effective and efficient" policy instruments, this research starts "further back". This step 'back', to eventually suggest better and more locally relevant policy solutions, entailed researching Andalusian farmers' motivations to implement or not, or, in other words, drivers and barriers that influence a farmer's choice to adopt conservation agricultural practices. Many different kinds of these practices are implemented by farmers worldwide, but this research will limit itself to the researching the uptake of 8 anti-erosive Best Management Practices (from here on 'BMP's').
To find these drivers and barriers, a survey was constructed and distributed among farmers in Andalusia and subsequently analyzed, to answer the main research question: *"What governance modes lead to a higher implementation rate of Best Management Practices on arable land by farmers in Andalusia, Spain?".*

Preliminary results indicated that the most popular BMP's among respondents are rotation with cereals, permanent grasslands and conservation tillage. Farmers teaching themselves the skills needed to implement the practices on their farm was found to be the strongest driver, and peer pressure the strongest barrier.
Literature suggests that drivers or barriers to implement Best Management Practices vary across the world, along with the relative importance of one driver or barrier compared to others. This is called "dependence on local context". Therefore, when choosing effective modes of governance to address this issue of soil governance, it is important to choose a region that has a common socio-economic situation and farmers adhere to the same set of laws and regulations with regards to subsidies. This study found that barriers to implementation of BMP are indeed context dependent, but this could not be validated for the drivers of adoption; these were more 'universal drivers', as identified in 'general' soil governance literature.

A mix of policy instruments, found in soil governance literature to specifically address certain drivers and barriers were suggested eventually to address the drivers and barriers identified by this research. Regulatory, economic, educational instruments and instruments focused on building social capital are suggested to address the soil erosion problem. Furthermore, it is suggested that policy instruments that complement each other are used, or that their combined effect achieves more than the sum of their parts. Lastly, it was found that a shift to more self-governing modes, with elements of (de)-centralized and interactive modes of soil governance would be most suited for the local context, which answers the main research question.

Chapter 1: Introduction

In this chapter, the common pool resource problem of soil in Andalusia will be explained. Next, best management practices (BMP's) that stop erosion are introduced. Understanding what drives farmers to implement is crucial, and will help solve the governance issue at hand, namely to shift policy making to fit the local context, meaning to the local (comparable) socio-economic conditions and coherent rules on European agricultural subsidies. Furthermore, the reader will find that the research field of "soil governance" is not quite as developed as of now; the motivations for farmers to implement conservation techniques appear very context dependent and will be explored further for the region. In order to 'fine tune' policy making, a detailed image has to be sketched of what drives and halts farmers from implementing BMP's in Andalusia. Only after finding this, and policy instruments as found in existing soil governance literature can be suggested to address these drivers and barriers. The shift in governance modes this would entail is discussed as well.

1.1 Societal background and problem

Soil erosion

Seventeen sustainable development goals (SDG's) were formulated in 2015 by the United National (UN) General Assembly to be achieved by 2030 (FAO, 2015). Each goal addressed different issues, among which poverty, education and global warming. As a part of SDG fifteen, "Life on Land", the Food and Agriculture Organization (FAO) of the UN announced soil erosion a cause for 'the loss of valuable economic assets and livelihood opportunities' (FAO, n.d. a). Furthermore, the FAO stresses the need for more collaboration among public and private actors to implement policies that stimulate (farming) practices regulating soil usage (FAO, n.d. b).

Soil erosion, defined as water or wind removing or detaching soil, either due to human or natural causes, poses a threat to farmers' livelihoods (Pimentel et al, 1995), as it lessens crop yield and damages the direct and indirect environment. In this case, the 'direct environment' is formed by the arable lands affected by erosion. The indirect environment can be lands and waterways situated away from the fertilized land.

Harmful effects on the direct environment include increased fertilization (to balance crop losses due to poor soil quality), due to losses in soil fertility as a result of erosion. This has in turn been linked to increased soil acidity (Penn & Bryant, 2008) and to damage the symbiotic relation between fungi growing in the soil and crop roots (Carrol & Salt, 2004). Then, 'off-side' erosion effects include waterway eutrophication and sedimentation as excess soil seeps into local waterways (Boardman, Bateman & Seymour, 2017; FAO, n.d. c).
Albeit erosion is a natural process in the formation of soil (Grimm, Jones & Montanarella, 2002), it is the accelerated degradation of soil by human causes that leaves the soil vulnerable to wind and water and that poses a threat to farmers' livelihoods, a problem mentioned previously.

The costs of erosion can be divided in direct costs, which are paid by the farmer, and indirect costs, which are usually paid by the local government. Examples of 'direct costs' due to erosion, mainly hitting farmers, are losses in harvest, as mentioned earlier, but added to this comes a damaged plantation, a reduction in fertile area to sow and finally, fertilizer costs to outbalance any deficit in nutrients in the plot's topsoil (EC, 2018). 'Indirect costs' due to erosion affect other sectors in than agriculture; examples are the disappearance of habitats for wildlife, farmers abandoning plots no longer profitable due to poor soil quality, a decrease in local biodiversity and, finally, damages due to public infrastructure by sediments due to agricultural run-off after precipitation.

Soil is a resource that is vital to grow crops, and in the case of heavy soil erosion, a substantial quantity is lost annually. It can be labeled as a common pool resource problem (CPR) (Ostrom, 2002). There are several points that advocate for this; there is only a finite reserve of the resource, and it regenerates at a slow (and predictable) rate. Multiple parties depleting the common resource soil from plots faster than it can regenerate creates an unsustainable situation. 'Appropriators' of soil act 'independently' to maximize personal profits, and little communication happens to coordinate farming (and especially tilling) in a sustainable fashion.

In the European Union (from here: EU), thirteen percent of arable is affected by erosion (EC, 2016a). This process happens at varying speeds; this depends on the local climate, the type of soil subject to water erosion and the (steepness of the) local landscape (USDA, 2001). This soil removal slowly but steadily leads to a transformation of the affected landscape; flat valleys slowly filling up with sediment, streams formed by precipitation in mountainous areas merging together on a plain (so-called alluvial plains), the forming of river deltas and valleys filling up with sediment, transported downhill during heavy rain events (García-Ruiz, 2010).

Of all European countries, Spain is one of the countries with the highest erosion rates. The autonomous community of Andalusia will be studied in this thesis, as it has one of the highest rates of erosion in the country, making addressing the issue urgent, as well as it constitutes a 'context' (a term that will be explained in detail below) within which tailored policy advice on how to combat the problem can be suggested. This section will further explained that natural causes combined with anthropogenic ones cause the current situation. Natural causes like climate, vegetation and soil quality make Spanish (agricultural) grounds very susceptible to erosion (Cammeraat, 2004; Domingues & Fons-Esteve, 2008; Grimm et al, 2002). Anthropogenic causes of soil erosion fall under the umbrella term of 'intensification of agriculture'; the amount of resources used by a farmer divided by the amount of production is referred to as the 'input intensity' of a farm (EUROSTAT, n.d.). Increasing farm intensity would mean either a higher production per unit of input, or the same production with lower input. This can be achieved in multiple ways, among which farming on slopes, heavy tilling of soil, removal of groundcover on agricultural lands or by increased use of pesticides and fertilizers (Giomi, Runhaar & Runhaar, 2016; Grimm et al, 2002; Hauck, Schleyer, Winkler & Maes, 2014; Schoonhoven, 2017). In doing so, much soil gets removed from agricultural plots; rainfall on slopes removes topsoil and transports it downhill; heavy tilling of soil and the removal of ground cover destabilizes the soil structure and leaves it more vulnerable to wind and water erosion.

Best management practices

BMP's are defined in Turpin et al (2015) as 'technological innovations' in agricultural practices, that provide environmental benefits by increasing soil quality. Farmers increase the quality of soil on the long term by adopting BMP's. These sustainable innovations are believed to spawn new inventions through competition, because the system favors early adopters; subsidies are limited. They are applied throughout the EU and enable a farmer to uphold or increase current yields while benefitting soil and water quality. These best management practices, applied on a bigger scale among more Andalusian farmers than is currently the case, are proposed as a solution to address the persistent problem of soil erosion in Andalusia.

Agricultural Best management practices describe those farming practices that conserve soil and water, prescribe ways to handle manure produced by cattle and to safeguard the local air quality (aascd, n.d.; Sharply et al, 2006). Often designed to fit the local possibilities and problems, they are tailored to suit farming grounds of a specific region. Moreover, they are designed to decrease overall costs for a farmers. Examples include an alteration in farming operations, like the rotation of crops, drip irrigation or no tillage, but also simpler activities, like not distributing manure on land if rain is forecasted.

BMP can be classified using different properties, namely by their main environmental objective (decreasing erosion, decreasing eutrophication, decreasing soil salinity, e.g.), the type of polluting substance they decrease, and on what environmental 'medium' they have the most impact (Enstice, 2009; Logan, 1993, Shiferaw, Okello & Reddy, 2009)). This can be water (where there is distinguished between ground water and surface water bodies), the air and the soil. Besides the ability to divide them into these three categories, they can be assigned in three more types ("structural, cultural and management"). Namely, some practices tend to change the topographical structure of the plot ("structural" practices), others pertain to different ways to cultivate (for example, conservation tillage and crop rotating), which is called "cultural" type and the last type refers to different types of management, which refer to environmentally neutral ways to control pest, dispose of manure, to irrigate, e.g.

Some authors argue that erosion controlling BMP's are among the most important ones (Hilliard & Reedyk, 2000). The usage of agricultural practices that contain nutrients and herbicides within plots, like intercropping or cover cropping, or conservation tillage, are examples of BMP's halting erosion. While BMP's have the overall goal of increasing local water and soil quality, the focus in this research lies on the latter; namely BMP's preventing the effects of erosion on agricultural lands (direct environment), and thereby also protecting the indirect environment of its effects.

While the local government does not bear the direct costs, it costs tax money to handle the indirect costs of erosion. Furthermore, the export of agricultural goods is one of the highest sources of income for the province as of now (Junta de Andalucía, 2015), involving many jobs that are in jeopardy with decreasing return from unfertile soils. On the other hand, current farmers themselves might not endanger their own income to a large extent within their lifetime

by harming the soil, and thereby might not have an interest in implementing the BMP's. So, while the actors causing the problem have only a small stake in it, the province of Andalusia has a great interest in maintaining the local soil quality. Add to this that even more actors are involved; farmers unions also have an interest into keeping their strong position in the South of Spain by having a 'fruitful' agricultural sector, but they are at risk of losing their power partly by many farmers leaving the business due to poor soil quality by erosion. Finding out new governance modes to stimulate the farmers to implement these practices is key; but first one needs to understand what drives them to do so in the first place.

In conclusion, the susceptibility of Andalusian soil to erosion, together with intensive forms of agriculture accelerating erosion, are a threat to the livelihoods of Spanish farmers (EC, 2018), the environment and the economic position of Andalusia as a major agricultural produce exporter. Agriculture is a large source of income for the province, but the detrimental effects of the farming activities will also lower the soils fertility in the long run, threatening income of the province and of its farmers. One solution to this common pool resource problem would be a higher uptake of BMP's among Andalusian farmers. These practices are not applied on a large scale as of now (Guzman et al, 2015: Junta de Andalucía, 2015), indicating that there are several barriers that farmers experience in implementing them. Paramount to sustained agricultural returns are mapping those barriers and addressing them in local policy making. Additionally, drivers of implementation should be researched as well, to find what motivates farmers to implement conservation agriculture practices on their plots. Understanding what motivates farmers to influence their decision making and subsequently implementing these findings into local policy making is important to limit the environmental effects of agricultural activities, and safeguard the future economic stability of the province.

1.2 Scientific background and previous studies

Proper environmental governance would warrant the right handling of the current common pool resource problem through fitting policies and regulations. This governing of soil, or 'soil governance', is defined as "the sum of all formal and informal institutions (e.g. legal prescriptions, regulation, market incentives, rules, norms, habits, attitudes) that concern soil-related decision-making processes of state and non-state actors' at all decision-making levels" (Juerges & Hansjürgens, 2018). Largely similar to the definition given by Driessen et al (2012), Juerges & Hansjürgens explain governance more detailed. They incorporate the habits and attitudes of different actors in the soil governance definition, there is room for the challenges presented by the different attitudes and habits actors hold vis-à-vis solving the problem at hand. While decreasing soil fertility is an issue known to both farmer and government, currently the Andalusian government has to pro-actively make decisions to omit a future problem (diminishing agricultural returns) they do not cause themselves. Farmers on the other hand might not see the direct problem if their environmental concern is low (Carlisle, 2016; De Jalón, Iglesias, Quiroga & Bardají, 2013; Kallas, Serra & Gil, 2009; Lalani, Dorward, Holloway & Wauters, 2016; Sánchez, Álvaro-Fuentes, Cunningham & Iglesias, 2016; Tambo & Abdoulaye, 2012; Wilson & Hart, 2000). This subtle difference given between 'regular' governance and soil governance might highlight the size of the governance challenge at hand.

Governance can be used to steer actors to adopt conservational practices in agriculture (Giomi and Runhaar, 2018; Prager et al, 2011; Ronchi, Salata, Arcidiacono, Piroli & Montanarella, 2019; Schoonhoven and Runhaar, 2018), like the different actors causing the common pool resource problem of soil erosion in Andalusia currently. In conservation agriculture actors, which in this case are the farmers, adopt practices that make use of the resources that a farmer needs to grow crops in a sustainable way. Resources like soil, water, air are conserved by for example handling manure properly, using less wasteful ways to irrigate plots, by using no-tillage practices, and by using less fossil fuels in cultivating their lands. These practices fall under the umbrella term of 'conservation agriculture'.

One way to analyze governance practices is to categorize them via the framework of (environmental) modes of governance (Driessen, Dieperink, van Laerhoven, Runhaar & Vermeulen). Where the term 'governance' denotes the collection of actors and institutions, the 'mode of governance' reflects their mutual relationships (Driessen et al, 2012). This framework distinguishes between centralized, de-centralized, public-private, integrated and self-governance. It does so according to key features determining the relationship between civil society, the market and the government. This allows researchers in turn to assign policy instruments, or, a way to couple the formulation of a policy to its implementation (Ali, 2012), in which the policies' intention should be clear to one of five categories proposed in the article. Policy instruments in this study to increase the adoption of erosion halting BMP's can categorized in 4 different groups (Juerges and Hansjürgens, 2018; Knowler and Bradshaw, 2007). These are regulatory instruments and taxation, economic instruments, educational or informational instruments, and instruments focused on building social capital.

This governance analysis can be done, among many other ways, by examining relationships between the actors involved, or by identifying key actors by assessing certain characteristics of the instruments. Public and private actors can implement different strategies or policy instruments (Runhaar, 2016), in order to achieve a certain (policy) goal. 'Strategy' means a plan, a "consciously intended course of action, a guideline (or set of guidelines) to deal with a situation" (Mintzberg, 1987). They are developed prior to the action taken and they need to be deliberate. A detailed, qualitative description of how to couple strategies or policy instruments to a governance mode can be found in the Driessen et al article (2012). Based on this article, a more detailed reasoning behind assigning policy instruments or strategies to prevent erosion to governance modes is presented in the theory chapter.

This paragraph will explain the link between policy instruments increasing the uptake of BMP's and drivers and barriers for a farmer in choosing to implement a Best Management Practice. Policy design, or the development of a policy with often a certain policy goal in mind, is used in this thesis to suggest more effective and efficient ways to steer farmers to implement Best Management practices. Please note that no original policy advice is suggested in this thesis to address the drivers and barriers; instruments are drawn from leading articles on soil governance. This makes their success only probable, and they can only be seen as an

hypothesis to solve part of the current soil erosion problem in Andalusia effectively. Choosing the right soil governance instruments to motivate farmers to adopt soil conservation practices are crucial for proper common pool resource management of soil. There is a need for policy instruments that address factors that motivate (drivers) or demotivate (barriers) 'effectively and efficiently' (Bartkowski & Bartke, 2018). Assisting farmers by giving technical advice or assistance can address the barrier of little knowledge to implement for example, just as actively educating them through programs on soil conservation can. Subsidies can be provided by the government, to make implementing a BMP profitable for a farmer that otherwise would 'make a loss', addressing the barrier of 'too little funds' partially. Together with policy instruments that regulate and tax the use of soil, these 3 categories of policy instruments are suggested to address a plethora of drivers and barriers, which are in turn divided in 4 categories (Knowler and Bradshaw, 2007). Drivers and barriers on a 'farm household and farmer' level, on a 'biophysical' level, on a 'farm financials and management' level, and several exogenous drivers and barriers, which in this case refers to drivers and barriers that do not fit the first three categories (an umbrella term describing all other influences that affect farmer decision making).

Several other authors in the field of soil governance subscribe as well to steering farmer's decision making, based on several drivers and barriers, through the use of policy instruments. They add to the concepts suggested by Knowler & Bradshaw (2007).
Juerges and Hansjürgens (2018) suggest using 'incentive based and instruments on a voluntary basis', to address drivers and barriers related to farmers' values, like environmental consciousness or risk adversity. Bartkowski and Bartke (2018) also suggest using economic instruments, like farming subsidies or enabling farmers to sell produce easily at an 'eco premium', or facilitating loans for farmers who are currently in debt. These could address farmers who want to earn more for the practice of implementing, or are currently lacking the funds to engage in a BMP. Sobels, Curtis and Lockie (2001) stress the importance of policy instruments increasing social capital to address barriers like peer pressure. The knowledge to implement BMP's has to 'dissipate' via channels that distribute this information. Especially in the case of practices that are complex in their execution, BMP uptake increases through means of media, seminars and 'extension officers' (middle-men between academia and farmers). Concluding, soil governance researchers couple several policy instruments to drivers and barriers of the choice to implement a Best Management Practice.

Ervin and Ervin (1982), one of the earliest review articles listing different motivations of farmers to implement conservation agricultural practices, state that several drivers and barriers can be identified that influence a farmers' decision to adopt or not adopt certain measures on their plot. Although it could deemed a quite 'dated' paper to the reader, subsequent literature since 1982 on conservation agriculture frequently features the central theoretical model used in this article, or an adapted version of it (Bartkowski & Bartke, 2018; Knowler & Bradshaw, 2007). The 'decision to resolve', or simply to implement a BMP as a reaction to the economic losses due to environmental degradation of farmer's plot, is a central concept in their research and is included in the theoretical framework of this thesis as well. Ervin & Ervin already mentioned many drivers or barriers relevant to influencing farmers decision making with regards to implementing conservation agriculture practices like BMP's, but drivers and barriers from other authors in the

field of conservation agriculture have been added to the theoretical framework in this thesis as well. To create a representable representation of drivers or barriers deemed relevant in the 'conservation agriculture' literature, many additional drivers or barriers were from other articles to our theoretical framework. It will be elaborated upon in the theory chapter.
Google Scholar and Scopus was used to find research articles; search terms included 'conservation agriculture', 'Best Management Practices', 'implementation', 'Spain', 'governance' and 'erosion'. Furthermore, the website of the European Commission and EUROSTAT proved very resourceful.

Achieving policy goals, like increasing the uptake of BMP's in Andalusia to lower province wide erosion rates, works differently for every 'context'. What this last term means exactly will be explained in the next section. In conclusion, different drivers and barriers are relevant for adoption, and a local government could adapt to this in order to achieve goals in erosion mitigation by implementing one of many instruments suggested in this section. This would involve a shift in governance. What this would add to soil governance literature is discussed in the next section.

1.3 Identification of the gap in literature

In this section, it is explained that good soil policy instruments are needed, as research shows little evidence of good soil governance examples. It will be explained that we are in search of the governance modes that correspond to these policy instruments, and that drivers and barriers of the choice to implement depend on 'local context'. Besides adding to literature what effective context dependent policy instruments are for the region of Andalusia, it will be researched as well if these drivers and barriers are actually context dependent. If this turns out to be not the case, policy instruments could be formulated for a larger region than Andalusia, increasing the utility of results. Lastly, the shift in governance modes to implement the suggested policy instrument to achieve better soil governance is an addition to literature discussed in this section.

Knowledge is limited on effective ways to govern soils sustainably (Ingram and Morris, 2007; Howard & Lawson, 2015; Prager et al, 2011; Wall and Six, 2015). Currently, soil research is often of the technical kind. Little research has been done on the financial and political features of this topic (Howard & Lawson, 2015), or in other words, how to intervene tactically in these kind of soil governance issues 'from above'. A recent systematic review of regulatory, financial and informational instruments within the EU (Ronchi et al, 2019), revealed through comparative analysis of those policies that there is no 'common EU strategy' to protect soil, highlighting that governance solutions are absent. Whether this is due to the inherent complexity of the problem at hand, or a lack of political will, is not made clear. Wauters & Mathijs (2014) argue for a policies tailored to the local needs, which is a form of adaptive governance. Juerges & Hansjürgens (2016) even go so far as to call soil governance an 'underdeveloped research field'. Knowledge on policy instruments to intervene tactically, in an 'effective and efficient' way (Bartkowski and Bartke, 2018; Juerges and Hansjürgens, 2018), to mitigate soil erosion is limited, as associated modes of governance are lacking in literature. A form of governance that

can precisely react to changes in all drivers or barriers affecting adoption among farmers, as to maintain a low erosion level. This adaptation could then be executed at the EU level; accounting for the differences in drivers and barriers of conservation agriculture across the EU, different programs and incentives should be designed for different regions. The CAP already exhibits some adaptive modes of governance, within the subsidies provided under the Rural development program. Although this program aims to achieve environmental goals (like reducing erosion) by offering EU farmers to adopt a practices tailored to their own farms, this research could still provide additional governance advice on how this program could be improved.

As stated in the previous section, over the past decades a wide range of research has been conducted on the reasons for the adoption of soil conservation measures among farmers (Knowler & Bradshaw, 2007). These drivers or barriers have been researched on locations on all continents, but pinpointing their relevance to farmers' adoption of conservation measures "remains difficult" however (Baumgart-Getz, Prokopy & Floress, 2012; Burton, 2004; Prokopy, Floress, Klotthor-Weinkauf & Baumgart-Getz, 2008). These authors agree that, although literature describes a fairly large collection of drivers and barriers to implementation, the importance of each one varies according to local socio-economic indicators and rules and regulations with regards to subsidies. Concretely, if a researcher were to compile a list of drivers to implementation for an average Andalusian farmer, and subsequently rank them according to their importance, this list would be different for a French or German farmer. This is due to the fact that there seem to be no 'universal drivers and barriers with a fixed importance that explain why farmers adopt conservation practices, according to Knowler and Bradshaw (2007). In other words, these seem to be context specific (Lahmar, 2010). 'Context' in this article seems to refer to the ensemble and interplay of the local topological situation (soil problems, climate, local pests), the agricultural market with its price volatility, the socio-economic situation and regulations and rules regarding farming (subsidies). Bartkowski & Bartke (2018) link the heterogeneous and multifunctional nature of soils to the high degree of difficulty associated with effective governance.

Concluding, many case studies researching local drivers or barriers to adopt conservation measures have been conducted. Many of them succeeded in logging relevant *local* drivers and barriers. Further studies found that these drivers or barriers are different for other local context however, and little 'universal drivers and barriers' exist. By finding what the context specific drivers and barriers are that influence farmer's choice to implement soil erosion mitigating practices, then coupling fitting policy instruments to address these drivers an barriers, and finally categorizing these policy instruments into environmental governance modes will add to the 'underdeveloped' field of soil governance.

1.4 Research aim

The erosion problem is hard to address effectively in Andalusia. On one hand, there needs to be enough political will to address a problem not directly caused by the government, and of which the effect will only slightly become more visible in terms on decreasing soil fertility and diminishing agricultural returns. On the other hand, farmers, who are largely responsible for the erosion happening on their plots, might not all be interested in adopting Best Management Practices mitigating the effects of erosion. It is not that they are purposefully digging their own grave, but addressing common pool resource problems effectively has proven to be notoriously difficult throughout history. This is an issue of good governance, and to understand what policy instruments might work, local authorities need to be knowledgeable on what drives or halts local farmers into adopting these measures. Andalusia is chosen because of the fact that it is a small enough region for there to be a comparable socio-economic situation throughout the region and that farmers need to adhere to the same set of laws and regulations with regards to subsidies. Drivers and barriers do not exist in a 'vacuum', they vary due to what authors in the field call 'local context'. After compiling a list of drivers and barriers from conservation agriculture literature, these can then be tested for their degree of importance to local farmers.

Based on the answers, additions to the literature can be made on the relative importance of these drivers or barriers in comparison to each other. Furthermore, it can be determined what to what extent local context plays a role in the importance of drivers and barriers. Based on this importance, suggestions can be made on how to govern the local soils better by drawing policy instruments from soil governance literature. Lastly, the shift in governance modes this would entail would entail will be an addition to environmental governance literature.

1.5 Research questions

Main question: **"What governance modes lead to a higher implementation rate of Best Management Practices on arable land by farmers in Andalusia, Spain?".**

Sub question 1: *What are drivers and barriers to the adoption of soil conservation measures on arable land by farmers in Andalusia?*

Sub question 2: *Based on drivers and barriers that influence a farmer's choice to implement Best Management Practices on arable lands in Andalusia, what policy advice can be formulated to public and private actors governing the region?*

Sub question 3: *What modes of governance correspond to the policy instruments used to steer farmers in Andalusia to adopt Best Management Practices on arable land?*

1.6 Research framework

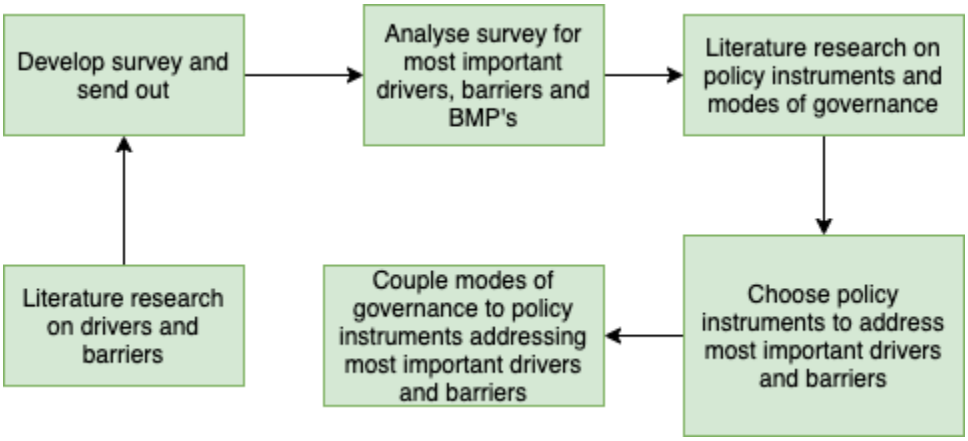

Figure 1: The research framework showing different steps and activities in the research process.

1.7 Scientific and social relevance

In this paragraph it will shortly be explained what this research adds to filling the gap in literature and what it adds to the field of conservation agriculture governance.

The contribution to governance literature of this research are the 'effective and efficient' policy instruments to address the complex problem of soil governance in Andalusia. In the process of discovering them, it will be revealed whether the drivers and barriers of the choice to implement are context dependent in Andalusia as well. The discovery whether drivers and barriers are context dependent in Andalusia is the second addition to literature. Finally, governance modes to describe the shift to better soil governance will be assigned to the proposed policy instruments, which is the final addition to literature.

To solve the complex problem of good soil governance in Andalusia, 'effective and efficient' policy instruments have to be implemented (Bartkowski & Bartke, 2018). In this research, these policy instruments will be found by first finding what drivers and barriers of implementation these instruments should address. Therefore, the local significance of drivers and barriers to implement a BMP on a farm have to be mapped for the region. On one hand, this could reveal whether the drivers and barriers for Andalusia are universal ones, meaning that drivers and barriers from 'general' conservation agriculture literature are proven to be locally relevant as well. On the other hand, this could reveal that drivers and barriers, deducted from local research paper or interviewing local farmers, are more important locally. Soil governance literature calls itself as a complex research field (Ronchi et al, 2019) because these drivers and barriers are context specific, meaning bound to a region. In this research, this will be tested and the results contribute to the soil governance literature. Finally, the coupling of governance modes to the proposed policy instruments (Driessen et al, 2012) will add to the governance literature what modes works better than others to achieve better soil governance. Concluding, policy instruments to increase the uptake of BMP's, discovering whether they are context dependent or not (can they be applied outside of the region to achieve the same effect?) and the

governance modes associated with this shift in governance are the additions to soil governance literature.

The societal relevance is threefold: first, by giving policy advice to public actors (regional agricultural departments and farmer's unions), it is suggested to them how to address the problem of governing the common pool resource of soil, and how to safeguard its future use. For a region that relies so heavily on local agriculture for food, work and income, soil erosion has the potential to cause societal disruption in the long term. Implementing the policy instruments suggested will likely have several economic and social benefits: they stimulate local businesses and wholesalers to sell more produce under an eco-label, for example. Being concerned with sustained ground quality in the region, they would be interested in hearing the findings of this research.
Second, less water erosion on arable land will lead to partly safeguarding farmers' future livelihood, ensuring soil quality because of less eutrophication on- and off-site and less sedimentation of waterways, which leads to the third relevance, namely that this in turn saves public funds otherwise used to restore and rid waterways of eroded soil.

Chapter one explored the problem at hand and described the governance issue associated with this. The next chapter, the reader will be introduced to the different drivers or barriers that influence the implementation of best management practices by farmers in detail. Some are hypothesized to drive the implementation choice; these are referred to as 'drivers'. Other are postulated to have the opposite effect; these are called 'barriers'. All drivers and barriers are included in the theoretical framework. The policy instruments that can be used to address the drivers and barriers will be explained as well. Lastly, the instruments' relationship with governance modes will be shown.

Chapter 2: Theory

The theories used in this research and the concepts used from these theories will be described in this section. It will be elaborated upon what the general use of theories are in academic research, and it will be explained in detail how that different parts of theory relate to each other and how these theories lead to the construction of the theoretical framework. The reader will be explained how the theory is appropriate to solving the problem of erosion as explained in the previous chapter.

2.1 Theoretical framework

The theoretical framework (figure 2), adapted from Ervin & Ervin (1982), showing drivers or barriers that influence the implementation of conservation measures for farmers. In this research, it will be researched to what extent these drivers or barriers influence the decision to resolve the problem of erosion on their plots in Andalusia and implement best management practices. The policy instruments that address the drivers and barriers are shown as well, as are the governance modes these can be coupled too. Note that the context dependency of drivers and barriers is shown in the framework also. Independent variables are constituted by the drivers and barriers that influence a farmers to make a choice to implement a Best Management Practices. Policies used to address these drivers and barriers are independent variables as well, as are the governance modes that can be assigned to them. Lastly, the dependent variables of this study is the choice of a farmer to implement a Best Management practice.

2.2 Drivers

This section will provide a discussion of different drivers of BMP implementation as found in literature.

The degree to which a farmer feels environmental concern is a driver in BMP implementation (Carlisle, 2016; De Jalón et al, 2013; Kallas et al, 2009; Lalani et al, 2016; Sánchez et al, 2016; Tambo & Abdoulaye, 2012; Wilson & Hart, 2000). This is often linked to their degree of education (about the environmental impacts of farming). This leads to the next drivers; the farmers education level. Farmers who are more educated, are generally more receptive and knowledgeable about the environmental problems present, both in the world and in the region, and they tend to implement more soil conservation measures.

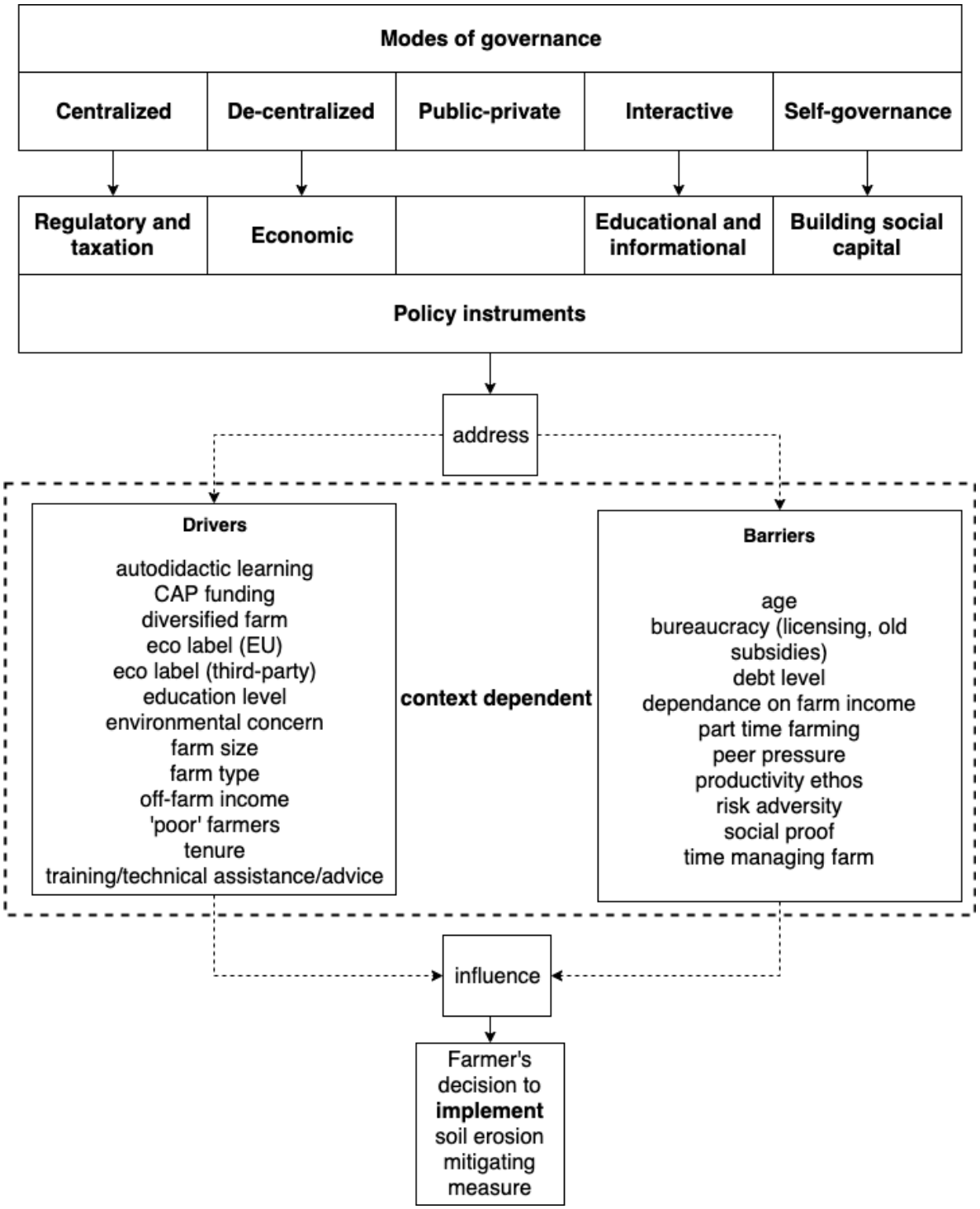

Figure 2: The different and context-dependent drivers and barriers that influence a farmer's choice to implement a BMP, the policy instruments to address these drivers and barriers, and the governance modes that can be coupled to the policy instruments.

Additionally, farmers trying to omit training or workshops to learn conservation agriculture techniques, might resort to teaching themselves from other sources of information (J. Ejea, personal communication, February 7, 2019). These self-teaching farmers are from here on referred as ‘autodidactic’ farmers. Also, diversification on the farm, meaning a range of different crops is cultivated already before a farmer considers implementing BMP’s, is a driver together with having a non-agricultural source of income (Ervin & Ervin, 1982; Kallas et al, 2009; Liu et al, 2018; Tambo & Abdoulaye, 2012).

Subsequently, a farm’s size is also of influence to farmers adopting conservation measures (Ahnström et al, 2009; Kallas et al, 2009; Wilson & Hart, 2000; Schroeder et al, 2013). While the first two authors claim a positive relation between farm size and implementation chance, the last two found it to be a barrier. Literature suggests namely that, while bigger farms have, on average, a larger range of management practices subsidies they qualify for, small farm holders might be more inclined to experiment and may find it easier to implement a new practices in their smaller scale operations.

Another driver is the ability to sell produce under an ‘eco label’, meaning wholesalers pay farmers a price premium (Giomi & Runhaar, 2018). In this research, a distinction will be made between the EU eco label and third party eco labels; the reason for this is that different forms of governance are associated with both.

Additionally, certain farm types have been linked to likeliness to adopt. The term farm type relates to a farm main source of income. This can be extensive grassland, intensive livestock, arable permanent crops and agro-forestry (in decreasing order of likeliness to implement).

Also, tenure, the degree to which the farmed land is privately owned by the farmer, is important; the more agricultural land is rented, the lower the chances of implementation (Carlisle, 2016; Wilson & Hart, 2000). While farmers need to do the effort to implement a practice, the landlords receive the subsidy in many cases. This provides a small incentive for a farmers to implement eventually; subsidy revision in this case is needed.

Moreover, technical assistance, training or advice constitutes a large stimulus for farmers to implement new practices. Via this mode of self-governance, networks are expanded, relevant know-how is exchanged and preliminary calculations on costs can be done at these events, catalyzing for many farmers the process of implementation (Leyva et al, 2007).

Lastly, subsidies, stemming from the EU, are also a relevant driver or barrier for farmers to implement conservation practices (Ervin & Ervin, 1982). The financial stimulus can help outbalance foregone income due to lower productivity, like in the case of agri-environment schemes. This driver might often be named as the first that could further the implementation of conservation agriculture practices, but the reader has hopefully been convinced that there are more ways to increase the implementation rate of BMP’s after reading this section.

2.3 Barriers

This section will provide a discussion of different barriers of BMP implementation as found in literature.

First, a farmers' adversity to risk is a barrier to implementation of new techniques (Ervin & Ervin, 1982; Kallas et al, 2009; Nowak, 1987); this is worth further exploring, as average income in the region is low and risk averse behavior might stimulate financially conservative choices, like not leaving land fallow or not applying vegetal strips to increase productivity.

Next, the farmers current age and the time since they have taken over management of the farm is also of influence, they namely constitute a barrier (Carlisle, 2016; Kallas et al, 2009; Sánchez et al, 2016; Schroeder, Isselstein, Chaplin & Peel, 2013).

Peer pressure, defined as the pressure exerted by a group of equal peers on a certain person to change their behavior according to the norms in that group of peers. In this case, BMP's implementation often conflicts with ruling norms among farmers about what constitutes 'good farming' (Carlisle, 2016; Liu, Bruins & Heberling, 2018; Schoonhoven & Runhaar, 2018). For example, a farmer might think about applying conservation tillage, but this goes against the local norms of 'keeping your land tidy' by regular tilling. This keeps up current forms of tillage.

Another barrier is constituted by the current ethos towards farming; this might be due the felt urge to 'catch up' with farmers from Northern Europe with regards to production quantities (Boix-Fayos et al, 2007); the ruling sentiment that production must be as efficient as possible. Implementing BMP's is perceived by some farmers to be incompatible current levels of efficiency, and thereby production. The effect lower production might have on their livelihoods might be enough to deter some farmers from implementing all together.

Moreover, the principle of 'social proof', or that farmers are not opposed to implementing BMP's but first like to see successful examples on plots of peers (Schoonhoven & Runhaar, 2018), constitutes a barrier as well.

A farmers' dependency on income from their farm is named as a barrier by Wilson & Hart (2000), while Lalani et al (2016) found that poorer farmers were likelier to engage in supportive schemes.
Boix-Fayos et al (2010) links part time farming to chances that a farmer is less likely to engage in conservation measures, as this excludes them from subsidies in many cases. As opposed to more wealthy farmers, they might have less money to spend on new farming activities. Budget constraints might in this case be real leading barrier. This contradicts Kallas et al's statement that off-farm income is a driver for implementation. This extra source of income could potentially offset the difference between wealthy (full time) farmers and part time farmers with other sources of income.

Furthermore,, the amount of debt also plays a role in the CA implementation (Ervin & Ervin, 1982; Leyva, Martínez & Roa, 2007)**;** prioritizing revenue in order to pay off debt steers farmers away from experimenting with new management practices.

Lastly, the excessive bureaucracy involved in applying for subsidies or changing your current subsidy, for example from a cereal subsidy to an almond subsidy, constitutes a barrier to implement for some farmers (Bartkowski & Bartke, 2018; J. Ejea, personal communication, December 18, 2018; Schulz, Breustedt & Latacz-Lohmann, 2014). The process of application is deemed 'too complicated' (Wilson & Hart, 2000), stopping farmers for applying for subsidies that might be indispensable for keeping the farm viable after implementing the practice. The local agricultural office (Oficina comarcale agrarica, or 'OCA'), is a local government office, where farmers can seek advice on subsidies; in practice however, these offices often lack the proper information to provide this advice to them. Furthermore, the need to license farming practices taught on seminars on environmentally friendly farming practices (given by farmers unions for example) is a demotivating driver or barrier for farmers.

2.4 Policy instruments

A range of different policy instruments discussed in soil governance literature will be considered in this thesis and is explained in this section.
Economic policy instruments, also called incentive based instruments (Prager et al, 2011), focusing on financial assistance can be used (Kibblewhite, Miko & Montarella, 2012; Knowler & Bradshaw, 2007; Posthumus, Deeks, Fenn & Rickson, 2011) to address drivers and barriers. Besides the common subsidies, expensive farming equipment could for example be made more readily accessible to farers through renting or 'cost-sharing programs'. Keeping in mind that farmers often hesitate to implement because of initial costs and 'transaction costs', organized shared ownership programs could sway farmers into implementing, where this didn't 'make sense from an individual perspective'.

Educative instruments and technical assistance, or 'information and capacity building' instruments, to inform farmers about the positive long term effects of implementing, financially and environmentally (Kibblewhite et al, 2012: Knowler & Bradshaw, 2007) are widely used as well. This information should be transmitted in a language and jargon they are familiar with. This can in turn lead to motivation, if the advice that is given comes from trusted sources; only then, the information is often deemed 'credible and appropriate enough' to actually work with.

Potentially one of the most effective instruments, but as well one of the most disputed; instruments related to regulating and taxation. Politicians not willing to 'stir the waters' of the agricultural lobby usually prefer to keep their hands off soil protection policies that prescribe hard regulations. Often also referred to a 'command and control' instruments (Prager et al, 2011), they are often associated with economic losses in the minds of farmers: this is why the approach used by the European Union might be more fruitful. EU cross-compliance regulations allow farmers to choose their own conservation measures on a farm-to-farm basis. This means that farmers can choose whether to adopt or not, which makes it easier to 'push for' in politics.

An example of using taxation as an instrument to further the use of BMP's is giving tax benefits on the purchase of equipment for erosion mitigating practices. Posthumus et al (2011) deem using hard regulation necessary to address farmers that neglect soil quality by farming in a way that put their plot at risk of soil erosion, by which they cause damage to the environment. Juerges & Hansjürgens (2018) deem planning instrument a part of regulatory instruments. In order to achieve large scale goals, like addressing the common resource pool problem of soil erosion in Andalusia, one has to work 'bottom-up', by connecting regional goals to Andalusia wide goals. This could be done by assigning a protected status to certain areas, or by pointing out priority region that need extra attention.

Investing in building social capital as well could enable the creation of a stimulating environment for farmers to start new practices on their farm. The 'learning process' that creates this social capital consists of fruitful discussion about conservation agriculture practices and finding shared goals in terms of soil governance. Ascribing positive values to farmers that implement BMP's via these meetings could positively benefit implementation. The more complex the information gets however, the more important it is to foster good channels of communications to ensure understanding and successful implementation (Sobels et al, 2001). These instruments are also referred to as 'cooperative instruments' in literature (Juerges & Hansjürgens, 2018). Bringing relevant stakeholders 'around the table' to discuss regional goal with regards to soil erosion, to discuss and compare visions, assets and logistics is seen as an indispensable part of a successful policy mix.

2.5 Modes of governance

This theory is the one used to describe different modes of environmental governance, and can be used to categorize a particular governance strategy or policy instrument under study by assigning one of 5 modes of governance to it, according to certain key properties (Driessen et al, 2012). From this theory, the concepts of 5 different modes of governance will be used, in addition to the concepts of civil society (CS), market (M) and state (S) as public or private actors. Civil society "refers to the space for collective action around shared interests, purposes and values, generally distinct from government and commercial for-profit actors. Civil society includes charities, development NGOs, community groups, women's organizations, faith-based organizations, professional associations, trade unions, social movements, coalitions and advocacy groups" (WHO, 2007).
The 5 governance modes are as follows: centralized governance, in which the most important public actors are a country's government and where market and civil society are largely steered by government policies; decentralized governance, in which market and civil society are also largely steered by government policies, but this time from "government at its various levels of aggregation", indicating a scattering of governing bodies and also public-private governance, in which market and government cooperate mainly; interactive governance, involving a more equal form of cooperation between CS and market and government, in which CS and market are given independence within certain boundaries determined by the government. Lastly, self-governance, referring to arrangements of governance in which private actors play a leading role.

Within this mode of governance, civil society and market enjoy even greater autonomy than in interactive governance.

To categorize the policy instruments into (mixes of) modes of governance, and answer the third research question, the framework proposed by Driessen et al (2012) will be used. Economic instruments are a form of decentralized governance, as at lower governmental levels policies are made and plans are initiated by democratically chosen actors and parties. Rules underlying the instruments are constructed by (local) representatives elected by popular vote. Rules are made in the policy sector of agriculture, with some overlap into other sectors. Educational instruments are a form of interactive governance, where information is exchanged between government, market and civil actors. Involved actors that spread information are included because of their knowledge of how to implement more effectively, and 'governing arrangements' between public and private actors could lead to the distribution of printed and electronic information more effectively. Regulatory instruments are a form of centralized governance, as state level agents make policies on a national level. Elected parties construct 'fixed and clear procedures' with regards to the agricultural sector, in order to achieve policy goals set at the provincial or national level. Building social capital requires more self-governance; private actors decide among themselves what goals are set and to what extent third parties have to be mobilized in order to achieve these goals. Rules can be of the informal kind, to adhere to cultural norms that are abided to in these governance arrangements. If there are formal rules to follow, these stem from the initiating actors themselves.

2.6 Discussion of literature

The absence of drivers sometimes poses a barrier (Weber, Driessen & Runhaar, 2011); many drivers discussed in this thesis could be formulated in a certain way to be barriers and vice versa, meaning the division between the two categories might not be as clear cut as presented in literature. For example, risk adversity is seen in the current framework as a driver. Consider the case of a farmer engaging in risk seeking behavior however, meaning their tend to take financial risks in managing their farm business. By formulating a driver called 'risk seeking behavior', the same phenomenon is formulated as a driver.

Next, it remains the question whether universal drivers and barriers simply do not exist due to different 'context', or that the failure to find common drivers and barriers between different contexts is due to other reasons. Prager et al (2010) raises 3 possible explanations for the failure of current research to find universal drivers and barriers, independent of context. First, it could be that the difference in 'analytical methods' used instead of the 'phenomenon under analysis' itself causes this. Second, they call for the need to isolate the influence of a region in which the research is conducted in the analysis. Third, they ascribe some of the variability of the results to the particular 'conservation agriculture' practices that is considered in a study. The drivers for adoption of BMP's might indeed differ from the adoption of other practices falling under the umbrella term of conservation agriculture practices.

Policy instruments and their associated modes of governance that work most ‘effectively and efficiently’ (Bartkowski & Bartke, 2018; Juerges & Hansjürgens, 2018), based on a ranking of the most important local drivers and barriers in choosing to implement, might not be the panacea it is made out to be by researchers. Finding the ‘common denominators’ in terms of drivers and barriers and subsequently acting on them by implementing policy instruments, might not give achieve policy goals of higher implementation rates, or even achieve a worse overall adoption rate than currently is the case. This could be imagined in a case where the differences between the most important drivers and the least important ones are not that large, and only a marginal fraction of the farmers population rates certain drivers or barriers as more important than others. Authors calling for ‘efficient and effective’ policy making might resort into policy making in that case that addresses the needs of a few farmers over the needs of majority. A possible solution to this problem is a combination of solely developing policy instruments that address drivers and barriers that are experienced by a large fraction of the farmers’ population on one hand, and keeping instruments tailored to farm level needs available, like the EU Rural Development Program does, on the other hand.

In addition, these modes of governance exist only in theory; in practice, achieving policy goals is a combination of different elements of governance (Prager et al, 2010). This means that governance modes for sustainable farming or to increase the implementation of conservation agriculture practices will contain different policy instruments that fall within the 5 theorized modes of governance proposed by Driessen et al (2012). When answering the research question, this nuance is kept in mind. This thesis will most likely provide policy instruments to increase the uptake of BMP’s that contain different elements of governance modes.

In the next chapter, an argument will be made for choosing a survey as a way of data collection, and the analysis of the survey will be explained.

Chapter 3: Methods

In this section, it will be explained how using a survey will reveal the importance of local drivers and barriers in the context of Andalusia. The design of the survey will be explained, as well as the way in which the survey will be analyzed. Here it will be described how the survey questions analysis will answer the research questions. We finalize this section by shortly revealing which experts are used to validate survey results.

3.1 Survey design

In order to obtain the qualitative data necessary to construct the theoretical framework of this thesis, literature on climate change mitigation methods, agri-environment schemes and conservation agriculture was consulted to find examples of drivers and barriers influencing BMP implementation.

The data sources consulted to answer the first sub question are “scientific articles in specialist journals” (Verschuren, Doorewaard & Mellion, 2010) and were retrieved from the ‘Universitaire Bibliotheek Utrecht’ (UBU) repository (the Utrecht university library). Also, experts were consulted to give additional insights on the drivers or barriers influencing implementation as found in literature. These people can provide the researcher with a “very wide diversity of information (...)” which can be gathered in a relative quick way. Using this data, a theoretical framework was constructed and subsequently tested using the survey.

In this survey (see appendix for the English version), respondents were asked what BMP’s they have implemented on their farm as of now, and to indicate what drivers or barriers influenced them into implementing those BMP’s. For example, say a farmers practices ‘rotation with cereals, they ‘check’ this box. Then, they were asked what drivers or barriers influenced them into doing so. In the case of driver or barrier ‘CAP funding’, farmers were asked the question ‘The receiving of CAP funding was important to me in choosing to implement this practice.’ They could subsequently indicate if they mostly disagree, slightly disagree, are neutral with regards to, slightly agree or mostly agree that a certain driver or barrier influenced them to implement. Lastly, they were asked to indicate whether some other reasons were important in their implementation, testing the importance of ‘unknown’ drivers or barriers in literature. Concluding, after completing the survey, data was acquired on what BMP’s are implemented per respondent, and the importance of all drivers or barriers in the case of every single BMP implemented.

Also, respondents were asked what BMP’s they have considered implementing on their farm, and to indicate what drivers or barriers influenced them into not implementing those BMP’s after all. In other words, what practices did they consider for implementation, but chose not to do so in the end? Note that this is different from asking farmers what BMP’s that have implemented as of now, which is further explained above. For example, suppose a farmer considered to start

‘intercropping’ on their land , they ‘check’ this box. Then, they’re asked what drivers or barriers influenced them into making the choice not to implement. In the case of the driver or barrier ‘peer pressure’, farmers are asked the question ‘This practice is not accepted in my community, as it is considered to be ”not the right way to farm”. They could subsequently indicate if they mostly disagree, slightly disagree, are neutral with regards to, slightly agree or mostly agree that this driver or barrier influenced them not to implement. Lastly, were asked to indicate whether some other reasons were important in their implementation, testing the importance of ‘unknown’ drivers or barriers in literature. Concluding, the survey acquired data on what BMP’s have been considered for implementation per respondent, and the importance of all drivers or barriers in the case of every single BMP implemented.

Arguably, validity of results might become compromised by having farmers answer multiple choice questions: this is addressed by having the survey checked by multiple Andalusian farmers to ensure unambiguity of questions and the completeness of the list of possible answers to questions. By having the survey checked on three different occasions, it was furthermore ensured that questions were in clear and concise Spanish. Also, farmers were given the option to provide answers to the questions themselves in the case their option was not provided.

Conducting interviews as an alternative way of gathering information would have meant losing a lot of possibly valuable data due to the language barrier; surveys on the other hand could be written in Spanish with the help of a native speaker. Thus, due to the fact that the researcher did not master the Spanish language well enough to conduct interviews with farmers, in addition to the possible high reach of a survey, the choice was made to collect surveys as a data source. A case study could also have been a choice to answer the research questions more in depth, but due to time constraints this would not have been viable. Comparing BMP uptake, local soil policy and local drivers and barriers of different regions to Andalusia to answer the research question of this thesis in more detail would have made results more credible; but a survey had to be conducted either way, as little research has been conducted on the drivers and barriers for BMP uptake among Andalusian farmers (Guzman et al, 2015).

The survey was distributed to 80 different respondents using different media, mostly through email or the social media platform Facebook. Although some of the contacted people were farmers themselves and thereby qualified to complete the survey themselves, all the people that were directly contacted were ‘gate keepers’, meaning that they had access to a large network of farmers to whom they could forward the survey. Among the gate keepers that forwarded the survey to farmers were 2 farmer’s magazines, 2 farmer’s unions, 4 environmental organizations focused on soil conservation and 1 scientific institute. The reach of gatekeepers varied between 1000 (regional farmers’ magazines and unions), 100 in the case of environmental organizations and around 10 in the case of the scientific institutes. A most conservative estimate amounts to 4500 farmers that received the survey: the number of farmers in Andalusia was 180000 in 2010 (EUROSTAT, 2012).

This means that it was accounted for that, at a response rate of 10% (a proven average in similar scenarios of researching farmers’ motivations for implementing environmentally friendly

practices on their farm in the Mediterranean, by means of a survey (Giomi & Runhaar, 2018)), 450 people would be surveyed out of a total of 180 000. As this accounts for only 0.25% of the population, this research can further be seen as an exploratory one rather that one to reflect a deep and extensive study of the target population with generalizable results. The relatively small sample would still be large enough to allow for a detailed image of the survey group, making the findings reliable enough to label as exploratory research. So, while the sample is large enough to be able to draw preliminary conclusions, the research results can be seen as indicative and could be guiding for future research. Results can be validated afterwards by contacting experts in the field. Local soil experts, with a background in the local agriculture, might provide more nuance and detail to the findings, as to make them more valid to extrapolate to the whole population. To ensure reliability further, the Spanish translation of the survey has been presented to multiple experts in the field of agriculture.

Surveys were collected between the period of 01-05 -2019 and 07-06-2019. In between this period, 4 reminders were sent to all 80 ‘gate keepers’ to kindly remind them to forward the survey. The data was collected using electronic surveys, distributed in networks of farmers. The survey was made accessible through a hyperlink leading the respondent to a Google Form created by the researcher (English copy provided in Appendix).

Concluding, in this section we expanded on the reason to conduct a survey, its design and its predicted reach. The next section will expand on the analysis of the results.

3.2 Analyzing survey results and interpreting them

A ‘ranking’ of driving drivers or barriers in the implementation of BMP’s in general was composed. This was done by determining the sign of the slope (Field, 2013) for each driver or barrier and subsequently ranking the drivers or barriers from most to least correlating with implementation. Please mind that the degree of the slope was not considered, as it was not deemed reliable due to the low response. A ‘ranking’ was furthermore constructed by counting the amount of times respondents marked that they ‘slightly agreed’ or ‘mostly agreed’ with certain drivers and barriers being important in implementing. This way, it could be found what drivers correlate with the adoption of BMP’s the most, and which the least. An identical approach was used with to create a ranking of the barriers to the implementation of BMP’s in general. This way, drivers or barriers correlating with not adopting BMP’s could be determined. Thus, this ranking of the drivers and barriers will help to add to literature in the field of conservation agriculture, as this reflects their importance in the local context.

Before discussing the results of the survey in the results chapter, it is important to note that response to the survey was limited; 16 farmers replied in total (0.4% of farmers who received the survey). Although a fellow researcher stated that these response rates were normal in comparable scientific studies at the European Network of Rural Development (F. Conti, personal communication, June 6, 2019), this means that no statistical analysis can be conducted on results. All trend lines fitted to graphs depicting one variable in function of another can only be used as a preliminary indication of a positive or negative relationship between two

variables (by watching the slope) (A. Elevelt, personal communication, June 18, 2019), but no Pearson correlation coefficient can be calculated for any relationship, as p-values are too high (Field, 2013). For this sample size, statistical tests are not revealing more 'meaning' behind data than descriptive analysis will do. A suggestion on how to use these results is suggested in Wassen, Runhaar, Barendregt & Okruszko (2011); they argue for more in-depth case-studies, building on drivers and barriers found to be preliminarily important. These follow-up studies could further examine what the mutual relation between these drivers and barriers is (checking for mutual influence) and further research what the 'contextual determinants' are (in this case, socio-economic factors and current regulations regarding farming and farming subsidies) that cause drivers and barriers to vary throughout the world. Thus, this exploratory research could provide helpful pointers as to conduct research on soil governance in Andalusia.

Answers to individual forms were received in Microsoft Excel. The survey results were entered in, analyzed and visualized using SPSS (IBM Statistical Package for Social Sciences Statistics, version 25). Also, Microsoft Excel (Microsoft Office Excel for Mac, version 15.13.3), was used for data analysis and visualization. These software packages allow the researcher to 'fit' trend lines, or lines indicating a certain trend in the results, to the acquired data. This could afterwards help to distinguish between positive and negative relationships between variables (by regarding the trend line's slope) and so preliminarily validate or falsify a driver in having indeed a positive relationship on the implementation of BMP's (idem for barriers, but in that case the negative relationship can be preliminarily validated or falsified). Please bear in mind that no statistical analysis could be conducted using the results of 16 respondents; this exploratory research can aid to determine future research by relying on descriptive analysis of the data (A. Elevelt, personal communication, June 18, 2019). This descriptive mode of analysis was also applied in ranking the barriers and drivers for their relative importance, for example; by simply counting the amount of times a certain driver of barrier was named by respondents as being important to the implementation of any BMP. Policy advice to answer sub question 2 based on analyzing survey results can be provided to the Andalusian ministry of agriculture and to the large farmers' unions like COAG (small farm holders) and ASAJA (young farmers). Answering the third sub question deepens the understanding of the importance and usefulness of certain modes of governance to realizing BMP implementation. Concretely, this would mean identifying what mix of governance works best (say for example, a mix of centralized and public-private governments, with elements of self-governance) and suggest ways to implement these new policies.

Validating research results

In order to validate and add more nuance to the research findings, local experts in the field of conservation agriculture were consulted. Alfonso Chico De Guzman, large local Spanish farmholder and chairman at the local farmer's organization 'AlVelAl', helping farmers to implement conservation practices, was consulted. Flavio Conti, policy analist at the European Network for Rural Development was asked to reflect on research findings as well, as his daily work consists partially of researching (on an EU level) what drives farmers to implement certain measures.
Also, Dan Mulder, project developer at Commonland, which includes a foundation and two companies that aim at restoring degraded landscapes, was asked for his thoughts. Next, Joris

De Vente, researcher at the Spanish National Research Council in Murcia was asked for his thoughts on research findings. De Vente works for the research group of ‘Conservation of Soils and Water’. Furthermore, prof. dr. Fuensanta García-Orenes, current researcher and teacher at the Department of Agrochemistry and Environment at the University *Miguel Hernández de Elche* was asked for advice. Last, Yanniek Schoonhoven, who published research on conservation agriculture implementation in Spain as well, was consulted.

Chapter 4: Results

4.1 Best Management Practices

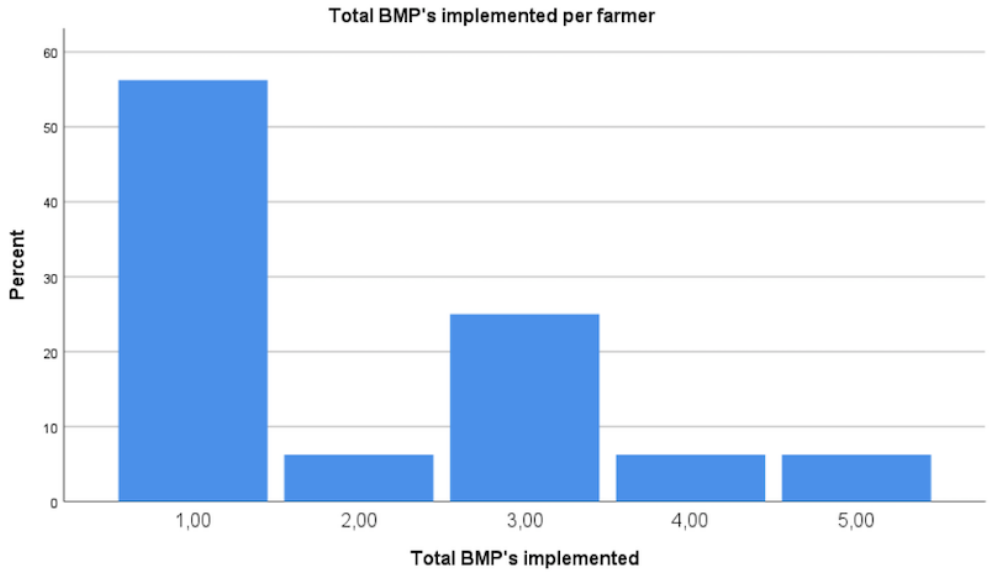

Figure 3: A bar chart representing the average amount of BMP's implemented per respondent. Note that the largest part of respondents (55%) implements only 1 practice.

Figure 4: A bar chart representing the average amount of BMP's considered for implemented before opting not too do so. Note that the largest part of respondents (65%) only considered one of the BMP's for implementation, that they eventually didn't adopt.

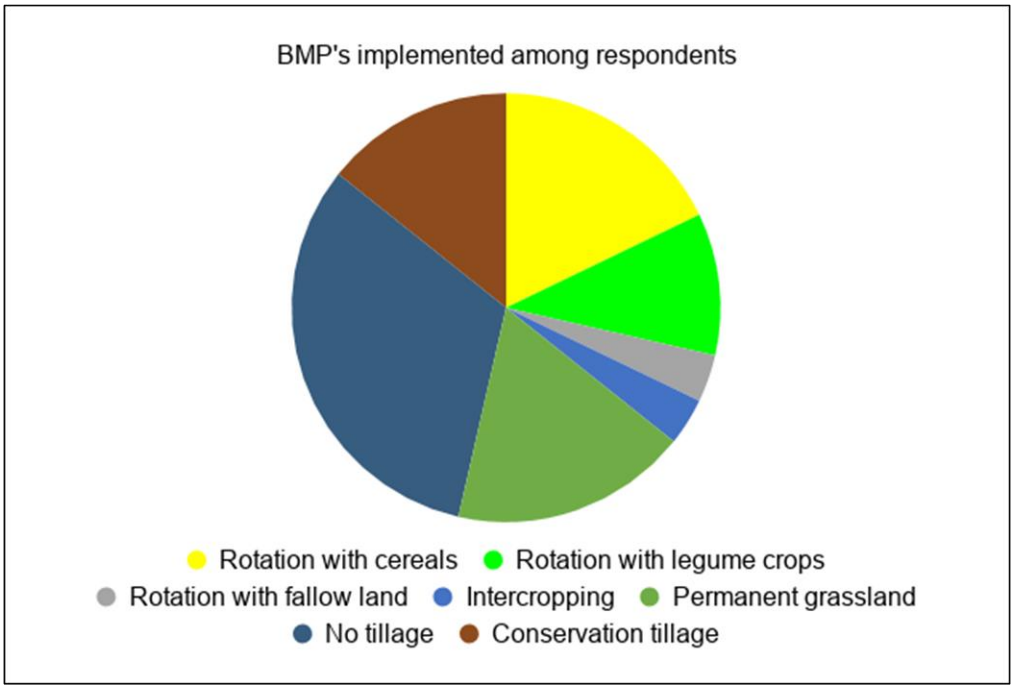

Figure 5: A pie chart representing all the BMP's implemented by respondents. Note that the 4 most popular BMP's overall (rotation with cereals, permanent grassland, conservation tillage and no tillage make up 75% of all BMP's implemented among the surveyed group, and as well that farmers could implement multiple BMP's as well.

In this exploratory research, it was found that 55% of respondents implemented 1 BMP, 1 respondent applied as many as 5 (figure 3). The other 45% of farmers applied between 2 and 5 BMP's. No respondents reported using more than 5. Most respondents considered implementing 1 BMP, before deciding they would not implement it after all (figure 4). Some respondents considered implementing 2 or 3. None considered implementing more than these.

Permanent grassland, rotation with cereals, no-tillage and conservation tillage were the most popular BMP's; together they make up for 75% of implemented BMP's among respondents (figure 5). As the crops associated with these practices make up a large share of Andalusian "Utilized Agricultural Area" (Junta de Andalucía, 2015), one could argue that if more farmers are cultivating a certain crop already, there is a higher chance that some of these farmers will find a way to implement a Best Management Practice for these crops. This effect could explain the high adoption rate of these practices in our preliminary results.

Now it has been shown what the most popular BMP's were according to the survey respondents. Rotation with cereals and conservation tillage were validated as being quite popular amongst farmers by local experts in the field (A. Chico de Guzman, personal communication, July 19, 2019; J. De Vente, personal communication, July 19, 2019; D. Mulder, personal communication, July 19, 2019; Y. Schoonhoven, personal communication, July 19, 2019). The fact that they cannot validate large implementation rates of no-tillage farming (4th

most popular BMP according to survey results) or validate the high prevalence of grasslands in Andalusia seems to further imply that the research findings are preliminary and furthermore support the statement that the respondents are young, highly educated and prone to taking risks when it comes to implementing practices that are considered to be unconventional.

4.2 Drivers

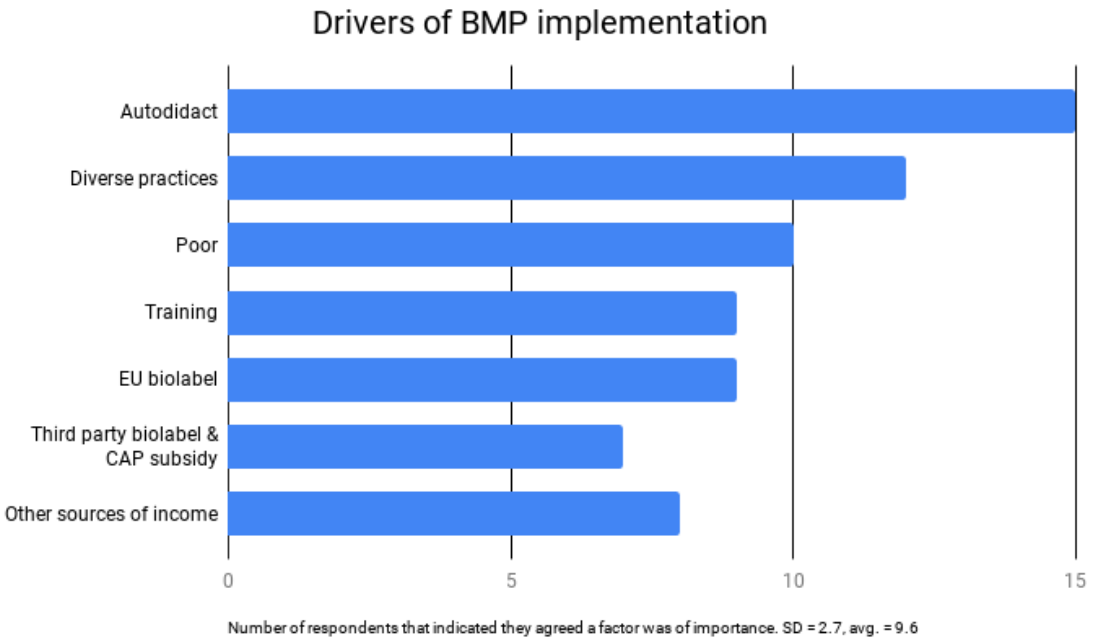

Figure 6: A ranking of the drivers of implementation for all 8 BMP's. On the left side, the different drivers or barriers are shown. The drivers are shown in decreasing order of the amount of times they were named as being 'important' or 'very important' to implementation by respondents. N=16.

Three drivers of implementation (figure 6) that appear most important to farmers were, in decreasing order of importance; (i) teaching themselves to implement a practice, (ii) that the practice fits within the diverse set of farming activities that a farmer already undertakes on their farm and lastly having a small budget to spend on it. The importance of training is ranked higher than that of selling produce under the EU eco label; this is because to the latter more respondents "mostly disagreed" with this driver or barrier being of influence to the implementation of the practice. These scores for individual drivers were calculated by counting the amount of time respondents indicated that the particular drivers was important to them in implementing any BMP. Please refer to the methods for a more detailed look at data analysis. Furthermore, it is important to note that 1 of the most important drivers was derived from local interviews, and 2 of the most important drivers were derived from conservation agriculture governance literature, featuring research conducted worldwide.

The hypothesis derived from literature that the "top three" drivers seem to correlate with BMP implementation is validated. All respondents either marked that they "mostly agreed", "slightly agreed" or felt neutral about those top 3 drivers or barriers being of influence to their

implementation of practices (except for one respondent that “mostly disagreed” with the fact that albeit that they had a low budget, they had implemented the practice). For a more detailed overview, please refer to figure 8 in the appendix. Considering the eco label (for both the EU as the third party labels) and ‘CAP funding’ as drivers is not as clear cut according to preliminary results. For these drivers and barriers, respondents marked “mostly disagree” as much as “mostly agree” to the question whether this driver or barrier was important for them in implementing a practice. This neither seems to confirm nor falsify the hypothesis of these drivers or barriers being drivers. The exact importance of these drivers or barriers seems contested; it might be worth exploring whether eco labels and CAP funding are only important to a certain group a farmers with similar characteristics. Lastly, in the case of ‘having other sources of income’, 6 respondents said they mostly disagreed with the driver’s importance, where only 3 respondents answered ‘mostly agree’ to the same question. This preliminarily falsifies this driver or barrier being a barrier and adds it to the list of drivers (next to selling produce under an eco label and receiving CAP funding) that could use more research in this local context.

Education

It was hypothesized that a higher education of a farmer would lead to a higher number of BMP’s applied to a higher number of implemented BMP’s on a farm. There seems to be a positive correlation indeed between the variables (refer to the appendix, ‘Drivers of BMP implementation’, figure 11) , thus the theory seems preliminarily confirmed. Important to note here is that education levels among Andalusian farmers are notoriously low (OECD, n.d.), so this is an additional reason why survey respondents are not representable sample for the entire farmers population of Andalusia (see figure 10 in the appendix for respondents’ education levels).

Farm size

There seems to be a strong correlation between farm size and the amount of BMP’s implemented (figure 12 in the appendix). The outlier in this case is clearly of influence on the slope of the trend line; it would have a more positive slope in the absence of the outlier. Even when taking the outlier into consideration, it is highlighted that the more land a farmer possesses, the higher the chance that they will implement more BMP’s. The hypothesis that a larger farm size correlates with the adoption of more conservation practices seems validated. This seems to indicate that more wealthy farmers are more likely to implement these practices, because possessing a large quantity of land would mean that they would have quantities of cash at their disposal. This seems in contradiction with other results of this study however; farmers indicate that them being poor, or “not having a large budget to spend on implementing the practice” constitutes no barrier for them to apply. If this were true in all cases, that less wealthy farmers are as likely to implement practices as the more wealthy farmers, than the trend line in graph ‘farm size’ would be flat. One explanation for both these facts could be that farmers have almost all their money in assets, like machinery and land, and often only little liquid capital. This explanation would also be in line with the finding that most farmers responded in the survey

that they “mostly disagree” with the fact that having debt present a barrier for them to implement new BMP’s.

Private versus leased property, or tenure

Theory predicts that, the larger the share of land that a farmers cultivates that is privately owned, the more BMP’s they implement. This amount of implemented BMP’s is also predicted to be inversely related with the share of land that is leased. Both these theories are validated by our preliminary results (figure 13 and 14 in the appendix). An upward trend line in graph relating the percentage of privately owned land versus the amount of implemented BMP’s, and a downward trend line in the graph depicting the percentage of leased land. Literature suggests that this lower degree of uptake among farmers that own less of 50% of land they cultivate is due to uncertainty on the side of farmers; they are often unsure of whether they forsake their contractual obligations as a tenant by implementing these Best Management Practices. Also, financial benefits go partly to the owner of the land in some cases according to literature; a small incentive for the farmer to implement remains. If this is indeed the case, policy makers should see to it that (i) BMP’s are ‘compatible’ for farmers currently leasing their land and (ii) subsidies are designed as such that tenants get full financial benefits from the EU for implementing the BMP’s.

Environmental concern

Literature suggested that, the higher farmers’ environmental concern, the more conservational practices they would apply. Preliminary results suggest the opposite (figure 15 in the appendix); it is found that farmers who rated themselves as scoring ‘7/10’ on a scale rating their environmental concern, applied more BMP’s on average than farmers who gave themselves a ‘10/10’ for their environmental concern. These preliminary results could be further examined in future research. Important to note here the respondents mostly consisted of young, highly educated farmers, which often have a higher concern for the environment than their older, lesser educated peers, so the sample is not representative in terms of environmental concern.

Main source of income or farm type

It was expected that extensive grassland, intensive livestock, arable permanent crops and agro-forestry would correlate with BMP implementation in decreasing order. Most respondents indicated their main income stems from cereals however, which is not mentioned in literature as correlated with adopting conservation practices. These findings do not aid in refuting or validating the literature hypothesis; future research could also include what portion of their income is constituted by their main form of income, to gain more information and be able to reflect and compare results with literature better. This factor could be further examined in future research by incorporating the lessons learned described in this paragraph.

Validation of most important drivers

Local experts agree on the importance of self-teaching and diverse practices on farms in implementing BMP's (A. Chico de Guzman, personal communication, July 19, 2019; D. Mulder, personal communication, July 19, 2019; Y. Schoonhoven, personal communication, July 19, 2019; J. De Vente, personal communication, July 19, 2019). A side note given by J. De Vente is that the potential of auto-didactic farmers depends on the openness of a farmer to experiment, meaning conservative farmers often do not resort to this solution. Also, they all see a link between a farmer engaged in a diverse farm (not practicing mono-culture) as more likely to be open to experiment with (environmentally friendly) practices and is usually associated with a relative capacity to innovate on the farmer's side. Lastly, local experts had some considerations in regards to calling farmer's being 'poor' a driver; and not only because it might seem not 'logical' to any reader at first. Some side-notes they gave were that it might be that being 'poor' does not have to be a barrier in the case that a strong business case can be made for the practice, or that implementing does not costs much, like in the case of conservation tillage. This also means that the economic value of subsidies is not to be underestimated, as this can sometimes change a practice that makes a loss, into one that turns a profit.

4.3 Barriers

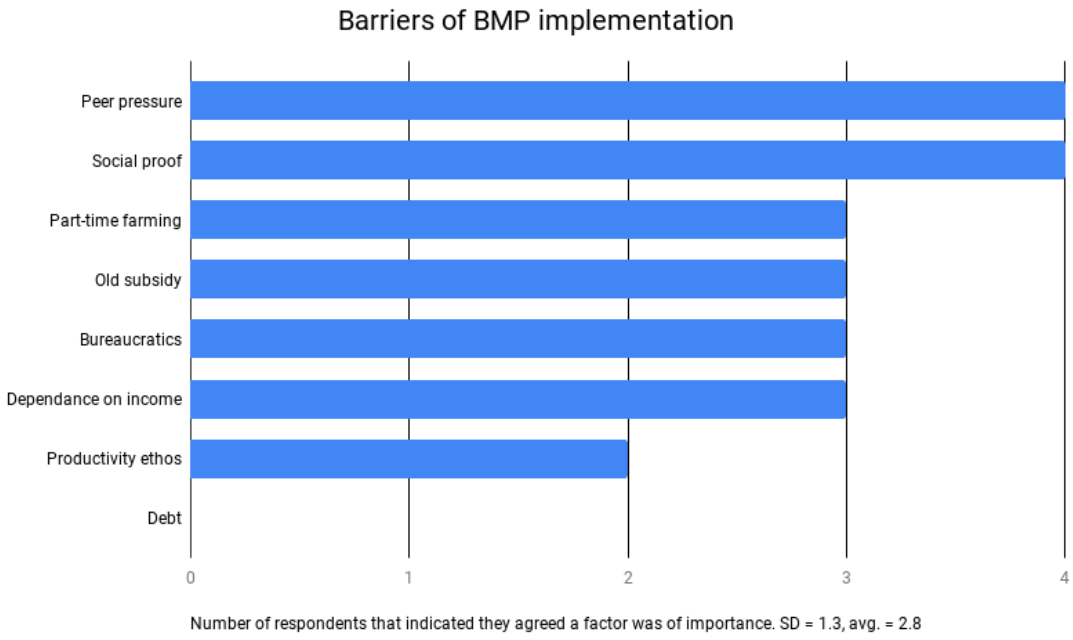

Figure 7: A ranking of the barriers of implementation. On the left side, the different barriers are shown. The graphs shows the amount of respondents that agreed on the importance of the barriers.

Preliminary results suggest the importance of peer pressure, social proof and dependence on income as barriers to implementation (figure 7). The ‘scores’ for individual barriers in this graph is determined solely by the sum of the times that respondents slightly or mostly agreed that this driver or barrier was a barrier to implementation. For a more detailed overview, please refer to figure 9 in the appendix. The order of drivers or barriers scoring the same (the ‘set’ of peer pressure and social proof and the ‘set’ of dependence on income, bureaucracy, old subsidy and part-time farming) got put in the current order by comparing the amount of times farmers responded they ‘mostly disagreed’ to the importance of the factor. The more respondents marked they ‘mostly disagreed’ with the driver or barrier being a barrier to implementation, the lower it got put in the order. The reason for this is that if many respondents do not agree with a driver or barrier constituting a barrier, it cannot be simply named a barrier still. If respondents agree as well as disagree about the importance of this barrier, than this means that this barrier could be investigated further; after all, why would some farmers agree with this driver or barrier stopping them from implementation and some of them do not? This is mostly clear in the case of ‘debt’ as a halting driver or barrier to implementation; 10 respondents indicated they ‘mostly disagreed’ with this (meaning it is no barrier to them). The importance of this barrier, bureaucracy and dependence on income can be a starting point for further research. Lastly, it is important to note that 3 of the most important barriers either stemmed from paper describing local research (barrier of part-time farming) or by interviewing local farmers (peer pressure and social proof). The (policy) implications of this will be discussed further below in 4.4.

Risk

Conservation agriculture literature suggests that farmers who avoid taking risks adopt less BMP’s. This is not indicated by research findings (figure 16 in the appendix, ‘Barriers of BMP implementation’); a weak downward trend line suggests it is suggested that farmers who implement more BMP’s are more adverse to taking risks. A possible explanation is that financial reasons were not leading in choosing to implement within the group of surveyed farmers. The risk adversity of farmers in literature is coupled to financial reasons; farmers might not like the prospect of losing out on short term profits due to failed implementation of new practices (Ervin & Ervin, 1982). Respondents indicated however that having debt was no barrier to them (figure 7) and that CAP funding was not a large driver to implementation. Financial reasons might not be leading in making the choice to implement or not in the surveyed group. Another possible explanation for the results can be given by looking at the results in the opposite way. More risk seeking farmers seem to adopt less BMP’s, although they know the risk that not adopting a more environmentally friendly might have bad financial implications for them in the future due to deteriorating land conditions, they still do not avoid this risk.

Time managing farm

The time that a farmers has managed the farm decreases their chance to adopt BMP’s according to literature. This is also suggested by preliminary survey results (figure 17 and 18 in the appendix). A downward trend line fitted to the data points (for both the ‘younger’ and ‘older’ half of respondents) indicates that the longer a farmer has managed the farm, the less BMP’s

they have implemented. Carlisle (2016) suggests this behavior of the ‘elder generation’ might stem from them being “more set in their ways” and, more importantly, more likely to be well integrated in the local farming community with its views on the “right way to farm”. This barrier can possibly reinforce two other barriers to implementation; ‘social proof’ and ‘peer pressure’. In aging farmer communities, where farmers have managed their farms for long times on average, it could be that the need for social proof of working examples of BMP’s is often missing and peer pressure keeps community members from trying them out.

Age

Literature suggested that, with age, the chances to implement new practices drop. This was not confirmed by our preliminary findings (figure 19 in the appendix). The trend line in this figure suggests no correlation between age and the amount of implemented BMP’s. Although the results are preliminary and more research is needed, these finding might be different if farmers over the age of 52 had participated in the survey. By including the farmers that might have a lower willingness to change and a more traditional mindset with regard to farming as opposed to the younger farmers (Schroeder et al, 2013) , the results could have been more useful.

Validation of most important barriers

Peer pressure, social proof and part-time farming are seen as strong local barriers (A. Chico de Guzman, personal communication, July 19, 2019; J. De Vente, personal communication, July 19, 2019; D. Mulder, personal communication, July 19, 2019; Y. Schoonhoven, personal communication, July 19, 2019). Some valid considerations were raised however; F. Conti suggested that the barrier of social proof should be linked to the driver of self-learning in articulating policy suggestions. Farmers could learn from peers that already implemented themselves, he stresses the need to learn from each other’s experiences on this matter. J. De Vente subscribed to this notion, and added that there is a need for not only more knowledge exchange on how to implement, but also how to adapt it to local climate conditions, or how to deal with uncertainties in crop yields. F. Conti furthermore suggested that part-time farming as a barrier could also be seen as confirmation for ‘CAP subsidies’ to be a driver. Also, part-time farmers might also view the business as more of a hobby, according to Y. Schoonhoven. They might be more open to experiment, focusing less on making the largest profit possible, which in turn makes them open to experiment with new practices like BMP’s.

Concluding, preliminary findings suggest that peer pressure, social proof and the time since the start of management of the current farm pose barriers to BMP implementation. This mirrors hypotheses from literature. Some barriers need more specific research as to what constitutes the ‘spread’ in agreement around the importance of them; the dependence on income from the farm, the bureaucracy and debt the farmers might be in.

4.4 Policy instruments and governance modes

In this section, policy instruments and associated governance modes used in soil governance literature to address drivers and barriers will be discussed for the most important drivers and barriers found is this research.

Policy instruments and governance modes

Before discussing the policy instruments that address the top 3 drivers and barriers in Andalusia, it should be remarked that, as mentioned in the discussion of literature in the theory chapter, policy instruments should only be implemented if the drivers and barriers they address are strong and are clearly more important than the others. As this is the case in this research, this makes a stronger point to implement them. First, policy instruments to address the most important drivers: to address the drivers of farmers who teach themselves to properly implement, educational instruments could increase the availability of public information on Best Management Practices. Farmers that do not use the 'paved ways' of traditional education through schools, meetings or courses should still have relatively easy access to information about the practices, as they operate 'alone'. An example of this could be the availability of implementation information in libraries (or in any places where farmers find themselves regularly) or websites, electronically and in print. Building social capital also addresses this driver: fostering (in)formal networks of farmers who try to implement, facilitating the flow of information of what practices work best on the local level.

Addressing the driver of managing an already diversified farm in terms of practices and crops cultivated, different instruments can be used. This result indicates strongly that running an already diversified farm facilitates adopting even more practices; using regulatory instruments and taxation to penalize mono-culture practices instead of using economic instruments to incentivize the use of more different practices through subsidies is suggested. Also, building social capital to spread knowledge on how to operate a more diverse farm, is proposed. Having 'tecnicos' (middle-men between large buyers of produce, local departments of the ministry of agriculture and farmers) spread knowledge to interested farmers on how other farmers diversified their farm, could help farmers learn from each other on what best works on the local level.

Assuming that 'poorer' farmers already are informed about the environmental and economic benefits of implementing BMP's, they might already be informed about these aspects of the practices, but might still benefit from knowing more detailed information about how to implement in the exact region of their plots, using their particular equipment. Lowering the barriers of access to networks of farmers that hold this knowledge might increase their chance to succeed in implementing. Concluding, to address the most important drivers, a mix of all instruments is suggested, with an emphasis on instruments that focus on building social capital.

The barrier of peer pressure, keeping farmers to keep up current norms of farming, could be used as a drivers as well. This idea, suggested by Wassen et al (2011), has direct effect on the choice of policy instrument to address the barrier of peer pressure. Making conservational agricultural practices the norm in communities through the use of 'soft' instruments like those focused on building social capital could sway the opinion of the people who haven't yet. By giving local prominent farmers that have adopted a stage at (in)formal meetings to speak about the benefits of the practices is an example of building this social capital. By showing that implementing works on their farm, the social proof that is needed to build trust in the new practices could be built amongst community members. Addressing the two most important barriers should go hand in hand, as providing proof that the practices work could sway an ever larger group of farmers, making the effect of peer pressure a positive force. This instrument should focus on farmers of all ages, as preliminary results indicated that this was not an important barrier to implement; merely the time a farmers has been managing their farm was.

Lastly, reformed economic and regulatory instruments could help address the barrier of part-time farming. By revising them to not penalize but create equal opportunities in terms of successful adoption of BMP's, farmers that devote not all of their working time to farming could be nudged to adopt more BMP's.

When comparing the suggested policy instruments with the associated modes of governance as shown in the theoretic frameworks, it becomes apparent that all modes of governance are involved in increasing the uptake of BMP's in Andalusia. Regulatory instruments are a form of centralized governance, where economic ones are a form of de-centralized governance. The use of education instruments requires interactive governance, and building social capital involved more self-governing. It should be noted however that emphasis should be laid on the more self-governing modes, as these are suggested most to address prominent drivers and barriers in the region of Andalusia.

To conclude this chapter, its main findings are reiterated. It started with stating findings on the most implemented BMP's. These findings were largely validated by experts, except for no-tillage. In the case of rotation with cereals, the most logical explanation for this can be sought behind the fact that cereals is one of the most popular crops. Assuming that farmers cultivating mainly cereals or mainly legumes are willing to implement to the same degree, but cereals is a more popular crop, more rotation with cereals will be implemented than legume crops. Another possible explanation is that rotation with cereals is more easy to implement; the practical considerations for farmers to implement should be researched further. A similar explanation is given for the high implementation rate of conservation tillage; a combination of high applicability in Andalusia (in olive groves and almond plantations) and low difficulty to implement. The fact that no-tillage and permanent grasslands were adopted so much among respondents can be traced back to the fact that farmers that responded were young and highly educated and not representative for the average (more traditional) farmer. This fact was also confirmed by experts.

Important local drivers identified in this chapter were self-teaching farmers, a farmer practicing diverse farming practices and farmers being ‘poor’. Important local barriers were peer pressure experienced by farmers, the need for social proof and part-time farming. These were validated by several local experts, with some side notes that are explained in this chapter as well. Some drivers and barriers were suggested for future research (the influence of CAP subsidies, farm type and bureaucracy, the role of a farmer’s dependence on farm income and the influence of eco labels for produce).

Targeted policy advice designed for different institutions was formulated, and regulatory, economic, educational and instruments focused on building social capital were all suggested. It was concluded that a shift to more (in order of importance) self-governance, (de)-centralized and interactive modes of governance might be effective at increasing the uptake of BMP’s in Andalusia. Policy advice addressing the drivers could actually be used outside of the context of Andalusia as well, in regions with the same, explicit drivers, as these were proven to not be context dependent.

Chapter 5: Conclusion, limitations and future research

5.1 Conclusions

Governing the common pool resource of soil in Andalusia through good use of policy instruments has proven to be a complex undertaking. An attempt was made in this thesis to provide suggestions for governance modes to address this problem effectively none the less. It was stated that, on one hand, the Andalusian government would benefit from mitigating soil erosion on agricultural land; the sustainability of agricultural returns would be safeguarded this way. Farmers on the other hand do not have a large personal stake in protecting their land from the effects of soil erosion; effects of a slimming layer of fertile topsoil might not be noticeable on a short time scale, and diminishing returns may be countered by an increased use of fertilizer or by putting new lands to agricultural use. The primary policy instrument used by the local authorities to sway farmers into more conservation agriculture practices, is by the use of subsidies.

This research wanted to determine if there are other drivers (and barriers) for farmers than the lack of financial means to the implementation of Best Management Practices, which are a form of conservation agriculture. Answering the first research question meant to map drivers and barriers to Best Management practice implementation, as found in literature. These were tested by the use of a survey, which was distributed to an estimated 4500 farmers in total. In this research, 14 drivers and 12 barriers found in literature were tested. Education, autodidactic learning, farming being ‘poor’ or having a diversified farm, tenure and farm size were validated as drivers. Environmental concern, off-farm income and receiving training, technical advice or assistance were found preliminary falsified. Furthermore, the time a farmer has been managing their current farm, the bureaucracy in applying for subsidies, peer pressure, the need for social proof and part-time farming were validated as barriers. Some barriers were preliminarily falsified: risk adversity, age, productivity ethos and debt. The influence of some drivers and barriers was inconclusive and/or very relevant for future research to determine governance modes to stimulate Best Management Practices implementation: CAP subsidies, bureaucracy, eco labels and the farm type and dependence on farm income. This answered the first research question.

In this research, the results hint at the fact that the 2 out of 3 most important drivers are actually universal ones and stem from ‘general’ conservation agriculture literature and the 3 most important barriers are taken either from local research papers or interviews with local farmers. Thus, while the drivers are more or less universal for the case of Andalusia, only the barriers seem context bound. The importance that soil governance literature ascribes to the context is only validated in this research for the barriers, but not for the drivers. This implies that the policy instruments addressing the barriers have to be more tailored to local circumstances that the drivers will have to be.

Policy instruments based on soil governance literature to address the most important drivers and barriers were formulated as well, answering the second research question. Regulatory instruments and taxation, economic instruments, educational and informational instruments and those designed to build social capital were all deemed useful to address drivers and barriers to implementation.

Reflecting on the governance modes to which policy instruments can be assigned, it was revealed that modes of self-governance would be vital in increasing the uptake of BMP's in the region. Building social capital plays a pivotal role in increasing the knowledge needed to address the drivers and the barriers that currently influence the choice of farmers to implement or not. Furthermore, (de-)centralized modes of governance are suggested as well. They are mostly related to revising regulations and subsidy grants to better 'fit' farm conditions facilitating BMP uptake, like enabling part-time farmers to receive subsidies as well, and penalizing mono-culture. Lastly, interactive modes of governing are important to increase the availability of (good) information on BMP's. Self-starting is the biggest driver is the biggest driver identified in this thesis, so capitalizing on this should prove fruitful. Especially when considering that BMP uptake is still in its infancy in Andalusia (Guzman et al, 2015), providing information to this growing group of adopters could also address the barrier of social proof, by the higher occurrence of practices all over the region. This mix of governance modes that is suggested answers the third and main research question and is the main finding of this thesis.

Preliminary findings on 'good' soil governance modes for Andalusia mean that maybe not more, but different ways of governing the region might be more fruitful to mitigate the effect of erosion, lowering the direct and indirect costs that stem from it, benefiting the Andalusian society as a whole. Reflecting on the soil definition of Juerges & Hansjürgens in their 2018 article, which included also the "[...] habits and attitudes that concern soil-related decision-making processes of state and non-state actors at all decision-making levels", it can be stated that this nuance to the definition of governance provides a valuable addition to Driessen et al's 2012 article. The drivers and barriers to implementation for farmers are largely based on habits and attitudes they hold towards farming and their environment, and this directly relates to the governance solutions that could be used to steer them.

The respondents to the survey were mostly young and highly educated farmers. Results thus may be biased towards what drives and stops farmers like them in terms of age and education to implement. No farmers older than 52 responded to the survey, and farmers older than the age of 55 make up half of the farmers population in Andalusia (Junta de Andalucía, 2015). Combine this with the fact that the province is infamous for its lowly educated citizens in comparison to the rest of Spain, it becomes clear that our sample might not be fit for extrapolation, along with the fact that N=16 for this research. This does not mean however that the results are not useful to guide future research. This exploratory research revealed some useful findings in terms of local drivers and barriers to implementation, and analyzing governance modes associated with current ways of steering farmers to implement provided a detailed insight into the complex world of soil governance. Many research findings were

validated by local experts, and the policy advice given based on this can lead the way to increased rates of implementation.

5.2 Discussion

Drivers and barriers

The policy instruments addressing drivers and barriers could mutually stimulate each other, making tactically intervening to increase BMP uptake possibly easier. These ‘complementary effects’ (Borrás & Edquist, 2013) of multiple instruments could achieve more than the sum of their parts. This is estimated in the case of addressing the driver of self-teaching farmers (autodidactic farmers) by making information about the benefits and implementation of BMP’s more readily available, leading to more instances of (isolated) farmers that implement. This could lead to, for example, those farmers providing the social proof that some other farmers needed to make ‘that final step’ to implement. This could in turn sway the norms held in a community on what constitutes ‘good ways of farming’, transforming the role of peer pressure from a negative one into a positive one in terms of BMP uptake in rural communities. This in turn touches upon the issue that in some cases, the absence of drivers can be seen as a barrier, and vice versa (Weber, Driessen & Runhaar, 2011). In choosing to address the issue of low BMP uptake in Andalusia (Guzman et al, 2015), authorities wanting to address the issue of soil governance ‘effectively and efficiently’ (Bartkowski & Bartke, 2018), could restrict themselves to the most important drivers and barriers that require policy instruments that have complementary effects, like in the case of self-teaching farmers, peer pressure and social proof and the educational or informational policy instrument.

Policy instruments

In this research, policy instruments used in soil governance to increase the adoption rate of conservation agriculture practices where used. Not all Best Management Practices were considered in this research, only the ones that were (in some EU countries) eligible for subsidies and soil erosion mitigation. Furthermore, BMP’s are just one of many conservation agriculture practices. This large variety in practices implies that not all instruments works for all practices, and that caution should be exerted when implementing any new policies to increase the uptake of BMP’s (Prager et al, 2010).
Next, it is important to note that there is a virtual endless spectrum of individual instruments that could be applied to address drivers and barriers, and that there is no fixed manner in which this should be done; there are merely ways that achieve policy goals with less unwanted indirect effects than others (Rossi et al, 2004). So, as there is no clear recipe to achieve this goal of increasing the uptake, different (combinations of) policy instruments could work just as well as the ones proposed. The ones chosen were merely the ‘conspicuous’ ones.

The findings on drivers bring the fact that, although the Andalusian governments' main 'weapon of choice' to increase BMP uptake is the policy instrument of CAP subsidy, different incentives to implement might be even more important. Maybe the economic incentives can be put on a figuratively lower pedestal, and more focus can be put on institutionalizing the exchange of information between farmers on BMP's, through farmers' unions or other (government funded) channels. Albeit the local government is apparently convinced of the role of subsidies in driving farmers to implement, Giomi & Runhaar (2018) find that the role of economic incentives if is negligible in their research on the reduction in us of agro-chemicals in Italian olive farming, highlighting that financial incentives might not always be very convincing in comparable industries and economies. The Andalusian government might 'diversify their bets' with regards to stimulating farmers to implement.

The survey

Survey results could not be extrapolated to the whole farmers' population of Andalusia for several reasons. The first is the low response rate to the survey (16 responses) and the second is that these results should be seen as preliminary indications for a group of younger, highly educated farmers. Half of the target group to which the survey was sent is namely more than 55 years of age (Junta de Andalucía, 2015). This means that a large part of the farmers' population was not included in this research: a group which might have different drivers and barriers to implementation, next to having different BMP's applied on their farms. Therefore, also different policy advice could be given based on this (now) missing information. Also, most of the respondents are educated far above the average education level for Andalusian farmers. Education levels among Andalusian citizens are notoriously low compared to the national average (OECD, n.d.). 78% percent of respondents noted having an education level of Bachelor's degree or higher. It is concluded that the respondents were overall young and educated, and that the elder, lower educated group of farmers is not represented in survey results.

A link between young, highly educated farmers and the adoption of sustainable practices on their farms is validated by local experts (A. Chico de Guzman, personal communication, July 19, 2019; F. Conti, personal communication, July 19, 2019; J. De Vente, personal communication, July 19, 2019; F. García-Orenes, personal communication, July 19, 2019). Some valid side notes were made by F. Conti and J. De Vente on the fact that the younger farmers should therefore not be considered to not be business 'savvy'. They will not make a move if a practice has not 'proven' itself. They might be more ambitious and prone to taking risks however, but may be also better able to distinguish good business plans from lesser ones though their education.

The research method of using a survey is not deemed suitable to conduct research in this geographical area. It was initially chosen to reach a high number of farmers, but the amount of effort in terms of sending reminders was not rewarded with a high response rate. Many reasons come to mind that could have caused this; it might be due to the perceived distance between the researcher and the farmer, or to the low faith held by farmers in research and government.

These might all add to the low response rate, but the fact remains that information was more easily gathered from farmers on site. Gathering info during the exploratory phase of this research on events like open days on farms, or meeting farmers during farms visits, worked better. This leads the researcher to believe that data gathering on drivers and barriers, now collected through surveys, would have been more easy in this case ‘on site’.

More research has to be conducted on how to implement the proposed policy instruments properly. The implementation of new policies can have unforeseen results, which have to be accounted for. Policies (in general) have to be checked; whether they meet their goals, and if a higher implementation is actually due to the new policies. Thus, this research method is fruitful if policy suggestions are checked carefully after implementation (by a policy impact assessment).

5.3 Future research

The policy instruments formulated in this thesis need more validation by research. Interviewing older and lower educated respondents will give a more detailed image of the local importance of the drivers and barriers. That could further strengthen the argument for the strong drivers and barriers found in this thesis and shed more light on those that need more research. Examples of drivers that need more research are having other sources of income, selling produce under an eco label and subsidies. Barriers that need to be further examined for their influence on the choice to implement are the dependence on income from the farm, the bureaucracy involved in adopting and debt the farmers might be in.

The elderly and lower educated group of farmers were not represented in our survey; it is important to research their vision on BMP implementation as well in the future to formulate effective policy advice. Although age was not validated as a barrier in this research to implementation (see figure 19 in appendix), the effects of managing a farm for a long time is negative on implementation (see figure 17 and 18 in the appendix). Thus, policy advice has to be tailored to the needs of older people that have been managing for a longer time. To do this, more research is needed on this age segment, as they (on average) have been farming for a longer time. Furthermore, this age segment is also the group that is most at risk of being under the influence of what seemed to be large barriers to adoption, namely peer pressure and the need for social proof of new techniques. Because of their age, they are more likely to have a traditional view of what the ‘right way’ of farming is (Carlisle, 2016, A. Chico de Guzman, personal communication, February 20, 2019). They are therefore more likely to keep practicing current practices and thereby halt others from adopting new ones, and policy instruments have to account for this.

It might be more fruitful (for a Spanish speaking person) to approach elder farmers in person during their afternoon lunch in a restaurant, as it is customary for farmers to spend several hours during weekday afternoons in one of the many bars and restaurants across Andalusia. A higher number of respondents, to allow for statistical analysis of survey results rather than a descriptive one, could be achieved by gathering data this way. This could be done at local farmers’ unions during (in)formal gatherings as well.

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Appendix

Drivers of BMP implementation

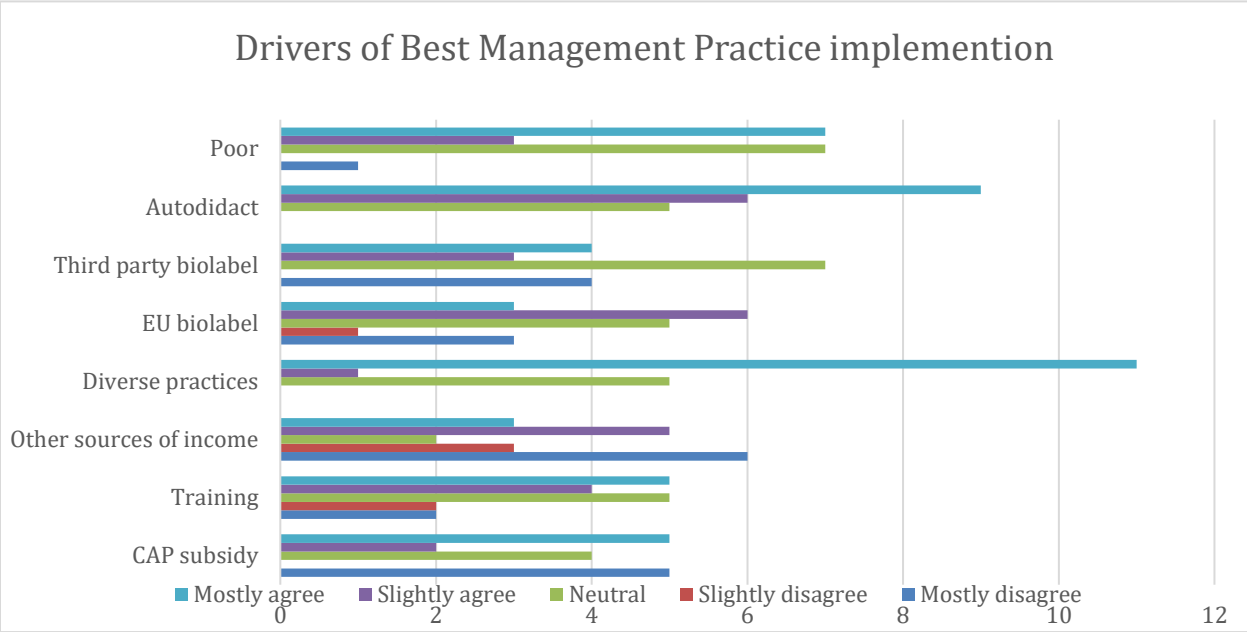

Figure 8: A more detailed representation of respondents' answers with regards to the importance of certain drivers of best management practice implementation. In this graph, neutral and disagreeing replies are included as well, as opposed to figure 9 discussed in the thesis, which only included data of respondents that marked 'slightly agree' and 'mostly agree'.

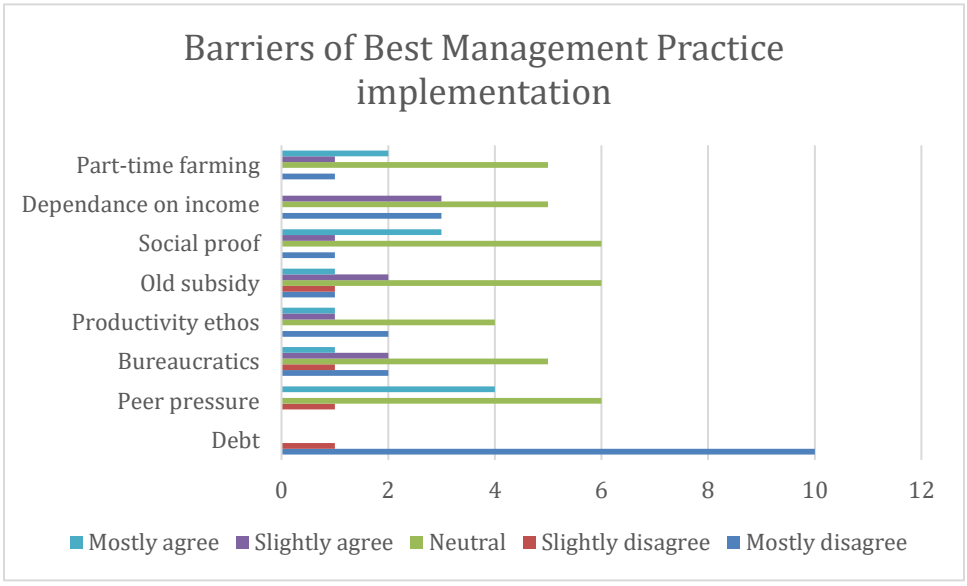

Figure 9: A more detailed representation of respondents' answers with regards to the importance of certain barriers to best management practice implementation. In this graphs, neutral and disagreeing replies are included as well, as opposed to figure 16 discussed in the thesis, which only included data of respondents that marked 'slightly agree' and 'mostly agree'

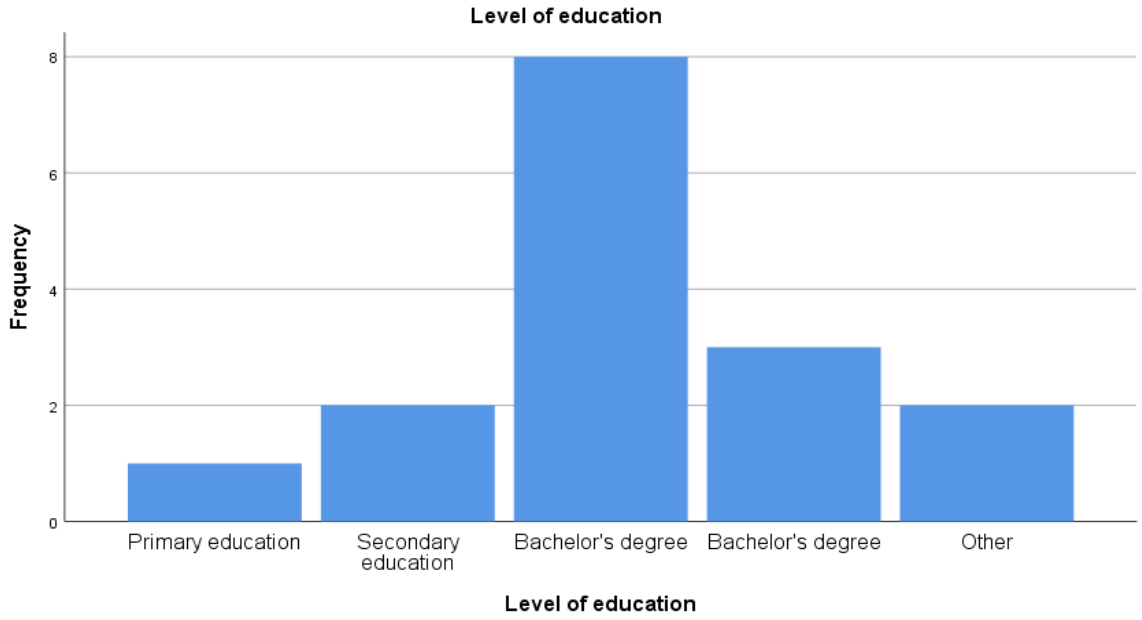

Figure 10: The levels of education among respondents. Remarkable is the amount of respondents with a degree of Bachelor's or higher (11). N =16..

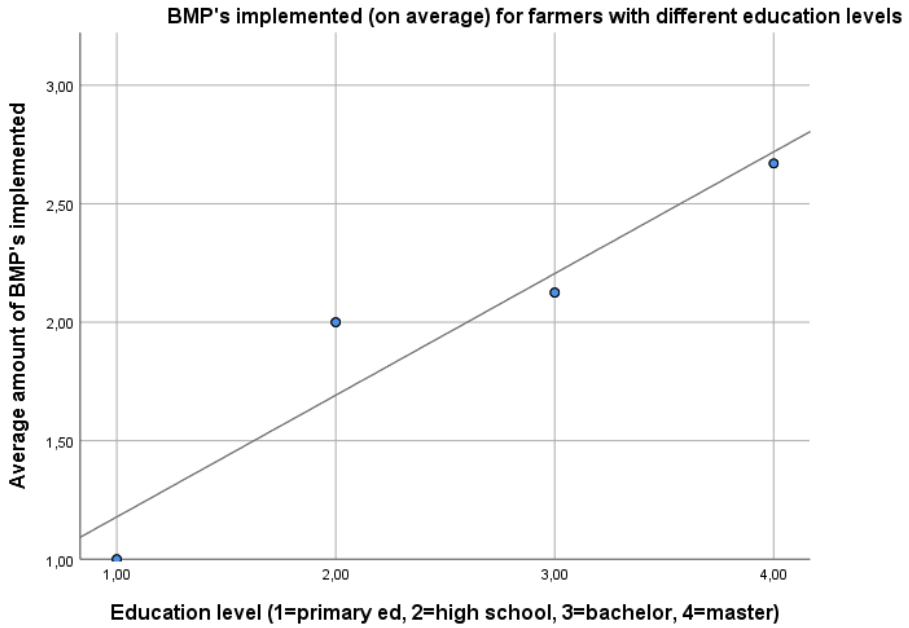

Figure 11: The total amount of best management practice in use (on average) by farmers of a certain education level. A positive correlation can be seen between the two variables in this graph.

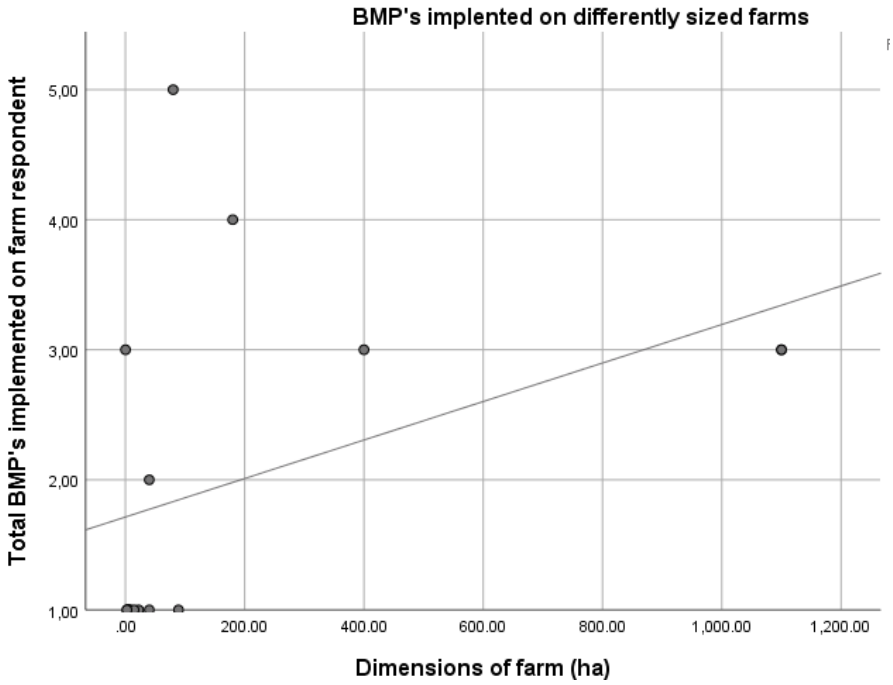

Figure 12: The total amount of best management practice in use on a farm in function of the farms dimensions in hectare. Note the upward slope of the fit, suggesting a positive correlation between the two variables.

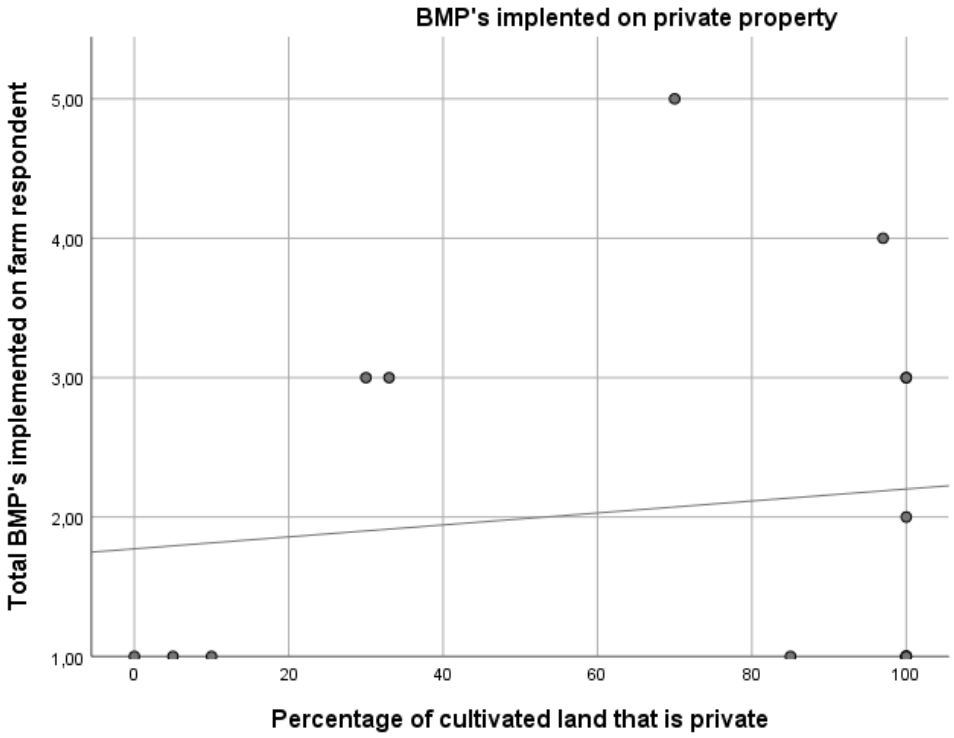

Figure 13: The total amount of best management practice in use on a farm in function of the percentage of private land in cultivation. Note the upward slope of the fit, suggesting a positive correlation between the two variables.

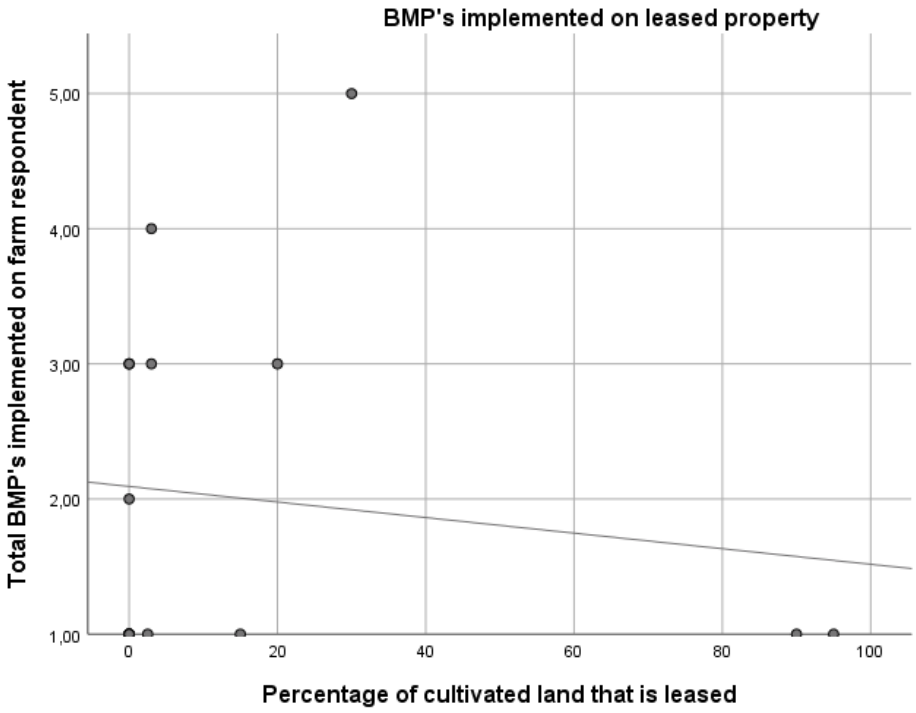

Figure 14: The total amount of best management practice in use on a farm in function of the percentage of leased land in cultivation. Note the downward slope of the fit this time, suggesting a negative correlation.

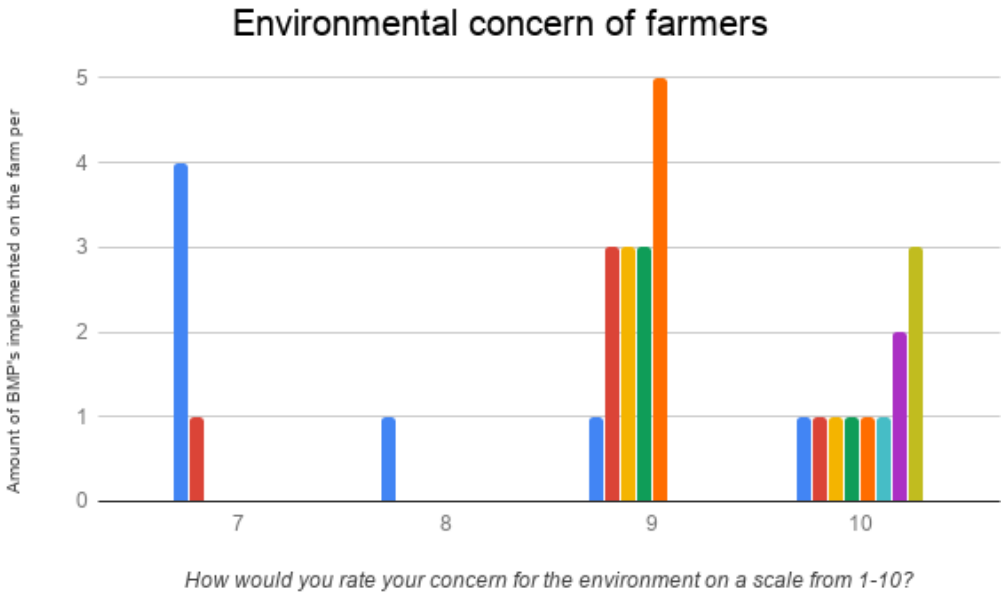

Figure 15: The total amount of best management practice in use on a respondent's farm versus the environmental concern of respondents. Individual responses are recorded in this plot, meaning that amount of implemented BMP's are shown versus the environmental concern of farmers. These preliminary results indicate that the hypothesis of a positive relationship is validated. Different colors of the bars represent individual respondents and might help the reader to distinguish between bars more easily; the different coloring does not bear any further meaning.

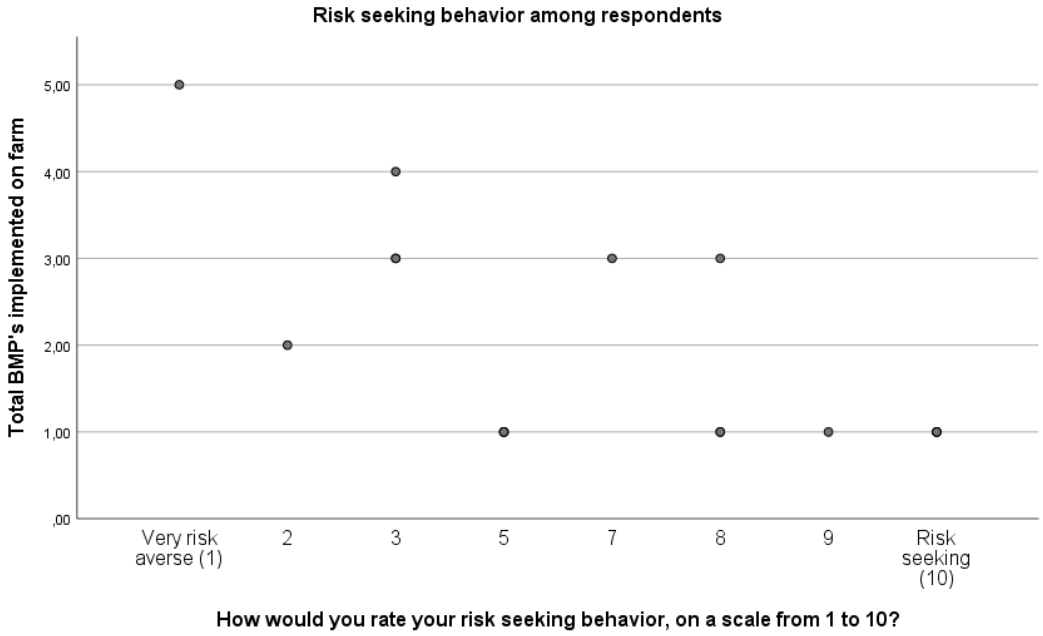

Figure 16: The total amount of best management practice in use on a farm in function of the risk adversity of farmers. Risk averse farmers rate themselves low on this scale', risk seeking farmers rate themselves a high (with 10 being very risk seeking). Note the downward trend, suggesting a negative relation between the BMP implementation and risk seeking behavior.

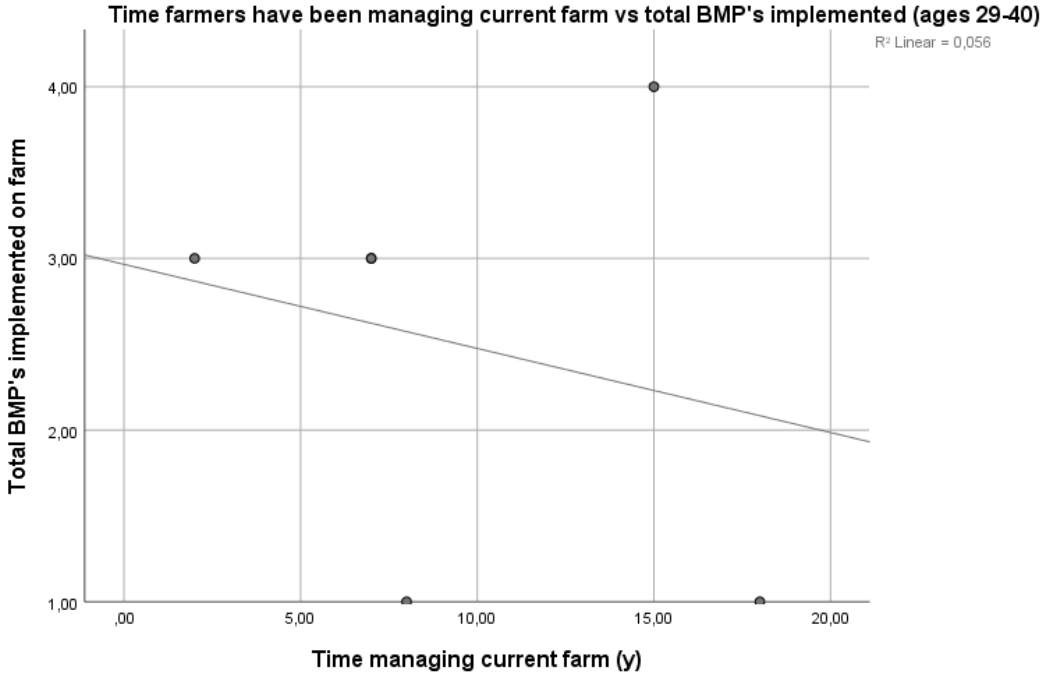

Figure 17: The total amount of best management practice in use on a farm in function of the years a respondent has been managing their current farm (ages 29 to 40). Preliminary results suggest a negative relationship, as suggested by literature. Note the data points on the x-axis as well.

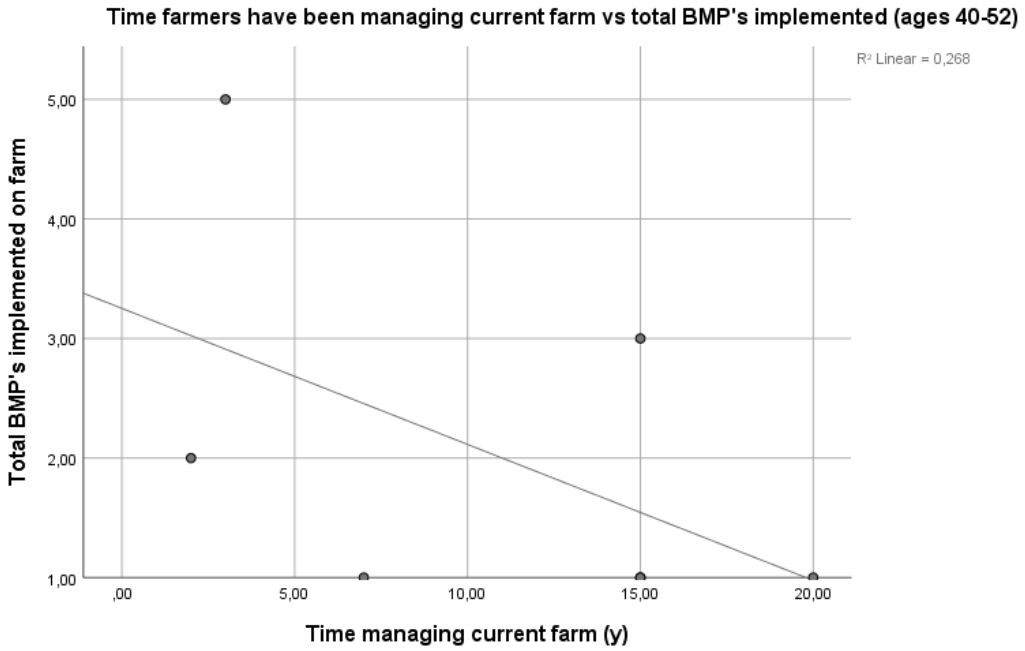

Figure 18: The total amount of best management practice in use on a farm in function of the years a respondent has been managing their current farm (ages 40 to 52). Preliminary results suggest a negative relationship, as suggested by literature.

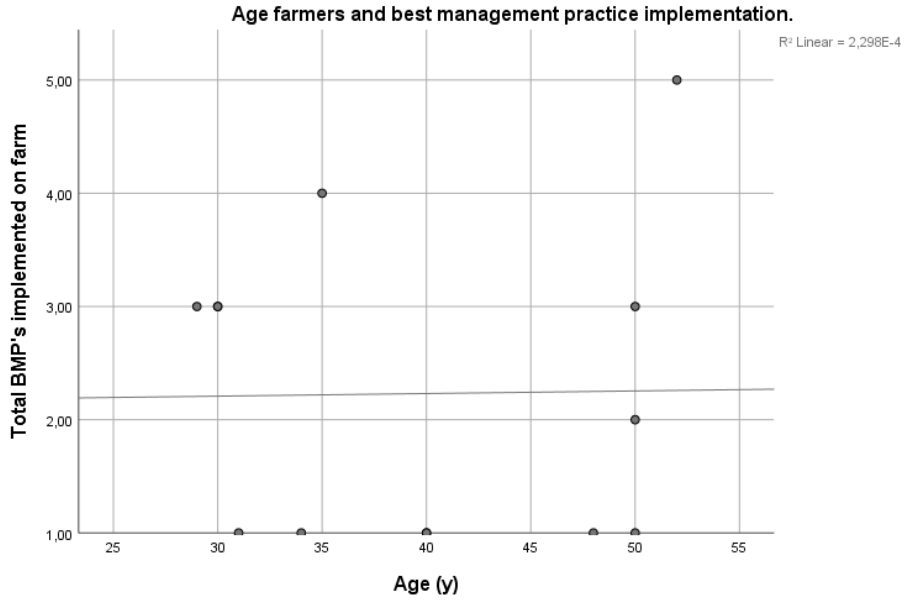

Figure 19: The total amount of best management practice in use on a farm in function of the age of the farmer. A positive nor negative correlation is suggested by the trend line.

The Best Management Practices and associated modes of governance

For this research, a selection of 8 BMP's halting erosion has been made, based on their applicability. Some BMP's, like rotation with tubers or root crops, are eligible for subsidy as well; there is very little arable land upon which the management practice can be applied in the Southern region of Spain however (Junta de Andalucía, 2015). Thus, it has been left out in this research. A detailed discussion of the reason why some BMP's are included and some not is provided below as well. The geographical focus of this study is the erosion-prone Southern Spanish province Andalusia. As previously mentioned, not all erosion preventing BMP's are subsidized by the EU in Andalusia. Please refer to table 1 for a comprehensive overview of the BMP's considered in this study and whether they are subsidized.

Best Management Practice	**Subsidized in Andalusia, Spain?**
Rotation with cereals	Yes
Rotation with legume crops	Yes
Rotation with fallow land	Yes
Rotation with grasslands	Yes
Intercropping	No
Permanent grasslands	No
Conservation tillage	Yes
No tillage	Yes

Table 1: Erosion preventing Best Management Practices (left column) and whether they are eligible for European CAP subsidy in Andalusia (right column).

The practice of crop rotation denotes that different crops are cultivated on the same plot over consecutive seasons. Rotating with cereals involves planting cereals as more than half of the crops in rotation on the plot. The same applies for rotating with grasslands. For rotating with legumes, only a quarter of the crops in rotation should be legume crops. The same applies for rotating with fallow lands. Fallow land is defined as arable land in the crop rotation that is excluded from production during one crop year. The aim is to let the soil recover for one crop year. It can take the form of land without crops, land where weeds are allowed to spontaneously grow, or land used to produce green manure (EC, 2009).
Intercropping is a practice that entails the growing of 2 or more different crops in parallel on the same plot. Permanent grassland entails that a designated plot is not ploughed before sowing, but sown with grass. No tilling involves not turning the soil; this means that the soil is not ploughed; plots are often seeded without turning the soil, by using direct drilling or sod-seeding for example. Due to decreasing run-off when applied on slopes and the increased microbiological activity which leads to more stable soils (Peigné, Ball, Roger-Estrade & David, 2007), this is very effective against erosion. Finally, conservation tillage also involves that the soil is not inversed, which is sometimes combined with reduced or minimal tilling. Tilling is conducted however, at a reduced depth (5-15 cm), more than once per year, sometimes using tools like a grubber, cultivator or a rotovator. Thirty percent of soil cover is maintained after the

plot is sown with new crops. Not all erosion preventing BMP's are listed here however; rotation with tuber or root crops and rotation with cover/catch crops are excluded from this list as their implementation is limited in the area of study (Junta de Andalucía, 2015).

Note that not all BMP's that are eligible for subsidy in Andalusia are included in the survey: the practices that could be applied on more than 5% of Andalusian arable land were included: those below this (<5%) (like "rotation with tubers and root crops", or "rotation with cover and catch crops") were left out of the survey (Junta de Andalucía, 2015; Grazing and intercropping of plantation trees in Spain, n.d.; Pardo et al, 2011; Soane et al, 2012). Even when striving for 450 responses, this would mean that less than 25 of these would statistically apply the practice, thus it would be harder to draw conclusions from this.

Best Management Practices and the EU subsidy system: greening, agri-environmental schemes and cross-compliance

Farmers within the EU can apply for subsidies for certain agricultural practices if they meet the requirements within the Member State or, in this case, those of the Autonomous Region of Andalusia. It is important to describe all requirements and rules for farmers in order to qualify for funding; this namely means that difference modes of governance can be assigned to them, and can be subsequently evaluated for their effectiveness. Refer to table 2 for a comprehensive overview of subsidies per BMP in Andalusia.

Best Management Practice	**Eligible for greening payment?**	**Eligible for agri-environment scheme payments?**	**Subject to cross-compliance (cross compliance standard)**
Rotation with cereals	yes	no	no
Rotation with legume crops	yes	no	no
Rotation with fallow land	yes	no	no

Rotation with grassland	yes	no	no
Intercropping	no	no	no
Permanent grassland	no	no	no
No / Zero tillage	no	Yes	Yes (GAEC1 GAEC5)
Conservation tillage	no	Yes	Yes (GAEC1 and GAEC 5)

Table 2: Best management practices and subsidy schemes that support them. In the left column, erosion preventing BMP's are listed. Not all are eligible for subsidies however. In the second and third column, it is shown whether the BMP in question in eligible for EU subsidy in Andalusia. In the second, it is shown whether 'greening payments' can be applied for, the third whether agri-environment scheme funds under the Rural Development Program can be requested. The last column species what (and if) cross-compliance applies to the particular BMP. It is important to know the subsidies incentivizing their use, as this implies rules and regulations, which in turn a couples subsidies (and thus BMP's) to a certain mode of governance.

The subsidies are provided under the Common Agricultural Policy (CAP). Within this subsidy system, grants are provided under 'greening payments' (EC, n.d. a). Among other things, they incentivize farmers to diversify their crops and to maintain permanent grasslands. This system will be elaborated upon below; agri-environment schemes, cross-compliance and Good Agricultural Practices (GAEC's) will be explained as well after this.

Greening requirements for payments are not the only support that farmers get from the EU to incorporate sustainable practices into their farming; agri-environment schemes as part of the rural development program, payments schemes on a voluntary basis, can also be claimed by European farmers. Policy makers aimed to 'enhance and protect the environment' by having farmers provide environmental services (like purifying water, or controlling pests) (EC, n.d. b). Compensating farmers for foregone profits due to the implementation of these sustainable practices is the main goal of these schemes. Examples of these practices are organic agriculture, preserving the scenery by incorporating forests and other habitats into farming practices, or purposefully lowering productivity by 'extensification' of their farming in a beneficial way to the environment. Having erosion mitigation as primary or secondary benefit, these schemes also constitute a large part of the source of the financing behind the BMP's considered in this research.

Cross-compliance is market mechanism that ensures that all farmers that receive direct payments comply with compulsory EU standards, including but not limited to food quality, animal wellbeing and environmental standards (EC, n.d. c). These pertain to all farmers receiving CAP subsidies, greenings payments ánd agri-environmental schemes, meaning also to those that are aimed at mitigating erosion.
“Cross compliance states that a farmer who receives direct payments has to respect statutory management requirements (SMRs) and GAECs”. (Turpin, 2015). Within the legal framework of cross compliance, ‘Good agricultural and environmental conditions’ were defined by the EU (EC, 2015). Member states set minimal requirements for the environmental conditions agricultural land should meet, as recorded in Annex 2 of Council Regulation (EC) No 1306/2013. Member states (or in the case of Spain, provinces or Autonomous Communities like Andalusia) set their own minimal requirement in terms of GAEC’s. Only GAEC 1 and 5 are relevant for this research, as those are the only ones affecting the selection of BMP’s used in this research. Both GAEC 1 and 5 are mandatory in nature, as opposed to some GAEC’s that are on a voluntary basis. The specifics of GAEC conditions are not mentioned here, as they are not relevant to our findings.

Best Management practices and modes of governance

In this section, it will be discussed to which modes of governance the BMP’s included in this study (8 in total, see right column figure 5) belong. In order to do this, first the rules and regulations that apply to them will be discussed in order to assign a proper mode of governance to them.

First, greening payments (EC, n.d. a) are a mix of centralized, decentralized and public-private governance. Very clear rules, coupled to plot size and total farmed area, state on a farm level which crops have to be cultivated and the size of the area of ground cover to maintain. Subsidy cuts result from rule violation. This highlights the centralized and decentralized nature of this mode of governance, due to the ‘fixed rules and procedures’. Individual states must too meet a certain requirements regarding overall compliance with these rules (on a national level) and face financial penalties in the case of non-compliance, enforced in a top-down fashion by a strong central authority, the EU. The fact that national goals have to be adhered to (uniform goals), but that different actors need to comply to individual standards (related to total size farm for example), shows elements of public-private governance. This is further strengthened by the fact that rules made in ‘Brussels’ apply to the very local level. De-central elements are highlighted by the fact that the EU delegates the responsibility to maintain the ratios of grasslands to total agricultural area. Furthermore, the autonomy to choose how to approach this is left to member states, within ‘top-down determined boundaries’, and is set by the EU. Moreover, it is left to government ‘at various levels of aggregation’ to check whether this really happens. In Spain, this means for example that the various Andalusian provinces report to the Andalusian government, which in turn report to the national government, which then in turn should justify their choices to the EC in Brussels.

Next, cross-compliance is a centralized mode of governance. It covers the two elements of Statutory Management Requirements (SMR's) and Good Agricultural and Environmental Conditions (GAEC's) (EC, n.d. c). The first refers to 13 standards in the areas of food safety, plant health, animals wellbeing and the environment. Clear procedures, enforced by a 'principal agency', highlight the centralized character of this mode of governance.

Third, agri-environment schemes are a mix of public-private governance and interactive governance. One public-private element is the fact that farmers commit themselves for multiple year to implementing farming practices that benefit the environment, surpassing their legal obligations (EC, n.d. b). In other words, farmers (private actors) are free to choose how they execute this in practice, as long as they operate within the given options provided by the EU and legal boundaries. The fact that farmers in essence get reimbursed for foregone income due to the implementation of environmentally friendly practices, shows a clear procedure and process during the contract. This indicates elements of interactive governance, just as the fact that the public-private governance arrangement is participatory, because farmers get extra funds for helping the EU meet its environmental goals. Lastly, different policy sectors and levels are integrated through this subsidy scheme; agri-environment schemes aid the EU in achieving its goals, but in order to achieve this, it's designed at the appropriate level (national, regional,…) with adequate partners outside the farming sector to fit local farmers' practices and geological conditions and challenges. Governance modes assigned to different BMP's are summarized in the following table:

BMP (incentives)	**Centralized elements**	**Decentralized**	**Public-private**	**Interactive governance**	**Self-governance**
Rotation with cereals (greening)					
Rotation with legume crops (greening)					
Rotation with fallow land (greening)					
Rotation with grassland (greening)					
Intercropping (none)	No intrinsic governance incentives!				

Permanent grassland (none)	No intrinsic governance incentives!				
No tillage (AES + Cross-compliance)					
(9) Conservation tillage (AES + Cross-compliance)					

Table 3: Best Management Practice and their modes of governance. Different subsidy schemes support the BMP's, and not all BMP's are incentivized by the same subsidies. Different modes of governance (or mixtures of modes of governance) can be assigned to the subsidy schemes, as discussed above. This way, different modes of governance can be assigned to each BMP, incentivized by subsidy schemes

The survey (English)

Original (Spanish) available at hyperlink https://forms.gle/V7vM58KeQ9ZU9rQA6

Survey

Dear farmer, my name is Yanni Evers, I am a 25 year old student from the Netherlands and I study environmental sciences. My thesis discusses and researches the reasons for Andalusian farmers to adopt 'Best Management Practices' (BMP's) to stop water erosion on their land. It is important to stop erosion, because it threatens farmers' livelihoods and tax payer money is used to neutralize its effects; that is why I try to understand the motivations of farmers to take measures against erosion. This will allow creating advice for organizations and governments to better support farmers in this task.

First, you will be asked some introductory questions. Next, you will be what BMP's you adopted, and the reasons for this for each BMP. Finally, you will be asked what BMP's you have considered implementing in the past, but didn't in the end, for each BMP. The survey will take 10 minutes on average. The results of the survey will be anonymous. Thank you very much for your time.

Introductory questions

1. **Is your farm located in Andalusia, Spain?**
   Mark only one oval.
   - ◯ Yes
   - ◯ No

2. **Age**

   _____

3. **Education level**
   Mark only one oval.
   - ◯ Primary education
   - ◯ Secondary Education
   - ◯ Bachelor's degree
   - ◯ master's degree
   - ◯ Other: _____

4. **Farm's dimensions (ha)**

   _____

5. **Main source of income**
   Mark only one oval.
   - ◯ tree crops (olives)
   - ◯ tree crops (almonds)
   - ◯ cereals
   - ◯ intensive cattle raising
   - ◯ extensive cattle raising
   - ◯ Other: _____

6. **Time you have been managing your farm (years)**

7. **Percentage of cultivated land that is your private property (%).**

8. **Percentage of cultivated land that is leased (%).**

9. **How high is your concern for the environment? (scale 1 to 10)**
Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
No concern for the environment	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Highest concern for the environment.

10. **Do you, in general, avoid taking risks? (scale 1 to 10)**
Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Very risk averse	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Not risk averse

11. **Mark the BMP's that are implemented on your farm (between 0 and 8 answers possible).**
Check all that apply.

- ☐ rotation with cereals (+definition practice)
- ☐ rotation with legume crops
- ☐ rotation with fallow land
- ☐ Rotation with grassland
- ☐ intercropping
- ☐ permanent grasslands
- ☐ No tillage
- ☐ Conservation tillage (non-inversion tillage, this might be combined with reduced or minimal tilling)

Definitions of all BMP's are listed below.

Rotation with cereals: The growing of different species of crops in a crop rotation with >50% coverage with cereals.

Rotation with legume crops: The growing of different species of crops in a crop rotation with >25% coverage with legume crops.

Rotation with fallow land: The growing of different species of crops in a crop rotation with >25% fallow.

Rotation with grassland: The growing of different species of crops in a crop rotation with >50%

grassland.

Intercropping: The growing of two or more different arable crops simultaneously in different rows in the same field.

Permanent grassland: This entails that a designated portion of your land is not ploughed but seeded with grass.

No tilling: A form of cultivation without turning the soil. Sod-seeding or direct drilling are included.

Conservation tillage (non-inversion tillage, this might be combined with reduced or minimal tilling): Tillage without inversion, at a reduced depth (5-15 cm), one or multiple times a year. Can be done using a grubber/cultivator or a rotovator. About 30% of soil cover left after seeding or the incorporation of organic matter.

12. **Select all BMP's that are implemented on your farm from the drop-down menu (between 0 and 8 answers are possible). For every practice, you will then be asked for your reasons that lead you to implement the practice on your farm. You will be redirected to this question until you choose the last option in the drop-down menu.**
Mark only one oval.

- ◯ rotation with cereals *Skip to question 13.*
- ◯ rotation with legume crops *Skip to question 15.*
- ◯ rotation with fallow land *Skip to question 17.*
- ◯ Rotation with grassland *Skip to question 19.*
- ◯ intercropping *Skip to question 21.*
- ◯ permanent grasslands *Skip to question 23.*
- ◯ No tillage *Skip to question 25.*
- ◯ Conservation tillage (non-inversion tillage, this might be combined with reduced or minimal tilling) *Skip to question 27.*
- ◯ I have selected all BMP's I implemented on my farm. Next question. *Skip to question 29.*

Skip to question 12.

rotation with cereals

13. *Mark only one oval per row.*

	Mostly disagree	slightly disagree	neutral	slightly agree	Mostly agree
The receiving of CAP funding was important to me in choosing to implement this practice.					
Receiving training, technical assistance or advice was important for me to implement this practice.					
I have other sources of income outside the farm; this extra money helped me implement this practice.					
This practice fits well within the system of diverse crops that I cultivate.					
The ability to obtain a higher price for my products by selling them under the European organic label was important in applying implementing this practice.					
The ability to obtain a higher price for my products by selling them under a third party eco-label (like EUREPGAP) was important in applying implementing this practice.					
I taught myself to implement this practice.					
I implemented this practice, although I did not have a large budget to spend on implementing it.					

rotation with cereals

14. **Please list other reasons you had for adopting this practice (if applicable) (more than one answer possible).**

Skip to question 12.

rotation with legume crops

15. *Mark only one oval per row.*

	Mostly disagree	slightly disagree	neutral	slightly agree	Mostly agree
The receiving of CAP funding was important to me in choosing to implement this practice.					
Receiving training, technical assistance or advice was important for me to implement this practice.					
I have other sources of income outside the farm; this extra money helped me implement this practice.					
This practice fits well within the system of diverse crops that I cultivate.					
The ability to obtain a higher price for my products by selling them under the European organic label was important in applying implementing this practice.					
The ability to obtain a higher price for my products by selling them under a third party eco-label (like EUREPGAP) was important in applying implementing this practice.					
I taught myself to implement this practice					
I implemented this practice, although I did not have a large budget to spend on implementing it.					

rotation with legume crops

16. **Here you can list other reasons, that were not listed in the previous matrix, for adopting this practice.**

Skip to question 12.

rotation with fallow land

17. *Mark only one oval per row.*

	Mostly disagree	slightly disagree	neutral	slightly agree	Mostly agree
The receiving of CAP funding was important to me in choosing to implement this practice.					
Receiving training, technical assistance or advice was important for me to implement this practice.					
I have other sources of income outside the farm; this extra money helped me implement this practice.					
This practice fits well within the system of diverse crops that I cultivate.					
The ability to obtain a higher price for my products by selling them under the European organic label was important in applying implementing this practice.					
The ability to obtain a higher price for my products by selling them under a third party eco-label (like EUREPGAP) was important in applying implementing this practice.					
I taught myself to implement this practice.					
I implemented this practice, although I did not have a large budget to spend on implementing it.					

rotation with fallow land

18. **Here you can list other reasons, that were not listed in the previous matrix, for adopting this practice.**

Skip to question 12.

rotation with grassland

19. *Mark only one oval per row.*

	Mostly disagree	slightly disagree	neutral	slightly agree	Mostly agree
The receiving of CAP funding was important to me in choosing to implement this practice.					
Receiving training, technical assistance or advice was important for me to implement this practice.					
I have other sources of income outside the farm; this extra money helped me implement this practice.					
This practice fits well within the system of diverse crops that I cultivate.					
The ability to obtain a higher price for my products by selling them under the European organic label was important in applying implementing this practice.					
The ability to obtain a higher price for my products by selling them under a third party eco-label (like EUREPGAP) was important in applying implementing this practice.					
I taught myself to implement this practice.					
I implemented this practice, although I did not have a large budget to spend on implementing it.					

rotation with grassland

20. **Here you can list other reasons, that were not listed in the previous matrix, for adopting this practice.**

Skip to question 12.

intercropping

21. *Mark only one oval per row.*

	Mostly disagree	slightly disagree	neutral	slightly agree	Mostly agree
Receiving training, technical assistance or advice was important for me to implement this practice.					
I have other sources of income outside the farm; this extra money helped me implement this practice.					
This practice fits well within the system of diverse crops that I cultivate.					
The ability to obtain a higher price for my products by selling them under the European organic label was important in applying implementing this practice.					
The ability to obtain a higher price for my products by selling them under a third party eco-label (like EUREPGAP) was important in applying implementing this practice.					
I taught myself to implement this practice					
I implemented this practice, although I did not have a large budget to spend on implementing it.					

intercropping

22. **Here you can list other reasons, that were not listed in the previous matrix, for adopting this practice.**

Skip to question 12.

permanent grasslands

23. *Mark only one oval per row.*

	Mostly disagree	slightly disagree	neutral	slightly agree	Mostly agree
Receiving training, technical assistance or advice was important for me to implement this practice.					
I have other sources of income outside the farm; this extra money helped me implement this practice.					
This practice fits well within the system of diverse crops that I cultivate.					
The ability to obtain a higher price for my products by selling them under the European organic label was important in applying implementing this practice.					
The ability to obtain a higher price for my products by selling them under a third party eco-label (like EUREPGAP) was important in applying implementing this practice.					
I taught myself to implement this practice					
I implemented this practice, although I did not have a large budget to spend on implementing it.					

permanent grasslands

24. **Here you can list other reasons, that were not listed in the previous matrix, for adopting this practice.**

Skip to question 12.

no tillage

25. *Mark only one oval per row.*

	Mostly disagree	slightly disagree	neutral	slightly agree	Mostly agree
The receiving of CAP funding was important to me in choosing to implement this practice.					
Receiving training, technical assistance or advice was important for me to implement this practice.					
I have other sources of income outside the farm; this extra money helped me implement this practice.					
This practice fits well within the system of diverse crops that I cultivate.					
The ability to obtain a higher price for my products by selling them under the European organic label was important in applying implementing this practice.					
The ability to obtain a higher price for my products by selling them under a third party eco-label (like EUREPGAP) was important in applying implementing this practice.					
I taught myself to implement this practice					
I implemented this practice, although I did not have a large budget to spend on implementing it.					

no tillage

26. **Here you can list other reasons, that were not listed in the previous matrix, for adopting this practice.**

Skip to question 12.

Conservation tillage (non-inversion tillage, this might be combined with reduced or minimal tilling)

27. *Mark only one oval per row.*

	Mostly disagree	slightly disagree	neutral	slightly agree	Mostly agree
The receiving of CAP funding was important to me in choosing to implement this practice.					
Receiving training, technical assistance or advice was important for me to implement this practice.					
I have other sources of income outside the farm; this extra money helped me implement this practice.					
This practice fits well within the system of diverse crops that I cultivate.					
The ability to obtain a higher price for my products by selling them under the European organic label was important in applying implementing this practice.					
The ability to obtain a higher price for my products by selling them under a third party eco-label (like EUREPGAP) was important in applying implementing this practice.					
I taught myself to implement this practice					
I implemented this practice, although I did not have a large budget to spend on implementing it.					

Conservation tillage (non-inversion tillage, this might be combined with reduced or minimal tilling)

28. **Here you can list other reasons, that were not listed in the previous matrix, for adopting this practice.**

29. **Mark the BMP's you considered implementing in the past, but haven't as of now(between 0 and 8 answers are possible).**
Check all that apply.

- [ ] rotation with cereals (+definition practice)
- [ ] rotation with legume crops
- [ ] rotation with fallow land
- [ ] Rotation with grassland
- [ ] intercropping
- [ ] permanent grasslands
- [ ] No tillage
- [ ] Conservation tillage (non-inversion tillage, this might be combined with reduced or minimal tilling)

Definitions of all BMP's are listed below.

Rotation with cereals: The growing of different species of crops in a crop rotation with >50% coverage with cereals.

Rotation with legume crops: The growing of different species of crops in a crop rotation with >25% coverage with legume crops.

Rotation with fallow land: The growing of different species of crops in a crop rotation with >25% fallow.

Rotation with grassland: The growing of different species of crops in a crop rotation with >50% grassland.

Intercropping: The growing of two or more different arable crops simultaneously in different rows in the same field.

Permanent grassland: This entails that a designated portion of your land is not ploughed but seeded with grass.

No tilling: A form of cultivation without turning the soil. Sod-seeding or direct drilling are included.

Conservation tillage (non-inversion tillage, this might be combined with reduced or minimal tilling): Tillage without inversion, at a reduced depth (5-15 cm), one or multiple times a year. Can be done using a grubber/cultivator or a rotovator. About 30% of soil cover left after seeding or the incorporation of organic matter.

30. **Select all BMP's you considered for implementing, but chose not to do so in the end from the drop-down menu (between 0 and 8 answers are possible). For every practice, you will then be asked for your reasons that lead you to not implement the practice on your farm.You will be redirected to this question until you choose the last option in the drop-down menu.**
Mark only one oval.

- ◯ rotation with cereals *Skip to question 31.*
- ◯ rotation with legume crops *Skip to question 33.*
- ◯ rotation with fallow land *Skip to question 35.*
- ◯ Rotation with grassland *Skip to question 37.*
- ◯ intercropping *Skip to question 39.*
- ◯ permanent grasslands *Skip to question 41.*
- ◯ No tillage *Skip to question 43.*
- ◯ Conservation tillage (non-inversion tillage, this might be combined with reduced or minimal tilling) *Skip to question 45.*
- ◯ I have selected all BMP's I considered implementing on my farm. Go to final section of the survey. *Skip to question 47.*

Skip to question 47.

rotation with cereals

31. *Mark only one oval per row.*

	Mostly disagree	Slightly disagree	Neutral	Slightly agree	Mostly agree
Due to the extent of my current debt I feel hesitant to engage in this practice on my farm.					
This practice is not accepted in my community, as it is considered to be 'not the right way to farm'.					
The bureaucratics involved in implementing this practice (applying for subsidy, obtaining a license, etc...) constitute a large demotivating factor to me.					
I feel the need to be as productive as possible, and this management practice would decrease my productivity.					
I am currently waiting for my old subsidy to expire before applying for new one, granting sufficient funds to apply this practice.					
First I want to see successful examples on these practices in the plots of other farmers.					
I feel too dependent on my income from agriculture to experiment with new measures on my land.					
I would do it if I could get a grant for the practice; However, due to my part-time farming I am not eligible for this.					

rotation with cereals

32. **Here you can list other reasons, that were not listed in the previous matrix, for not adopting this practice.**

Skip to question 30.

rotation with legume crops

33. *Mark only one oval per row.*

	Mostly disagree	Slightly disagree	Neutral	Slightly agree	Mostly agree
Due to the extent of my current debt I feel hesitant to engage in this practice on my farm.					
This practice is not accepted in my community, as it is considered to be 'not the right way to farm'.					
The bureaucratics involved in implementing this practice (applying for subsidy, obtaining a license, etc...) constitute a large demotivating factor to me.					
I feel the need to be as productive as possible, and this management practice would decrease my productivity.					
I am currently waiting for my old subsidy to expire before applying for new one, granting sufficient funds to apply this practice.					
First I want to see successful examples on these practices in the plots of other farmers.					
I feel too dependent on my income from agriculture to experiment with new measures on my land.					
I would do it if I could get a grant for the practice; However, due to my part-time farming I am not eligible for this.					

rotation with legume crops

34. **Here you can list other reasons, that were not listed in the previous matrix, for not adopting this practice.**

Skip to question 30.

rotation with fallow land

35. *Mark only one oval per row.*

	Mostly disagree	Slightly disagree	Neutral	Slightly agree	Mostly agree
Due to the extent of my current debt I feel hesitant to engage in this practice on my farm.					
This practice is not accepted in my community, as it is considered to be 'not the right way to farm'.					
The bureaucratics involved in implementing this practice (applying for subsidy, obtaining a license, etc...) constitute a large demotivating factor to me.					
I feel the need to be as productive as possible, and this management practice would decrease my productivity.					
I am currently waiting for my old subsidy to expire before applying for new one, granting sufficient funds to apply this practice.					
First I want to see successful examples on these practices in the plots of other farmers.					
I feel too dependent on my income from agriculture to experiment with new measures on my land.					
I would do it if I could get a grant for the practice; However, due to my part-time farming I am not eligible for this.					

rotation with fallow land

36. **Here you can list other reasons, that were not listed in the previous matrix, for not adopting this practice.**

Skip to question 30.

rotation with grasslands

37. *Mark only one oval per row.*

	Mostly disagree	Slightly disagree	Neutral	Slightly agree	Mostly agree
Due to the extent of my current debt I feel hesitant to engage in this practice on my farm.					
This practice is not accepted in my community, as it is considered to be 'not the right way to farm'.					
The bureaucratics involved in implementing this practice (applying for subsidy, obtaining a license, etc...) constitute a large demotivating factor to me.					
I feel the need to be as productive as possible, and this management practice would decrease my productivity.					
I am currently waiting for my old subsidy to expire before applying for new one, granting sufficient funds to apply this practice.					
First I want to see successful examples on these practices in the plots of other farmers.					
I feel too dependent on my income from agriculture to experiment with new measures on my land.					
I would do it if I could get a grant for the practice; However, due to my part-time farming I am not eligible for this.					

rotation with grasslands

38. **Here you can list other reasons, that were not listed in the previous matrix, for not adopting this practice.**

Skip to question 30.

intercropping

39. *Mark only one oval per row.*

	Mostly disagree	Slightly disagree	Neutral	Slightly agree	Mostly agree
Due to the extent of my current debt I feel hesitant to engage in this practice on my farm.					
This practice is not accepted in my community, as it is considered to be 'not the right way to farm'.					
The bureaucratics involved in implementing this practice (applying for subsidy, obtaining a license, etc...) constitute a large demotivating factor to me.					
I feel the need to be as productive as possible, and this management practice would decrease my productivity.					
First I want to see successful examples on these practices in the plots of other farmers.					
I feel too dependent on my income from agriculture to experiment with new measures on my land.					

intercropping

40. **Here you can list other reasons, that were not listed in the previous matrix, for not adopting this practice.**

Skip to question 30.

permanent grasslands

41. *Mark only one oval per row.*

	Mostly disagree	Slightly disagree	Neutral	Slightly agree	Mostly agree
Due to the extent of my current debt I feel hesitant to engage in this practice on my farm.					
This practice is not accepted in my community, as it is considered to be 'not the right way to farm'.					
The bureaucratics involved in implementing this practice (applying for subsidy, obtaining a license, etc...) constitute a large demotivating factor to me.					
I feel the need to be as productive as possible, and this management practice would decrease my productivity.					
First I want to see successful examples on these practices in the plots of other farmers.					
I feel too dependent on my income from agriculture to experiment with new measures on my land.					

permanent grasslands

42. **Here you can list other reasons, that were not listed in the previous matrix, for not adopting this practice.**

Skip to question 30.

no tillage

43. *Mark only one oval per row.*

	Mostly disagree	Slightly disagree	Neutral	Slightly agree	Mostly agree
Due to the extent of my current debt I feel hesitant to engage in this practice on my farm.					
This practice is not accepted in my community, as it is considered to be 'not the right way to farm'.					
The bureaucratics involved in implementing this practice (applying for subsidy, obtaining a license, etc...) constitute a large demotivating factor to me.					
I feel the need to be as productive as possible, and this management practice would decrease my productivity.					
I am currently waiting for my old subsidy to expire before applying for new one, granting sufficient funds to apply this practice.					
First I want to see successful examples on these practices in the plots of other farmers.					
I feel too dependent on my income from agriculture to experiment with new practices on my land.					
I would do it if I could get a grant for the practice; However, due to my part-time farming I am not eligible for this.					

no tillage

44. **Here you can list other reasons, that were not listed in the previous matrix, for not adopting this practice.**

Skip to question 30.

Conservation tillage (non-inversion tillage, this might be combined with reduced or minimal tilling)

45. *Mark only one oval per row.*

	Mostly disagree	Slightly disagree	Neutral	Slightly agree	Mostly agree
Due to the extent of my current debt I feel hesitant to engage in this practice on my farm.	◯	◯	◯	◯	◯
This practice is not accepted in my community, as it is considered to be 'not the right way to farm'.	◯	◯	◯	◯	◯
The bureaucratics involved in implementing this practice (applying for subsidy, obtaining a license, etc...) constitute a large demotivating factor to me.	◯	◯	◯	◯	◯
I feel the need to be as productive as possible, and this management practice would decrease my productivity.	◯	◯	◯	◯	◯
I am currently waiting for my old subsidy to expire before applying for new one, granting sufficient funds to apply this practice.	◯	◯	◯	◯	◯
First I want to see successful examples on these practices in the plots of other farmers.	◯	◯	◯	◯	◯
I feel too dependent on my income from agriculture to experiment with new practices on my land.	◯	◯	◯	◯	◯
I would do it if I could get a grant for the practice; However, due to my part-time farming I am not eligible for this.	◯	◯	◯	◯	◯

Conservation tillage (non-inversion tillage, this might be combined with reduced or minimal tilling)

46. **Here you can list other reasons, that were not listed in the previous matrix, for not adopting this practice.**

Skip to question 30.

Final remarks

47. **I would like to receive the results of this survey.**
Mark only one oval.

◯ Yes
◯ No

48. **Comments**

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