DESIRE REPORT series

Sustainability goals of stakeholders in study sites

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Introduction

Sustainability is often discussed in relation to three dimensions: social (people), environmental (planet), and economic (profit), known as the "three pillars". The three dimensions are often represented as three overlapping circles (or ellipses) in a Venn diagram (Venn 1880), to show that these dimensions are not mutually exclusive and can be mutually reinforcing.

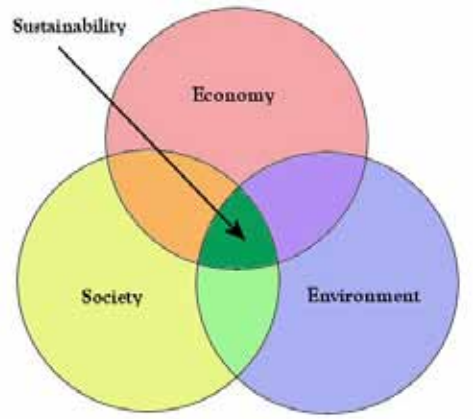

Figure 1: The Venn diagram for sustainability

The World Commission on Environment and Development chaired by Brundtland defined sustainable development as: “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland 1987).

Restoration of land degradation is often costly and labour-intensive. The benefits of mitigation measures should therefore outweigh the investments made. Sometimes restoring a severely degraded area is less cost-effective than prevention of (further) degradation in a much less degraded area, but the decision which measures to take where depends on the objectives of the various stakeholders and the intended land use. Taking measures to restore soil fertility in a soil suffering from nutrient depletion is not a sensible idea if the same land is intended for new construction activities.

A goal is ‘the end towards which an effort is directed’. Defining sustainability goals helps to identify the perception of sustainability among various stakeholders and of their main concerns, objectives, and interest in achieving sustainability. They help in choosing the means and a pathway towards achieving sustainability.

This report presents an inventory of the main sustainability goals among stakeholders in the DESIRE study sites. Information was obtained through the study site coordinators that obtained their information through stakeholder workshops (e.g. as organized for WB3 activities) and from strategic and policy frameworks, for example from ministries. A questionnaire and a common reporting format was sent to the study sites. This report presents the responses from all sites. Other information on

priorities for land management, including sustainability, were assessed in relation to the selection and prioritization of sustainable land management (SLM) strategies in WB3 workshops, as these strategies are implicitly based on the sustainability goals of the stakeholders. Figure 2 shows that in the conceptual framework of DESIRE, sustainability goals follow from rural livelihoods, and form the basis for selecting SLM strategies or other options to generate income. Sustainability goals thus play a crucial role in the loop 'land use and management', 'Desertification processes', 'Rural livelihoods', 'sustainability goals' and SLM strategies. Without such goals responses to negatively affected rural livelihoods would likely be unsustainable and might thus result in adverse land use and increased desertification. Within DESIRE, the sustainability goals were considered in the analysis of options for land management and desertification control. The sustainability goals are also relevant for activities in Work Block 5, where scenarios will be formulated for decision support and policy development.

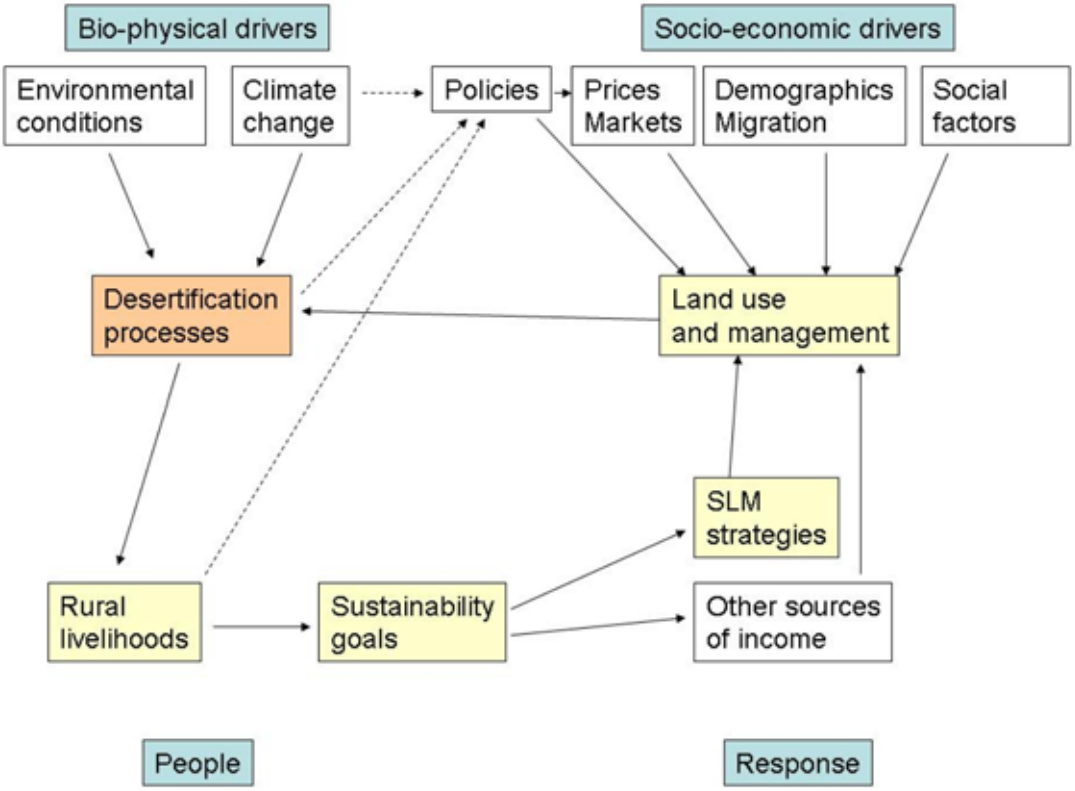

Figure 2. Conceptual framework of DESIRE

Results

The sustainability goals that were identified in the DESIRE study sites are listed per site in this section. Annex 1 and Annex 2 provides examples of a more detailed analysis that was performed by the study sites in Botswana and in Crete. These more detailed reports give examples of how sustainability goals fit into the whole desertification problem, and what their role can be in finding solutions to these problems.

Study Site: China, Loess Plateau

Soil erosion and water shortage are the main limiting factors on the Loess Plateau even after long time of implementation of integrated measures. The sustainable development of agriculture systems and the rural economy without more ecological cost in the Loess Plateau is the main objective of research and projects including of DESIRE. The list of sustainable agriculture and rural economic goals identified above were assessed by expert estimate (study site coordinator).

Sustainability goals	
Goal 1	Reduction of soil erosion and runoff losses;
Goal 2	Improvement of the water use efficiency of precipitation;
Goal 3	Maintenance of function and production of soil and vegetation;
Goal 4	Conservation of bio-diversity;
Goal 5	Maintenance of the loess landscape;
Goal 6	Improvement of local socio-economic condition;
Goal 7	Reduction of sediment load of the Yellow River;
Goal 8	Mitigation of flood risk of the lower reaches of the Yellow River and Its branches.

Study site: Spain, Guadalentin basin

Sustainability Goals	
Goal 1	Maintenance and restoration of the productive capacity of the agricultural-, forest-, and scrublands systems
Goal 2	Reduce water loss and maintain or restore aquifer levels
Goal 3	Reduce soil erosion and prevent flooding and siltation of reservoirs
Goal 4	Increase soil fertility and soil organic matter content
Goal 5	Integration of agriculture and ecological systems in a 'mosaic landscape'
Goal 6	Conservation of biological diversity
Goal 7	Production of labelled 'quality products' from ecological agriculture
Goal 8	Use of organic waste and sludge for local green energy production

Source: discussions between stakeholders during two stakeholder workshops in 2007 – 2008

Study site: Greece, Crete.

The analysis of the sustainability goals for protecting natural resources from land degradation and desertification was conducted following two main approaches: (a) farm survey, and (b) stakeholder workshop. The purpose of the farm survey was to collect data on indicators (WB2) and to discuss with individual farmers possible sustainability goals for environmental protection. The farm survey included informal discussions with the farmers related to: (a) the physical condition of the farm and the problems faced in crop production and loss in land productivity, (b) the impacts of land degradation and desertification on the physical environment and on the social and economical characteristics of the area, and (c) the possible actions and goals for protection and restoration of natural resources. The farm survey was conducted in two dominant land use types: (a) agricultural crops (olives and vines) and (b) and pastures. Forests are also important land uses in the island but these areas are strictly controlled by public agencies.

These 7 sustainability goals were selected from 11 identified goals of sustainability for the study site of Crete. Considering the most important processes of degradation and existing actions or trends for sustainable use of natural resources more widely accepted by the local society, these 7 sustainability goals for land protection from desertification have been identified and proposed.

Sustainability Goals	
Goal 1	Policy enforcement of existing regulations on protection of natural resources
Goal 2	Awareness and technology dissemination
Goal 3	Sustainable management of grazing land
Goal 4	Preservation of olive plantations
Goal 5	Water conservation and increasing water availability
Goal 6	Promotion of organic farming
Goal 7	Delineation and protection of productive agricultural soils

Study site: Greece, Maggana

The sustainability goals identified by expert estimate can be used as a starting point for the local community to develop their own visions and goals for alternation of the ominous ecological future.

Sustainability Goals	
Goal 1	Conservation of soils that provide high levels of productivity
Goal 2	Groundwater management in the broader area
Goal 3	Groundwater recharge in order to reverse seawater intrusion phenomenon
Goal 4	Application of suitable cultivations
Goal 5	Surface water management and transport
Goal 6	Conservation of current biological diversity
Goal 7	Remediation and conservation of saline soils
Goal 8	Improvement of local economy
Goal 9	Enforcement of groundwater management laws

Source: expert estimate, study site leader.

Study site: Portugal, Mação, Gois

The goals can be used as a starting point for a community to develop their own vision and goals for sustainable forestry. The list of sustainable forest management goals that were developed by other communities and organizations has been useful for this work package.

"Our goal is to sustain and expand a renewable resource that will meet future consumer demand at competitive prices while, at the same time, respecting the diverse demands imposed by society, including the rational protection of sanctuary and habitat." *(Source: http://www.communitiescommittee.org/fsitool/index.html)*

The table shows the sustainability goals that were identified for the two study sites.

Sustainability goals	
Goal 1	Conservation of biological diversity;
Goal 2	Maintenance of productive capacity of forest ecosystem;
Goal 3	Maintenance of forest ecosystem health and vitality;
Goal 4	Conservation and maintenance of soil and water resources;
Goal 5	Maintenance of forest contribution to global carbon cycles and climate change mitigation;
Goal 6	Maintenance and enhancement of long-term multiple social and economic benefits;
Goal 7	Streamlining and simplification of policy and legal instruments;
Goal 8	Provide agricultural lands to balance opportunities with the protection of ecological systems;

Source: information from regional and national plans and stakeholder workshops.

Study site: Italy, Rendina basin

Sustainability Goals	
Goal 1	Conservation and maintenance of soil and water resources
Goal 2	Maintenance of forest ecosystem and vitality with special regards to functionality to preserve groundwater recharge and water quality
Goal 3	Maintenance of ecosystem through guided adaptation to climatic changes
Goal 4	Suggest improvement and adaptation of current policy and legal tools in order to tackle future trends involving soil and water conservation
Goal 5	Suggest solution to present contradictions in soil conservation regional policies

Source: expert estimate, study site leader.

Study site: Tunesia, Zeuss Koutine.

Sustainability goals	
Goal 1	Conservation of biological diversity
Goal 2	Maintenance of productive capacity of pasture and agriculture ecosystem
Goal 3	Conservation and maintenance of soil and water resources
Goal 4	Maintenance of vegetation cover health and vitality
Goal 5	Maintenance of vegetation cover contribution to global carbon cycles and climate change mitigation
Goal 6	Maintenance and enhancement of long-term multiple social and economic benefits
Goal 7	Streamlining and simplification of policy and legal instruments
Goal 8	Provide agricultural and pasture lands to balance opportunities with the protection of ecological systems

Source: expert estimate, study site leaders and national policy plans.

Study site: Cape Verde, Ribeira Seca.

Sustainability Goals	
Goal 1	Stop soil erosion, decreasing the loss of soil and runoff in the steep slopes
Goal 2	Recovery of soil fertility and increase productivity in the long-term
Goal 3	Improvement of soil characteristics (water storage capacity, depth of top soil, organic matter content)
Goal 4	Decrease of slope gradient
Goal 5	Improvement of water and soil quality downstream -Stop the salinization
Goal 6	Improvement of water catchments, decreasing runoff
Goal 7	Improvement of plant cover
Goal 8	Achievement of community awareness regarding the necessity for soil and water conservation

Source: expert estimate, study site leader, policy documents, field visit, research results.

Study site: Russia, Dzhanybek and Novy.

The proposed goals can be used as a starting point for a community to develop their own vision and goals for sustainable agriculture management.

The list of sustainable agricultural management goals that were developed by other communities and organizations has been useful for this work package.

The table shows the sustainability goals that were identified for Dzhanybek and Novy (Russia) study sites.

Sustainability Goals	
Goal 1	Conservation and effective use of soil and water resources
Goal 2	Maintenance and enhancing of long-term multiple economic and social benefits
Goal 3	Adapting and introducing of new environment-friendly land management technologies
Goal 4	Restoring and conservation of environment and biodiversity
Goal 5	Dissemination of good practise results among all groups of stakeholders
Goal 6	Institution building for an efficient management of soil and water resources

Source: expert estimate, study site leader and stakeholder workshop.

Study site: Karapinar, Turkey.

The question of sustainability can be approached in different ways according to land use types involved. Since the pasturelands are already mostly spoiled in regard to biological diversity, it can hardly be talked about sustainability of pasturelands. Actually cattle breeding which is rapidly decreasing in extend and intensity, almost totally relies on fenced feeding. Therefore, before putting forward some sustainability goals, pasturelands of the region should radically be rehabilitated.

As with the cropland which is mostly irrigated type, basic sustainability goal designated by governmental organizations and farmer unions includes preservation of groundwater resources and productivity of the soil. The former is regarded particularly significant since the groundwater level costs much electricity consumption and soil degradation. A variety of attempts ranging from legal limitation of free boreholing to partial funding of new cost-efficient irrigation techniques are under way. Other basic goals involve protection of soil fertility by careful use of chemical fertilisers and suitable soil tillage methods against wind erosion. Selected technologies to be held in the Karapinar hotspot overlap with the sustainability goals of the area.

The table shows the sustainability goals that were identified for Karapinar study site.

Sustainability Goals	
Goal 1	Rehabilitation of pasture lands
Goal 2	Preservation of groundwater resources
Goal 3	Increase soil productivity
Goal 4	Soil fertility protection

Source: information from farmer interviews, governmental organizations and farmer unions and expert estimates.

Study site: Keskin, Turkey.

The mountain villages (i.e. Uludere and Eğriöz villages) of the hotspot still have significant number of cattle that frequents the pasturelands. For those stakeholders, increasing biological diversity as well as the amount of fodder production in pasturelands is the basic sustainability goal.

Dry croplands which are generally slightly to highly sloping actually undergo significant water erosion though neither farmer nor state organizations are financially capable of taking protective or mitigation measures. But they rather think of preserving or improvement of soil fertility as the major sustainability goal. For this reason they mostly prefer chemical fertilizers instead of mid-to long term soil preservation measures. Enlargement of forest cover and their maintenance and protection are viewed as fundamental sustainability goals by both farmers and state organizations. Lastly, optimum use of groundwater by any means in the irrigated croplands of the Keskin and Yukarısöğütönü villages are adopted as principal sustainability goal by farmers of these villages.

The table shows the sustainability goals that were identified for Keskin study site.

Sustainability Goals	
Goal 1	Increasing biological diversity
Goal 2	Improving productivity of fodder production on pasture lands
Goal 3	Conservation and improvement of soil fertility
Goal 4	Forest cover increase and maintenance
Goal 5	Efficient use of ground water sources

Source: information from governmental organizations and farmer unions and expert estimate, study site leader.

Study site: Boteti area, Botswana.

The Boteti area is confronted by problems that pose a challenge to the attainment of the three sustainable development goals of ecological (environmental) integrity, economic (livelihood) efficiency and social equity. Several indicators support this claim. Thus, sustainability goals for the Boteti relate to securing livelihoods and environmental protection aligned to poverty alleviation. In this regard, through WOCAT workshops, land users identified several interventions that had potential to meet sustainability goals in their area. These were game ranching, water harvesting, biogas production and utilization and solar power utilization. This report discusses the opportunities (and constraints) associated with these interventions, partly as revealed by WOCAT workshops (e.g. Boteti Stakeholder Report No. 2).

The table shows the sustainability goals that were identified for study site.

Sustainability Goals	
Goal 1	Securing livelihoods
Goal 2	Environmental protection
Goal 3	Poverty alleviation

Source: Stakeholder workshops.

Study site: Secano interior, Chili

The areas of rainfed agriculture in Mediterranean Central Chile have at least 2 main attributes, which should be preserved and enhanced. First is the livelihood for a significant number of farmers (~300.000), who use and generate their incomes from agriculture activities, and contain a valuable cultural and social heritage that the country can not lose. Secondly, being semi-natural areas, where the anthropogenic impact on the environment have been not as overwhelming or devastating as in other areas of more intensive agriculture, these zones have great interest in terms of biodiversity and semi natural landscape.Taking into account both aspects the sustainability goals are to allow rural population to improve their living conditions and to conserve natural and cultural patrimonies. Sustainability goals 1-4 are those of farmers in the area and sustainability goal 5-6 are from the Ministry of Agriculture.

Table 1. Sustainability goals that have been identified in the study area.

Sustainability Goals	
Goal 1	Enhancement of the productive potential of the dryland agroecosystems
Goal 2	Rehabilitation and restoration of degraded soils
Goal 3	To decrease and control soil degradation (erosion and fertility depletion)
Goal 4	To enhance water storage capacity of the soils and watershed
Goal 5	Maintenance of balance between ecological and productive value of the agro-ecosystems
Goal 6	Design, implementation and introduction of technological innovations in the traditional farming systems allowing rural population to improve profitability, productivity and sustainability of agriculture, preserving the environment and cultural and natural patrimony of this vast area of Central Chile

Source: Stakeholder workshops, policy document Ministry.

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Annex 1: Stakeholder analysis and sustainability goals in Botswana

Sustainability goals in the Boteti area

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1.1 Introduction

As can be gauged from the WP1.3 report, the Boteti area is confronted by problems that pose a challenge to the attainment of the three sustainable development goals of ecological (environmental) integrity, economic (livelihood) efficiency and social equity. Several indicators support this claim.

Poverty: the Boteti area has had the highest proportion of permanent destitutes among the 5 subregions of the Central District of Botswana (Central District Council, 2003). Indeed participants in WOCAT workshops confirmed that poverty was the main issue for the communities of Boteti, which they blamed on a harsh, constricted and resource depleted environment (see also Chanda et al., 2007). There is a very high dependence on local natural resources for fuel wood, grazing and traditional construction.

Environment: the area is a well known desertification hot spot in Botswana and has been the focus of several confirmatory studies (e.g. Ministry of Agriculture, 1993; Perkins, 2007; Chanda, et al., 2007; DESIRE, on-going). The once abundant wildlife is now rare as species have retreated to protected areas to the north and west (Perkins, 2007) and wildlife migration into the area is constrained by wildlife and veterinary fences (see WB1.3 report). Recent (May 2009) field survey for degradation indicators by the DESIRE team found that overgrazing is a major problem in the area.

Livelihood productivity: The overgrazing problem just alluded to suggests that livestock production (a major livelihood source in Boteti) is not efficiently practised. Arable agricultural production is constrained by poor soils, unreliable rainfall and the failure of floods for the more productive *molapo* (flood recession) farming along the Boteti river valley. The people link their poverty to a progressive decline in the resource base which has adversely affected the productivity of the various livelihood systems (i.e. livestock rearing, *molapo* farming, wildlife and veldproduct

utilization).

Thus, sustainability goals for the Boteti relate to securing livelihoods and environmental protection aligned to poverty alleviation. In this regard, through WOCAT workshops, land users identified several interventions that had potential to meet sustainability goals in their area. These were game ranching, water harvesting, biogas production and utilization and solar power utilization. This report discusses the opportunities (and constraints) associated with these interventions, partly as revealed by WOCAT workshops (e.g. Boteti Stakeholder Report No. 2).

1.2 Game ranching

This option was highly popular to the land users in the WOCAT workshops, rivaling biogas production and utilization. This is evidenced in Table 1 which presents negotiated scores of the various sustainability interventions. However, while the option has obvious advantages for the environment and socio-economy of Boteti, the range ecologist on the team (Dr. Perkins) points out the constraints to the realization of its potential (see subsection b below and Appendix 1 from which the subsection is extracted).

Table 1: Negotiated scoring adopted by Boteti WOCAT workshop participants

Scoring	To improve the appearance and state of the environment by reducing degradation	To improve harvest	To protect the ozone layer	Profit	To create employment	Education	To alleviate poverty	To conserve culture and natural resources	To promote cooperation, self reliance and volunteerism
Game ranching	5	0	2	5	5	5	5	5	5
Rain harvesting	2	5	2	3.5	2.5	3.5	4	3.5	3.5
Bio gas	5	2.5	4.5	5	4	5	5	5	3.5
Solar cooker	3.5	0	3.5	3	1.5	2.5	2.5	3.5	1

Source: Stakeholder Workshop No. 2, p.10

a) *The general advantages of game ranching*

Game ranching is profitable and can bring economic returns from wildlife resources. Some of the income generating activities include game viewing, trophy hunting, selling biltong and live sale to other ranches. Game ranching can promote local tourism by bringing wildlife closer to people. Lodging facilities can be built inside the ranch and handicrafts sold. Game ranching also promotes culture, where the young generation may also benefit from viewing, interacting and relating to wildlife with a stronger sense of cultural understanding. It is noted that totems (tribal name or badge) for the people of Botswana bear mainly names of wildlife species, a cultural practice from time immemorial. Thus game ranching is seen as revival of culture. For these reasons (economic and social) game ranching is a highly favoured option by the community who see their poverty as the main product of an unfavourable environment in which they live. The

community also sees game ranching as a solution to the overgrazing caused by livestock. Some of the environmental advantages of game ranching are that it can use marginal areas, which can otherwise not be effectively and sustainably used by the cattle. The Boteti area with poor soils, sparse vegetation, saline water and surrounded by wildlife sanctuaries is a good candidate for this venture. Game ranching also allows for the optimization of the range by having a variety of species as they utilize different niches within the ecosystem, as browsers and mixed feeders (Plate 1), unlike cattle which are grazers only. Game ranches can help in conserving threatened and endangered species, thereby reversing or preventing desertification.

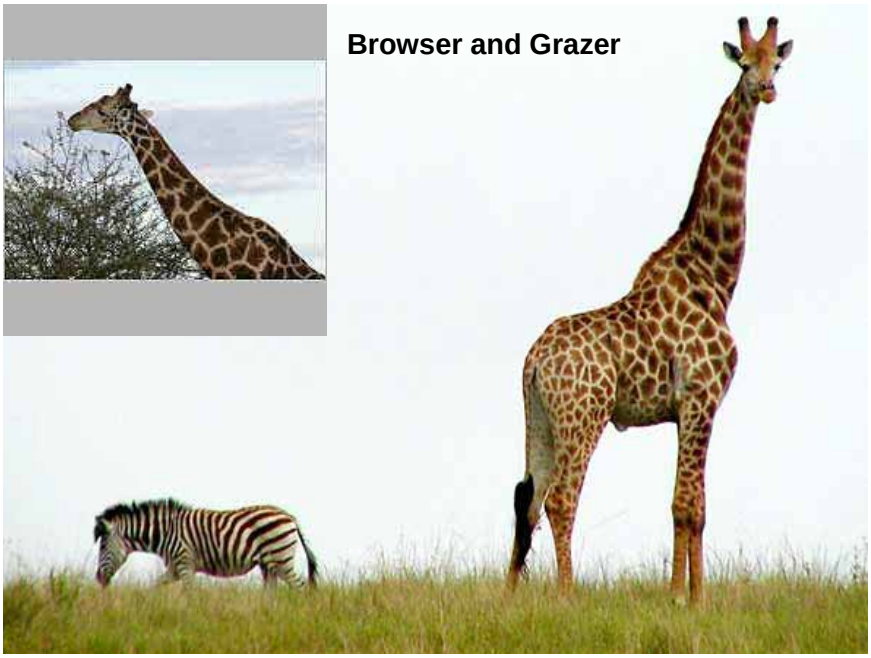

Plate 1: Two wildlife species exploiting different ecosystem niches (Photo: Provided by W. Mphinyane)

b) *Realities for game ranching in Boteti – a SWOT analysis* (extracted from Appendix 1)
The huge wildebeest and hartebeest resource in the Kalahari System has now been lost, while the huge zebra resource in Makgadikgadi has also declined catastrophically. Recovery of the key Kalahari ungulates to those population levels of the 1970s is undoubtedly no longer possible as the available habitat has declined due to livestock expansion and key resource areas have either been lost or are under unprecedented pressure. Securing the key resource areas, would however result in a substantial recovery of the key wild ungulate populations and renewed opportunities for the various forms of game use proposed by DHV (1980).

However, with many recent reports quoting wildlife figures from the late 1980s or even 1990 onwards, there is a very real danger that the potential of the Kalahari resource base to support wild ungulates, as proven by the resources that existed at the time of the DHV (1980) survey, will simply be forgotten or denied. The potential for a meaningful balance between the livestock and wildlife sectors does still exist but does not lie within existing Policy initiatives. Indeed, to continue along the

current path of fenced livestock production and game ranching, is to conflict with the known ecological realities of the Kalahari System and will be unsustainable ecologically and counter productive socio-economically.

Despite the virtual absence of rigorous, consistent and reliable records and data, there is clear evidence that game ranching has increased considerably as a form of extensive land use in southern Africa, especially on private land in South Africa, Namibia and Zimbabwe. Botswana has lagged behind, mainly due to the relative scarcity of private land, the high start-up costs and the fact that hunting and tourism are concentrated in Controlled Hunting and concession areas where free moving wildlife forms an attractive alternative to fenced, “artificial” populations as are found on fenced game ranches.

In Botswana, as in SA and Namibia, owners of game-fenced ranches with adequate fencing are exempted from many of the provisions of conservation legislation. For example, they may hunt any time of the year, may cull at night, may receive payment for hunting, and, subject to meat hygiene legislation, may sell venison and game products.

The removal of subsidies from the commercial livestock sector is undoubtedly a critical development which in South Africa, Namibia and Zimbabwe, overcame a powerful farmer lobby and meant that land use reverted back to wildlife based economies. In Botswana, domestic (e.g. tax breaks and subsidised services and infrastructure for cattle ranches) and international subsidies (the EU Cotonou Agreement) together with support for livestock sales and processing, marketing and veterinary disease control all remain in place. As a result wildlife based economies are disadvantaged. It follows that there is little or no willingness amongst those with an interest in the farming sector to create or maintain livestock free land for wildlife use. As livestock owners tend to be amongst the most politically and economically powerful within the country, land use is effectively locked into a commercial cattle ranching system for the foreseeable future.

Disease control restrictions prevent valuable trophy species such as buffalo, roan and sable being introduced to game ranches anywhere south of the Makgadikgadi Pans fenced southern boundary. Even disease free buffalo are not allowed south of this line – which effectively corresponds with the ‘red line’ fence in Namibia.

It is important to place the potential for game ranching in the Mopipi - Boteti area within the broader spatial context of its location between two protected areas (The Central Kalahari Game reserve and Makgadikgadi Pans National Park), and two distinct and now separated ecosystems – the Kalahari and Makgadikgadi. Game ranches that are isolated from either system are unlikely to be viable, whereas there are two possibilities:-
if a cluster of network of ranches, or a conservancy, can be used to link the two ecosystems
if game ranches can be ‘bolted’ on to the existing protected areas – i.e incorporated within their fenced boundaries via a step wise spatial expansion

A SWOT analysis of the game ranching potential in Mopipi reveals the following:-

Opportunities

Wildlife-based outdoor recreational activities is likely to increase

Wilderness areas and the biodiversity they contain can only increase in value

Climate change will increase this advantage and require increased flexibility in land use and livelihood options – which wildlife based systems can offer

Removal of livestock subsidies will create opportunities for wildlife based production

Rationalise land use planning and strengthen both the wildlife and livestock sectors

Strengths

Drought affected marginal environments are best suited to wildlife based economies.

Ecosystem services and products more likely to be maintained through wildlife based production systems – i.e. sustainability of production

Migratory systems have a higher carrying capacity than permanent grazing systems

Rural communities have the knowledge (ITK) to manage the resource

Equity more likely to be addressed through wildlife based CBNRM than livestock systems

The future of African wildlife conservation will be determined by the fate of areas found surrounding the Parks

Economic diversification – and diversification of the tourism product

Reintroduce species once found in the ecosystems concerned and link protected areas via a corridor

Constraints

Livestock subsidies artificially increase the value of domestic stock

Disease control restrictions prevent the re-introduction of the most valuable and, increasingly rare species (e.g. buffalo, roan, sable and tsessebe)

Predator numbers (especially of lions) decline due to Problem Animal Control and direct persecution (e.g. the poisoning of hyenas as occurred along the southern fence of Makgadikgadi), so removing an important 'big five' product from the area.

Low densities of game found in the area today and meat export/movement barriers

Low value of the species found in the area today (i.e. absence of the big five)

Start up costs (fencing, water provision and species reintroduction) are extremely high on game ranches.

Reluctance to create large areas of livestock free land on the part of those with interests in the livestock sector – spatial scale of game ranches inappropriate

Land cover changes resulting from permanent livestock grazing, namely bush encroachment is damaging the aesthetic and wilderness value of many areas, possibly for as long as 60-100 years – so decreasing the substituitability of livestock and game land uses,
A politically powerful elite dominates the livestock sector
Poor domestic markets for game meat
Expansion of fenced cattle ranches and cattleposts

Weaknesses
The ITK within rural communities is rapidly being lost
CBNRM is currently floundering in many areas and its future is uncertain
The future of trophy hunting, and hunting in general, is in question in Botswana.
Cattle and crops is the politically preferred production system
Negative ecological implications associated with small, fenced properties stocked with wildlife (including area selective grazing, biosphere effects, vulnerability to drought, genetic inbreeding etc).

It should be noted that the opportunities are dominantly ecological and socio-economic in terms of the sustainability and equity potential they offer local communities, while the constraints are political and economic. Indeed as long as the subsidies remain intact the prevailing hierarchy of land use, which elevates livestock to an artificial advantage over that of wildlife, will continue.

While game ranching emerged as the most preferred strategy (Table 1) (overall score = 4.1), it could not be adopted for piloting because of the high start-up costs and much longer-term release of benefits for environment and society.

1.3 Rainwater harvesting

Water is scarce and therefore expensive in Botswana. Better water management and improvement of the quality, quantity and efficient storage and utilization of water is necessary. Rainwater harvesting is an effective means of water provision. Harvested rainwater can be very useful especially at arable lands and cattle posts where water is not provided through standpipes as is the case in the villages. People who have harvested rainwater do not need to travel long distances to fetch water. This is also helpful where ground water is sometimes too salty (e.g. in parts of the Boteti area) for human and/or animal consumption. Plates 2 and 3 indicate the type of water catchment structure and storage facilities common in Botswana and Boteti (i.e. roof catchment and either underground or above-ground storage tanks).

Plate 3: Existing water harvesting structure and underground water storage tank (Mopipi) (Photo: L. Magole)

Plate 4: Plastic water harvesting storage tanks (green) fitted to residential roof structures (Photo: J. Atlhopheng)

If harvested on a large scale and harvesting facilities carefully spatially distributed, harvested rain water could relieve pressure on scarce underground water supply and be used to redistribute livestock grazing pressure. This is particularly significant given the observed the non-optimal distribution of watering points in the Mopipi-Mokoboxane area which encourages overgrazing (CAR, 2006, p.19). Approached this way, rain water harvesting could be an instrument towards environmental sustainability (through prevention of overgrazing and associated erosion of herbaceous species diversity) and social sustainability (through supply of relatively clean water for human consumption at the cattle posts and arable lands).

While water harvesting has obvious has clear environmental socio-economic benefits and is a known strategy in Boteti (promoted and piloted by the Ministry of Agriculture in the area [Plate 3] and countrywide), it was not highly favoured by the land users who participated in WOCAT workshops (Table 1 above) mainly because they felt that the benefits might accrue to individuals rather than the community at large. Thus, community members were more concerned about

1.4 Bio gas

Biogas provides a clean, easily controlled source of renewable energy. Cow dung is collected from cattle sheds or, in the case of Boteti, around cattle watering points and kraals (Plate 4), mixed with water and channeled into fermentation pits. The resulting gas is produced as a by-product of this fermentation and collected in a storage tank from where it is piped into the user's house (Plate 5). It can be used for electricity production, cooking, water heating and laundry. By using biogas one can save time, use less labor and save trees. The gas doesn't have smoke or smell, so it reduces eye and respiratory irritations. The used cow dung, i.e.sludge, is a better fertilizer and cheaper than manufactured products. Thus with biogas, the final waste product (sludge) is used as fertilizer. It was also indicated that, other organic wastes like cuttings in the kitchen could be used to generate biogas. Thus a total recycling system incorporating the toilet, kitchen and garden could be part of the set-up.

Since cow-dung is collected from around water points and or cattle kraals, not in the open veldt or range, there is no danger of any decline in soil fertility in the range. In most cases, the water points and cattle kraals act as excessive concentration points for cow dung (not suitable for most plants). The points around boreholes, due to excessive manure (cow dung), are devoid of vegetation and have therefore been termed 'sacrifice zones', the sacrifice paid for keeping the cattle industry. Some of the sacrificial zones persist for over 100 years. Thus biogas is mainly seen as halting this process, of creating bald patches on the landscape.

Plate 4: Cattle dung by cattle post kraal

Plate 5: Biogas infrastructure (Photo: Rural Industries Innovation Centre [RIIC], Kanye, Botswana)

Biogas production emerged as the next most popular strategy to game ranching (Table 1) (overall score = 3.8). It was less costly to pilot than game ranching, and biogas facilities are easy to set up. However, general poverty in Mopipi and Mokoboxane means that community members cannot afford the cost of implementing the strategy. They therefore pleaded with DESIRE to provide funds for the purpose or assist in raising the required funds. The objective, commitments and benefit indicators as agreed by community members are presented in Table 2 below.

Table 2: The objective, commitments and benefit indicators of the biogas strategy

Objective	Technology	Commitments made by different stakeholders	Stakeholders	Indication of improvement
To reduce depletion of trees	Biogas	To consult with the community Form the committee that will look after the test plot Find a plot Find ways of raising money Provide education Being involved in the day to day running of the project Maintenance Organize evaluation meetings Write reports	VDC The community Committee The committee and Desire The committee, Desire and RIIC The community and Desire The committee and RIIC Desire Desire	Reduction in cutting down of trees More people buy and use biogas Improvement in the lives of people*

* Improvement in welfare would arise from the benefits discussed under Step 7 above. Time saved from firewood collection, jobs created and income gained due to biogas –based enterprises would serve as indicators.

Source: Stakeholder Workshop No. 2, p.14

1.5 Solar cooker

As can be seen in Table 1, this was the least popular strategy considered. The focus was on sunlight as a fuel for cooking. A solar cooker needs an outdoor spot that is sunny for several hours and protected from strong winds, and where food will be safe. Solar cooker would not work at night or on cloudy days. Food cooks best in black, shallow, thin metal pots with black tight-fitting lids to hold in the heat and moisture. One or more shiny surfaces reflect extra sunlight on to the pot. Solar cookers are better than other means because fuel is free and abundant, provide extra income, saves time (food doesn't need to be stirred and would not burn. Solar cooker is portable, allowing solar cooking at work sides, picnics and camping sites.

Plate 6: Solar at work during Workshop 2 (Mopipi) (Photo: R. Chanda)

While solar cooking could relieve pressure on woody vegetation as an energy source, community members felt it had insufficient socio-economic benefits. Also considering the relatively high wind speeds in the area, solar cooking could not be a very practical strategy.

1.6 Concluding remarks

There is great need to pursue environmental, social and livelihood sustainability in the Boteti area. Fortunately this need is much appreciated by local land users, who are also willing to be directly involved in the pursuit of the goals. Indeed, with external support and facilitation, they have organized themselves into a Trust and adopted a land and range resources management plan (CAR, 2006). Unfortunately, the communities feel incapable of pursuing the goals on their own due to serious capacity problems. There Is therefore need for a co-management strategy in which land users, DESIRE, government, non-governmental organizations and even the private sector would be complementing players. Government has adopted a CBNRM Policy under which it has established an environmental fund which is not yet fully functional. The communities have had financial and capacity-building support from GEF and UNDP (e.g. for the development of the Trust and the Management Plan as well as for the construction of a drift fence) (CAR, 2006; Chanda et al., 2007). At the moment the communities' hopes are pinned on DESIRE to mobilize funds and co-management partnerships for the implementation of the WOCAT-generated sustainability strategy (biogas production and use). Failure by DESIRE to assist in this way would surely deal a heavy blow to future applied research initiatives in the area.

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Annex 2: Stakeholder analysis and sustainability goals in Crete

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Stakeholder analysis and sustainability goals for Crete study site

2.1 Introduction

In the coming years the formulation of agro-environmental tools to support sustainable development of rural areas and to support our society's demands for protection of the environment becomes increasingly important. The European Union Program of policy and action in relation to the environment clearly identifies the need for applying such land management practices that support the sustainable use of natural resources. The sustainable use of natural resources requires an adequate management of the key activities associated to them with a great interest and measures adapted for soil and water conservation.
Sustainable farming is defined as an agricultural system evolving towards greater human utility, increased efficiency of resource use, minimum depletion of non-renewable resources, and environmental interaction favourable to humans and to most other species. Sustainable farming is associated with measures applied in agriculture in order to confront, overcome, and prevent land degradation and desertification. The main threats to agricultural and natural ecosystems are related to the following processes: soil erosion, soil salinization and alkalization, loss of organic matter, chemical contamination of soils and waters, loss in biodiversity, soil compaction and sealing. All these processes are associated with land desertification. Soil erosion and particularly accelerated erosion which is caused by anthropogenic activity leads to deterioration or loss of one or more soil functions and vegetation performance. Factors which usually lead to accelerated erosion are stripping of natural vegetation especially clearance of forests, change in cultivation techniques, over-grazing, wildfires, land leveling, cultivation of steep slopes. The soil organic matter content reflects a dynamic equilibrium between inputs from vegetation and the decomposition of organic matter by soil biota. Decline in organic matter content is an important component of land degradation greatly affecting soil erosion and CO_2 emission to the atmosphere. Intensification of agriculture and wildfires leads to drastically decline of organic matter content. Soil salinization is a process that leads to excessive amounts of water soluble salts in the soil resulting from upward movement of ground water to the soil surface due to evapotranspiration and from irrigation with poor quality of water. Soil contamination and water pollution may occur over wide areas introduced by diffusion from the atmosphere, or more

locally by industrial activity or by the application of fertilizers and pesticides. Soil biodiversity is exceptional diverse and it is closely related to soil functionality and climatic conditions. Soil compaction is related to reduction of air-filled porosity causing a deterioration or loss of one of soil functions. It is caused by external forces arising from surface loading exerted by agricultural machineries or from the grazing animals. Soil sealing is related to urban expansion and connecting infrastructures that leads to complete or partial sealing of soil surface, resulting in loss of any agricultural function by eliminating water infiltration and gaseous exchanges with the atmosphere. The above mentioned threats are motivated by various drivers and pressures resulting in degradation of the various agricultural ecosystems. Sustainability has the main objective to alleviate the above processes and ensure minimum depletion of natural resources. The various agricultural ecosystems are subjected to various degradation risks depending on the type and the intensity of the threat. The objective of this topic was to identify sustainability goals and objectives for protection and restoration of natural resources in Crete study site through facilitated discussion and multi-criteria evaluation in focus groups including local stakeholders.

2.2 Methodological approach

The analysis of the sustainability goals for protecting natural resources from land degradation and desertification was conducted following two main approaches: (a) farm survey, and (b) stakeholder workshop. The purpose of the farm survey was to collect data on indicators (WB2) and to discuss with individual farmers possible sustainability goals for environmental protection. The farm survey included informal discussions with the farmers related to: (a) the physical condition of the farm and the problems faced in crop production and loss in land productivity, (b) the impacts of land degradation and desertification on the physical environment and on the social and economical characteristics of the area, and (c) the possible actions and goals for protection and restoration of natural resources. The farm survey was conducted in two dominant land use types: (a) agricultural crops (olives and vines) and (b) and pastures. Forests are also important land uses in the island but these areas are strictly controlled by public agencies.

The stakeholder workshop 1 was conducted in the municipality of Agia Barbara included farmers, land managers and policy makers drawn from the local community, including public organizations such as the Forestry and Natural Environment Department of Heraklion, the Agricultural Department of Heraklion and NGOs. The various speakers analyzed the causes and impacts of land degradation and desertification using the results of research projects conducted in the area. Each presentation was followed by a discussion of 30-50 minutes. At the end, the participants were asked to provide their opinion and stance with respect the major forces and processes of land degradation and possible actions for sustainable use of natural resources. After the discussion, people were asked to vote on which of the options they consider as the most important assigning different scores. The various identified sustainability goals were categorized according to their importance based on multi-criteria evaluation taking into consideration the most importance processes of

desertification, the social and economic characteristics of the area, and the existing trends in the island on sustainable use of natural resources.

2.3 Identified sustainability goals

The analysis of the information obtained from the farm survey and the stakeholder workshop showed that farmers have realized that the existing land management practices applied has in many cases created problems on plant production, farmer's income and on the environment. Also stakeholders have pointed out that restoration of degraded hilly areas used as pastures or for agricultural crops are costly and impossible under the existing social and economic conditions, but farmers promptly accept to change land management practices for preventing further degradation and protection of the environment. Of course some of the changes on land management practices can be achieved under the existing policies or after providing financial support by the local government or European Commission. Some of the most important sustainability goals pointed out by the local stakeholders can be summarized as following:

Policy enforcement of existing regulations on protection of natural resources
Reduction of grazing animal density
Technology transfer to farmers
Preservation of olive plantations
Water conservation and increasing water availability
Afforestation of degraded agricultural or grazing land
Control of illegal expansion of agricultural land on natural areas
Measures for protection of forest fires
Promotion of organic farming
Delineation and protection of productive agricultural land
Reduction of soil and water pollution

Based on the above identified goals of sustainability for the study site of Crete and considering the most important processes of degradation and existing actions or trends for sustainable use of natural resources more widely accepted by the local society, the following sustainable goals for land protection from desertification have been identified and proposed:

Policy enforcement of existing regulations on protection of natural resources
Awareness and technology dissemination
Sustainable management of grazing land
Preservation of olive plantations
Water conservation and increasing water availability
Promotion of organic farming
Delineation and protection of productive agricultural soils

Policy enforcement of existing regulations on protection of natural resources

Policy enforcement refers to the implementation of existing regulations on environmental protection. For example the Greek regulation 1032/1979 defines policies for the protection of forested areas and considers

measures for the improvement and development of these areas. Farmers have realized that there many regulations for protection of the environment but they are not implemented. EU policies have affected considerably the formulation of policies in the study area of Crete and in the whole country. For example the Water Resources policy aims the sustainable planning and management of water resources to ensure their adequate protection while meeting present and future development needs. However, the water resources policy faces implementation problems. It has no dedicated financial instruments. Many and competing decision makers and water users from various spatial levels are involved in water resources complicating sustainable actions.

The Biodiversity policy (Habitat Directive and NATURA 2000 network) refers to the protection of biodiversity and sensitive ecosystems including decertified areas. However, their implementation is fraught with problems. Violations are frequent as most users of land pursue other than environmental goals. Policy makers and implementers are reluctant to enforce the directive, which, in addition, is not tied to any financial instrument.

The Forest policies have the potential to protect forest resources as well as to restore degraded lands by controlling forest fires, deforestation, etc. However, they are frequently violated as they conflict with the economic goals of the users of land.

The spatial planning policies and systems are of instrumental importance at national and regional level. Theoretically, they aim at guiding the optimal spatial distribution of economic activities and uses of land towards sustainable management of resources. Development control (e.g., zoning, green belts, etc.) coupled with economic instruments may help protect resources from present and future degradation by moderating population pressures. However, these policies are often either absent or inadequate; their formulation is influenced by vested interests, and bureaucratic problems, administrative compartmentalization.

The Greek National Action Plan for combating desertification includes guidelines for proper land management in the sensitive and affected areas. Its implementation is hampering by the absence of strong spatial policies and the involvement of many and conflicting interests in the land development process.

Awareness and technology dissemination

It has become obvious that desertification is a serious local regional and international environmental problem, with severe global consequences that requires consistent combating strategies. The success of such strategies depends on how well our society is informed about the multiple consequences in our life. People of Crete have pointed out the importance of warning the society on this major global environmental problem and disseminating existing knowledge on combating desertification. In this aspect there is an urgent need for national and local administrations and citizens to take knowledge-supported decisions and action concerning the causes and consequences of desertification, and to implement effective mitigation solutions for combating desertification. This means that local farmers should be accordingly informed about the negative impacts of desertification and educated in appropriate land management practices for alleviating the desertification impacts.

The growing use of information and communication technologies (ICT) has opened an enormous window of opportunities for the transfer and exchange of knowledge. The internet has become a privileged instrument of information transmission; of ideas and concepts, sharing results, with the advantage of being interactive and allowing work in real time. A new reality is being faced, one that makes possible effective spreading of the practical and applied components of science, which is essential for the progress of human society as a whole. Furthermore, the existing organized information on easily used tools can help scientists to disseminating knowledge to the farmers.

Sustainable management of grazing land

Crete has a long history of overgrazing but in some areas of the island such as Asterousia and Psiloritis mountains overgrazing resulted in land desertification. Since 1980, sheep and goats have increased by about 3 times, mainly due to European subsidies. Overgrazing resulted in a land with sparse shrubs, which is the last degradation stage of the mountain these sparse shrubs have increased by 85% between 1961 and 1989 at the expense of denser scrublands and forests (Papanastasis, 2004). Overgrazing removes the vegetative cover and expose the soil to erosion. If overgrazing occurs for a long period under semi-arid climatic conditions such as those prevailing in Crete, then land desertification is expected.

Farmers in Crete have realized that land is overgrazed with adverse consequences on the environment. Reduction of grazing intensity or application of alternative land management scenarios are welcome by the local people under the condition that their income will not decrease. Successful mitigation of desertification in grazing lands and landscapes can be achieved if integrated grazing management is applied. Such a management involves the use of alternative grazing lands feed resources, existing or developed for this particular purpose, so that the high grazing pressure on grazing land is alleviated. Some other social-political measures for protection grazing land are: (a) enhancement the use of local breeds by providing financial support through subsidies or better prices of products, (b) promotion of the production of quality animal products so that to encourage farmers to reduce the high number of animals and concentrate fewer but more productive ones, (c) allocating the present subsidies under the condition that the number of animals will be reduced to a sustainable number, (d) diversifying farmer income by promoting other activities such as honey production, collection of aromatic plants and developing agro-tourism.

Preservation of olive plantations

Olive's plantations are supremely adapted to Mediterranean climatic conditions. They can tolerate low temperatures down to -15°C in midwinter. Foliage is damaged by frost only during active growth. Olive plantations can be considers as a natural forest. Biodiversity under certain land management practices and in particular traditional and marginal ones provide dry food and protection to numerous species of microorganisms, small and large animals, birds, other understory plant species and thus contribute decisively to maintaining high biodiversity levels in one area. In Crete, about 65% of agricultural land is covered by olive plantations which are separated by other plantations by the other plantations by the

beautiful silvery-green color of leaves. Several tourist resorts are surrounded by olive plantations and many tourist complexes have their grounds decorated with old or new olive trees.
Olives present a particularly high adaptation and resistance to long term droughts. The olive groves can be considered as a natural forest highly adapted in dry Mediterranean conditions, with lower vulnerability to fires as compared to pine forests protecting hilly areas from desertification. Soil erosion rates can be substantially decreased in olive groves with understory vegetation of annual plants. The annual vegetation and plant residues have a high soil surface cover, preventing surface sealing and minimizing the velocity of the overland runoff water. Furthermore, olive tress are evergreen plants interrupting raindrop impact on soil surface, therefore, soil erosion is highly reduced. Olive plantations growing in hilly areas under proper farming practices greatly contribute to higher amount of rain water infiltration into the soil enriching subterranean aquifers and springs.
Of course intense cultivation of olive groves by plowing the soil and applying high amount of fertilizers greatly contributes to land degradation and ground and surface water pollution. Intensive cultivation of olive plantations account for 30% of the overall area of Crete. Preservation of olive groves and promotion of sustainable farming will greatly contribute to protection of silly areas sensitive to desertification.

Water conservation and increasing water availability

The sustainable use of water resources requires an adequate management of the key activities associated to them with a great interest and measures adapted for water conservation by local authorities and land users. Although precise estimations of the available water resources in Crete have not been made, most related entities agree that the water consumption and use constitute only a small percentage (less than 5 %) of the annual precipitation. The annual water accumulation from rainfall and snow fall for Crete has been estimated by the Greek Institute of Geological Research (IGME) to 7.2 billion of m^3. From this amount 3.6 billion of m^3 are lost, 1.6 billion m^3 are moved by surface water toward the sea and the remaining 1.6 billion m^3 are moved underground with its' final destination the sea. Although the Messara valley receives on average about 600 mm of rainfall per year it is estimated that about 65 % is lost by evapotranspiration, 10 % as runoff to sea and only 25 % percolates into the ground for recharging aquifers. In the area of Chania the yearly water capacity is estimated at 150 million m^3 of water (both ground and underground sources). The existing water works projects in Chania are estimated to capture and utilize only 35% of the water resources. The rest is unable to be stored in water reservoirs and it is flowing to the sea. The uneven distribution of rainfall during the winter months and the high demand for water during the summer months creates water availability problems in Crete.
Transfer of water from western to eastern Crete faces severe technical, social and cost limitations. At present, there is little surface runoff storage and the groundwater is being depleted rapidly. Groundwater is the key resource controlling the economic development of Messara valley while spring water is mainly used in Chania region. Following the detailed agricultural development study conducted by the United Nations Food and

Agriculture Organization in 1972 (FAO, 1972) for the exploitation of the Messara valleys water resources, an extensive network of pumping stations has been installed since 1984 using the water for irrigation of olive groves. The consequences were the increase in plant productivity and the dramatic drop of 20 m or more of the groundwater level in some places. In addition, It is estimated that about 30% of the water distributed to agriculture for irrigation is lost through the network in the Chania region. Furthermore, in Heraklion prefecture, water network is old and leaky, with up to 50% of water being lost according to local residents. Therefore, water conservation can be achieved by decreasing losses of water along the conveyance structures by constructing lined instead of unlined conveyance canals or channels, sealing channels using sealing materials, etc. Furthermore, water can be conserve by applying techniques such as: using crops of lower water requirements, scheduling irrigation according to water requirements, decreasing of water applied to olive groves up to 30% without significant change in oil production, promoting higher rain water infiltration into the soil by applying the appropriate cultivation technique.

As it was mentioned above, the highest amount of precipitation is lost as surface runoff or deep percolation. Construction of new surface reservoirs, in Crete will greatly contribute to the increasingly demands for water in the agriculture and tourism sector. It has already initiated the construction of a reservoir in Alikianos, Chania region, (the Aposelemis dam) for storing spring water during the winter period and using in the dry period. In addition, the municipality of Agia Barbara, in Heraklion prefecture, is preparing for building a small water reservoir in the watershed of Larani. In the Messara valley has initiated the construction Faneromeni dam near Vori. The work has initiated in 1999 and finished in 2003, but the network for transferring the water is not yet constructed. Another major irrigation project is planned for the Messara valley for redirection of the Platys River, which flows into the sea in Agia Galini area.

Promotion of organic farming

Organic farming is a natural way of producing agricultural products avoiding or largely excluding of widespread use of manmade pesticides, synthetic fertilizers, plant growth regulators, along with livestock feed additives. Land management practices in organic farming includes natural crop rotation, application of crop residues and animal manures, and mechanical control of growing weeds, insects, and other pests that can be harmful to plants. Such techniques can be considered as friendly to the natural environment reducing the rate of land degradation and supporting a higher farmer income. Farmers of Crete have adopted the philosophy of organic farming, as agricultural products are in many cases in Crete are sustainable, without the use of manmade fertilizers and other alternative methods. The first idea was to encourage a parallel sustainable development of tourism and agriculture which is facilitated by many agricultural products consumed by tourists. Organic agriculture is a good “tool” for this because it produces high quality agricultural products in close proximity to hotels and other tourist locations. When properly applied, organic practices can also help protect natural resources and environmental quality.

In Crete the bio-intensive agriculture was the first large scale project on

parallel development that was implemented in Greece in 1995. This resulted from the combined efforts of MASH (the consultant for organic production) and Grecotel (the largest hotel chain in Greece) which was the final consumer of the organic products and provided funding for the project. Emphasis was given to vegetables as the primary product and the use of bio-intensive-organic agriculture fulfilled the goal of combining healthy and high quality agricultural products with parallel protection of the environment. The co-existence of farmers and hotels has successfully proceeded over the past decade. Between 1995-2000, the program tested the performance of about 150 varieties of vegetables under bio-intensive methods according to EC Regulation 2092/91 (organic agriculture regulation). Low cost composting methods were introduced to farmers for producing natural fertilizers that promote healthy soils

The natural environment of Crete favors the development "earth friendly" growing crops, particularly for basic agricultural products, such as olive oil, wine, meat and cheese which are well adapted to the climatic conditions of Crete. In the last few years a group of farmers applying organic farming were united in a project to make publicly available selected organic products that would meet the exact requirements of modern consumers. This task started from olive oil producers. Demands for such products were very impressive. Every year new farmers join the organized groups of organic farmers, while scientific research in the field of organic farming is flourishing.

Today the Western Messara valley is considered as the most important organic olive production centre in Crete. The "Organic Farmers of Messara" cooperative includes around 200 olive growers. Most of these growers have small-scale operations, 1.5-10 ha size. Members of the co-operative have formed a producer group (Organic Olive Growers of Messara) consisting of young and older farmers. The cooperative has its own employees controlling the quality of the products, processing, and marketing the olive oil and olives produced by its members. Olive products are consumed in local and international markets.

Delineation and protection of productive agricultural soils

In the last decades urban and industrial areas are expanded in productive agricultural soils. The internal population migration towards the coastal zone is linked with economic activities such as tourism, harbour facilities, naval and storage facilities and services such as fishing, and infrastructure development resulting in a tremendous expansion of artificial land cover over rather short time periods. The coastal zone includes many wetlands which play a crucial role in maintaining and enhancing environmental quality and providing valuable economic benefits through their many functions such as water purification, carbon sequestration, maintenance and equilibrium of the water cycle, hosting millions of migratory birds, and providing excellent environments for leisure.

Unfortunately often urbanisation has expanded on illegal basis. Whether the decision makers could or could not stop such a process is often an open question accompanied with much controversy. The concentration of activities in such narrow strips of land is accompanied with loss of fertile agriculture soils and valuable coastal habitats as well as pollution and increased environmental damage. Such productive land has to be mapped and protected from any other use except agriculture.

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