Assessment of Cultural Practices in the High Mountain Eastern Mediterranean Landscape

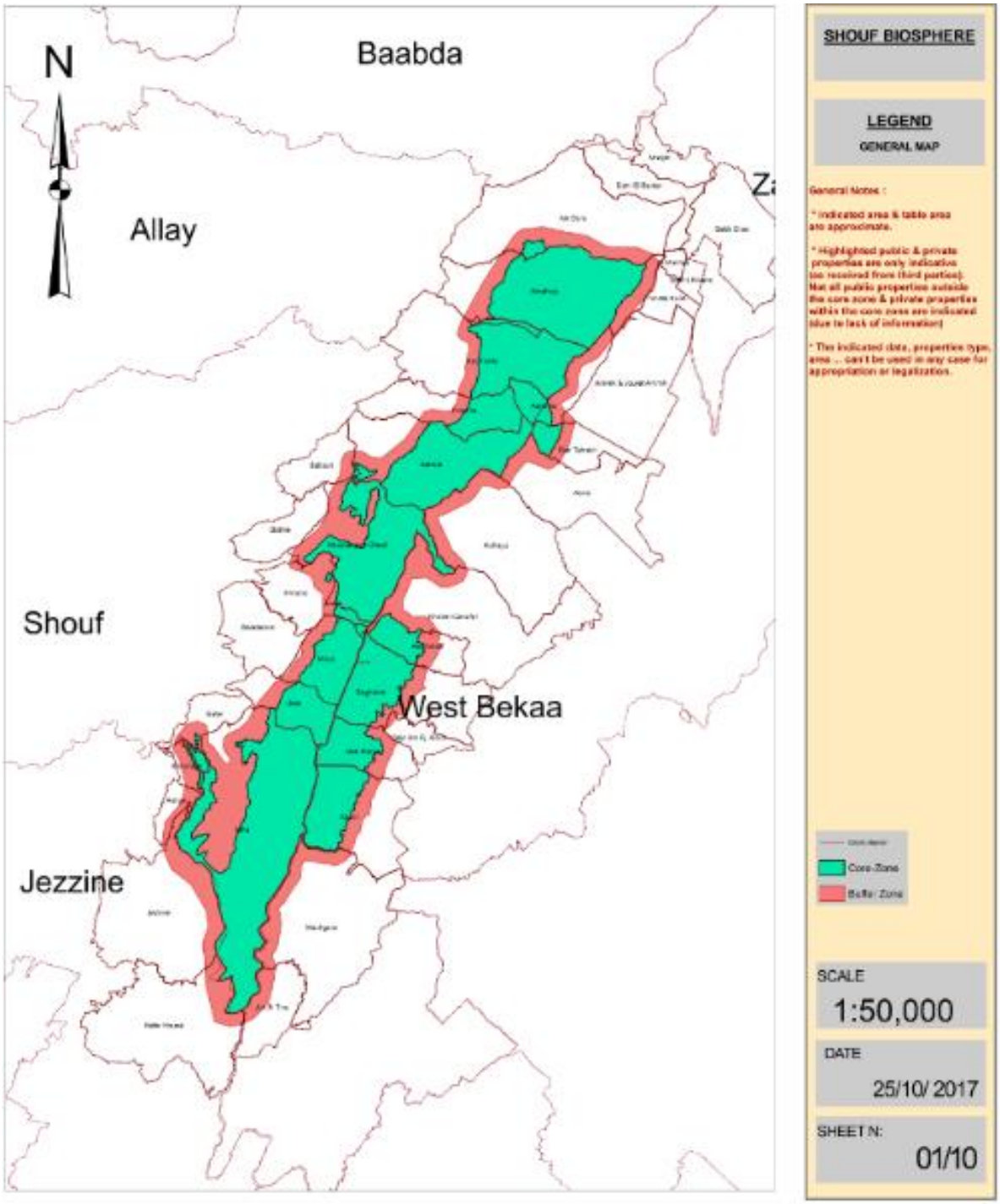
Al-Shouf Cedar Society

CEPF

INDEX

The Study Area- Shouf Biosphere Reserve	02
Introduction	03
1. The Shouf Biosphere Reserve (SBR)	04
A. Legal status of the Shouf Biosphere Reserve	04
B. Physical characteristics	04
C. Natural characteristics	05
D. Socio-economic feature	07
2. Assessment	09
• Literature Review	09
• Overview	10
• Introduction	11
A. Traditional agricultural practices in the Levantine Mountains	12
B. Some general recommendations	13
C. Guidelines	15
D. Traditional Agricultural Techniques	24
E. Best Agricultural Practices	25
F. Additional Best Management Practices	26
G. Livestock:	30
• Conclusion of Literature Review:	31
• Special mention	32
• References in English:	34
3. Biodiversity in Lebanon	37
4. Survey	41
5. Monitoring of Biodiversity Programme in the Shouf Biosphere Reserve	42
6. Biodiversity and Cultural Practices at the at the SBR	47
7. Recommendations	48
A. Agriculture:	49
B. Water management:	51
C. Promotion of Ecotourism:	52
8. Information sheet	54
A. Agriculture	54
B. Grazing	60

The Study Area- Shouf Biosphere Reserve



Introduction:

This report has been developed in the context of the Mediterranean Basin Biodiversity Hotspot Small Grants of CEPF. Its aim was to "support CSOs to work with local community land managers and local businesses to pioneer innovative ways to sustain the elements of traditional land-use practices that are important for biodiversity", under Strategic Direction Investment Priority 3: to promote the maintenance of traditional land-use practices necessary for the conservation of Mediterranean biodiversity in priority corridors of high cultural and biodiversity value.

It is based on the work done by the Reserve since 2012, starting with the Mediterranean Mosaics Project when ACS developed its first Forest Landscape Restoration (FLR) plan, covering an ecological corridor connecting the Beqaa Valley and the Ammiq wetland in the east to the western slopes of the Shouf Biosphere Reserve mountain range.

Innovative techniques and the respect of cultural practices have been the key elements that guaranteed the success of the process, starting from the production of the seedlings. The work was done in a participatory approach, involving local authorities, farmers and small-medium size businesses, in addition to other players in the region.

It involves a thorough portrayal of the site where the assessment was conducted, a literature review of cultural/traditional practices and their links to biodiversity. Included in the report is a description of the Monitoring of Biodiversity Programme, a pioneer initiative, implemented by ACS and aiming at showing that sustainable agriculture systems do positively affect quality and quantity of biodiversity.

The assessment also probed local knowledge and tried to identify the trends and drivers of change that have been influencing agriculture in the past years.

Based on all the above, this assessment has been able to define a series of cultural practices that are embedded in the local culture, proven to be beneficial to biodiversity and most importantly replicable in other areas in Lebanon, and in similar sites around the Mediterranean.

1. The Shouf Biosphere Reserve (SBR)

A. Legal status of the Shouf Biosphere Reserve

- **National status**

Lebanese Government legislation, Law No. 532 of 24 July 1996 declared "The communal lands of Niha, Jbeih, Mreste, Khraibe, Maasser, Barouk, Bmohreh, Ain Dara, Ain Zhalta villages, in addition to the Government owned lands on the eastern side of Barouk Mountain" a Nature Reserve.

- **International status**

In July 2005, UNESCO declared the Shouf Cedar Nature Reserve a "Biosphere Reserve" called the Shouf Biosphere Reserve (SBR) with an area of approximately 50,000 hectares - or 5% of the total area of Lebanon. The SBR includes the:

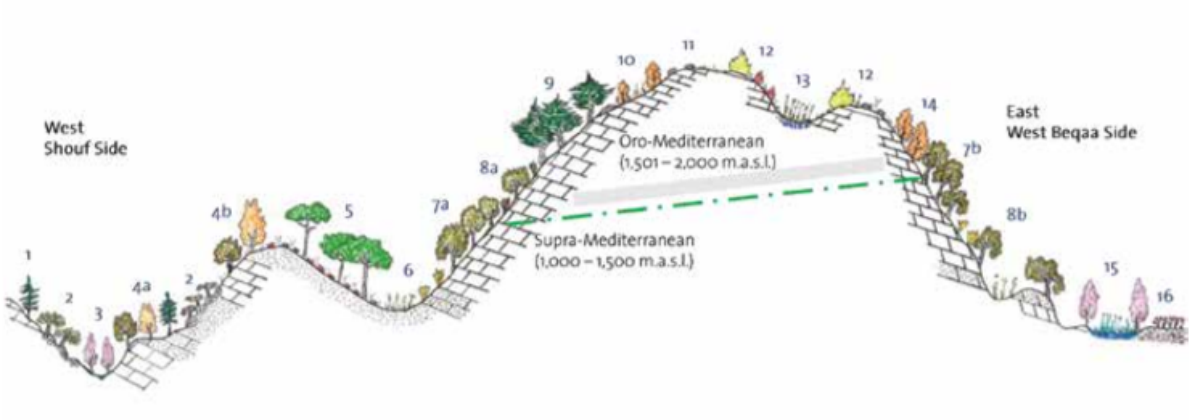
- A Core Zone (161 sq. km) of the SBR consists of the protected areas of Al-Shouf Cedar Reserve (Law 532), Ammiq Wetland, and private lands.
- A Buffer Zone (54 sq. km) consists of municipal lands incorporated into the Al-Shouf Cedar Reserve (Law 532), and private lands.
- A Development (Transition) Zone (233 sq. km) consists mostly of private lands, municipal lands, and religious trusts (Awqaf).

B. Physical characteristics

- **Elevation**

Elevation increases rapidly and over a short distance from the lowest elevation of 1100 meters to the highest elevation of 2000 meters.

Bioclimatic zones in the Shouf Biosphere Reserve Landscape



Supra-Mediterranean Bioclimatic Zone

1 - Brutia pine (Pinus brutia) forest
2 – Oilve & fruit tree plantation in agricultural terraces
3 - Riparian forest (Alnus orientalis, Platanus orientalis, Populus alba, Salix spp)
4a – Mixed forest (Quercus calliprinos, Q. Infectoria, P. Brutia)
4b – Mixed oak forest (Quercus calliprinos & Q. Infectoria)
5 – Stone pine (Pinus pinea) forest
6 – Low mountain pastures and shrubland (Sarcopoterium spinosum & Calycotome villosa)
7a – Dense oak (Quercus calliprinos) forest in the more humid Shouf side
7b – Dense oak (Quercus calliprinos) forest in the more dry and continental Beqaa side
8b – Open oak (Quercus calliprinos) forest in the more dry and continental Beqaa side
15 – Ammiq wetland with Fraxinus syriaca and Ulmus minor forest
16 – Vineyards in the flatland area of Beqaa valley

Oro-Mediterranean Bioclimatic Zone

8a – Open oak (Quercus calliprinos Woodland and high mountain shrubland (Spartium junceum, Styrax officinalis, Colutea cilicica)
9– Cedar (Cedrus libani) forest
10 – Open oak (Quercus brantii subsp. look) forest and copses of Rosaceae tree species (Sorbus torminalis, S flavellifolia, Pyrus syriaca, Prunus ursina, Crataegus azarolus)
11 – Mountain Summit throny cushion shrubland (Astragalus spp., Onobrychis cornuta, Acantholimon ulicinum, Berberis libanotica, Prunus prostrata)
12 – High mountain juniper Woodland (Juniperus excelsa)
13 – Doline depression humid pastureland (Hordeum bulbosum, Blysmus compressus, Alepecurus arundinaceus)
14 – Dense oak (Quercus brantii subsp. look) forest and Quercus Calliprinos
7b – Dense oak (Quercus calliprinos) forest in the more dry and continental Beqaa side

Forest Landscape Restoration Guidelines

- **Climate**

A typical Mediterranean climate with four distinct seasons where the average temperature of the warmest month (Aug) is 20 °C, and the coldest month (Jan) is 4 °C. The summers are warm and dry while the winters are cold and wet.

✓ **Climate Change**

Available information about climate change in Lebanon can be found in Lebanon's third national communication to the UNFCCC {MoE/UNDP/GEF (2016)}. It concludes that there is a 40% reduction of snow cover with an increase of 2ºC, that snow residence moved from 110 to 45, and the shift of snow fall from 1,500 m altitude to 1,900 by 2090. There is an earlier snow melt with reduced water availability in the soil, rivers and springs during summer. Drought periods are expected to be 9 days longer by 2040 and 18 days longer by 2090, and the dry

summer season will extend in length with 43 additional days with maximum daily temperature higher than 35°C. This will lead to soil moisture reduction and a higher risk of forest fires.

ACS is developing a comprehensive and integrated climate change resilience strategy for the SBR (considering not only ecological features but also socio-economic activities in the development area). It aims to identify major needs and guide mainstreaming and integrating Climate Change in the day to day work of SBR, and provide necessary information to inform decision making.

C. Natural characteristics

- **Ecosystems**

Based on the Corine Classification (1999) the reserve belongs to 3 Mediterranean levels:

1) the "Supra-Mediterranean Level" of vegetation which extends over the lower parts of the eastern and western slopes up to 1500 meters of altitude, with oak trees as dominant, however on the western slopes the cedar trees dominate between 1050 - 1925 meters

2) the "Montane Mediterranean Level" that covers both slopes between 1500 and 1900 meters with cedars dominant on the western slopes and absence of cedar trees on the eastern slopes where the oak and hawthorn trees predominate

3) the "Oro-Mediterranean level" of vegetation which extends above 1900 meters.

- Flora

The list of Shouf Biosphere Reserve species includes 436 identified plant species distributed over 61 families. The reserve provides habitat to 25 internationally and nationally threatened species, 48 endemic to Lebanon (Lebanon/Syria/Turkey), 14 rare species, whilst 214 species are restricted to the Eastern Mediterranean/Middle East area.

The Shouf Biosphere Reserve is most famous for hosting one of the largest stands of Lebanese cedar (Cedrus libani) in the country. The reserve hosts about 620 hectares of cedar forest, which are largely confined to the steeper and less accessible areas, and represents the natural southern limit of this tree. For the scientist, as well as the visitor, it is important to remember that human intervention in the region of the SBR is as old as recorded history. Nowadays the

cedar forest, protected from grazing and other human interference, is showing clear signs of natural regeneration.

Whereas the cedars are found at the higher altitude of the western slopes of the Shouf, the lower altitudes and eastern slopes are the domain of evergreen and broadleaf East Mediterranean oaks, such as *Quercus infectoria, Quercus calliprinos*, and *Quercus brantii* sp. Look – an endemic subspecies to the reserve. Many of the oak forests have been subject to regular harvesting for firewood and charcoal production, resulting in extensive areas of coppiced oak woodland and low forest with shrub vegetation. Finally, a large portion of the SBR, especially in the most degraded areas (mostly above 1900 meters) is dominated by scrubland and high mountain pastures. These ecosystems are particularly rich in aromatic, edible, and medicinal herbs and plants.

- **Mammals**

The Shouf Biosphere Reserve is one of the last remaining areas in Lebanon where larger mammals that once roamed the region can still be found, such as the wolf, wild boar and wild cat - or can be reintroduced such as the ibex and mountain gazelle. Wolves are few and their numbers are unlikely to hold a stable population, due to the absence of large herbivores on which the wolf feeds. Striped hyenas are found on the borders of the reserve, mainly feeding on the garbage dumps and agricultural crops of surrounding villages. Wild boar, wild cat and jungle cat have all increased in numbers since the reserve was established, as well as the jackal, red fox, porcupine, and squirrel. The gazelle is sporadic in the area. Preparations for the reintroduction of the Nubian ibex are well underway.

- Birds

Over 250 bird species have been recorded in the SBR and the Ammiq Wetland (the wetland is a Ramsar site and Important Bird Area - IBA). The birdlife of the Shouf mountains includes rare or endemic birds such as the Syrian serin (Serinus syriacus), Eagle owl, Chukar partridge, Long-legged buzzard, etc. The whole area, placed strategically between Europe, Africa, and West Asia, is very important for bird migration. Every year countless storks, birds of prey and other migrants pass over the SBR.

- Reptiles and amphibians

The region contains 31 species, including chameleon, tortoise, and several species of snakes, lizards, frogs, and toads. Some of the most important are:

D. Socio-economic features

- **Cultural heritage**

The Shouf is a nexus of many cultures, religions, and historical events all of which have left an imprint that makes the area's cultural heritage as rich as its ecosystems. The setting of the Shouf Biosphere Reserve Landscape is a nexus of many cultures, religions, and historical events all of which have left an imprint which makes the area's cultural heritage as rich as its ecosystems.

- **Demographic trends and human use**

Most of the estimated 170,000 people who inhabit the villages around the SBR depend on agricultural activities. However, an increasing number of them continue to leave their villages to work in construction, government, and small businesses. The downward trend of agricultural activities is a result of an aging population, poor marketing strategies, soil degradation, and excessive use of pesticides and fertilizers.

Unfortunately, security issues and political instability have also had a marked impact on people's livelihoods. The 2006 war, in particular, was a breaking point, and economic activity has not yet returned to pre-war status. The lack of employment opportunities has led to increased migration, and local society is heavily dependent on revenues from Lebanese who live and work abroad.

Adding to this is the impact of the Syrian Crisis on Lebanon: In a country of four million Lebanese nationals, the Government of Lebanon has estimated that there are 1.5 million Syrian refugees, in addition to more than 280,000 Palestinian refugees. The number of people living in poverty in Lebanon has risen by nearly two-thirds since 2011, and local unemployment has also increased significantly.

- **Current land-use at the SBR**

A significant positive change took place since the establishment of the Al-Shouf Cedar Reserve in 1996, where a number of adverse practices used to be prevaent, largely uncontrolled, such as wood cutting, overgrazing, barbeque fires at the base of ancient cedars (leading to their death), accumulation of trash, etc.

✓ **Causes of land abandonment**

a. **Ecological drivers**, sometimes referred to as geo-bio-physical drivers, are the first cause of land abandonment.
b. **Socio-economic and demographic drivers**: retirement of a generation of traditional farmers. Due to the increase of urbanization and rural exodus, newer generations have looked for other occupations that offered greater financial rewards and shorter working hours.

✓ **Major adverse effects of human activities occurring in and around the SBR**

a. Development activities: Housing and commercial establishments in the buffer and transition zones of the SBR are a real and growing threat. The declaration of a protected area (1996) and biosphere reserve (2005) and subsequent increase in visitor numbers has encouraged more hotels and restaurants to establish themselves near the entrances.
b. Visitors: the number of visitors to the core zone of the Shouf Biosphere Reserve is increasing every year (in 2004 they were 28,067 visitors whereas in 2019 there were around 116,000).
c. Hunting: The lack of serious enforcement of any rules or regulations concerning hunting in Lebanon is a grave threat to all forms of wildlife, particularly birds. The most serious threat is to migrating birds of prey during their bi-annual passage over Lebanon and the Shouf Biosphere Reserve.

2. Assessment

Literature Review

The goal of this literature review is to present the studies that were done on the links between traditional land use practices (mainly agriculture) and their effect on biodiversity. It also presents the existing good traditional agricultural practices, the challenges they face, and some recommendations.

Landscape Approach at Farm Level

Figure 6. THE LANDSCAPE APPROACH AT FARM LEVEL: combinations of practices ranging from conservation to income generation.

- **Overview**

Agricultural lands in Lebanon provide resources for both agricultural and industrial crops and are used for grazing as well. About 26.5% of Lebanon's lands are cultivated of which 50% are irrigated. Almost 31% of the exploitable agricultural land is located in the Bekaa. Fruit trees occupy 31% of the total agricultural land used, followed by cereals (22%), olive trees (22%) and vegetables (16%). The remaining 9% of agricultural land is occupied by industrial crops, like tobacco (5%) and other small crops (4%). Agriculture constitutes the main source of income for an average of 30 to 40% of the population in Lebanon. Due to the important aesthetic and cultural values of agricultural lands in Lebanon, agrotourism appeared as a new use of agricultural lands. Agro-tourism provides income, utilization of existing facilities, natural conservation, and recreation and education of the population in urban and rural areas. Agro-tourism is still a new and limited tourism area in Lebanon; it is mainly linked to winery tours (primarily in Bekaa and recently in Batroun), seasonal fruits picking activities (mainly apple and cherry), and olive oil making tours (from picking to pressing) organized by ecotourism agents. In September 2014, the Rural Tourism Strategy for Lebanon4 was developed. The strategy suggests key directions and practical actions that could be implemented over the next five years to improve the competitiveness of rural tourism in Lebanon including agro-tourism.

- Introduction

Many studies have been conducted on cultural land use practices. Some articles detailed the best practices, others focused on traditional agricultural techniques; however, none of the studies proves the positive effect of these practices and their impact on biodiversity.

Traditional Agriculture has been defined as a primitive style of farming that involves the intensive use of indigenous knowledge, traditional tools, natural resources, organic fertilizers and cultural beliefs of the farmers. It is noteworthy that it is still used by about 50% of the world population. We aim to increase this percentage as much as possible in the Shouf by emphasizing best practices, encouraging farmers to go back to implementing these practices and by assessing the maintenance and sustainability of the traditional land use practices that are favorable for biodiversity.

Traditional cultural practices linked to agricultural, pastoral and forestry systems can ensure that resources are not wasted on unfeasible or unnecessary restoration and that restoration efforts do not have unintended, detrimental side effects.

Local people in the Shouf Biosphere Reserve (SBR) have contributed to the ecological diversity through the development and use of cultural practices, enriching the natural landscape with a greater diversity in terms of habitats and species. SBR is currently implementing the below cultural practices:

i. Restoration of stonewall terraces

ii. Sustainable agriculture (animal and plant production, transformation, link to ecotourism)

iii. Sustainable collection of wild edible and medicinal plants,

iv. Sustainable grazing

v. Biomass management and composting

vi. Conservation and sustainable management of high mountain forests according to criteria framed within the local cultural and spiritual heritage

It is important to note that local communities play a key role in sustainable smallholder farming around the world, thanks to their traditional knowledge and understanding of ecological systems and local biodiversity. The preservation and continued evolving use of this knowledge is embedded in recognizing "indigenous" (in the case of SBR it is the local communities) peoples' fundamental right to follow their own traditional ways of growing food.

A. Traditional agricultural practices in the Levantine Mountains:

1. Agroforestry

Agroforestry involves the deliberate maintenance and planting of trees to develop a microclimate that protects crops against extremes. Blending agricultural with forestry techniques, this farming system helps to control temperature, sunlight exposure, and susceptibility to wind, hail, and rain. This system provides a diversified range of products such as food, fodder, firewood, timber, and medicine while improving soil quality, reducing erosion, and storing carbon.

2. Crop Rotation

The principles of crop rotation have been successfully used in these areas for thousands of years in agriculture and are still used today. Crop rotation is the practice of growing different crops on the same land so that no bed or plot sees the same crop in successive seasons. It is a practice designed to preserve the productive capacity of the soil, minimize pests and diseases, reduce chemical use, and manage nutrient requirements, all of which help to maximize yield. The practice of crop rotation builds better soil structure and increases the ability to store carbon on farms.

3. Mixed-/Inter-cropping

Mixed cropping, also known as intercropping, is a system of cropping in which farmers sow more than two crops at the same time. By planting multiple crops, farmers can maximize land use while reducing the risks associated with single crop failure. Intercropping creates biodiversity, which attracts a variety of beneficial and predatory insects to minimize pests and can also increase soil organic matter, fumigate the soil, and suppress weed growth.

4. Polyculture

Polyculture systems involve growing many plants of different species in the same area, often in a way that imitates nature. By increasing plant biodiversity, polyculture systems promote diet diversity in local communities, are more adaptable to climate variability and extreme weather events, and are more resilient to pests and diseases. Polycultures are integral to permaculture systems

and design and provide many advantages such as better soil quality, less soil erosion, and more stable yields when compared to monoculture systems.

5. Water Harvesting

Water harvesting is defined as the redirection and productive use of rainfall, involving a variety of methods to collect as much water as possible out of each rainfall. Many water harvesting structures and systems are specific to the ecoregions and culture in which it has been developed. This may involve collecting water from rooftops, from swollen streams and rivers during monsoon season, or from artificially constructed catchments. This ensures that farmers have a substantial amount of water stored up in the case of drought or limited rainfall.

B. Some general recommendations:

- Using cultural controls is a good first step for preventing crop loss from pests and plant stresses. Some cultural controls need long term planning and are usually not a quick method of stopping a disease or insect pest. However, if the preferred option is to use cultural controls, overall farm health can improve over time.

- Improving Soil Health: There are many ways to improve the soils on the farm. One of the best ways is to increase organic matter levels. Although adding mulch, leaves, and manure may help to increase your organic matter levels, a more effective method is to grow cover crops with high biomass production. By increasing organic matter in the soil, moisture and nutrient retention levels will improve. Additionally, more organic matter will enhance the bioactivity of the soil and increase beneficial microorganisms.

- Proper Planting Dates: Plant seeds or transplants at the correct time of year. Setting out transplants too early or too late can cause unnecessary stress to the young plants. Plants under stress will never out-yield a plant that has not seen stress periods. Additionally, some plants that have undergone undue stress may flower, bolt, or senesce (grow old) before it is time. A stressed plant is a weakened plant and may be more susceptible to disease and insect pests.

- Plant Resistant or Tolerant Varieties: Many new varieties being released have some type of pest resistance. Resistance or tolerance to an insect or disease is usually listed next to the variety in seed catalogs or the seed salesman can provide more information. With an increased number of chemical labels being cancelled, it is important to look into alternative controls. Using resistant or

tolerant varieties is a good way to control pests in the field. Besides pest tolerance or resistance, it is important to produce locally adapted varieties that do well under regional environmental conditions. Varieties that do not tolerate cold or hot conditions for a certain region should not be grown for commercial production in the region.

- Crop Rotation: Planning crop rotations is a long term project and can be a key way of culturally controlling pests. Because different plant families are hosts to different plant diseases and insect pests, some problems can be avoided by planting non-susceptible crops. Many rotations should be prolonged for more than one growing season. Some soil-borne diseases may take up to 5 or more years to suppress through crop rotation.

- Increase Crop Diversity: Using methods like intercropping, companion planting, and trap cropping can help to control insect pests in the field. Additionally, intercropping and companion planting may create symbiosis (both plants benefit from each other's presence) among the plants. For instance, planting a legume crop within a corn or grain crop may give off supplemental nitrogen fixed by the legume to the corn or grain crop. Some crops also are offensive to certain pests and may act as a repellent. Also, some plants may be more attractive to some pests and can be sacrificed as trap crops.

- Timing and Amount of Irrigation: Many plant diseases thrive under wet conditions. It is important to keep the plant foliage dry to prevent conditions that are suitable for bacterial or fungal growth in the plant. Overhead irrigation early in the day will give enough time for plants to dry under sunny or windy conditions. Allowing the plants to stay wet overnight will increase the chance of disease. Additionally, wet soil conditions favor growth of soil-borne diseases. The use of soil moisture measuring devices, like irrometer tenisometers, is a good way to prevent under watering or over watering and soil saturation. When soil is saturated disease organisms can swim or flow through a field, increasing the chance for infecting plants. Additionally, when soil is saturated, oxygen is depleted and roots can be suffocated. Roots require oxygen as well as water for good growth.

- Avoid Working in Wet Fields: Any activity in a wet field can spread fungal spores or bacteria throughout a field. Tractors that brush plants down a row or workers moving from plant to plant will easily spread disease organisms that are in the water on plants. It is best to wait until the field dries before working in the field.

- Do Not Introduce Pests: Before planting look over the transplants to check for insects or diseases. Make sure the seed you buy is certified and treated properly. Cleaning your tillage equipment before traveling into a new field is important.

Wash off any soil or plant debris from your tractor or equipment with a sanitizing agent like chlorine. Also, cleaning hand tools like pruning shears, hoes, rakes, or shovels can help reduce the spread of soil-borne disease.

- Use Mulch as a Soil Covering: Using plastic or organic mulches to cover the soil will help to control weeds and may reduce the spread of soil diseases. Remember, however, that some plastic mulch will not be good at controlling weeds (i.e. white, clear, yellow, red, blue). By having the soil covered, fungal and bacterial disease organisms may not be splashed up onto the plant. Be cautious about using some organic mulch that may utilize high amounts of nitrogen during decomposition or may help to encourage some unwanted pests, like rodents.

Good Sanitation: Keeping fields free of weeds or infested or infected plants is a way to reduce plant stress and pest spread. Weeds are prolific seed producers and one plant can produce thousands of seeds for next year's weed crop. A plant that is dying from a disease should be removed from the field to reduce the source of innoculum to other plants. When removing these infected plants, make sure they are disposed of far away from the crop field so that wind or water will not transport the spores from the discarded plants.

The concept of Good Agricultural Practices (GAP) is the application of available knowledge to the use of the natural resource base in a sustainable way for the production of safe, healthy food and non-food agricultural products, in a humane manner, while achieving economic viability and social stability. The underlying theme is one of knowing, understanding, planning, measuring, recording, and managing to achieve identified social, environmental and production goals. This requires a sound and comprehensive management strategy and the capability for responsive tactical adjustments as circumstances change. Success depends upon developing the skill and knowledge bases, on continuous recording and analysis of performance, and the use of expert advice as required.

C. Guidelines

The Guidelines portray the norms of good agriculture within 10 groups of resource concerns and practices. This structure is designed to provide the framework within which detailed management guidelines can be prepared for individual farming systems and for integrated production systems within specific agro-ecosystems.

1. SOIL

The physical and chemical structure, and biological activity of the soil, are fundamental to sustaining agricultural productivity and determine, in their complexity, soil fertility. Soil management shall maintain and improve soil fertility by minimizing losses of soil, nutrients, and agrochemicals through erosion, runoff and leaching into surface or ground water. Such losses represent inefficient and unsustainable management of these resources, in addition to the deleterious off-target effects. Soil management also seeks to enhance the biological activity of the soil and protect surrounding natural vegetation and wildlife.

2. WATER

Agricultural land use carries a high responsibility for the management of water reserves in quantitative and qualitative terms. Careful management of water resources and efficient use of water within agriculture - for rainfed crop and pasture production, for irrigation where applicable, and for livestock - are criteria for good agricultural practice. They include maximizing the infiltration of rain water on agricultural land and covering the soil as often as possible in order to avoid surface run-off while minimizing leaching to water tables. The maintenance of an adequate soil structure including the adequate spacial arrangement of continuous macropores and the management of soil organic matter are important factors to achieve this. Efficient irrigation methods and technologies minimize losses in the supply and distribution of irrigation water by adapting the quantity and timing to the agronomic necessities and avoiding leaching and salinization. Water tables should thus be managed to prevent excessive rise or fall. A Good agricultural practice will:

• Maximize water infiltration and minimise unproductive efflux of surface waters from watersheds.

• Manage ground and soil water by proper use or avoidance of drainage where required and by build-up of soil structure and soil organic matter.

• Avoid the contamination of water resources with production inputs, waste or recycling products of organic, inorganic and synthetic nature caused directly by inadequate handling practices and technologies and indirectly by erosion and leaching.

• Adopt techniques to monitor crop and soil water status and prevent soil salinization.

• Avoid unproductive irrigation water losses and adopt water-saving measures and recycling where possible.

• Enhance the functioning of the water cycle to increase soil moisture storage and minimize runoff of water and associated contaminants. This may include monitoring of water status, monitoring and proper use of irrigation water, establishing permanent cover, or maintaining or restoring wetlands as needed

• Manage water tables to prevent excessive extraction or accumulation.

• Provide adequate, safe, clean watering points for livestock.

• Increase soil organic matter levels to maximize moisture retention and root penetration.

3. CROPS AND FODDER PRODUCTION

Individual annual and perennial crops, cultivars and varieties are chosen for their suitability to the site and their role within the crop rotation for the management of soil fertility, pests and diseases, available inputs, and local consumer and market needs. Perennial crops are used to provide long-term production options and opportunities for intercropping. Annual crops are grown in sequence, including those with pasture, to maximize the biological benefits of interactions between species and to maintain productivity. Rangelands are managed to maintain plant cover, productivity and species diversity. Harvesting of all crop and animal products removes their nutrient content from the site and must ultimately be replaced to maintain longterm productivity.

A Good agricultural practice will:

• Select cultivars or varieties on an understanding of their characteristics, including response to sowing or planting time, productivity, quality, market acceptability, disease and stress resistance, edaphic and climatic adaptability, and response to fertilizers and agrochemicals.

• Devise crop sequences to optimize use of labour and equipment and maximize the biological benefits of weed control by competition, mechanical, biological and herbicide options, provision of non-host crops to minimize disease and, where appropriate, inclusion of legumes to provide a biological source of nitrogen.

• Apply fertilizers, organic and inorganic, in a balanced fashion, with appropriate methods and equipment and at adequate intervals to replace nutrients extracted by harvest or lost during production.

• Maximize the benefits to soil and nutrient stability by re-cycling crop and other organic residues.

• Integrate livestock into crop rotations and utilize the nutrient cycling provided by grazing or housed livestock to benefit the fertility of the entire farm.

• Rotate livestock on pastures to allow for healthy re-growth of pasture plants.

• Adhere to safety regulations and observe established safety standards for the operation of installations, equipment and machinery for crop and fodder production.

4. CROP PROTECTION

Maintenance of crop health is essential for successful farming for both yield and quality of produce. This requires long-term strategies to manage risks by the use of disease- and pest resistant crops,12 crop and pasture rotations, disease breaks for susceptible crops, and the minimal use of agrochemicals to control weeds, pests, and diseases following the principles of Integrated Pest Management. Any measure for crop protection, but particularly those involving substances that are harmful for humans or the environment, has to be carried out with state of the art knowledge and equipment.

A Good agricultural practice will:

• Decide on interventions following consideration of all possible methods and their short and long-term effects on farm productivity and environmental implications in order to minimize the use of agrochemicals, in particular promote integrated pest management (IPM).

• Use resistant cultivars and varieties, crop sequences, associations, and cultural practices that maximize biological prevention of pests and diseases.

• Maintain regular and quantitative assessment of the balance status between pests and diseases and beneficial organisms of all crops.

• Apply pest and disease forecasting techniques where available.

• Store and use agrochemicals according to legal requirements, e.g. registration for individual crops, rates, timings, and pre-harvest intervals.

• Assure that agrochemicals are only applied by specially trained and knowledgeable persons

• Assure that equipment used for the handling and application of agrochemicals complies with established safety and maintenance standards.

• Maintain accurate records of agrochemical use.

• Adopt successful organic management practices where and when applicable.

5. ANIMAL PRODUCTION

Livestock require adequate space, feed and water to ensure animal welfare and productivity. Record keeping of livestock and of breeding programmes will ensure

traceability of type and origin. Stocking rates are adjusted and supplements provided as needed to livestock grazing pasture or rangeland. Chemical and biological contaminants in livestock feeds are avoided to prevent their entry into the food chain. Manure management avoids nutrient losses, minimizes negative, and stimulates positive effects on the environment. Land requirements of livestock production are evaluated to ensure sufficient land for feed production and waste disposal.

A Good agricultural practice will:

• Site livestock units appropriately to avoid negative effects on the landscape, environment, and animal welfare

• Avoid biological, chemical and physical contamination of pasture, feed, water and the atmosphere.

• Frequently monitor the condition of stock and adjust stocking rates and feeding accordingly.

• Provide adequate, clean water.

• Ensure staff is properly trained in the handling and treatment of animals.

• Design, construct, choose, use and maintain equipment, structures and handling facilitates to avoid injury and loss.

• Make optimal use of by-products and wastes and ensure they do not contaminate crops, products, land, or water resources.

• Take precautions to prevent residues from veterinary medications and other chemicals given in feeds from entering the food chain.

• Avoid the non-therapeutic use of antibiotics wherever possible.

• Carefully record stock acquisitions, breeding, losses, and sales.

• Carefully record feeding plans, feed acquisitions and sales.

• Provide for clean and safe handling and on-farm processing of products (e.g., milk and eggs).

• Integrate livestock and agriculture to avoid problems of waste removal and ensure recycling of nutrients in an efficient way.

• Treat animal waste in such a way as to reduce nutrient loss and greenhouse gas emissions.

• Adhere to safety regulations and observe established safety standards for the operation of installations, equipment and machinery for animal production

6. ANIMAL HEALTH

Successful animal production requires attention to health. The health of livestock is maintained by proper management and housing, by preventive treatments such as vaccination and by regular inspection, identification, and treatment of ailments, using veterinary advice as required.

A Good agricultural practice will:

• Minimize risk of infection and disease by good pasture management, safe feeding, appropriate stocking rates and good housing conditions.

• Keep livestock, buildings and feed facilities clean and provide adequate, clean bedding under housed conditions.

• Seek appropriate veterinary advice to avoid disease and health problems.

• Ensure good hygiene standards in housing by proper cleansing and disinfection.

• Monitor disease incidence and treat sick or injured animals promptly in consultation with a veterinarian.

• Purchase, store and use only approved veterinary products in accordance with directions and regulations.

• Comply with withdrawal periods for veterinary medicinal products.

• Keep detailed records of all sickness, medical treatments and mortality.

7. ANIMAL WELFARE

Farm animals are sentient beings and as such their welfare must be considered. Good animal welfare is recognised as freedom from hunger and thirst; freedom from discomfort; freedom from pain, injury or disease; freedom to express normal behaviour; and freedom from fear and distress.

A Good agricultural practice will:

• Provide adequate and appropriate feed and clean water at all times.

• Avoid non-therapeutic mutilations, surgical or invasive procedures, such as tail docking and de-beaking.

• Minimise transport of live animals (by foot, rail or road) and the use of livestock markets.

• Avoid rough handling and the use of instruments such as electric goads

• Maintain animals in appropriate social groupings where possible; isolation of animals (such as veal crates and sow stalls) should be prohibited, except for injury and sickness.

• Avoid overcrowding and conform to minimum space allowances and maximum stocking densities.

• Maintain slaughter methods that are humane and appropriate for each species, with attention to supervision, training of staff and proper maintenance of equipment.

8. HARVEST AND ON-FARM PROCESSING AND STORAGE

Product quality depends upon implementation of acceptable protocols for harvesting, storage, and where appropriate, processing of farm products. Harvesting must conform to regulations relating to pre-harvest intervals for agrochemicals and with-holding periods for veterinary medicines. Food produce should be stored under appropriate conditions of temperature and humidity in space designed and reserved for that purpose. Operations involving animals, such as shearing and slaughter, must adhere to animal health and welfare standards.

A Good agricultural practice will:

• Harvest food products following relevant pre-harvest intervals and with-holding periods.

• Process produce hygienically, e.g. for washing, use recommended detergents and clean water.

• Store food products under hygienic and appropriate environmental conditions.

• Pack food produce for transport from the farm in clean and appropriate containers.

• Maintain accurate records regarding harvest, storage and processing.

9. ENERGY AND WASTE MANAGEMENT

Farms require fuel to drive machinery for cultural operations, for processing, and for transport. The objective is to perform operations in a timely fashion, reduce the drudgery of human labour, improve efficiency, diversify energy sources, and reduce energy use. Farming produces by-products, some of which are potential pollutants of soil, water, or air. The production of these by-products should be minimized while others are resources that can be reused or recycled.

A Good agricultural practice will:

• Establish input-output plans for farm energy, nutrients, and agrochemicals so as to ensure efficient use and safe disposal.

• Adopt energy saving practices in building design, machinery size, maintenance, and use (e.g. zero or minimum tillage).

• Investigate alternative energy sources to fossil fuels (wind, solar, biofuels), and adopt them where feasible.

• Identify and recycle most organic wastes and inorganic materials, where possible.

• Minimize non-usable wastes and dispose of them responsibly.

• Store fertilizers and agrochemicals securely and in accordance with legislation.

• Maintain accurate records of energy use, and of storage and disposal.

• Establish emergency action procedures to minimize the risk of pollution from accidents.

10. HUMAN WELFARE, HEALTH, AND SAFETY

Farming must be economically viable to be sustainable. The social and economic welfare of farmers, farm workers, and their local communities depends upon it. Health and safety are also important concerns for those involved in farming operations. Due care and diligence is required at all times.

A Good agricultural practice will:

• Direct all farming practices to achieve an optimum balance between economic, environmental, and social goals.

• Provide adequate household income and food security

• Establish and adhere to safe work procedures with acceptable working hours and allowance for rest periods.

• Instruct workers in the safe and efficient use of tools and machinery.

• Pay reasonable wages and not exploit workers, especially women and children.

• Buy inputs and other services from local merchants if possible.

11. WILDLIFE AND LANDSCAPE

Agricultural lands accommodate a diverse range of animals, birds, insects, and plants. Much public concern about modern farming is directed at the loss of some

of these species from the countryside because their habitats have been destroyed. The challenge is to manage and enhance these wildlife habitats while keeping the farm business economically viable.

A Good agricultural practice will:

• Identify and conserve wildlife habitats and landscape features, such as isolated trees, on the farm.

• Create, as far as possible, a diverse cropping pattern on the farm.

• Minimize the impact of operations such as tillage and agrochemical use on wildlife.

• Manage field margins to reduce noxious weeds and to encourage a diverse flora and fauna with beneficial species.

• Manage water courses and wetlands to encourage wildlife and to prevent pollution.

• Monitor those species of plants and animals whose presence on the farm is evidence of good environmental practice

Conclusion

Prior to the widespread application of chemical inputs and mechanized technology, populations depended on natural resource cycles for agricultural management. Some of the locals in the mountains still rely on shifting cultivation to produce crops for subsistence and local markets, especially in the tropics. In general, traditional agriculture is dependent on the recycling of organic matter and nutrients, and natural rainfall patterns. Different species of crops are planted in rotation in one field to protect against pest or disease outbreaks, and nitrogen sources are accumulated in fields through rotations of legume planting. Shifting cultivation in forested areas relies on the fallow periods for organic matter to accumulate over a few years, as farmers cultivate other fields. Some farmers employ slash-and-burn techniques to clear forestland that is grows in their areas of field rotation. Slash and burn agriculture is a widely used method of growing food in which wild or forested land is clear cut and any remaining vegetation burned. The resulting layer of ash provides the newly-cleared land with a nutrient-rich layer to help fertilize crops. Debates have persisted over the ecological sustainability of traditional land use patterns, with some studies pointing to forest degradation caused by slash-and-burn techniques, while others state that shifting cultivation is less ecologically damaging in the long term. The debate over ecological impact is hard to resolve as many ecosystems have developed in tandem with small-scale but long-term anthropogenic impacts. Such

impacts would include those facilitated by shifting cultivation or controlled burns, which function as periodic disturbances that allow for certain species of trees and vegetation to flourish. Some researchers have argued that for many indigenous societies, a combination of cultural beliefs and agricultural or hunting practices has allowed for the sustainable harvesting of flora and fauna, especially with agroforestry-based food systems. Such advocates point to the absence of large-scale anthropogenic ecosystem disturbances in the areas that such communities inhabit, in comparison to industrial agriculture and livestock raising.

D. Traditional Agricultural Techniques

Traditional agriculture is a type of farming that uses techniques developed over decades or centuries to ensure good, sustainable yield over time in a specific area or region. Traditional farms are based around mixed crops that complement one another.

Traditional agricultural techniques are most often practiced on small family farms and in developing countries. Crops are mixed, often using multiple varieties of the same crop, and are sometimes planted in associated groups. For example, vine-based beans might be planted with corn. Crop timing is based on traditional experience, and tilling and other farm techniques are based on proven traditions. Modern techniques are often blended with traditional techniques. Because this sort of agriculture is based on artisanal knowledge, it does not scale up well and does not provide the enormous crop yields of industrial agriculture. However, it is often more sustainable and less polluting than similar industrial techniques. Crop rotation and crop mixing are two examples of traditional farming techniques. These techniques are more labor intensive and produce lower crop yields than modern techniques.

Crop rotation involves dividing a parcel of land into multiple sections. Each planting season, one section is left idle. The idle section is rotated each season. This allows the soil to replenish nutrients. Crop mixing involves planting multiple types of complementary crops on the same land. The products released into the soil by one crop serve as nutrients for the other. For example, people customarily planted corn, beans and squash together in a form of crop mixing.

Below are some traditional farm operations in the :

Row cropping is the production by planting and cultivating crops in rows. This was done completely by hand, then farm animals like oxen or mules began to be used for the task of pulling plows, and finally, farmers began to use tractors.

Animal husbandry hasn't changed as much in the basic sense, as animals like cows, pigs, goats, sheep, and fowl are raised to produce meat, eggs, or simply wool or fiber products. Modern technology, of course, has introduced more efficient methods of milking cows, shearing sheep, producing feed, and has developed improved breeds of various livestock.

Orchard crop production is one of the oldest forms of agriculture. Olives, grapes, and dates, along with other fruits, nuts, and berries that are raised essentially the same way as they have for centuries.

Other agricultural practices like kitchen gardening, subsistence farming, and aquaculture are practiced in many regions of the world, as are ornamental plant growing, flower growing, and timber/forestry.

E. Best Agricultural Practices:

Agricultural Best Management Practices (BMPs) are practical, cost-effective actions that agricultural producers can take to conserve water and reduce the amount of nutrients (fertilizers and animal waste) and other pollutants entering water resources. BMPs are designed to benefit water quality and water conservation while maintaining or even enhancing agricultural production.

Categories of practices include:

- Nutrient management to determine nutrient needs and sources and manage nutrient applications (including manure) to minimize impacts to water resources.
- Irrigation management to address the method and scheduling of irrigation to reduce water and nutrient losses to the environment.
- Water resource protection using buffers, setbacks and swales to reduce or prevent the transport of sediments and nutrients from production areas to waterbodies.

Agricultural Best Management Practices (The Anne Arundel Soil Conservation District's Agricultural Services Division)

Conservation practices, frequently called best management practices, or BMPs, are tools that farmers can use to reduce soil and fertilizer runoff, properly manage animal waste, and protect water and air quality on their farms while achieving multiple positive environmental outcomes.

A variety of BMPs exist, including practices such as cover crops, conservation tillage, irrigation efficiency, and contour farming. BMPs are primarily used to modify land management practices on croplands, specifically those focused on reducing erosion and nutrient runoff.

These practices can help to directly protect drinking supplies, as well as help to protect animal habitat, fisheries and agricultural uses such as irrigation and stock watering.

- Animal Waste Storage Structure
  A fabricated structure that provides temporary storage for animal waste. These BMPs are designed for the proper handling, storage, and utilization of animal waste in order to prevent or abate pollution of surrounding waterways. these typically consist of storage sheds or pits to store solid waste. Liquid or slurry manure is commonly stored in lagoons, ponds, or steel or concrete tanks.

- Contour Farming
  Contour farming promotes better water quality by farming with the contour of a field as opposed to farming up and down a slope. This practice may reduce soil erosion by as much as 50 percent.

- Cover Crops
  Cover crops are small grains, specifically planted to provide soil cover during the winter. This practice is tailored to the specific crop benefits and/or soil concerns of the farmer. Cover crops control erosion by protecting the soil from wind and water. They can also be used for excess nutrient uptake, increased soil nutrients and organic matter, and weed suppression. Common cover crops in Anne Arundel County include cereal rye, oats, and winter wheat.

- Crop Residue Management
  Crop residue management is implemented as part of reduced tillage and continuous no-till farming systems. This practice involves leaving residue from previous crops on the soil surface to prevent erosion and shield the soil from rain or wind until the next crop can produce a protective canopy. Seasonal residue management can be used with conventional tillage systems when crop residue is left in the fall to protect fields during winter. Crop residue management further benefits farmers by reducing trips across the field, which reduces soil compaction and saves time, energy, and labor.

- Crop Rotation
  Crops rotation provides a number of benefits including plant diversity, weed suppression, reduced pesticide and fertilizer costs, and reduced soil erosion. Farmers who follow this practice change or rotate crops seasonally or every few years in a sequence based on the specific needs of their farm operation.

- Diversion
  A diversion is an earthen embankment built near the top of a steep slope to direct runoff water away from a specific area such as a feed lot. It can also be used to direct and collect water into a pond. Vegetation in the diversion channel also filters runoff water, improving water quality.

- Fencing
  Fencing is used to exclude livestock from specific areas that need to be protected from grazing or browsing.

- Integrated Pest Management
  Integrated pest management (IPM) is a tailored approach to reducing crop and environmental damages by insects, weeds, and diseases. Crops are scouted to determine the type of pest (insect, weed, or disease), along with the stage of development and extent of the problem. Management strategies are determined based on an analysis of potential damage weighted against the cost of control. When pest control is cost-effective, additional evaluations are made to determine the most suitable control measures based on cost, result, and environmental impact.

- No-Tillage Farming
  No-till farming is a form of conservation tillage, where crops are seeded directly into the vegetative cover or crop residue with no disturbance to the soil surface.

- Rotational Grazing
  Rotational grazing is a pasture management technique used to increase forage quality, decrease pasture erosion, and distribute nutrients evenly throughout a pasture. With this practice, a pasture is divided into small sections, called paddocks, for grazing management. Livestock are then rotated through the pasture into each section according to the recommended schedule. The paddocks are given periods of rest between grazing rotations to maintain a vigorous plant community and high-quality forage.

F. Additional Best Management Practices

- Field Borders: Strips of grass around the edges of field that can provide wildlife habitat, trap field runoff or provide a buffer for insecticidal spray drift.
- Irrigation Management: The process of determining and controlling the volume, frequency and application rate of irrigation water in a planned, efficient manner.
- Lined Waterways/Outlets: A waterway or outlet having an erosion-resistant lining of concrete, stone, synthetic turf reinforcement fabrics or other permanent materials.
- Riparian Buffers/Buffer Strip: Trees, shrubs or grasses planted next to waterways including rivers, streams and drainage ditches filter runoff, improve water quality, protect the soil from erosion and provide wildlife habitat.
- Sinkhole Protection: Establishing a grass buffer around sinkhole areas to prevent untreated runoff from entering the ground water
- Spring Developments: Collecting, storing, and sometimes transporting spring water to provide water for livestock, usually as an alternative to surface water such as streams or ponds.
- Terrace: An earthen ridge around a hillside that stops water flow and stores or guides water safely off a field.
- Water Well: Drilling of a well to provide water to troughs installed as an alternative livestock water source to surface water, or to improve a grazing system.
- Wellhead Protection: Changing farming practices near the farmstead to prevent risk of contamination of water sources
- Wetland Restoration: Restoring the water and plant community in a former or degraded wetland to improve water quality and provide wildlife habitat.
- Wildlife Habitat Enhancement: Practices to develop, improve or maintain habitats for desirable wildlife.

Tillage is an important activity in agriculture. It can be very beneficial to biodiversity or extremely harmful. This table summarizes what the literature review has collected.

	Description	Effects
Conventional Tillage	Familiar to most farmers and machinery widely available. More equipment is needed than in reduced tillage systems. • Incorporates manure without specialized equipment. • Soil warms faster in the spring than with less tillage. • Allows maximum frost action on soil. This breaks the soil into smaller clumps. • Low levels of surface residue permit high levels of water evaporation. This allows earlier planting and is a plus for poorly-drained soils.	• Low residue levels make soil vulnerable to crusting and erosion by wind and water. • Tillage stimulates weed growth and reduces levels of organic matter. • Working wet soil may cause compaction and the development of plow pans. • During the growing season, high evaporation resulting from lack of residue can reduce crop yields.
Mulch Tillage	Most of the same advantages as conventional tillage. • Residue left on soil surface reduces erosion and water run-off. • Labour inputs are lower than in conventional tillage. • Fewer trips over the field reduce costs. • Management skill levels required similar to conventional tillage.	• High residue levels can slow soil warm-up in the spring. • Stimulates weed growth. • Primary tillage will not be effective under wet conditions. • High residue levels require attachments on the planter.
No-Till/Ridge Tillage	• Lower input and capital expenses.	• High residue levels can slow soil warm-up.

	• Labour inputs per acre are greatly reduced. • More organic matter is located near the surface, which improves soil structure. • High levels of residue drastically reduce soil erosion. • Increased biological activity in soil, which improves structure and increases the speed of pesticide breakdown.	• Success depends on the characteristics of the soil. • Fewer options are available to work in manure. • Above-average management skills are required.

G. Livestock:

Efficient livestock production requires good management practices which include appropriate feeding and health care and the selection and development of breeds that are well adapted to the specific production environments. The livestock sector has been undergoing change at an unprecedented pace over the past few decades. Booming demand in the world's most rapidly growing economies for food derived from animals has led to large increases in livestock production, supported by major technological innovations and structural changes in the sector. This surging demand has been mostly met by commercial livestock production and associated food chains. At the same time, millions of rural people still keep livestock in traditional production systems, where they support livelihoods and household food security. Beyond their direct role in generating food and income, livestock are a valuable asset, serving as a store of wealth, collateral for credit and an essential safety net during times of crisis.

Livestock is the world's largest user of land resources, with grazing land and cropland dedicated to the production of feed representing almost 80 % of all agricultural land. Feed crops are grown in one-third of total cropland, while the total land area occupied by pasture is equivalent to 26 % of the ice-free terrestrial surface.

Traditionally, animal husbandry was part of the subsistence farmer's way of life, producing not only the food needed by the family but also clothing, transport and the natural fertilizers. Killing the animal for food was a secondary consideration, and wherever possible its products, such as wool, eggs, milk were

harvested while the animal was still alive. Traditionally and nowadays, people and livestock move seasonally between fixed summer and winter pastures; in mountainous regions the summer pasture was up in the mountains, the winter pasture in the valleys and coasts. Livestock provide a variety of food and nonfood products; the latter include leather, wool, pharmaceuticals, bone products, industrial protein, and fats. Livestock manure helps maintain the fertility of grazing lands. Manure is commonly collected from barns and feeding areas to fertilize cropland.

Conclusion of Literature Review:

The best practices that were implemented in the mountains according to these articles are agroforestry, integrated crop-animal farming, intercropping, crop rotation, organic composting, cover cropping, etc...

The evolution of traditional cultural practices is a subject of much discussion in legal, scholarly, and community forums. It is generally accepted that all cultures are to some degree in a continual state of sociocultural evolution. However, major questions surround the legitimacy of newly evolved cultural expressions, especially when these are influenced by modernization or by the influence of other cultures.

Deviation of traditional cultural practices took place years ago through land abandonment, introduction of harmful chemicals and pesticides, intensive land management and uncontrolled tillage and irrigation, etc...

Results of these actions are starting to appear; such as biodiversity loss, spread of pests and diseases, land degradation, deforestation, very low production and many others. Here comes the need to maintain these cultural practices. The importance of preserving and maintaining cultural practices lies within the conservation of biodiversity for they positively affect biodiversity.

Special mention

1. *A study entitled: "Landscape context affects the sustainability of organic farming systems" has been recently published in the USA to shed the light on the fact that multifunctional sustainability benefits of organic farms might be mediated by landscape context. Assessing how landscape context affects sustainability may aid in targeting organic production to landscapes that promote high biodiversity, crop yields, and profitability. Results show biodiversity benefits of organic farming respond differently to landscape context compared to yield and profitability benefits, suggesting these sustainability metrics are decoupled. More broadly, results show that the ecological, but not the economic, sustainability benefits of organic agriculture are most pronounced in more intensive agricultural landscapes.*
2. *A report published by FAO in 2019 describes certain aspects of the links between biodiversity and agriculture. It describes them as "associated biodiversity", the vast range of organisms that live in and around food and agricultural production systems1, sustaining them and contributing to their output.*

   According to the countries that contributed to the report, changes in land and water use and management is the driver that most negatively affects the regulatory and supporting functions of ecosystems. For example, ecosystems help to regulate climate, filter air and water and safeguard soil fertility. They also support plants and animals by providing diverse habitats. These functions are all severely threatened by irresponsible changes in land and water management.

   The loss of traditional lifestyles as a result of population growth, urbanization, the industrialization of agriculture and food processing is also negatively affecting BFA and the maintenance of traditional knowledge related to it.

   More knowledge needed on associated biodiversity

   More knowledge is needed on associated biodiversity and on its role in supplying ecosystem services. In particular, more information is need about micro-organisms and invertebrates. Many associated biodiversity species have never been identified and described, particularly in the case of invertebrates and micro-organisms. Even when they have, their functions within the ecosystem often remain poorly understood. Over 99 percent of bacteria and protist species remain unknown. For several types of associated biodiversity, including soil micro-organisms and those used for food processing, advances in molecular techniques and sequencing technologies are facilitating characterization. Several countries have active programmes for characterizing soil micro-organisms using molecular methods. In many countries, however, gaps in terms of skills, facilities and equipment constrain opportunities to benefit from these developments.

   The use of many biodiversity-friendly practices is increasing

The use of a wide range of management practices and approaches that are favourable to the sustainable use and conservation of biodiversity for food and agriculture is increasing. Eighty percent of reporting countries indicate that one or more of the biodiversity-focused practices on which they were invited to report are being used in one or more types of production system. A much higher proportion of OECD countries than non-OECD countries report the use of these practices.

However, it is difficult to fully evaluate the extent to which these approaches are being implemented because of the variety of scales and contexts involved and the absence of data and appropriate assessment methods. Although countries generally indicate that the impacts of the biodiversity-focused practices on diversity are positive, they emphasize the need for more research in this regard, even for practices where research on production issues is well established.

Many biodiversity-focused practices are relatively complex and require good understanding of the local ecosystem. They can be knowledge-intensive, context-specific and provide benefits only in the relative long term. Many countries note major challenges in scaling up such practices and promoting them through capacity development and strengthened policy frameworks.

Enabling frameworks for the sustainable use and conservation of BFA remain insufficient

Enabling frameworks for the sustainable use and conservation of biodiversity for food and agriculture urgently need to be established or strengthened. Most countries have put in place legal, policy and institutional frameworks for the sustainable use and conservation of biodiversity as a whole. Policies addressing food and agriculture are reported to be increasingly based on ecosystem, landscape and seascape approaches. However, legal and policy measures explicitly targeting wild foods or components of associated biodiversity and their roles in supplying ecosystem services are not widespread.

Constraints to the development and implementation of effective policy tools include a lack of awareness among policy-makers and other stakeholders of the importance of BFA, in particular wild foods and associated biodiversity, to livelihoods and food security. There is a large knowledge gap in terms of how existing policies are affecting these components of biodiversity and the ecosystem services they provide. Diverging interests among stakeholders hamper the development and implementation of laws, policies and regulations, as do shortages of human and financial resources.

References in English:

- Eva Perroni, originally published by Food Tank. Five Indigenous Farming Practices Enhancing Food Security. [August 14, 2017]
- Michelle Infante-Casella, Gloucester County Agricultural Agent, RCE. Controlling Pests with Cultural Methods. Editors note: this article was directed at organic farmers; the advice is excellent for home gardens, too.
- Good Agricultural Practices – a working concept Background paper for the FAO Internal Workshop on Good Agricultural Practices Rome, Italy 27-29 October 2004
- "Development of a Framework for Good Agricultural Practices" (2003). Principles for Good Agricultural Practices FAO's Committee on Agriculture (COAG) available at http://www.fao.org/DOCREP/MEETING/006/Y8704e.HTM. section 2 p.6-7 and section 3 p.9.
- Yale School for Forestry and Environmental Studies. Global Forest Atlas Smith, E. A., & Wishnie, M. (2000). Conservation and subsistence in small-scale societies. Annual Review of Anthropology, 29, 493-524.
- Tilman, D. (1999). Global environmental impacts of agricultural expansion: the need for sustainable and efficient practices. Proceedings of the National Academy of Sciences, 96(11), 5995-6000.
- Frank Robertson, Construction, Farming, Art (1979-present) Answered Jul 14, 2018
- Food and Agriculture Organization of the Unites States. FOA's role in animal production.
- FAO, Food and Agricultural Organization (2010) Climate smart agriculture: policies, practices and financing for food security. Adaptation and Mitigation, Food and Agriculture Organization of the United Nations (FAO), Rome, Italy
- Dury J, Schaller N, Garcia F, Reynaud A, Bergez JE (2012) Models to support cropping plan and crop rotation decisions: a review. Agron Sustain Dev 32(2):567–580
- FAO. 2019. The State of the World's Biodiversity for Food and Agriculture, J. Bélanger & D. Pilling (eds.). FAO Commission on Genetic Resources for Food and Agriculture Assessments. Rome. 572 pp. (http://www.fao.org/3/CA3129EN/CA3129EN.pdf) Licence: CC BY-NC-SA 3.0 IGO.

- Landscape context affects the sustainability of organic farming systems Olivia M. Smitha, Abigail L. Cohenb, John P. Reganoldc, Matthew S. Jonesb, Robert J. Orpetb, Joseph M. Taylorb, Jessa H. Thurmanb, Kevin A. Cornella, Rachel L. Olssonb, Yang Geb,d, Tohmé, G., & Tohmé, H. (2004). Recherches sur le statut actuel des plantes endémiques du Liban. Archeology & History in Lebanon, 64–69.
- Tohmé, G., & Tohmé, H. (2011). Nouvelles recherches sur la flore endémique et naturalisée du Liban. Lebanese Science Journal, 12, 133–141.
- Tohmé, G., & Tohmé, H. (2014). Illustrated flora of Lebanon (2 ed.). CNRSL.

  Tohme, G. & H. Tohme (2007) Illustrated Flora of Lebanon. CNRS.
- Lebanon e-flora (http://www.lebanon-flora.org) that provides easy access to species information for amateurs, botanists, ecologists and plant geneticists
- The IUCN Red List of Threated Species (http://www.iucnredlist.org/search) provides information about the conservation status and threats of the world vascular plants.

  Web sites on the accepted names of the SBR plant species: (i) www.theplantlist.org; (ii) http://ww2.bgbm.org/EuroPlusMed; (iii) The international Plant Names Index http://www. ipni.org

  Christina M. Kennedye, and David W. Crowderb
  a. School of Biological Sciences, Washington State University, Pullman, WA 99164; b. Department of Entomology, Washington State University, Pullman, WA 99164; c. Department of Crop and Soil Sciences, Washington State University, Pullman, WA 99164; d. Department of Entomology, China Agricultural University, Beijing 100193, China; and e. Global Lands Program, The Nature Conservancy, Fort Collins, CO 80524
  Edited by Hans Herren, Millennium Institute, Washington, DC, and approved December 19, 2019 (received for review April 23, 2019)
- Needs Assessment Report: Supporting sustainable and eco-friendly agriculture practices by Salwa Tohme Tawk,
- Adaptive Forest Landscape Restoration as a Contribution to More Resilient Ecosystems in the Shouf Biosphere Reserve (Lebanon) by Nizar Hani et al.,
- Shouf Built Heritage Conservation Project in the Higher Shouf Region by Zaher Ghossaini 2017, and
- Restoration of Historical Agricultural Terraces, Assessment, Cost-Benefit Analysis and Marketing by Al-Shouf Cedar Society-Scientific Team, MORES s.a.r.l., Pedro Pajares, 2017.

References in French:

FAO. 2016. Les évaluations des ressources forestières mondiales. Dans: FAO [en ligne]. (www.fao.org/forest-resourcesassessment/fr/).

FAO. 2016. Commission des ressources génétiques pour l'alimentation et l'agriculture. Dans: FAO [en ligne]. (www.fao.org/nr/ cgrfa/cgrfa-home/fr/).

FAO. 2016. Agriculture durable et biodiversité. Dans: FAO [en ligne]. (http://www.fao.org/3/a-i6602f.pdf).

3. Biodiversity in Lebanon

The most comprehensive references on plants in Lebanon remain the works of George and Henriette Tohme, which have constituted the baseline for all other studies in the field, and for our present assessment. All results of this assessment are validated against these references. Years of research have yielded comprehensive directories, many publications and a generous herbarium available to everyone. It is also worth noting that the studies they have undertaken have contributed to the establishment of nature reserves in Lebanon (now 15). Their work is based on their field work and another valuable resource « la nouvelle flore du Liban et de Syrie », by Paul Mouterde.

For the purposes of this study,

Much of Lebanon's rich biodiversity is heavily threatened by human activities. Although National Red Lists for Species in Lebanon do not exist, reports indicate that up to 5% of Lebanese fauna is threatened. Further, 7 mammal species are extinct (e.g. Syrian Brown Bear, Mesopotamian deer, Arabian gazelle); 31% of mammal species are reported as rare, 20% as vulnerable and 7.5% as close to extinction (CBD, country profile)

✓ Study conducted by Dr. Magda BouDagher :

Table 1
List of rare endemic plants species that were reported in only one, two or three cells. IPAs numbered from 1 to 31 correspond to cells with high (class 4) and very high (class 5) values IPAs numbered from 32 to 48 correspond to cells that were ranked with important, medium or low value.

Taxon	Number of cells	IPA cell number (Fig. 7)	Localities name
Alchemilla diademata Rothm.	1	3	Jabal Sannine
Alkanna maleolens Bornm.	1	14	Nahr Beirut
Anthemis didymaea Mouterde	1	32	Towmat Jezzine
Hieracium kneissaeum Mouterde	1	6	Jabal Kneisse
Salvia peyronii Boiss. ex Post	1	45	Jabal Moussa
Senecio mouterdei Arenes	1	33	Wadi Jhannam
Tripleurospermum sannineum (Thieb.) Mouterde	1	3	Jabal Sannine
Allium sannineum Gombault	2	3–6	Jabal Sannine and Jabal Kneisse
Alyssum libanoticum Nyaradi	2	29–40	Qammouaa and Laqlouq
Astragalus ehdenensis Mouterde	2	2–36	Ehden and Qarn Aitou
Cephalaria cedrorum Mouterde	2	21–19	Ain Zhalta and Barouk
Erysimum verrucosum Boiss. & Gaill.	2	11–17	Jabal Hermon
Iris cedreti Dinsm.	2	1–7	Arz Bcharre and Hasroun
Johrenia westii Post	2	25–44	Nahr el-Assi and Ouadi Taniyat er-Ras
Sagina libanotica Rech. f.	2	34–35	Nabaa el-Qamar and Ainata
Centaurea heterocarpa Boiss. & Gaill. ex Boiss.	3	41–42–43	Barr Elias, Aytanit and Marjayoun
Linum carnosulum Boiss.	3	1–22–46	Qornet el-Aachara, Jabal Makmel and Jurd Bcharre
Prunus agrestis (Boiss.) Mouterde	3	37–38–39	Aarsal, Riyeq and Wadi el-Qarn
Senecio exilis Blanche ex Boiss.	3	22–47–48	Jabal Makmel, Qornet es-Sawda and Qornat el-Jamal

Table 2
List of the 31 top ranked IPAs. From 1 to 11 IPA index class 5, from 12 to 31 IPA index class 4. Each IPA is characterized by its IPA-INDEX, species index (SP_INDEX); species richness (SP_RICHNESS); RICHNESS_INDEX; habitat index (HAB_INDEX); N, number of species endemic to Lebanon; Habitat types: A – Cedar forest, rocky mountain slopes; B – Coastal area; C – Dense mountain woodland; D- High mountain plateau; E – High mountain plateau, cedar forest; F – Junipers, fir and cedar forest; G – Sparse mountain woodland; H – Steep and relatively preserved valley; I – Sub-arid mountain slopes.

IPA cell rank	Localities	IPA INDEX	SP_INDEX	SP_RICHNESS	RICHNESS_INDEX	HAB_INDEX	N	Habitat types
1	Jabal Makmel, Bcharre Cedars	760	748	490	5	7	23	E
2	Ehden, Foum el-Mizab	752	742	552	5	5	22	E
3	Jabal Sannine	673	664	363	5	4	27	D
4	Nahr el-Kalb	586	573	446	5	8	5	H
5	Wadi Qadisha	525	514	418	5	6	11	H
6	Jabal Kneisse	495	488	300	4	3	18	D
7	Jbal Mneitre, Jourd Hasroun	485	479	374	5	1	18	D
8	Tyr Coast	471	465	253	4	2	0	B
9	Nahr el-Kalb, Bikfaya, Hemlaya	461	446	431	5	10	9	H
10	Ehmej, Jaj	455	442	417	5	8	10	G
11	Jabal Hermon, Rachaya	435	426	259	4	5	4	D
12	Nahr Beirut	395	381	336	4	10	2	H
13	Nahr Beirut	393	380	285	4	9	5	H
14	Nahr Beirut	363	352	261	4	7	6	H
15	Saofar, Qraye, Roueissat	353	341	296	4	8	8	G
16	Nahr el-Kalb, Baskinta	348	336	327	4	8	10	H
17	Jabal Hermon	332	327	191	3	2	7	D
18	Ehmej	317	305	329	4	8	12	C
19	Jabal Barouk, Maaser ech-Chouf	306	292	264	4	10	8	A
20	Nahr Ibrahim, Lessa, Janne, Qartaba	300	283	295	4	13	11	H
21	Ain Zhalta, Ain Dara, Bmahray	293	275	305	4	14	13	A
22	Jabal Makmel	289	284	125	3	2	16	D
23	Wadi el-Harir	286	279	138	3	4	1	I
24	Nahr Damour	284	271	317	4	9	1	H
25	Wadi Taniyat er-Ras, Ras Baalbek	277	272	116	3	2	2	I
26	Hadeth el-Jebbe Cedars, Tannourine	270	254	275	4	12	2	A
27	Jbeil Coast	262	248	219	4	10	3	B
28	Bmahray	259	249	190	3	7	5	A
29	Jabal Akkar, Qammouaa	254	238	211	4	12	4	F, A
30	Qobayat	250	238	120	3	9	4	F
31	Qaa	242	239	104	3	0	2	I

- ✓ Environment for Life association conducted a similar study in Mount Hermon- Lebanon with whom a potential cooperation is foreseen. They want to validate the negative impacts of Cultural Practices on biodiversity, knowing that the drivers are mostly socio-economic (such as the absence of trust in authorities), in addition to the abuse of the use of pesticides and the abundance of soil erosion. They summed up their recommendations for Cultural practices as follows:
  - Adoption of High Nature Value farming system with low grazing impact on herbaceous;
  - Understory and presence of a mosaic of semi-natural patches;
  - Repair and maintenance of deteriorating traditional stonewalls;
  - Lowering management intensity of olive groves and reduce tendency towards irrigation;
  - Reduce the use of pesticides whilst avoiding wide spectrum insecticides;
  - Replace the use of herbicides by traditional and low intensity grazing or ploughing;
  - Keep old trees in place, as they are attractive to beneficial birds;
  - Set a strategy to moving towards less “zibar” and better oil quality;
  - Focus on organic olive oil as this is becoming more popular in Lebanon;
  - Production of extra virgin olive oil, favored or not, is like organic olive oil, holds favorable prospects due to having a growing export potential;
  - More studies are needed to protect traditional olive groves farming from intensified farming systems.

- Another study was conducted on the Eastern side of the Shouf Biosphere Reserve to monitor the Gypsy moth, *Lymantria dispar*, by Dr. Nabil Nemer, Expert in Forest Entomology and Ecology in June 2019. The study provided insights on the outbreaks in Ain Zhalta / Ammiq region and concluded that the development indicates that the gypsy moth is in its gradation phase therefore, an alert system should be established, knowing that there are forests known as "susceptible to caterpillar attacks", which serve as a starting point for the invasion, they are always attacked first. The report urgently recommends to delineate, by zones of density, the primary foci of

infestations of this pest at the national scale on distribution maps. This procedure will make it possible to set up an alert and monitoring network, to predict the gradations of the insect if it is desired to program control interventions sufficiently in advance.
He concludes that in Lebanon, most of the natural enemies of this insect pest are present, including the Calosoma beetle species which we noticed two months ago in high number in the Bekaa region and to which we have made several announcements to avoid killing it since it is a predator for a number of caterpillars including and especially the gypsy moth.

4. Survey

A survey to assess the local knowledge on Cultural Practices and the links to biodiversity was conducted. It was based on the assumption that farmers have performed experiments (interventions and consequent observations) long before modern science, and that they have inherited some or most of their knowledge from their ancestors. The survey wanted to know if they were aware of any cultural practices. If yes, what they were and whether they implemented them, and if these practices are linked to livelihoods. And finally whether they were aware of any link between these practices and biodiversity.

- Questionnaire: included 29 questions covering 10 themes about crops, soil, insects, fertilizers & pesticides, tilling, irrigation, alternative management, livestock, production and self-evaluation, and biodiversity.
- **Participants**: 29 farmers were interviewed. The selection of participants was based on previous experience of ACS in working with farmers. The following criteria were adopted in selection: income is heavily dependent on agriculture; well-known in village; trusted by other farmers and gives advice to colleagues; more than ten years of agricultural experience. The sample was distributed among the following villages: Bater - Niha - Jbaa - Mrusti - Khraibeh – Maasser el Shouf - Barouk - Fraidis - Ain Zhalta - Boutme – Al Mokhtara.

  Each interview took around one hour. Two team members visited all the farmers. The direct outputs were an Excel sheet with all the answers and a report (in Arabic).
- **Focus group**: Purposive sampling was used to select 9 farmers considered to possess traditional knowledge and willing to play an active role in the meeting

The survey showed that the transformation in agriculture took place years ago, starting in the 70s in Lebanon, especially during the war, which led to the abandonment of many agricultural lands and to the urbanization of many other regions. The interviewed farmers, despite their experience and age, belong to the generation of change, and have not been very engaged in implementing traditional practices. They had wanted quick profit, which was true for a period of time, but which led to a degeneration of the environment and a counter-effect on profit. They are all faced now with the failure of this “modern” outbreak and are looking for alternative solutions.

Conclusions:

Adopting sustainable traditional agricultural practices has become a need and not only a subject of a study. The farmers are convinced, but they need and are explicitly seeking guidance to the emerging problems. What they are mostly interested in is linking traditional methods of agriculture to the market.

5. Monitoring of Biodiversity Programme in the Shouf Biosphere Reserve

Development of the Programme was based on:

A. Lessons Learned from other experiences

- Plants and invertebrates (spiders, wild bees and earthworms) have demonstrated to be good indicators for farming systems (farm-level and landscape-level) at European-wide level (methodology developed)
- Habitats and plant species are good proxy indicator of diversity of invertebrate taxonomic groups Ø Easy to monitor and available expertise
- Invertebrate species monitoring is difficult: lack of expertise, lack of knowledge, expensive and time-consuming Ø Option: BioBio "Dehesas" will target higher taxonomic levels instead of species, and use fauna tracks and signs
- Farm birds are good indicators at landscape-level, and are monitored in several Mediterranean countries (methodology developed)
- Reptiles seem to be good indicators of agriculture terrace systems and pastures ØData gathering is not very simple

B. Biodiversity groups analyzed: plants, bees, spiders, earthworms

- More species of vascular plants, spiders and earthworms in wood pastures as a whole (landscape scale) than in open pastures (not significant differences for bees):
- Not significant differences at plot scale (higher similarity among plots in open areas).
- The exception found for bees could be explained by the relative increase of *anemophilous* grasses (pollen dispersed by wind and loss of legumes and forbs (mostly *entomophilous*) in the neighbourhood of trees caused by the positive effect of trees on soil nitrogen availability
- The higher overall species richness found for wood pastures is explained by their higher spatial heterogeneity (b diversity).
- to determine the impact of cultural practices on biodiversity

The programme in the Shouf started in 2018 and the first phase ended in autumn 2019. A new cycle is under preparation, based on a thorough analysis of phase 1. The aim has been to generate the scientific knowledge needed to understand the links between biodiversity and cultural values that is critical to inform, implement and monitor all actions towards the preservation and restoration of the ecological functionality and cultural heritage of the landscape. It is defining the baseline data to monitor the effectiveness of the restoration, sustainable management and effective governance interventions.

For this purpose, ACS had designed and setup monitoring systems and tools to assess the evolution of the ecological and cultural values of the agro-silvo-pastoral systems and traditional practices, the natural habitats, and key species populations.

The data was collected and most of it has been examined, and the full analysis of biodiversity and ecocultural indicators in the Shouf agro-silvo-pastoral systems and natural habitats will be available soon.

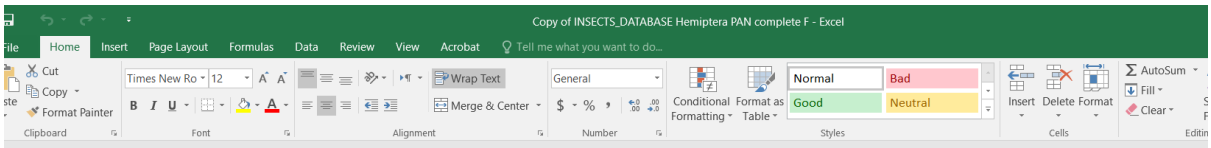
It is important to note that the identification and mapping of biodiversity and ecocultural indicators is an innovative action for Lebanon. It has been done in collaboration with international and national experts and will entail a considerable progress in the understanding of the ecological dynamic and status of the landscape, and the link between the natural and cultural heritage of the landscape.

Available documents at SBR:

- ✓ Identifying Potential Biodiversity Indicators for Farming Systems in the Shouf/West Bekaa Landscape (a detailed description of the whole process and the links to cultural practices); Monitoring Protocols.
- ✓ Forest and Landscape Restoration Guidelines http://shoufcedar.org/front-page/publications-2-2/ (the experience of Shouf Biosphere Reserve in the last 6 years)

	A	B	C	D	E	F	G	H	I
	ID_site	year	month	day	species	number	monitor_name		
	3	2019	5	17	Phoenicolacerta_laevis	2	Nijad		
	5	2019	5	23	Ophisops_elegans	2	Nijad		
	12	2019	5	23	Testudo_antakyensis	1	Nijad		
	2	2019	5	24	Phoenicolacerta_laevis	1	Lara		
	10	2019	5	30	Ophisops_elegans	1	Nijad		
	12	2019	6	7	Stellagama_stellio	1	Nijad		
	8	2019	6	7	Ophisops_elegans	1	Nijad		
	5	2019	6	7	Ophisops_elegans	1	Nijad		
	2	2019	6	8	Phoenicolacerta_laevis	2	Lara		
	1	2019	6	8	Phoenicolacerta_laevis	1	Nijad		
	3	2019	6	8	Phoenicolacerta_laevis	1	Nijad		
	3	2019	6	8	Phoenicolacerta_laevis	1	Nijad		
	7	2019	6	8	Stellagama_stellio	1	Nijad		
	7	2019	6	8	Malpolon_insignatus	2	Nijad	(Mating)	
	1	2019	6	13	Phoenicolacerta_laevis	1	Nijad		
	3	2019	6	13	Phoenicolacerta_laevis	2	Nijad		
	2	2019	6	13	Phoenicolacerta_laevis	5	Nijad		
	8	2019	6	14	Ophisops_elegans	1	Nijad		
	5	2019	6	14	Ophisops_elegans	1	Nijad		
	10	2019	6	20	Stellagama_stellio	1	Nijad		
	8	2019	6	20	Ophisops_elegans	1	Nijad		
	7	2019	6	20	Ophisops_elegans	1	Lara		
	2	2019	6	21	Phoenicolacerta_laevis	1	Lara		
	2	2019	6	21	Phoenicolacerta_laevis	1	Nijad		
	4	2019	6	21	Stellagama_stellio	1	Lara		
	5	2019	6	28	Ophisops_elegans	2	Nijad		
	10	2019	6	28	Stellagama_stellio	1	Nijad		

README | HERPS_DATABASE | DO_NOT_EDIT_metadata_list | Example_sheet



	A	B	C	D	E	F	G	H	I	J	K	L
	ID_site	year	month	day	ID_method	family_name	taxon_name	Nymphs or Immatures Belongs to Hemiptera, but	number	monitor_ name	Sampling No.	Remarks
	1	2019	5	10	PAN	Lygaeidae	He.Lygaeid.1		4		1	
	1	2019	5	24	PAN	Lygaeidae	He.Lygaeid.1		2		3	
	1	2019	6	21	PAN	Pentatomidae	He.Pentatomid.32		1		10	
	1	2019	6	21	PAN	Rhopalidae	He.Rhopalid.8		1		4	
	2	2019	5	10	PAN				5		1	Missing (to be checked later)
	3	2019	6	21	PAN	Lygaeidae	He.Lygaeid.1		2		4	
	3	2019	7	19	PAN	Lygaeidae	He.Lygaeid.19		1		6	
	3	2019	7	19	PAN	Lygaeidae	He.Lygaeid.5		1		10	
	4	2019	6	7	PAN	Geocoridae	He.Geocorid.3		1		3	
	4	2019	6	7	PAN	Pentatomidae	He.Pentatomid.29		1		3	
	4	2019	5	25	PAN	Thyreocoridae	He.Thyreocorid.1		1		1	
	4	2019	6	7	PAN	Rhopalidae	He.Rhopalid.7		1		3	

Other Publications/Studies are available, all prepared and/or compiled by the Shouf Biosphere Reserve, such as:

a. Restoration of Historical Agricultural Terraces, Assessment, Cost-Benefit Analysis and Marketing in Shouf Biosphere Reserve and Qadisha Valley Lebanon,

b. Stonewall Terrace Restoration Guidelines,

c. Road Map for Sustainable Agriculture,

d. Forest and Landscape Restoration Guidelines

e. Reference Guidelines on Forest Management Laws in Lebanon (Arabic),

f. Guide for valorisation of organic materials,

g. Monitoring of Biodiversity Protocols

Preliminary results of Monitoring of Biodiversity activity in the Shouf Biosphere Reserve:

The monitoring activities took place in agricultural lands and grazing sites. The aim was to observe the difference between abandoned sites (without any intervention), well managed sites (cultural practices) and intensively managed (using chemicals, machines...etc.). The first results confirmed the assumption that cultural practices have a positive impact. This was clearly seen form the number of plant species which is almost half less in the intensively managed sites which is consistent with the effect of agrochemicals and intensive ploughing in the flora species. An example is the high value legume plant species (herbaceous species from genera *Trifolium, Vicia, Lathyrus, Medicago, Melilotus, Psoralea, Ononis*) that are totally absent in intensively managed sites, and present in well managed and abandoned ones. The same applies to aromatic shrubs. As for habitats, it seems that intensive management practices are leading to a significant loss of habitat diversity.

The same applies to insects and reptiles, where biodiversity was higher in the abandoned and well managed lands, compared to the intensively managed. Adding to that is the very large number of holes (rats and mice) observed in the intensively managed lands. Further analysis is needed, but the project has a solid baseline that will enable it

to move forward in phase 2 where the indicators will be simplified and indexes will be used and the monitoring will be up scaled to a landscape level.

Plant species:

1) *Cedrus libani* which is the symbol of Lebanon and main component of the reserve,

2) *Quercus brantii* an endemic subspecies which characterizes much of the site

3) *Arrhenatherum elatius* and *Melica inaequiglumis* because they are rare and localized

4) *Helichrysum pallasii* due to its status as threatened in the past and not very common

5) *Tulipa montana* and *Phytolacca pruinosa* for their ornamental and economic value

6) *Cephalaria cedrorum* because of its endemism to Shouf area

7) *Gundelia tournefortii* as locally threatened because it is heavily collected and uprooted

8) *Origanum ehrenbergii* and *Origanum syriacum* as well as *Rhus coriara* which are considered multipurpose species and consequently widely harvested by people

9) *Geum urbanum* and *Micromeria myrtifolia* for their medicinal values.

Reptile Species

Fire salamander	Salamandra infraimmaculata
Common European toad	Buo cf. bufo
Green Toad	Bufo virdis
Middle East tree frog	Hyla savignyi
Levant Snake	Eireis levantinus
Mediterranean chameleon	Chameleo chamaeleon
Barouk rat snake	Elaphe sauromates
Mount lebanon rock lizard	Phoenicolacertakulzeri
Common wall lizard	Phoenicolacerta laevis
Agama	Laudakia stellio stellio
Levant viper	Macrovipera lebetina
Montpellier snake	Malpolon monspessulanus
Lebanon mountain viper	Montivipera bornmulleri
Water snake	Natrix tessellate tessellata
snake-eyed lizard	ophisops elegans
Turtle	Testudo antakyensis

6. Biodiversity and Cultural Practices at the at the SBR

In addition to its intrinsic value, the recreational and aesthetic values of biodiversity play an important role in the SBR with a growing ecotourism industry in the development zone, enhanced by the scenic beauty of the region, the cultural value of all the historical sites, in addition to the religious value for the traditional communities.

However, what is important for this study is the economic value, as it will be the incentive for the local communities to engage in any change and to implement any cultural practice. This is linked to nutrition (sustainable agriculture); preservation of native plant and animal species; preservation of genetic variability where a collaboration is ongoing with the Lebanese Agricultural Research Institute(LARI) and Kew Gardens; and sustainable harvesting of wild plants (oregano, gundelia). It is also the basis for direct investment opportunities such as the value chains of selected species (oregano, pomegranate, sumac, figs, walnuts, and pine nuts) and the eco-briquettes.

Current situation: the general trend in the region and the country is that of land degradation, deforestation, loss of biodiversity, invasion of pests and the abundance of industrial & agricultural waste. What we are currently witnessing are the consequences of a deviation that took place many years ago caused by land abandonment; modern practices (many of which emerged during the civil war) have significantly altered the natural and social make-up of lands: the intensive use of chemical pesticides and herbicides; the intensive use of chemical fertilizers; intensive irrigation; excessive tilling; adoption of non-native species and mono cropping.

At the root of the drivers of these changes lies an unrealistic perception of natural resources, exacerbated by population growth, internal migration esp. due to civil war; an almost total lack of planning, the rising costs of infrastructure due to population growth and an unprecedented urban sprawl.

Current land management practices in Lebanon are not sustainable as they continue to erode the country's natural resource base (soil, water, green cover, and landscapes).

The results have been catastrophic, for the environment with all its components, including biodiversity, and for the farmers. But change is happening, in the right direction.

-

7. Recommendations

Ahead of addressing the recommendations of the study, it is worth mentioning that the support to cultural practices as a general approach comes from identifying, conserving and protecting the Important Biodiversity Areas, equally extended outside protected areas. This should be paralleled with strengthening community institutions and promoting livelihoods that support biodiversity conservation such as eco- tourism, small scale production systems at the household level and the corresponding trade practices. At the scientific/research level, the support should come from promoting the values that combat climate change, and assess and conduct inventories of biological diversity.

Current "modern" practices have shown serious limitations, and farmers, local communities and authorities are currently looking for alternatives.

For any solution to be effective, it has to support the development of support structures (cooperatives, municipalities…), and cover socio-economic and gender considerations, be available to the market, and present itself **as a replicable model.**

Any restoration activity in the SBR is based on the seven principles of the **Forest Landscape Restoration** which has been adopted by the Shouf Biosphere Reserve as a comprehensive ongoing process aiming at recovering the landscape after the disturbances that have affected it due to series of ecological, socioeconomic, and cultural modifications, combined with water deficit, extreme weather events, and large-scale disturbances due to climate change and causing irreversible shifts towards undesirable conditions, all affecting human well-being.

Restoration:

- focuses on the Entire Landscape;
- addresses the root causes of the landscape degradation in the SBR;
- engages all concerned actors and supports participatory governance;
- restores multiple functions for multiple benefits;
- invests in 360º capacity development and knowledge generation;
- considers a wide range of implementation options with a cost-benefit approach;
- maintains and enhances natural ecosystems within the landscape.

A. Agriculture:

An overview of the sustainable agriculture roadmap of SBR

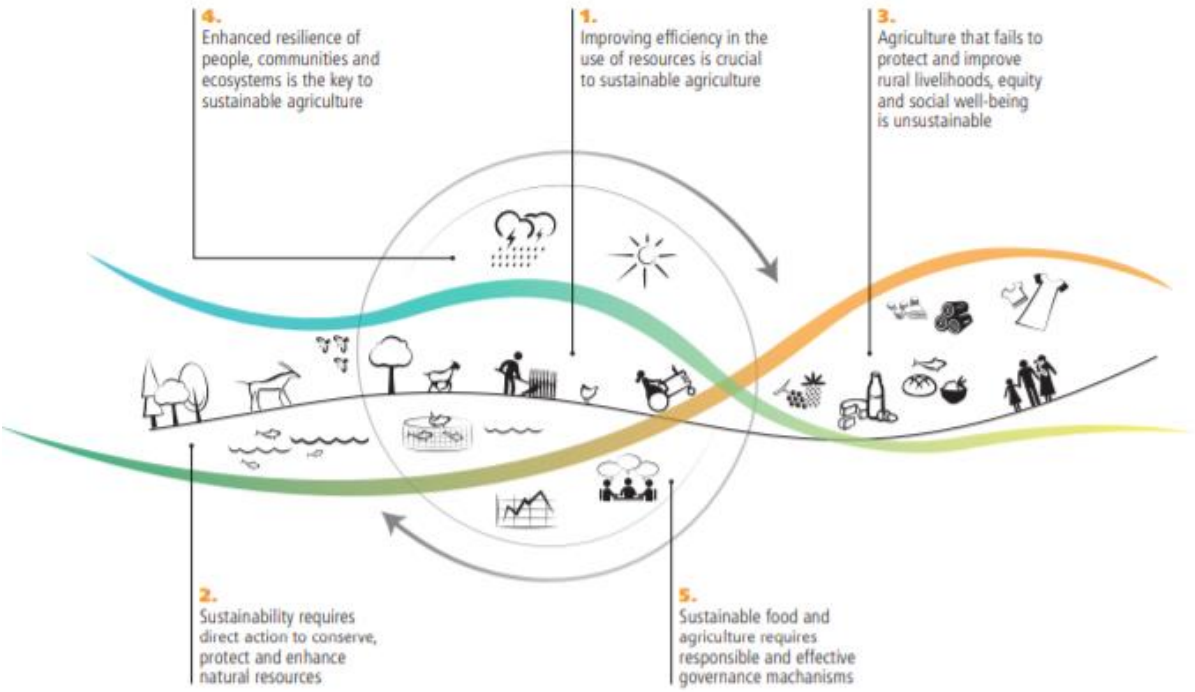


Figure 1. FIVE KEY PRINCIPLES FOR SUSTAINABLE FOOD AND AGRICULTURE (FAO, 2014).

> ***Note:*** *Support to the landowners should come under the form of land stewardship agreements with the farmers that include other forms of sustainable agricultural practices and encourages good governance.*

- ✓ **Restoration of stonewall terraces** because they (i) Sustain fertile soil and slows down water runoff; (ii) Increase soil moisture through improved infiltration; (iii) Facilitate runoff water harvesting to fill local reservoirs and irrigate the crops during the dry season; (iv) Capture the sun heat in the rock walls and helps create a warmer micro-climate; (v) Support the production of diversified annual and perennial crops and livestock ; (vi) Play an important role in biodiversity conservation, by creating micro-habitats for plants, insects, reptiles, amphibians, birds and mammals; (vii) Act as firebreaks reducing the risk of fire spread, and providing access and water for fire-fighting; (viii) Have an outstanding cultural and aesthetic value with high potential for tourism development.

- ✓ This includes actual restoration activities, training & capacity building, and awareness raising.

✓ **Land preparation:**

1. **Conventional tillage systems** when crop residue is left in the fall to protect fields during winter selection of crops, when domestic animals are used to replace machinery (this is applicable in the SBR region where the lands are small), when the shoveling or picking is used, when the blade does not go very deep.
   Notes:
   - ✓ **Ploughing** during the dry season leads to the formation of dust on grapes which protects them from insects
   - ✓ **Testing the soil** can be done through traditional methods: the farmers know the soil by its color. They also use ploughing to determine the quality and type of soil. A traditional method of testing the porosity of the soil is taking a sample, kneading it with water and observing it for a few days.
2. **Weeding** is done manually using a sickle and fed to the livestock. Some weeds are good for the crops
3. **In-situ organic matter recycling:** which optimizes nutrient content, circulates energy flow within the immediate habitat, conserves water, and creates a balance between pests and their natural enemies.
4. **Use mulch** (shredded branches and leaves) to cover the soil to minimize evaporation and prevent weed proliferation.

- **Planting:**

1. **Plantation/reintroduction of traditional crops,** such as grapes, figs, etc. that have proved their resilience to pests and their adaptation to the harsh and dry environment of Lebanon's mountains. They are often rain-fed or require minimal irrigation.
2. **Poly-culture:** diversifies used crops yielding a mixture that is comparatively more resistant to soil pests and diseases. A diverse system facilitates concurrent recycling of biomass and nutrients by different co-existing crops.
3. **Cover crops (usually leguminous):** which reverse soil degradation and support other crops by fixing atmospheric nitrogen and adding organic matter.

- **Livestock management**
  Livestock integration with crops: which secures feed to livestock (chicken and small ruminants especially) and provides manure for organic matter sustainability and nutrient availability. This integration sponsors self-soil fertility and productivity, and controls soil erosion.
  Rotational grazing:

B. Water management:

The Shouf Biosphere Reserve conducted, in 2017, a study, implemented by leading water and environmental management consultancy ANTEA Group: "Groundwater assessment of the Shouf Biosphere Reserve-Lebanon". The study proposed recommendations on how this vital water resource in the Shouf mountains can be managed sustainably despite the challenges faced by the Lebanese water sector on both the infrastructure and management fronts.

It is recommended to tackle the issue of water in the villages on a case by case basis, taking into consideration the principles sustainable agriculture.

Some suggestions related to water management:

- ✓ Introduce rain fed crops
- ✓ Introduce drip irrigation and other sustainable irrigation practices
- ✓ Build small reservoirs for irrigation and low level river support
- ✓ Establish some hill lakes
- ✓ Restore old traditional water systems
- ✓ Define in-stream flows for rivers (minimum downstream flows)
- ✓ Convene training sessions for water management and best practices

C. Promotion of Ecotourism:

This recommendation is based on the assumption that economic incentives are a very important condition for conservation. Promoting ecotourism creates those incentives and plays an important role in raising awareness of sustainable development, the importance of conserving biodiversity for human wellbeing and motivating people.

In addition to communication and promotion of local small businesses, it is primordial to deal with the market and create enhance the demand for products that are beneficial to biodiversity.

Farmer markets target local inhabitants and visitors. They prevent abuse from the wholesale markets and can create a niche for the products that are linked to cultural practices.

DMO: In order to ensure the sustainability of all ecotourism activities, and because of the direct link between the success of any entrepreneurial activity and ecotourism, the creation of a management unit is necessary. The Destination Management Organization(DMO) will take the strategic approach to link-up what could be very separate entities for the better management of the destination. This unit will support in marketing the destination and in coordinating all activities in addition to establishing partnerships and networks. It will oversee and manage the resources rationally and serve as the data analytics for the necessary information structure ensuring that all stakeholders can benefit in the long term.

The DMO will play an important role in the dissemination of the report, sharing the knowledge with other similar practitioners, leading to sharing the findings and to the replication of the practices.

8. Information Sheets

The recommended best practices

A. Sustainable Grazing

The recommended cultural practice	**Sustainable Agriculture- includes stonewall terrace restoration and water management**
Description of the practice	A holistic approach to farming, that preserves resources, meets basic nutritional requirements, reduces the vulnerability of farmers to climate change and other risks improving their quality of life of and that of their communities, is economically viable and at the same time supports rural institutions such as farmer cooperatives. It includes: **a. Restoration/building stonewall terraces** where some of the oldest continue to have an impact on the landscape due to the strong cultural identity linked to the mountainous agriculture terraced systems, **b. Conventional tillage systems** when crop residue is left in the fall to protect fields during winter selection of crops, when domestic animals are used to replace machinery (this is applicable in the SBR region where the lands are small), when the shoveling or picking is used, when the blade does not go very deep. c. **Manual weeding** Some weeds are good for the crops d. **In-situ organic matter recycling:** which optimizes nutrient content, circulates energy flow within the immediate habitat, conserves water, and creates a balance between pests and their natural enemies. e. **Mulching (shredded branches and leaves)** to cover the soil to minimize evaporation and prevent weed proliferation. f. **Plantation/reintroduction of traditional crops,** such as grapes, figs, etc. that have proved their resilience to pests and their adaptation to the harsh and dry environment of Lebanon's mountains. They are often rain-fed or require minimal irrigation. g. **Poly-culture:** diversifies used crops yielding a mixture that is comparatively more resistant to soil pests and diseases. A diverse system facilitates concurrent recycling of biomass and nutrients by different co-existing crops. h. **Cover crops (usually leguminous):** which reverse soil degradation and support other crops by fixing atmospheric nitrogen and adding organic matter.

		i. **Water management:** through the introduction of rain fed crops; drip irrigation and other sustainable irrigation practices; building small reservoirs for irrigation and low level river support; establishing some hill lakes; restoring old traditional water systems; defining in-stream flows for rivers (minimum downstream flows)
Justification criteria		Sustainable agriculture as defined by the project, plays a critical role in terms of enhancing ecosystem services to sustain both biodiversity and human well-being.
1	The practice has proven itself	The practices defined under sustainable agriculture lead to the restoration of the ecological functionality of the terrace systems to avoid environmental risks, regain biodiversity values and enhance their integration in the eco-cultural landscape. Many components of the practice have proven themselves, such as cultivation in stone wall terraces which provides a wide range of ecosystem services: (i) Sustains fertile soil and slows down water runoff, (ii) Increases soil moisture through improved infiltration; (iii) Facilitates runoff water harvesting to fill local reservoirs and irrigate the crops during the dry season; (iv) Captures the sun heat in the rock walls and helps create a warmer micro-climate; (v) Supports the production of diversified annual and perennial crops and livestock; (vi) Plays an important role in biodiversity conservation, by creating micro-habitats for plants, insects, reptiles, amphibians, birds and mammals. (vii) Acts as firebreaks reducing the risk of fire spread, and providing access and water for fire-fighting; (viii) Has an outstanding cultural and aesthetic value with high potential for tourism development.[1]
2	Economic and social efficiency	This practice will support green economic opportunities to enhance people's livelihoods, jobs generation and market links between producers and consumers, through the production and marketing of aromatic/medicinal/edible plants, positively impacting the socio-economic situation in the region. Besides, the proposed restoration activities support land use management based on the sustainable use of natural resources, increase people's awareness about the ecosystem services provided by the Lebanese mountain landscape, and enhances its eco-tourism attractions. This work has led to the identification six crops: pine nuts, figs , walnuts, sumac, pomegranate, and oregano and the current and future production situation quantitatively and qualitatively. The work includes recommendations for necessary actions needed to apply fair trade principles with available products and/or enhancing production of less available products. The work focused on enhancing each activity through a corresponding value chain that includes production practices, processing, packaging, storing and transportation to markets.
3	Current use	It used to be a common practice in the region, and in other mountainous regions. The past decades, starting mainly with the Lebanese war, witnessed its regression and an invasion of modern, high input agriculture. The excessive use of machinery, chemical fertilizers & pesticides, the adoption of mono cropping and also intensive

[1] Stonewall Terrace Restoration Guidelines, FAO, Al-Shouf Cedar Society (ACS) and MORES s.a.r.l.,

		irrigation have shown serious limitations, and the farmers are looking for alternatives and starting to implement these sustainable practices.
4	Sustainability (knowledge and know-how transmitted)	Some farmers and practitioners have lost the knowledge and know how that is usually transmitted through families and generations. Many of them still have the knowledge and are currently trying to re-acquire the know-how. The SBR is playing a vital role in compiling, validating and sharing the knowledge and know-how. It is also supporting in the implementation and creating replicable models.
…	….	
Threats affecting the practice (drivers of change)		• Urbanization • Migration • Land abandonment • Diminishing water resources • Polluted water resources • Disappearance of cultural practices • Difficult economic situation • War in Syria and tensions in the country • Extractive industry (quarries) **All these threats will be increasingly exacerbated by the impact of climate change.**
Current dynamic level		The dynamics affect the whole landscape of the study area, extending to a national level. The approach considers the whole landscape as a fundamental element for development and that local communities have to guarantee its sustainability. The current status is similar to that of the whole agricultural sector in Lebanon: a degradation that has seriously affected the livelihoods of the local communities. In the case of the SBR, and thanks to the sustainable models it is creating, there is an awareness of the necessity to restore those practices with the support of research and sustainable management directives.
Target area and importance in biodiversity		The SBR, with its core, buffer and development zones, is an important plant area; its flora includes 1056 identified plants distributed over 101 families, i.e. ca. 1/3 of that the whole country (ca. 3000 species). The SBR has a rich flora including 48 taxa endemic to Lebanon or the Syria/Lebanon/Turkey area and 214 species that are restricted to the Eastern Mediterranean or Middle East area, as well as medicinal, edible, and aromatic plants. The SBR, however, is most famous for hosting the largest stand of Lebanese cedar (*Cedrus libani*) in the country. The cedar of Lebanon is a highly symbolic, world-famous conifer tree, and one of the most cited plants in history, religion and mythology. Moreover, the reserve hosts about 620 hectares of cedar forest, which are largely confined to the steeper and less accessible areas and represents the natural southern limit of this species.. As for birds, 250 species have been recorded in the SBR and the Ammiq Wetland. Finally, the region contains 31 species of reptiles including chameleon, tortoise, and several species of snakes, lizards, frogs, and toads.

Impacts on biodiversity of practice	
Presence of: Ramsar site Biosphere Reserve or protected area	The study area is a Man and Biosphere Reserve. It comprises, in additional to the development and buffer zones, a protected area (Shouf Cedar Forests) and the Ammiq wetland, a Ramsar site and Important Bird Area - IBA
Effects of the recommended practice(direct effects)	The restoration of dry stone wall terraces includes interventions for the maintenance and recovery of marginal habitats linked to the agriculture terraces, such as hedges, tree and shrub shelters, isolated trees, ruderal vegetation along roads, the stone walls, etc. Installation and preservation usually require low-cost techniques and minimal labour. Preserving and restoring small strips of land left unploughed have major environmental benefits: • Species diversity in marginal agricultural habitats is significantly high including insects that play a major role in crop pollination and pest control. • Marginal habitats act as barriers to slow runoff water, improve water infiltration, prevent wind desiccation and erosion, prevent loss of soil nutrients, and create microclimate conditions in croplands. • Natural vegetation strips (NVS) have little competition with crops for space and can play an important role for fodder provision. Economically valuable wild trees or shrubs can be planted in the border of stone walls, providing additional source of income, as for instance oak honey or edible fruits and nuts. While restoring dry stone walls, seeds, rhizomes and bulbs of wild plants, such as species from the genus *Cyclamen*, *Capparis spinosa, Sedum spp*, ferns, can be incorporated in the crevices between the stones to enrich the habitat type. Cultivating different varieties of the same crop species and different crop types in the same plot increases resilience: Each variety and each crop species tolerates different environmental constraints (e.g. drought, frost, heat, pests) and all together reduce the risk of losing the entire harvest. Each variety and/or species may fructify in a different period, which lengthens the production season and increases market opportunities. Different species and products helps diversify market opportunities. The diversity of crop species and varieties increases the aesthetic and cultural value, as well as the tourist potential of the landscape.
Effects of the recommended practice(indirect effects)	The diversity of habitats linked to farming systems increases the ecosystem services (e.g. Pollination, presence of insects that fight pests, soil fertilization, water conservation, edible species). Biodiversity plays an essential role for the functioning of extensive natural landscapes, that consist of different ecosystem types such as forests, pastures, scrubland and agriculture land. Landscapes with a greater

		biodiversity are more productive and their productivity shows lower year-to-year variation under climatedriven environmental changes.
Targeted animal and/or vegetable species (that will be protected or that will have better conditions such as for their nutrition or reproduction)		*Rhus coriaria; Rosa canina; Zizyphus jujube;Myrtus communis; Oryganum syriacum; Thymbra spicata; Gundelia tournefortii; Tragopogon longirostris; Allium ampeloprasum; Hypericum perforatum; Matricaria chamomilla; Ceratonia silique; Salvia urticifolia; Salvia fruticose; Rosmarinus officinalis ; Capparis spinose; Cyclamen persicum; Putoria calabrica; Rosularia libanotica*
Recommended solutions for the recommended practice		
1	Institutional, regulatory and legal	Understanding ownership rights in the targeted degraded lands and setting clear agreements with the farmers or local authorities are some of the recommended solutions. An important regulatory aspect that the SBR is working on is the master plan for land use recognizing cultural practices and taking into consideration conservation needs linked to the protected area.
2	Communication, awareness raising and capacity building of stakeholders	• Involving all concerned local people – namely farmers, working in, or owning the targeted lands, the cooperatives and the municipalities - in the planning, implementation, and monitoring of the activities. • Raising awareness and know-how of farmers and local authorities on the value • Enabling local shepherds to benefit from the established enclosures through trade-offs, such as the provision of the mown grass that is annually cut inside the enclosure to facilitate the growth of the planted seedlings. Differences in the growth of grass inside the enclosure (much higher) and outside the enclosure also help raise the awareness of local shepherds about the benefits of temporary exclusion of grazing as part of a rotation system. • Integrating enclosure management into agriculture, livestock grazing and forest management.
3	Governance	The development of sustainable agriculture depends on the active participation of all stakeholders, at different scales, including vulnerable groups, in planning, decision making, and direct involvement in the implementation, monitoring and eventually benefit. It has been observed that almost all the agricultural cooperatives lack the know-how regarding business planning, management and governance. Thereby, environment of cooperation between farmers and cooperative representative is absent. It is recommended a special effort on training cooperative representatives on governance and management in order to be able to achieve the ultimate goals of the cooperatives as well as showing like a union of farmers could tackle needs and challenges and ensure sustainability.
Indicators for monitoring of implementation		- areas of restored lands - number of committed farmers - number of products - income increase - no. of women and youth engaged

Role of women in implementation of recommended practice	Women are/will be engaged in the production process rather than in the implementation phase. They play an important role in the implementation of the practices, in the transformation and the marketing. This has provided them income generating opportunities and enhanced their role in family economic security, or independently. They have also played an important role in linking these practices to ecotourism activities, a growing source of income for the region.
Level of visibility: supply, transformation, storage, marketing, … of products and services from the recommended practice	There is a growing demand for agricultural products that respect the environment and biodiversity, but the farmers in the region have not developed the skills that will enable them to access the markets starting with developing business plans, packaging and marketing their products. SBR is playing a role here by building capacities and creating marketing opportunities, whether in the region itself such as the creation of farmer markets or linking with markets in the cities and also abroad. SBR has also created a link between the producers and the service providers in the region, encouraging the latter to buy their products from the local farmers.
Level of visibility of the value chains of products and services provided by the recommended practice	Six crops: pine nuts, figs, walnuts, sumac, pomegranate, and oregano, have been identified for the development of value chains to work on production, processing, packaging, storing and transportation. Special attention has to be given to the production process (the implementation of the recommended practice) since it is the basis for the quality of the product and usually the most difficult to control.
Main incentives needed to promote the recommended practice	**Financial**: Access to the existing revolving fund credit system (Cedar Loan) Support to compensate income gaps at the beginning of the process **Other** Knowledge sharing Access to markets
…….	

B. Sustainable Grazing

The recommended cultural practice		**Sustainable Grazing(mainly goats)**
Description of the practice		This requires rotating systems with periodic resting periods to allow the regrowth of healthy pastures. The following methods can be adopted, separately or interchangeably: a. Rotational grazing: grazing and resting b. Livestock grazing in thinned and pruned forest land **Temporary exclusion of animal grazing in degraded landscapes:** This represents a very successful approach in the forest restoration approach, resulting in a very fast recovery of the former vegetation and the quality of soil. c. Restoration of grazing lands: • • Planting of oak acorns and seedlings - predominantly oak species together with azerole, wild pear, wild apple, stone pine, among other wild fruit trees – in small fenced areas of 0.25 to 0.5 ha if livestock grazing occurs, scattered throughout the pasture land, to increase food availability (especially acorns) when the grass is dry (late summer and autumn) and provide shelter to livestock during summer. • Create shelters by planting trees (same as previous) and shrubs (Spartium junceum, Cistus spp. In acid soils) in strategic places of open pastures (e.g. division between land users' pasture grounds; along ravines and roads) to increase food availability, shelter and soil water retention. • Enriching grass cover by seed sowing of highly palatable species proposed by shepherds (e.g. Trifolium spp.) as an important food for livestock to improve the production of milk. • Restoring and/or constructing small water reservoirs in critical areas to overcome water shortage and ensure water needs for livestock, and in this way avoid shepherd's temptation to illegally surpass the limits of the core zone in search of water.
Justification criteria		
1	The practice has proven itself	The environmental benefits provided are: • Water conservation: significantly lower runoff coefficients, higher infiltration and increased soil moisture availability are demonstrated in enclosure sites as compared to degraded grazing land creating more favourable conditions for plant growth. • Erosion reduction: on a larger scale, the recovery of grass cover in temporary enclosures help prevent soil erosion and increases soil fertility. • Higher diversity of palatable grass species, pasture quality and productivity: after one year, major improvement of pasture conditions occurs, and in few years species diversity and the quality of pastures is significantly improved.

		• When seedling planting takes place in the fence plots, the higher availability of woody species, such as oaks, azaroles, hawthorns, and wild pears, play a major role in increasing the presence of highly valuable palatable species to feed the animals while creating shelter areas with microclimate conditions for the grass to remain green over a longer period, and as a protection against high insolation.
2	Economic and social efficiency	In addition to being a traditional practice, the restoration/ reintroduction of rotational grazing provides additional sources of income for the local communities. Other than meat and wool , the traditional cheese (labneh ambariz) can be an important product of the region. Other similar regional products exist in Lebanon and can be developed. **Note:** Temporary enclosures have the additional value of lowering funding requirements for the restoration of grasslands which is a critical issue inlandscape restoration approaches.
3	Current use	The number of herds has decreased lately to the change, the Shouf forest landscape restoration-FLR initiative has implemented enclosure measures for the temporary exclusion of grazing in small land plots to protect planted seedlings from grazing. The FLR initiative in the SBR has supported livestock grazing as a complementary activity of the thinning and pruning management interventions in forest land.
4	Sustainability (knowledge and know-how transmitted)	There is no "documented" knowledge on the know-how. It is mainly transmitted from parents to children or to apprentices. The SBR, in collaboration with Dr. Mounir Abi Said, prepared in 2012 a study about the subject, updated in 2018. The two studies included meetings with all the shepherds in the region and one to one discussions about the methods followed and the way forward.
…	….	
Threats affecting the practice (drivers of change)		• Urbanization • Scarcity of manpower • Extractive industry (quarries) • Improper management of forest and grazing resources, due to an outdated legal framework matched with poor law enforcement. • Fires, which are one of the most important elements that destroy Lebanon's natural resources. **All these threats will be increasingly exacerbated by the impact of climate change.**
Current dynamic level		The dynamics affect the whole landscape of the study area, extending to a national level. The approach considers the whole landscape as a fundamental element for development and that local communities have to guarantee its sustainability. The current status is similar to that of the whole agricultural sector in Lebanon: a degradation that has seriously affected the livelihoods of the local communities. In the case of the SBR, and thanks to the sustainable models it is creating, there is an awareness of the necessity to restore those practices with the support of research and sustainable management directives.

Target area and importance in biodiversity	The SBR is an important plant area; its flora includes 1056 identified plants distributed over 101 families, i.e. ca. 1/3 of that the whole country (ca. 3000 species). The SBR has a rich flora including 48 taxa endemic to Lebanon or the Syria/Lebanon/Turkey area and 214 species that are restricted to the Eastern Mediterranean or Middle East area, as well as medicinal, edible, and aromatic plants. The SBR, however, is most famous for hosting the largest stand of Lebanese cedar (*Cedrus libani*) in the country. The cedar of Lebanon is a highly symbolic, world-famous conifer tree, and one of the most cited plants in history, religion and mythology. Moreover, the reserve hosts about 620 hectares of cedar forest, which are largely confined to the steeper and less accessible areas and represents the natural southern limit of this species.. As for birds, 250 species have been recorded in the SBR and the Ammiq Wetland. Finally, the region contains 31 species of reptiles including chameleon, tortoise, and several species of snakes, lizards, frogs, and toads. Also add some info on the reserve buffer zone.
Impacts on biodiversity of practice	Higher diversity of palatable grass species, pasture quality and productivity: after one year, major improvement of pasture conditions occurs, and in a few years species diversity and the quality of pastures is significantly improved. When seedling planting for purposes of regenration takes place in the fenced plots, the higher availability of woody species, such as oaks, azaroles, hawthorns, and wild pears, play a major role in increasing the presence of highly valuable palatable species to feed the animals while creating shelter areas with microclimate conditions for the grass to remain green over a longer period, and as a protection against high insolation.
Presence of: Ramsar site Biosphere Reserve or protected area	The study area is a Man and Biosphere Reserve. It comprises, in additional to the development and buffer zones, a protected area (Shouf Cedar Forests) and the Ammiq wetland, a Ramsar site and Important Bird Area - IBA
Effects of the recommended practice(direct effects)	**The principles of rotation and resting:** Adjusting the utilisation needs according to climate conditions and type of grasslands is a relevant measure in most grassland. Grassland productivity and species diversity is dependent on the mobility of livestock, the length of continuous grazing on the same parcel, the frequency with which the patch is re-grazed, dispersion of animals and herds around the site, and the interval during which the patch is rested. Unmanaged grazing or complete exclusion from grazing often will lead to ageing grasses that cease to grow productively causing land degradation and loss of biodiversity. Controlled grazing allows for more even distribution of dung and urine that can enhance soil organic matter and nutrients for plant productivity thus regenerating grasslands and improving livestock production simultaneously. **Grazing inn managed forest areas**, a common practice: the practice prevents the regrowth of the cut stems and controls the growth of understory vegetation, especially in areas with high fire risk (e.g. along the roads) which makes it one of the best fire prevention practices.

Effects of the recommended practice(indirect effects)		hemipteran species richness prevents clashes between shepherds
Targeted animal and/or vegetable species (that will be protected or that will have better conditions such as for their nutrition or reproduction)		Animals: goats (*Capra aegagrus hircus)* Vegetable species: *Quercus brantii; Quercus calliprinos ; Quercus infectoria; Pinus pinea; Acer tauricolum; Sorbus flabellifolia; Sorbus torminalis; Malus trilobata ; Prunus ursine; Crataegus azarolus; Crataegus monogina ; Pyrus syriaca ; Prunus dulcis; Arbutus andrachne .*
Status of the targeted species		
Recommended solutions for the recommended practice		Rotational grazing and the establishment of enclosures require a number of prerequisites to be effective:
1	Institutional, regulatory and legal	Understanding ownership rights in the targeted degraded pastures and setting clear agreements with the municipal forest committees and local shepherds for the protection of the enclosure areas.
2	Communication, awareness raising and capacity building of stakeholders	• Involving all concerned local people – namely shepherds using the targeted pastures and the municipal forest committees - in the planning, implementation, and monitoring of the enclosures. • Raising awareness and know-how of local shepherds on the value of the temporary exclusion areas from grazing to improve the productivity and quality of pastures as well as the value of scattered tree thickets as a key adaptation measures to help livestock face current and future climate shocks. • Enabling local shepherds to benefit from the established enclosures through trade-offs, such as the provision of the mown grass that is annually cut inside the enclosure to facilitate the growth of the planted seedlings. Differences in the growth of grass inside the enclosure (much higher) and outside the enclosure also help raise the awareness of local shepherds about the benefits of temporary exclusion of grazing as part of a rotation system. • Integrating enclosure management into agriculture, livestock grazing and forest management.
3	Governance	Municipal forest committees, the SBR staff, local farmers and shepherds agreed on land management practices supporting a successful combination of protection (e.g. enclosure to protect against livestock and bushfire), management (e.g. thinning operations to select the best stems; rotating management in a division of forest parcels; controlled grazing/fuelwood collection during rainy season and grazing restrictions for at least 18 months in logged forests; banning the lopping of fodder trees), and active restoration (e.g. enrichment by direct seeding using local farmer's techniques for cereal sowing).
Indicators for monitoring of implementation		- no. of goats (animals in case other species are to be considered) - area of restored hectares - increase of regeneration (indicator species monitored, stems/ha from seeding and re-sprouting) - no. of people engaged (in the implementation and in the production) - no. of women and youth engaged

Role of women in implementation of recommended practice	Women are/will be engaged in the production process rather than in the implementation phase. Their role is vital in the making of the cheese in particular and this activity will provide them with income generating opportunities and enhance their role in family economic security, or independently.
Level of visibility: supply, transformation, storage, marketing, … of products and services from the recommended practice	The existing services are very out-dated and they have to be updated to meet modern standards (hygiene in particular), without losing their traditional distinction.
Level of visibility of the value chains of products and services provided by the recommended practice	A value chain analysis similar to the ones conducted for other products of the SBR will have to be developed for the products linked to this practice
Main incentives needed to promote the recommended practice	**Financial**: Access to the existing revolving fund credit system (Cedar Loan) Compensation for grazing for fire prevention **Other:** Access to rich grazing lands through agreements with local authorities Access to water sources Access to veterinary services
…….	