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MED-GOLD

Turning climate-related information into added value for traditional **MED**iterranean **G**rape, **OL**ive and **D**urum wheat food systems

Deliverable D4.1

Report on the identified specific needs and opportunities

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DOCUMENT STATUS SHEET

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Lead Beneficiary	HORT@ From research to field	
Contributors	Valentina Manstretta, Pierluigi Meriggi, Matteo Ruggeri (HORTA), Chiara Monotti(Barilla), Massimiliano Pasqui, Piero Toscano (CNR), Sandro Calmanti (ENEA), Andrea Toreti, Matteo Zampieri (JRC)	
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EXECUTIVE SUMMARY

Crop production, and the one of durum wheat in particular, is heavily affected by weather and climate, and therefore is highly vulnerable to climate change and variability.

This deliverable aims to identify the critical decisions and need of information of players along the durum wheat food chain, collected to design a tool able to address the current needs for this sector.

This document summarizes the information gathered by possible end users of the climate services to be developed in the Project, their needs and expectations from a climate services for the durum wheat sector. Two workshops were organised in Italy to investigate the specific needs in this sector: one with the Italian regional stakeholders, breeding, academic world and stocks exchange markets representatives; a second one with durum wheat farmers, producers' associations and elevators.

With this deliverable, the project has contributed to the achievement of the following objectives (DOA, PartB Table1.1):

No.	Objective	Yes
1	To co-design, co-develop, test, and assess the added value of proof-of-concept climate services for olive, grape, and durum wheat	X
2	To refine, validate, and upscale the three pilot services with the wider European and global user communities for olive, grape, and durum wheat	
3	To ensure replicability of MED-GOLD climate services in other crops/climates (e.g., coffee) and to establish links to policy making globally	
4	To implement a comprehensive communication and commercialization plan for MED-GOLD climate services to enhance market uptake	X
5	To build better informed and connected end-user communities for the global olive oil, wine, and pasta food systems and related policy making	X

1. INTRODUCTION

Durum wheat (*Triticum durum*) is mainly used in Europe for the production of pasta, couscous and bulgur. The global production of durum wheat is currently around 38 million tonnes (MT), the EU being the top producer, followed by Canada. As an average of the last 5 years, the European production of durum wheat was around 8.6 MT, mainly concentrated in the Mediterranean countries: Italy has produced around 50% of the total durum wheat European production, followed by France (20%), Greece (13%) and Spain (11%) [RD.1]. Several studies [RD.2; RD.3] highlighted the detrimental effect on cereals cropping of the projected higher temperatures and lower rainfall in the Mediterranean area, leading to i) heat stress in critical phenological phases; ii) increased plant water demand and decreased water availability; iii) shortened and anticipated growing period. Thus, for durum wheat a warmer and drier climate may lead to yield losses in the Mediterranean area ranging from −8% to −50%. However, these estimates do not take into account the CO_2 fertilisation effects that could partially counterbalance (in terms of yield) those effects. Negative effects on grain quality as well as higher risk of pest, diseases, and mycotoxin contamination have also to be taken into consideration, as it is of utmost importance for the pasta making processing.

1.1. PURPOSE

This document defines the needs and key decisions in the durum wheat sector; it describes and report the workshops held on 15th and 16th May 2018 at the HORTA S.r.l. premises in Ravenna (Italy), and reports the main outcomes.

The aim of the workshops was to investigate specific user's needs in the durum wheat sector, providing cornerstone information for the Work Package 4 (WP4) activities, trying to understand what influence prior knowledge of climatic conditions for the next months (seasonal predictions) or coming years (decadal predictions, climate projections) may have in decision-making inherent to the agricultural process and field management decisions.

During the first workshop, held on May 15th, an institutional meeting was organised, which involved 11 technical experts from Italian political institutions, breeding, academic world and stocks exchange markets. The aim of this first workshop was to ascertain the key operational and strategic decision-making processes that could potentially benefit from the use of climatic information.

During the second workshop, held on May 16th, an interactive session involved 15 participants divided into 3 focus groups. The participants included durum wheat farmers, producers' association and elevators coming from different Italian regions. The participants had been selected among the users of granoduro.net®, a DSS platform developed by Horta S.r.l. for the management and optimization of durum wheat production.

1.2. SCOPE

Climate directly affects the biologic cycles of crops; in the specific case of the durum wheat weather and climatic conditions affect crop management, yield and quality of grain, the development of crop diseases and pests. Climatic information (sub-seasonal, seasonal and decadal predictions) and climate projections could assist with the planning of the cropping season at its very beginning, in order to enable a better use of technical inputs, thus improving production in term of quality and quantity.

The production of durum wheat is very dependent on climate, and the influence of Climate Change on the crop has been highlighted [RD.2; RD.4; RD.5]. Italy is the leading region for durum wheat production in Europe, so that changes in the durum wheat production due to climate change can have a relevant impact in the area.

1.3. DEFINITIONS AND ACRONYMS

1.3.1. DEFINITIONS

Concepts and terms used in this document and needing a definition are included in the following table:

Table 1-1 Definitions

Concept / Term	Definition
Climate Service	Timely production and delivery (translation and transfer) in customized products (projections, forecasts, information, trends, economic analysis, assessments, etc.) of useful climate-related data, information and knowledge that support adaptation, mitigation and disaster risk management to decision makers
Weather predictions	Predictions up to 10 days in the future
Climate information	Predictions from 10 days up to years in the future, it includes Sub-seasonal predictions, Seasonal predictions, Decadal predictions and Climate projections
Sub-seasonal predictions	Predictions for the next few weeks
Seasonal predictions	Predictions for the next few months or seasons
Decadal predictions	Predictions for the next 10 years, from which information on the next 2-10 years can be extracted. These predictions are affected both by the initial state of the climate system (present-day) and by the near-term projected increase in greenhouse gas.
Climate projections	Information for the next 10-30 years or more. These projections are affected only by the near-term projected increase in greenhouse gas, whereas the initial-state (present-day) is not taken into account.
Decision Support System	A Decision Support System is an ICT platform collecting in real time information from the crop environment, organize and interpret the information relying on models and produce alarms and support to the decisions of the crop manager
Facilitator	A person of MED-GOLD who explains each step of the sessions, clarifies questions and manages the group
Presenter	A person of MED-GOLD who explains at the beginning and end of the workshops and Interactive Sessions
Rapporteur	A person of MED-GOLD who takes notes during the FG at the end of Interactive Session 1 and 2 and reports back the conclusions to the wider group
Time keeper	A person of MED-GOLD who is responsible for keeping the time during the workshop

1.3.2. ACRONYMS

Acronyms used in this document and needing a definition are included in the following table:

Table 1-2 Acronyms

Acronym	Definition
DSS	Decision Support System
FG	Focus Groups
MT	Million Tonnes
WP	Work Package

2. REFERENCES

2.1. REFERENCE DOCUMENTS

The following documents, although not part of this document, amplify or clarify its contents. Reference documents are those not applicable and referenced within this document. They are referenced in this document in the form [RD.x]:

Table 2-1 Reference Documents

Ref.	Title	Date
[RD.1]	EU Crops Market Observatory – Cereals http://agridata.ec.europa.eu/extensions/DashboardCereals/CerealsProduction.html	accessed 3rd october 2018
[RD.2]	Dettori, M., Cesaraccio, C., & Duce, P. (2017). Simulation of climate change impacts on production and phenology of durum wheat in Mediterranean environments using CERES-Wheat model. Field Crops Research, 206, 43-53.	2017
[RD.3]	Zampieri, M., Ceglar, A., Dentener, F., & Toreti, A. (2017). Wheat yield loss attributable to heat waves, drought and water excess at the global, national and subnational scales. Environmental Research Letters, 12(6), 064008.	2017
[RD.4]	Schleussner, C. F., Deryng, D., Müller, C., Elliott, J., Saeed, F., Folberth, C., ... & Seneviratne, S. I. (2018). Crop productivity changes in 1.5 C and 2 C worlds under climate sensitivity uncertainty. Environmental Research Letters, 13(6), 064007.	2018
[RD.5]	Asseng, S., Ewert, F., Martre, P., Rötter, R. P., Lobell, D. B., Cammarano, D., ... & Reynolds, M. P. (2015). Rising temperatures reduce global wheat production. Nature Climate Change, 5(2), 143.	2015

3. APPRAISING NEEDS AND CRITICAL DECISIONS

As a first step in the development of the climate service for the durum wheat sector, in order to recognize the current need in the sector, WP4 partners organized two participatory workshops where several actors in the durum wheat food chain participated. Participatory workshops are one of the most effective methods for gaining knowledge, where the attendees are the principal actors.

3.1. WORKSHOPS STRUCTURE

The workshops were held on the 15th and 16th May 2018 at the Horta S.r.l. premises in Ravenna, with the first one addressed to Institution representatives, and the second one focused on farmers and technicians. Italian WP4 partners (Barilla, CNR, ENEA, HORTA, JRC) also attended both the workshops, contributing to the smooth running of the activities. The workshop language was Italian, the native language of the invited people, so encouraging the free exchange of ideas. For this reason, non Italian partners of WP4 had difficulties in attending the workshops.

In the first workshop, on May 15th, 11 people participated, representing local political institutions, breeding companies, academic world and stocks exchange markets. The aim of this first workshop was to ascertain the key operational and strategic decision-making processes that could potentially benefit from the use of seasonal climate forecasts and long-term climate change projections.

In the second workshop, on May 16th, 15 participants joined the initiative, representing durum wheat farmers, producers' association and elevators technicians, coming from all over Italy. Participants were selected among the users of Horta's Decision Support System (DSS) granoduro.net®, for the management of durum wheat crop and that is presently used by Barilla suppliers. In order to account for the differences due to the geographic areas, participant were divided into 3 focus groups (FG), on the base of the Region they came from.

On both days, the aim and scope of the MED-GOLD project and of the workshop were presented to the participants, so to make them aware of the Project activities and to illustrate the expected contribution. All the interactions with participants were carried out following guidelines developed in Task 1.2 (D1.6). On the first day the workshop was carried out as a free discussion, facilitated by a questionnaire prepared by HORTA. Participants were asked to think and discuss on if and how the availability of climate information would benefit their activity; on the aspects of the durum wheat management and food chain that would likely be affected by the availability of long term weather forecasts/ climate projection; on the most interesting time scale for this kind of information.

On the second workshop, the participants were assigned to 3 FG according to the geographic region of provenance: North, Centre and South Italy. As participants coming from southern Italy were few, a mixed group was created, comprehending some participants from the Centre and those from the South. In the end the 3 groups were: North, Centre, Mixed (= Centre + South). The workshop was structured by UnivLeeds, in collaboration with the other WP4 partners, with several activities aimed at retrieving the information needed. UnivLeeds prepared the scheme of presentation, matrix and consent form used in the workshop. The workshop was run by a Presenter and a Timekeeper who controlled time consistency in the workshop. Initially, the aims and scope of the MED-GOLD project were presented, then people were divided in the focus groups. The workshop was then structured in three main interactive sessions carried out into the FG:

a) Current use of the DSS granoduro.net®

b) Identification of the key farming decision

c) Potential use of weather and climate information.

In each FG, 2 people from MED-GOLD partners acted as Facilitator and Rapporteur, helping in achieving smooth discussions of every FG and taking notes on discussion going on in the FG. At the end of each session discussion, the FG main findings were reported to the all the participants, highlighting possible differences in the various regions.

Answers given in writing by the participants, and the comments and summaries reported to all the participants by the Rapporteur of each FG were collated and summarized.

3.2. WORKSHOPS RESULTS

At the end of the workshops, documents filled out by the participants were collected by MED-GOLD partners, in order to be translated, collated and summarised to understand the needs of the durum wheat sector. For this task, a full account of the outcomes of the second workshop FGs was reported in a spreadsheets prepared by UnivLeeds in order to identify the most relevant information for WP4 activities.

3.2.1. FIRST WORKSHOP RESULTS

Participants to the first workshop showed an overall interest for weather forecast, mainly to allow intervention in the field for crop protection, and sub-seasonal (up to 3 months) climate predictions, useful to plan crop fertilisation, i.e. to save fertilizer in case on sub-optimal weather conditions, also to limit crop sensitivity to climatic stress and environmental pressure (nitrogen leaching).

Climate information for the next 2-5 years, which can be potentially derived from decadal climate predictions, were considered useful for planning the supply chain contracts.

Climate projections were considered useful for breeding/genetic improvement activities, policy development, monitoring new pathogens, pests and weeds, as well as monitoring and prevention of the introduction and spreading of invasive alien species. Aspects in the durum wheat sector most likely to benefit from climate information are summarise in Fig. 3.1.

The useful weather information is considered to be the variation of the range and the volatility of weather parameters, such as temperature and precipitation. Information on extreme weather phenomena, such as heat waves and drought would also be appreciated. Climatic projections can give indications on future cultivation areas of the world, including marginal areas, so to inform on production estimation for market and food security.

Sectors that would most benefit from climate information are considered to be genetic improvement which would benefit most from climate projections, and plant protection, which would benefit from both seasonal forecast (for field agro-management) and from climate projections (e.g. emerging risks of new pest and diseases as well as changes in the most incurring ones).

Legislation, Policy and CAP are also considered important sectors where climate projections could play a key role, for instance by allowing the development of tailored interventions on land and water resources as well as defining regional incentives on specific sectors/cultivations. Plant nutrition (especially regarding N) is another sector that could benefit from weather and climate predictions, e.g. allowing correct fertilisation planning. The food industry is influenced in terms of quantity and quality of productions and, therefore, in the definition of market prices. Mechanisation is recorded to be somehow another component that could benefit from climate predictions and projections in terms of development/use of best suited machinery and investments according to future soil humidity.

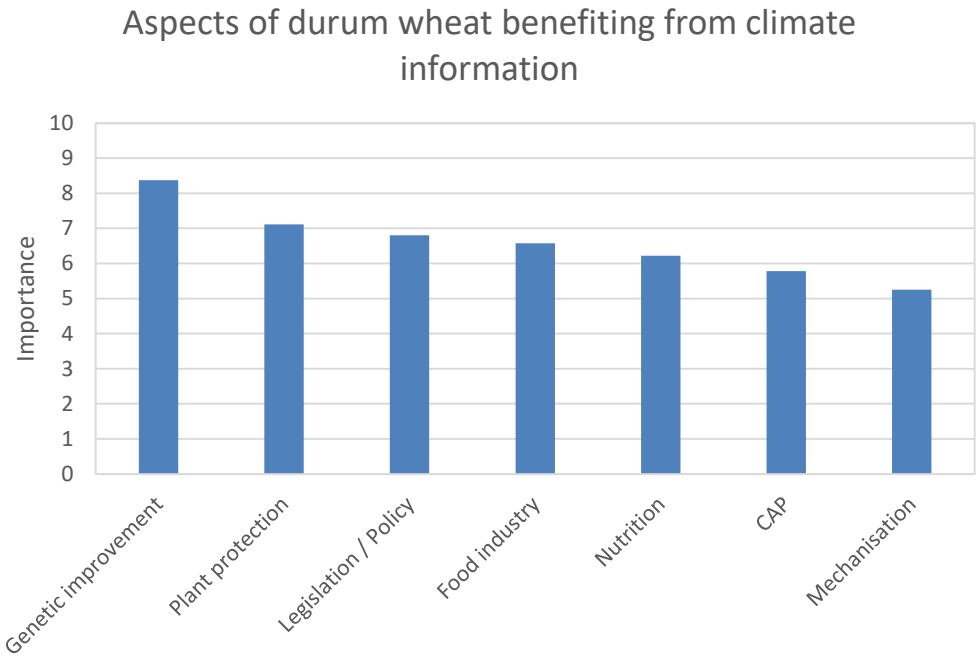

Figure 3-1 Chart ranking aspects of the durum wheat sector most likely benefiting from the availability of climate information according to the workshop's participants. Participants were asked to vote for each aspect on a scale from 1 to 10 (1 = not influenced; 10 = very influenced), votes were averaged.

3.2.2. SECOND WORKSHOP RESULTS

3.2.2.1. CURRENT USE OF GRANODURO.NET®

The main component of granoduro.net® proving advice to the users are: i) sowing advice, suggesting the seed dose and sowing time; ii) fertilisation advice, suggesting nutrients doses both before sowing and during the cropping season; iii) crop development during the season; iv) crop protection, providing alarms for the main durum wheat diseases and grain mycotoxin contamination; v) soil water balance. The DSS granoduro.net® is identified as a relevant source of information with some services used more than others for agronomic planning, checking personal decisions and learning about pests and diseases warnings during the growing season.

The most used tools in granoduro.net® are the ones on crop protection and fertilization. As for the former, the system helps identifying the critical phases of the infection risk and the most suitable treatment product. Concerning the latter one, the system suggests quantities of nutrients and timings of fertilisation. Another appreciated tool of granoduro.net® is the sowing advice. Crop phenology information was evaluated as the most critical tool, since it is extremely sensitive to small scale parameters and geomorphology factors (sun exposition, topography, soil temperature, etc). Water balance was generally identified as relevant, but in particular for forecasted estimates. The advice on weeds management is a less used tool.

3.2.2.2. IDENTIFICATION OF THE KEY FARMING DECISION

In general, the main decisions that are to be taken by the users are: preparation of the field, the choice of the variety, and the sowing timing (usually in October/November). Then, several actions have to be taken during the growing season, such as fertilization, crop protection treatments and weed control treatments. All these activities, including harvesting, are affected by climate and weather conditions (Fig. 3.2). For these activities, consultations and field evaluations are occurring with frequency of a month or less. Soil moisture is a primary variable of interest in all these phases for different reasons ranging from the field workability to the plant dynamics. All agro climatic variables affecting soil moisture are therefore important, such as precipitation, radiation, near surface temperature and wind speed. In case of fertilization and of the crop protection and weed control treatments, precipitation is

the most important factor. After harvesting, history of observed agro climatic variables during the growing seasons is analysed to estimate the quality of the final product for commercial purposes.

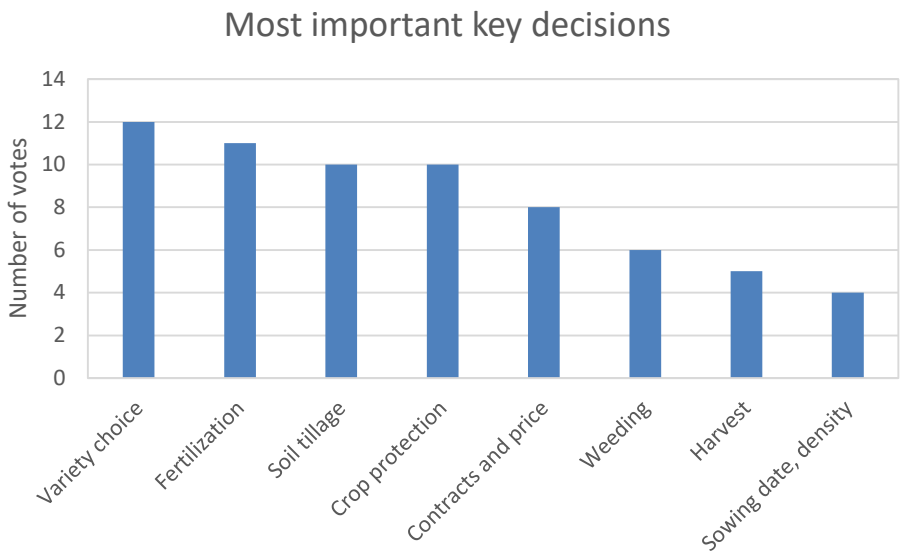

Figure 3-2 Chart showing key decisions for the durum wheat sector and the number of times the decision was cited from the participants.

3.2.2.3. POTENTIAL USE OF CLIMATE INFORMATION

A clear interest in several different time scales emerged from the meeting, as several decisions can be influenced by the availability of climate predictions and projections.

Improved climate services are expected to facilitate the decision connected to all activities during the vegetative phase, especially fertilization and weed/diseases treatments.

Seasonal forecast information would be relevant in the agro-management planning from October to July mainly for fertilisation and variety/density selection at sowing to minimize the exposure to weather extremes and maximize both the yield and the protein content, the use of fertilizers (e.g. nitrogen) and the harvesting time. Sub-seasonal information would also be of interest, mainly at the monthly time scale, for pests/disease and weed management in supporting decisions, as well as water balance, even with a wind impact estimate. Soil moisture variability has received large attention. Predictions needs are mostly in terms of humidity, temperature and precipitation, soil water balance and wind.

Decadal predictions and climate projections are not directly of interest for granoduro.net® users, but are recognized as potentially important for breeding and seeds producers, and they can have an impact on strategic policies (from CAP to regional ones). This kind of information can however play a relevant role in supporting planning decisions which require several years to be implemented, such as decisions in terms of equipment purchase (irrigation plants), emergence of new pests/diseases, use of new varieties.

Interest was raised for global forecasts, identifying areas at risk in the major world producing regions, as this could affect commodity prices, which are the main drivers of the market.

Table 3-1 Months of the year in which each key decision is taken

Critical key decision	Most important months											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Variety choice												
Sowing date, density												
Soil tillage												
Fertilization												
Weeding												
Crop protection												
Harvest												
Contracts and price												

Table 3-2 Weather variables affecting each of the key decisions

Critical key decision	Most important months	Most important weather variables
Variety choice	from September to November	Temperature, Rain, Soil moisture
Sowing date, density	from September to November	Temperature, Rain, Soil moisture
Soil tillage	from August to October	Temperature, Rain, Soil moisture, Wind
Fertilization	October-Novembre and from January to April	Temperature, Rain, Soil moisture, Wind
Weeding	February-March	Temperature, Rain, Wind
Crop protection	from February to May	Temperature, Rain, Soil moisture, Wind, Solar radiation
Harvest	June-July	Temperature, Rain
Contracts and price	from June to October	Temperature, Rain

4. CONCLUSIONS

During the workshops, the MED-GOLD partners had the opportunity to assess the needs of climate information by different actors in the durum wheat sector. The document provides a description of the workshops conducted, the methodology followed and the main results obtained in terms of the needs for climate information and critical decisions of users from this sector, which are summarized in Figure 3-3.

The outcome of the workshops is the main achievement of task 4.1 'Appraising needs and critical decisions for the specific case' and constitutes a first step for the design of the pilot service that will be developed in MED-GOLD for the durum wheat sector. Information needs identified in Task 4.1 will be the base to set the scene for the work in task 4.2 'Developing the tool'.

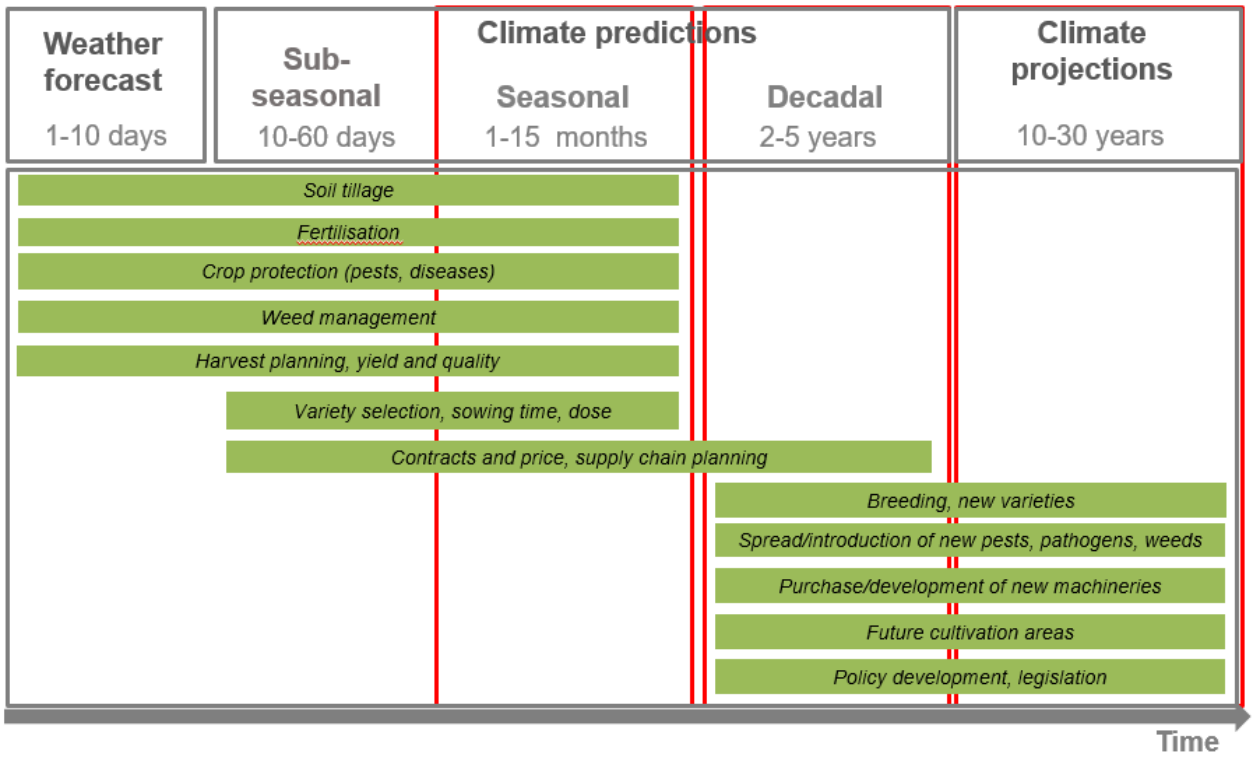

Figure 3-3 Chart illustrating participants needs in terms of weather and climatic information for the durum wheat sector.

ANNEX A. PICTURES FROM THE WORKSHOPS

Figure A-1 Participants and MED-GOLD partners attending the 16th May workshop at Horta s.r.l. premises in Ravenna (Italy)

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