LIFE16 CCA/IT/000011

Preparing desertification areas for increasing climate change

General Guidelines

Version 1.0 March, 2022

Contents

SCOPE

WHY TO IMPLEMENT A DESERTIFICATION ADAPTATION MODEL OF LAND MANAGEMENT

The **Desertification Adaptation Model (*DAM*)** framework of land management has been designed to respond to two of the most critical problems experienced by farmers, public lands and communities of the Mediterranean Basin, the *need to adapt to current Climate Change* and the *need to reduce and counteracts* the increasing phenomenon of *land degradation and desertification risk*.

These two issues are inter-related, as land degradation often characterizes fragile areas where the co-occurrence of climatic unfavourable conditions, mostly prolonged aridity and high temperatures, and un-appropriate land management leads to loss of ecosystem quality, biodiversity, productivity, soil erosion, which are at the base of land abandonment, economic impoverishment and social crisis.

To achieve successful long-term self-sufficiency, use of the land in areas under climatic and degradation risk we need to put in place land management sustainable and adaptation strategies to protect and enhance the quality of the land.

These GENERAL GUIDELINES present in brief key concepts useful to implement a **Desertification Adaptation Model (*DAM*)** with the help of the REPLICATION MANUAL. Both documents are part of the Desert-Adapt **Replication toolkit.**

THE 3 PILLARS OF SUSTAINABLE LAND MANAGMENT

When the landowners create their land management plan, they should always consider the importance of the environmental, economic and social impact of the plan.

The Economic pillar: long term land protection needs to be economically profitable to be self-sustainable. The most appropriate areas of a land property could be assigned to agro-production (ex. nut production) and eco-services (ex. bird watching or trekking) that provide economic income. Ideally, we should aim at diversifying income sources (as many as possible), at choosing agro-production which are best adapted to the local climate and we should avoid intensive agriculture practices.

The Environmental pillar: the DAM land management plan should look like a mosaic, where crops or productive lands are alternated to more natural areas, where ecosystem quality and biodiversity are restored and nurtured to provide key ecosystem services for the whole area (wildlife corridors, niches for pollinators, niches for natural enemies of pests, seed banks). The mosaic, in combination with sustainable agriculture practices in productive areas, aims at increasing the overall quality of the whole land, increasing its value over time.

The Social pillar: the land management plan should be inclusive for the local population, good actions should be communicated and, especially in municipalities, citizens should be involved into land protection and land use activities so to provide a feeling of collective efficacy and common responsibility.

The harmonization of the three pillars, wherever is possible might lead to higher probability of long term success.

The lack of sufficient economic profits (little or no development of the economic part of a land management plan) might not allow long term support of sustainable management measures without external funding.

The lack of sufficient environmental protection due to an almost exclusive focus on economic profitability (intensive exploitation of land) might lead to long term environmental degradation which will reduce land value and productivity leading to irreversible quality loss and desertification.

The lack of integration in the local social context might result in failure of economic and/or environmental protection goals (poor local markets, increased risks like fires, robberies, waste dumping, etc).

HOW DO WE CREATE A DESERTIFICATION ADAPTATION MODEL?

The Desert-Adapt REPLICATION TOOLKIT includes a simple REPLICATION MANUAL that guides the landowners through 10 steps necessary to create their own DAM.

Here, in this General Guidelines, we explain in more details some of the most important steps that the user will encounter in the replication manual, to help the user to make more informed choices. The user can refer to the manual to see the operative and practical actions needed in each step.

SETTING MANAGEMENT GOALS and OBJECTIVES

WHAT DO WE AIM TO WHEN IMPLEMENTING THE DESERTIFICATION ADAPTATION MODEL OF LAND MANAGEMENT?

In order to create a good plan, the land manager needs firstly to define the management goals and operative targets or objectives of the plan, i.e. the economic, ecological and social problems of concerns that need to be addressed and solved on the short, medium, long term, depending on the target. In The following box you find the main objectives of an adaptive land management strategy and you can see if you need to implement any of these objectives in your land.

The pillars of adaptive land management strategy

The environmental pillar: protect and enhance ecosystem quality and services

- Protect and support plants and trees in your land
- Increase plant biomass and cover
- Increase soil organic matter
- Reduce soil erosion and loss
- Stimulate biodiversity at all levels
- Reduce fire risk
- Protect quality and quantity of water bodies

The economic pillar: seek long-term self-sustainable economic investments

- Differentiate income sources including bioproducts and ecoservices which valorise your local natural capital
- Prefer local varieties and breeds which are adapted to local climatic conditions and soils
- Focalize the attention on management options that save money whilst increasing land quality
- Avoid agronomic species that are not climate adapted
- Focus on investments which have long term positive effect on your land

The social pillar: be inclusive for the local population

- Contribute to raise awareness and become a testimonial of sustainability with your personal experience
- Make your natural capital a shared good and responsibility

Public and private owners might give a different importance to the proportion of the three pillars in their plan, and this is expected and acceptable as long as criteria on long term sustainability for all the 3 pillars are met. An ideal good plan should consider all the three aspects of land sustainability represented in the 3 pillars.

When creating your objectives you should consider the following questions:

- Which are the key environmental, economic and social problems you are addressing in your land?
- Which specific aspects of the problems you have listed are you addressing?
- Do you have main actual limitations to set an operational plan?

This phase should finish with a list of management goals which clearly state the objective of your operative action

THE OPERATIONAL DAM PLAN TO PUT IN PRACTICE THE MANAGEMENT GOALS

Once your goals are set based on problems you aim to solve and once you have a clear picture of you operational and economic limits you have defined **"WHY"** you are doing your specific plan. Now you can proceed with the detailed OPERATIVE definition of your plan defining **"WHAT"** are you going to do in each area of your land and **"HOW"** are you going to do it.

Each of the 3 pillars can be immagined as a set of ***functions***.

By function we mean the purpose or use of a specific area of land

Additionally, for each function, you can decide to assign a certain number of ***Adaptation Measures,*** *i.e actions that we do to implement in the field the chosen function maximizing land protection and sustainability.*

Each landowner should introduce in the DAM plan the right balance of functions associated to the three pillars and the needed Adaptation Measures. These might differ depending on the land characteristics, problems and management goals of the landowner. However, in all cases the final outcome should be a mosaic where no piece of land is abandoned or left without an appropriate thinking.

Assigning 'functions' to the land

Assigning functions to the land means to identify different areas of your land that will have an economic, ecological or social purpose.

ECONOMIC FUNCTIONS

To assign an **economic function** means to identify the land use and a complementary set of activities aimed to produce **economic income**.

Economic functions might be of two main types:

Bioproducts

The land is assigned to the production of an agronomic commodity for direct marketing, either as a primary product (chestnuts, pistachios, prickly pear, cereals for food and feed, wood from forest management) or as primary products for transformation (*lavandula* leaves for oil extractions, pistachios for cream and sweets, prickly pear for jam).

Ecoservices

An area of the land is assigned to a *nature-based* set of activities aimed to create business. Examples can be hiking trials, photo hunting, bird watching, carbon credits, touristic visits, etc. depending on the type of available landscape and farm activities that characterize your area.

ENVIRONMENTAL FUNCTIONS

To assign an **environmental function** to an area of your land means to dedicate such area to increase the natural quality of your land.

The **environmental function** might have a purpose limited to improve the land area where it is applied: for examples to control erosion, waste control, re-afforestation to increase C sequestration, etc.

The **environmental function** might have a purpose which produce benefits which go beyond the area where its applied. For example ecological corridors for wildlife, wild life protection, biodiversity promoting plants that support pollinators, increasing greening areas surrounding crop fields to support biodiversity, pollinators and natural enemies of pests, buffer green zone of water sources.

SOCIAL FUNCTIONS

To assign a **social function** means to identify an area of the property aimed at supporting the local population directly or indirectly.

These functions might be more often selected by public landowners like municipalities. Examples are to favour the production of goods like vegetable and fruit that can be used by the whole community during thematic fares organized by the municipality, or create hiking paths in the restored nature for the local community use or to favour local tourism, set up eco-services where disabled people can be employed to contribute to eco-tourism, etc.

In theory the same piece of land might be assigned to more than one function from the 3 pillars, for example a green area surrounding a water body might have an ecological function (to protect the water quality) and might also be used to produce berries or feed for animals (economic function).

A list of possible economic, environmental and social function is included in the REPLICATION TOOLKIT. The list can be used to have ideas but the landowner can add more of his/her own.

Selecting plant species

After having assigned the functions, some of the function will require to plant new plants.

Planting can be conceived for different purposes:
Plants used at creating new marketing opportunities, new orchards of pistachios, almonds, or aromatic plants.
Plants aimed at implementing already existing economic functions, seeding new species to increase the biodiversity of pastures or increase the quality of pastures by seeding leguminous plants.
Plants aimed at in-farm use associated to an already existing economic activity, like fodder or carobs used as animal feed for animal breeders, strips of flower bushes within agricultural land to support pollination.
Plants aimed at creating eco-services to be eventually introduced into a tourism scheme, for example plants allowing wild birds nesting and feeding thus favouring bird re-colonization of area, or re-afforestation of degraded areas with local species to re-create the natural environment.
Plants aimed at implementing the quality of the ecosystem in line with its ecological vocation, planting more oaks in degraded areas of Dehesa, Montado or Mediterranean agro pastoral systems; recovering open areas under erosion risk with plant cover to reduce soil loss and degradation, re-foresting burned areas, etc.

When choosing which plants to introduce in your land it would be important to take into account some relevant preliminary **information you might collect and that could influence your choice**

- limitations due to the ecology of the plant (ex. not very resistant to dry conditions or acid soil)
- regulatory limitations (alien species list for a specific area, specific regulations for Natura 2000 and SIC areas)
- successful examples of use of climate resistant species by other farmers in the same area
- information on local races adapted to local agro-ecological conditions
- list of native species for natural areas
- best options for market opportunities

Preliminary market evaluation for species with direct economic function

The plant species that give direct access to the market (to primary distribution or to transformation chain) should be chosen on the basis of their potential for marketing and their suitability to local agro-climatic conditions.

A land design in areas under climatic and desertification risk should not include species which are routinely irrigated or have high evapotranspiration rates and are not typically used in Mediterranean climate.

We have included in the REPLICATION TOOLKIT a list of species commonly used in agroforestry plans and the main marketable products they provide, derived from previous experiences in Southern Mediterranean areas. As suchthe list may include plants that might not be allowed in particular countries or regions. For example prickly pear (*Opuntia ficus-indica* (L.) Mill.) is very diffused in Southern Italy while is considered an invasive species in Portugal. So please use the list with a critic eye.

An analysis of local marketing opportunities and distribution channels for the newly introduced marketable species should be done when choosing the new species on which to invest

Factors that should be taken into account when evaluating the marketing potential of a product are:

1. Available markets and relative price (local sale at the farm, consumers, distributer, auctions, wholesale, processor, importer/exporter, shops or restaurants).
2. Volume of the products to sell needed. Mainstream market high volumes→ low price. Niche markets small volumes → high price.
3. Competition in the market (niche market are often more profitable).
4. Added value (dried, packed, labelled, cut or un-cut, processed).
5. Transport distance to the market.
6. Season to sell (outside the season is better).
7. Quality (size, colour etc) of the product to sell (and this is related to growing circumstances).
8. Your required profit margin and your costs (where costs are based on local wages, taxes, fuel etc).

To identify the profit margin the land owner should make a preliminary cost/benefit analysis in order to understand the real margin of profit beyond the costs incurred for the crop management.

Within the cost analysis the following elements should be included:

<u>Initial costs (investment)</u>

1. Seeds or planting material, and wages for planting
2. Protection material (fences, plant protectors).

3. Interest rates (costs of initial investment, bank costs etc).

Annual costs

4. Wages and/or costs for subcontracting for annual maintaining the land and plants (pruning, weeding etc)
5. Machine costs (fuel & electricity, maintenance, depreciation).
6. Costs for water (mostly in the first stages of planting, thereafter only for emergency irrigation).
7. Other material like biological fertilizers.

Adaptation measures

8. The costs of adaptation measure to increment plant survival should be included. Failure to consider appropriate adaptation measure might lead to failure of the investment due to massive seedling death in the first summer season.
   To read more on adaptation measure see next paragraph.

Harvesting costs

9. Harvesting (wages, renting machines, 1st level packaging etc)

For many fruit species it will be only year 6 or 7 when the first production can be expected while many herbs can be harvested in year 2. Thus the real costs in the first years will be lower and the cost/benefit analysis will need to take into account the years needed to reach the optimal production rates.

The investments costs are usually calculated in 'payback' terms. The time it takes, in years, to pay back the initial investment with the profit from the plantation. In fruit and berry production the payback is usually 7 years. With herbs it will be 3.

Final list

Once the complete analysis is finished the land manager can define a final list of species which are going to be used, the planting calendars along the year, all the necessary inputs for the field operations.

Selection of Adaptation Measures (AM's)

The Adaptation Measures are a key element of the DAM plan. They represent the management operations or actions to be taken in the field in order to optimize plant survival and productivity, to protect ecosystem quality, to enhanced ecosystem services on the long term and hence reducing degradation and desertification risk.

Great care should be given to consider as many Adaptation Measure as needed and implement them in the field, within budget or logistic limitations.

A list of Adaptation Measures which can be adopted in the field is provided with the REPLICATION TOOLKIT together with a folder containing the detailed description of each Adaptation Measure. This set of Adaptation Measures is based on experience gathered from previous projects and is not omni-comprehensive.

Other Adaptation Measures can be proposed on the basis of land manager experience or experience of local stakeholders or from other sources (guidelines of other projects, official reports, etc).

Each area with a specific assigned function might include many Adaptation Measures

As a driving indication Adaptation Measures should always aim to the following:
Soil protection (for example reduce soil disturbance, increase soil organic matter quantity and quality, reduce soil erosion, reduce soil compaction, stimulate soil microbial diversity and functionality, use organic inputs)
Plant protection (for example stimulate plant beneficial symbioses, use plant protectors from grazing, avoid overgrazing, support water retention in the areas surrounding the plants, avoid stressful plant management like extreme pruning, limit use of big machines close-by the trees, etc)
Water efficiency and waterbodies protection (for example reduce water evaporation, create buffer zones, avoid or limit chemical use in waterbodies proximity, limit nearby erosion, increase soil infiltration potential in compacted soils, slowdown water runoff, optimize water infrastructures)
Biodiversity protection (for example introduce crop rotations, promote pasture improvement with seed mixes and leguminous, favour mychorrization, offer support to wildlife like feed, artificial water collectors, poles, bird nests, insects hotels, etc)
Fire risk protection: (for example create land mosaics, use fire repellent plants fence on the land borders, keep clean using sustainable methods like goat grazing, don't leave dead wood, avoid dense tree crowns, have water reservoirs at handy distance, etc).

Fire risk analyses

To have a fire risk plan is very important in areas characterized by dry and hot periods.

Particular attention should be posed to a preliminary risk analysis that can lead the DAM plan towards specific choices aimed at limiting fire risks. An initial check of the fire risk situation might be using the following Table

Element contributing to risk or risk description	Information available
Fire prevention laws existing in the region/area	If yes integrate main directives into the DAM plan
Landowner already has initiatives to reduce the fire risk in his/her land	If yes integrate the plan into DAM planning

Land is under prevailing wind direction?	If yes consider to create corridors or barriers in the areas upwind
Land is close to roads or people frequented areas which might create fire risk of cigarettes, campfires	Create buffer zones with little vegetation or fire repellent plants
What is the surrounding area main vegetation?	To know which surrounding areas are more fire prone areas help to plan the properties areas borders which needs higher protection priority
Any fire preventing measure adopted by neighbours?	To know the level of readiness and engagement to adopt, as well as share best practices with neighbours
In case of fire closest firefighter location	To be aware of the time needed to get help and hence plan the DAM measures accordingly
Do you have firefighting equipment?	In case not it should be bought where is needed
Available water sources close by?	Map the available water sources and include them into an emergency plan or create dedicated ones

FINAL STEPS, DOCUMENTATION AND TIMELINE OF THE ACTIONS

A short document summarizing the essential features of our DAM plan output can be very useful to keep track of the main elements we have considered in our planning exercise. The minimal set of reported elements can be:

1. Main problems we aimed to solve or ideas we wanted to implement
2. Main goals we wanted to reach
3. Final list of selected functions by pillar
4. Final list of selected species
5. Final list of Adaptation Measures with the indication of where they are applied
6. A DAM map with functions and Adaptation Measures

We suggest the landowner to store the background documents used to make choices with a short note of the use he/she made of them, the fire risk analysis, the cost/benefit analysis for the selected species.

A google MAP of the assigned functions and Adaptation Measures

In order to have the overall DAM plan clearly displayed into a visual form that helps to optimize functions and Adaptation Measures distribution, the land manager can create a map of the DAM. The work can start from an aerial picture or a cadastral map of the land (see Fig. 1) that can be drawn in a first sketch and then replaced with a final version in CAD or by simply overwriting on the map with pen mark.

Figure 1 - Initial aerial (or google earth) picture with lines defining the border of assigned function drawn by hand

However a further available instrument to represent the DAM is Google Earth map that can be created using the program Google Earth Pro (GE) (see tutorial at https://www.youtube.com/watch?v=7XIw3fqOxWM)

The final GE gives the number of hectares for each function, which is required to calculate costs, planting material etc, in the next steps. It will look like the map on the right in following Figure 2.

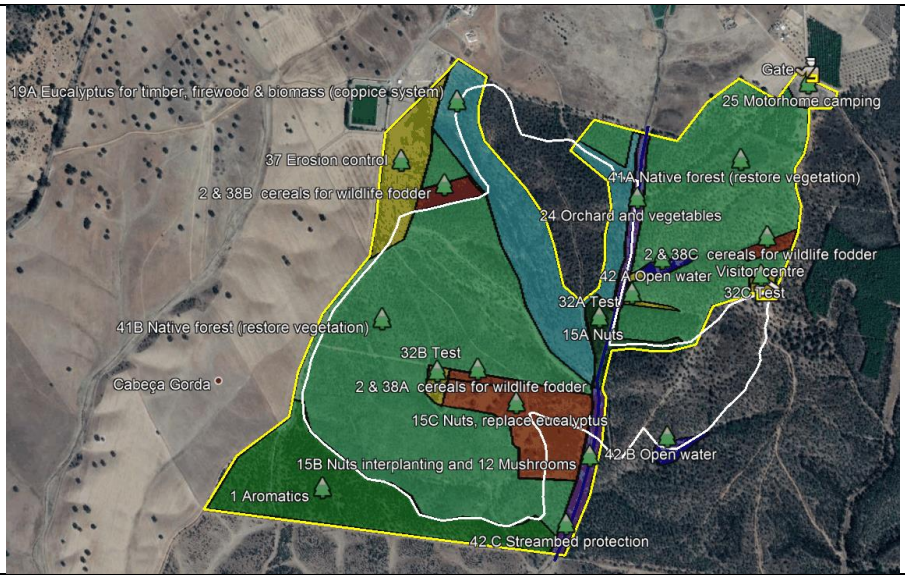

Fig. 2 – Same map as above implemented in google earth “my maps” system which shows polygons assigned to different functions and their names.

In the google earth maps it is possible to create layers of information. The same list of functions can be considered as a layer that can be overlapped to the original aerial view of the land and can be switched on and off. Similarly, layers of Adaptation Measures can be created, or information added as features of the layers. Google Earth maps are saved as KMZ files, and these can be shared with third parties. Being georeferenced the areas can also be tracked using a phone when going to the field.

To explore examples of DAM plans produced by the DESERT-ADAPT project visit the project website: http://www.desert-adapt.it/index.php/en/case-studies