Research-based participatory approaches for adopting Conservation Agriculture in the Mediterranean Area

Deliverable 2.1

Report on the definition of data that need to be collected from private farmers

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Executive summary

Main goal of WP 2 is to understand the reasons for low adoption of CA in the 8 Mediterranean Countries involved in CAMA by collecting information in target Region/Areas and data from farmers.

This Report (namely Deliverable 2.1- Report on the definition of data that need to be collected from private farmers) together with Deliverable 2.2 (Guidelines for data collection in the 8 different Countries and definition of sampling procedures) and Annexes aims to guide each partner in the process of data collection, both from farmers and from literature.

In summary:

- **Country/area characterization and selection:** Country regions/areas selection should consider the following factors: soil and water conservation needs; CA potential/adoption urgency; existence of factors and indicators hampering CA adoption, and non existence of experiments constraints. Partners can collect data for Country regions/areas characterization and selection from published data (ex. statistical data/census data, recognised studies, maps, applications to CAP agri-environment soil conservation measure or other national/international programs), and unpublished secondary sources (see paragraph 3.3). The information output will be considered to the regions/area characterization and selection where surveys and WP3 field experiments will be conducted. In Annex 2 a characterization of Portugal Mainland and of Alentejo region is presented as example of the work to be done by each partner for Country/area characterization. This example represents a template that all Countries/partners could take into consideration in their investigation/collection data. Each partner is required to identify a responsible for collecting the data needed to finalize the country/region characterization and for undertaking its own country/region characterization (see Annex 3).
- **Data collection:** all CAMA partners have to collect data in their countries (see paragraph 3.3) in order to describe the regional contexts where (online) surveys will be conducted and field experiments will be established (WP3). For this purpose, Deliverable 2.2 and Annex 2 are provided to guide Partners for data collection in the 8 different Countries.
- **Online survey for the identification of factors hampering CA adoption:** following a literature review (see paragraphs 3.1, 3.2 and Annex 1), a well-structured (online) survey is proposed (see paragraph 3.4) (online here) to provide a standardized and quantifiable tool to collect data from a group of selected farmer from each CAMA Country. The results of the online survey will allow the identification of factors hampering CA adoption to be overcome through farmer's field experiments run by WP3. All partners have to identify a person per each country in charge of the survey translation from English into local language and to conduct surveys/interviews (see Annex 4). Surveys should be aimed at users and non-users of CA technology and at a minimum of 20 farmers and others - public services or association extensionists; technical consultants; enterprise/company technicians (e.g. of seeds and fertilizers companies); machinery service company (contractors); researchers; and others. The definition of the online standardized survey represents a deviation from the original WP2 workplan due to need to avoid face-to-face interviews and meeting with farmers during the COVID-19 pandemic. The shift to the online modality took longer time to set a common robust format to be translated into each local language.
- **Identification of Farmers' needs:** in the context of WP2 and WP3 work a farmers' and fields' network (see 3.5) is proposed. Partners will have to identify among the respondents of the online survey at least 3 farmers per country (see Annex 5). These farmers will implement on-farm demonstration fields in WP3 to test innovative solutions related to their expressed needs. These farmers will be also involved in online focus groups aimed at commenting and analysing results of the online survey for their Region.

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1. Introduction

In the first tasks of WP2 of CAMA Project, a literature review was carried out in order to identify factors and indicators hampering Conservation Agriculture (CA) adoption mainly in the Mediterranean region, and additionally in Europe and in the World.

The literature review presented was based on published articles, book chapters and proceedings of Congress/Workshop and represents a baseline to be followed by each WP2 partner for its Country regions/area characterization, based on previous data/information about factors and indicators hampering and influencing CA adoption.

Partners can collect data from published data (ex. statistical data/census data, recognised studies, maps, applications to CAP agri-environment soil conservation measure or other national/international programs), and unpublished secondary sources. The information output will be considered to the regions/area selection where surveys and WP3 field experiments will be conducted.

This Deliverable includes a Portugal Mainland characterization considering published data based namely on environment and territory data, on access to CA financing program (EU and/or National funding) and on structural characteristics of agricultural holdings. Portugal Mainland characterization represents an example for the other countries.

Following the literature review, and considering other indicators/factors influencing CA adoption, a survey content and its implementation was developed/proposed.

The need of a WP2 and WP3 farmers' and fields network was identified, and its features were pointed out.

APOSOLO & CREA will revise and compile all partners' contributions - Country regions/areas characterization and selection and survey answers - that will be part of the D2.4 - Report and analysis on the results of the data collected in the two years of evaluation [M33].

2. Materials and methods

a) **published information** (articles, book chapters and proceedings of Congress/Workshop) on CA implementation and adoption barriers in the Mediterranean/Europe/North Africa/Other regions was compiled;

b) publications were **numbered** by consultation order, and **title, authors, publication year and geographic scope** were identified;

c) Conservation Agriculture (CA) adoption **barriers identification and published information contents** were **highlighted** as relevant issues;

d) **a list of barriers** were grouped into 3 principal categories and 10 secondary categories;

e) **quantification of barriers** referenced in the consulted publications grouped into 10 secondary categories was undertaken;

f) **the most important CA adoption obstacles** to be considered in **Country/regions/areas characterization and selection were identified**;

g) **sources of information were included**;

h) **Portugal characterization and selection** example was provided;

i) **data to be collected through the survey** based on the literature review and considering other indicators/factors influencing CA adoption was identified;

j) other features of the **survey development** as survey format and interviewees (*e.g.* number and type) were specified;

k) **criteria for the establishing of farmers' and fields network** of WP2 and WP3 that could be a "show window" was adopted.

3. Results

3.1. Publications review

The undertaken publication review involved 34 published documents on CA implementation and adoption barriers in the Mediterranean/Europe/North Africa/Other regions, which comprise articles, book chapters and proceedings of Congress/Workshop. The year of documents publication was from 2001 to 2019.

All the publications were numbered by consultation order, and the title, the authors, the publication year and the geographic scope were recorded. CA adoption barriers were identified, and the published information contents were highlighted as relevant issues. Each publication analysis has been summarised in a template table (Table 1).

Table 1. Publications analysis | Template table

Number	#
File Name	"#_author"&"year"
Year	20XX
Title	XXXXXXXXXXXXX
Authors	XXXXXX
Geographic scope	Af - Africa; Au -Australia; E - Europe; I - Indian Himalayan Region; Ir - Iran; M - Mediterranean; ME - Middle East; Mo - Mozambique; NA - North Africa; SA - Southern Africa; S - Spain; Sw - Swiss; W - Worldwide; Za - Zambia
Relevant issues	CA adoption barriers identification and published information contents highlighted as relevant issues

Tables of publication summary analysis are specified in Annex 1.

It is important to notice that the following consulted documents:

- **number 3** was reviewed, however was not considered on output results because they were preliminary;
- **number 5 and 34 -** its research was undertaken in certain regions, therefore the outputs are regional specific, Indian Himalayan Region and Zambia, respectively;
- **number 18** is about CA global adoption, although it does not refer factors and indicators hampering CA adoption.

3.2. Factors and indicators hampering CA adoption

The 88 factors and indicators hampering CA adoption identified through the Publications Review were classified in 3 principal categories and then in 10 secondary categories (Table 2). Additionally, factors and indicators grouped into 10 categories were accounted in order to identify the main obstacles of CA adoption (Table 3).

The principal categories defined were: natural conditions; socio-economic conditions; and technical and agronomic conditions/options.

The secondary categories outlined were: agro-climatic conditions; crop residues/livestock; culture/mind-set; knowledge/research; investment; long-term results; policy; risk; socio-economic conditions; and technical factors.

The following two tables (Table 2 and Table 3) allowed to understand which are the barriers of CA adoption and to quantify the main reasons of CA adoption challenge.

Considering the number of times that factors and indicators hampering CA adoption were referenced in the consulted publications, the identified main ones - top five - in the Mediterranean/Europe/North Africa/Other regions, in descending order, were:

1) Socio-economic conditions
2) Knowledge/research
3) Technical factors
4) Policy
5) Culture/mind-set

These identified obstacles will be overcome by on-farm experiments in farmers´ fields run by WP3.

Table 2 - Factors and indicators hampering CA adoption | Classification

Principal category	Second category	Factors and indicators
1. Natural conditions	1. Agro-climatic conditions	Climate
1. Natural conditions	1. Agro-climatic conditions	Drainage
1. Natural conditions	1. Agro-climatic conditions	Low productivity soil
1. Natural conditions	1. Agro-climatic conditions	Slope
1. Natural conditions	1. Agro-climatic conditions	Soil erosion rate
1. Natural conditions	1. Agro-climatic conditions	Soil texture
1. Natural conditions	1. Agro-climatic conditions	Soil type
1. Natural conditions	1. Agro-climatic conditions	Water availability
2. Socio-economic conditions	5. Investment	Difficulties for European farmers to buy good quality NT (no-till/no-tillage/minimum tillage) direct seeders
2. Socio-economic conditions	5. Investment	High prices of imported seeders
2. Socio-economic conditions	5. Investment	Large investment costs may discourage adoption
2. Socio-economic conditions	6. Long-term results	Lack of an immediate increase in farm income with CA
2. Socio-economic conditions	6. Long-term results	Long gestation periods for the benefits of CA to materialize
2. Socio-economic conditions	6. Long-term results	Probable initial yield reductions
2. Socio-economic conditions	7. Policy	Inadequate policies, for example, commodity-based subsidies (EU, US) and direct farm payments (EU)
2. Socio-economic conditions	7. Policy	Lack of policy support
2. Socio-economic conditions	7. Policy	Requirement of policies and institutional support to producers and supply chain service providers
2. Socio-economic conditions	8. Risk	CA considered as a risky and uncertain crop production activities in North Africa
2. Socio-economic conditions	8. Risk	Perceived risk of adopting CA
2. Socio-economic conditions	8. Risk	Socio-economically risky for European farmers to give up tillage-based farming
2. Socio-economic conditions	9. Socio-economic conditions	Access to credit and banking facilities
2. Socio-economic conditions	9. Socio-economic conditions	Additional costs induced by plant control
2. Socio-economic conditions	9. Socio-economic conditions	Advisors being unable to provide suitable advice due to inadequate information or training
2. Socio-economic conditions	9. Socio-economic conditions	Age
2. Socio-economic conditions	9. Socio-economic conditions	Capital requirements for additional fertilizer, herbicides, implements (hoes, rippers, sprayers)
2. Socio-economic conditions	9. Socio-economic conditions	Collaboration with contractors requires compromises regarding cultivation time as they have many clients
2. Socio-economic conditions	9. Socio-economic conditions	Different goals
2. Socio-economic conditions	9. Socio-economic conditions	Education
2. Socio-economic conditions	9. Socio-economic conditions	Experience
2. Socio-economic conditions	9. Socio-economic conditions	Farm size
2. Socio-economic conditions	9. Socio-economic conditions	Financial viability consideration

Table 2 - Factors and indicators hampering CA adoption | Classification (cont.)

Principal category	Second category	Factors and indicators
2. Socio-economic conditions	9. Socio-economic conditions	Full time/part time operator
2. Socio-economic conditions	9. Socio-economic conditions	Inadequate extension and technology transfer systems
2. Socio-economic conditions	9. Socio-economic conditions	Income no-tillage leads to reduced yields/lower performing
2. Socio-economic conditions	9. Socio-economic conditions	Innovativeness index
2. Socio-economic conditions	9. Socio-economic conditions	Lack of leadership from farmers and farmer organisations
2. Socio-economic conditions	9. Socio-economic conditions	Lack of markets for products sale
2. Socio-economic conditions	9. Socio-economic conditions	Management strategies
2. Socio-economic conditions	9. Socio-economic conditions	Needs of farmer networks
2. Socio-economic conditions	9. Socio-economic conditions	Not being a members of organisations
2. Socio-economic conditions	9. Socio-economic conditions	Peer compliance
2. Socio-economic conditions	9. Socio-economic conditions	Profit-orientation
2. Socio-economic conditions	9. Socio-economic conditions	Small-scale farmers are hesitant to invest scarce labour, land, seed and fertilizer in cover crops that do not result in something to eat or to sell
2. Socio-economic conditions	9. Socio-economic conditions	Social capital/social networks
2. Socio-economic conditions	9. Socio-economic conditions	Social relationships among farmers (criticisms)
2. Socio-economic conditions	9. Socio-economic conditions	Tenure
2. Socio-economic conditions	9. Socio-economic conditions	Weak local farmers' organizations and institutions
3. Technical and Agronomic conditions/options	10. Technical factors	CA is a knowledge-intensive cropping practice
3. Technical and Agronomic conditions/options	10. Technical factors	Continuous use of no-tillage is incompatible with certain crops such as potatoes or vegetables
3. Technical and Agronomic conditions/options	10. Technical factors	Crop residue management difficulties and occasional higher incidence of weeds, pests and diseases
3. Technical and Agronomic conditions/options	10. Technical factors	Decision to adopt a comprehensive CA package is complex rather than a unitary decision
3. Technical and Agronomic conditions/options	10. Technical factors	Difficulties for European farmers to buy good quality NT (no-till/no-tillage/minimum tillage) direct seeders
3. Technical and Agronomic conditions/options	10. Technical factors	Excessive topsoil compaction
3. Technical and Agronomic conditions/options	10. Technical factors	Lack of access to specific inputs, machinery and equipment
3. Technical and Agronomic conditions/options	10. Technical factors	Lack of cover crop and of suitable rotations for integrated pest, weed, disease control
3. Technical and Agronomic conditions/options	10. Technical factors	Lack of markets for purchase of inputs
3. Technical and Agronomic conditions/options	10. Technical factors	Lack of mechanization service providers for use, maintenance and repair of agricultural equipment are also real limiting factors
3. Technical and Agronomic conditions/options	10. Technical factors	Lack of sufficient biomass for mulching
3. Technical and Agronomic conditions/options	10. Technical factors	Machinery constraints and weed control
3. Technical and Agronomic conditions/options	10. Technical factors	Manure cannot be worked into the soil
3. Technical and Agronomic conditions/options	10. Technical factors	Need for new implements and operating skills for CA
3. Technical and Agronomic conditions/options	10. Technical factors	Ownership of conventional tillage machinery
3. Technical and Agronomic conditions/options	10. Technical factors	Problems in the adaptation of the technologies to farmers' conditions
3. Technical and Agronomic conditions/options	10. Technical factors	Soil loosening is important for maintaining soil fertility

Table 2 - Factors and indicators hampering CA adoption | Classification (cont.)

Principal category	Second category	Factors and indicators
3. Technical and Agronomic conditions/options	10. Technical factors	There is a higher risk of crop failure
3. Technical and Agronomic conditions/options	10. Technical factors	Unavailability of suitable herbicides to facilitate weed and vegetation management
3. Technical and Agronomic conditions/options	2. Crop residues/livestock	Competition for crop residues with its use as livestock feed, crop residues are partial removal as hay or by grazing livestock
3. Technical and Agronomic conditions/options	3. Culture/mind-set	CA concept and principals are counterintuitive and contradict the common tillage-based farming experience
3. Technical and Agronomic conditions/options	3. Culture/mind-set	Local farmer knowledge
3. Technical and Agronomic conditions/options	3. Culture/mind-set	Tradition/heritage traditions and prejudice
3. Technical and Agronomic conditions/options	4. Knowledge/research	Absence of dynamic and effective innovation systems
3. Technical and Agronomic conditions/options	4. Knowledge/research	Attendance at field demo's and test plots
3. Technical and Agronomic conditions/options	4. Knowledge/research	CA is knowledge-intensive and a complex system to learn and implement
3. Technical and Agronomic conditions/options	4. Knowledge/research	Lack of knowledge on how to do it (know how) and of experiential knowledge about CA and the mechanism to acquire it
3. Technical and Agronomic conditions/options	4. Knowledge/research	Lack of management knowledge/skills
3. Technical and Agronomic conditions/options	4. Knowledge/research	Lack of observed benefits
3. Technical and Agronomic conditions/options	4. Knowledge/research	Need of exhibitions and conferences in various conservation areas and the establishment of workshops
3. Technical and Agronomic conditions/options	4. Knowledge/research	Need of research to managing CA-based crop-livestock integration as a win-win strategy
3. Technical and Agronomic conditions/options	4. Knowledge/research	Number of demonstration projects should be increased and networks of long-term experiments established
3. Technical and Agronomic conditions/options	4. Knowledge/research	Scientific uncertainty about the efficacy of practices
3. Technical and Agronomic conditions/options	7. Policy	Lack of concerted policy support and multi-stakeholder network to promote CA
3. Technical and Agronomic conditions/options	7. Policy	Limited policy experience and expertise to assist in the transformation of conventional tillage-based systems to CA systems
3. Technical and Agronomic conditions/options	9. Socio-economic conditions	Concern for soil erosion
3. Technical and Agronomic conditions/options	9. Socio-economic conditions	Farmers were not closely involved in on-farm demonstrations and at field days and other extension activities
3. Technical and Agronomic conditions/options	9. Socio-economic conditions	Lack of awareness of how conventional tillage (ConvT) leads to soil degradation and of soil erosion as a problem
3. Technical and Agronomic conditions/options	9. Socio-economic conditions	Lack of real-life "best practice" examples to show farmers
3. Technical and Agronomic conditions/options	9. Socio-economic conditions	Needs of more investment in research on training and extension work and development of farmers and technicians/extension training
3. Technical and Agronomic conditions/options	9. Socio-economic conditions	No-tillage fields are irregular, disorganised and not cultivated

Table 3 - Factors and indicators hampering CA adoption | Quantification

Publication number [1]	Year	Region [2]	Factors and indicators hampering CA adoption [3] 1. Agro-climatic conditions	2. Crop residues/livestock	3. Culture/mind-set	4. Knowledge/research	5. Investment	6. Long-term results	7. Policy	8. Risk	9. Socio-economic conditions	10. Technical factors
14	2001	W	x		x	x	x	x		x	x	x
10	2007	M				x					x	x
31	2007	W	x			x			x		x	x
15	2009	W	x		x	x			x		x	x
22	2009	Au		x		x		x			x	x
23	2009	W				x	x		x		x	
11	2010	Sp				x					x	x
12	2010	W			x	x			x			x
20	2010	E/W	x	x	x	x			x		x	x
33	2010	Sw			x						x	x
1	2012	M	x		x	x			x		x	x
13	2012	W			x	x			x			x
34 [4]	2012	Za			x				x		x	x
9	2014	W	x		x	x	x	x	x		x	x
19	2014	W				x			x		x	
28	2014	SA		x	x				x		x	x
29	2014	Af		x		x		x	x		x	x
30	2014	Au		x		x						x
4	2015	W	x	x							x	
16	2015	Sp							x			
6	2015	M				x	x		x			x
17	2015	ME/W		x	x		x				x	x
5 [4]	2016	I		x	x	x						x
7	2016	E			x	x			x	x	x	
21 [4]	2016	Mo				x					x	
8	2017	Mo/NA			x	x	x		x	x	x	x
18 [5]	2017	W										
24	2017	Au				x				x	x	x
2	2018	W		x	x	x	x		x			x
32	2018	SA		x							x	x
25	2019	W				x		x			x	
26	2019	W			x						x	
27	2019	Ir				x					x	
Total			7	10	16	24	7	5	17	4	25	23

[1] Publication number 3 was reviewed however was not considered on output results

[2] Af - Africa; Au -Australia; E - Europe; I - Indian Himalayan Region; Ir - Iran; M - Mediterranean; ME - Middle East; Mo - Mozambique; NA - North Africa; SA - Southern Africa; S - Spain; Sw - Swiss; W - Worldwide; Za - Zambia

[3] 1. Agro-climatic conditions: climate; soil type; soil texture; soil erosion rate; slope; low productivity soil; water availability; drainage

2. Crop residues/livestock: competition for crop residues with its use as livestock feed, crop residues are partial removal as hay or by grazing livestock

3. Culture/mind-set: CA concept and principals are counterintuitive and contradict the common tillage-based farming experience; tradition/heritage traditions and prejudice; local farmer knowledge

4. Knowledge/research: CA is knowledge-intensive and a complex system to learn and implement; lack of knowledge on how to do it (know how) and of experiential knowledge about CA and the mechanism to acquire it; need of research to managing CA-based crop-livestock integration as a win-win strategy; lack of management knowledge/skills; scientific uncertainty about the efficacy of practices; the absence of dynamic and effective innovation systems; need of exhibitions and conferences in various conservation areas and the establishment of workshops; number of demonstration projects should be increased and networks of long-term experiments established; lack of observed benefits; attendance at field demo's and test plots

5. Investment: large investment costs may discourage adoption; difficulties for European farmers to buy good quality NT (no-till/no-tillage/minimum tillage) direct seeders; high prices of imported seeders

6. Long-term results: long gestation periods for the benefits of CA to materialize; probable initial yield reductions; lack of an immediate increase in farm income with CA

7. Policy: lack of policy support; requirement of policies and institutional support to producers and supply chain service providers; inadequate policies, for example, commodity-based subsidies (EU, US) and direct farm payments (EU); limited policy experience and expertise to assist in the transformation of conventional tillage-based systems to CA systems; lack of concerted policy support and multi-stakeholder network to promote CA

8. Risk: perceived risk of adopting CA; socio-economically risky for European farmers to give up tillage-based farming; CA considered as a risky and uncertain crop production activities in North Africa

9. Socio-economic conditions: farm size; tenure; collaboration with contractors requires compromises regarding cultivation time as they have many clients; profit-orientation; income no-tillage leads to reduced yields/lower performing; additional costs induced by plant control; capital requirements for additional fertilizer, herbicides, implements (hoes, rippers, sprayers); financial viability consideration; education; experience; age; full time/part time operator; lack of awareness of how conventional tillage (ConvT) leads to soil degradation and of soil erosion as a problem; concern for soil erosion; management strategies; different goals; innovativeness index; access to credit and banking facilities; social capital/social networks; peer compliance; social relationships among farmers (criticisms); needs of more investment in research on training and extension work and development of farmers and technicians/extension training; inadequate extension and technology transfer systems; lack of real-life "best practice" examples to show farmers; farmers were not closely involved in on-farm demonstrations and at field days and other extension activities; needs of farmer networks; advisors being unable to provide suitable advice due to inadequate information or training; weak local farmers' organizations and institutions; not being a members of organisations; lack of leadership from farmers and farmer organisations; lack of markets for products sale; no-tillage fields are irregular, disorganised and not cultivated; small-scale farmers are hesitant to invest scarce labour, land, seed and fertilizer in cover crops that do not result in something to eat or to sell

10. Technical factors: ownership of conventional tillage machinery; problems in the adaptation of the technologies to farmers' conditions; machinery constraints and weed control; lack of access to specific inputs, machinery and equipment; difficulties for European farmers to buy good quality NT (no-till/no-tillage/minimum tillage) direct seeders; lack of mechanization service providers for use, maintenance and repair of agricultural equipment are also real limiting factors; lack of markets for purchase of inputs; unavailability of suitable herbicides to facilitate weed and vegetation management; crop residue management difficulties and occasional higher incidence of weeds, pests and diseases; excessive topsoil compaction; soil loosening is important for maintaining soil fertility; lack of sufficient biomass for mulching; continuous use of no-tillage is incompatible with certain crops such as potatoes or vegetables; lack of cover crop and of suitable rotations for integrated pest, weed, disease control; there is a higher risk of crop failure; manure cannot be worked into the soil; need for new implements and operating skills for CA; CA is a knowledge-intensive cropping practice; the decision to adopt a comprehensive CA package is complex rather than a unitary decision

(4) research undertaken in certain regions, regional specific outputs

(5) article about Conservation Agriculture (CA) global adoption, although it does not refer factors and indicators hampering CA adoption

3.3. Country regions/areas characterization and selection

The target regions/areas of each Country where surveys will be conducted and where on-farm experiments will be run by WP3 should comprise representative agro-climatic, socio-economic and farmer's conditions, and should be also a region where water and soil conservation are a matter of concern, where there are both users and non-users of CA technology, and where a potential/urgency of CA adoption exists. Selecting areas, where human resources and logistics facilitate the demonstration field's implementation, should be a priority as well.

In summary, **Country regions/areas selection** should consider the following **factors**:

- **soil and water conservation needs** depending on climate data observed, climate change projections, soil classification, soil quality, soil organic matter content, risk of soil erosion;
- **CA potential/adoption urgency** depending on utilised agricultural area, type of crops, farmer's age, farmer's education, users of CA and precision agriculture technology, existence of CA know-how and extension service;
- **existence of factors and indicators hampering CA adoption** like crop residues/livestock competition, tradition on tillage based farming and on fallow, lack of cover crops and of suitable rotations. Although the identified obstacles in the publications review, it should be noted that in certain regions other barriers could have more relevance. Therefore, it is necessary that each partner compare the identified factors and indicators hampering CA adoption with the ones referred in its own regions according to its regional specificities, for instance the size and type of the agricultural holding, farmers education, policies, available resources and industrial inputs;
- **no existence of experiments constraints** like human resources and logistics.

The necessary **data** for Country regions/areas characterization and selection to be collected by each Country, in order to define target regions/areas, are depicted in Table 4, even though each Country could evaluate the proposal list and adapt it to its reality and to data availability. Data should be updated as far as possible, and at National level, including a regional characterization.

Data sources should be:

- **published data / primary and secondary data**
  - maps; statistical data; and studies/articles;
  - published by National, European and African Institutions such as National Ministry of Agriculture, National Statistical Institute, European Environment Agency, European Statistics, Joint Research Centre, Foundations; others.
- **unpublished data / primary and secondary data**
  - assembly and analysis of background data on farmers´ conditions if existent, for instance.
- **exploratory surveys** - informal talks with the community leaders, farmers leaders, farmers´ organizations (especially the technical/assistance department), extension agents, input suppliers, machinery contractors, who are familiar with farming systems and practices in the Region/Area and with farmers´ attitude towards CA or change.
- Other **research or demonstration projects on CA** in course or carried out in the Country.

Table 4 - Country regions/areas characterization and selection | Example of data to be collected

Environment and territory Pedo-climatic data	Socio-economic
Average annual temperature (ºC) and precipitation (mm)	Agricultural holdings (nº) and utilized **agricultural area (hectare)**
Forecasted maximum temperature and precipitation anomalies (ºC)	Utilized agricultural area per use (crop use) (hectare)
Relative air humidity (%)	Irrigated utilized agricultural area **(hectare and % of utilized agricultural area)**
Extreme weather events – maximum and minimum temperature, drought or heavy rain, strong winds (ºC, mm, $km.h^{-1}$)	**Agricultural sole producer age class**
Land use (hectare)	Agricultural sole producer education level (basic, secondary & higher)
Soils FAO classification Soil chemical, physical & biological characterization	**Total agricultural labor force per time dedicated (% of time – full-time & part-time)**
Orography	Information and Communication Technologies use (% or total number of farmers)
Estimated soil erosion by water ($t.ha^{-1}.year^{-1}$)	**New machinery/ technology available (total number)**
Areas susceptible to desertification (Aridity Index - ratio of Precipitation and Potential Evapotranspiration **P/PET)**	**Contractors' availability (total number)**
Topsoil organic carbon content ($gC.kg^{-1}$)	**Soil cover – residues management (seeding) & cover crops seeds availability (% of farmers that referred)**
Potential and actual soil erosion risk (from low to high)	Good markets for new crops availability - crops rotation (total number)
Land quality (from low to high)	Input & machinery costs (% of farmers that referred)
	Training and advice services availability (% of farmers that referred)
	Sources of information about farmers' **work (e.g. researcher, other farmers, internet)**
	Weed, pests & diseases control
	Fertilization
	Agri-environment measure (EU + National Funds) - Soil conservation, no-till and strip-till **(number of beneficiaries and area – hectare)**
	Other measures related to CA **(number of beneficiaries and area – hectare)**

Considering the mentioned factors, the data to be collected and the sources of data to Country regions/areas selection, **Portugal Mainland characterization and Alentejo region selection** is presented in Annex 2. This example represents a template that all Countries/partners could take into consideration in their investigation/collection data, in order to describe the regional contexts where surveys and WP3 field experiments will be undertaken.

The Country regions/areas characterization and selection also allows to propose guidelines for survey development as survey format, content and targeted farmers.

In Annex 3, each partner will be required to fill in the name of the responsible for collecting the data needed to finalize the country/region characterization and for undertaking its own country/region characterization, and subsequently send this information to WP2 task 2.1 leader – APOSOLO.

Detailed guidelines of this task will be presented in Deliverable number 2.2.

3.4. Survey content

The use of surveys addressed to farmers has also been identified as a capable/useful source of information to characterize reality in a different detail level directly from farmers.

A well-structured survey will be used in formal interviews to provide a standardized and quantifiable information from each interviewee. In addition, to identifying soil and water conservation needs and CA potential/adoption urgency, the survey main purpose is to confirm and give value to the different factors/constraints identified by the literature review.

The final results should allow the identification of obstacles to be overcome as well as to test the strategy through farmer's field experiments run by WP3.

Questions included in the survey should be preferentially multiple choice and queries and open answers should be avoided.

A survey template proposal will be available in English to partners. However, it should be translated to national language. The survey must include preliminary and general information about the farmer or non-farmer - public services or association extensionist; technical consultant; enterprise/company technician (e.g. of seeds and fertilizers companies); machinery service company (contractor); researcher; other-, and CA-user or CA-non user, as well as data on barriers to CA adoption – agronomic; pedo-climatic; economic, organizational and practical; policy related; and social and cultural (Table 5).

The survey provided to partners, being single and general, should be adapted according to the reality of all CAMA countries.

The protection of farmers' personal data will be strictly complied with the applicable requirements (EU General Data Protection Regulation – GDPR, 2016).

All partners will have to identify a person per each country in charge of the survey translation from English into local language and for conducting the surveys/interviews. **In the Annex 4, each partner will have to fill in the name of the responsible for translating the survey from English into local language and for conducting surveys/interviews and subsequently forward it to WP2 task 2.2 leader – CREA.**

The survey, in national language, must be structured such as not to create fatigue on farmers in order to obtain the most of information, and must be well explained for the purpose it is done. It should take preferably 30 minutes and not more than 1 hour. Good communication with farmers will guaranty the success of collecting data and their acceptance of on-farm experiments. Farmers should feel that the project aims to bring real and effective solutions for CA practice according to their needs. The sample of interviewees from each CAMA country will be contacted by e-mail, which will be sent by the national/local partner.

Surveys will be built in the format of online Google Forms with the option of being answered directly by the interviewee or by the interviewer (in case the interviewee cannot). The answers will be automatically recorded and can be accessed by the task leader. The survey should be applied to a representative **sample of 20-50 entities**, which should include: farmers; public services or association extensionists; technical consultants; enterprise/company technicians (e.g. of seeds and fertilizers companies); machinery service company (contractors); researchers; and others who can provide relevant information, or to a minimum of 20 farmers and others (adjustable for each Partner´s Country). Sample size can be adjusted in function of the amount of variability in the population of farmers. A number of replacement farmers has to be predicted in order to replace farmers in the sample who are not available, do not answer or do not fulfil the requirements.

It is recommended doing some few (2 or 3 per Country) or at least one trial to answer the survey in order to identify understanding and answering difficulties of the survey questions.

The guidelines of this task will be presented too in Deliverable number 2.2.

Table 5 – Survey template | Data to be collected

Preliminary & General information	Barriers to CA adoption				
	Agronomic	Pedo-climatic	Economic, organizational & practical	Policy	Social & cultural
farmer or if non-farmer which link to farmers	crop diversification	soil features (type, physical conditions, texture, compaction, biological and chemical fertility)	new machinery/ technology (e.g. availability, needed to purchase, costly, correct use)	public support/public incentives & subsidies	training services
CA user or non-user	crop residues/mulch	water availability (irrigation/rain)	lack of service companies (contractors)	support needed to	advice services
country & region	cover crops	climate	market to purchase inputs & machinery, and to sell farm products		training & advices services benefits/advantages
age	no-till	orography (e.g. slope; parcels size)	advice and support		economic, environmental and social aspects that contribute to the spread of CA
level of education	sowing operations		cost of inputs and machinery		farmers' sources of information
farm size	weed control				CA communication ways
crop rotation	pests & diseases				
irrigation					
field advice services					
information & communication technologies					

3.5. A farmers' and fields network

It was decided by WP2 and WP3 leader team to define a farmers' and fields network of WP2 and WP3 that could be a "show window". It is recommended that this network includes at least 3 farmers per Country, who should be identified among the respondents of the online survey. These farmers will implement on-farm demonstration fields on WP3 to test innovative solutions regarding several CA agricultural aspects under different conditions and according to identified farmers´ more important needs when practicing CA. These farmers will be also involved in online focus groups, led by WP3, aimed at commenting and analysing results of the online survey for their Region.

Farmers will provide data about their field, such as: plot size; climate; soil and rotation crop data.

Farmers and their fields will be selected considering the following criteria:

- Available and dedicated farmers - who will get involved, who are able to interact with advisers/researchers and who will be prepared to receive 5 or 6 visits for Diagchamp field diagnosis;

- Accessible/geographically close to advisers/researchers;
- Located in each WP2 selected Country regions/areas;
- Without human resources and logistics constraints for on-farm experiments;
- Cereals must be included in the cropping system - cereals crops as wheat, maize, triticale and barley. It will be perfect if wheat will be included at least 1 year in the experiment fields, namely *Triticum durum*;
- For 3 crop cycles (2020/21; 2021/22 and 2022/23);
- Rainfed and irrigated farming;
- At least 3 farmers per Country.

The protection of farmers personal data will be strictly complied with the applicable requirements (EU General Data Protection Regulation – GDPR, 2016).

In Annex 5 each partner will be required to fill in the name of the farmers and fields to be part of the network of WP2 and WP3, and to subsequently send the information to WP2 task 2.1 leader – APOSOLO.

4. Conclusions

All CAMA partners will have to define the data to be collected and their sources, as well as to investigate/collect data in their countries (see 3.3), in order to describe the regional contexts where surveys will be conducted and field experiments will be established. Areas where CA is urgent and where farmers are most likely to collaborate should be given preference.

A **survey** template proposal (see 3.4), whose main purpose is to identify actual factors and indicators hampering or not CA adoption, will be available to partners. All partners will have to identify a person per each country in charge of the survey translation from English into local language and to conduct surveys/interviews. Surveys should be aimed at users and non-users of CA technology and at a minimum of 20 farmers and others - public services or association extensionists; technical consultants; enterprise/company technicians (e.g. of seeds and fertilizers companies); machinery service company (contractors); researchers; and others.

In the context of WP2 and WP3 work, **farmers' and fields network** (see 3.5) will be defined. Partners will have to identify at least 3 farmers per Country. These farmers will implement on-farm demonstration fields on WP3, in order to test innovative solutions regarding several CA agricultural aspects under different conditions and according to identified farmers´ more important needs when practicing CA, which are referred to in the literature and answered/validated in the surveys.

Plan for the next year

Per Country, partners must identify and inform the WP2 tasks leaders of the name and contact of the responsible person who will be asked to develop – until April22 - the following tasks:

- data collection to finalize the country/region characterization and selection;

- country/region characterization and selection;

- survey translation from English into local language;

- surveys/interviews conduction, and fill in surveys in online Google Form;

- identification of at least 3 farmers, who will belong to a farmers' and fields network to be created/implemented*.*

Annex 1 - Summary analysis tables of publications

Number	**14**
File Name	14_FAO2001
Year	**2001**
Title	The economics of conservation agriculture
Authors	FAO
Geographic scope	Worldwide
Relevant issues	Chapter 2 Factors influencing the adoption of conservation agriculture Other factors influencing the adoption of conservation agriculture A number of studies have sought to identify barriers to adoption beyond the obvious divergence between on-farm costs and wider social benefits under CA. For example: • Large investment costs may discourage adoption (Wandel and Smithers, 2000). • The perceived risk of adopting CA may serve as a barrier (Uri, 1998b; Stonehouse, 1996; McNairn and Mitchell, 1992). • Long gestation periods for the benefits of CA to materialize may serve as a barrier to farmers with short-term planning horizons (Tweeten, 1995). • Barriers may be particular to culture and recent history (Nyagumbo, 1997). TABLE 7 Statistically significant factors affecting the farmer’s decision to adopt a conservation technology Farmer characteristics; Farm characteristics; Information factors; Biophysical and technical factors; Social factors

Number	10
File Name	10_Stewartetal2007
Year	2007
Title	Evaluation of Conservation Agriculture Technology in Mediterranean Agricultural Systems
Authors	**C., Cantero-Martínez, D. Gabiña, J.L. Arrúe; pp. 157–164** Management to Improve the Livelihood of People in Dry Areas | Proceedings
Geographic scope	Mediterranean
Relevant issues	General conclusions of MEDRATE project regarding Conservation Agriculture The results showed CA as one of the main promising technologies to develop for the Mediterranean Region. However, there is still a general low level of adoption by the farmers. This would indicate that **there may be problems in the adaptation of the technologies to farmers' conditions, especially the small farmers in some Mediterranean countries, or that the relations between research and extension services may not function adequately. The number of demonstration projects should be increased, networks of long-term experiments established, and more investment in research on training and extension work** (…) For CA adoption, another challenge is the development of **innovation systems by information dissemination and training of farmers and technicians. Subsidy and credit programmes** for the purchase of implements may serve as drivers of conservation agriculture adoption particularly by small-scale farmers. Policies should be addressed to support conservation agriculture research and development.

Number	31
File Name	31_KnowlerandBradshaw2007
Year	**2007**
Title	Farmers' adoption of conservation agriculture: a review and synthesis of recent research
Authors	Duncan Knowler and Ben Bradshaw
Geographic scope	Worldwide
Relevant issues	As outlined by Feder et al. (1985), researchers typically select a number of potential independent variables for inclusion in their analysis based on prior theorizing and test, usually via logistic (logit) or probit regression, to determine which variables correlate with adoption in some statistically significant sense. For our review of conservation agriculture adoption, we selected 31 separate analyses drawn from a total of 23 published studies (see Table 3). Selection was undertaken to ensure compatibility of method and to include just those practices consistent with the concept of conservation agriculture as defined by the FAO (2001) and García-Torres et al. (2003). (…) Table 4 identifies all the factors that were found to correlate with conservation agriculture adoption in at least one instance. Table 4 Factors found to significantly affect farmers' adoption of conservation agriculture in at least one analysis (of a total of 31 analyses) **Farmer and farm household characteristics; Farm biophysical characteristics; Farm financial/management characteristics; Exogenous factors.** (…) For instance, the variables **'education' and 'farm size'** seem to show convergence towards a positive and significant influence but many incidences are also significantly negative or insignificant. … and **'awareness of environmental threats'** (always positive), as these involve the largest numbers of incidences. McNairn and Mitchell (1992) argue that encouraging the adoption of conservation practices requires assurance of long-term multiple (i.e. economic and non-economic) benefits from adoption, unambiguous and accurate **information**, and active promotion. **Education** plays a key role in motivating adoption and requires tailored, credible and appropriate information and experience that is communicated through the proper channels. **Extension services** to provide information and assistance can be highly effective, especially in the case of new or emerging technologies, although public agents need not be the exclusive providers of such services. **Financial assistance** for the adoption of various conservation practices is well established in Europe and, to a lesser degree, North America (…) Finally, although tried in some locations, regulating soil erosion via taxes and other penalties is not a common approach (Libby, 1985), notwithstanding its potential effectiveness (…) Clearly, **financial viability** is an important consideration and may limit interest. Yet a majority of studies suggest that the techniques associated with conservation agriculture have at least modest advantages over conventional practices on this account. It is tempting to conclude that other non-financial factors may be constraining further adoption, such as **farmers' knowledge of conservation agriculture techniques** or **the availability of appropriate technologies**. Indeed, our review of 31 separate analyses of conservation agriculture adoption revealed nearly 170 significant variables, only a small subset of which concerned financial criteria. Nevertheless, a more detailed synthesis of these adoption studies indicated that **there are few if any influences on adoption that apply universally**. (…) The one exception to our somewhat pessimistic conclusion derives from the potential of **social capital** as a more universally influential factor in conservation agriculture adoption.

Number	15
File Name	15_FriedrichandKassam2009
Year	2009
Title	4th World Congress on Conservation Agriculture
Authors	Friedrich, T. and Kassam, A.H. pp.257 Adoption of Conservation Agriculture Technologies: Constraints and Opportunities | Proceedings
Geographic scope	Worldwide
Relevant issues	Farmers in a country or region, where CA is not practiced, face a number of problems which make adoption difficult. These problems are of diverse nature, such as **intellectual, social, biophysical and technical, financial, infrastructural and policy.** (…) Fortunately, besides the constraints to adoption, there are many opportunities which facilitate the change to CA. The higher the pressure on farmers and the bigger the problems for them to carry on with their business, the easier it is to introduce a change. Farmers that are still complacent with their situation are reluctant to change.

Number	22
File Name	22_LlewellynandDEmden2010
Year	2009
Title	Adoption of no-till cropping practices in Australian grain growing regions
Authors	Rick S. Llewellyn and F. H. d'Emden
Geographic scope	Australia
Relevant issues	**Reasons for non-adoption stated by those who have not used no-till.** **Reasons for non-adoption** stated by those who have not used no-till Table 19 shows the most common reasons cited for non adoption by those who have not used no-till. The generally high proportion of growers who have used no-till limits the ability to analyse stated reasons for non-adoption in each region. Only the four regions with the lowest level of adoption are shown (NSW Mallee is excluded due to a low number of observations). The most common reasons cited for non-adoption fall into **the non-specific category of 'lack of observed benefits'**. This includes responses such as **'doesn't suit my farm' and 'happy with current method'**. Other reasons cited included **machinery constraints and weed control** (including herbicide) concerns, particularly in SA Mallee and SA Western EP **4.8 Profiling adopters and non-adopters** In this section the characteristics of adopters and nonadopters of no-till are presented with the aim of identifying differences that may help in understanding no-till decision making and inform research, development and extension (R, D & E) planning. Tables 24 to 34 show the results of statistical analysis testing differences in **farm and farmer characteristics between no-till users and non-users** in each state and most regions. Where differences were significant they have been included in the table. Also presented are significant differences in beliefs relating to the relative effects on the range of agronomic

	factors of no-till seeding with stubble retention compared to cultivation and full-cut seeding without stubble retention over the longer-term (see section 4.7). The **age of the main seeding machine** on each farm was tested but not presented. In all states and tested regions, with the exception of Vic. Wimmera, **no-till users had significantly newer seeding machinery** by 4 to 8 years. There was no significant difference between no-till users and non-users relating to the perceived relative effect of a no-till **stubble retention system on herbicide costs** and **herbicide resistance** in any state or region so these do not appear in the tables. Essentially, an equally high proportion of no-till users and non-users believed that herbicide costs and herbicide resistance would be higher under the no-till scenario described. Comments on the results in the Tables 24 to 34 have been limited mainly to common results at the state level. **However, it should be recognised that there are many region-specific differences between adopters and nonadopters.** No-till users have tended to have a **greater increase in their arable area managed over the past 10 years than nonusers**. In Queensland Southern and Vic. Loddon, **non-users have a particularly smaller arable area managed relative to no-till users**. In other states and regions the difference is either not significant or much smaller. There is an exceptionally strong association between **the use of a cropping consultant and no-till adoption, with use often more than twice as common among no-till users**. A key finding is that in many states and regions a significantly higher proportion of non-users have a preference for managing livestock rather than cropping systems. For example 58 per cent of **non-users** in NSW regions would prefer **livestock to cropping if able to choose one**. In the SA Mallee, only 33 per cent of non-adopters of no-till prefer cropping over livestock. This compares to 70 per cent of no-till users. Several perception-based variables indicate that many non-users have preconceived ideas that **no-till systems are lower performing**. While it is recognised that people who are adherents of a practice are more likely to speak favourably of, or promote, that practice, it also follows that non-users (of no-till) are less likely to expect production gains as a result of no-till systems. Non-users are also much less likely to expect advantages of moisture retention and the ability to seed on less opening rain under a no-till system than no-till users. In many regions, adopters and non-adopters did not have significantly different perceptions of the ability of the no-till with stubble retention system to reduce soil erosion. However, in NSW Central West, SA Mallee and VIC Wimmera, a substantial proportion of **non-users expressed the belief that no-till with stubble retention would not lead to less erosion than a system with multiple cultivations and stubble burnt over the longer term**. While users and non-users generally did not have differences in beliefs about the **likelihood of herbicide resistance or higher herbicide costs, overall, it was more common for no-till users to expect less weed emergence under no-till with stubble retention systems**. SA Western EP was the only region where non-users were much more likely than users to expect pre-emergent herbicides to be less effective under no-till and stubble retention. As expected, joining a no-till or conservation farming group is widely and very strongly associated with no-till adoption.

	4.9 Identifying significant drivers of adoption **Factors significantly associated with use** Predictable factors consistently associated with no-till use in the lower-adopting regions and extensive use regions include **newer seeding machinery and higher proportion of land cropped** (Table 35). **Use of a consultant is highly significant in each case. In lower adopting regions, higher education is significantly associated with no-till use and extensive use (it is also significantly associated with the decision to use some no-till across all regions (data not presented))**. Perceptions of most consistent influence are perceptions of greater soil moisture retention under no-till with stubble retention compared to a cultivation-based system with no stubble retention (Table 35). The results suggest **that positive shifts** in this perception **are associated with more extensive no-till use. Negative perceptions of crop disease and long term reliability of wheat yields under a no-till system** are also shown to be significantly associated with less extensive no-till use. **Perceptions of reduced pre-emergent herbicide effectiveness and a perceived lack of reduction in the amount of rainfall needed to allow for reliable seeding** were shown to be influential constraints to extensive no-till use across the full sample.

Number	23
File Name	23_Kassametal2009
Year	2009
Title	The Spread of Conservation Agriculture: Justification, Sustainability and Uptake
Authors	Amir Kassam, Theodor Friedrich, Francis Shaxson and Jules Pretty
Geographic scope	Worldwide
Relevant issues	While large numbers of small-scale farmers (in Paraguay, China and various African countries) have adopted CA practices, experience indicates **that the spread tends to be at a slower pace than among larger-scale farmers**. With food security among their major objectives, many small-scale farmers are hesitant **to invest scarce labour, land, seed and fertilizer in cover crops that do not result in something to eat or to sell**. They also suffer from restricted access to relevant **knowledge as well as to inputs or credit**. As a result, there is an increasing recognition of the need to encourage farmers to move towards full adoption of CA at their own pace, testing out promising approaches initially on small areas of their farms and progressively expanding as their confidence in the results develops. However, because of these constraints, some researchers (e.g., Gowing & Palmer 2008; Giller et al., 2009) have suggested that either the evidence for the case for CA is not adequate or that under present circumstances CA is inappropriate for the majority of resource-constrained smallholder farmers and farming systems in Africa. **Distribution of CA across farm types** CA should be applicable to any size of farm (large land holdings, commercial farmers, medium-scale farmers, small-scale farmers). In Latin America, Africa and Asia, it has been shown to work in large, medium and small farms. However, the area of CA to date comprises mainly large farms which, under

	labour shortage situations, can capture the economies of scale with the use of CA machinery and equipment. Based on the experience of CA adoption as a knowledge-intensive set of principles and practices, it may be assumed that the CA adoption rate will grow **at a slower pace in smallholder farming systems than in mechanized medium- and large-scale systems** (FAO, 2008). The most important reason is that too **little research and development attention is being paid to the special needs of smallholders,** especially on affordable CA equipment. Another important reason is **the logistics of how to reach a greater number of small farmers in remote areas, with shrinking budgets for extension services.** While mass media strategies can work well with **well educated medium- and large-scale farmers,** individual assistance over a period of time is generally necessary when working with small-scale subsistence farmers. Lately, extension initiatives involving experiential testing and learning based on FFS-type approaches, including the use of on-farm farmer discovery benchmark sites, are showing promising results, particularly in Africa. With increasing awareness of the need for **sustainable production** intensification, and of improved understanding of how to achieve it, CA is an **option for sustainable and productive agriculture**. CA is sometimes referred to as win–win agricultural production systems as it is applied globally on over 105 million ha of cropland across different agro-ecosystems and cropping systems. In the 1940s Edward Faulkner in his revolutionary ‘Ploughman’s Folly’ stated that ‘no one has ever advanced a scientific reason for ploughing’. Wherever CA has been adopted and practised properly it has proven beneficial. **Yet the question arises: if CA is so good, why is it not spreading faster?** CA is **knowledge-intensive** and a **complex system to learn and implement**. It cannot be reduced to a simple standard technology and thus pioneers and early adopters face many hurdles before the full benefits of CA can be reaped (Derpsch, 2008b). Indeed, the scaling up of CA practices to achieve national impact requires a dynamic complement of enabling **policies and institutional support to producers and supply chain service providers**.

Number	**11**
File Name	11_Morenoetal2010
Year	**2010**
Title	Conservation Agriculture Under Mediterranean Conditions in Spain
Authors	F. Moreno, J.L. Arrúe, C. Cantero-Martínez, M.V. López, J.M. Murillo, A. Sombrero, R. López-Garrido, E. Madejón, D. Moret, and J. Álvaro-Fuentes
Geographic scope	Spain
Relevant issues	(…) this low degree of adoption is a consequence of inadequate **extension and technology transfer systems and lack of access to specific inputs, machinery and equipment**. In summary, important cost savings (fuel, fertilizers) have been reported for conservation agriculture in Spain compared with conventional tillage. However, its adoption is still low mainly due to **inadequate extension and technology transfer systems and lack of access to specific inputs, machinery and equipment. Crop residue management difficulties and occasional higher incidence of weeds, pests and diseases, besides social relationships among farmers (criticisms)** may also difficult the establishment of conservation agriculture in local scenarios.

Number	**12**
File Name	12_Derpschetal2010
Year	**2010**
Title	Current status of adoption of no-till farming in the world and some of its main benefits
Authors	Rolf Derpsch, Theodor Friedrich, Amir Kassam, Li Hongwen
Geographic scope	Worldwide
Relevant issues	The main barriers to its adoption continue to be, **knowledge on how to do it (know how), mindset (tradition, prejudice), inadequate policies as commodity based subsidies (EU, US), availability of adequate machines** (many countries of the world, especially countries like China with small landholdings and high yield-levels) and **availability of suitable herbicides to facilitate weed management** (especially in developing countries). These barriers must be overcome not only by farmers but also by scientists, researchers, extension workers, university professors, politicians and all stakeholders involved in the farming industry if a greater adoption is aimed to be achieved.

Number	**20**
File Name	20_Lahmar2010
Year	**2010**
Title	Adoption of conservation agriculture in Europe Lessons of the KASSA project (Knowledge Assessment and Sharing on Sustainable Agriculture)
Authors	Rabah Lahmar
Geographic scope	Europe/Worldwide
Relevant issues	The **lack of knowledge** on conservation agriculture systems and their **management** and, the **absence of dynamic and effective innovation systems** make it difficult and socio-economically risky for European farmers to give up ploughing which is a paradigm rooted in their cultural backgrounds. In Norway and Germany the adoption of conservation agriculture **has been encouraged and subsidised** in order to mitigate soil erosion. In the other European countries the adoption process seems mainly driven by farmers and, the major driving force has been the **cost reduction in machinery, fuel and labour saving**. Soil and water conservation concerns did not appear as main drivers in the European farmers' decision to shift or not to conservation agriculture. Farmers in UK and the Scandinavian countries seem to have been among the pioneers in CA adoption. According to Soane and Ball (1998), by 1978, 8–10% of the winter cereals in the **UK** were performed under no-tillage (NT) or reduced tillage (RT); however, by 1990, there was a strong move of farmers back to mouldboard ploughing because of a number of unforeseen problems of **weed and crop residue management**. The same scenario occurred in the **Scandinavian** countries between the 1970s and the late 1990s (Rasmussen, 1999), whereby the reasons given were **residue management problems, grassyweeds infestations and excessive topsoil compaction**. In **Italy** the no-tillage trials started in 1968, but CA expansion began only in the 1990s. **It was driven by the need to reduce cropping costs and the availability on the Italian market of sowing equipment and adequate herbicides.** In **France** farmers' interest in CA began in the 1970s, mainly driven by the need to reduce labour time, but in the 1980s this interest decreased due to **favourable economic conditions and the higher costs of herbicides**. By the 1990s, the reform of the Common Agricultural Policy (CAP) and the international market conditions urged farmers to seek again for **reducing production costs and improving productivity**. This new interest in CA was helped by the availability of **adapted implements** and **the decrease of herbicides price**. CA is used in many parts of the country but the most extended CA acreage is in southern France (Aquitaine, Midi-Pyrenees) and in Ile de France. In **Spain**, CA principles were introduced in the 1970s using knowledge from USA (Fernandez-Quintanilla, 1997) and later from Australia, but the real development of CA practices began by the 1980s. It has been favoured by the involvement of **technical advisers, farmers' cooperatives, multinational and national companies and scientists** as well as the **financial support provided to some regions** (e.g. Castile-Leon) (…) **Labour saving** in particular may allow developing other agricultural or non-agricultural activities generating additional benefits. Also, the savings may be offset by **additional costs induced by plant control, and it is reasonably arguable that the rise of the cost of pesticides and/or heavy infestations of weeds, pests and diseases may lead farmers to favour specific crops or to go back to conventional practices.** However, according to KASSA findings, **development, dissemination and sustainability of CA-based systems** are

	affected by many factors acting as drivers or **constraints** at farm and off-farm levels (Table 1). Most of the drivers can become constraints and vice versa. Factors listed in table (1) make it clear that conservation agriculture is not equally appropriate for all European agroecosystems and, that a shift from plough-based agriculture to CA-based agriculture **is not a simple matter of technical change**. Table 1 Drivers/constraints for conservation agriculture - **Farm and market Conditions; Biophysical conditions; Social, cultural, technological, institutional, and policy environments; Impact of conservation agriculture on health and on the environment.** (…) The **lack of scientific evidence on long-term socio-economic and ecological impact of CA systems, the scatter of the available results, the diversity of CA practices used and the wide range of European contexts do not allow to draw a comprehensive picture on CA within Europe** or to anticipate its future development. The short-term socio-economic benefits that CA provides through the **reduction of costs of production, the need to improve farms' competitiveness, market globalization and the steady increase of fuel cost are likely sufficient to boost CA systems within Europe and to overcome the farmers' and societal possible reluctance due to socio-cultural barriers or environmental considerations**. This conversion process is likely already ongoing.

Number	**33**
File Name	33_Schneideretal2010
Year	**2010**
Title	Soil conservation in Swiss agriculture—Approaching abstract and symbolic meanings in farmers' life-worlds
Authors	Flurina Schneider, Thomas Ledermann, Patricia Fry, Stephan Rist
Geographic scope	Sw
Relevant issues	This paper explores the significance of 'life-worlds' for better understanding why farmers adopt or reject soil conservation measures and for identifying basic dimensions to be covered by social learning processes in Swiss agricultural soil protection. Data was collected through **semi-structured interviews, informal discussions, participatory observation, group discussions document and literature review**. (…) In addition to the formal interviews, informal conversations with sample farmers before and after the interviews and with many other farmers during farmer meetings and field trips were considered as well. In fact, these informal discussions proved to be a very important element of the study, as socio-cultural aspects and elements relating to a more symbolic level of meaning were often not addressed during formal interviews but came up at a later stage, when contact was informal. (…) It is not surprising that most arguments of both groups of farmers refer to **economic, ecological, agronomic and social dimensions**. However, a new and rather unexpected result was that **aesthetics** plays a crucial role as well when farmers reflect about options for addressing soil erosion. Although rejecters and adopters referred to the same five dimensions, they accentuated different aspects. Nevertheless, both groups of farmers justified their practice mainly using arguments pertaining to **financial, ecological and**

	agronomic dimensions. Regardless of whether farmers had or had not adopted no-tillage they stressed the dimensions of financial feasibility. **Table 1 Farmers' main arguments in relation to no-tillage** **Economic dimension; Ecological dimension; Agronomic dimension; Social dimension; Aesthetic dimension** **(…) traditional tillage agriculture may be one of the main and quite underestimated reasons** why farmers refuse innovations such as no-tillage when these are justified only by economically and technologically inspired instrumental reasoning. Moreover, agricultural contractors stated that the perceived aesthetics of fields was one of the most important prejudices against no-tillage among their clients. Major differences between farmers who adopt and farmers who reject no-tillage were found to depend on the degree of coherence they could create between the abstract meanings of no-tillage in the everyday life-world, the symbolic meanings of no tillage referring to other provinces of reality and their images of themselves. Thus, soil conservation measures such as no-tillage must fit not only **into the practical requirements of daily farming life but also into the universe of farmers' life-world**. Consequently, adopting no tillage, farmers have to fundamentally reconstruct their existing practices, experiences and concepts, including abstract and symbolic meanings. In other words, a process of innovation cannot be seen as a simple change of technology; it must be conceptualised as a broad change of the entire life-world.

Number	1
File name	1_Kassametal2012
Year	**2012**
Title	Conservation agriculture in the dry Mediterranean climate
Authors	Amir Kassam[a], Theodor Friedrich[b], Rolf Derpsch[c], Rabah Lahmar, Rachid Mrabet, Gottlieb Basch, Emilio J. González-Sánchez, Rachid Serraj
Geographic scope	Mediterranean climate
Relevant issues	Morocco - Lack of concerted **policy support and multi-stakeholder network to promote CA** remains a major constraint to CA adoption. Tunisia - One limiting factor for further spread of CA is the **unavailability of low cost CA equipment**. There are good reasons for individual farmers not to adopt CA in her/his specific farm situation. The origin of the hurdles **ranges from psychological, intellectual, social, financial, biophysical and technical, infrastructural to policy issues.** **Unavailability of suitable CA equipment and machinery** is a constraint in general, and especially in the CWANA (Central and West Asia and North Africa) region.

Number	13
File Name	13_Friedrichetal2012
Year	**2012**
Title	Overview of the Global Spread of Conservation Agriculture
Authors	Theodor Friedrich, Rolf Derpsch and Amir Kassam
Geographic scope	Worldwide
Relevant issues	The main barriers to the adoption of CA practices continue to be: **knowledge on how to do it (know how), mindset (tradition, prejudice), inadequate policies, for example, commodity based subsidies (EU, US) and direct farm payments (EU), unavailability of appropriate equipment and machines (many countries of the world), and of suitable herbicides to facilitate weed and vegetation management** (especially for large scale farms in developing countries) **2.2 Adoption in Europe** CA is not widely spread in Europe, excluding Russia (Table 4): no-till systems do not exceed 1% of the arable cropland. Only Africa has a smaller absolute area under CA than Europe. Since 1999 ECAF (European Conservation Agriculture Federation) has been promoting CA in Europe, and adoption is visible in Spain, Finland, France and UK, with some farmers at 'proof of concept' stage in Ireland, Portugal, Germany, Switzerland, and Italy. Especially in Spain, Portugal and Italy the growth of CA in perennial crops, such as fruit orchards, vineyards and olive plantations, has exceeded the adoption rate in annual crops. **2.4 Adoption in West Asia and North Africa**

	In the WANA (West Asia and North Africa) region, much of the CA work done in various countries has shown that yields and factor productivities can be improved with no-till systems. Extensive research and development work has been conducted in several countries in the region since the early 1980s such as in Morocco, Tunisia, Syria, Lebanon and Jordan, and in Turkey (Table 6). While Morocco and particularly Tunisia showed a modest growth in CA adoption, the uptake has literally exploded in Syria, spreading over nearly 20,000 ha in only few years. The main reason for the rapid uptake has been the shortage of fuel and increased availability of locally produced affordable no-till seeders, which are now being exported to other countries in the region, and the efforts of development and promotion activities by organization such as GIZ, ICARDA, ACSAD and Aga Khan Foundation. Originally the adoption of CA was mainly driven by acute problems faced by farmers, especially wind and water erosion, as for example southern Brazil or the Prairies in North America, or drought as in Australia. In all these cases farmers' organization was the main instrument to generate and spread knowledge that eventually led to mobilizing public, private and civil sector support. More recently, again pressed by erosion and drought problems, exacerbated by increase in cost of energy and production inputs, government support has played an important role in accelerating the adoption rate of CA, leading to the relatively fast adoption rates for example in Kazakhstan and China, but also in African countries such as Zambia and Zimbabwe, among others, and this is attracting support from other stakeholders. Today the main reasons for adoption of CA can be summarized as follows **(1) better farm economy** (reduction of costs in machinery and fuel and time-saving in the operations that permit the development of other agricultural and non-agricultural complementary activities); **(2) flexible technical possibilities for sowing, fertilizer application and weed control (allows for more timely operations); (3) yield increases and greater yield stability (as long term effect); (4) soil protection against water and wind erosion; (5) greater nutrient eficiency; and (6) better water economy in dryland areas**.

Number	**34**
File Name	34_Nyanga2012
Year	**2012**
Title	Factors Influencing Adoption and Area under Conservation Agriculture: A Mixed Methods Approach
Authors	Progress H. Nyanga
Geographic scope	Zambia
Relevant issues	This study uses mixed methods approach to document factors influencing adoption of CA among smallholder farmers under the Conservation Agriculture Project (CAP) in Zambia. **Quantitative analysis indicated that CA trainings, previous experience in minimum tillage, membership in farmer organisations, and ownership of CA tillage equipment significantly increased the likelihood of CA adoption. (…) Qualitative approaches showed that good rapport with farmers, trust, reciprocity and altruism, monitoring and evaluations, extension strategy, quality and extent of technical knowledge in CA within CFU (Conservation Farming Unit), and artificial incentives positively influenced adoption of CA.**

	There were significant differences between CA adopters and non adopters in attendance of **CA trainings, membership in agricultural related organisations, access to credit, distance to the nearest market, ownership of animal draft power (ADP) and ownership of CA tillage equipment (chaka hoe and ripper)** (Table 1). There was also significant association between pre-CAP experience with minimum tillage and farmer classification (CA adopter or non-CA adopter). Results and discussion of various factors influencing the adoption of CA are given in the following sections. **3.2 Trainings and Rapport** The CA adoption model showed that training in CA significantly increased the likelihood of adoption of CA. (…) **3.3 Experience and Worldviews of farmers** **3.4 Equipment and Prestige** The CA adoption regression model showed that ownership of a chaka hoe increased the likelihood of adoption of CA significantly and so did ownership of a ripper (Table 2). This is because these implements are used for minimum tillage in CA among sampled farmers. The model for area under CA indicated that a ripper also had a positive and significant influence on area under CA. This is because of the labour saving effect of a ripper. **3.6 Equity Dimension of CA Innovation and Wealth** **Most indicators of wealth, ADP, level of education, access to credit and income had negative coefficients indicating that these variables reduced the likelihood of adopting CA by a farmer** (Table 2). (…) Focus group discussants also pointed out that some farmers, especially those who were perceived to be rich by the community, did not see any need for adoption of CA. One of the relatively resource rich farmers aged 68, a retired civil servant, argued that **he did not see any need to change from conventional agriculture to CA because he was quite comfortable with his levels of production and claimed that he was even doing better with conventional agriculture than farmers who were using CA in the same community.** **3.7 Institutional Aspects** Membership in agricultural organisations had a significant positive influence on adoption of CA **3.8 Labour Sharing Arrangements, Reciprocity and Altruism** Labour sharing arrangements between and among farmers was reported by focus group discussants to have a positive effect on adoption of CA. **3.9 Agricultural Extension Staff, Monitoring and Evaluation** A dedicated and hard working agricultural extension staff had a positive influenced on adoption of CA. (…) This study has shown that both quantitative and qualitative factors influence the adoption of CA. Quantitative analysis indicated that **CA trainings, previous experience with minimum tillage, membership in farmer organisations, and ownership of CA tillage equipment increased** the likelihood of CA adoption significantly.

	Quantitative approaches further indicated that increase in number of **CA trainings attended, farm size and number of rippers owned and use of herbicides had a positive significant influence on area under CA**. Qualitative approaches showed that **good rapport with farmers, trust, reciprocity and altruism, monitoring and evaluations, extension strategy, quality and extent of technical knowledge in CA within CFU, and artificial incentives positively influenced the adoption of CA**. Traditional leadership was reported to enhance adoption of CA in most cases. Prestige was reported to withhold some men from adopting CA basins. Women were mostly involved in CA basins while men were mostly involved in ADP ripping. **Some worldviews of farmers had negative influence on adoption of CA. Donor support and collaboration** with the Zambia National Farmers Union and the private sector were other contextual factors for the high adoption of CA among sampled smallholder farmers. The study raises the following considerations; attendance in CA trainings should be further encouraged; there is need to improve access to appropriate CA tillage equipment and encourage farmers to join various farmer organisations. Good rapport and trust with farmers is essential. Trainings on proper use of herbicides and potential harm of herbicides should be supported. Use of artificial incentives as empowerment packages can increase the adoption of CA. Effective feedback from farmers through monitoring and evaluation is essential. In the promotion of CA, it is important to pay attention to both quantitative and qualitative factors.

Number	**9**
File Name	9_Kanwaretal2013
Year	**2014**
Title	Conservation Agriculture Global Prospects and Challenges (Book)
Authors	Ram A. Jat, Kanwar L. Sahrawat, and Amir Kassam
Geographic scope	Worldwide
Relevant issues	**Chapter 1** The more common factors that hinder the widespread adoption of CA in different parts of globe include **tillage mindset and lack of awareness of how conventional tillage (ConvT) leads to soil degradation, lack of sufficient biomass for mulching, need for new implements and operating skills for CA, weed menace in CA fields, probable initial yield reductions, and the lack of sufficient research and government policies in many countries**. Although soil degradation due to soil erosion is widespread in both developed and less-developed nations, **it seems there is a lack of a sense of urgency on the part of both farmers and policy makers to check soil degradation probably due to its slow, creeping and often unnoticeable nature. Farmers and policy makers in general do not recognize how CA can contribute to reverse the rampant process of soil degradation and thereby lead to sustainable agricultural intensification.** Moreover, there is a prevailing feeling among farmers that **to obtain good crop yields, tilling the land is essential**. As Hobbs and Govaerts (2010) pointed out, overcoming this mindset about tillage is probably the most important factor in the large scale promotion of CA. It is difficult to convince famers,

	particularly in less developed countries, about the potential benefits of CA, except about cost reductions due to zero/reduced tillage. Further, probable **yield reductions during the initial years of the adoption of CA may dampen the spirits of smallholders**. In CA fields, higher weed intensity due to no/reduced tillage, nutrient immobilization, and higher number of insect pests and disease during the conversion phase may cause slight yield reductions compared to ConvT. Weed management is a major challenge in the successful adoption of CA. **Chapter 6 Europe** 6.1.1 History of Conservation Agriculture in Europe: beginnings and expansion over the years in different regions and cropping/production systems 6.1.3 Prospects for Conservation Agriculture in Europe CA development in Europe has been particularly slow, with some few exceptions, for example Finland. There is a number of reasons for this slow adoption in Europe. One of these is the moderate climate, which does not cause too many catastrophes requiring urgent action. Another reason is that agricultural **policies** in the European Union (including direct payments to farmers and subsidies for certain commodities) take the pressure off farmers for extreme cost savings and discourage the adoption of diversified crop rotations. In addition to this, there are interest groups opposed to the introduction of CA, which results for example in **difficulties for European farmers to buy good quality NT** (No-till/no-tillage/minimum tillage) **direct seeders** with low soil disturbance and high residue handling capacity. Most of the European farmers practising CA have directly imported CA equipment from overseas or have had contact with small import agents. However, also in the EU, the environmental pressure is increasing and a new European CAP is being prepared, which most likely will be more favourable to CA. Yet, in France, for example, prospects for adoption are still poor and, despite some very positive experiences, development is slow. One problem is, as in many other countries, **the confusion between concepts and the belief that reducing tillage might be a gradual pathway towards CA**. Unfortunately this is in most cases not true and farmers face many problems with this approach, which force them to revert to the plough and not to adopt CA. **Soil type and water availability** are the major yield-determining factors and also influence the attraction for farmers to switch to CA. Based on the two abovementioned variables, the Italian territory below 800 m above sea level (i.e. approximately 77% of the total surface area) has been divided into three vocational classes for maize and wheat production under CA (high, medium, low), showing than 30% of the Italian territory is highly suitable or easy to adapt for CA, 39% of it is challenging and in 8% agriculture in general is challenging. In poorly-drained asphictic soils the application of CA techniques can be difficult and it is challenging to obtain similar yields as in tillage-based systems. However, **in heavy soils in semi-humid and humid areas, positive results can be achieved** if drainage problems are addressed adequately. The best comparative advantage is achieved in heavy soils in dry areas. 6.3.1Residue management and supply; 6.3.2 Non-availability of suitable implements and inputs; 6.3.3 Tillage mindset; 6.3.4 Skill requirement; … **Chapter 12 – North Africa** 12.3 Difficulties in the Adoption of Conservation Agriculture in North Africa

	12.3.1 Residue management; 12.3.2 Availability of suitable implements; 12.3.3 Mindset of farmers; 12.3.4 Skill requirements; 12.3.5 Yield reduction; 12.3.6 Weed infestation

Number	**19**
File Name	19_Kassametal2014
Year	**2014**
Title	The spread of Conservation Agriculture: policy and institutional support for adoption and uptake
Authors	Amir Kassam, Theodor Friedrich, Francis Shaxson, Herbert Bartz, Ivo Mello, Josef Kienzle and Jules Pretty
Geographic scope	Worldwide
Relevant issues	The benefits of CA provide an indication why many farmers worldwide are adopting CA systems and why CA is receiving attention from the development and research community as well as from government, corporate and civil sectors. However, not all synergistic interactions in CA systems are fully understood nor fully recognized. In general, **scientific research on CA lags behind farmers' own discoveries**. Similarly, knowledge and service institutions in the public and private sectors tend to be aligned to supporting conventional tillage-based systems. Further, there is **limited policy experience and expertise** to assist in the transformation of conventional tillage-based systems to CA systems for small and large farmers in different ecologies and national contexts. (…) Generally for early adopters there are many hurdles as is often the case with new systems requiring significant behavioural change. Further scaling up of CA practices to achieve sub-national and national impact will thus require enabling policies and institutional support **(including training, access to knowledge and research)** to both producers and input supply chain service providers (including equipment and machinery). **3. Necessary conditions for the CA adoption** CA is both management and knowledge intensive and complex to practice, requiring more planning than tillage-based systems. **It cannot be reduced to a technology package, adoption requiring both change and adaptation based on experiential learning.** The following sections elaborate the necessary conditions for the introduction of CA and transformation of tillage-based systems. The support to foster these necessary conditions must be mobilised at the individual, group, institutional and policy levels within the private, public and civil sectors so that the behaviour patterns of all stakeholders involved in the CA innovation system are mutually reinforcing to induce the development of the sufficient conditions, or the enabling environment, for adoption and spread. **In cases where the learning process is missing or the benefits to the farmer are not obvious, then non-adoption or disadoption can occur.** **3.1 Reliable local individual and institutional Champions; 3.2 Dynamic institutional capacity to support CA; 3.3 Engaging with farmers; 3.4 The Importance of farmers' organizations; 3.5 Providing knowledge, education and learning Services; 3.6 The need for scientists and extension agents to recognise and characterise the problems related to CA adoption and facilitate problem solving; 3.7 The need to build up a nucleus of knowledge**

	and learning system for CA in the farming, extension and scientist community; 3.8 Mobilizing input supply and output marketing sectors for CA; … The **lack of knowledge about CA as well as a supportive enabling environment for its promotion, and the fact that the national institutions, public and private, are mainly serving tillage-based agriculture**, are the main reasons for CA not spreading faster in Africa, Asia and Europe. However, the evidence of increased adoption and uptake in these continents during the recent years indicates that the situation is changing, and the uptake of CA is expected to continue over coming years.

Number	28
File Name	28_AnderssonandSouza2014
Year	**2014**
Title	From adoption claims to understanding farmers and contexts: Aliterature review of Conservation Agriculture (CA) adoption amongsmallholder farmers in southern Africa
Authors	Jens A. Andersson, Shereen D'Souza
Geographic scope	Southern Africa
Relevant issues	This literature review of Conservation Agriculture (CA) adoption among **smallholder farmers in southern Africa (Malawi, Zambia and Zimbabwe)** analyses the historical background of the upsurge in CA promotion, the various definitions of CA that have emerged since the 1990s, the barriers to its adoption, as well as uptake figures and adoption studies. (…) assessing the literature on CA adoption and barriers to adoption becomes a difficult task. Such an assessment is further complicated by two additional factors. First, the integrated nature of the CA concept – the three CA principles are generally seen as highly interdependent – raises questions regarding the meaning and benefits of partial adoption. Second, contextual factors such as input support, subsidies, agricultural policies, and markets often shape the adoptability of new technologies and practices by farmers, including CA. For our understanding of the factors influencing CA adoption, it may be useful, following Sumberg (2005), to distinguish **adoption constraints from prerequisite conditions; the former referring to the 'goodness-of-fit' between the innovation and the potential users (innovation x potential users)**, while the latter focuses on contextual factors that cannot be influenced by the innovation-development process. Thus, constraints recurring in the literature, such as **limited availability and competing uses for crop residues, weed pressure** (Umar et al., 2012, p. 923; Marongwe et al., 2011,p. 156; Aune et al., 2012), **capital requirements for additional fertilizer, herbicides, implements (hoes, rippers, sprayers) and, in some situations, labour requirements (Baudron et al., 2012; Mazvimavi,2011), fall into the first category. Factors such as relative land abundance, communal tenure arrangements (Baudron et al., 2012), absent or dysfunctional markets for legumes (Thierfelder et al.,2013a) and limited access to financial capital (see Wall, 2007), relate to the prerequisites for adoption.** **2.3.1. Limited availability and competing uses for crop residues; 2.3.2. Basins and weeds: labour constraints to adoption; 2.3.3. The performance of CA; 2.3.4. Returns on investment and costs; 2.3.5. Adoption constraints and pre-requisite conditions: Crop rotation** - farm-level constraints; **2.3.6. Mindset of the plough; 2.3.7. Institutional and policy issues: prices and maize subsidies**

Number	**29**
File Name	29_Corbeelsetal2014
Year	**2014**
Title	Understanding the impact and adoption of conservation agriculture in Africa: A multi-scale analysis
Authors	Marc Corbeels, Jan de Graaff, Tim Hycenth Ndah, Eric Penot, Frederic Baudron, Krishna Naudin, Nadine Andrieu, Guillaume Chirat, Johannes Schuler,Isaiah Nyagumbo, Leonard Rusinamhodzi, Karim Traore, Hamisi Dulla Mzoba, Ivan Solomon Adolwah
Geographic scope	Africa
Relevant issues	This paper seeks to better understand the reasons for the limited adoption of CA and to assess where, when and for whom CA works best. (…) The impact on farm income with the practice of CA on some fields of the farm is far less evident, and depends on the type of farm. The lack of an **immediate increase in farm income** with CA explains in many cases the non-adoption of CA. Smallholders have often short-term time horizons: future benefits do not adequately outweigh their immediate needs. Another key factor that explains the limited CA adoption in mixed crop-livestock farming systems is the fact that **crop harvest residues are preferably used as fodder for livestock**, preventing their use as soil cover. Finally, in most case studies good **markets for purchase of inputs and sale of produce** – a key prerequisite condition for adoption of new technologies– were lacking. The case studies show clear evidence for the need to target end users (not all farmers are potential end user of CA) and adapt CA systems to the local circumstances of the farmers, considering in particular the farmer's investment capacity in the practice of CA and the compatibility of CA with his/her production objectives and existing farming activities. (…) CA is a **knowledge-intensive cropping practice** that needs capacity building with farmers and extension services. Other recurrent constraints to CA adoption were the **availability and accessibility (cost) of markets for CA inputs** (specialized no-tillage implements, (legume) seeds, and herbicides), **the limited availability of social networks** for interacting on CA and the **competition for crop residues** with its use as livestock feed. (…) Private sector support is often uncertain, because only a small part of farm output is **marketed**. However, the recent food crisis put market regulations and production incentives back on the world agenda, with a particular focus on Africa where yield gaps and hence the perspectives of production increases are the largest. (…) As argued by Sumberg (2005), **the market, institutional and policy contexts**, in which a new technology is promoted, should essentially be seen as prerequisite conditions. **Markets and policy** are often outside the control or influence of the CA development-dissemination process. (…) This is mainly because the short-term yield benefits from CA are small or highly variable. (…) The **competition for crop residues with livestock** is a key issue that has to be considered when promoting CA. (…) Priority is **often given to demonstrating CA rather than to adapting** it in a participatory manner to the local context, even though the use of local group-based learning approaches such as 'farmer field schools' and 'lead farmer to farmers-extension' is increasing. Given the broad range of stakeholders involved in the development and diffusion of CA, a multi-stakeholder approach through a so called **innovation network** is probably the best approach for

	adapting CA to the local conditions of farmers. Such a local innovation network of farmers, extension agents, researchers, input suppliers, equipment manufacturers, service providers, traders, and policy makers should foster dynamic interactions and synergies for joint learning and experimenting with CA to develop viable CA practices. **Table 5 - Drivers and constraints for adaption of conservation agriculture** in six case studies in sub Saharan Africa—as assessed by the QAToCA tool.

Number	30
File Name	30_Kirkegaardetal2014
Year	2014
Title	Sense and nonsense in conservation agriculture: Principles, pragmatism and productivity in Australian mixed farming systems
Authors	John A. Kirkegaard, Mark K. Conyers, James R. Hunt, Clive A. Kirkby, Michelle Watt, Greg J. Rebetzke
Geographic scope	Australia
Relevant issues	Yet even in Australia, while broadly applicable, the adaptation and application of CA principles within specific farming systems remains pragmatic due to the diverse **biophysical and socio-economic factors** encountered. Most “no-till” adopters continue some strategic tillage (~30% cropped area) for a range of sound agronomic reasons, intensive cereal systems dominate, and **partial removal of crop residues** as hay or by grazing livestock. (…) Advances in **machinery design, herbicide chemistry and precision agriculture (PA) technologies can facilitate zero-till**, full residue retention approaches in some circumstances on specific soils (Rainbow and Derpsch, 2011). The factors that lead farmers to retain flexibility in their approach to soil disturbance in Australia are shared by farmers in other countries, but what is the case for pursuing the “no disturbance” ideal and what risks are involved in retaining the current flexible approach to tillage currently practiced by Australian farmers? 4.1. Weed management and the emergence of herbicide resistance;.4.2. Tillage for incorporation of slowly mobile elements… (…) though recent studies in Australia have also shown the **trade-off between grazing residues for stock or maintaining them** for soil cover to conserve water for cropping favour residue maintenance (…) Such management options represent the evolution and pragmatic integration of CA principles to local conditions and balance resource protection in the long-term with shorter-term productivity imperatives. In addition to individual on-farm concerns of productivity, profitability and business risk, it appears that such practices are more favourable in terms of wider overall carbon and energy balance than previously thought. Further innovations in mixed farming systems will also inevitably emerge to minimise any on-going trade-offs inherent in integrating livestock and cropping on mixed farms. Our Australian experience suggests that we should continue to apply **good science** to sift the sense and nonsense in the evolution and adaptation of CA worldwide, and be pragmatic rather than prescriptive in how the principles are applied.

Number	4
File Name	4_Gilleretal2015
Year	**2015**
Title	Beyond conservation agriculture
Authors	Ken E. Giller, Jens A. Andersson, Marc Corbeels, John Kirkegaard, David Mortensen, Olaf Erenstein and Bernard Vanlauwe
Geographic scope	Worldwide
Relevant issues	… In addition to **labor**, a second problem is **the competition for crop residues for soil mulching or livestock feed** in smallholder farms across the (sub-) tropics that are commonly mixed crop-livestock farms. This results in CA in practice being merely no-till, with counterproductive impacts on yields, water retention and erosion control. Livestock are often key in the provision of meat and milk, of traction and manure, as well as being a means of accumulating capital and managing risk (Herrero et al., 2010). **Smallholders prioritize feeding of crop residues to livestock** over soil mulching (Giller et al., 2009; Naudin et al., 2014; Erenstein et al., 2015). Soil cover may be limited due to fast degradation of crop residues or removal by termites (Erenstein, 2002). Where crop productivity is poor due to exhaustion of soil fertility and soil degradation, the amounts of crop residues available are limited (Rufino et al., 2011). The need for increased productivity to produce acceptable grain yields and the crop residues needed for mulch and stockfeed suggests that use of mineral fertilizers is a pre-requisite for the success of CA (Vanlauwe et al., 2014b). There is mounting evidence that claims for (full) CA adoption in Africa have been too optimistic as adoption is often partial (one or two principles only), limited in extent (both in terms of numbers of practicing farmers and area), and frequently temporary in nature as reports on dis-adoption suggest (Andersson and D'souza, 2014; Arslan et al., 2014). Even CA practices on small farms in Brazil, tend to be partial and on limited land areas at best (Bolliger et al., 2006). In South Asia's rice-wheat systems no-tillage is still largely confined to the wheat season (Erenstein and Laxmi, 2008). As the growing literature on CA shows, **such limited and partial adoption of CA is rooted in agro-ecological and socio-economic constraints** (Arslan et al., 2014), not only at the plot and farm-level, but also in the wider market, institutional and policy context (Andersson and D'souza, 2014).

Number	16
File Name	16_GonzalezSanchezetal2015
Year	**2015**
Title	A renewed view of conservation agriculture and its evolution over the last decade in Spain
Authors	E.J. Gonzalez-Sanchez, O. Veroz-Gonzalez, G.L. Blanco-Roldan, F. Marquez-Garcia, R. Carbonell-Bojollo
Geographic scope	Spain
Relevant issues	Globally, the reasons for this increase mainly derive from the **economic benefits that no tillage (NT) practices entail, given the drastic reduction of mechanised operations and the subsequent drop in fuel consumption and working time**. During the expansion of CA systems, achievement of similar yield levels compared with TT (traditional tillage) has been demonstrated by multiple studies, and has been a major driver for farmers to shift to CA. (…) In Europe, CA is recognized as an **effective practice to protect soil, and has been identified as a solution to serious environmental** problems that affect European soils. An impact assessment, carried out in accordance with the European Commission's guidelines and on the basis of available data, shows that soil degradation could cost up to s38 billion a year. **To promote soil conservation practices, European Union's (EU) Member States have tools available, such as the National Rural Development Programmes (RDP)**, which are co-financed by the EU and its Member States. In Spain the RDPs supported some measures promoting CA during the period 2007–2013.

Number	6
File Name	6_Bashouretal2016
Year	**2015**
Title	An overview of Conservation Agriculture in the dry Mediterranean environments with a special focus on Syria and Lebanon
Authors	I. Bashour, A. AL-Ouda, A. Kassam, R. Bachour, K. Jouni, B. Hansmann, and C. Estephan
Geographic scope	Mediterranean area
Relevant issues	CA adoption in the Middle-East is low compared to other regions. **Lack of knowledge on CA practices and systems** discourages farmers from giving up ploughing. The main reason why farmers in the Middle-East have begun to apply the no-till system has been the **cost reduction in fuel, labor and machinery required for land preparation. Soil and water conservation concerns do not appear to be the main drivers in the Middle-Eastern farmers' decision to adopt or not to adopt CA**. The adoption and uptake of CA by Middle Eastern farmers has been slow but it is nonetheless occurring gradually. **Collection of information and research parameters** related to agricultural practices are needed for designing a suitable soil and water conservation program for sustainable production intensification. Governmental policy encouraging the adoption and spread of CA systems in the Middle-East region is certainly a necessary condition for uptake. **4. Factors Limiting the Spread of CA in Syria and Lebanon** Although CA has been shown to save water, fuel and labor, and reduce the production costs, in addition to increasing net profit, the rate of adoption of CA in Syria, Lebanon and other Middle-East countries has been very slow and this may be due to the following constraints. 4.1. Unavailability of CA seeders; 4.2. Crop residue management; 4.3. Weed infestation; 4.4. Education; 4.5. Governmental support; 4.6. Research

Number	**17**
File Name	17_Lossetal2015
Year	**2015**
Title	The Practical Implementation of Conservation Agriculture in the Middle East
Authors	Stephen Loss, Atef Haddad, Jack Desbiolles, Harun Cicek, Yaseen Khalil3, and Colin Piggin
Geographic scope	Middle East/Worlwide
Relevant issues	**7.0 Promoting adoption of CA** In **Morocco CA** was first investigated by researchers in the late 1980's, and proving successful at increasing sustainable production, a program of field demonstrations was instigated to promote adoption. About 30 years later, CA only covers around 6,000 ha in Morocco with only a small proportion of unassisted adoption. Similar research also occurred in Turkey during the 1990s where adoption of ZT (zero tillage) was negligible until recent years. **If the benefits of CA were significant, then why wasn't the technology adopted by farmers?** A few large farmers in these countries did initially adopt CA because of their **financial ability to purchase large ZT seeders imported from America and Europe, and they had greater incentives to save on fuel and input expenses** because of their big acreages. In contrast, there was virtually **no adoption** by the majority of farmers who owned relatively small to medium areas of land, mainly because the imported ZT seeders used were too large, heavy and expensive. Another factor in the poor adoption was **the way the technology was demonstrated and presented to farmers**. In some cases, farmers were **not closely involved in on-farm demonstrations and at field days and other extension activities** they were often told they must adopt all three pillars to benefit from CA. In contrast the early projects in Morocco and Turkey, the ICARDA Iraq CA project mentioned in sections 1.0 and 2.61 was effective at promoting the adoption of ZT and early sowing in Iraq and Syria. There are pertinent lessons from this project that can be applied in other parts of the Middle East and elsewhere, **especially the development of simple and cost-effective ZT seeders, and the flexible participatory extension approach.** **8.0 CA misperceptions and challenges** There are a number of misperceptions about CA in the Middle East that are often held by farmers and others when they are first informed about the concept of CA. Some of these misperceptions **originate from people outside the region who have dogmatic and rigid views on what is CA, and how it should be implemented**. We have presented these misperceptions below as coming from farmers (i.e. I was told ....), but these are sometimes proliferated by academics, farm advisers and researchers with **inflexible mind-sets**. These misperceptions will be dispelled as more people become aware of CA, and see it successfully implemented in the Middle East. **8.1 CA won't work in my conditions; 8.2 I was told I must use a disc ZT seeder to eliminate soil Disturbance; 8.3 I was told I must not graze my crop residues; 8.4 Legumes and other crops are more work and don't yield like**

	cereals; 8.7 CA needs more inputs, especially pesticides; 8.8 ZT contradicts our knowledge and culture.

Number	**5**
File Name	5_Choudharyetal2016
Year	**2016**
Title	Conservation Agriculture and Climate Change: An Overview
Authors	Mahipal Choudhary, Prakash Chand Ghasal, Sandeep Kumar, R.P. Yadav, Sher Singh, Vijay Singh Meena, and Jaideep Kumar Bisht
Geographic scope	Indian Himalayan Region
Relevant issues	The CAPs (conservation agricultural practices) are facing a great challenge between the scientific community and the farmers to change the mind-set and explore the opportunities that offer for natural resource management. The CA is also considered as way to sustainable agriculture (Sangar et al. 2005). **A mental change of farmers, technicians, extensionists, and researchers away from conventional method which is soil degrading tillage toward natural resource-conserving systems like no-tillage is the need of the hour** (Derpsch 2001). Hobbs and Govaerts (2010), however, reported that probably the most important factor in the adoption of CA is **change of mental attitude of farmer to tillage**. The following are a few important constraints which restrict wide-scale adoption of CA: • **lack of appropriate machinery** especially for small and medium farmers: although significant effort have been made tin developing and promoting machinery for seeding wheat in no-tillage systems, successful adoption will require **rapid effort in developing, standardizing, and promoting quality implements aimed over a range of crops and cropping sequences** (Bhan and Behera 2014). • The great use of crop residues for animal feed and fuel: Specially under rain-fed or dryland situations, farmers face a scarcity of fodder due to less biomass production of different crops. **There is competition between CAPs and animal feeding for crop residue**. This is a major problem for adoption of CA (Bhan and Behera 2014). • Burning of crop residues: For timely sowing of the next crop and without machinery for sowing under CA systems, farmers prefer to sow the crop in time by **burning the residue**. This has become a common feature in the rice–wheat system in north India. This creates environmental problems for the region (Tripathi et al. 2013). • **Lack of knowledge** about the potential of CA to agriculture leaders, extension agents, and farmers: This implies that the whole range of practices in CA, including planting and harvesting, water and nutrient management, diseases and pest control, etc., need to be evolved, evaluated, and matched in the context of new systems (Bhan and Behera 2014). • **Skilled and scientific manpower**: Managing CA systems, need for enhanced capacity of researchers to face problems from a systems perspective and to be able to work in close relationship with farmers and other stakeholders. Strengthened knowledge and information sharing mechanisms are urgently needed.

	Some area-specific constraints in semiarid areas during the transformation to CA system relate **to initial low supply of crop residues and vegetation biomass for soil mulch cover development, to initial short-term competition for crop residue as animal feed, and to weeding during initial phase** while soil mulch cover and integrated weed management practice is being established. However, farmers, those are really interested in adoption of CA, are finding solution for these problems locally. Lots of this type of cases have been reported for small and large farms in different parts of the world. It is said that **convincing farmers** that crop cultivation is also possible with reduced tillage is major problem in promotion and adoption of CA system on a wide scale (Bhan and Behera 2014).

Number	7
File Name	7_GonzalezSanchezetal2016
Year	**2016**
Title	Conservation Agriculture and its contribution to the achievement of agrienvironmental and economic challenges in Europe
Authors	Emilio J. González-Sánchez, Amir Kassam, Gottlieb Basch, Bernhard Streit, Antonio Holgado-Cabrera, and Paula Triviño-Tarradas
Geographic scope	Europe/ECAF
Relevant issues	In some EU countries, notably Spain, Finland, and France, moderate success has been achieved while other member states lag far behind in terms of CA adoption. The reasons are manifold and range from the **cultural entrenchment** of soil tillage over the wrongly perceived need for increased herbicide inputs to the missing recognition of CA as an overall framework for sustainable production systems and for sustainable production intensification. Currently, however, CA is not being popularised in the EU. **The lack of knowledge on CA systems and their management, and the absence of dynamic and effective innovation systems and lack of policy support, make it difficult and socio-economically risky for European farmers to give up tillage-based farming**, including mouldboard ploughing which is a practice rooted in their cultural traditions. Currently, there are some 2.3 Mha of arable cropland under CA system in Europe, mainly in Spain, France, Finland, UK, Italy, Portugal and Switzerland, and 1.8 Mha in woody crops. The adoption process seems mainly farmer-driven, motivated by the reduction in the cost of fuel, labour and machinery. This adoption trend is expected to grow in the future in response to increasing energy and input costs (…) However, **farmers need to be made aware of the possibility of higher productivity and profit potential with CA as well as of improved soil health and ecosystem services including soil and water conservation so that these advantages are also considered amongst the main drivers in the European farmers' decision to shift to CA or not**. At the same time, farmers wishing to switch to CA systems should be encouraged and offered **financial and institutional support** to minimize transitional risks.

Number	**21**
File Name	21_Lalanietal2016
Year	**2016**
Title	Smallholder farmers' motivations for using Conservation Agriculture and the roles of yield, labour and soil fertility in decision making
Authors	Baqir Lalani, Peter Dorward, Garth Holloway, ErwinWauters
Geographic scope	Mozambique
Relevant issues	This study is the first to incorporate a quantitative socio-psychological model to understand factors driving adoption of CA. Using the Theory of Planned Behaviour (TPB), it explores farmers' intention to use CA (within the next 12 months) in Cabo Delgado, Mozambique where CA has been promoted for almost a decade. **Older farmers** have a more positive attitude towards CA. The **more educated a farmer, the more positive his/her attitude towards CA**. Farmers who are **members of other organisations** have a more positive attitude towards CA. More importantly, there are two other farmers' characteristics with a far greater impact. Farmers who are **members of a CA Farmer Field School** have a substantially more positive attitude towards CA, they perceive higher social norms, and they find it substantially easier to use. Finally, the **poorer a farmer is on the poverty index, the more positive his/her attitude, the more favourable his/her perceived social norms and the easier he/she finds it to apply CA**. (…) Table 7 shows that **farmers with a high intention to use CA** perceive that they have enough **labour and knowledge and skills to use CA**. It is interesting to note that those with **high intention to use CA do feel that CA does require adequate knowledge and skills which signals a potential barrier to using CA**. However, farmers **with high and low intention do not feel that group work is a pre-requisite to using CA**. **Pests and soil type** which have been cited as potential barriers to adoption for CA in other farming contexts **do not seem to affect usage in this farming system**. For example, farmers with high intention to use CA feel they are able to adequately control pests and that pests do not limit the success of using CA. Furthermore, farmers with high intention also believe that mechanisation is not needed to perform CA thus supporting the notion that this **manual form of CA** as opposed to tractor or animal powered is perceived to be a favourable option for farmers in this region. For farmers with larger land holdings that would like to increase the scale of CA, other forms of CA, animal or tractor powered direct seeding systems may be attractive.

Number	**8**
File Name	8_Kassametal2017
Year	**2017**
Title	Conservation Agriculture for Africa Building Resilient Farming Systems in a Changing Climate (Book)
Authors	Amir H. Kassam, Saidi Mkomwa, and Theodor Friedrich
Geographic scope	Mozambique / North Africa
Relevant issues	**Chapter 6** Innovation Systems and Farmer Perceptions Regarding Conservation Agriculture in Cabo Delgado, Mozambique (Lalani et al.) The majority of farmers (> 80% of those not using CA) cited **lack of information** as the primary reason. Only a handful of farmers considered **lack of labour or concern over weeds** as the reason for not using CA. Moreover, **lack of equipment or inputs is unlikely to be an impediment in this setting**. The fact that farmers using CA in this district are not using external inputs such as fertilizers and herbicides may provide more of an incentive to use CA (or at least experiment with or test CA on their land), given the low capital requirements needed to use CA. **Chapter 7** **Conservation Agriculture in North Africa: Experiences, Achievements and Challenges** Adoption of CA systems faces a number of **cultural, economic and technical constraints** in North Africa. **The small farm size, weak local farmers' organizations and institutions, the local knowledge and heritage traditions and the non-availability of appropriate technologies** are the major constraints to widespread application of this promising system for the region. In fact, **affordable no-till (NT) seed drills are one of the main constraints** raised during discussions with farmers. Since the small farmers and mechanization service providers that are the basis of the farming system and agricultural production cannot manage to pay for reliable international drills, NT adoption will be constrained (Boulal et al., 2014). The CANA project is working within the three North African countries – **Algeria, Morocco and Tunisia** – on development and manufacturing of low-cost seed drills for smallholder farmers and some promising results are expected within the coming years. These seed drills will not solve the problems of adoption but will expose any other hidden problems. **Lack of trained farmers and mechanization service providers for use, maintenance and repair of agricultural equipment are also real limiting factors. The improper use of herbicides or seed drills** may have an undesirable outcome on the adoption of CA technology. CA adoption could be also hindered by **lack of appropriate and timely financial resources**. Smallholder farmers cannot afford to take chances and put their savings, which are normally invested in animal production, into **risky and uncertain crop production activities** that are subject to climate change and unfavourable consequences. Therefore, these smallholder farmers **need support from government institutions** during the initial phase of NT system implementation until they improve their incomes and gain confidence and expertise to develop and manage good quality CA cropping systems.

Number	18
File Name	18_Kassametal2017
Year	**2017**
Title	Global Spread of Conservation Agriculture: Interim Update 2015/16
Authors	Amir Kassam, Theodor Friedrich, Rolf Derpsch
Geographic scope	Worldwide
Relevant issues	There are now a multiple set of drivers supporting the adoption and spread of CA globally. In the early years, particularly in North and South America, and in Russia and China, **the main driver for change was soil erosion and degradation (the dust bawls in America and elsewhere)**, and this has continued to be so today given the extensive soil erosion and degradation caused by conventional tillage agriculture. Even in the earlier years, drought would exacerbate the situation because degraded and eroded agricultural soils would be more vulnerable to dry periods during the rainy season. This too has continued to be so today, given that there is an increase in the occurrence of extreme events (i.e. droughts) due to **climate change**. Since the 1970s, there has been continuing increase in the **cost of energy from fossil fuels, and cost of machinery and labour, as well as the cost of production inputs** such as mineral fertilizer and biocides (herbicides and all forms of pesticides). Consequently, farmers have been trying to reduce their production costs, and **CA has allowed farmers to not only reduce production costs but also minimise erosion, degradation and effects of droughts**. Since 2000, more attention has been paid to combating **the loss of ecosystem services and resilience to biotic and abiotic stresses** arising from the practice of conventional tillage agriculture (…) **Figure 1: History of global adoption of CA annual cropland systems since 1974 (Mha)**.

Number	24
File Name	24_Kuehneetal2017
Year	2017
Title	Predicting farmer uptake of new agricultural practices: A tool for research, extension and policy
Authors	Geoff Kuehnea, Rick Llewellyna, David J. Pannellb, Roger Wilkinsonc, Perry Dollingd, Jackie Ouzmana, Mike Ewinge
Geographic scope	Australia
Relevant issues	ADOPT (**Adoption and Diffusion Outcome Prediction Tool**) is the result of such an attempt, providing predictions of **a practice's likely rate and peak level of adoption** as well as estimating the importance of various factors influencing adoption. It employs a conceptual framework that incorporates a range of variables, including variables related to **economics, risk, environmental outcomes, farmer networks, characteristics of the farm and the farmer, and the ease and convenience of the new practice**. ADOPT is the first tool designed to allow those involved in agricultural systems research, development, extension and policy to make quantitative predictions about the adoption outcomes for new farming practices. It is based on a framework structured around **a) characteristics of the practice that influence its relative advantage, b) characteristics of the population influencing their perceptions of the relative advantage of the practice, c) characteristics influencing the ease and speed of learning about the practice, and d) characteristics of the potential adopters that influence their ability to learn about the practice.**

Number	2
File Name	2_Kassametal2018
Year	**2018**
Title	Global spread of Conservation Agriculture
Authors	A. Kassam, T. Friedrich and R. Derpsch
Geographic scope	Worldwide
Relevant issues	Major constraints to the adoption of CA practices continue to be: **knowledge** about the existence of CA and on how to do it (know how), **mind-set** (tradition, prejudice), inadequate **policies**, for example, commodity-based subsidies (EU, US) and direct farm payments (EU), **unavailability of appropriate equipment and machines** (many countries of the world) and of **suitable management strategies to facilitate weed and vegetation management**, including mechanical, biological and chemical options as herbicides (especially for larger farms in low-income countries). Other area-specific constraints in semi-arid areas during the transformation to CA system relate: to initial **low supply of crop and vegetation biomass for soil mulch cover development; to initial short-term competition for crop residue as livestock feed; and to initial adoption of new manual weed management practices when the soil mulch cover and integrated weed management practice is being established**. The major drivers for CA adoption globally continue to be **the need to increase input factor productivity, yield and total farm output, improved sustainability of production and farm land, better incomes, timeliness of cropping practices, ease of farming and reduction in drudgery, and improved ecosystem services** such as clean water, control of erosion and land degradation, carbon sequestration, cleaner atmosphere and the rehabilitation of degraded agricultural lands. The uptake of CA in Africa and Asia is expected to accelerate in the coming years. When government policies support baselevel initiatives, as in Kazakhstan and China, rapid growth rates occur The main reason for the rapid uptake is the increased availability of locally produced **affordable no-till seeders** in Syria, Iran and Turkey, which are also being exported elsewhere in the WANA region, and the efforts of development and promotion activities by organisation such as GIZ, ICARDA, FAO and Arab Centre for the Studies of Arid Zones and Dry Lands (ACSAD) as well as bodies such as INRA in Morocco, American University in Beirut, Aga Khan Foundation in Syria and Réseau Innovations Agro-Systèmes Méditerranéens (RCM) across the WANA Mediterranean region.

Number	32
File Name	32_Wardetal2018
Year	2018
Title	Early adoption of conservation agriculture practices: understanding partial compliance in programs with multiple adoption decisions.
Authors	Patrick S. Ward, Andrew R. Bell, Klaus Droppelmann, Tim Benton
Geographic scope	SA | Malawi
Relevant issues	Perhaps due to this context specificity, it has been observed that "there are few if any universal variables that regularly explain the adoption of conservation agriculture" Giller et al. (2009), for example, refers to **weeds** as the "Achilles heel" of CA, since CA (particularly reduced tillage) increases weed pressure during the early years of CA adoption, and since controlling weeds manually is very labor intensive. Giller et al. (2009) also points to **competing uses for crop residues**, limited availability of labor, and access to **physical inputs** as important constraints to the adoption of CA, arguing that CA may not be suitable for the majority of farming systems in Africa south of the Sahara. This study contributes to the technology adoption literature by clearly demonstrating **(a) that the decision to adopt a comprehensive CA package is complex rather than a unitary decision, and that (b) there is some intrinsic interrelatedness in farmers' decisions regarding the various practices that comprise CA.** (…) The results suggest that, on average, farmers with **larger land holdings** are more likely to comply with the full CA scheme and follow through with practicing zero tillage, residue mulching, and intercropping (or crop rotation), as are more **educated farmers**. Farmers who have **more neighbors complying with the CA** program are more likely to themselves fully comply with the program's requirements, though we cannot strictly identify whether this effect is itself causal. Adoption itself is a complex process. These include a range of variables that describe household and farm characteristics. **Larger farmers** (i.e., those with larger plots of land) **are more likely to adopt the new technology, as are ones with more females in the household** (perhaps due to access to labor). More **highly educated households** are also more likely to be willing to adopt. **Peer compliance** is also correlated with adoption rates. In themselves, these findings are confirmatory rather than novel, as such relationships have been found around the world (e.g., Sutherland et al., 2012 talks about the neighbor effect in adopting organic farming; many studies have shown income/size to correlate to technological uptake). Similar patterns have been found before with respect to the role of **farm-size (or profit-orientation, e.g., Aoki, 2014) on adoption of new technology, or education** (e.g., Genius et al., 2014; Kersting and Wollni, 2012; Reimer et al., 2012). While we did not study the sequence of adoption in the present study, we found strong peer compliance which suggests a range of hypotheses, **including social learning and support** (e.g.,Genius et al., 2014). In addition to these generic factors influencing adoption, we show that adoption is rarely about a single decision, rather a sequence of decisions.

Number	25
File Name	25_Reicosky2019
Year	2019
Title	Conservation Agriculture Systems: soil health and landscape management
Authors	Don Reicosky
Geographic scope	Worldwide
Relevant issues	They identified key barriers to uptake of CA practices that included perceived **scientific uncertainty about the efficacy of practices; lack of real-life 'best practice' examples to show farmers; difficulty in demonstrating the positive effects of soil carbon management practices and economic benefits over a long timescale; and advisors being unable to provide suitable advice due to inadequate information or training.**

Number	26
File Name	26_ReicoskyandJanzen2019
Year	2019
Title	4 Conservation Agriculture Maintaining Land Productivity and Health by Managing Carbon Flows | Soil and Climate CRC Press
Authors	D. C. Reicosky and H. H. Janzen
Geographic scope	Worldwide
Relevant issues	**4.2.5 Site-Specific Adoption of CA, Locally Applied** Complementary Supporting Practices No two **farms** are the same and no two farmers are the same; different **management strategies, different goals, different personalities demand management flexibility in adapting practices of fertility, herbicides, pesticides, diversification and local farmer knowledge** (Anderson 2008). While the three principal facets (Figure 4.3) are the foundation of CA systems, there is need for another "complementary/support component" to enable integration and incorporation of comprehensive agronomic and management practices to fine-tune the functional system (Corsi et al. 2012). The complementary practices include **incorporation of animals and poultry into the production system with additional site-specific diversity supporting services including genetic biodiversity for use in breeding crops, soil formation and structure, soil fertility, nutrient cycling and the provision of irrigation water.**

Number	27
File Name	27_Motalebanietal2019
Year	2019
Title	Socio-Economic Factors Influencing the Adoption of Conservation Tillage Technology
Authors	Sodabeh Motalebani, Mansour Zibaie and Azar Sheikhzeinoddin

Geographic scope	Iran
Relevant issues	In this research, **Theory of Planned Behavior (TPB)** has been used to investigate the intention of farmers for the application of conservation tillage. To this purpose, the information needed to examine the components of belief and attitudes, subjective norms and perceived behavioral control, and the effect of these factors on the intent of farmers to use conservation agriculture (CA), using a **questionnaire** containing a number of open and closed questions, were collected. Open questions include **personal and economic characteristics** of the household and closed questions in a multi-degree scale in the form of a Likert scale (from totally opposing to completely agreeable). In this research, the **intention of farmers to accept CA technology** is considered as a dependent variable, and the variables of TPB include: **1) farmers' attitude towards CA use, 2) subjective norms (probability of carrying out protective tillage in the next year), 3) perceived behavioral control (how difficult it is to run CA in the next year)**, each of which has been questioned by farmers in several ways. According to Table (1), the **farmers' attitude** has had the greatest impact on his intention to apply soil tillage methods in next year. Perceived behavioral control variables and subjective norms are in the next rankings in terms of effectiveness in terms of farmers' intentions. So, as you can see, all three TPB variables have a significant effect on farmers' intentions. In the first stage, the coefficient of multiple correlations (R) is 0.88 and the coefficient of determination (R2) is equal to 78%. Therefore, farmer's attitude, mental norms and perceived behavioral control, explain 78% of the dependent variable variations, which explain the intention to accept soil conservation activities. Then, in the next step, **by adding the characteristics of the farmers**, the coefficient of correlation coefficient was 0.92 and the coefficient of determination was equal to 85%. The results of the study on the factors affecting farmers 'intention to apply conservation methods using the theory of planned behavior (TPB) showed that **farmers' attitude** had the greatest impact on his intention to apply soil tillage methods. Then, **perceived behavioral** control variables and **subjective norms** are most affected by the intention of farmers to apply protective technology. Based on the results of this study, the following measures can be effective on the adoption of protection technology for soil tillage by farmers: 1. **Farm size** has a positive and significant effect on the adoption of conservation activities. 2. **Access to credit and banking facilities** has a positive and meaningful effect on the adoption of protective tillage technology, so it is advisable to allocate more credits for this purpose. 3. Considering that the attitude has a positive and meaningful relationship with intent, it is suggested that through methods such as the **establishment of extension classes, holding exhibitions and conferences in various conservation areas and the establishment of workshops provided the ground for a more favorable attitude towards the adoption of protection technology for soil tillage**.

Annex 2 - Portugal characterization and region selection

CAMA | Research-based participatory approaches for adopting Conservation Agriculture in the Mediterranean Area

APOSOLO |Portuguese Association for Soil Conservation Tillage

WP 2 | PORTUGAL characterization and region selection

nov.2021

PRIMA
PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

Horizon 2020
European Union Funding
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PORTUGAL characterization

Factors and indicators hampering Conservation Agriculture (CA) adoption

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Regarding the undertaken Literature Review (LR) in order to identify factors and indicators hampering Conservation Agriculture (CA) adoption mainly in the Mediterranean region, and additionally in Europe and in the World; the soil and water conservation needs; the CA potential/adoption urgency; and the no existence of experiments constraints Portugal was characterized and a region was selected considering:

✓ The obstacles identified in LR, regardless of its final score

- Agro-climatic conditions
- Crop residues/livestock competition*
- Culture/mind-set*
- Knowledge/research*
- Investment*
- Long-term results*
- Policy
- Risk*
- Socio-economic conditions
- Technical factors

* qualitative obstacles for which there are not published data

APOSOLO

PORTUGAL characterization

Factors and indicators hampering Conservation Agriculture (CA) adoption

✓ Sources of information

- published data
  - maps
  - statistical data
  - studies/articles
  - Portuguese applications to agri-environment soil conservation measure
- Portuguese Institutions responsible for published data
  - ANACOM – National Communications Authority
  - APA - Portuguese Environment Agency
  - DGT - Territory General Direction
  - GPP - Office of Planning and Policy
  - ICNF - Nature Conservation and Forestry Institute
  - IFAP - Agriculture and Fisheries Financing Institute
  - INE - Statistics Portugal

PORTUGAL characterization

Factors and indicators hampering Conservation Agriculture (CA) adoption

- ✓ Sources of information
  - European Institutions responsible for published data
    - EEA - European Environment Agency
    - EUROSTAT – European Statistics
    - JRC - Joint Research Centre

- ✓ Expert knowledge due to
  - experience of Portuguese farmers who have been practising CA for some time
  - Portuguese farmers who follow CA principles and of their major constraints to CA practices adoption

PORTUGAL characterization

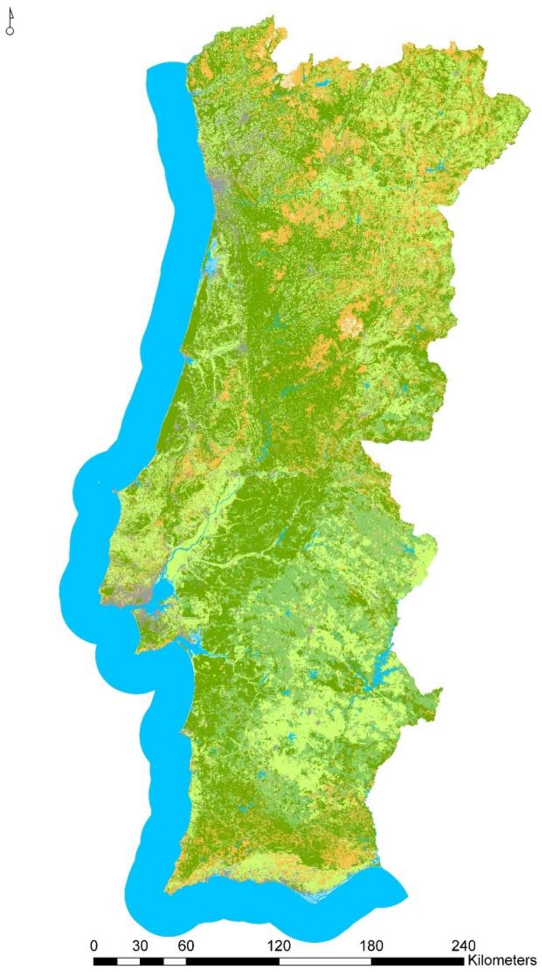
Factors and indicators hampering Conservation Agriculture (CA) adoption

Portugal characterization was divided in three main themes:

- ✓ Environment and territory
- ✓ Agri-environment measure (EU + National Funds)
- ✓ Structural characteristics of agricultural holdings

Environment and territory

Land use 2018



1. Artificialized territories
2. Agriculture
3. Grasslands
4. Agroforestry surfaces
5. Forest
6. Shrub
7. Open area or with low vegetation
8. Wet areas
9. Surface water bodies

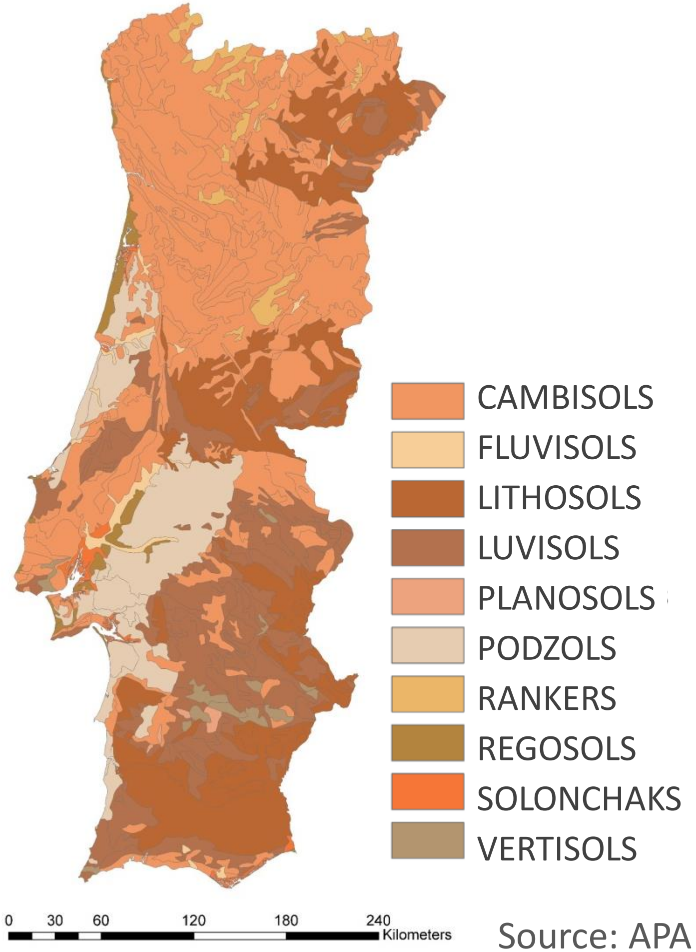
- ✓ Utilised agricultural area (UAA) – that includes agriculture, permanent grassland and agroforestry surfaces – represents about 40% of the mainland Portugal area

Source: DGT – Territory General Direction (http://www.dgterritorio.pt/)

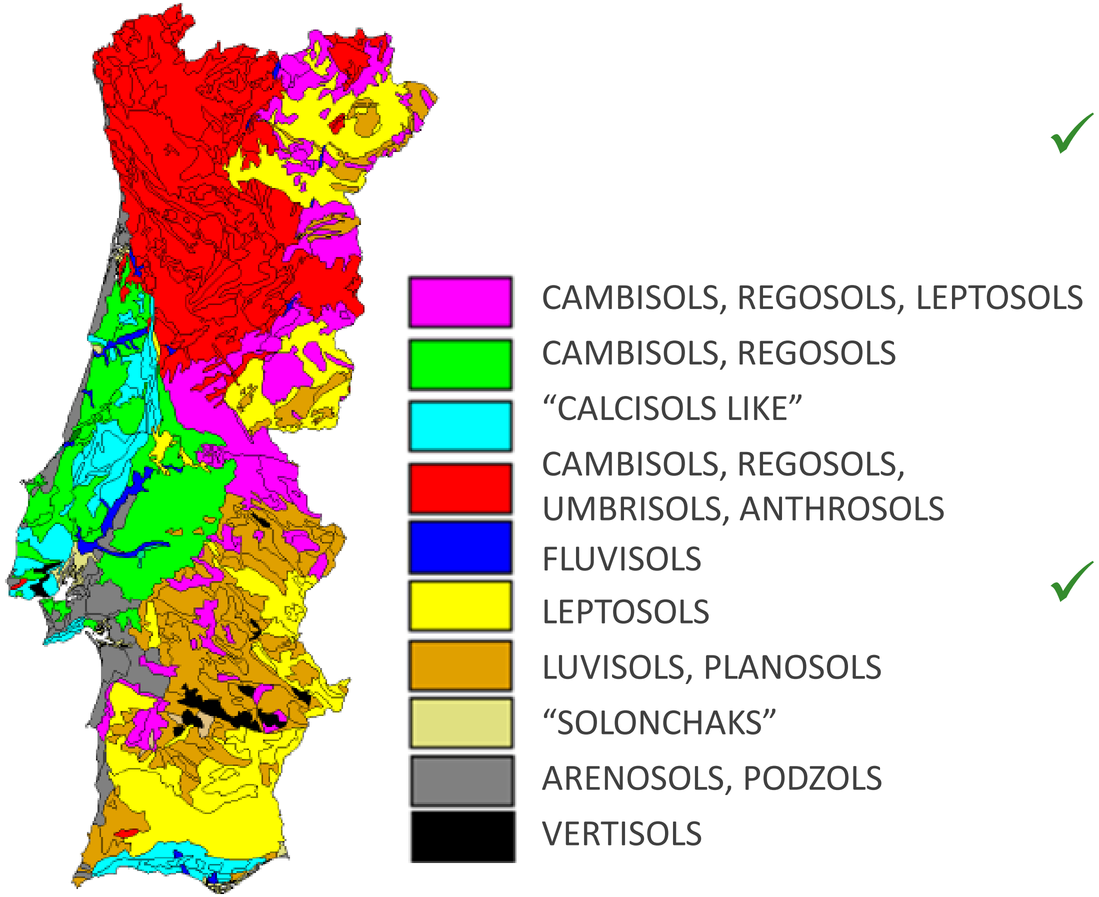
Environment and territory

Soils FAO classification (1971 and 2015 cartography)

Created in 1971



Draft presented in 2015

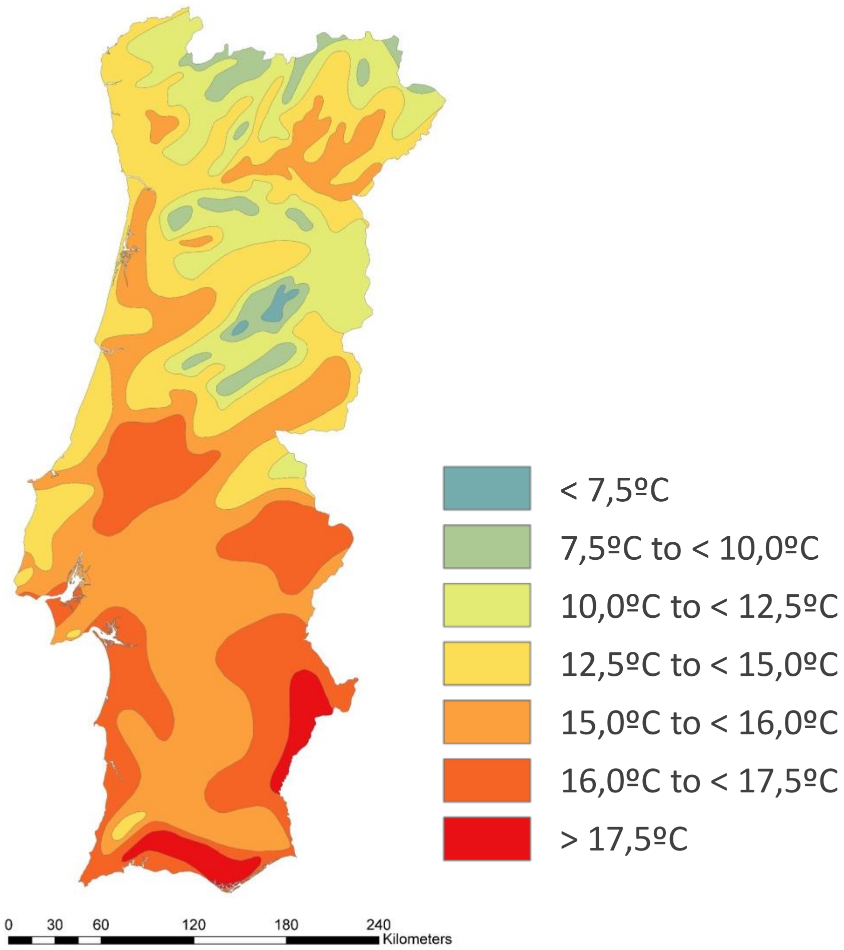


- ✓ In river Tagus North region, where prevail the Cambisols, soils are more homogeneous than soils located in the South region
- ✓ In the South region Leptosols, and Luvisols and Planosols are in majority

Source: APA - Portuguese Environment Agency (https://apambiente.pt/)
ISA – Higher Institute of Agronomy (http://www.iniav.pt/fotos/editor2/2_informacao_recurso_solo_manuelmadeira.pdf)

Environment and territory

Average annual temperature 1931-1960 (ºC)

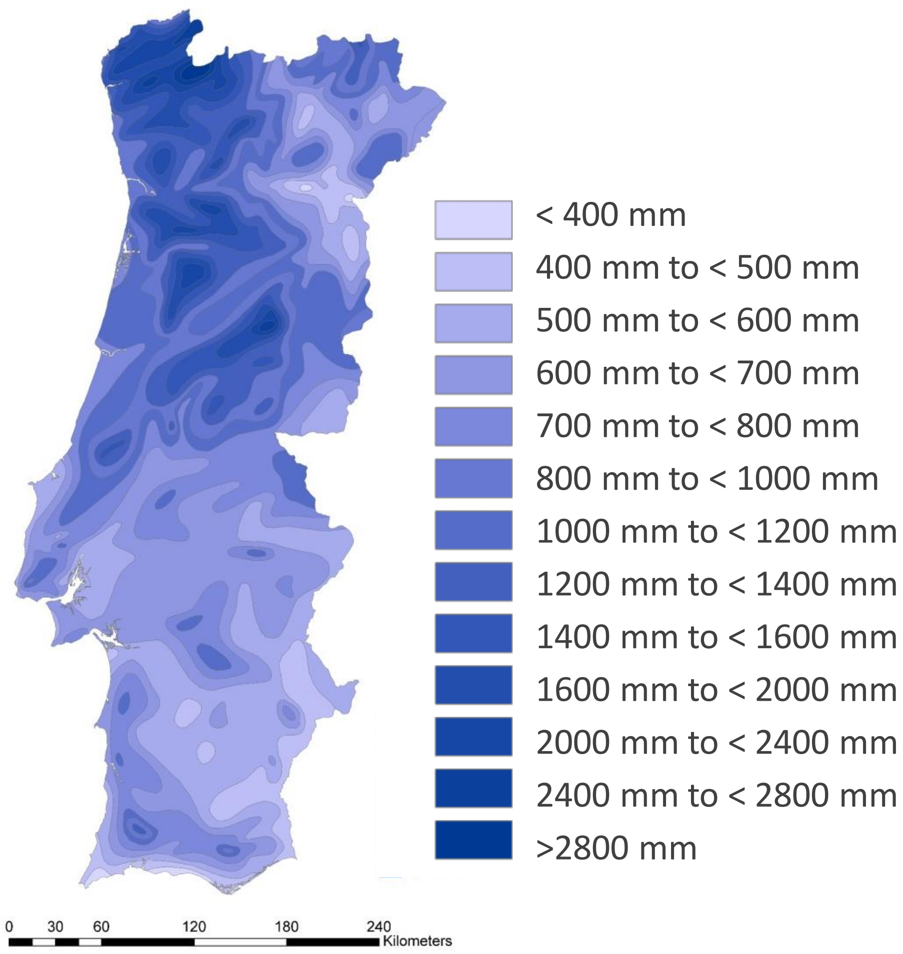


- ✓ The temperature distribution includes the combined effect of latitude, orography and the effect of the Atlantic Ocean
- ✓ During Winter there exists a temperature gradient along the North-South direction, and in Summer along the coastal area-inland direction
- ✓ Regardless the years period considered the map shows the temperature distribution in Mainland Portugal

Source: APA - Portuguese Environment Agency (https://apambiente.pt/)

Environment and territory

Average annual cumulative precipitation 1931-1960 (mm)



- ✓ The Northwest region is one of the European regions that registers higher average annual cumulative precipitation
- ✓ Average annual cumulative precipitation in several Alentejo zones does not exceed 500 mm
- ✓ In Mainland Portugal there are very strong interannual precipitation variations which are responsible for the vulnerability to droughts and floods spells
- ✓ Regardless the years period considered the map shows the precipitation distribution in Mainland Portugal

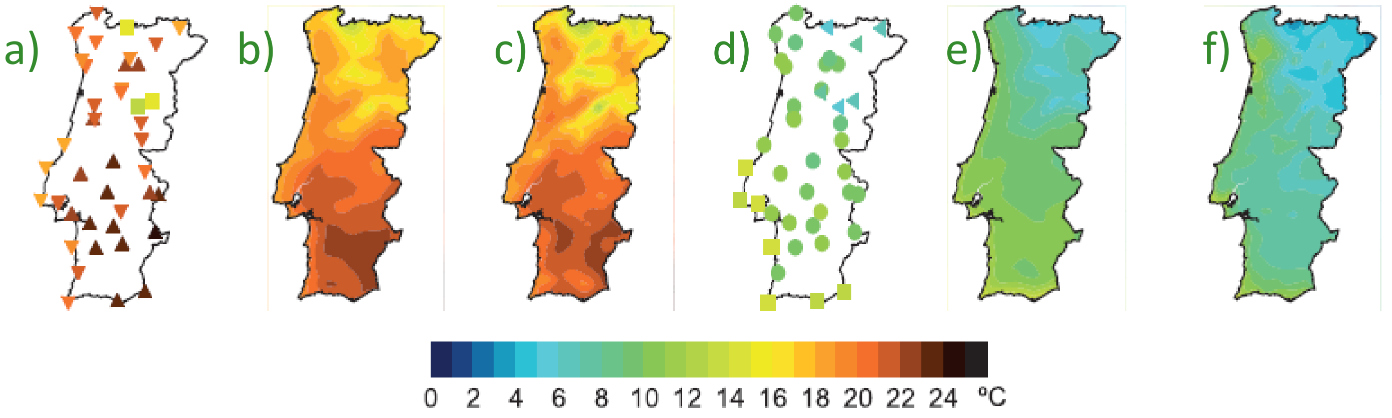
Source: APA - Portuguese Environment Agency (https://apambiente.pt/)

Environment and territory

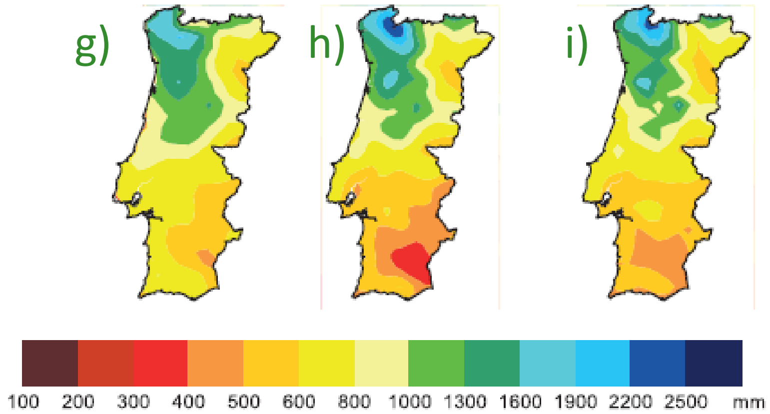
Annual average temperature and cumulative precipitation 1971-2000 (ºC and mm)

Maximum temperature (a) observed, (b) average Euro-CORDEX multi-model, (c) WRF9km

Minimum temperature (d) observed, (e) average Euro-CORDEX multi-model, (f) WRF9km



Precipitation (g) observed, (h) average Euro-CORDEX multi-model, (i) WRF9km



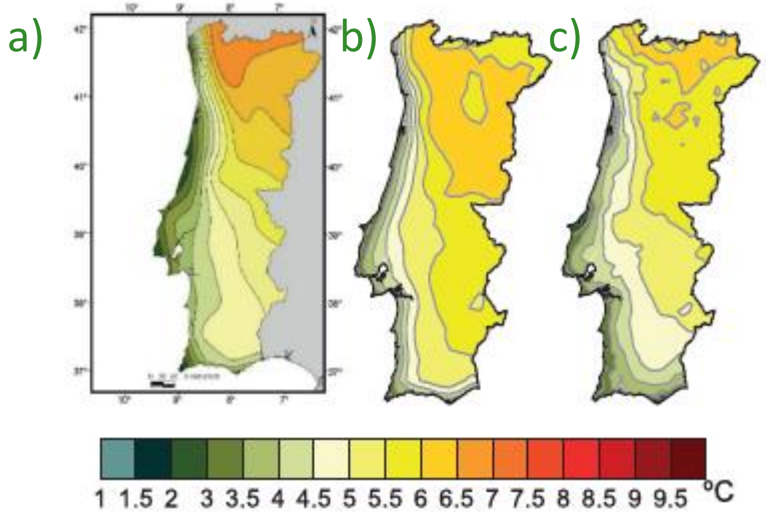
Source: Miranda *et al., 2018 cit. in* GPP - Office of Planning and Policy (https://www.gpp.pt/)

- ✓ Global circulation models (GCMs) are the best known way to simulate climate change scenarios
- ✓ The confidence in the ability of GCMs to project future climate has increased significantly
- ✓ Regional climate models are used to assess in greater detail the impacts of global warming in Portugal, the results displayed show a similarity between the climate data observed and control simulation data

Environment and territory

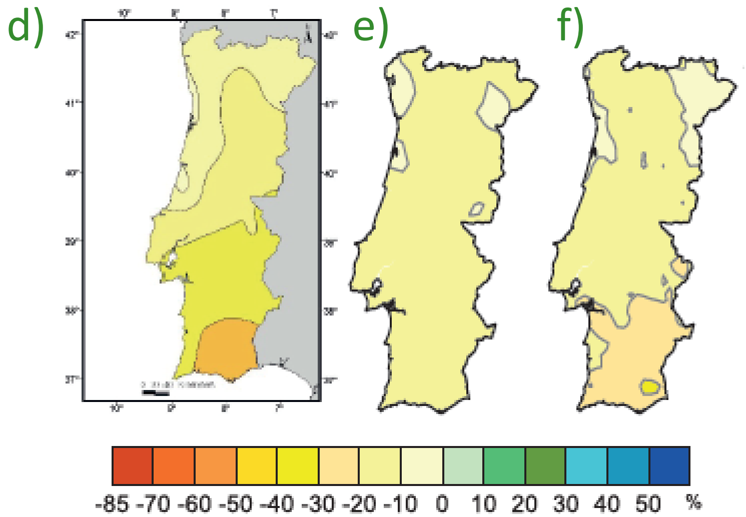
Forecasted maximum temperature and precipitation anomalies – at the end of the XXI century

Maximum temperature anomalies (a) scenario A2, HadRM3 model 50km, (b) CORDEX 12km and (c) WRF 9km RCP8.5 scenario



- ✓ Models projected a temperature increase mainly in the interior North and Centre
- ✓ Models projected a precipitation decrease mainly in the South

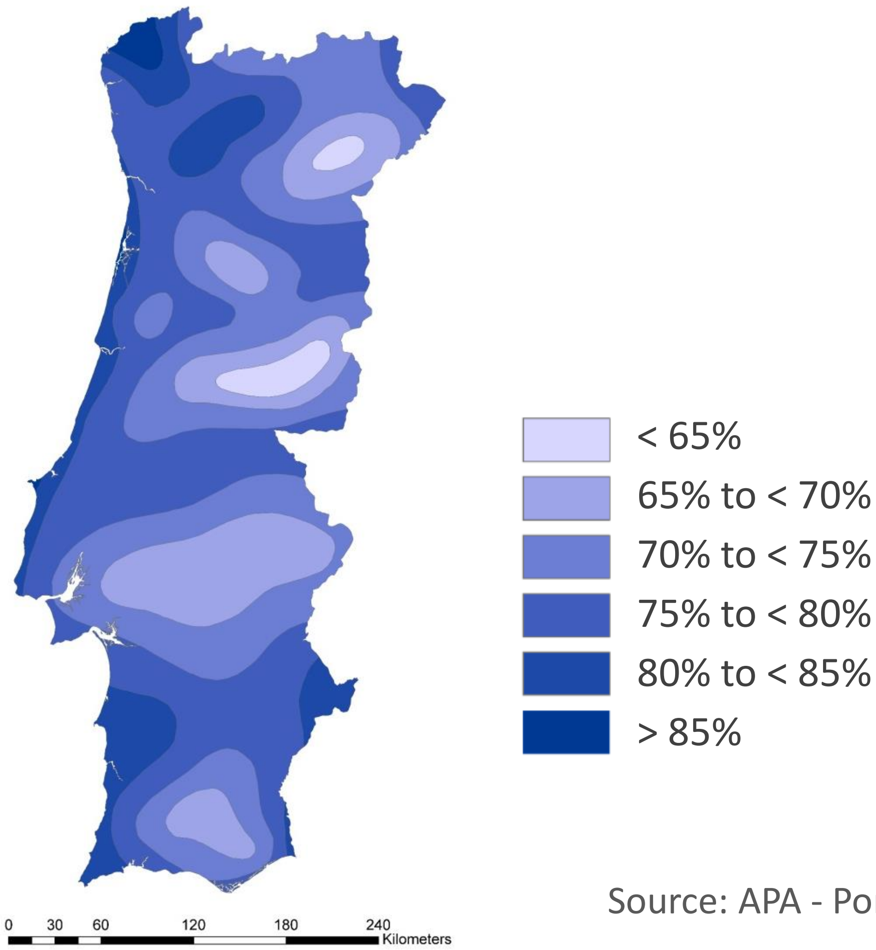
Precipitation anomalies (d) scenario A2, HadRM3 model 50km, (e) CORDEX 12km and (f) WRF 9km RCP8.5 scenario



Source: Miranda *et al., 2018 cit. in* GPP - Office of Planning and Policy (https://www.gpp.pt/)

Environment and territory

Relative air humidity 1931-1960 (%)



- Northwest and coastal areas are drier than the South and inland
- Relative air humidity lower values occur in the inland territory, the furthest areas from the Atlantic Ocean
- Regardless the years period considered the map shows the relative air humidity distribution in Mainland Portugal

Source: APA - Portuguese Environment Agency (https://apambiente.pt/)

Environment and territory

Estimated soil erosion by water - Agricultural areas and natural grassland (t.ha^{-1}.year^{-1})

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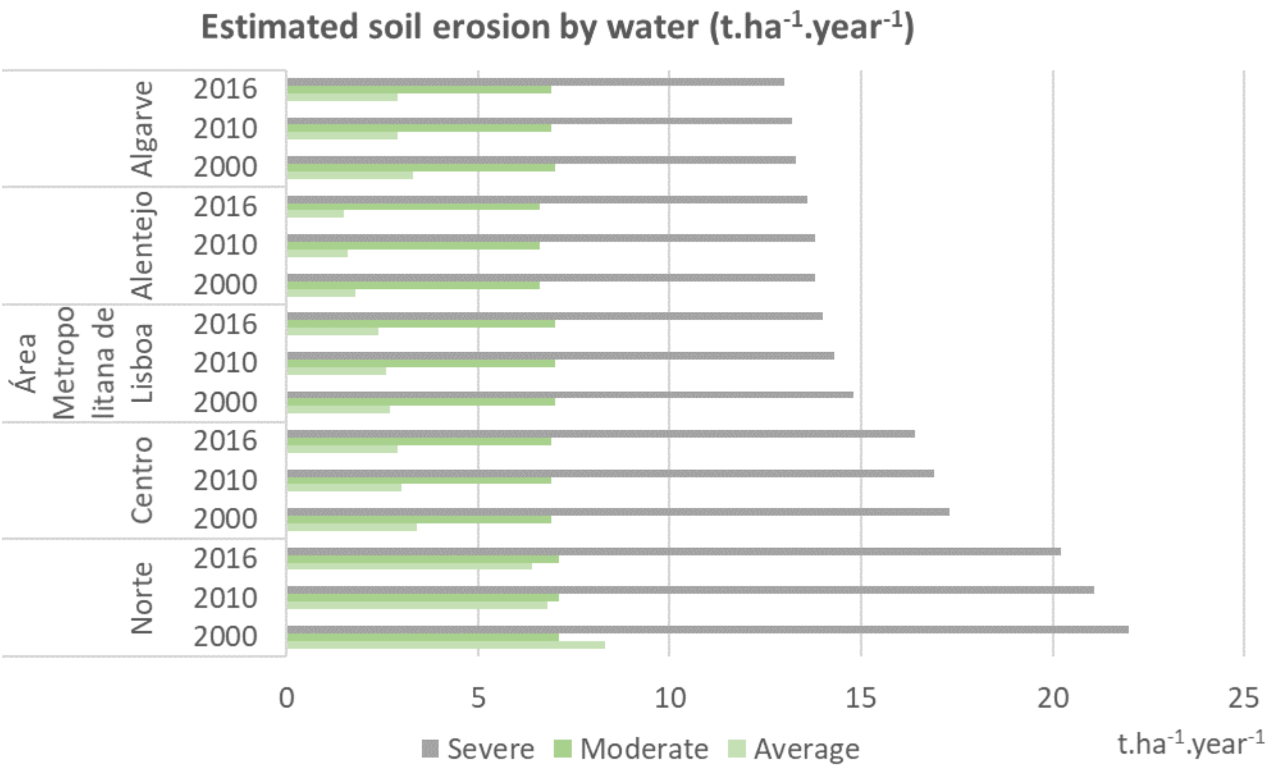
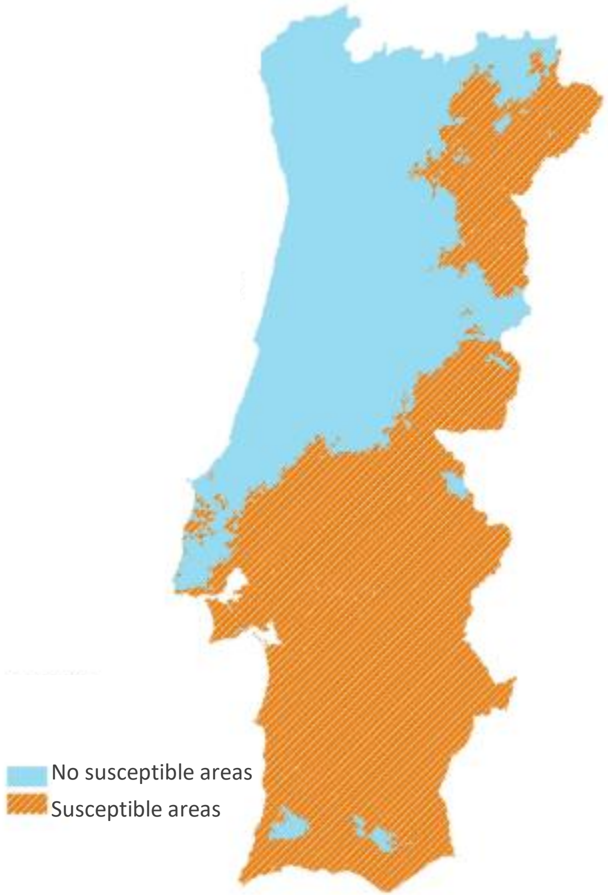


- Estimated soil erosion losses by water are higher in the North of Mainland Portugal, where cumulative precipitation of great volume is measured
- From 2000 to 2016 only the North region showed a decrease in the soil erosion losses
- The severe soil erosion losses are very high across the territory

Source: EUROSTAT (https://ec.europa.eu/eurostat/data/database)

Environment and territory

Areas susceptible to desertification, Aridity Index 1980-2010



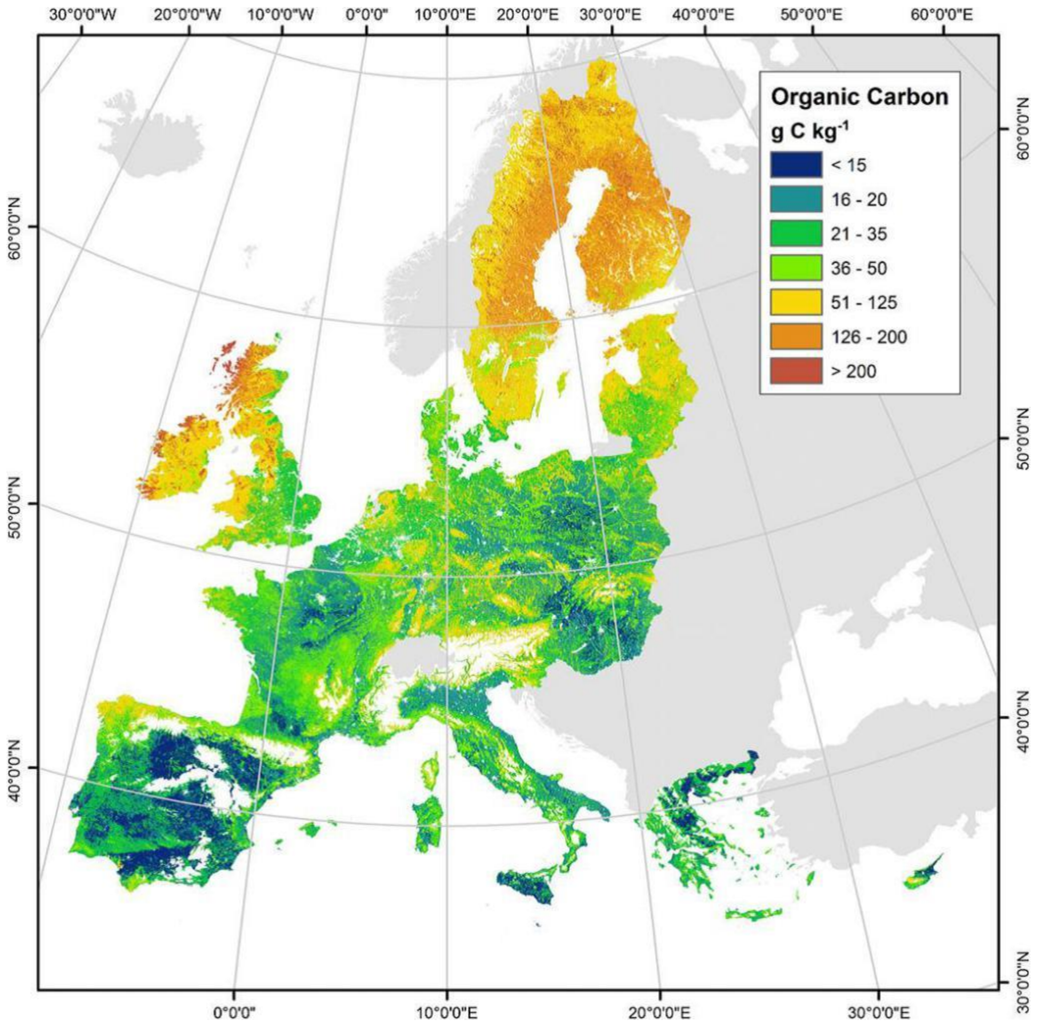
- ✓ From 1980 to 2010 the susceptibility to desertification has increased from 36% to 58% of the mainland surface

- ✓ The Aridity Index is calculated as the ratio of Precipitation and Potential Evapotranspiration (P/PET)

Source: ICNF - Nature Conservation and Forestry Institute (http://www2.icnf.pt/)

Environment and territory

Topsoil organic carbon content, 2015 ($gC.kg^{-1}$)

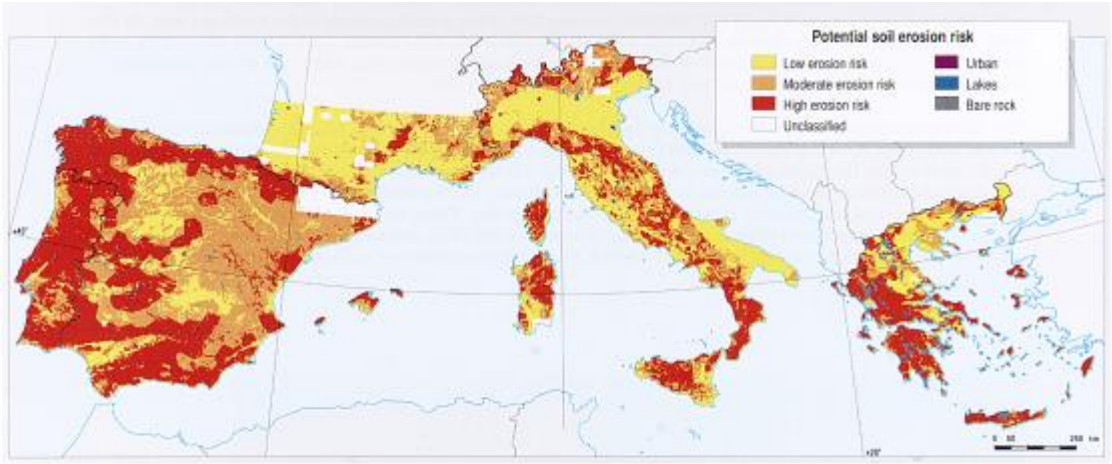


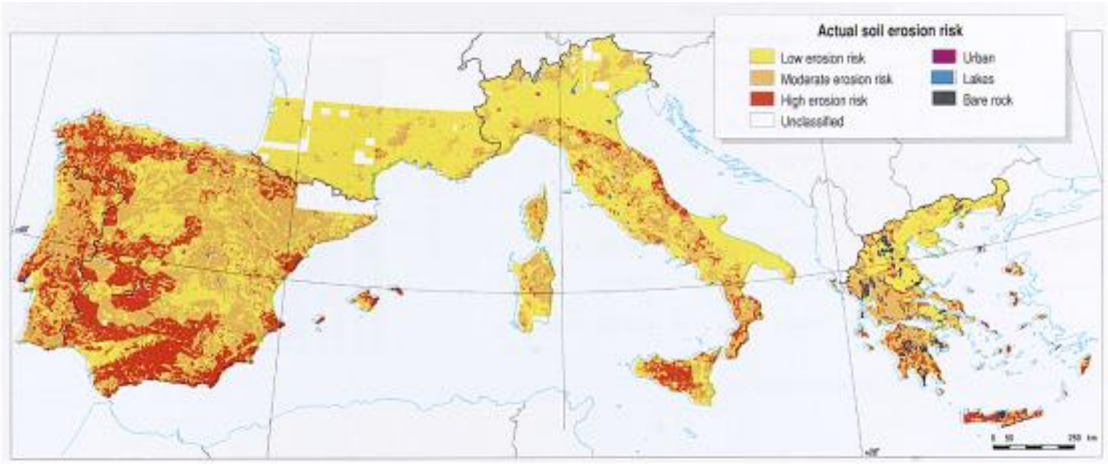
- ✓ Portuguese soils have a low topsoil organic carbon content due to the soil and climate characteristics
- ✓ In 2015 Alentejo showed the lowest value (<15$gC.kg^{-1}$)

Source: JRC - Joint Research Centre (https://ec.europa.eu/jrc)

Environment and territory

Potential and actual soil erosion risk in southern Community countries



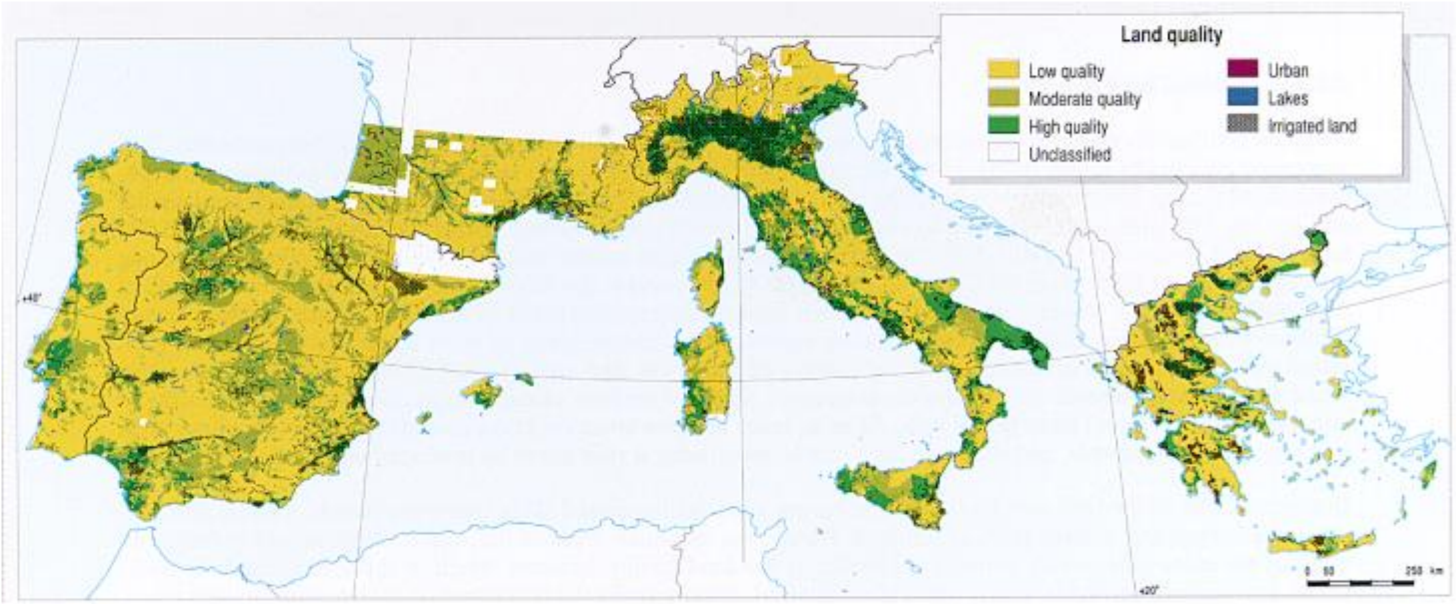


- ✓ In Mainland Portugal the potential and actual soil erosion risk is high because of soil and climate conditions

Source: EEA - European Environment Agency (https://www.eea.europa.eu/)

Environment and territory

Land quality in southern Community countries



✓ Land quality in Mainland Portugal is mostly low, mainly due to erosion

Source: EEA - European Environment Agency (https://www.eea.europa.eu/)

Agri-environment measure (EU + National Funds)

7.4.1 Soil conservation | no-till and strip-till (nº and ha)

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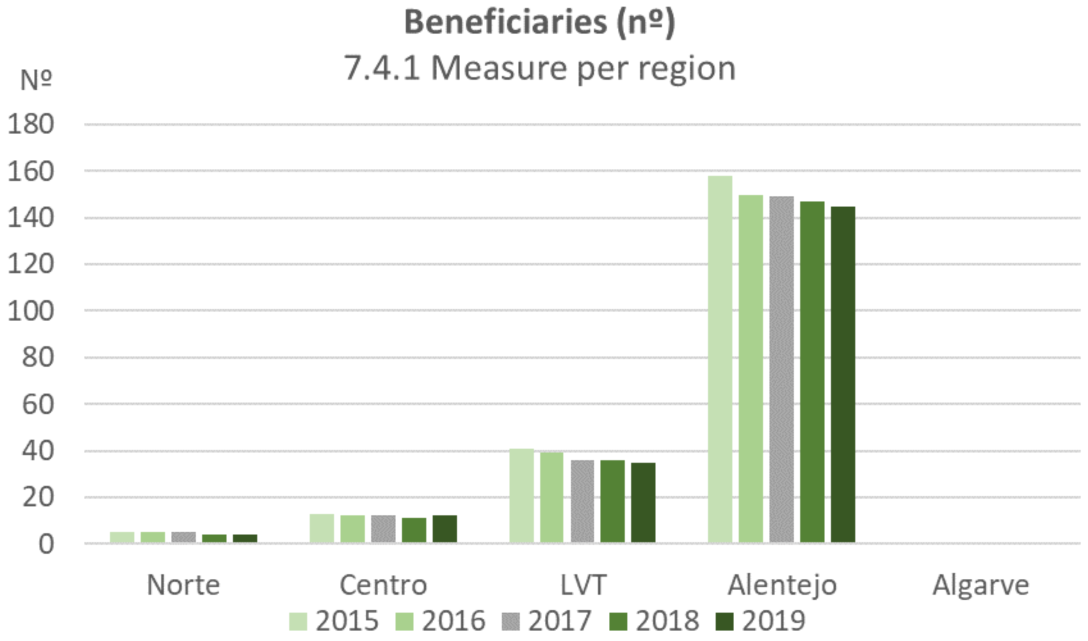

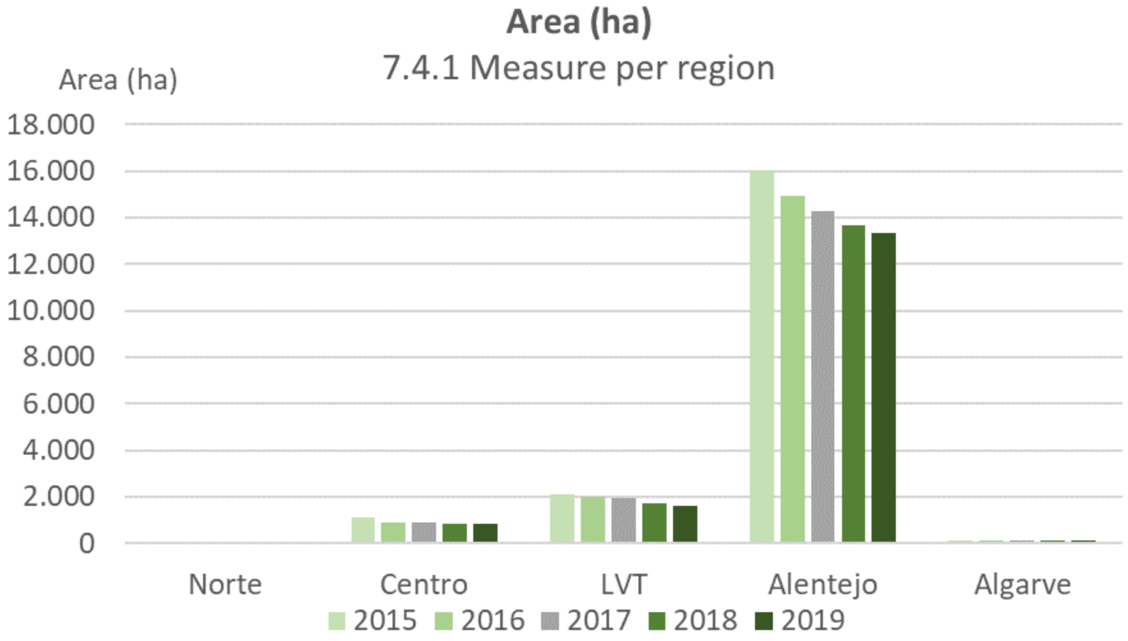

- ✓ Alentejo, followed by LVT region, has the greatest farmers' adherence to agri-environment measure 7.4.1 in terms of number and area
- ✓ In Alentejo, between 2015 and 2019, the beneficiaries' number and adherent area decreased 8% and 17%, respectively

Source: IFAP - Agriculture and Fisheries Financing Institute (https://www.ifap.pt)

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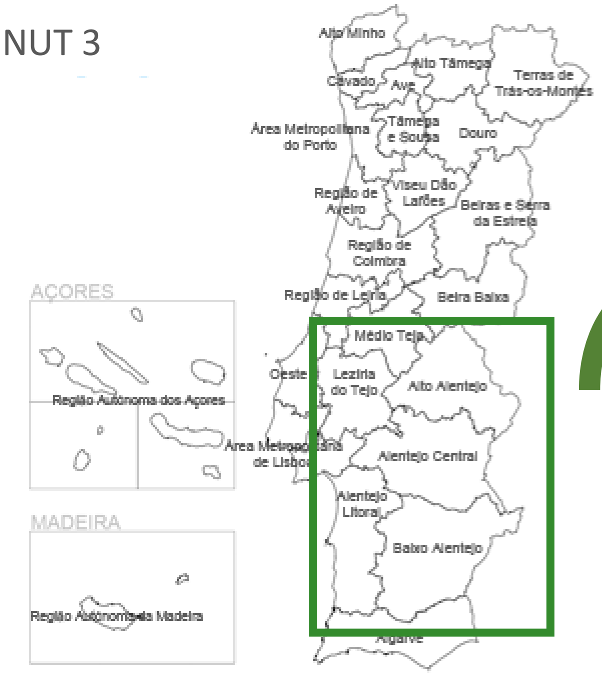
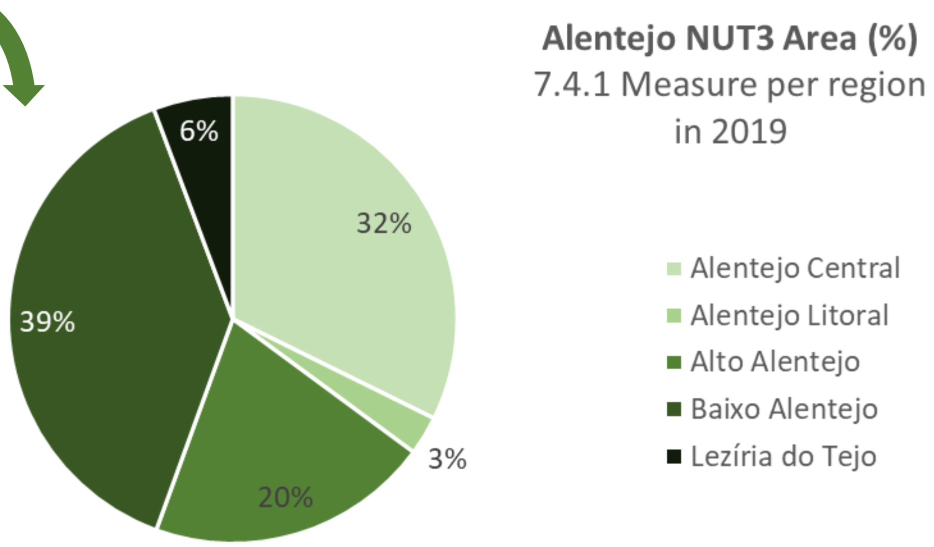
Agri-environment measure (EU + National Funds)

7.4.1 Soil conservation | no-till and strip-till, Alentejo 2019 (%)

NUT 3



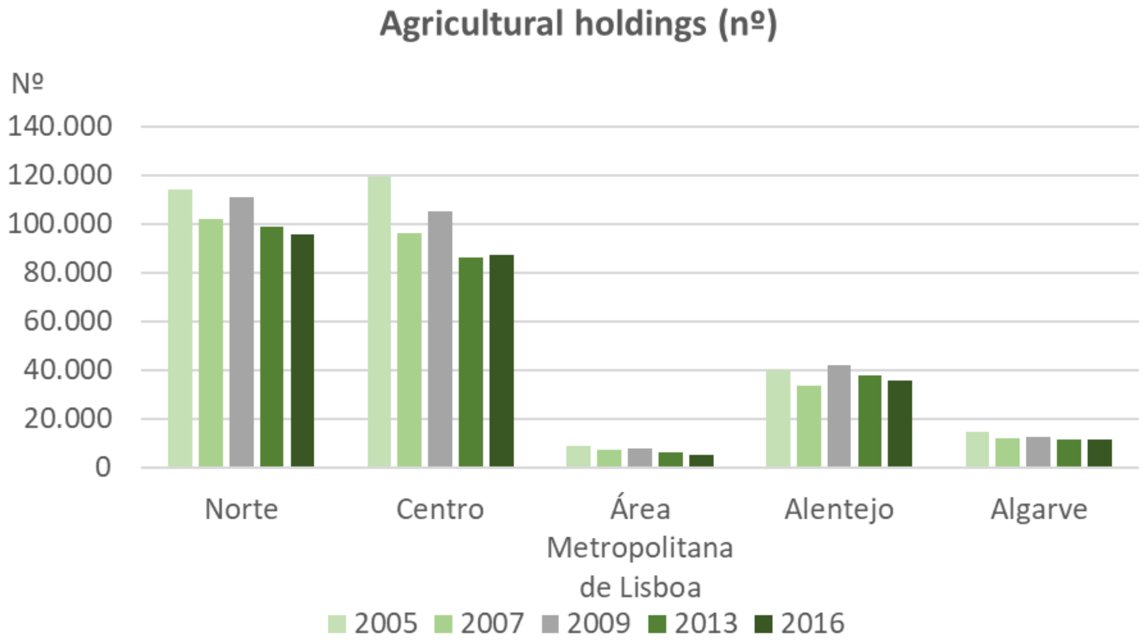


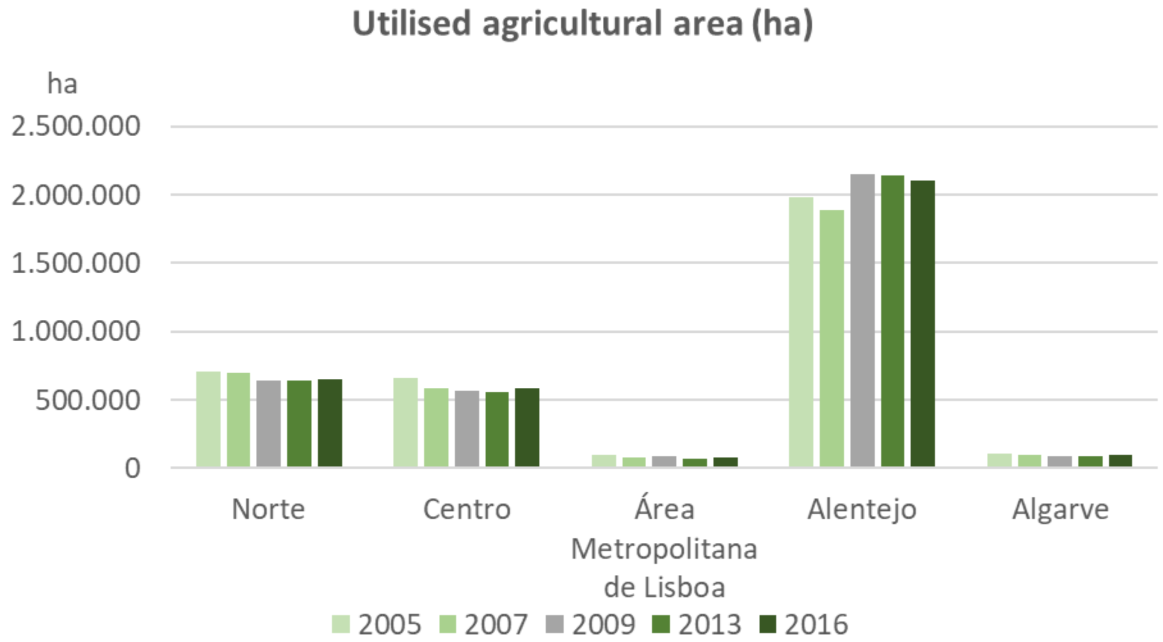
✓ In Alentejo region, during 2019, Baixo Alentejo (39%) and Alentejo Central (32%) were the sub-regions with the highest area in measure 7.4.1

Source: IFAP - Agriculture and Fisheries Financing Institute (https://www.ifap.pt)

Structural characteristics of agricultural holdings

Agricultural holdings (nº) and utilised agricultural area (ha)



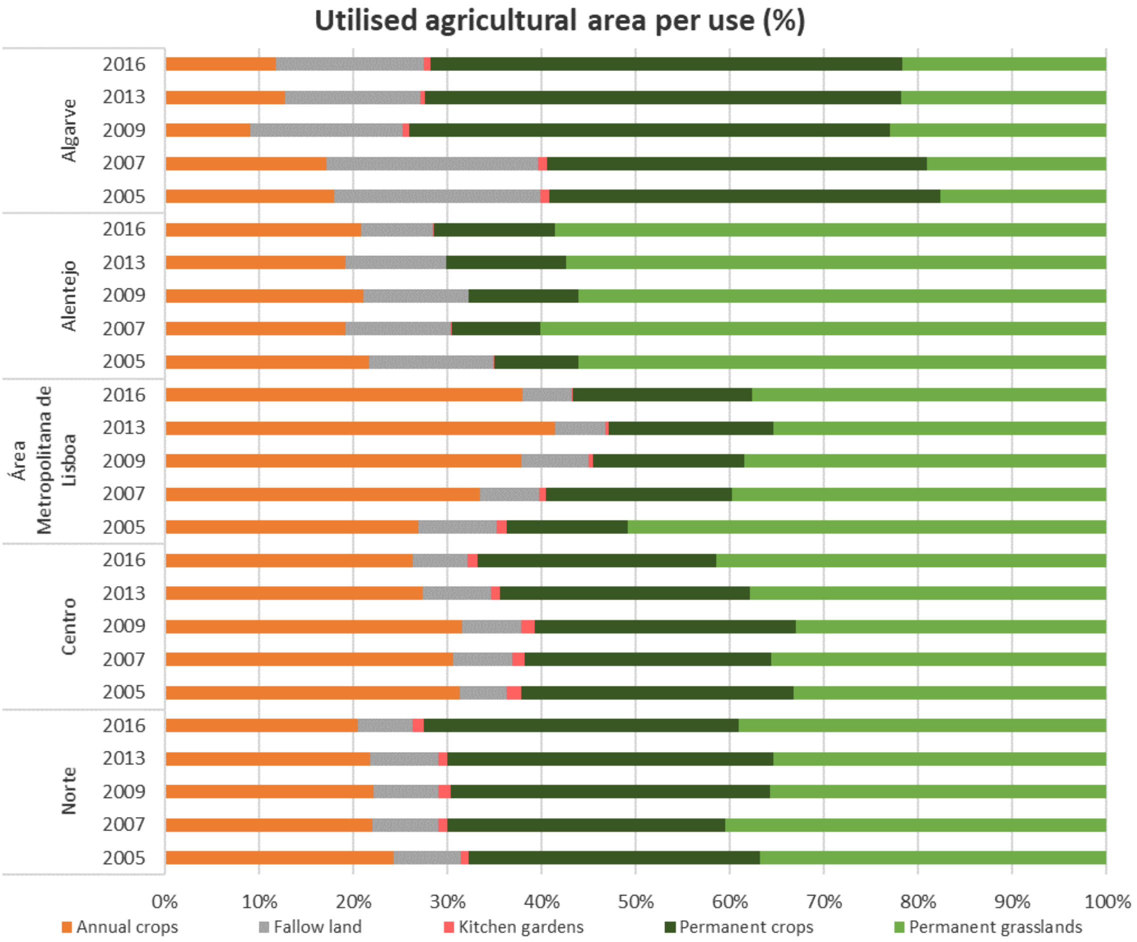


- ✓ In Mainland Portugal from 2005 to 2016 agricultural holdings number decreased (-20%), showing an agricultural activity abandonment, with a slowdown on its reduction from 2013 to 2016
- ✓ UAA from 2005 to 2016 showed a slight decrease (-1%)
- ✓ Agricultural holdings number is higher in the North and Center, while the UAA is higher in Alentejo; in 2016 the average UAA per farm was 59ha in Alentejo and 7ha in the North and Center regions

Source: INE – Statistics Portugal (https://www.ine.pt/)

Structural characteristics of agricultural holdings

Utilised agricultural area per use (%)

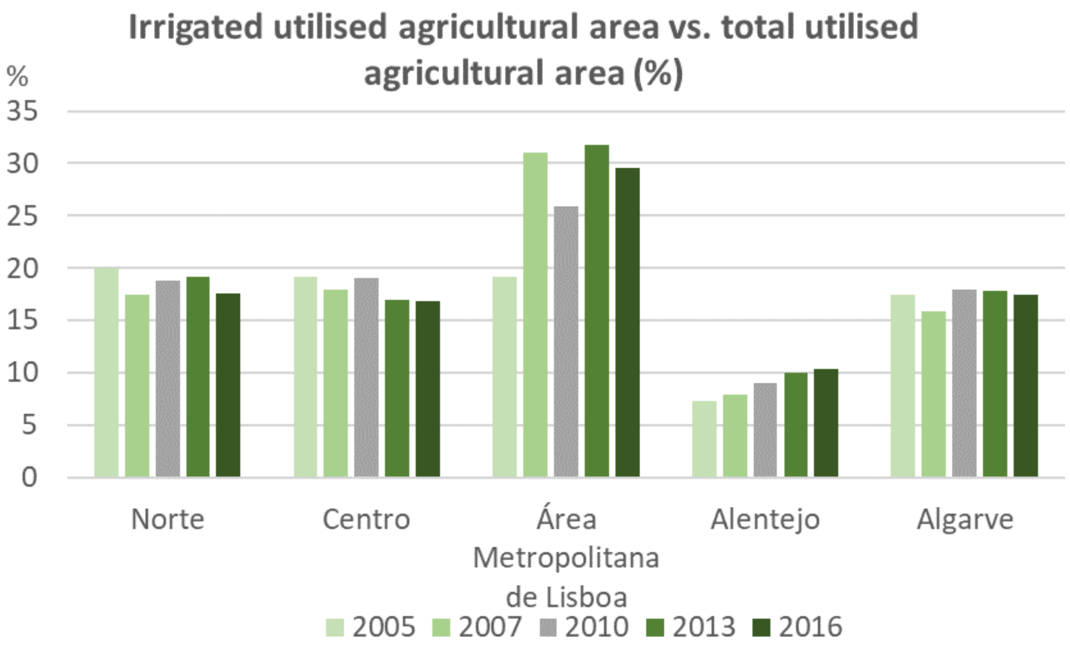


- ✓ In 2016, 51% of the UAA in Mainland Portugal was devoted to permanent grasslands, 29% to arable land and 20% to permanent crops
- ✓ In the North and Center, arable land (annual crops and fallow land), permanent crops and grasslands are equally distributed. In Algarve permanent crops and in Alentejo permanent grasslands are the most important occupation, respectively

Source: INE – Statistics Portugal (https://www.ine.pt/)

Structural characteristics of agricultural holdings

Irrigated utilised agricultural area (%)

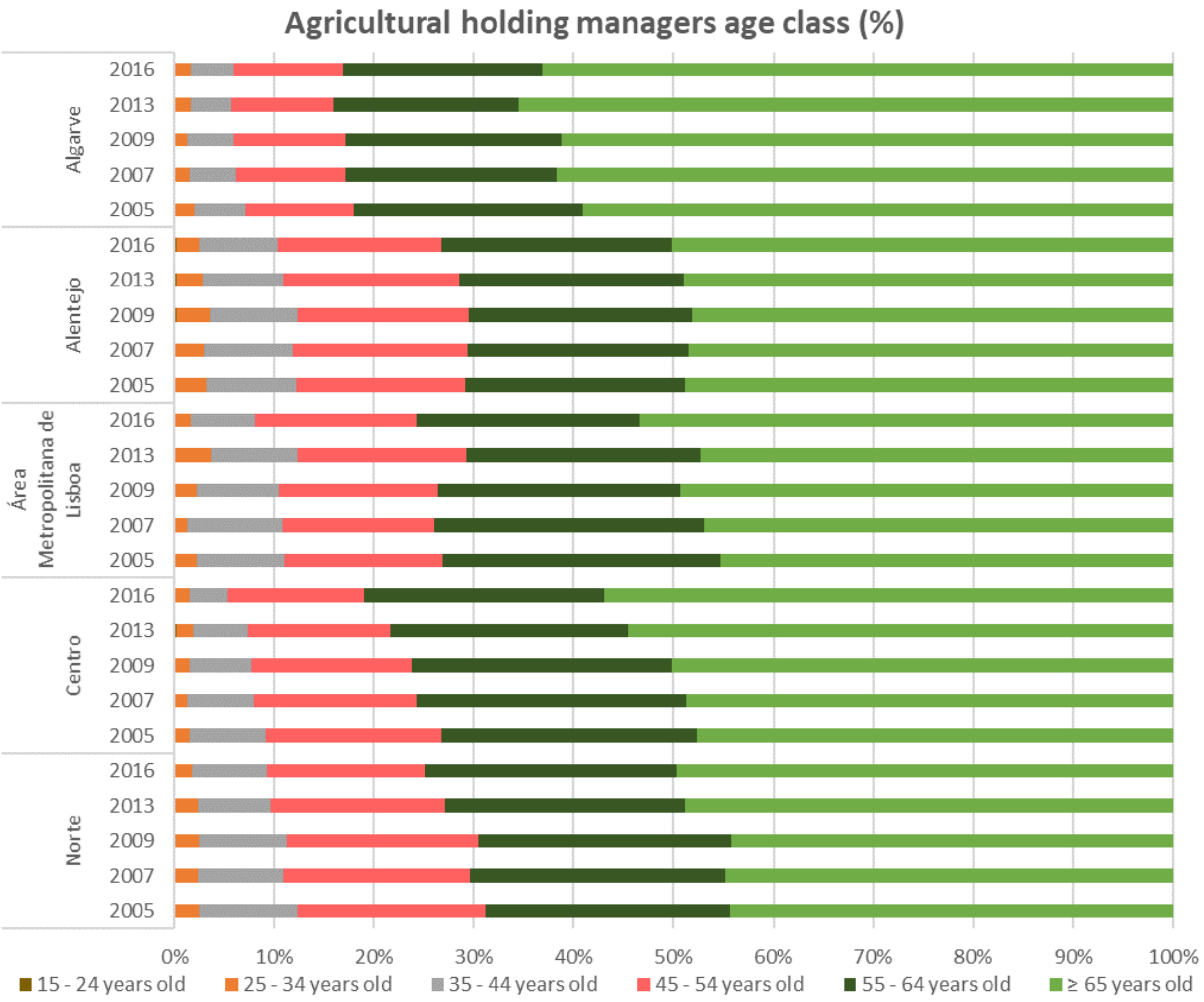


- ✓ Alentejo is the region with the largest irrigable area, which has increased since 2005 mainly due to the Alqueva Multipurpose Project
- ✓ In terms of irrigated area proportion of the UAA - Alentejo and Lisbon Metropolitan Area are the regions with the lowest (10%) and the highest value (30%), respectively

Source: INE – Statistics Portugal (https://www.ine.pt/)
EUROSTAT (https://ec.europa.eu/eurostat/data/database)

Structural characteristics of agricultural holdings

Agricultural sole producer age class (%)

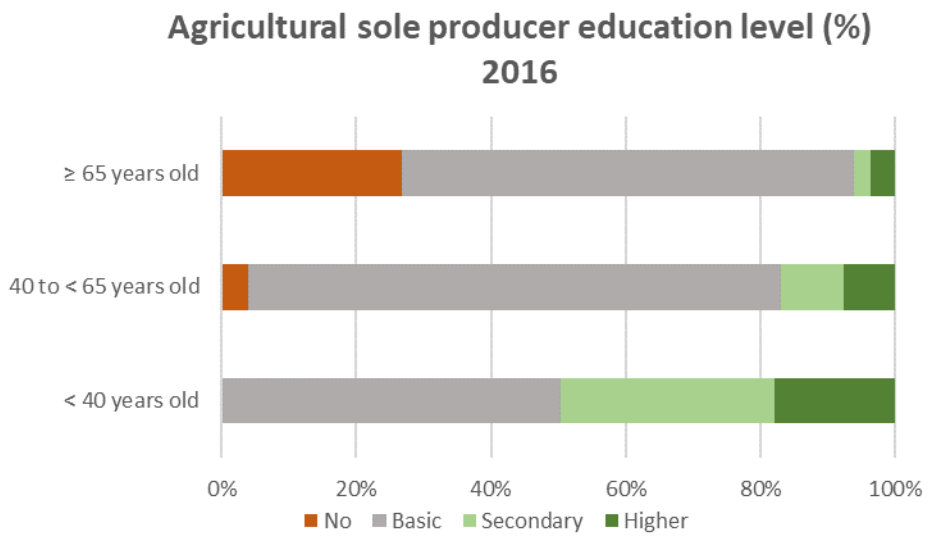


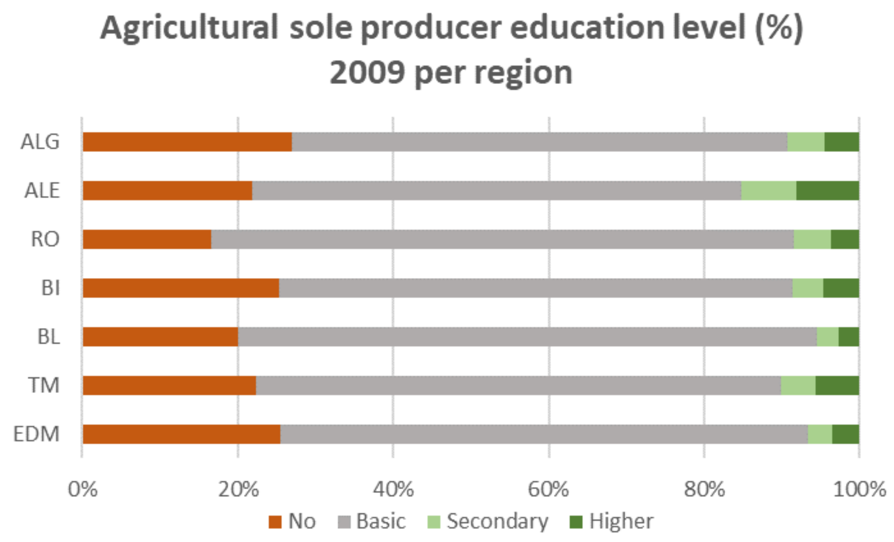
- ✓ In 2016, in mainland Portugal 53% of the agricultural holding managers were over 65 years old, exhibiting an aging trend
- ✓ In 2016, the North and Alentejo are both the regions where the percentage of managers under 65 years old is higher (50%)

Source: INE – Statistics Portugal (https://www.ine.pt/)

Structural characteristics of agricultural holdings

Agricultural sole producer education level (%) in Portugal (2016) and per region (2009)



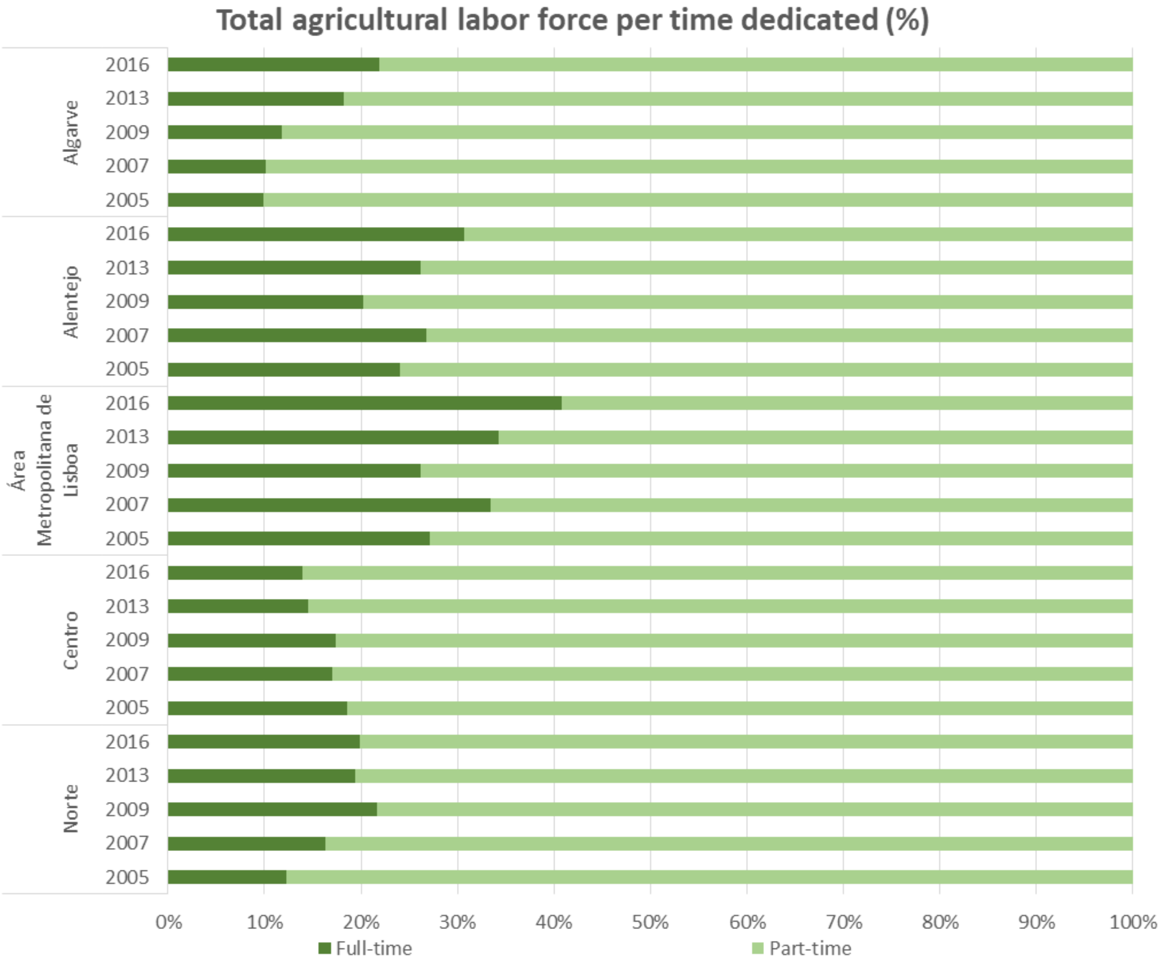


- ✓ In 2016, the majority of Portuguese agricultural sole producers only completed basic education (71%) and only 6% had higher education qualifications
- ✓ In 2009 Alentejo was the region where agricultural producers completed an upper level of education - 7% secondary education and 8% higher education

Source: INE – Statistics Portugal (https://www.ine.pt/)

Structural characteristics of agricultural holdings

Total agricultural labor force per time dedicated (%)



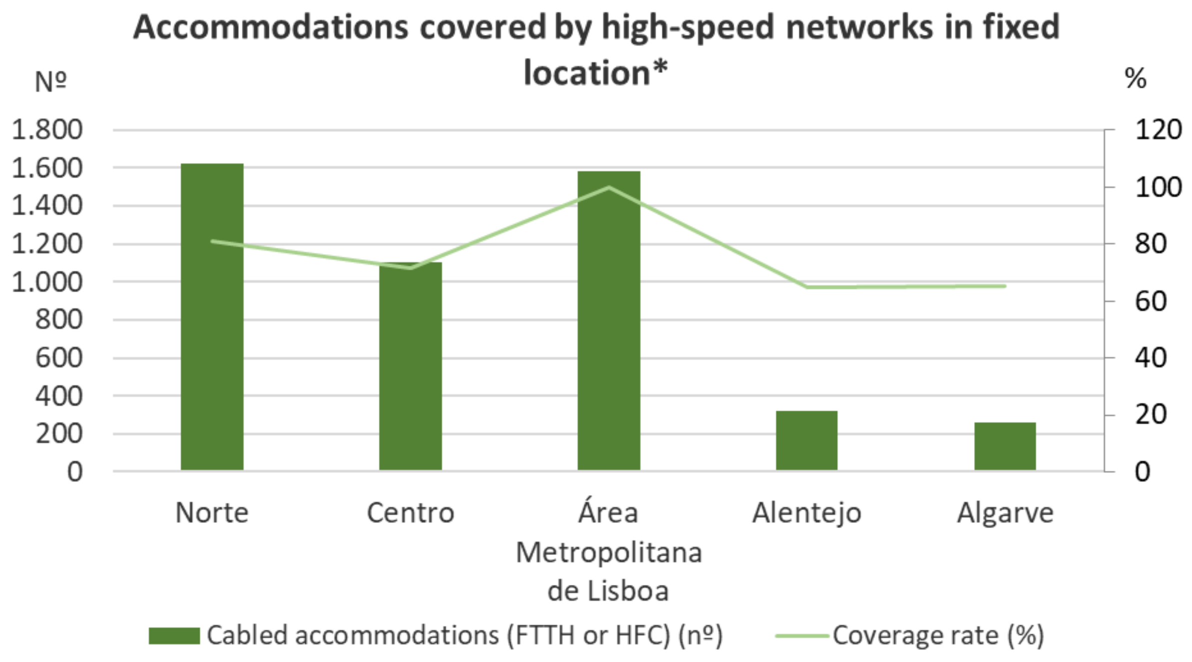
- ✓ In 2016, approximately 20% of the agricultural labor force in Mainland Portugal declared a full time dedication

- ✓ In 2016, the Center and Alentejo were the regions with higher time dedicated to the agricultural holdings (41% and 31%, respectively)

Source: INE – Statistics Portugal (https://www.ine.pt/)

Structural characteristics of agricultural holdings

ICT - Information and Communication Technologies – in Portugal



* Fibre to the Home (FTTH) or supported in networks Hybrid Fibre-Coaxial (HFC)

Source: ANACOM – National Communications Authority (https://www.anacom.pt/); GPP - Office of Planning and Policy (https://www.gpp.pt/)

- ✓ In Portugal, in 2018, 5,1 million accommodations were cabled with a network of high speed
- ✓ The coverage of high speed was at least 81,2% in Portugal
- ✓ The North and Lisbon region are both the regions where the coverage rate is higher, 81% and 100% respectively
- ✓ In 2017, in Portuguese rural areas, 59% of households had fast broadband coverage (>= 30Mbps) (GPP, 2019)

Conclusions

Portugal characterization allowed to:

- ✓ **regions/area selection** where the surveys and WP3 field experiment will be conducted in Portugal
- ✓ propose guidelines for **survey development** as survey format, content and targeted farmers

Conclusions

Selected regions for survey interviews and to be indicated to WP 3

- ✓ Data collection - environment and territory, agri-environment measure and structural characteristics of agricultural holdings – allowed us to conclude where in Mainland Portugal survey interviews and on-farm experiments can be undertaken
  - **Alentejo region**, including Lezíria do Tejo

- ✓ Reasons to select Alentejo region
  - adverse observed climate and climate change projections
  - poor soils/low productivity soil
  - existence of users and no-users of CA technology
  - crop residues/livestock competition
  - tradition on tillage-based farming and on fallow
  - on-farm experiments already established by R&D Institutions
  - where should exist less experiments constraints
    - human resources and logistics
  - extensive dry farming systems associated to a low income
  - has the highest UAA

Conclusions

Selected regions for survey interviews and to be indicated to WP 3

✓ Reasons to select Alentejo region (continuation)

- lack of cover crops and of suitable rotations
- more educated, younger and full-time dedicated agricultural producers
- awareness about soil erosion
- use of no-tillage is difficult on certain crops (ex. rapeseed, tomato, garlic, potatoes, and industrial crops)
- lack of markets for products sale of CA practices
- where exists Conservation Agriculture know-how that promotes new adoptions
- 3 main agricultural fairs occur in Alentejo, that could be real-life examples to show farmers
  - AGROGLOBAL (Cartaxo); Feira Nacional da Agricultura (Santarém) and OVIBEJA (Beja)
- where are located Experimental Centres for annual crops – including INIAV – a CAMA partner

✓ WP 3 should confirm suggested region

Conclusions

Survey development

- ✓ Simplified format
- ✓ Well-structured
  - multiple choice questions
  - avoid open answers
  - including questions about qualitative obstacles for which there are not published data
- ✓ 30 minutes long maximum
- ✓ Online – filled in by the interviewer or by the farmer
  - Google forms
  - Word format
- ✓ 50 farmers and others
- ✓ Users and non-users of CA technology
- ✓ Dry and irrigated farming
- ✓ ICT users and innovative farmers
- ✓ Agricultural producers with an upper level of education

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MP: +351 963 819 652

www.facebook.com/APOSOLO

Annex 3 – Responsible persons for country/region characterization

Note: Please, after filled in this table send it to APOSOLO (aposolo.portugal@gmail.com)

	Partner	____
Responsible for collecting data	**Name**	
	Contact (e-mail)	
Responsible for doing country/region characterization	**Name**	
	Contact (e-mail)	

Note: Please, after filled in this table send it to APOSOLO (aposolo.portugal@gmail.com)

Annex 4 – Responsible persons for survey

Note: Please, after filled in this table send it to CREA (danilo.marandola@crea.gov.it)

	Partner	____
Responsible for translating the survey from English into local language	**Name**	
	Contact (e-mail)	
Responsible for conducting surveys/interviews	**Name**	
	Contact (e-mail)	

Note: Please, after filled in this table send it to CREA (danilo.marandola@crea.gov.it)

Annex 5 – Farmers and fields to be part of the network

Note: Please, after filled in this table send it to APOSOLO (aposolo.portugal@gmail.com)

	Partner	____
Farmer 1	**Name**	
	Contact (e-mail)	
	Field Location (geographical coordinates)	
	Cropping system and main crops	
	Rainfed or irrigated farming	
Farmer 2	**Name**	
	Contact (e-mail)	
	Field Location (geographical coordinates)	
	Cropping system and main crops	
	Rainfed or irrigated farming	
Farmer 3	**Name**	
	Contact (e-mail)	
	Field Location (geographical coordinates)	
	Cropping system and main crops	
	Rainfed or irrigated farming	
Farmer 4	**Name**	
	Contact (e-mail)	
	Field Location (geographical coordinates)	
	Cropping system and main crops	
	Rainfed or irrigated farming	

Note: Please, after filled in this table send it to APOSOLO (aposolo.portugal@gmail.com)