D2.2 Data requirements manual

WP2: Earth observation data products and services

Carlo De Michele, Stelios Kotsopoulos

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Lead Author	Carlo De Michele	**Email**	carlo.demichele@ariespace.com	
	ARIESPACE	**Phone**	0039 081 195 64 282	
Other authors	Stelios Kotsopoulos (AgroApps)			
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Executive summary

The data products and services offered by DIANA will be based on a combination between EO data provided by various satellites as well as meteorological and complementary data derived from different data sources, especially from pilot areas.

The purpose of this document is to describe the data requirements needed for implementation of all methodologies and algorithms, as defined in deliverable D2.1.

For each DIANA service -i) Non-authorized water abstraction detection and monitoring; ii) Seasonal drought forecasting and monitoring; iii) Supporting the implementation and monitoring of the WFD - the data types and specifications required for their implementation have been addressed.

From methodological point of view, data requirements listed in this document have been defined considering *"Users' and stakeholders' requirements analysis"* provided in the deliverable D1.1. This approach ensures to meet the realities in which to apply DIANA services addressing properly the users' requirements in terms of spatial, temporal and spectral resolution and by extending the operational capabilities of the platform offered.

It is worth to note that to meet the needs of final user in each specific context, an adaptation of algorithms could be necessary and consequently changes in data requirements will arise during the running of services in each pilot areas.

Bearing this in mind, the information contained in this document will represent an easy reference guide to adapt the data collecting to each different context.

1 Data requirement for Non-authorized water abstraction detection and monitoring

The monitoring of irrigated areas and water consumptions and abstractions will be performed based on dense time series of EO images acquired during the entire growing season from a multi-sensor constellation of satellites, coupled with meteorological and *in situ* data, which meet the needs of our users in terms of spatial, temporal and spectral resolution. The list of the auxiliary data comprises meteorological data and forecasts, *in situ* information of main crops phenology and development, historical and actual water consumption as well as existing land use/land cover maps. The data requirements are listed in the Table 1.

Datasets are labelled accordingly to the implementation phase:

1) Operation: datasets needed for the ordinary operation of the service
2) Calibration: data required during the first irrigation season for local calibration to improuve the accuracy
3) Validation: data required during the first irrigation season for the accuracy assessment

Table 1: Overview of local data requirements, source of data and availability.

Implem. phase	Datasets	Details	Data availability and Source
1	Satellite images	Time series of high resolution imagery covering the entire crop growing season, and more specifically bi-weekly EO images from a high-resolution (HR) Virtual Constellation (multi-sensor time series at 10-30m resolution).	Landsat8 (multispectral, 30m resolution, global cover every 16 dd); Minimum mapping area 1 ha. Source: https://espa.cr.usgs.gov/ Sentinel-2 satellites, launched in 2014 (2A) and 2016 (2B). (multispectral, global cover every 5 dd with both satellites). Minimum mapping area 0.1ha. Source: https://scihub.copernicus.eu/ In areas where smaller spatial scales prevail, RapidEye (5m by 5m) provides a high-quality reliable solution. Source: http://eyefind.rapideye.com/
1	Meteorological data	Daily agro-meteorological data and rainfall data for the calculation of crop water consumption.	• (Agro)meteorological station networks – Generally available in each MS.

			Source: connection with local authorities (e.g.: http://cma.entecra.it/dati.htm). • Alternative options: WMO or collaboration with Agri4cast (MARS-JRC) who use those same data to drive their products (yield forecast). Source: https://www.ecmwf.int/en/forecasts/datasets/reanalysis-datasets/era-interim PROBA satellite (rainfall maps). Available in all MS.
2	Soil maps of water retention capacity		• National databases. • European products, however with limited accuracy, currently available in some MS and some areas. Source: Italy: http://www.soilmaps.it/ita/cartadeisuoli1.html World:http://www.fao.org/soils-portal/soil-survey/soil-maps-and-databases/harmonized-world-soil-database-v12/it/
2	*In-situ* Information for main crops phenology and development	Historical data, consortium archives and knowledge.	• FAO database can be used as basic reference; • National databases, currently available in some MS and some areas. • Allen, Richard G. et al. "Crop evapotranspiration-Guidelines for computing crop water requirements-FAO Irrigation and drainage paper 56." FAO, Rome 300.9 (1998): D05109. • Steduto, Pasquale et al. Crop yield response to water. Rome: FAO, 2012.
2	Detailed information about selected test farm	Data collected during field inspections according to the deployed form.	Field inspections, potentially available for each pilot.
2	Existing land use/land cover maps *(optional)*		CORINE Land Cover and the 5 new Copernicus High Resolution Layers. LPIS (for parcel delineation). Available in all MS for 2006. Currently being produced for 2012

			data (updated every 6 years for Corine LC and every 3 years for the 5 HRL). Not yet accessible in all countries.
2	Vectorial layers to define irrigable area boundaries	Irrigable areas boundaries.	Water User Association archives. Available in some MS.
3	Abstraction monitoring data (actual water consumption)	Flow meter data in selected locations for calibration and continuous ground truthing of crop water consumption.	Monitoring networks. Available in some MS, for pressurized systems. Not available for gravity irrigation systems.
3	Historical water consumption	Historical data	Monitoring network and consortium archives. Available in some MS, for pressurized systems. Not available for gravity irrigation systems.
3	Water rights map	List and map of cadastral parcels with regular irrigation right.	Water User Association archives. Available in some MS.
3	Cadastral maps	Comprehensive register of the real estate or real property's metes-and-bounds of a country.	National government entities or agency. Available in all MS.

Below, the explanation of data requirements listed in the table 1.

Satellite images

Reference Earth Observation (EO) data are based on two Sentinel-2 satellites, launched in 2014 (2A) and 2016 (2B). Compared to previous satellites, Sentinel-2 increased spatial, temporal and radiometric resolutions. They are able to "see" spatial scales from 0.1ha and temporal is important to build dense time series imagery covering the entire crop growing season. They can be downloaded in real time from the official portal (https://scihub.copernicus.eu/) and then processed to derive indices and parameters to produce NDVI and evapotranspiration maps.

Minimum requirements for satellite images:

- Spatial resolutions: 10m by 10m, even if 30m by 30m is acceptable.
- Temporal resolutions: 10 dd (minimum 2 coverages per month).
- Radiometric resolutions: RED, NIR and SWIR (to calculate vegetation indices: NDVI, LAI and other indices). All bands are needed to calculate albedo for Penman Monteith equation.

Meteorological data

Daily meteorological data are need to resolve Penman Monteith equation, according to FAO 56 paper. Meteorological data must be provided spatialized, according to a regular mesh, or led back to a spatialized raster. Minimum admissible (allowable) spatial

resolution is more or less 12 Km. Anyway, spatial resolution must be compatible with meteorological variability of pilot.

Daily meteorological data:

- Average minimum and maximum temperature at 2 m [°C].
- Wind speed at 10 m [m/s].
- Relative humidity [%].
- Total incident solar radiation [W/m2].
- Atmospheric pressure on the ground [Pa].
- Total rain [mm/d].
- Temperature on the ground [°C].

Soil maps of water retention capacity

This type of map is important to set the boundary conditions in water balance models: ground water table. Generally, these maps are produced by geo-hydrological studies at the basin scale. Minimum acceptable spatial scale is 1: 10000 or better, taking into account the average size of the plots.

Information for main crops phenology and development

For each pilot, "a-priori" knowledge of main crop types and rotation must be acquired. This data need to lead the classification process, providing phenological and management information of main crops cultivated in the test area. At district scale crop information are needed to analyze temporal patterns of vegetation indices in order to recognize the crops' phenology in unsupervised pre-classification step. Detailed information on management of main crops (sowing and harvesting period, cycle time, etc.) should be acquired to help the interpretation of different phenological patterns class. Inspired by FAO database, the table below have been processed to collect knowledge about pilot. Each pilot will complete table with different level of details, according with owned information. According with specific pilot organization, also other kind of information would be useful, e.g. other class would be defined as *"spring crops" or "summer crops", irrigated or non-irrigated crop*. The complete tables are shown in the technical annex.

Table 2: Example of table of main crops to be completed at district scale.

HERBACEOUS CROP	ESTIMATION OF CULTIVATED HECTARES	Note
☐ **Alfalfa**		
☐ **Aubergine (eggplant)**		
☐ **Barley**		
☐ **Burley Tobacco**		

☐ **Corn**		
☐ **…. And so on**		

Table 3: Example of table of main crops management to be completed at district scale.

Herbaceous crops								
☐ **Watermelon**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Row distance (m)	Irrigation (period and irrigation system)	
☐ **Alfalfa**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Number of mowings	Irrigation (period and irrigation system)	
☐ **Strawberry**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Row distance (m)	Structures for Protection	Possible period for removal of protection	Irrigation
	☐Camarosa ☐Candonga ☐Tethis ☐Sabrina								

Tree crops						
CROP	CROP VARIETY	Tree spacing (m x m)	PREVALING (MAIN) AGE	PRUNING PERIOD	GRASSING	IRRIGATION (PERIOD AND IRRIGATION SYSTEM)
☐ **Kiwi**			☐ New plant ☐ Old ☐ Medium			
☐ **Citrus**			☐ New plant ☐ Old ☐ Medium			
☐ **Apricot**			☐ New plant ☐ Old ☐ Medium			

Detailed information on selected test farm

Testing farms must be identified within the boundary of each pilot. Testing farms should be selected based on the quality and quantity of available data, including irrigation consumption records. In these selected testing farms, data must be collected with field inspections, also repeated during the same irrigation season, differentiating for different types of crops. Data collected at farm scale are used in the supervised classification process: they are involved both as truth on the ground and to evaluate accuracy of final products. The complete tables are included in the technical annex.

Table 4: Tables to be filled with crop details in selected farms (Herbaceous and Tree crops).

Herbaceous crops						
Date _____ Crop Type _____ Field ID _____	GPS coordinates and Altitude	Hectares	Cycle Time	Crop Change	Sowing/Planting Date	Harvesting Date (forecast)
	Row distance (m)	Structures for Protection	Period for removal of protection	Irrigation (period and irrigation system)	Irrigation provided (Woltmann meter/ Card Log)	Number of harvests during the irrigation season.
					_____ m^3 ☐ Inspected field ☐ Multi-fields	
	Note					

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Tree crops						
Date _____ Crop Type _____ Field ID _____	GPS coordinates and Altitude	Hectares	Harvest Date (forecast)	Tree spacing (m x m)	Structures for Protection	Period for removal of protection
	Irrigation (period and irrigation system)	Irrigation provided (Woltmann meter/ Card Log)	Age	Pruning period	Grassing between rows	
		_____ m^3 ☐ Inspected field ☐ Multi-fields				
	Note					

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Water Abstraction data (actual water consumption)

Actual water consumption should be collected for testing farms or testing sub-district. For each test farm, water consumption must be known at least with monthly frequency. A water meter must be located at the beginning of each partition district of pilot and the subtended area by the meter must be well defined. Volumes measured by water meter must be known at least monthly. Also irrigation system efficiency is an important information to be acquired, in order to correctly calculate the irrigation water requirement and water consumption. So for every partition district, also average irrigation system efficiency must be indicated, according to the distribution system.

Moreover, even if over-use in water-stressed crops wants to be estimated, among the satellite data also Thermal Infrared (TIR) becomes important to be acquired.

Historical water consumption

Historical water consumption is just as important because they indicate the truthfulness of current consumption and they reveal reasons for variation. So, as for current consumption, for previous irrigation seasons, water consumption of test farms and of partition district must be known.

Existing land use/land cover maps (optional)

Land cover or land use maps (generally based on Satellite classifications) identify areas exhibiting different surface cover or type to well-characterized classes (e.g. water, bare rock, forest, agriculture, urban). This type of maps helps to exclude not agricultural areas and to limit the study to agriculture areas, inside the pilot.

Vectorial layers to define irrigable area boundaries

These geo-data provide the extent of irrigable area, and in such cases the areas equipped with flowmeters.

Water rights map

After performing classification and identifying irrigated and non-irrigated areas, this map must be intersected with parcels boundary with regular irrigation rights. For each pilot must be acquired a vector layer (or list of parcels) of plots with regular irrigation concession. For each farm, cadastral references, extension of irrigated area, irrigation period, permitted crops and water volume, will be indicated. Based on these data not compliant over abstraction will be detected.

Cadastral maps

For each pilot, updated and comprehensive register of the plots property must be acquired in vector format. Cadastral vector layer is used to unequivocally identify irrigating particles without authorization.

2 Data requirement for drought monitoring and seasonal drought forecasting

The drought monitoring and seasonal forecasting system is using various meteorological (observational and forecast data) to drive either vLAPS data assimilation system or WRF-Hydro model, and complementary data for the definition of the characteristics of the simulation domains of the models. Besides the data products described below, the system is also flexible enough to incorporate other sources of data including output from other models and remote sensing. The required data that are used by the system are described in Table 5:

Table 5: Overview of data requirements, source of data and availability for the drought monitoring and seasonal drought forecasting system.

Datasets	Details	Sources	Data availability
Satellite images	Time series of high or medium resolution imagery in daily and bi-weekly temporal resolution.	Satellite imagery databases and service providers.	These can be acquired with satellites like Landsat8, Sentinel-2 and MODIS Terra.
Meteorological observations and reanalysis data	Hourly data for the data assimilation system and reanalysis data for the hydrologic reconstruction of soil moisture time series.	WMO station network and MERRA reanalysis data.	https://madis.ncep.noaa.gov/ https://climate.copernicus.eu/climate-data-store and NASA web api.
Weather and Climate Forecasts	Short range weather forecast to be used as background forecast for the data assimilation system. Seasonal	NCEP-National Weather Service NCEP-Climate Prediction Center.	GFS (ftp://ftpprd.ncep.noaa.gov/pub/data/nccf/com/gfs/) CFS (ftp://ftpprd.ncep.noaa.gov/pub/data/nccf/com/cfs/)

	climate forecasts for seasonal drought forecasting.		
Maps of soil physical properties	Maps of the soil mechanical analysis and hydraulic properties.	Soil Grids-International Soil Database.	International Soil Database (https://www.soilgrids.org).
Topography data	Digital Elevation Data for the WRF-Hydro model.	EU-DEM	Available for all MS at 30m spatial resolution.
Existing land use/land cover maps		CORINE Land Cover and the 5 new Copernicus High Resolution Layers.	Available for all MS for 2012.

Below, the datasets of Meteorological Observations and Reanalysis Data, and the datasets of Weather and Climate Forecasts are described in detail. All the other datasets of Table 5 was described previously in this document and there is no need to be described again.

Meteorological Observations and Reanalysis Data

The required meterological observations are provided by the MADIS System. The Meteorological Assimilation Data Ingest System (MADIS) is a meteorological database and data delivery system that provides atmospheric observations covering the globe. The observations are derived from multiple official and unofficial sources, including metar messages from surface weather stations, radiances and atmospheric profiles from satellites, airborne observations, station radiosondes and ocean meteorological parameters from ships and buoys. The dataset concerning the meteorological information from surface weather stations is free to use both for commercial and noncommercial purpose, and they are delivered in CF compliant netcdf files.

The required reanalysis data that are used to reconstruct the historical hydrological status of the pilot areas are provided by NASA (Global Modelling and Assimilation Office) and refers to the MERRA Reanalysis Dataset. Modern Era Retrospective Analysis for Research and Applications (MERRA) is a global reanalysis dataset containing atmospheric and hydrological fields produced by the Godard Earth Observing System (GEOS) atmospheric model and data assimilation system (DAS). MERRA dataset focus on the satellite era from 1979 to present and covers the globe with

an approximately resolution of 60km. The dataset is free to use both for commercial and non-commercial purposes, and it is delivered in CF compliant netcdf files.

Weather and Climate Forecasts

The Drought Monitoring and Drought Seasonal Forecasting System is using weather forecasts produced by the global forecasting model GFS. The GFS forecasts is a global atmospheric dataset containing atmospheric information (analysis and forecast fields) produced by the global numerical weather prediction system GFS. GFS model runs operationally 4 times per day under the administration of National Center of Environmental Predictions (NCEP)/ National Oceanic and Atmospheric Administration and produces forecasts for 16 days ahead. GFS dataset covers the globe with a spatial resolution of 27Km for the first 8 days and with a spatial resolution of 75Km for the last 8 days. NCEP/NOAA provides the data free of charge for commercial and noncommercial use in GRIB2 format.

Regarding the climate forecasts, the system is using forecasts produced by the Climate Prediction Center of NCEP (CFS). The Climate Forecast System (CFS) data is a global seasonal forecasting dataset containing atmospheric and oceanic forecast fields produced by the global numerical climate model CFSv2. The CFSv2 is a climate model representing the global seasonal interaction between Earth's oceans, land and atmosphere, and incorporates all the latest scientific advancements in data assimilation and climate simulation methodologies. CFS model runs operationally 4 time per day under the administration of NCEP/Climate Prediction Center producing seasonal forecasts for the next 9 months. CFS dataset covers the globe with an approximately spatial resolution of 56Km and is available free of charge for commercial and noncommercial use through NCEP in GRIB2 format.

3 Data requirement for the Support for the implementation and monitoring of the WFD

The Support for the implementation and monitoring of the WFD is a service based on the reuse of data produced by the other two DIANA services and they are described previously.

References

- Allen, Richard G. et al. "Crop evapotranspiration-Guidelines for computing crop water requirements-FAO Irrigation and drainage paper 56." FAO, Rome 300.9 (1998): D05109.
- Steduto, Pasquale et al. Crop yield response to water. Rome: FAO, 2012.
- Satellites image
  - Landsat8 - https://espa.cr.usgs.gov/
  - Sentinel-2 - https://scihub.copernicus.eu/
  - RapidEye - http://eyefind.rapideye.com/
- Meteorological data
  - (Agro)meteorological station networks – connection with local authorities (e.g. for Italy: http://cma.entecra.it/dati.htm)
  - reanalysis data - https://www.ecmwf.int/en/forecasts/datasets/reanalysis-datasets/era-interim
- Soil maps of water retention capacity
  - Italy - http://www.soilmaps.it/ita/cartadeisuoli1.html
  - World - http://www.fao.org/soils-portal/soil-survey/soil-maps-and-databases/harmonized-world-soil-database-v12/it/
- Meteorological observations and reanalysis data
  - https://madis.ncep.noaa.gov/
  - https://climate.copernicus.eu/climate-data-store
- Weather and Climate Forecasts
  - GFS - ftp://ftpprd.ncep.noaa.gov/pub/data/nccf/com/gfs/
  - CFS - ftp://ftpprd.ncep.noaa.gov/pub/data/nccf/com/cfs/
- Maps of soil physical properties
  - https://www.soilgrids.org

Acronyms

EO: Earth Observation

HR: high resolution

NDVI: Normalized Difference Vegetation Index

LAI: Leaf area index

RED: Reflectance in visible red band

NIR: Near Infrared Reflectance

SWIR: Short-wavelength infrared

TIR: Thermal Infrared

MS: European Member State

ECMWF: European Centre for Medium-Range Weather Forecasts GFS: Global forecast system Model

CFS: climate Forecasting System

WRF: Weather Research and Forecasting model

4 Annexes

4.1 Crop summary - consortium scale

Table 5: herbaceous crop summary.

HERBACEOUS CROP	ESTIMATION OF CULTIVATED HECTARES	Note
☐ Alfalfa		
☐ Aubergine (eggplant)		
☐ Barley		
☐ Burley Tobacco		
☐ Corn		
☐ Fresh-cut vegetables		
☐ Kentucky Tobacco		
☐ Lettuce		
☐ Melon		
☐ Parsley		
☐ Pea		
☐ Pepper		
☐ Potato		
☐ Pumpkin		
☐ Sulla		
☐ Spinach		
☐ Strawberry		
☐ Sunflower		
☐ Tomato for canteen		
☐ Tomato for industry		
☐ Watermelon		
☐ Zucchini		

Table 6: trees crop summary

TREE CROP	ESTIMATION OF CULTIVATED HECTARES	Note
☐ **Apple**		
☐ **Apricot**		
☐ **Cherry**		
☐ **Chestnut**		
☐ **Citrus**		
☐ **Fig**		
☐ **Hazelnut**		
☐ **Kaki**		
☐ **Kiwi**		
☐ **Medlar**		
☐ **Olive**		
☐ **Peach**		
☐ **Pear**		
☐ **Plum**		
☐ **Vineyard**		
☐ **Walnut**		

4.2 Crop summary - consortium scale

Table 7: herbaceous crop details.

Herbaceous crops								
☐ **Watermelon**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Row distance (m)	Irrigation (period and irrigation system)	
☐ **Alfalfa**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Number of mowings	Irrigation (period and irrigation system)	
☐ **Strawberry**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Row distance (m)	Structures for Protection	Possible period for removal of protection	Irrigation (period and irrigation system)
	☐Camarosa ☐Candonga ☐Tethis ☐Sabrina								

☐ **Sunflower**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Irrigation (period and irrigation system)

☐ **Lettuce**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Row distance (m)	Structures for Protection	Possible period for removal of protection	Irrigation (period and irrigation system)

☐ **Corn**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Irrigation (period and irrigation system)
	☐ Corn grain ☐ Silomais ☐ Granturchino	☐ Early 76-105 ☐ Medium 105-120 ☐ Tardive 121-160		For Early Corn _____ For Medium Corn _____ For Tardive Corn _____	For Early Corn _____ For Medium Corn _____ For Tardive Corn _____	

☐ **Aubergine (eggplant)**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Row distance (m)	Structures for Protection	Possible period for removal of protection	Irrigation (period and irrigation system)

☐ **Melon**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Row distance (m)	Irrigation (period and irrigation system)

☐ **Fresh-cut vegetables**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Row distance (m)	Structures for Protection	Possible period for removal of protection	Irrigation (period and irrigation system)

☐ **Barley**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Irrigation (period and irrigation system)
	☐ Barley to unload ☐ fodder barley ☐ grain barley	☐ Early ☐ Medium ☐ Tardive		For Early Barley _____ For Medium Barley _____ For Tardive Barley _____	For Early Barley _____ For Medium Barley _____ For Tardive Barley _____	
☐ **Potato**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Irrigation (period and irrigation system)
	☐ Early ☐ second Harvesting ☐Common	For Early Potato _____ For Medium Potato _____ For Tardive Potato _____		For Early Potato _____ For Medium Potato _____ For Tardive Potato _____	For Early Potato _____ For Medium Potato _____ For Tardive Potato _____	

☐ **Pepper**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Row distance (m)	Structures for Protection	Possible period for removal of protection	Irrigation (period and irrigation system)

☐ **Pea**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Row distance (m)	Structures for Protection	Possible period for removal of protection	Irrigation (period and irrigation system)
☐ **Tomato for industry**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Row distance (m)	Structures for Protection	Possible period for removal of protection	Irrigation (period and irrigation system)
☐ **Tomato for canteen**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Row distance (m)	Structures for Protection	Possible period for removal of protection	Irrigation (period and irrigation system)

☐ **Parsley**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Row distance (m)	Structures for Protection	Possible period for removal of protection	Irrigation (period and irrigation system)
☐ **Spinach**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Row distance (m)	Structures for Protection	Possible period for removal of protection	Irrigation (period and irrigation system)

☐ **Sulla**	Crop Variety	Cycle Time	Sowing/ Planting Period	Harvesting Period	Irrigation (period and irrigation system)

☐ **Burley Tobacco**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Row distance (m)	Irrigation (period and irrigation system)

☐ **Kentucky Tobacco**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Row distance (m)	Irrigation (period and irrigation system)
☐ **Pumpkin**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Row distance (m)	Irrigation (period and irrigation system)

☐ **Zucchini**	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Row distance (m)	Structures for Protection	Possible period for removal of protection	Irrigation (period and irrigation system)
☐ _____	Crop Variety	Cycle Time	Crop Change	Sowing/ Planting Period	Harvesting Period	Row distance (m)	Structures for Protection	Possible period for removal of protection	Irrigation (period and irrigation system)

Table 8: tree crop details.

Tree crops						
CROP	CROP VARIETY	Tree spacing (m x m)	PREVALING (MAIN) AGE	PRUNING PERIOD	GRASSING	IRRIGATION (PERIOD AND IRRIGATION SYSTEM)
☐ **Kiwi**			☐ New plant ☐ Old ☐ Medium			
☐ **Citrus**			☐ New plant ☐ Old ☐ Medium			
☐ **Apricot**			☐ New plant ☐ Old ☐ Medium			
☐ **Chestnut**			☐ New plant ☐ Old ☐ Medium			
☐ **Cherry**			☐ New plant ☐ Old ☐ Medium			
☐ **Fig**			☐ New plant ☐ Old ☐ Medium			
☐ **Kaki**			☐ New plant ☐ Old			

			☐ Medium			
☐ **Apple**			☐ New plant ☐ Old ☐ Medium			
☐ **Medlar**			☐ New plant ☐ Old ☐ Medium			
☐ **Hazelnut**			☐ New plant ☐ Old ☐ Medium			
☐ **Walnut**			☐ New plant ☐ Old ☐ Medium			
☐ **Olive**			☐ New plant ☐ Old ☐ Medium			
☐ **Pear**			☐ New plant ☐ Old ☐ Medium			
☐ **Peach**			☐ New plant ☐ Old ☐ Medium			
☐ **Plum**			☐ New plant ☐ Old			

			☐ Medium			
☐ **Vineyard**			☐ New plant ☐ Old ☐ Medium			
☐ _____			☐ New plant ☐ Old ☐ Medium			
☐ _____			☐ New plant ☐ Old ☐ Medium			
☐ _____			☐ New plant ☐ Old ☐ Medium			
☐ _____			☐ New plant ☐ Old ☐ Medium			

4.3 Field inspection schedule

Table 9: herbaceous crop - Field inspection schedule.

<table>
<tr><th colspan="7">Herbaceous crops</th></tr>
<tr><td rowspan="6">Date

_____

Crop Type

_____

Field ID

_____</td><td>GPS coordinates and Altitude</td><td>Hectares</td><td>Cycle Time</td><td>Crop Change</td><td>Sowing/Planting Date</td><td>Harvesting Date (forecast)</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Row distance (m)</td><td>Structures for Protection</td><td>Period for removal of protection</td><td>Irrigation (period and irrigation system)</td><td>Irrigation provided (Woltmann meter/ Card Log)</td><td>Number of harvests during the irrigation season.</td></tr>
<tr><td></td><td></td><td></td><td></td><td>_____m^3
☐ Inspected field
☐ Multi-fields</td><td></td></tr>
<tr><td colspan="6">Note</td></tr>
<tr><td colspan="6"></td></tr>
</table>

Table 10: tree crop - Field inspection Schedule.

Tree crops						
Date _____ Crop Type _____ Field ID _____	GPS coordinates and Altitude	Hectares	Harvest Date (forecast)	Tree spacing (m x m)	Structures for Protection	Period for removal of protection
	Irrigation (period and irrigation system)	Irrigation provided (Woltmann meter/ Card Log)	Age	Pruning period	Grassing between rows	
		_____m^3 ☐ Inspected field ☐ Multi-fields				
	Note					