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SYNTHESIS REPORT "BEST PRACTICES TO COMBAT DESERTIFICATION. AN OVERVIEW"

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Prevention and Restoration Actions to Combat Desertification.
An Integrated Assessment
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This Deliverable is the Synthesis report “Best Practices to Combat Desertification. An Overview”.
The Synthesis report is intended to give a general overview of the project findings with reference to the evaluation of the restoration interventions assessed in the different LTEM sites. It summarizes the evaluation criteria adopted, and the main results obtained, by site and action type.
The present report has been assembled by Claudio Zucca (NRD), with the collaboration of Ramon Vallejo (CEAM) and Susana Bautista (UA).

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1. LIST OF ABBREVIATIONS

ABDN: University of Aberdeen, UK.

AUTh: Aristotle University of Thessaloniki, Greece.

BGU: Ben-Gurion University of the Negev, Israel.

CEAM: Centro de Estudios Ambientales del Mediterráneo, Spain.

CMCC: Euro Mediterranean Center on Climate Change, Italy.

FUERM: Fundación Universidad Empresa Región de Murcia - Spanish Ministry of Environment, Spain.

IEB: Instituto de Ecología y Biodiversidad, Chile.

LPN: Liga para a Protecção da Natureza, Portugal.

NENU: Institute of Grassland Science, NE Normal University & Wulanaodu Desertification Res. Station, Shengyang Institute of Applied Ecology, China.

NRD: Nucleo Ricerca Desertificazione, University of Sassari, Italy.

NWU: School of Environmental Sciences and Development, North-West University, South Africa.

UA: University of Alicante, Spain.

UANL: Universidad Autónoma de Nuevo León, Mexico.

UHAM: Dryland Research Center at BioCenter Klein Flottbek, University Hamburg, Germany.

UTRIER: University of Trier, Germany.

2. INTRODUCTION

Policy and management responses to desertification can be grouped under two major classes: prevention and restoration. The boundaries between these are vague, as they form a continuum of potential prevention, mitigation and restoration actions, to be adapted to particular sites and dynamics through adaptive management approaches (Fig. 1).
Examples of prevention and mitigation actions include measures to improve water management and agricultural practices, often referred to as soil and water conservation (SWC) or sustainable land management (SLM). For extremely degraded lands, rehabilitation and restoration approaches often involve the improvement in the quantity and/or quality of vegetation cover through, for example, reintroduction of selected species, control of invasive species, and reforestation programs.

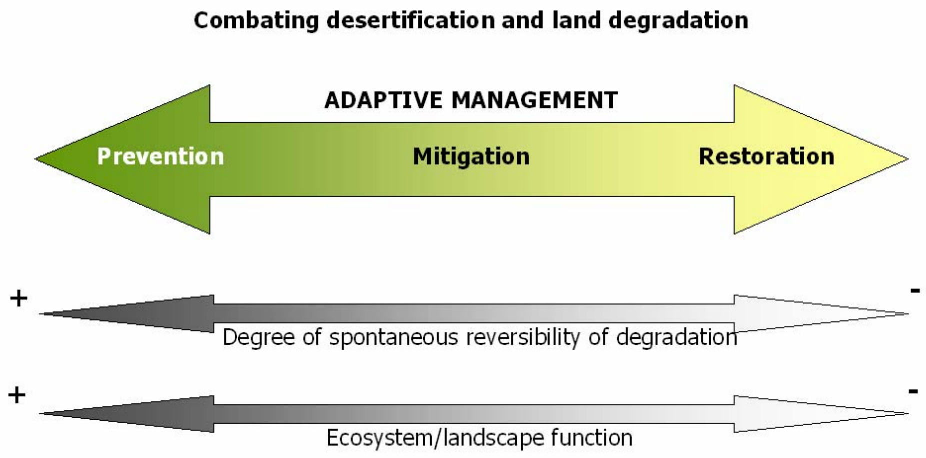

Figure 1. Continuum of actions to combat desertification and land degradation. Source: Zucca et al., 2012.

Desertification is driven by a combination of proximate causes and underlying forces that vary from region to region and change over time (Geist and Lambin, 2004; Reynolds et al., 2007). Approaches and strategies to prevent and reverse desertification need therefore to address complex causal patterns and a multiplicity of actors, factors, and scales (Zucca et al., 2012). In general, to develop the appropriate engagement between scientific and local environmental knowledge is critically important in this regard.

2.1 About the concept of “best practices”

PRACTICE rationale intrinsically assumes that there are not absolute best practices to combat desertification, applicable anywhere at any time, under any circumstances. The best practices essentially depend on trade-offs between individual perspectives of stakeholders, in given socio-environmental contexts, and they are unavoidably dynamic, that is changing with time along with socioeconomic changes. History shows many examples of “best practices” applied decades ago that are unacceptable today, and we often see contrasting restoration goals and practices applied in different socio-environmental contexts. Therefore, best practices should be tailored to the specific socio-environmental conditions of each region and historical time. Stakeholders are best placed to identify the links between ecosystem function and their well-being, and stakeholder knowledge can enhance and supplement scientific data, and rationalise land-use decisions in relation to culture and society.

2.2 The PRACTICE approach to best practices

The PRACTICE project assumed that the development of integrated biophysical and socio-economic analytical methods for evaluating progress and success, along with a framework for knowledge sharing and transfer, are crucial to combating desertification. On the other hand, monitoring and evaluation are necessary to assess the benefits of restoration, establish cost-effective thresholds for the management alternatives, and identify priority areas for action.

Recent methodological approaches for assessing and evaluating the effectiveness of management and restoration programs focus on indicators that relate to ecosystem integrity and services, and human well-being (Adeel and King, 2004; Bautista et al., 2010; SER, 2004; Ward, 2006). The ecosystem goods and services (EG&S) framework is increasingly thought to provide a basis to assess and value the impacts of land change and degradation, as well as the effects of the actions aimed at reversing it (MEA, 2005).

PRACTICE adopted the EG&S framework to drive the selection of the assessment indicators, and to ensure the definition of consistent, coherent and comprehensive indicator sets.
In the same time, by engaging the stakeholders (SHs) from the outset of the assessment, and maintaining the interaction throughout the process, the project achieved the integration of local knowledge and SH priorities into the assessment.
“Site-specific” indicators suggested by the local SHs were integrated with the “common” indicators prioritized by the scientists by means of the selection and weighting procedure specifically developed by the project as a part of the PRACTICE Integrated Assessment Protocol (IAPro).

Finally, the comparison and outranking (level of general preference) of the actions assessed was performed by means of a flexible multicriteria approach.
Such an approach allows taking into account that the evaluation of the PRACTICEs depends on tradeoffs between criteria, individual stakeholder perspectives and interests, as well as dynamic socio-environmental contexts.

3. THE LTEM SITES AND THE EVALUATION OF THE ACTION

Ten PRACTICE partners (CEAM, UA, NRD, AUTh, UHAM, LPN, BGU, NENU, IEB, and UANL) were in charge for the following LTEM sites:
EL SAUCE and LAS CAÑAS (Chile), CHANGLING (China), LAGADAS (Greece), MIGDA, PARK SHAKED and YATTIR (Israel), PULA-PIXINAMANNA (Italy), EL SALADO and EL CASTAÑÓN (Mexico), OULED DLIM (Morocco), GELLAP/NABAOS and NARAIS/DURUCHAUS (Namibia), REMHOOTGE/PAULSHOEK (South Africa), CASTRO VERDE (Portugal), MIER and MOLOPO (South Africa), AYORA, AGOST and ALBATERA (Spain).

The types of actions assessed are summarized in Table 2, according to the categories listed in Table 1.

Table 1. Categories of prevention/restoration actions applied in PRACTICE LTEM sites.

REHABILITATION AND RESTORATION	Afforestation (tree species, forestry)
	Tree/shrub plantation (slow growing species, native)
	Fodder shrub plantation (productive)
	Control of shrub encroachment
	Erosion control & water harvesting
	Dune stabilization
MITIGATION AND PREVENTION	Passive restoration (grazing pressure exclusion)
	Post fire management
	Rangeland management
	Improved farming practices

Across the sites, actions aimed at improving rangeland management are the most numerous, followed by afforestation strategies (both types) and by erosion control interventions.
The actions of the first group are particularly represented in the driest regions (lower part of the table), whereas afforestation interventions are most common in dry sub-humid to semi-arid sites (upper part of the table).

In most sites, multiple actions have been compared with each other and/or with “no actions” used as control plots. No-action plots are areas still affected by pressure factors (e.g.: overgrazing, wildfires, unsustainable farming practices) and not subjected to any kind of management specifically aimed at reducing or mitigating degradation.

The present report outline the evaluation carried out at sites where the IAPro has been fully implemented.

Table 2. The actions assessed in each LTEM site, by type of strategy.

	REHABILITATION AND RESTORATION						MITIGATION AND PREVENTION			
	afforestation forestry	tree/shrub plantat. (slow growing, native)	fodder shrub plantat. (productive)	control of shrub encroach	erosion control & w. harv.	dune stabil.	passive restoration (pressure exclosure)	post fire manag.	range manag.	improved farming
LAGADAS, Greece	X								X	
PULA, Italy	X						X	X		
AYORA, Spain	X							X		
AGOST, Spain	X									
ALBATERA, Spain	X	X								
CASTRO VERDE, Portugal		X							X	X
CHANGLING, China									X	X
MIGDA, LEVAHIM, SHAKED, YATTIR, Israel	X	X			X				X	
OULED DLIM, Morocco			X		X					
EL SALADO, Mexico							X			
EL CASTAÑÓN, Mexico									X	
EL SAUCE, Chile					X					
LAS CAÑAS, Chile					X		X			
NARAIS/DURUCH, Namibia									X	
GELLAP/NABAOS, Namibia									X	
REMH/PAULS, South Africa									X	
MIER, South Africa		X		X		X			X	
MOLOPO, South Africa		X		X					X	
Tot	6	5	1	2	4	1	3	2	10	2

3.1. The evaluation criteria

As reminded above, in PRACTICE the evaluation of the actions is based on the ecosystem goods and services (EG&S) framework: best actions have the greatest positive impact on the provision of goods and services by the ecosystem.

One of the strengths of PRACTICE is related to the integrated, site-specific sets of indicators developed by the project to quantify the effectiveness of the actions. The indicators proposed by the local stakeholders are related to the perceptions and expectations they have with regard to the actions. The relative weights given to the indicators are linked to the importance assigned by the stakeholders to the different evaluation criteria, under the influence of local environmental, socio-economic, and cultural factors.

For these reasons the presentation of the results of the evaluation (the comparison and ranking of the actions) must necessarily be introduced by an overview of the indicators used.

The indicators and their weights can contribute to clarify the contextual value of the evaluations performed.

The analysis of the indicators selected at sites suggested that their linkage with the EG&S can be highlighted by grouping them according to the following categories:

- Supporting and Regulating (S & R)
- Provisioning (P)
- Cultural/aesthetic (C/A)
- Wealth (W)
- Security and social (S & S)

Where:

"Wealth" includes the indicators related to the economic aspects (e.g.: income, costs, etc,), and to other direct or indirect individual wealth/health factors (e.g.: "family wealth", "people satisfaction", "cattle conditions").

"Security and social" include factors related to the perceived environmental security as affected by the actions (e.g.: "flood hazard"), as well as aspects related to social processes (e.g.: "mitigation of local conflicts", "Degree of involvement of local communities"). Indicators related to environmental "risks" are usually associated to the regulating services. However, they are most often given high priority by the stakeholders in relation to security.

The case of the Pula-Pixinamanna site (Italy) can be taken as an example. Table 3 shows how the 11 indicators selected in the Italian site were weighted by the stakeholders, and assigned to the above 5 categories for the aims of the present report.

The indicators selected in the LTEM sites are summarized in Table 4. The table shows:

- the percentage of indicators assigned to the above categories in each site;
- the assignment of the three first ranked indicators.

The representation offered by Table 4, although very simplified, highlights some major differences.

Table 3. Indicators and weights selected at Pula-Pixinamanna (Italy).

Indicator	Weight	S & R	P	C/A	W	S & S
Employment generation	0,109				x	
Landscape Naturality	0,106			x		
Timber production and firewood	0,106		x			
Hydrogeological Hazard	0,105					x
Plant and Animal diversity	0,101	x				
Fire Hazard	0,101					x
Cost of the actions (implementation and management)	0,086				x	
Recreational Activities	0,080			x		
Degree of Multi-functionality	0,080				x	
Soil Fertility	0,075	x				
Soil pH	0,064	x				

In particular it can be observed that some sites, such as the Spanish ones, show a greater ecological concern of the stakeholders, associated to relatively few socio-economic expectations (half of the indicators belong to the first category, as well as the 3 first ranked).
In other sites, such as in Morocco, in South Africa and in one site from Chile, the greater importance assigned to the Provisioning and Wealth indicators suggests the existence of higher social and economic expectations. In these areas the rural population heavily relies on natural resources and the actions can significantly affect their livelihood.
Other sites show more balanced profiles.

3.2. The datasets

The IAPro implementation generated an impressive amount of data. As already underlined, the heterogeneity of the actions, the diversity of the biophysical and socio-economic conditions of the sites, and the varying SH's priorities, resulted in quite different datasets and data collection strategies across the sites.
This diversity constitutes one of the most innovative, and challenging aspects of the project.
Innovative because the project adopted a bottom-up approach to select "site specific" socio-ecological indicators to be measured together with the "common" ("science-driven") ones. The bottom-up approach as a strategy for selecting indicators has been advocated by the UNCCD several years ago. However, there are few examples of application, most often targeting the impact indicators, and not aimed at assessing the effectiveness of restoration. Challenging because "data availability" is generally considered as a key factor in the indicator selection process. So the indicators for which data are not already available are most often discarded. PRACTICE wanted to integrate "expert" (common) and "SH" (site-specific) indicators, and to rank them altogether in a participatory event. Through the process, some indicators emerged which were not taken into consideration before. It was sometimes not easy (or not possible) to produce data "on-demand", to measure/calculate those indicators. In these cases, suitable proxies were defined and data collected.

Table 4. Summary of the indicators selected in PRACTICE LTEM sites. The table shows the fraction of indicators assigned to the five categories of EG&S framework (right) in each site, and the assignment of the three first ranked indicators (left, in bold) to the same categories

Site / Country	nr	S & R	P	C/A	W	S & S	S & R	P	C/A	W	S & S
		Assignment of the 3 first ranked					% of indicators assigned to each category				
Lagadas / Greece	9	**2**				**1**	33	22	11	22	11
Pula / Italy	11		**1**	**1**	**1**		27	9	18	27	18
Ayora / Spain	13	**2**				**1**	46	8	23	15	8
Agost / Spain	13	**3**					46	8	15	15	15
Albatera / Spain	14	**3**					50	7	14	21	7
Castro verde / Portugal	11	**2**			**1**		45	18	18	18	0
Ouled Dlim / Morocco	11		**3**				9	36	9	36	9
El Salado / Mexico	6	**3**					67	0	0	33	0
El Castañón / Mexico	7	**1**	**1**		**1**		43	14	0	43	0
El Sauce / Chile	9	**2**			**1**		44	0	11	44	0
Las Cañas / Chile	12				**1**	**2**	33	0	8	33	25
MIER/South Africa	11	**1**			**2**		18	36	0	36	9
Molopo/ South Africa	11		**2**		**1**		18	45	0	27	9

4. THE BEST PRACTICES

4.1. The multicriteria analysis – outranking example

The multi-criteria (MCDA) evaluation of the actions was carried out through Electre 1S software (Aït Younes et al., 2000). The evaluation is performed by means of a pair-wise comparison of the actions, and shows whether each action outranks (or is outranked by) the other actions.
Input data are: indicators values (generally as mean and standard deviation for quantitative data, and as single values for qualitative data); indicator weights; preference thresholds, calculated or estimated by the user.
The overall outcome of the evaluation is qualitative, and is best expressed in graphical form.

Again, the Italian site can be taken as an example. In Pula, five actions were considered:

- No action. Area still under pressure (grazing, and occasional wild fires)
- Self restoration as a management choice, in areas included in the managed perimeter, no longer exposed to pressure factors.
- Reforestation: dense stone pine plantations implemented during the 1950s-1960s, by means of sub-soiling along contour lines or hole soil preparation.
- Recent stone pine and cork oak re-plantation, in areas previously reforested (as in action “2”), and affected by fire in 1999.
- Re-naturalization of a “2” situation, by means of sylvicultural interventions (thinning), to establish a more complex forest system.

The graphical result of the action outranking is shown in Figure 2. The arrows linking the action squares indicate that the to-action is outranked by the from-action. So it can be seen that action number 1, self restoration, clearly outranks all the other actions. Second best option is action 2 (reforestation), outranking all the remaining ones, followed by action 4 (renaturalization) and by the action 0 (no-action).

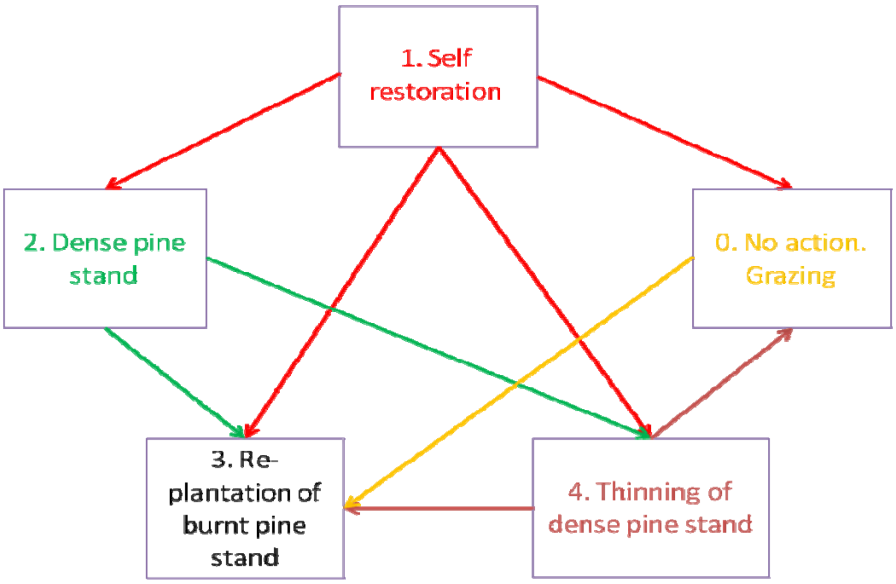

Figure 2. Action outranking for the Pula-Pixinamanna site.

4.2. The evaluation of the actions

For the reasons explained above, linked to the contextual value of the evaluation process, the results obtained in the LTEM sites cannot be generalized. It is clear that the interventions considered are only a sample of the possible actions to combat desertification, although well representative of a range of dryland contexts. However, the number and the geographical distribution of the sites, and the local relevance of the actions selected in each site, make PRACTICE a unique example worldwide, with a very high potential policy impact (Rojo et al., 2012).

Also, this Report does not pretend to list the “overall best practices”, or to state whether the considered actions are absolutely good or not. First of all, the adopted evaluation approach does not allow comparing the actions across sites. They must be compared within the sites, in relation to the local context. Secondly, PRACTICE assumes that there are no absolute best practices. The “goodness” of restoration actions depends on trade-offs between criteria, individual SH perspectives and interests, as well as dynamic socio-environmental contexts. But, best practices should always incorporate participatory approaches.

In PRACTICE, the evaluation is a process tool. Changing constraints and societal goals could change the final outranking of the actions. Furthermore, the evaluation is a social learning tool. It helps the local communities to increase their knowledge about the actions and to get more aware of the possible costs and benefits related to them.
However, the assessment was far from being a kind of simulation exercise. The actions selected were long established, locally well known restoration options. The involved SHs were highly familiar with these interventions, by which in most cases their family income is strongly affected. At the end of the evaluation process, the stakeholder platform achieved a new collective awareness about the effectiveness of the different options.

The outranking results obtained in the different project sites are summarized in Table 5.

Table 5. Summary of the action outranking results performed at PRACTICE LTEM sites.

Site, Country	Action	No action	Outranking
LAGADAS, Greece			
		Control area (no grazing and no reforestation)	**2**
	Moderate grazing		**1**
	Overgrazing		**4**
	Partial reforestation with *Pinus pinaster*		**3**
	Full reforestation with *Pinus pinaster*		**4**
PULA, Italy			
		Area still under pressure (grazing/fire)	**4**
		Self restoration of mixed Med forest	**1**
	Dense stone pine plantations		**2**
	Stone pine and cork oak re-plantation, after fire		**5**
	Re-naturalization of dense pine plantation (thinning)		**3**
AYORA, Spain			
		Post fire shrubland.	**3**
		Dense post fire pine forest.	**3**
	Post- fire pine reforestation		**2**
	Thinning of dense post-fire pine forest		**1**
AGOST, Spain			
		Alpha-grass steppe	**3**
	Aleppo pine afforestation N-facing		**1**
	Aleppo pine afforestation S-facing slopes (subsoiling)		**2**
	Aleppo pine afforestation S-facing slopes (planting holes)		**3**
CASTRO VERDE, Portugal			
	Actions		
	Traditional agriculture with tillage		**3**
	Traditional agriculture with direct sowing		**2**
	Permanent pastures		**4**
	Holm oak plantation		**1**
	Sub-actions		
		Traditional agriculture with tillage (control area)	**2**
	Traditional agriculture with tillage and the application of sewage sludge in the subsoil		**1**
		Traditional agriculture with direct	**2**

		sowing (control area)	
	Traditional agriculture with direct sowing and the application of sewage sludge in the subsoil		**3**
OULED DLIM, Morocco			
		Overgrazed rangeland	**4**
		Irregular cereal cropping in rangeland	**3**
	Atriplex n. Plantation (A)		**1**
	Atriplex n. Plantation (B)		**2**
EL SALADO, Mexico			
		No action	**2**
	Strict grazing exclosure		**1**
EL CASTAÑÓN, México			
		No action	**2**
	Grazing management for grassland improvement		**1**
EL SAUCE, Chile			
		No Action (slope); under pressure (overgrazing and fuelwood collection)	**4**
		No Action (catchment); under pressure (overgrazing and fuelwood collection)	**3**
	Soil stabilization (slope)- mechanic and biological (plantation of trees, shrubs, cacti) to control runoff		**1**
	Runoff control in micro-basins, gullies and ravines (*quebradas*) - mechanic		**2**
LAS CAÑAS, Chile			
		No Action (slope); under pressure (overgrazing and fuelwood collection)	**5**
		No Action (catchment); under pressure (overgrazing and fuelwood collection)	**3**
		No action (forest)	**4**
	Soil stabilization (slope)- mechanic and biological (plantation of trees, shrubs, cacti) to control runoff		**2**
	Runoff control in micro-basins, gullies and ravines (*quebradas*) - mechanic		**2**

	Conservation and management (pruning) of native forests/shrubs (strict enclosure), water sources and watercourses.		**1**
MIER, South Africa	*Duneveld*		
	Bush control		**2**
	Dune stabilization		**4**
	Grazing management		**1**
	Revegetation		**3**
	Hardveld		
	Grazing management		**1**
		No grazing management	**3**
	Revegetation		**2**
		No revegetation	**3**
MOLOPO, South Africa			
	Rotational grazing		**1**
		No rotational grazing	**5**
	Chemical control of woody species (by airplane and by hand)		**4**
	Re-vegetation with native species		**2**
	Cutting of unwanted woody species		**3**
	Stem burning of unwanted woody species		**4**

It is not the goal of this summary report to perform a detailed analysis of the reasons behind the results obtained in each site, and the correlations of these with the socio-economic and environmental factors characterizing the local contexts. However, some very broad tendencies can be outlined here, to highlight some of the main differences, commonalities, and patterns. Overall, a clear distinction in the evaluation of actions is observed depending on the degree of dependence of local populations' economic welfare on the natural resources.

In many cases traditional afforestation/reforestation strategies were not positively evaluated, particularly in the wetter conditions of the Italian and Greek sites. Here, although the socio-economic expectations of the local populations with regard to the areas are still relevant (as shown by the importance given to the economic and provisioning indicators), the communities would prefer to avoid the "heavy" traditional interventions. In Pula they realized that the natural dynamics can perform a better job if the pressure factors are removed. In Lagadas, they see that the land productivity is still high enough to effectively support a grazing system, if it is well managed, and they do not believe in the usefulness of the afforestation.

Also in some dry sites such as the South-African ones, where the population heavily relies on the local natural resources, people feel that good management still could be the best solution. However, they also feel that the active removal of the encroaching shrubs (intended as a major indicator of land degradation), is an unavoidable mitigation strategy. In other local contexts, similar to the above in terms of climatic and socio-economic conditions, people strongly support the restoration interventions. In Ouled Dlim (Morocco), the productivity of the degraded rangeland is so low that investment, or abandonment, are the only viable options. In Chile the no-action option on slopes subjected to erosion is considered as the worst one. There, people understand that doing nothing would not be a sustainable strategy.

On the other hand, in sites such as the Spanish ones, people do not seem to expect significant economic return from the site areas in the short time. They perceived that land as a degraded territory that cannot contribute significantly to their income, and give priority to restore it for the future. The highest weights are assigned in these cases to the indicators linked to the supporting and regulating functions (soil quality, biodiversity).

In Portugal (Castro Verde) the economic importance of the agricultural activities is partly counterbalanced by the environmental concerns linked to the fact that the area is also a special wildlife protection site. The slow growing, relatively unproductive but ecologically friendly Holm oak plantations are here ranked as the best action besides the improved (no tillage) agricultural practices, whereas traditional grazing received the lowest level of preference.

Overall, it is clear that the diversity of the contexts explored and the richness of the datasets created by the project bear a great potential for in-depth analyses, which are beyond the scope of this report.

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