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SYRIAN ARAB REPUBLIC

Sustainable Land Management Practices Report in Syria

Acknowledgment:

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Background:

The Secretariat of the United Nations Convention to Combat Desertification (UNCCD), in cooperation with the United Nations Environment Programme (UNEP) and with the support of the Global Environment Facility (GEF), launched a special programme to support States Parties to the Convention in preparing national reports on the state of desertification for the period 2016-2019 to follow up on the progress made towards implementing the Strategic Framework of the Convention on Desertification 2018-2030 and the 2030 Agenda for Sustainable Development, describing the Convention as the sponsoring agency for indicator 15.3.1: "Proportion of land that is degraded over total land area."

Within the framework of its commitments to the International Convention to Combat Desertification (UNCCD), the Syrian Arab Republic implemented the project "**Strengthening institutional and professional capacities at the national level of country Parties to enhance UNCCD monitoring and reporting**" in cooperation with the United Nations Development Programme (UNDP) - Damascus office and the United Nations Environment Programme (UNEP). The aim is to respond to the increasing challenges of land degradation facing Syria and to adapt to the effects of climate change by organizing and implementing several activities in the fields:

1- Developing standardized data collection tools and methods for monitoring and reporting on land management in the Syrian Arab Republic.

2- Enhancing the competence of national staff by providing them with the necessary specialized knowledge and skills in monitoring land degradation issues in different ecosystems, identifying their causes and impacts (environmental, economic, and social), and enabling them to make evidence-based decisions and to select the best sustainable land management practices.

3- Collecting and analyzing data to assess the effectiveness of sustainable management practices currently applied in the project areas, to help develop, improve, and disseminate these practices in appropriate areas.

4- Raising awareness, stimulating community engagement, and changing behaviors towards more sustainable practices.

This report, titled "**Sustainable Land Management Practices in the Syrian Arab Republic**", is part of the national efforts to address the issue of land degradation, which has reached serious levels as a result of the war in Syria. It comes in light of the impacts of climate change, especially drought, the effects of which are expected to worsen in the coming years, which threatens the ability of ecosystems to provide their services and thus threatens food security and the livelihoods of the population. The proportion of degraded land to the total area of the country, according to the SDG Indicator 15.3.1, has reached 43.91% between 2000 and 2015 **(The National Program for Land Degradation Neutrality, 2019)**.
Therefore, adopting and spreading sustainable management practices is no longer an option, but a necessity and an urgent need to reverse and mitigate land degradation and to protect lands that have not yet degraded.

The main objective of the report is to improve land management and combat desertification by moving towards the adoption and dissemination of sustainable land management practices in Syria. This will contribute to supporting the achievement of national goals to neutralize the effects of land degradation and to implement the SDGs, especially SDG 15.

This document targets key stakeholders in the field of combating land degradation. This includes those responsible for developing relevant policies, plans, and programs, in addition to technicians, researchers, and technical and donor institutions and organizations, through:

- Evaluating current sustainable land management (SLM) practices applied in the project areas (the Southern Region - the Central Region - the Coastal Region) in terms of effectiveness and gaps in knowledge, application, and adoption.

- Promoting awareness and knowledge of the importance of SLM at the level of decision makers, implementers and the local community as a viable solution to land degradation and to adapt to climate change.

This report is an important step towards promoting SLM in Syria, which requires a comprehensive and long-term vision, based on cooperation among all actors, whether governmental, community-based, or international, to achieve tangible progress in reducing land degradation, mitigating the effects of drought, and enhancing the sustainability of natural resources, thus contributing to neutralizing land degradation throughout the territory of the Syrian Arab Republic and enhancing Syria's contribution to the achievement of the SDGs, especially SDG 15.

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Chapter 1:
Land Degradation

Introduction:

Land degradation is one of the urgent environmental challenges that require adopting immediate solutions. This is attributed to its great impact on the environment and living organisms. Land degradation is defined according to (UNCCD, 1994), as the reduction or loss, in arid, semi-arid and dry sub-humid areas of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest, and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns; or soil erosion caused by wind and/or water; deterioration of the physical, chemical, and biological properties of soil. Land degradation is caused by negative human activities and practices that misuse natural resources and also by mismanagement of ecosystems, which contribute to the degradation of large areas of land. It can also be caused by climatic factors that are difficult to control, the most important of which are successive droughts and changes in various climate elements. The effects of soil degradation can be manifested in several ways, the most important of which are: declining soil fertility through reduced crop yield and quality, lack of nutrients, soil compaction, the decay and extinction of many animals and plants due to the degradation of their natural habitats, and the loss of significant areas of agricultural land.

Main forms of land degradation in the Syrian Arab Republic

The lands of the Syrian Arab Republic are subject to various forms of degradation, mainly as a result of the mismanagement and misuse of natural resources (water, soil, and vegetation), while drought is a contributing factor to land degradation. The following are the main forms of degradation in Syria:

Wind Erosion:

The lands of the Syrian Arab Republic are subject to wind erosion (particularly in the Badia and the eastern region). The wind starts to transport sand (wind erosion) when its speed exceeds 3 m/s, and medium-intensity winds of 4-5 m/s continue to blow, which leads to the complete erosion of the land surface and the formation of sand dunes. In addition, it leads to sand drifting to vital roads and facilities, covering vegetation, and provoking sand and dust storms. Previous studies conducted over the past 30 years in the Syrian Badia have shown that dust storms have increased in frequency.

Dust Storms:

Dust storms are an environmental issue characterized by high-speed winds in the Badia and at the edges of deserts. These winds stir up dust and cause the stripping of the fragile surface soil that can be carried and transported. These storms may be local in origin or transient that sweep across large areas. In recent years, these storms have swept across large areas of the Syrian Badia, especially in the eastern region, causing serious damage to natural rangelands, agricultural lands, livestock, vital facilities, traffic on public roads, and air traffic.

Residents of areas affected by dust storms suffer from serious health issues, especially asthma and other respiratory diseases.

Water Erosion:

The coastal areas, especially the mountainous highland areas of the Syrian Arab Republic, are considered the most vulnerable to water erosion due to human intervention, which has led to the destruction of the vegetation that once protected the soil from the effects of heavy rains.

There is also destruction of the earth's surface and the formation of gullies in the soil and valleys in the mountainous areas, with increased chances of flooding, sometimes with devastating effects.

In the interior areas, water erosion is the least damaging cause compared to other major causes, such as wind erosion and soil salinization, due to the lack of rainfall in these areas.

Decline in Rangeland Area:

Various factors have contributed to the acceleration of the process of rangeland degradation, especially since plants, animals, and humans are parts of the ecosystem that are affected by one other and by other components of the ecosystem. As a result of the degradation of rangeland, their area and productivity have decreased, leading to a decline in animal production from these lands. In addition, there is the impact of vegetation degradation on air and environmental cleanliness and soil permeability, leading to a decrease in soil moisture reservoir, increased surface runoff, loss of good topsoil, emergence of sand dunes, and an increase in drought and desertification.

Physical Degradation:

Soil hardening and crust formation are among the main forms of physical degradation that occur in a number of irrigated agricultural projects in Syria.
Forms of physical degradation include:

•Soil salinization:

In addition to the existence and spread of saline soils and natural sabkha soils, a significant amount of irrigated lands in Syria turns into saline soils every year. Salinity makes the land unfit for cultivation or plant growth, and over time the land is no longer classified as agricultural land and enters the list of desertified lands.

•Waterlogging:

Excessive irrigation and poor internal soil drainage are the two main causes of water logging, which inevitably leads to secondary salinity in the soil.

Chemical degradation, loss of nutrients and degradation of soil fertility:

Agricultural intensification and lack of adherence to agricultural guidelines and cycles have led to a decline in land fertility and the exclusion oflarge areas from agricultural investment. Moreover, the loss of nutrients, especially in irrigated areas, leads to a decrease in the productive capacity of the land and its degradation to varying degrees.

•Soil and water pollution:

Soil and water resources in Syria are exposed to many sources of pollutants that vary depending on the prevalent type of agricultural systems and technologies applied. This issue arises from the irrational use of chemical fertilizers and pesticides, partially treated and untreated sewage, as well as saline and hard agricultural wastewater.
Large areas of agricultural land are also exposed to pollution from the discharges of factories and industrial facilities, whether liquid or non-liquid, which changes the nature of these lands and affects their composition. The severity of this pollution has increased in recent decades until it became visible in many Syrian regions, and it needs to be studied to reduce it and prevent its risks.

Soil biodegradation:

Healthy soils play an essential role in maintaining ecosystems or biodiversity. Soils are home to more than 25% of biodiversity, and this diverse community of organisms maintains the health and fertility of the soil.

Main Causes of Land Degradation:

- The reality of land degradation in the Syrian Arab Republic indicates that a large proportion of its land is degraded or threatened by desertification due to various factors, mainly overgrazing, increased pastoral loads, cutting down forest trees and pastoral shrubs, forest fires, wind and water erosion, soil salinization, and modern agricultural practices that include excessive use of fertilizers and pesticides. This leads to the deterioration of the natural quality of the soil, the decline in the fertility of agricultural lands, and the destruction of the soil structure and its pollution, including industrial waste, urban expansion, and the movement of vehicles on unpaved roads, which disrupts the natural balance of natural vegetation growth and reproduction, and leads to land degradation.

● **The causes of land degradation and desertification in Syria in general can be summarized into two main factors:**

1.Climatic factors that are difficult to control, the most important of which are the succession of droughts and changes in various climate elements.

2.Improper human practices in the exploitation of natural resources and mismanagement of ecosystems.

○ 1.Climate change:

Especially the process of seasonal and precipitation shifts, and extreme phenomena such as heat waves, intense rainfall, or retention of precipitation for long periods.

○ 2.Improper human practices:

The rapid increase in population growth rates and the high consumption rates of individuals have led to an increase in demand for agricultural products, which has put severe pressure on natural resources, including soil. This has contributed to the disruption and degradation of ecosystems in various forms. This includes the exploitation of marginal, sensitive, and unstable environments where the dynamic balance of environmental components is not resilient to change. It is a significant example of human mismanagement and misuse of natural resources.

• Degradation of vegetation and deforestation:

One of the main causes of land degradation is encroachment on vegetation and deforestation for agriculture, urbanization, or logging. The vegetation that protects the soil is removed, exposing the soil to erosion, leading to the loss of topsoil and nutrients. This makes the land less fertile and less able to support plant and animal life, and decreases biodiversity.


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• Forest fires:

Wildfire destroys the habitats of living organisms and affects the complex relationships between diverse plants and animals, leading to the loss of ecosystems and biodiversity. Wildfire destroys land that is habitable and adaptable to certain types of plants and animals. They can also lead to the extinction of certain animals.

• Early grazing and overgrazing:

Overgrazing continuously consumes plants without allowing them time to regenerate, which can lead to soil compaction, erosion, and loss of plant diversity. This can transform the land into a barren, desert-like landscape.

• Farming the desert and using the land in pastoral areas for rain-fed agriculture:

Soil plowing in marginal areas and during drought leads to soil disintegration and makes the soil vulnerable to wind erosion as a result of active wind movement and loss of the nutrient-rich topsoil, in addition to soil compaction and loss of nutrients.

• Improper agricultural practices such as misuse of water resources for irrigation:
Unsustainable agricultural practices, such as excessive use of chemical fertilizers and pesticides, monoculture, improper irrigation techniques, and the use of wastewater for irrigation, contribute to land degradation. Excessive use of chemicals can lead to soil salinization, nutrient imbalance, and contamination of soil and water resources with heavy elements. In some areas, reliance on irrigation without proper water management, along with excessive irrigation, has depleted water resources and degraded previously productive farmlands.

• Misuse of land:
It refers to wrong methods of land resources management, such as the expansion of agriculture at the expense of rangeland or forests, the use of inappropriate technologies and machinery, as well as failure to adhere to proper agricultural cycles, and other practices that would affect production, soil fertility and health, and the environment.

• Human activities, especially industrial activities:
Industrial activities, including mining, manufacturing, and waste disposal, can have significant impacts on land degradation. Mining operations often involve the removal of large amounts of soil and vegetation, leaving behind barren landscapes. Improper disposal of waste can contaminate soil and water, making the land unfit for agricultural use or other purposes. For example, in areas with manual oil refining activities in the northeast (such as Deir ez-Zor), oil spills and improper waste disposal have led to the destruction of farmland and water pollution.

• Urbanization:
The expansion of cities and the construction of infrastructure, such as roads, buildings, and dams, can lead to the loss of fertile land. Urbanization often involves the conversion of agricultural land into residential or industrial areas, leading to fragmentation of ecosystems and reduced soil quality. In addition, the construction of dams can alter natural water flow patterns, causing flooding of farmland and loss of fertile soil. A notable example is the rapid urbanization of parts of Ghuta, where fertile agricultural lands have been converted into urban areas, contributing to land degradation.

• The environmental-economic-social implications of land degradation:
The long-term consequences of soil degradation go beyond the loss of fertile land for agriculture and include environmental, economic, and social consequences, leading to reduced food production, conflict, and migration waves.

In environmental terms: land degradation disrupts the delicate balance of ecosystems and depletes biodiversity. When soil erosion occurs, for example, it leads to the loss of fertile topsoil, which is essential for plant growth and the maintenance of various organisms in the food chain. As a result, the productivity of agricultural land is diminished, leading to lower crop yields and reduced food security. Moreover, land degradation contributes to increasing greenhouse gas emissions, exacerbating climate change and increasing the impact on ecosystems.

In economic terms: the impact of land degradation is significant. It directly affects the agricultural sector, which relies heavily on fertile land for crop production. Declining agricultural productivity increases costs for farmers, who must invest in fertilizers, irrigation, and other inputs to compensate for land degradation. These additional expenses often lead to lower profits and can push vulnerable farming communities into poverty. Moreover, land degradation also affects industries that rely on natural resources such as timber, minerals, and water, leading to lower economic output and potential job losses.

In social terms: the impact of land degradation is equally important. Poor communities, especially in rural areas, rely heavily on agriculture for their livelihood and income. Land degradation disrupts their livelihoods, making it more difficult to meet their basic needs and perpetuating the cycle of poverty. Moreover, as land becomes less productive, people are forced to migrate to urban areas in search of alternative sources of income, putting additional pressure on already overcrowded cities. This can lead to social unrest, increased inequality, and the loss of cultural heritage associated with traditional agricultural practices.

Challenges and Opportunities:

1– Challenges:

1. **Climate change:** Climate-related phenomena such as extreme and severe weather events like floods, torrential rains, droughts, heat waves, and unseasonal, irregular, and unpredictable distribution of rainfall.
2. **Population growth and urban sprawl.**
3. **Land degradation increases affected areas as available resources become scarce,** in addition to limited arable land, declining soil fertility, small, fragmented, and dispersed agricultural holdings, and limited adoption of modern agricultural technologies.

2– Opportunities:

There are many opportunities to mitigate or prevent land degradation. The old saying goes, "prevention is better than cure." The same principle applies to addressing the global issue of soil degradation, as the costs of preventing salinization can be a fraction of the cost of restoring salinized areas.

1. **Following appropriate agricultural policies based on the prevailing soil and surrounding conditions**, (e.g., taking measures to combat water and wind erosion, improving irrigation systems, and following agricultural cycles.)
2. **Utilizing modern and smart farming methods**
   One of the most sustainable strategies to avoid soil degradation is to use proper tillage machinery. This is also known as conservation agriculture, which refers to tillage methods that aim to make only minor changes to the natural state of the soil while maximizing productivity. Zero tillage, also known as conservation agriculture, is being tested by a small number of farmers in Syria, where efforts are focused on ensuring that no soil is left bare by planting "cover crops" immediately after harvest and on restoring nutrients and plant matter to the soil. It also helps keep the soil moist and increases the soil's carbon stock.
   To make farming on hillsides possible, terraced farming must be adopted, which is more manageable. Terraces help avoid the risk of water erosion while also allowing more water to reach the crops. In addition, full crop cover is required in hillside planting fields to keep the soil in place. This can be done through intercropping, which involves growing two crops in the same field, such as growing tobacco between rows of trees.
3. The existence of strategies, action programs, and plans to stop, limit, or reverse land degradation processes, such as national plans to combat desertification, LDN programs, and drought management strategies.
4. Spreading awareness of the importance of soils and the sustainable techniques for soil use. Raising awareness of the target groups in particular, along with transforming negative land use behavior into sustainable practices, has a significant impact on the process of land protection and sustainability.

Chapter 2:

The concept of Sustainable Land Management (SLM)

Sustainable land management (SLM) is a set of activities that can be practiced by local population to adapt to the impacts of climate change, maximize environmental resilience and conserving the environment while meeting social and economic needs. It involves the implementation of practices and techniques that maintain the productive capacity of the land, in addition to the use of land resources and ecosystems (such as soil, vegetation, and water) to meet the needs of current and future generations, without compromising the long-term productive potential of these resources and their ecological functions.

First - Definition of SLM:

SLM is defined as "the use of land resources, including soils, water, animals, and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions." This definition, from the 1992 United Nations Earth Summit, presents SLM as a holistic approach to achieving long-term productive ecosystems by integrating biophysical, sociocultural, and economic needs and values.

The concept of SLM revolves around the recognition that land is a finite resource and that its use should not affect future generations' ability to use it. This concept applies to any ecosystem and any type of land use that contributes to addressing desertification, land degradation and drought (DLDD), mitigating and adapting to climate change, and achieving the goal of neutralizing the impact of land degradation. Despite growing evidence of the potential advantages of SLM technologies as land-based solutions to address DLDD and adapt to climate change and mitigate its effects simultaneously, there is no one-size-fits-all procedure for achieving SLM. This is because SLM strategies must take into account socio-ecological systems, and their vulnerability and capacity to adapt to human activities and climate change impacts.

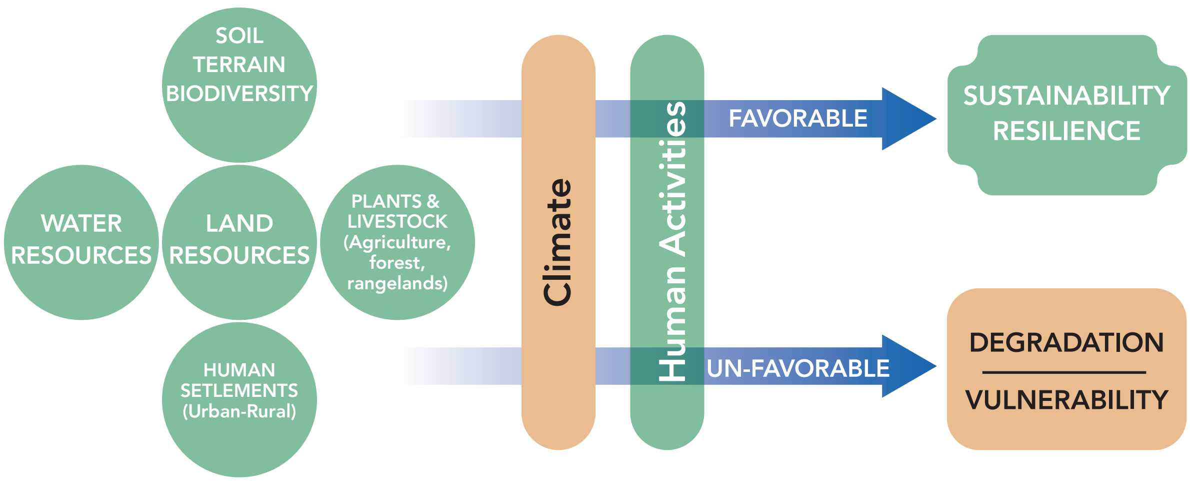

Figure 1:
Human activities, land use, and sustainability of land resources.

Second - Benefits (environmental, economic, social):

SLM is vital and can bring many different environmental, social, and economic benefits. Adopting these practices enables us to improve the health of our ecosystems, enhance our food security, improve the livelihoods of rural communities, reduce environmental degradation, and address many global challenges such as DLDD by following effective land management practices to increase production, achieve food security, mitigate land degradation, conserve natural resources, enhance resilience to changing environmental conditions, produce local energy, and access to clean water for smallholder farmers:

1- The environmental benefits of sustainable land management:

practices provide a range of regulatory and supportive ecosystem services that are critical for conserving water and soil resources and mitigating the effects of climate change. These services play a vital role in maintaining the balance and functions of ecosystems, ultimately benefiting the well-being of both humans and the environment.

Furthermore, SLM practices support climate change mitigation by reducing carbon dioxide emissions that contribute to global warming, and through techniques such as agroforestry and conservation agriculture, carbon sequestration can be enhanced, helping to reduce atmospheric carbon dioxide levels and mitigate the effects of climate change.

Degraded soils in drylands often have minimal soil organic carbon, but through SLM, organic carbon can be significantly increased.

Restoring degraded soils and ecosystems not only sequesters carbon, but also provides many additional benefits. It helps improve soil structure and moisture, which are critical for drought-prone areas. In addition, restored ecosystems promote biodiversity conservation and support the recovery of native plant species, contributing to public health and resilience in dry areas. Through SLM practices, degraded lands can be transformed into productive and vibrant ecosystems that provide many environmental services.

2- The economic benefits of SLM:

SLM practices enhance food security and increase agricultural productivity, and they can increase global yields by 30-170%. This enhances food security, especially for smallholder farmers. SLM practices play a critical role in ensuring the long-term viability of ecosystems and agriculture. One of the main benefits of SLM is that agricultural yields can be increased by implementing SLM practices such as crop rotation, intercropping, and integrated pest management. Farmers can improve their production, which contributes to improving food security and the well-being of local communities while maintaining soil health and biodiversity.

3- The social benefits of SLM:

SLM helps local communities by preserving the cultural landscapes and traditional knowledge of land users, supporting their involvement in economic and tourism activities, and integrating social, economic and environmental needs and values for sustainable development. It thus improves their food security and reduces poverty, along with gender and other inequalities.

Third - The relationship of SLM to neutralizing land degradation and the land-related SDGs:

After decades of fieldwork on SLM methods and practices, there are many SLM options to reverse the negative trends of land degradation and desertification and to identify affected communities and target areas to implement locally appropriate SLM options for managing land resources, with the aim of scaling up SLM over large areas.

According to the conceptual framework for neutralizing the impact of land degradation, which aims to preserve the natural capital of land and land-dependent ecosystem functions and services. SLM is one of the key mechanisms for achieving impact on land degradation through the services provided by neutralizing land degradation. These services, which can be achieved by adopting SLM, are:

- **Provisioning services** (e.g., provision of food, water quality, raw materials, and medical services).
- **Regulating services** (e.g., climate regulation, climate change mitigation, disaster risk reduction, habitat regulation for pests and diseases, and water use regulation).
- **Support services** (e.g., water recycling, soil fertility).
- **Cultural services** (e.g., cultural heritage, entertainment, and tourism).

LDN provides many environmental and social benefits, which help address issues such as food security, income equality, poverty, and resource availability. The application of SLM can help increase the productivity of crops. In addition, LDN offers huge advantages for climate change mitigation and adaptation. Halting and reversing land degradation can transform land from a source of greenhouse gas emissions to a sink by increasing carbon stocks in soils and plants. Soil alone can sequester about 1 to 3 million tonnes of carbon dioxide (CO2) per year, while the entire land sector has the potential to mitigate about 7 to 11 million tonnes of CO2 per year, equal to about one-third of the total CO2 emissions from fossil fuels (UNCCD, 2015). In the same way, LDN plays a key role in strengthening the resilience of rural communities to climate shocks by securing and improving the provision of vital ecosystem services.

There is a direct link between LDN and the SDGs in combating poverty, supporting food security, protecting the environment, and the sustainable use of natural resources, and thus, it helps create a direct contribution to the achievement of these and other SDGs (UNCCD, 2016), especially Target 15.3, **"combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world by 2030."** Sustainable land use is also directly and indirectly linked to many of the SDGs adopted in the United Nations 2030 Agenda, in particular:

-SDG 2:

"End hunger, achieve food security and improved nutrition and promote sustainable agriculture." Sustainable land management practices implemented in the area of soil and water conservation, such as integrated soil fertility management, erosion control measures, and water harvesting, support activities aimed to build resilience to future droughts and increase production, thereby improving food security.

-SDG 6:

"Ensure availability of water and sanitation for all." SLM helps improve water use efficiency in drylands, especially rainfed lands, through water harvesting, terracing, and other practices that provide water for agriculture and livestock, reduce runoff loss, and enhance groundwater storage.

-SDG 13:

"Take urgent action to address climate change and its impacts." SLM can be a powerful tool in mitigating climate change by sequestering carbon and reducing carbon loss. This includes conservation agriculture, mulching, crop rotation, sustainable forest management, and soil erosion control.

-SDG 15:

"Protect, restore and promote the sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss." Achieving this goal relies heavily on SLM to ensure that resources such as soil, water, and biodiversity are managed in ways that maintain their ability to support terrestrial ecosystems and thereby support life and livelihoods.

As a result, the effects of land degradation and desertification often extend beyond the local to the global level. Soil erosion, fire, and deforestation, for example, lead to an increase in greenhouse gases and thus climate change and associated climate events. Working towards the adoption and dissemination of SLM practices helps achieve the SDGs, currently the largest international approach that has been developed for a sustainable future.

Fourth - Key global initiatives on SLM practices:

4.1. Global Soil Partnership: The Global Soil Partnership was established in 2012. Its mission is to promote sustainable soil management, improve soil management to ensure healthy and productive soils, and support the provision of essential ecosystem services to achieve food security, climate change adaptation and mitigation, and sustainable development.
It is based on 5 pillars:

- **Pillar 1:** Soil management.
- **Pillar 2:** Awareness raising on the importance of soil.
- **Pillar 3:** Agricultural research.
- **Pillar 4:** Soil data and information.
- **Pillar 5:** Harmonization of methods and indicators for soil.

Syria joined the partnership in 2015, and some of the most significant accomplishments achieved through cooperation with the partnership include:

- The establishment of the Global Soil Laboratory Network, where 10 soil analysis laboratories have joined.
- Completion of the Syrian soil salinity map and global adoption of it.
- Study of several Syrian areas of contamination with oil, explosive residues, sewage and wastewater.

4.2. World Overview of Conservation Approaches and Technologies (WOCAT): It is a global network founded in 1992. It aims to improve land management by collecting, documenting, and disseminating knowledge on SLM techniques and practices, especially in arid and semi-arid regions. It provides a global database of documented SLM techniques and comparisons from countries around the world. It supports national and regional projects by providing guidance, tools, and resources to help local communities develop SLM plans.

4.3. TerrAfrica: It is an initiative launched in 2005 by the World Bank and African partners to address environmental challenges in Africa, such as desertification and land degradation, and to promote sustainable land management on a large scale, with a focus on sustainable agriculture and rehabilitation of degraded land.

4.4. World Bank: The World Bank plays a role in financing programs and initiatives that promote SLM, especially in developing countries. It encourages the adoption of strategies that promote sustainable land use, to conserve natural resources and achieve economic development.

These initiatives are all working at different levels to achieve a common goal of improving SLM. While some focus on documenting and sharing technical knowledge, others facilitate collaboration and provide funding and technical support.

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Chapter 3:
Sustainable Land Management Techniques by Land Use

Sustainable land management focuses on conserving soil resources by building agricultural systems that are resilient to climate change, including extreme weather events and rising temperatures; reducing vulnerability to droughts and floods; and adopting techniques that minimize soil erosion, improve soil health, and promote efficient use of water. By implementing practices such as terracing, agroforestry, precision irrigation, crop diversification, conservation agriculture, and integrated pest management, which strengthen agroecosystems' resilience to climate shocks, maintain productivity, and ensure the long-term sustainability of agricultural livelihoods.

Sustainable land management techniques by type of land use:

First - in agricultural lands (irrigated - rainfed):

1- Controlling soil erosion:

Soil erosion can be minimized by adopting appropriate soil conservation practices such as:

- Intercropping, creating water retention basins, and building terraces.
- Planting trees and perennials that stabilize the soil due to their deep roots.
- Leaving plant debris in the soil after the harvest season, which creates heavy soil and prevents soil erosion, especially if it is exposed to wind.
- Building dams to trap water and creating water channels, to avoid the flow of rainwater or floods to neighboring lands and avoid soil erosion.
- Leveling sloping areas to prevent soil erosion from top to bottom if possible, or exploiting by division into fields used for planting trees or seasonal produce.
- Cross-slope barriers are measures taken on sloping land and can take the form of earthen embankments, stone lines, or vegetation strips to reduce runoff velocity and soil los.
- The use of windbreaks and barriers (bio - mechanical) that reduce wind speed.

2- Improving soil structure and fertility :

Sustainable practices to improve soil structure include:

A. Application of conservation agriculture:

It is based on three principles:

1 - Minimal mechanical soil disturbance, i.e. no-till and direct application of seed and/or fertilizer.

2 - Permanent organic soil cover of at least 30 percent with crop residues or cover crops.

3 - Multi-species cropping through diversified crop chains and combinations that include at least three different crops.

Conservation agriculture enriches the soil with organic matter and living organisms, thus increasing soil fertility, preserving soil moisture by improving the rate of water infiltration and storage in the root zone; reducing the effects of climate change and erosion risks; and mitigating global warming by increasing the efficiency of the soil to sequester carbon and reduce its emission into the atmosphere by reducing frequent tillage operations.

• Use of organic soil stabilizers to protect the soil from erosion and to increase soil fertility by adding organic and chemical fertilizers that increase the green area, and resist soil erosion.

• Integrated management of fertilization and nutrient addition to the soil to maximize crop production while minimizing the depletion of soil nutrient stocks and the degradation of soil physical and chemical properties that can lead to land degradation.

• Improved soil fertility by incorporating cover crops that add organic matter to the soil, which improves soil structure and contributes to healthy and fertile soils; or by using green manure or growing legumes to fix atmospheric nitrogen through the process of biological nitrogen fixation.

3- Vegetation management:

• Controlling unwanted vegetation, which extends from grass and shrubs to branches and trees. This vegetation sometimes threatens some facilities such as power lines, railroads, and others and can have significant impacts on communities and on the quality of the provided service.

• Planting multiple, diverse, and environment friendly species to maximize biomass above and below the soil and increase organic matter.

4- Integrated Pest Management (IPM):

It is a holistic approach to pest control that prioritizes environmental and human health.
Unlike traditional pest control practices that rely heavily on chemical pesticides, the IPM program combines multiple strategies to manage pest populations in a more sustainable, effective, and environment friendly way that effectively controls weeds and pathogens that can affect crop yields using a range of flexible methods such as:

• Installing insect traps.

• Cultural measures (varietal selection, fallow, crop rotation, intercropping, cover strips, cover crops).

• Creating rows of trees to prevent pests from crossing between blocks.
This technique provides a haven for plants and animals endemic to the area.

• The use of biological agents to increase crop resistance.

• Biological pest control: Its primary goal is to regulate pest species by providing habitats for their natural enemies.

• Standardized use of plant pesticides in terms of changing the application rate, type, timing, and precise application of pesticides.

• Use of eco-friendly botanical pesticides made from natural plant extracts to help control pests and diseases.

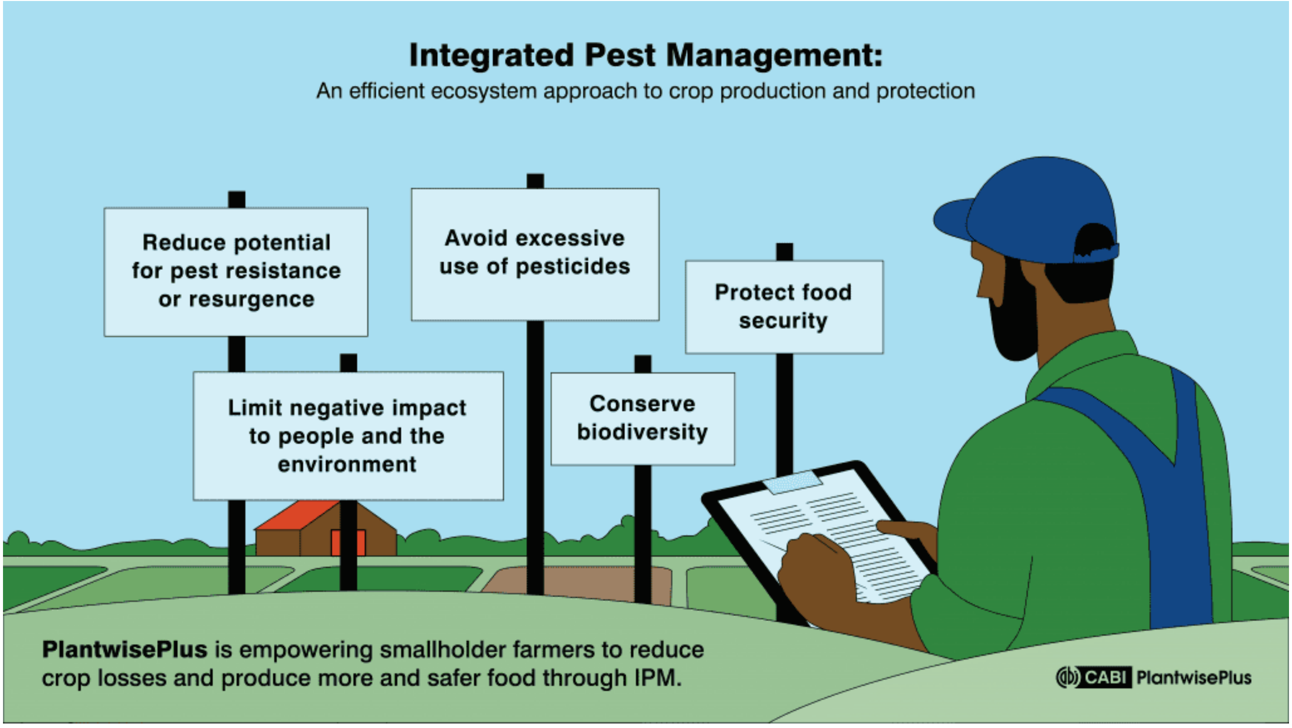


Figure 2:
Integrated Pest Management

5- Water management:

Improving soil moisture management is critical to optimizing food production and water supply in a sustainable manner.

Improved water management, along with better soil and crop management, would increase agricultural productivity in rainwater-dependent areas.

It is essential that the region's water management procedures and land uses are tailored to the different climate zones:

A - In arid and semi-arid areas:

- Intensive rainwater harvesting (tanks.... etc.)
- Recycling wastewater, especially for supplemental irrigation.
- Precision irrigation using sprinkler systems, drip irrigation, and sub-soil drip irrigation.
- Measures to reduce evaporation from reservoirs and soils, such as adding cover crops or sawdust.
- Scheduling irrigation and irrigation rates more accurately, repairing leaks in dryland irrigation systems, and irrigating at night to avoid evaporation losses.
- The use of intermittent irrigation for some types of crops.
- Efficient inter-basin water transfer and ensuring there is no wastage or loss.

B - In sub-humid areas:

- On-site water conservation through flood control barriers and dams, and maximizing groundwater recharge.
- Storing water in streams and dams.
- Recycling wastewater for use in irrigation.
- Rehabilitation and reconstruction of morphological structures in rivers.
- Adopting crop rotation and appropriate agricultural practices (tillage systems, soil cover management, etc.).

Second - Forest land:

1- Reducing deforestation:

Best sustainable practices for reducing deforestation:

- Securing alternative sources of income for local people to reduce deforestation.
- Adopting a participatory approach based on the forest products for the local population to minimize encroachment on the forest.
- Creating protected areas in forests.
- Increasing awareness of the important ecological functions provided by forests.

2- Afforestation/Reforestation:

Forest land that is degraded or on the verge of degradation can recover naturally through natural regeneration or through artificial afforestation. Afforestation leads to an increase in biomass (above and below ground), the accumulation of organic carbon in the soil, and an associated increase in soil biological activity and ecosystem biodiversity.
Since arable soils typically have a much lower soil organic carbon content than forests or rangelands, land-use changes through afforestation will result in a gradual accumulation of soil organic carbon, which will depend on the planted species and planting techniques.

Sound and sustainable practices include:

- Afforestation using environmentally friendly and adaptable plant species and varieties.
- Artificial afforestation and afforestation in previously unforested areas with suitable land.
- Reversing forest degradation by reintroducing native forest species that were dominant and are adaptive to the prevailing conditions.
- Engaging local community stakeholders and adopting a participatory approach.
- Re-introducing favorable vegetation after forest fires.
- Not intervening in burned areas and leaving them to regenerate naturally.

3- Sustainable forest management:

Sustainable forest management involves maximizing the benefits of forests (wood, food, ecosystem services) to meet local community needs in a way that conserves forests and ecosystems for current and future generations.

The most important practices include:

- Selective logging: Cutting down trees that are large, old, diseased, or of poor quality to encourage the growth of the remaining trees in the forest. Selective tree removal aims to reduce the amount of accumulated (dead) fuel that forms a hotspot in the event of fires (creating fire lines) as part of vegetation management to enhance the resilience of the ecosystem in our fire-prone areas.
- Species rotation in forest plantations for small-scale production of forest products (such as wood fuel, sap for maple syrup, timber, and pulpwood), as well as recreational uses, such as birdwatching, bushwalking, and wildflower gardening.
- Forest irrigation, fertilization, and application of animal manure to some forested lands.
- Protecting rare and endangered plant species in their locations and establishing nurseries to produce them.

4- Forest restoration:

Through:

- Natural forest regeneration, which involves converting deforested lands with degraded vegetation into more productive forests. The method aims to accelerate, rather than replace, by removing or minimizing barriers to natural forest regeneration, such as soil degradation and competition with invasive species.

5- Fire, pest, and disease management:

Through:

- Promoting fire-resistant species: Like combining the removal of fire-prone species with planting fire-resistant species and creating firebreaks.
- Early control of fires, establishing an early warning system for fires, and patrolling during times of greatest risk of fire (summer).
- Creating tree-free strips in forests also helps prevent the spread of diseases within the forest.
- Mulching after wildfires. Inclined forest mulch is spread immediately after wildfires in order to prevent soil erosion and minimize the flow of water over the surface.

6- Water management:

Through:

- Terraces are constructed on steep slopes to minimize the force of water runoff and prevent erosion.
- Planting trees on mountain slopes, along with ditches that accumulate and collect moisture.
- Collecting rainwater in artificial pits, dams, and ditches on mountain slopes and hills to accumulate water in the soil around the roots of trees planted in the ditches.
- Establishing a strong bio-drainage system in forests.

Third - Rangeland management:

- Rangeland management and optimization of rangeland capacity through the application of rotation of rangeland access periods and the application of the permitted animal density (timing and intensity of grazing to ensure that the carrying capacity is not exceeded).
- Resting rangelands by stopping grazing for predetermined periods to optimize rangeland capacity.
- Replanting degraded rangelands with formerly dominant vegetation, such as: Planting grazing shrubs in degraded rangeland.
- Off-season irrigation of rangelands and early irrigation to retain soil moisture during the dry season as a mechanism to improve rangelands.
- Cut-and-carry fodder production to ensure the sustainability of dominant and adapted species in the rangeland and to provide fertilizer from on-site grazing residues.
- Work to follow the Hima system in pastoral areas.

Fourth - Presentation of cases of sustainable management from the central, southern, and coastal areas of the project:

1 - Water harvesting/water dam technique:

Date of evaluation: 22/7/2024

Evaluation based on:

- Field surveys of the technical site using the Sustainable Land Management (SLM) practice assessment form within the framework of the project " Strengthening National-level Institutional and Professional Capacities of Country Parties towards enhanced UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment.

  (Member of the sub-working teams in the central region formed by Decision No. 799/Q dated 09/05/2024 - General Commission for Scientific Agricultural Research in Hama)

- Information of a research study titled "Identifying suitable sites for rainwater harvesting (RWH) in Masyaf region using GIS/RS technologies".
- Interviews with specialists/technicians.
- This technique belongs to the water management and vegetation management group, and is part of traditional knowledge as it is an ancient technique dating back to Roman times.

1.1 - Description of the technique:

The implementation of the water dam technique dates back as early as the Roman era. It was implemented on natural rock in a low area based on a heterogeneous geometric shape. The structure of the dam consists of the floor and shoulders (walls), which are made of natural rocks found on the site. The shoulder walls are reinforced with cement materials, and local stones. The dam stretches over a small area of approximately 1.5 km, with dimensions of 47m long x 30m wide x 5m deep. The current capacity of the dam reaches about 2800m^3 due to the accumulation of silt in the dam's floors, while the maximum capacity of the dam in the event of silt removal reaches about 7000m^3.

This type of dams is widespread in most historical sites in Syria and differ in the method of water collection. The dimensions of these dams vary according to the targeted area, as they can be 20×20×4 or more, with a capacity of 1000m^3 at the farm level up to 10,000m^3. Water is collected by directing rainwater through the stream channel, to be used for irrigation and watering livestock.

1.2 - Location of the technique monitored and evaluated:

- Syrian Arab Republic, Hama Governorate, Masyaf District, Hirbnafsah Subdistrict, Salawa Town.
- Location coordinates: N 35.00.15.5 - E 36.34.33.5
- The site (Masyaf Basin area) is characterized by plateaus with a 9-15% slope, vegetation cover of rangelands with some forestry and agricultural sites planted with fruit trees such as grapes, olives, and figs in scattered areas. It is mainly dependent on rainwater irrigation in addition to a number of supplementary irrigation through tankers. The average annual rainfall rate is estimated at about 400 mm. The soil is moderately deep (30-75 cm), with loamy sand and silty clay texture and pH of (7.1-8.5).

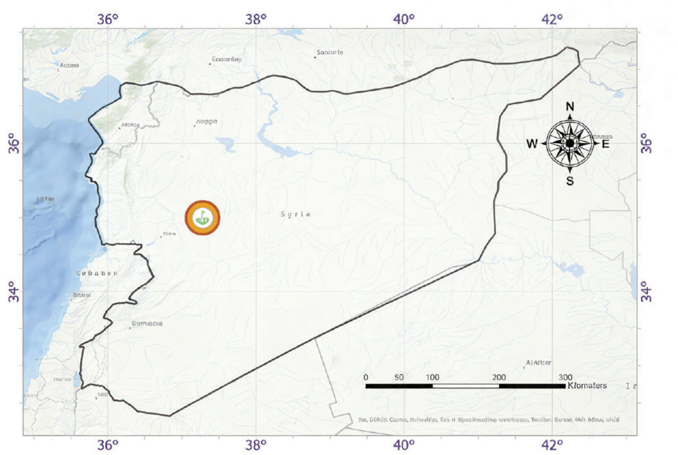
1.3 - Stakeholders benefiting from the technique:

The local community in neighboring areas, especially shepherds, as well as researchers in the field of SLM practices.

1.4 - Main objective of the technique:

- Avoiding land degradation.
- Optimizing plant production.
- Preserving the ecosystem.
- Creating an economic impact by providing drinking water for livestock as the area is a rangeland for more than 10,000 sheep, and improving the livelihoods of the local population in the neighboring areas.
- Creating a beneficial social impact.
- Adapting to climate change.
- Maintaining/improving plant and animal biodiversity, as the dam, when full in the spring, becomes a destination for birds of prey and river ducks

Water harvesting/water dam technique



1.5 - Main types of land degradation the technique addresses:

- water soil erosion.
- Physical soil degradation.
- Biological soil degradation.
- Deterioration of water quality.

1.6 - Main causes of land degradation at the site:

- Climate change and associated weather events such as extreme rainfall and prolonged rainfall delay.
- Increased frequency and severity of drought.
- Loss of soil by wind and water erosion.
- Improper human practices such as overgrazing and encroachment on grazing lands.

1.7 - On-site and off-site impacts of technique implementation:

- Improved water use efficiency and improved plant production by saving irrigation water.
- Increasing livestock productivity.
- Optimizing groundwater recharge.
- Decreasing workload.
- Improving food security.
- Minimizing storm water runoff and thus reducing soil erosion.
- Reducing the risk of natural disasters such as floods and torrents.
- Minimizing sediment and siltation.
- Increasing the knowledge and awareness of the local community and the technicians about the issue of land degradation and the importance of applying SLM practices to avoid and reverse land degradation.
- Minimizing damage to public and private infrastructure.

1.8 - Requirements for establishing and adopting the technique:

The establishment of water dams or large watersheds requires government investment due to the high cost of their construction in low-lying areas or valleys. They take advantage of the rocky nature of the area and reinforce it to prevent leakage. Their importance increases in dry areas where surface runoff is directed through a stream to the dam basin. In addition, it requires the used labor to have the knowledge and skill in design and implementation. Moreover, it requires machinery and equipment.

The main costs in dam construction are for labor, while maintenance costs depend largely on the quality of the design of the structures.

The benefits of applying the water dam technique at the site are positive in terms of construction and maintenance costs in the short term (1-3 years) if the rocky nature of the area is utilized, and very positive in terms of long-term returns (more than 10 years).

1.9 - Advantages and disadvantages of the technique:

1.9.1 - Advantages of the technique from both land users' and technicians' perspective:

- Providing drinking water for livestock in neighboring areas.
- Contributing to the rural development of the region.
- Increasing groundwater storage.
- Supporting the livelihoods of local populations.

1.9.2 - Disadvantages:

- Reliance on rainfall in light of declining rainfall due to increasing severity, frequency, and duration of drought.
- The high cost of maintaining the technique (paid labor, machinery, building materials).
- The need for regular maintenance of the dam.

1.9.3 - Recommendations for overcoming the disadvantages of the technique from the perspective of the local community and relevant technicians:

- Revitalizing the technique by performing maintenance on the dam, which includes removing silt and sediment from the dam floor, which reaches a depth of about 3 meters in the dam's body.
- Preparing a proposal for the dam revitalization project and submitting it to local or international donors to reintroduce the dam into service. This would contribute to creating a positive change in the ecosystem and reversing land degradation at the site.

2 - Stone terraces/ terraces technique:

Date of evaluation: 22/7/2024
Evaluated based on:

- Field surveys of the technology site using the SLM practices assessment form within the framework of the project "Strengthening institutional and professional capacities at the national level of country Parties to enhance UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment.
  (member of the sub-working teams in the central region formed by Decision No. 799/Q dated 9/5/2024 - Hama Forestry Department)
- Interviews with specialized technicians.
- Interviews with land users.

Date of the implementation of the technique: 2022
This technique belongs to the slope management and erosion control group.

2.1- Description of the technique:

Stone terracing is an ancient local technique in Syria that was introduced by the Romans and Byzantines more than 2,000 years ago, and new terraces are still being built today.
Stone terraces are implemented on sloping lands (usually on lands sloping more than 25%) and are suitable for a wide range of climatic zones from arid to humid. They are used in arid and dry areas mainly for water conservation purposes, and in sub-humid and humid areas to protect against soil erosion. Stones are arranged in lines across the slope to form walls, with permeable walls slowing and filtering water runoff, preserving soil moisture, and trapping sediment from outside the site. Terrace walls are 1-2.5 meters high, and level beds are 3-25 meters wide, depending on the slope, and along contour lines. In areas with 0.5-2% heavy rainfall, they can be graded across the slope to allow safe drainage of excess surface water along the barriers. This is an effective technique to minimize runoff velocity and soil loss, reduce slope and/or slope length, retain moisture, and create a suitable environment for planting.

The technique observed at the Ain al-Zarqa site is evenly distributed over the entire site on an area of 10 dunums. They are 2 m high x 2 m wide x 40 m long. The building materials used in the construction of the walls are local stones, and in locations where there are steep slopes, crescent arches were created around the seedling in a direction perpendicular to the direction of the slope. The terraces were planted with fruit trees (olives, figs, grapes, and peaches) and summer vegetables (eggplants, peppers, and tomatoes).

2.2 - Location of the technique monitored and evaluated:

- Syrian Arab Republic, Hama Governorate, Masyaf District, Hirbnafsah Subdistrict, Ain al-Zarqa Town.
- Location coordinates: -35.032233 36.194093
- The ground is moderately sloping, with a slope greater than 60%, the soil is moderately deep (51-80 cm), silty clay, with low organic matter content of less than 1% due to heavy rainfall and nutrient erosion. The type of land use is agricultural; the average rainfall range is 1501-2000 mm/year. The irrigation method applied at the site: mainly rain-fed fruit trees and irrigated summer vegetables.

2.3 - Stakeholders benefiting from the technique:

- Land user.

2.4 - Main objective of the technique:

- Facilitating the delivery of agricultural services and improving the aesthetics.
- Preventing water soil erosion and loss of organic matter.

2.5 - Main types of land degradation the technique addresses:

- Water soil erosion.

2.6 - Main causes of land degradation at the site:

- Soil loss due to water erosion.
- Rainfall intensity and sloppiness of the land.

2.7 - On-site and off-site impacts of technique implementation:

- Increasing the quantity and quality of plant production.
- Optimizing water management.
- Increasing soil fertility.
- Increasing farm income.
- Increasing expenditure on agricultural inputs.
- Increasing farm income.
- Increased workload.
- Achieving food security.
- Increased groundwater reserve.

2.8 - Requirements for establishing and adopting the technique:

The construction of stone terraces requires a lot of labor, adding cement materials, stone crushing equipment, equipment for leveling the terraces, seedlings, and seeds for planting. Moreover, it is very difficult to use tractors; it is more convenient to use animals for construction, but they are more expensive than tractors due to the lack of fodder. The cost of building one meter is 152,000 Syrian pounds, the largest share of which is the cost of labor.

Construction costs often exceed the benefits in the short term while being positive in the long term. There is need for maintenance. However, if they are built properly, maintenance requirements become low.

2.9 - Advantages and disadvantages of the technique:

2.9.1 - Advantages of the technique from both land users' and technicians' perspective:

- Preventing soil erosion and increasing organic matter.
- Increasing soil moisture.
- Reducing the workload, facilitating the provision of the necessary agricultural services.
- Availability of raw materials (local stones) for the construction of the terraces in the region.
- Availability of experienced and skilled labor in the area.

2.9.2 - Disadvantages:

- High establishment costs.

2.9.3 - Recommendations for overcoming the disadvantages of the technique from the perspective of the local community and relevant technicians:

- Supporting local residents during the building of the terraces.
- Government agencies should cooperate with local residents and provide them with administrative facilities.

3 - Afforestation/protection technology - Al Bustan Reserve:

Date of evaluation: 22/7/2024

Evaluated based on:

- Field surveys of the technology site using the SLM practices assessment form within the framework of the project "Strengthening institutional and professional capacities at the national level of country Parties to enhance UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment,
  (member of the sub-working teams in the central region formed by Decision No. 799/Q dated 9/5/2024 - Hama Forestry Department)
- Interviews with specialized technicians at the Hama Forestry Department.

Date of the implementation of the technique: 1997

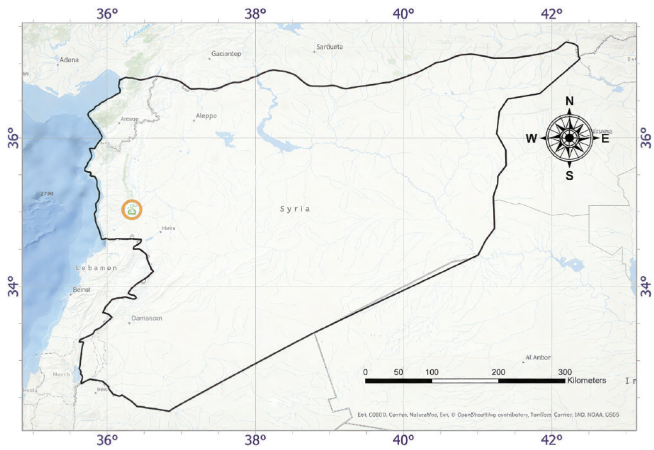
This technique belongs to the natural and artificial forest management group.

○ 3.1 - Description of the technique:

Al-Bustan Reserve is located on white rocky terrain, and it contains permanent waterfalls and a rare plant community. The reserve extends along the eastern slope of the coastal mountain range between the karst mountains. The reserve is surrounded to the north by the agricultural lands of Al-Rasafa village and a permanent waterway in the summer and winter. To the west, it is surrounded by natural forests, and to the east by agricultural lands and residences belonging to Al-Bayda and Al-Bustan villages and the tourist waterfalls of Al-Bayda.

The reserve ranks third in terms of area in Hama governorate, behind the Jabal Al-Bilas and Al-Shiha reserves. It is considered one of the most suitable reserves for eco-tourism activities due to its diverse terrain, flora, and fauna, which gives it a great uniqueness. The predominant plant species in the reserve are pine, oak, and arbutus, in addition to the spread of types of medicinal and aromatic plants, such as sage and tulip. The reserve is home to many animals such as deer, hyenas, wild boars, foxes, hedgehogs, squirrels, and reptiles, in addition to types of birds such as quail, blackbirds, partridges, and birds of prey.

Afforestation/protection technology - Al Bustan Reserve:



○ 3.2 - Location of the technique monitored and evaluated:

- Syrian Arab Republic, Hama Governorate, Masyaf District, Masyaf Area, Al-Bustan Town / Al-Bustan Reserve.
- Location coordinates: 36 19 57,2 – 35 01 57,1
- The site is a protected area built on forest land with a slope of 31-60%. Its approximate area reaches 400 hectares, 550-850 meters above sea level. Its soil is shallow and does not exceed 20 cm, with a medium texture (sandy), and a good content of organic matter (more than 3%). Two irrigations are applied when planting the seedlings, and then they are left to rely on rainwater, which ranges between 1501 and 2,000 mm/year in the area. This technique was implemented as part of the government's efforts to protect forested land and increase afforestation.

3.3 - Stakeholders benefiting from the technique:

- Government sector.
- Local community.

3.4 - Main objective of the technique:

- Preventing/avoiding land degradation.
- Preserving the ecosystem.
- Creating economic impact.
- Creating a beneficial social impact.
- Disaster Risk Reduction.
- Adapting to climate change.
- Maintain/improve plant and animal biodiversity.

3.5 - Main types of land degradation the technique addresses:

- Biological soil degradation.

3.6 - Main causes of land degradation at the site:

- Climate change.
- Soil loss due to water erosion.
- Fires.

3.7 - On-site and off-site impacts of technique implementation:

- Increasing plant production through permanent protection.
- Increasing groundwater levels and availability of drinking and irrigation water.
- Creating jobs and generating income for local population.
- Improving the microclimate.
- Improving climate resilience.

3.8 - Requirements for establishing and adopting the technique:

The process of managing and protecting the reserve requires the provision of labor and seedlings. The high cost of a single seedling, which reaches about 6,000 Syrian pounds, at a rate of 50 seedlings per dunum, bringing the cost of a dunum to about 300,000 Syrian pounds.

The benefits of applying on-site afforestation and protection techniques are balanced against establishment and maintenance costs in the short term (1-3 years), and they are very positive in terms of long-term (more than 10 years) returns.

3.9 - Advantages and disadvantages of the technique:

3.9.1 - Advantages of the technique from both land users' and technicians' perspective:

- The possibility of investing in the reserve by implementing eco-tourism activities, due to the unique diversity of its terrain, plant and animal diversity, and the presence of waterfalls.

3.9.2- Disadvantages:

- The local community is not highly engaged due to conflicting interests with the goal of establishing the reserve.

3.9.3 - Recommendations for overcoming the disadvantages of the technique from the perspective of the local community and relevant technicians:

- Participatory management of the reserve with the local community.

4 - Afforestation technique/green belt around the city of Masyaf:

Date of evaluation: 22/7/2024

Evaluated based on:

- Field surveys of the technical site using the Sustainable Land Management (SLM) practice assessment form within the framework of the project " Strengthening National-level Institutional and Professional Capacities of Country Parties towards enhanced UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment.

  (Member of the sub-working teams in the central region formed by Decision No. 799/Q dated 9/5/2024 - Directorate of Agriculture in Hama - Forestry Department)
- Official (government) data from the Forestry Department.
- Interviews with specialized technicians.

Date of the implementation of the technique: 2019

This technique belongs to the forest management, soil erosion control, and water management group.

4.1 - Description of the technique:

Artificial afforestation was carried out on an area of 2,000 hectares by implementing 0.5 x 0.5 x 0.5 x 0.5 meter holes, 5 meters apart, at a density of 500 plants/hectare. On steep sites, crescent arches were created around the seedling in a direction perpendicular to the direction of the slope. The plant species used in afforestation are laurel, carob, linden, rosemary, eucalyptus, and Monterey pine. The irrigation method applied at the site is mainly: rain-fed, with supplemental irrigation by tankers during the first two years of cultivation. Some of the sites within the afforestation project have been subject to fires in recent years.

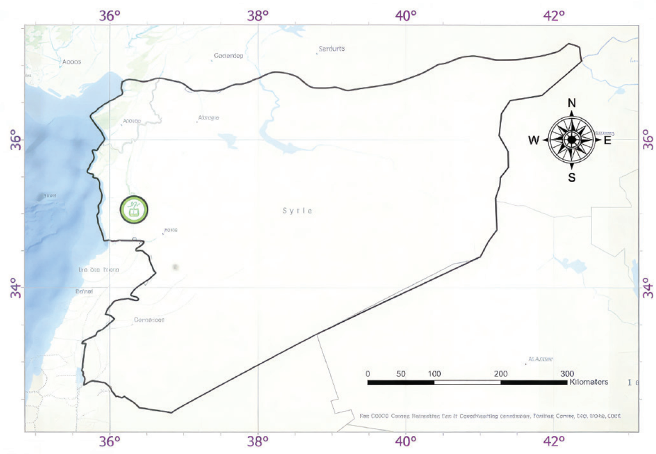
4.2 - Location of the technique monitored and evaluated:

- Syrian Arab Republic, Hama Governorate, Masyaf District, Masyaf subdistrict, Masyaf City/ Western Hama.
- Location coordinates: N:35 03 22,33 – E:36 19 40,93
- The technique is spread over the entire site, with an area of 2,000 hectares, which is forest land interspersed with urban areas, with 13-45% slopes and rainfall rate of 1,501-2,000 mm/year. Very shallow (15-30 cm), moderately acidic (pH 5.6-6.5), medium silt loam texture, low organic matter content (less than 0.86%), medium salinity (4.1-8 decimals).

4.3 - Stakeholders benefiting from the technique:

- Government sector.
- Local community.

Afforestation technique/green belt around the city of Masyaf



4.4 - Main objective of the technique:

- Rehabilitation of degraded land.
- Preserving the ecosystem.
- Creating a beneficial economic impact.
- Disaster Risk Reduction.
- Adapting to climate change.

4.5 - Main types of land degradation the technique addresses:

- Water soil erosion.
- Wind soil erosion.

4.6 - Main causes of land degradation at the site:

- Soil loss due to water erosion.
- Improper human practices like logging.
- Fires.

4.7 - On-site and off-site impacts of technique implementation:

- Increasing the quantity and quality of plant production.
- Availability of drinking water and improving its quality.
- Increased groundwater reserve.
- Diversification of income sources.
- Minimize stormwater runoff.
- Risk reduction of natural disasters like floods and torrential rains.
- Minimizing soil erosion and pollution.
- Increasing the knowledge and awareness of the local community and the technicians about the issue of land degradation and the importance of applying SLM practices to avoid and reverse land degradation.

4.8 - Requirements for establishing and adopting the technique:

- This technique was implemented in artificial reforestation and the implementation inputs were labor force, equipment and tools, including machinery and water tanks for watering, fuel, and seedlings).
- Establishment costs per dunum have reached over 500,000 Syrian pounds.

The benefits of applying on-site afforestation technique are positive in terms of establishment and maintenance costs in the short term (1-3 years) and very positive in terms of long-term outcomes (more than 10 years).

4.9 - Advantages and disadvantages of the technique:

4.9.1 - Advantages of the technique from both land users' and technicians' perspective:

- Preserving peri-urban forest areas and ensuring the sustainability of their components.
- Windbreaks that reduce the strength and speed of the wind.

4.9.2 - Disadvantages:

- Lack of community interaction, due to the lack of awareness of the importance of vegetation around cities, and the spread of negative practices that include logging and overgrazing, which negatively affected the project.

4.9.3- Recommendations for overcoming the disadvantages of the technique from the perspective of the local community and relevant technicians:

- Environmental awareness by raising local communities' awareness about the importance of forests.

5 - Conservation agriculture technique:

Date of evaluation: 23/7/2024

Evaluated based on:

- Field surveys of the technical site using the Sustainable Land Management (SLM) practice assessment form within the framework of the project " Strengthening National-level Institutional and Professional Capacities of Country Parties towards enhanced UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment.

  (Member of the sub-working teams in the central region formed by Decision No. 799/Q dated 09/05/2024 - Directorate of Environment in Hama)
- Research study titled "The Impact of Conservation Agriculture on Soil Fertility and Increasing Productivity"
- Interviews with specialized technicians (Salamiya Agricultural Research Center).

Date of the implementation of the technique: 2008

This technique belongs to the soil erosion control, soil structure improvement, and fertilization management group.

5.1 - Description of the technique:

Crops are planted in unprepared soil by opening a narrow trench or strip with just enough width and depth to adequately place and cover the planted seeds and fertilizer. It also includes early planting (before the rains).

Conservation agriculture is based on four principles: Not tilling the soil, continuous mulching of the soil surface with plant residues or green cover crops, proper crop rotation that includes leguminous crops, and effective weed control.

Since 2006, work began on spreading this technique amongst farmers in various regions in Al-Hasakah governorate, and it began to spread in various Syrian governorates.

National committees were formed in most governorates to follow up the proper functioning and success of this technology in cooperation with more than one research organization such as ICARDA, ACSAD and the Public Authority for Agricultural Investment and Development, with the membership of representatives from the The General Commission for Scientific Agricultural Research (GCSAR) and the Agricultural Extension Directorate.

In order to provide the requirements for working with this technique, there was a movement towards local manufacturing of no-till seeders under the supervision of the General Commission for Scientific Agricultural Research (GCSAR) and ICARDA. Farming with local no-till seeders has been implemented since 2009 in Salamiya, Al-Bab in Aleppo, and Qamishli.

In 2013, Syria ranked 36th globally in the field of conservation agriculture out of 55 countries applying the conservation agriculture system, with an area of 30,000 hectares distributed over the Syrian territory, and it was ranked 5th in Asia.

The technique is spread in the Salamiya and its countryside on 30,000 hectares of agricultural land planted with crops (barley and legumes) at a rate of 100 kg/hectare.

Before commencing the implementation of conservation agriculture at the site, a two-year preparatory phase was carried out, during which a number of good agricultural practices for successful conservation agriculture were implemented. In addition, there were training courses for farmers, in cooperation with agricultural extension and the Aga Khan Foundation.

During the process of implementing the technique, scientific tests were conducted for a number of agricultural varieties and machinery in terms of productivity and acclimatization compared to traditional farming. Based on that, several barley varieties that proved to be successful and effective in terms of seeding rates and density were adopted, leading to the adoption of a package of techniques that contribute to the success of conservation agriculture.

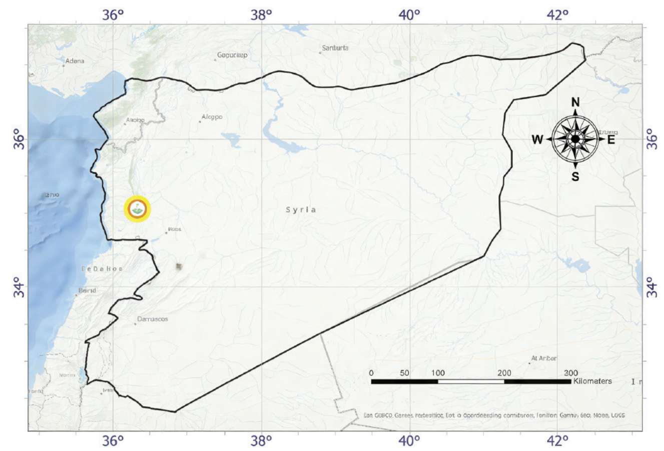
5.2 - Location of the technique monitored and evaluated:

- Syrian Arab Republic, Hama Governorate, Salamiya District, Salimiyah Subdistrict, Karim Village/ Agricultural Research Center.
- Location coordinates: N:35 03 22,33 – E:36 19 40,93
- The land is level (less than 0.5%), and it is rainfed, with a rainfall rate of 251-500 mm/year. The soil is deep (>75 cm) of clay loam texture, with marginal organic matter content (0.86-1.26).
It is moderately alkaline (7.1-8.5), with no salinity.

5.3 - Stakeholders benefiting from the technique:

- Government sector.
- Local land user.
- Local community.
- Researchers.
- NGOs.

Conservation agriculture technique:



5.4 - Main objective of the technique:

- Avoiding land degradation.
- Optimizing productivity.
- Preserving the ecosystem.
- Creating a beneficial economic impact.
- Creating a beneficial social impact.
- Adapting to climate change.
- Improving biodiversity.

5.5 - Main types of land degradation the technique addresses:

- Wind soil erosion.
- Chemical soil degradation.
- Biological soil degradation.

5.6 - Main causes of land degradation at the site:

- Soil loss due to wind erosion.
- Improper human practices like excessive tilling.
- Increased frequency and severity of drought.
- Climate change and associated weather events such as extreme rainfall events, seasonal shifts, and prolonged drought.

5.7 - On-site and off-site impacts of technique implementation:

- Increasing the quantity and quality of plant production.
- Increasing soil water content.
- Improving soil permeability.
- Improving surface water quality.
- Preventing soil compaction.
- Decreasing expenditure on agricultural inputs.
- Diversification of income sources.
- Decrease workload.
- Improving food security.
- Minimizing soil erosion.
- Reducing labor and saving time.
- Improving the amount and activity of soil organisms.
- Increasing soil organic carbon content and reducing carbon emissions.
- Reducing air pollution.
- Increasing the knowledge and awareness of the local community and the technicians about the issue of land degradation and the importance of applying SLM practices to avoid and reverse land degradation.

5.8 - Requirements for establishing and adopting the technique:

The implementation of this technique requires abandoning soil preparation (plowing prior to deep or shallow planting) and maintaining minimal soil disturbance during planting with suitable seeder at a rate of 100 kg seed/ha. The process of keeping the soil surface covered all the time with a thick layer of plant residues is an essential factor for the success of the conservation agriculture system. Hence, it is necessary to leave as much of the previous crop's residues as possible above the soil surface because these plant residues reduce the speed of water runoff and wind speed over the topsoil. As a result, it reduces water loss through evaporation and soil loss through water and wind erosion, and it increases the soil ability to retain moisture and improve its organic matter content due to the increased activity of living organisms in the soil. This process is done using a harvester equipped with chopping blades for hay, to ensure uniformity in cutting and spreading the residue. The implementation of the conservation agriculture technique also requires weed control, especially in the first years after adopting the conservation agriculture system. This process relies mainly on pesticides, the most important of which are Glyphosate (RoundUP), Paraquat, and 2,4-D. This requires experience and knowledge of the type of grass, the type of pesticide used to combat it, when to add it, and how it works, as well as the age of the plant, its morphological and physiological condition, the weather conditions prevailing during the control process, and the soil type.

The benefits of implementing conservation agriculture are very positive in terms of establishment and maintenance costs in the short term (1-3 years); they are very positive in terms of returns in the long term (more than 10 years).

5.9 - Advantages and disadvantages of the technique:

5.9.1 - Advantages of the technique from both land users' and technicians' perspective:

- Reducing expenditures on agricultural inputs by reducing the consumption of fuel, fertilizers, and seeds, and cutting the costs of using agricultural machinery.

5.9.2 - Disadvantages:

- The emergence of broad and narrow leaf weeds that are difficult to control with pesticides, and the need for manual weeding work, which is expensive in terms of the cost of the necessary labor.

5.9.3- Recommendations for overcoming the disadvantages of the technique from the perspective of the local community and relevant technicians:

- Supporting farmers by providing machinery.
- Clearing the land of stones to ensure effective work of the harvester.
- Spraying weeds with the right chemical pesticides at the right time.

6 - Biogas Technique:

Date of evaluation: 23/7/2024

Evaluated based on:

- Field surveys of the technical site using the Sustainable Land Management (SLM) practice assessment form within the framework of the project " Strengthening National-level Institutional and Professional Capacities of Country Parties towards enhanced UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment.

(Member of the sub-working teams in the central region formed by Decision No. 799/Q dated 2024/05/09 - Directorate of Environment in Hama)

- Research study titled, "Biogas Fertilizer Applications in Soilless Agriculture".
- Interviews with specialized technicians (Salamiya Agricultural Research Center).

Date of the implementation of the technique: 2018

This technique belongs to the integrated soil fertility group.

6.1 - Description of the technique:

Biogas is an advanced, clean, environment-friendly, and cheap technique that provides advantages through the exploitation of agricultural and animal by-products in an environmentally safe and economically feasible way to make additional income. It is suitable for rural areas to meet energy requirements and provide organic fertilizer that increases agricultural productivity, and, at the same time, a safe way to dispose of plant and animal wastes.

Biogas technology is based on decomposition and biodegrading of waste into its organic components by fermenting it in isolation from air and oxygen at certain temperatures, which is known as the anaerobic fermentation process, where special bacteria analyze the waste through successive and overlapping biological processes that generate biogas, which is a gaseous mixture consisting of 50-70% methane gas, 25-40% carbon dioxide gas, and other gases in small proportions. This gas is lighter than air and colorless, and it has a distinctive odor. It is also environment-friendly because it reduces the release of carbon monoxide, which leaves negative effects on the atmosphere, and there are no risks involved in using it. Fermentation also produces liquid organic waste, which is considered a high-quality fertilizer with excellent specifications. It is odorless, does not attract insects, flies, or mosquitoes, and is free of pathogenic microbes and parasites, which makes its handling safer from a health standpoint than the original organic waste before the fermentation process. The fertilizer also contains natural plant hormones and growth regulators. Field experiments have shown that the residual effect of this fertilizer after harvesting the first crop plays a role in increasing the productivity of the next crop in the agricultural cycle.

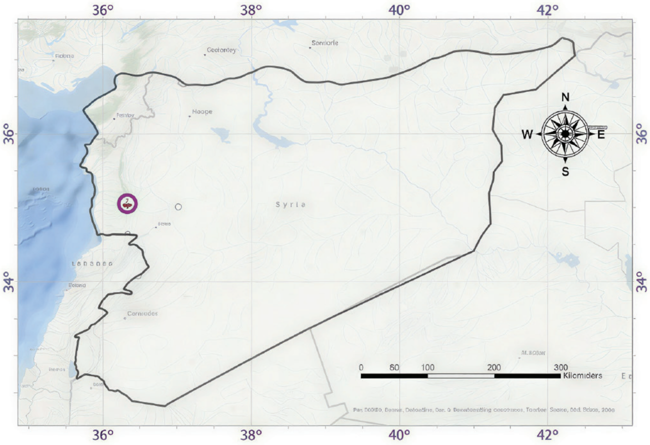
In the research experiment carried out at the Salamiya Research Center, the Indian model with a movable floating dome was used, which consists of a metal or plastic tank with a volume of approximately 2 m^3, an inlet for adding organic matter, an outlet for biogas fertilizer, and a biogas valve. This unit produces a daily amount of 10-20 liters of biogas fertilizer, in addition to gas for domestic use that is enough for a quarter of an hour.

6.2 - Location of the technique monitored and evaluated:

- Syrian Arab Republic, Hama Governorate, Salamiya District, Salimiyah Subdistrict, Karim Village/ Agricultural Research Center.
- Location coordinates: N:35 03 22,33 – E:36 19 40,93
- The technique was implemented at the Agricultural Scientific Research Center in Salamiya.

The land is level (less than 0.5%), and it is rainfed, with a rainfall rate of 500-251 mm/year.
The soil is deep (>75 cm) of a clay loam texture, with marginal organic matter content (1.26-0.86). It is moderately alkaline (8.5-7.1) with no salinity.

Biogas Technique:



○ 6.3 - Stakeholders benefiting from the technique:

- Government sector.
- Local community.
- Researchers.
- Specialists in SLM.
- NGOs.

○ 6.4 - Main objective of the technique:

- Avoiding land degradation and/or Rehabilitation of degraded land.
- Optimizing productivity.
- Preserving the ecosystem.
- Creating a beneficial economic impact.
- Creating a beneficial social impact.
- Improving biodiversity.

○ 6.5 - Main types of land degradation the technique addresses:

- Physical soil degradation.
- Biological soil degradation.

○ 6.6 - Main causes of land degradation at the site:

- Biological soil degradation: Reduced soil fertility due to low organic matter content.

○ 6.7 - On-site and off-site impacts of technique implementation:

- Increasing the quantity and quality of plant production.
- Decreasing expenditure on agricultural inputs.
- Diversification of income sources.
- Improving income.
- Reducing pollution.
- Improving some soil properties.
- Increasing the knowledge and awareness of the local community and the technicians about the issue of land degradation and the importance of applying SLM practices to avoid and reverse land degradation.

6.8 - Requirements for establishing and adopting the technique:

The establishment of the technology requires the provision of the digester consisting of several main parts, namely the inlet or feeding tank, the fermenter, the outlet tank, and the gas tank connected to a pipeline network to the collection tank and the feeding tank to provide the water necessary for the process of mixing the waste with water according to studied ratios to obtain a homogeneous mixture in preparation for its introduction to the fermenter for 30-40 days, depending on temperatures and other conditions required for the success of the anaerobic fermentation process.

After that, a daily feeding process is carried out at a rate of up to 0.22 m^3, where the amount of gas produced per day reaches 0.22 m^3 liquid fertilizer and 3 m^3 gas.

The cost of establishing a biogas production unit with a capacity of 2 m^3 is around 15-20 million Syrian pounds. In addition, there are the costs of maintenance operations depending on the type of manufactured material, which can be subject to wear or leakage.

The benefits of applying biogas technology are limited compared to the start-up costs in the short term (1-3 years) due to the need to provide the organic material needed for production, but they are very positive in terms of returns in the long term (more than 10 years), especially if it is turned into a commercial investment project.

6.9 - Advantages and disadvantages of the technique:

6.9.1 - Advantages of the technique from both land users' and technicians' perspective:

- Producing clean fertilizer.
- Producing gas for domestic use.
- Possibility of turning it into a business.
- It can be implemented in a participatory manner among the local population.

6.9.2 - Disadvantages:

- Difficulty in securing constant supply of the organic material needed for the technology to work.
- The high price of advanced digesters used for the application of this technique.
- Frequent digester failures.

6.9.3 - Recommendations for overcoming the disadvantages of the technique from the perspective of the local community and relevant technicians:

- Supporting the manufacture of biorefinery designs with local expertise to minimize the establishment cost so that it can be implemented in conjunction with livestock farming projects.
- Establishing large and highly productive plants through government support and in cooperation with international organizations to support rural development.
- Spreading awareness of the importance and benefits of this technique and mainstreaming it in the Syrian countryside.

7 - Soilless farming/aquaponic farming technique:

Date of evaluation: 2024/7/23

Evaluated based on:

- Field surveys of the technical site using the Sustainable Land Management (SLM) practice assessment form within the framework of the project " Strengthening National-level Institutional and Professional Capacities of Country Parties towards enhanced UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment.

  (Member of the sub-working teams in the central region formed by Decision No. 799/Q dated 2024/05/09 - Directorate of Environment in Hama)
- Research experiments in soilless farming.
- interviews with specialists (Salamiya Agricultural Research Center).

Date of the implementation of the technique: 2018

This technique belongs to the integrated soil fertility group, and fish farming.

7.1 - Description of the technique:

The technique was implemented at the Agricultural Scientific Research Center in Salamiya, in a greenhouse with an area of 10 m².

Aquaponic farming represents the integration of closed-system aquaculture and hydroponics into one production system.

The ecosystem of this technique consists of water, fish, and bacteria, where the water circulates through the fish tank and through filters and media in which plants grow, and then returns to the fish. Fish waste is removed from the water through a mechanical filter that removes solid waste, and then through a biofilter that processes dissolved waste.

The biofilter provides a good site for the growth of the bacteria that converts ammonia, which is toxic to fish, into nitrate, which is the most accessible nutrient for plants. This process is called nitrification. Then, the plants in their growing media are supplied with water containing nitrates and other nutrients for the plants to absorb, and finally, the water returns to the fish tank, filtered and pure. In aquaponic farming, effluents are converted through the plant growing media and are not released into the environment.

At the same time, nutrients are provided for the plants from a sustainable, cost-effective, and chemical-free source.

This integration eliminates some of the unsustainable factors caused by stand-alone aquaculture and hydroponics systems.

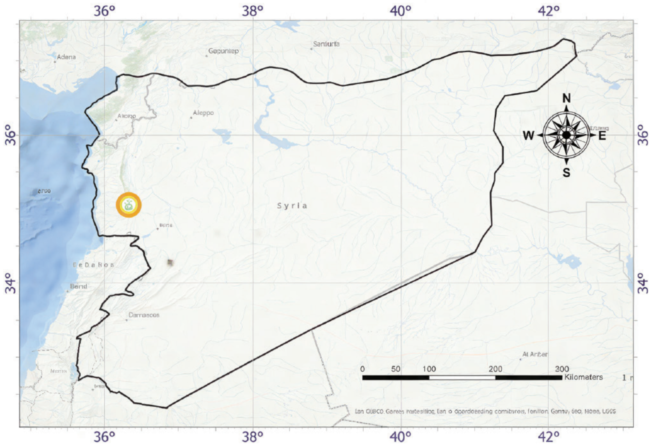
7.2 - Location of the technique monitored and evaluated:

• Syrian Arab Republic, Hama Governorate, Salamiya District, Salimiyah Subdistrict, Karim Village/ Agricultural Research Center .

• Location coordinates: N:35 03 22,33 – E:36 19 40,93

• The land is level (less than 0.5%), located within the third stabilization zone, with a rainfall rate of 251-500 mm/year. The soil is deep (>75 cm) of clay loam texture, with marginal organic matter content (0.86-1.26). It is moderately alkaline (7.1-8.5), with no salinity.

Soilless farming/aquaponic farming technique:



7.3 - Stakeholders benefiting from the technique:

• Government sector.

• Local community

• Researchers.

• Specialists in SLM.

• NGOs.

7.4 - Main objective of the technique:

• To use compost tea to avoid lack of elements in the aquaponic system, and thus: Optimize production, preserve the ecosystem, and create a beneficial economic and social impact.

7.5 - Main types of land degradation the technique addresses:

• Severe levels of all types of soil that have rendered the land unproductive.

7.6 - Main causes of land degradation at the site:

• This type of technique is used when the land is degraded and unproductive and if soil is unavailable and water is scarce.

7.7 - On-site and off-site impacts of technique implementation:

- Increasing the quantity and quality of plant production.
- Decreasing expenditure on agricultural inputs if renewable energy is adopted for running the pump.
- Diversification of income sources.
- Improving income.
- Strengthening food security.
- Reducing poverty.
- Reducing labor.
- Addressing the effects of climate change.
- Increasing the knowledge and awareness of the local community and the technicians about the issue of land degradation and the importance of applying SLM practices to avoid and reverse land degradation.

7.8 - Requirements for establishing and adopting the technique:

The implementation of the technique requires:

- 1 m^3 aquarium (25-30 kg fish).
- 1 m2 bacterial growth medium basin.
- Soilless grow bed with an area of approximately 6 m^2.
- 100W, 220V water pump.
- Filters (mechanical filter - biofilter).

Any type of fish can be grown using this technique, but leafy plants are preferred, especially for beginners. The cost of establishment is high, including materials and labor costs, reaching about 5000,000-6000,000 Syrian pounds depending on the quality of the materials used.

The benefits of applying aquaponic technique are neutral compared to the start-up costs in the short term (1-3 years), but they are very positive in terms of returns in the long term (more than 10 years), especially if it is turned into a commercial investment project. The possibility of fish kills and the energy costs of running the system should be taken into account.

7.9 - Advantages and disadvantages of the technique:

7.9.1 - Advantages of the technique from both land users' and technicians' perspective:

- Not using chemical fertilizers or pesticides.
- Clean animal (fish) and vegetable products.
- Saving water.
- Yields are greater in the long term compared to conventional farming in the same unit area.
- Compatible with small home systems where soil is not available for planting and for container farms, and it can be converted into a large-scale commercial project, so it is suitable for any space you have.
- Naturally more resilient to pests, nutrient deficiencies, and fluctuations.

7.9.2 - Disadvantages:

- High establishment cost.
- It needs experience.
- Farmers do not accept adopting the technique if soil is available.

7.9.3 - Recommendations for overcoming the disadvantages of the technique from the perspective of the local community and relevant technicians:

- Supporting the manufacture of biorefinery with local expertise to minimize the establishment cost so that it can be implemented in conjunction with fish farming projects.
- Spreading awareness of the importance and benefits of this technique and building capacities.

8- Water Harvesting Pit Technique/Al-Hardaneh Pit:

Date of evaluation: 23/7/2024

Evaluated based on:

- Field surveys of the technical site using the Sustainable Land Management (SLM) practice assessment form within the framework of the project "Strengthening National-level Institutional and Professional Capacities of Country Parties towards enhanced UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment.

(Member of the sub-working teams in the central region, Directorate of Water Resources in Hama

- Interviews with specialized technicians (General Company of Sanitation in Hama).
- Reports issued by the former Ministry of Irrigation project.

Date of the implementation of the technique: 1999

This technique belongs to the water management and water harvesting group.

8.1 - Description of the technique:

The technique was implemented as part of a project implemented by the Ministry of Irrigation. It is considered a small pit at the following dimensions: from the bottom 27.5 x 47.5 m, longitudinal slope 1:5 and transverse slope 1:5, length of the service road 38 m, maximum storage volume 2,2017 m^3.

8.2 - Location of the technique monitored and evaluated:

- Syrian Arab Republic, Hama Governorate, Salamiya District, Bari al-Sharqi sub-district, al-Hardaneh Village.
- Location coordinates: 34°59'39.3"N 37°16'42.2"E
- The technique is located in the fourth stability zone with a rainfall rate of less than 250 mm/year, within an unprotected area mainly dominated by pastures, in addition to rainfed agricultural lands planted with olive and pistachio trees. The land slopes at a rate of 10-6%, and the soil is 50-21 cm deep with a medium texture (calcareous alluvial), and it is poor in organic matter.

8.3 - Stakeholders benefiting from the technique:

- Local community.

8.4 - Main objective of the technique:

- Creating a beneficial economic impact by providing water for approximately 1000,000 sheep in the neighboring areas.

8.5 - Main types of land degradation the technique addresses:

- Water soil erosion.
- Wind soil erosion.

8.6 - Main causes of land degradation at the site:

- Human malpractices, especially overgrazing.
- Impacts of climate change and associated extreme weather events.
- Increased frequency, severity, and duration of droughts.

8.7 - On-site and off-site impacts of technique implementation:

- Increasing livestock productivity.
- Diversification of income sources.
- Improving income.
- Strengthening food security.
- Reducing poverty.
- Optimizing groundwater reserve.
- Addressing the effects of climate change.
- Increasing the knowledge and awareness of the local community and the technicians about the issue of land degradation and the importance of applying SLM practices to avoid and reverse land degradation.

8.8 - Requirements for establishing and adopting the technique:

The implementation of the technique requires: The implementation of the technique requires: reinforced concrete (Spillway- retaining wall - entrance threshold), submerged concrete, backfill, stone cladding, as well as labor and machinery.

The cost of constructing small, medium and large pits is high, where small pits can cost up to 4-5 billion Syrian pounds.

The benefits of applying the water harvesting pit technique compared to construction costs are negative in the short term (1-3 years) due to the high construction cost, while they are slightly positive in terms of returns in the long term (more than 10 years). The better engineered the dam is, the lower the maintenance costs are.

8.9 - Advantages and disadvantages of the technique:

8.9.1 - Advantages of the technique from both land users' and technicians' perspective:

- Providing drinking water for livestock.
- Ensuring the stability of the population.

8.9.2 - Disadvantages:

- High establishment cost.
- The need for expertise in engineering design and construction.
- Difficulty for local shepherds to access the pit at times due to the deteriorating security situation during the years of war, which affected the movement and mobility of the local population.

8.9.3 - Recommendations for overcoming the disadvantages of the technique from the perspective of the local community and relevant technicians:

- Providing local or international funding to rehabilitate and exploit the pit according to scientific methods, especially restoring the pacification basin with concrete and removing the dam reservoir from the accumulated silt.

9 - Compost production from organic waste:

Date of evaluation: 23/7/2024

Evaluated based on:

- Field surveys of the technical site using the Sustainable Land Management (SLM) practice assessment form within the framework of the project " Strengthening National-level Institutional and Professional Capacities of Country Parties towards enhanced UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment.
  (Member of the sub-working teams in the central region formed by Decision No. 799/Q dated 09/05/2024 - Directorate of Environment in Hama)
- Interviews with specialized technicians (Hama Governorate- Directorate of Technical Services).

Date of the implementation of the technique: 21 /9 /2021

This technique belongs to the water management group.

9.1 - Description of the technique:

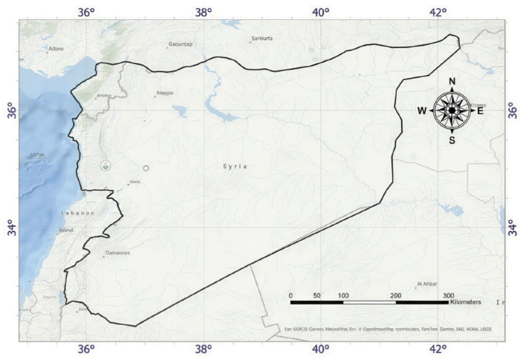
This technique is based on manufacturing compost (organic fertilizer) by taking advantage of the waste (organic residues) resulting from the collection and sorting of garbage waste, drying and fermenting it aerobically and anaerobically, then rehydrating with leachate, scrubbing and sifting, and fermenting it for 45 days to reach the desired result in producing organic fertilizer. The produce is packaged in the form of fine sand granules or capsules used in nurseries, in addition to special liquid packages that are added in special water tanks and mixed to be distributed through drip networks.

The technique was implemented as part of an initiative between the private sector and the government sector (Hama Governorate - Technical Services), within an area of 368 dunums, where 10 tonnes of waste is sorted daily out of the 125 tonnes that arrive at the landfill, 35% of which is converted into organic fertilizer and 35% solid materials are recycled as raw materials.

9.2 - Location of the technique monitored and evaluated:

- Syrian Arab Republic, Hama Governorate, Salamiya District, Salamiya sub-district, al-HardanBurkan Alsakhr landfill.
- Location coordinates: 35°0'47"N 37°0'58" E
- The site belongs to the Directorate of Technical Services in Hama, where the investor exploited the existence of an industrial facility in Al-Burkan landfill and rehabilitated and maintained the facility, rehabilitated the landfill cells, equipped the sorting plant and completed the missing requirements.

Compost production from organic waste:



9.3 - Stakeholders benefiting from the technique:

- Government sector.
- Local community.
- Private sector.
- Local land user.
- Researchers.

9.4 - Main objective of the technique:

- Waste disposal as the area is agricultural and rich in organic waste.
- Mitigating the environmental pollution caused by waste, especially groundwater contamination and the spread of insects and diseases.
- Profitable business objective.

9.5 - Main types of land degradation the technique addresses:

- Biological soil degradation.
- Chemical soil degradation.
- Physical soil degradation.
- Deterioration of water quality.

9.6 - Main causes of land degradation at the site:

- Waste accumulation; about 125 tonnes of waste arrive in the landfill on a daily basis.
- Landfilling waste without observing environmental requirements.

9.7 - On-site and off-site impacts of technique implementation:

- Increasing the quantity and quality of plant production.
- Improving income.
- Strengthening food security.
- Minimizing soil pollution.
- Minimizing groundwater pollution.
- Reducing expenditure on agricultural products.

9.8 - Requirements for establishing and adopting the technique:

The implementation of the technique requires securing organic waste, machinery, fuel and labor, in addition to equipping an industrial facility with a sorting plant consisting of:

- Drum and conveyor belts to sort solid waste from organic waste.
- 45-day fermentation yards for sorted organic waste with drainage to collect leachate in a tank to prevent groundwater contamination.
- Drying yards after fermentation.
- Grinding and sifting roller.
- After hydration and fermentation, a liquid is prepared from the fermented, purified and pasteurized product.
- Packaging and marketing.

The benefits of applying the compost production technique from waste compared to establishment costs are balanced in the short term (1-3 years) due to the high establishment cost, and positive in terms of returns on the long-term (more than 10 years). Maintenance costs are reduced by using local expertise.

9.9 - Advantages and disadvantages of the technique:

9.9.1 - Advantages of the technique from both land users' and technicians' perspective:

- Providing rich organic fertilizer (18 major and minor elements) free of chemical impurities or heavy elements, fast dissolving, and easily absorbed by the plant.
- Potential for applying foliar spraying.
- Suitable for use in dry areas as it has low water requirements.
- Providing job opportunities.

9.9.2 - Disadvantages:

- N/A.

9.9.3 - Recommendations for overcoming the disadvantages of the technique from the perspective of the local community and relevant technicians:

- Supporting the facility's operation with a renewable energy system.
- Upgrading the facility by expanding and adding more machinery.
- The possibility of utilizing treated sludge in sewage treatment plants.
- Developing the project to produce methane gas and convert it from liquid vapor to dry vapor for use in generating a 5-megawatt turbine.

10- Afforestation technique/Green Belt Technique:

Date of evaluation: 2024/7/24

Evaluation based on:

- Field surveys of the technical site using the Sustainable Land Management (SLM) practice assessment form within the framework of the project " Strengthening National-level Institutional and Professional Capacities of Country Parties towards enhanced UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment.

  (Member of the sub-working teams in the central region formed by Decision No. 799/Q dated 09/05/2024 - Directorate of Forestry in Homs)
- Official (government) data.
- Interviews with specialized technicians.

Date of the implementation of the technique: 21 / 9 /2021

This technique belongs to the afforestation/reforestation group.

10.1 - Description of the technique:

The Green Belt Project is one of the afforestation projects that is still being implemented by the Ministry of Agriculture and Agrarian Reform since the 1980-1979 season. The main objective of the project is to establish a green strip of fruit, forestry and pastoral trees between the desert and the agricultural areas with a length of 1,100 kilometres and a width ranging from 0.5 to 20 kilometres extending from the Jordanian-Syrian border in the south to the Turkish border in the north, thereby helping to:

- Establishing a temperate zone between the wet and dry zones, thus avoiding vegetation degradation.
- Optimizing the use of the project area as it is less suitable for growing economic field crops.
- Protecting land from erosion by preserving the soil, preventing the risk of floods, storing water and recharging underground reservoirs.
- Increasing the area of vegetation cover and creating a balanced microclimate and local environment.

The technique was implemented according to the following phases:

First phase of the project:

- From 1980-1982, 14,000 hectares were planned to be reclaimed, with a 66% implementation rate of 9,310 hectares.

Second phase of the project:

- In the period between 1983-1985, 4,500 hectares were reclaimed.
- From 1986 to 1997, an area of 15,682 hectares was reclaimed.
- The total area from the beginning of the project to the end of 1997 was 41,000 hectares, of which 34,000 almond, pistachio, olive and vine trees were planted.
- At the end of 1999, the reclaimed area was about 48,800 hectares of which 41,000 hectares were planted, and from 2000 to 2024, 21,000 hectares were reclaimed and planted without food rationing.

The area reclaimed from the beginning of the project in 1980 until 2024 was 69,000 hectares. Plant species used to create the green belt: Forestry trees (Aleppo pine) - Fruit trees (almond, olives, pistachio), with a density of 150-200 trees/hectare, and supplemental irrigation was carried out in the first seven years

The project is served by the plant species produced in the nursery affiliated to Homs Forestry Directorate, which was reactivated in 2018 after it was destroyed during the war. The area is currently 1 dunum (plan 5 dunum), with a production capacity of 32000 plants / year. The nursery produces (Pistacia Atlantica - Aleppo Pine – Tamarisk - Almond – Cupressus - Melia Azedarach), and is irrigated using manual sprinklers due to the destruction of the drip irrigation network that was in place. This nursery is the first in Syria to produce 70-80% germinated Pistacia Atlantica, which has encouraged the local community to revive its cultivation in the region.

10.2 - Location of the technique monitored and evaluated:

• Syrian Arab Republic, Homs Governorate, Mukharram District, Jubb al-Jarrah sub-district, Dweir al-Gharbi Village.

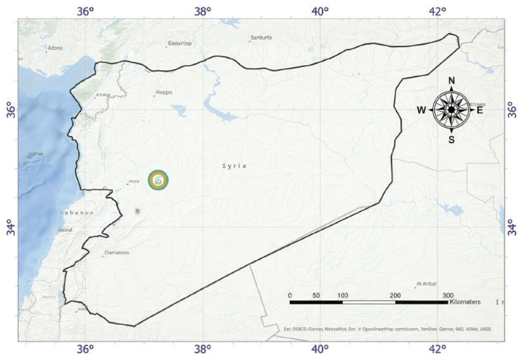
• Location coordinates: 34°'48'09.6 N 37°'14'19.3

• Land used on the site are pastures and agricultural land (crops - fruit trees), it is a moderately sloping land with a slope of 8-3%, the soil is shallow (15-30 cm) with medium texture, moderate pH and low organic matter content (less than 0.86%).

• The irrigation method applied at the site is irrigated for the first seven years and then supplementary irrigation in the summer.

• The importance of the site comes from the fact that it is located between the 300-200 mm rainfall lines, which is the safety valve that separates two areas, the first of which is agricultural with good economic returns and the second is pastoral. The fact that the belt site is less suitable for agriculture, as it only gives one season every five years due to the low rainfall rates and their monthly and annual distribution, the apparent variation in the start of the rainy season from year to year, the high rate of evaporation from the soil and the nature of the surface roots of the crops. The approach was to plant this area with perennial plants that make it more stable and protect the first and second stabilization zones, thus preventing the encroachment of the desert towards agricultural areas, in addition to improving the local climate and creating stable agriculture that contributes to eliminating unemployment, providing income for the farmers covered by the project and reducing migration towards cities.

Afforestation technique
Green Belt Technique:



10.3 - Stakeholders benefiting from the technique:

- Government sector.
- Local community.

10.4 - Main objective of the technique:

- Preventing/avoiding land degradation.

10.5 - Main types of land degradation the technique addresses:

- Wind soil erosion.

10.6 - Main causes of land degradation at the site:

- Climate change and associated weather events such as extreme rainfall and prolonged rainfall delay.
- Soil loss due to wind erosion.

10.7 - On-site and off-site impacts of technique implementation:

- Increasing the quantity and quality of plant production.
- Increasing the productivity of livestock in the region.
- Availability of irrigation and drinking water.
- Minimizing expenditure on agricultural inputs.
- Diversifying income sources and increasing farm income.
- Improving food security.
- Increased groundwater reserve.
- Minimize stormwater runoff.
- Minimizing soil erosion.
- Increasing the knowledge and awareness of the local community and the technicians about the issue of land degradation and the importance of applying SLM practices to avoid and reverse land degradation.

○ 10.8 - Requirements for establishing and adopting the technique:

The Syrian state has secured the requirements for the implementation of the project, the most important of which are:

- Providing the heavy machinery needed for land reclamation by excavating the soil, removing stones, building runways according to the nature of the land, and constructing agricultural roads at the work sites.
- Providing long-term agricultural loans to secure the financial needs of farmers to reclaim and cultivate their lands.
- Holding training courses and seminars specialized in fruit trees to raise the agricultural level of the farmer in the field of cultivation and service of fruit trees.

Implementation costs include: Land reclamation costs (labor, equipment, tools and machinery) amounting to 500,000 SP per dunum. Afforestation costs (the price of an olive sapling is 3500 SP - daily labour rate is 50,000 SP).

The benefits of applying on-site afforestation within the greenbelt are balanced against establishment and maintenance costs in the short term (1-3 years), and they are very positive in terms of long-term (more than 10 years) returns.

○ 10.9 - Advantages and disadvantages of the technique:

○ 10.9.1 - Advantages of the technique from both land users' and technicians' perspective:

- Increasing income from agricultural land.
- Increasing the invested area.
- Presence of the nursery.
- High technical expertise in plant production in the nursery.

○ 10.9.2- Disadvantages:

- Lack of local community engagement due to the absence of incentives that were previously offered, and which ended with the end of external project funding from supporting organizations.
- Lack of awareness and lack of testing of appropriate species when afforesting and reclaiming land.
- Unstable seasonal labor.
- Fragile infrastructure as the nursery needs fencing.

○ 10.9.3 - Recommendations for overcoming the disadvantages of the technique from the perspective of the local community and relevant technicians:

- Not expanding olive cultivation within the region and replacing it with pistachios.
- Reviving the cultivation of bitter grafted almonds that are resistant to capnode.
- Fencing the nursery.
- Allocating the nursery to the production of Pistacia Atlantica because of its success and excellence in germinating it at high rates and benefiting from the revenues of its investment to serve the nursery.

11- Rangeland management/Wadi Al Teen Reserve:

Date of evaluation: 24/7/2024

Evaluation based on:

- Field surveys of the technical site using the Sustainable Land Management (SLM) practice assessment form within the framework of the project " Strengthening National-level Institutional and Professional Capacities of Country Parties towards enhanced UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment.

  (Member of the sub-working teams in the central region formed by Decision No. 799/Q dated 2024/05/09 - Badia Commission – Hama Branch)

- Interviews with specialized technicians (Badia Commission branch in Al Quaryatayn).

Date of the implementation of the technique: Wadi Al Teen Reserve was established in 2011

This technique belongs to rangeland management - vegetation management - energy efficiency.

11.1 - Description of the technique:

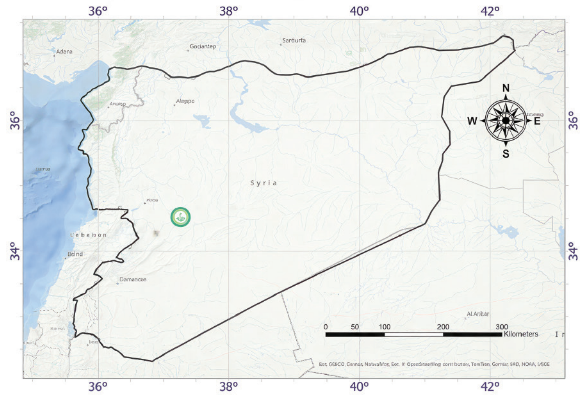
Wadi Al Teen Reserve was established in 2011 and reopened in 2020, the Reserve has an area of 40,000 hectares and was rehabilitated and planted with pastoral plants (American Artiplex - Salt Artiplex - Ruta) to ease the burden on livestock breeders in neighboring residential communities by providing fodder for the livestock. Ghadeer Al-Theeb well was operated on solar energy to cover the needs of sheep in the surrounding communities, which exceed 6,000 heads, ensuring continuity of service throughout the day and reducing fuel consumption, especially at the current time with the scarcity of water and the difficulty of providing it.

400 hectares are planted annually at a rate of 200,000,000 plants (800,000 salt Artiplex, 800,000 Ruta, 400,000 American Artiplex) with a distance of 5 metres between planting lines, and the plant is irrigated by tankers filled from Ghadir al-Deeb well at the time of planting. The pastoral load reaches 30,000 heads per year.

11.2 - Location of the technique monitored and evaluated:

- Syrian Arab Republic, Homs Governorate, Al Quaryatayn District, Wadi al-Teen sub-district, Ghadeer Al-Theeb village.
- Location coordinates: 34°31'17"N 37°15'48” E
- Type of land use: Pasture.
- Rainfall: Less than 125 mm/year.
- Sloppy land with a slope of 0-2%.
- Soil texture is calcareous, turning sandy in some locations.
- The soil is of medium depth 30-75 cm.
- Soil organic matter content is less than 1%.
- Medium alkaline soil 7.1-8.5.
- No salinization.
- The irrigation method applied at the site is mainly rainfed, in addition to supplementary irrigation after planting through tanks from Ghadeer Al-Theeb well.

Rangeland management
Wadi Al Teen Reserve:



○ 11.3 - Stakeholders benefiting from the technique:

• Government sector.

• Local community (mainly herders).

○ 11.4 - Main objective of the technique:

• Preventing/avoiding land degradation.

• Preserving the ecosystem.

• Creating economic impact: By providing drinking water for livestock as the area serves as a rangeland.

• Creating a beneficial social impact: By improving the livelihoods of local people in neighboring areas.

• Adapting to climate change.

• Preserving biodiversity.

• Reducing the risk of drought.

○ 11.5 - Main types of land degradation the technique addresses:

• Water soil erosion.

• Wind soil erosion.

• Physical soil degradation.

○ 11.6 - Main causes of land degradation at the site:

• Climate change and associated weather events such as extreme rainfall and prolonged rainfall delay.

• Increased frequency and severity of drought.

• Loss of soil by wind and water erosion.

• Improper human practices such as overgrazing and encroachment on grazing lands.

○ 11.7 - On-site and off-site impacts of technique implementation:

• Increasing the quantity of plant production.

• Increasing the productivity of the livestock by providing drinking water for the sheep in the area.

• Decreasing workload.

• Availability of water for the livestock.

• Diversifying income sources and increasing income.

• Improving food security.

• Minimizing soil erosion.

11.8- Requirements for establishing and adopting the technique:

Effective rangeland management depends on a number of factors, including the cultivation of appropriate species with high fodder value and that are able to adapt to drought conditions to contribute to the site's ability to provide fodder, the ability of livestock to access grazing sites and water points in the dry season, following a grazing system that ensures the provision of rangeland plants including the most favored species by taking into account the grazing load of the site, and adapting the intensity of grazing to climatic conditions in dry periods to allow plants to recover.

It is important to raise herders' awareness of the risks of drought, climate change and improper practices on pastures and their degradation.

The establishment process requires seedlings and watering tanks in addition to labor.

The establishment costs are high, so the benefits of applying the technique are negative compared to the establishment and maintenance costs in the short term (3-1 years), and positive in terms of returns in the long term (more than 10 years)

11.9 - Advantages and disadvantages of the technique:

11.9.1 - Advantages of the technique from both land users' and technicians' perspective:

- Soil stabilization.
- Stabilization of dunes.
- Community stabilization.
- Supporting local livelihoods.
- Ecosystem improvement.
- Providing fodder.

11.9.2 - Disadvantages:

- Low rainfall.
- The reserve is large, thus requires significant effort and work.
- High preliminary expenses.

11.9.3 - Recommendations for overcoming the disadvantages of the technique from the perspective of the local community and relevant technicians:

- Increasing the number of specialized technicians and workers.
- Providing incentives for workers.

12- Water Management Technique/Mheen:

Evaluation date: 25/7/2024

Evaluation was based on:

- Field surveys of the technical site using the Sustainable Land Management (SLM) practice assessment form within the framework of the project " Strengthening National-level Institutional and Professional Capacities of Country Parties towards enhanced UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment.
  (Member of the sub-working groups in the central region formed by Decision No. 799/Q dated 5/9/2024 - Directorate of Water Resources in Homs)
- Interviews with specialized technicians (Homs Water Resources Directorate).
- Interviews with land users.

Date of implementation of the technique: 2006

This technique falls under to the water management - energy efficiency category.

12.1 - Description of technique:

The Ain al-Qusayr Irrigation Project was launched after being rehabilitated in cooperation between the Ministry of Water Resources, Homs Governorate, the Food and Agriculture Organization of the United Nations (FAO), and the World Food Programme (WFP). The project was launched as a result of the water network being severely damaged during the war. The project aimed to contribute to improving the reality of water in the area by providing irrigation water for agricultural lands, encouraging residents to return and work on their lands, and achieving stability for them. The rehabilitation process included replacing damaged pipes of various diameters, replacing valves that serve the network, installing water meters, and providing covers for manholes to close all sewage network halls. The project operates primarily through renewable solar energy, in addition to installing a transformer and a power generator.

The project irrigates 380 dunums of agricultural land through two lines: the first is pressurized and feeds a drip irrigation network, and the second, 1,200 meters long, feeds 24 hectares using the surface irrigation method.

The current storage capacity of Al-Qaryatayn Dam is estimated at 1,480,000 m³, with a design capacity of approximately 5 million m³. There was Ras Al-Sin Spring, but it has dried up due to climate change and low rainfall.

Five wells were implemented to provide a water source for irrigating orchards covering 300 hectares, with a conveyance line of approximately 11 km

Plants grown: fruit trees, olive trees, and fig trees, with distances ranging from 5-7 meters depending on the plant. Some crops are also planted between the trees in some areas.

12.2 - Location of the technique monitored and evaluated:

- Syrian Arab Republic, Homs Governorate, Al-Qaryatayn District, Mheen Subdistrict, Ain al-Qusayr Village.
- Site coordinates: 34°15'29" N 37°2'33" E
- Type of land use: agricultural land (crops and fruit trees).
- Rainfall rate: less than 250 mm/year.
- Flat land with a slope of 2-0.5%.
- Soil texture: sandy loam.
- Soil depth: 30-15 cm.
- Soil organic matter content: low, less than 0.86%.
- Soil pH: medium alkalinity, 8.5-7.1.
- Moderate salinity.
- Irrigation method used at the site is primarily irrigation.

12.3 - Stakeholders benefiting from the technique:

- Land user.
- Local community.

12.4 - Main objective of the technique:

- Preventing/avoiding land degradation.
- Improving plant production.
- Preserving ecosystems.
- Rehabilitation of degraded lands.
- Creating a beneficial economic impact.
- Creating a beneficial social impact: by improving the livelihoods of locals in neighboring areas and reducing conflicts over natural resources.
- Adapting with climate change.
- Providing stability for locals, reduce migration to cities, and encouraging persons to return to their areas with the return of safety.

12.5 - Main types of land degradation the technique addresses:

- Wind erosion.

12.6 - Main causes of land degradation at the site:

- Climate change and associated climate events, such as extreme rainfall and prolonged droughts.
- Increased frequency and severity of droughts.
- Soil loss due to wind and water erosion.

12.7 - On-site and off-site impacts of technique implementation:

- Increasing crop production by saving irrigation water.
- Increasing groundwater levels.
- Reducing expenditure on agricultural inputs.
- Diversifying sources of income.
- Reducing workload.
- Improving food security.
- Reducing surface runoff.
- Reducing the risk of natural disasters such as floods and torrents.
- Reducing the risk of fires.
- Reducing soil pollution.
- Reducing soil erosion.
- Reducing damage to public and private infrastructure.
- Empowerment of women.

12.8 - Requirements for establishing and adopting the technique:

Phase 1: Two wells were drilled and equipped with a tank and a 4 km, 44 mm pipeline connecting the wells to the canal.

Phase 2: A project to drill and equip three wells to provide the water needed for orchard irrigation. Asbestos pipes from the wells to the orchards, and a modern GBR irrigation network is installed within orchards.

The irrigation network has also been implemented, and electricity has been provided for the entire project, ensuring that orchard irrigation is fully integrated in terms of water provision.
The project is fully funded by the Syrian government, with no reimbursement of preliminary expenses, only an annual irrigation fee of 3,500 Syrian pounds per hectare.

The benefits of applying modern irrigation network techniques on site are positive compared to the preliminary and maintenance short-term expenses (1-3 years) and very positive in terms of returns in the long term (more than 10 years).

12.9 - Advantages and disadvantages of the technique:

12.9.1 - Advantages of the technique from both land users' and technicians' perspective:

- Preserving the environment and avoiding land degradation and depletion.
- Creating job opportunities.
- Contributing to the region's rural development.
- Supporting the livelihoods of the locals.

12.9.2 - Disadvantages:

- Ineffective filters lead to clogged pipes.

12.9.3- Recommendations for overcoming the disadvantages of the technique from the perspective of the local community and relevant technicians:

- Converting the entire project to drip irrigation, eliminating surface irrigation as it wastes water.
- Providing training courses for the local community in partnership with civil society and international organizations to encourage water management.
- Providing financial support for such technologies, as they contribute to increasing cultivated areas and thus mitigating the severity of deterioration.

13- Forest management technique (terracing):

Evaluation Date: 28-29/4/2024

Evaluation was based on:

- Field surveys of the technical site using the Sustainable Land Management (SLM) practice assessment form within the framework of the project " Strengthening National-level Institutional and Professional Capacities of Country Parties towards enhanced UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment.
  (Member of the sub-working group in the coastal area formed by Resolution No. 799/Q dated 5/19/2024 - Environment Directorate in Lattakia Governorate - Lattakia Forestry Department)
- Interviews with specialists/technicians from (the Directorate of Agriculture in Lattakia)
- Technical reports by the Directorate of Agriculture and Agrarian Reform in Lattakia.

Date of implementation of the technique: 2018

This technique falls under the Forest Management/Reforestation and Soil Erosion Control/Terracing group.

13.1- Description of technique:

- The technique was implemented as part of the "Reclamation and Reforestation of Burnt Forest Lands" project.
- As a result of the exposure of the forests of Khirbet Solas and Al-Sarsakiya to a fire in 2012, where 5,200 dunums in Solas and 190 dunums in Al-Sarsakiya were burnt, the vegetation cover was destroyed, with the damage in Solas amounting to 105,000 pine trees aged 100-20 years, and 2,200 broad-leaved trees aged between 70-2 years, in addition to the burning of weeds and accompanying plants with diameters less than 7 cm, estimated at a weight of 10,000 tons for fuel.
- These two forests are under permanent protection and are rain-fed.
- They were reforested after terracing with eucalyptus, robinia, brutia pine, and pine groves.

13.2 - Location of the technique monitored and evaluated:

- Syrian Arab Republic, Latakia Governorate, Lattakia District, Rabia Subdistrict.
- Location coordinates: N: 35° 44.522', E: 35° 54.213'
  N: 35° 41.379', E: 35° 57.927'
- The dominant plants in the Solas and Al-Sarsakiya forests are pine brutia and oak sedges, while the main associated plant species are arbutus, basil, clematis, and Palestine terebinth. The burned area in the Al-Sarsakiya forest amounted to 190 dunums, and it was difficult to accurately identify the damage. The burned area in the Solas Forest amounted to 5,200 dunums, resulting in the following damage:

- 105,000 pine trees, aged 20–100 years, were burned.
- 220 broad-leaved trees, aged 2–70 years, were burned.
- Accompanying weeds and plants less than 7 cm in diameter were burned, estimated to weigh 10,000 tons for fuel.

- The site is under permanent protection, and land use has not changed after applying the technique. It is in the first stability zone with a rainfall rate ranging between 751-1000 mm/year, a slope rate of 31-45%, and a medium-depth (30-75 cm) silty soil texture with a pH of 6.6-6.9.

13.3 - Stakeholders benefiting from the technique:

- The government sector.
- The local community, which responded positively to the implementation of the technique.

13.4 - Main objective of the technique:

- Avoiding land degradation.
- Preserving the ecosystem (forest).
- Preserving/improving plant and animal biodiversity.

13.5 - Main types of land degradation the technique addresses:

- Wind and water erosion.

13.6 - The main causes of land degradation at the site:

- Forest fires that have destroyed vegetation, leaving the soil exposed to rain and wind.

13.7 - On-site and off-site impacts of technique implementation:

- Reducing and regulating surface water runoff.
- Increasing groundwater storage.
- Reducing the risk of natural disasters such as floods and torrents.
- Reducing soil erosion.
- Increasing knowledge and awareness among the local community and technicians about land degradation and the importance of implementing sustainable land management practices to avoid and reverse degradation.

13.8 - Requirements for establishing and adopting the technique:

8-6 m width and 4-2 m height terraces were constructed, and dimensions varied according to the degree of slope and the mobility of the machinery. terracing required labor and heavy machinery from the Directorate of Agriculture and Agrarian Reform in Lattakia to break the slope and make the terraces.

The Solas fire site saw 3,380 man-hours, at a total cost of 24,858,900 SYP. The Sarsakiya fire site saw 141 man-hours, at a total cost of 1,108,000 SYP.

The on-site impacts of applying this technique are positive compared to the preliminary expenses in the short term (3-1 years) and the long term (more than 10 years).

13.9 - Advantages and disadvantages of the technique:

13.9.1 - Advantages of the technique from both land users' and technicians' perspective:

- Maintenance-free.
- Reduces soil erosion.
- Prepares the site for reforestation.
- Successful afforestation.

13.9.2 - Disadvantages:

- It may affect biodiversity and species that naturally recover and adapt after fire.

13.9.3 - Recommendations for overcoming the disadvantages of the technique from the perspective of local community and relevant technicians:

- Using local plant species that are adapted to the environmental conditions of the region when applying the technique.

14-Terracing technique (stone terraces) (reclamation of wasteland):

Evaluation Date: 5/5/2024

Evaluation based on:

- Field surveys of the technical site using the Sustainable Land Management (SLM) practice assessment form within the framework of the project " Strengthening National-level Institutional and Professional Capacities of Country Parties towards enhanced UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment.
(Member of the sub-working groups in the coastal region formed by Resolution No. 799/Q dated 5/9/2024 - General Authority for Agricultural Scientific Research in Tartous).
- Interviews with specialists/technicians.
- Reports and studies.

This technique falls under the category of soil erosion control (slope management), water management, and fertilization management (plant management).

14.1 - Description of technique:

- The technique is part of local traditional knowledge and dates back more than 50 years.
- The technique is spread evenly across the entire site.
- Terraces were constructed on fallow land, ranging in length from 10-1 meters and width from 2-0.5 meters.
- After the terraces were constructed, they were planted with olive trees, fruit trees, and tobacco, using a rain-fed irrigation method.

14.2 - Location of the technique monitored and evaluated:

- Syrian Arab Republic, Tartous Governorate, Al-Qadmus District, Al-Qadmus Subdistrict - Al-Khatriya Village.
- Location coordinates: N 35°06'18" - E 36°09'29
- The site is under permanent protection and was a fallow land before the intervention, within the first stability zone with a rainfall rate ranging between 1001-1500 mm/year, and a slope rate ranging between 31-45%. The soil texture is very good, clay loamy and sand loamy, but the soil is shallow, less than 15 cm, with a low organic matter content (<1.86%), a medium alkalinity (7.1-8.5), and does not suffer from salinization..
- Studies and research confirm that the rate of erosion in Qadmus has reached unprecedented levels, reaching approximately 165 tons/hectare in fallow agricultural lands, approximately 56 tons/hectare in burned forest sites, and 15 tons/hectare in forest soils.

14.3 - Stakeholders benefiting from the technique:

- Local land users.

14.4 - Main objective of the technique:

- Preventing/avoiding land degradation.
- Rehabilitating degraded lands.
- Improving plant production.
- Creating beneficial economic impact (increased income).
- Reducing disaster risk (landslides).

14.5 - Main types of land degradation the technique addresses:

- Water erosion.

14.6 - Main causes of land degradation at the site:

- Climate change and associated climate events, such as extreme rainfall.
- Increasing frequency and severity of droughts.
- Soil loss due to water erosion.
- Unsound human practices.

14.7 - On-site and off-site impacts of technique implementation:

- Increasing the quantity and quality of plant production.
- Reducing and regulating surface water runoff.
- Increasing soil water content.
- Reducing expenditure on agricultural inputs.
- Improving income.
- Diversifying sources of income.
- Improving food security.
- Reducing the risk of natural disasters such as floods and torrential rains.
- Reducing soil erosion.
- Reducing damage to public and private infrastructure.
- Increasing knowledge and awareness among the local community and technicians of land degradation and the importance of implementing sustainable land management practices to avoid and reverse degradation.

14.8 - Requirements for establishing and adopting the technique:

Terracing requires labor and heavy machinery. When building terraces, the following should be taken into consideration:

- The greater the slope, the smaller the length and width. Short, narrow terraces are more effective in reducing erosion on steep slopes.
- In soils with a high erosion potential, terraces should be shorter and narrower than in more cohesive soils.
- In areas with high rainfall, terraces should be shorter and narrower than in areas with low rainfall.
- Retaining walls should be strong enough to prevent landslides.

The cost of restoring fallow land using the terracing technique has reached 10 million Syrian pounds per dunum, in addition to approximately one million pounds annually for maintenance.

The benefits of applying this technique on-site are positive compared to the preliminary expenses in the short term (1-3 years) and very positive in the long term (more than 10 years).

14.9 - Advantages and Disadvantages of the Technique:

14.9.1 - Advantages of the technique from both land users' and technicians' perspective:

- Protecting soil and reducing soil erosion.
- Improving soil fertility and increasing its organic carbon content.
- Conserving biodiversity.

14.9.2 - Disadvantages:

- High preliminary expenses.
- Difficulty of implementation on steeply sloped sites.
- Requires high skill and a high risk of landslides in some cases where terraces are not constructed professionally.

14.9.3 - Recommendations for overcoming the disadvantages of the technique from the perspective of local community and relevant technicians:

- Raising awareness of land degradation, its causes and effects, and the importance of adopting and implementing sustainable land management practices.
- Providing support to farmers to invest in land using sustainable land management practices, which contributes to improving people's livelihoods.

15-Water harvesting technique:

Evaluation Date: May 2024

Evaluation based on:

- Field surveys of the technical site using the Sustainable Land Management (SLM) practice assessment form within the framework of the project " Strengthening National-level Institutional and Professional Capacities of Country Parties towards enhanced UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment.

  (Member of the sub-working groups in the coastal area formed by Resolution No. 799/Q dated 5/9/2024 - Directorate of Water Resources in Tartous).
- Interviews with technicians/specialists (Water Resources Directorate in Tartous).
- Reports and studies.

This technique falls under the category of Water Management (Water Harvesting) - Vegetation Management group.

15.1 - Description of Technique:

- The technique was implemented in 2016-2017.
- The technique is part of the Al-Bireh Dam, Irrigation Network, and Water Conveyance Project, implemented in cooperation with FAO.
- The technique is distributed over an area of 0.75 km².
- The technique consists of:
  - An earth-fill dam with a cartilage core, the dam is 148 m long and 15 m high. The lake area is 18,750 m² with a storage volume of 100,000 m³.
  - A polyethylene line for water conveyance from the dam's outlet to agricultural lands, with seven metal distribution valves.
  - A modern drip irrigation network with a water compressor for up to five wells.
- The dam's total area reached 750 dunams, with 4,000 beneficiaries.
- **Cultivated plant species:** various summer vegetables, fruit trees (apples and cherries).

15.2 - Location of the technique monitored and evaluated:

- Syrian Arab Republic, Hama Governorate, Masyaf District, Wadi Al-Oyoun Sub-district - Biret al-Jurd Village.
- Location Coordinates: N 34°57'45.21" - E 36°15'52.1"
- Type of land use: Rainfed pastures before the technique implementation, and agricultural lands (crops and fruit trees) irrigated by drip irrigation after the technique implementation.
- Rainfall rate: 1001-1500 mm/year.
- Nearly flat or undulating soil 0.5-2%.
- Soil texture: very good, loamy.
- Soil depth: 30-75 cm.
- Soil organic matter content: low, <0.86%.
- Low-pH soil: 6.6-6.9.
- Salinity: 0-4 DS/cm.

15.3 - Stakeholders benefiting from the technique:

- Local land user.
- The local community, which responded positively to the implementation of the technique.

15.4 - Main objective of the technique:

- Rehabilitating degraded lands.
- Improving production.
- Creating a beneficial economic impact.
- Creating a beneficial social impact.
- Preserving/improving biodiversity.
- Ensuring the stability of local residents in the village.

15.5 - Main types of land degradation the technique addresses :

- Physical soil degradation.
- Biological soil degradation.

15.6 - Main causes of land degradation at the site:

- Increased frequency, duration, and intensity of droughts.
- Geology of the region.
- Lack of necessary water during the summer.
- Unsound human practices.

15.7 - On-site and off-site impacts of technique implementation:

- Increasing crop production.
- Availability of irrigation water.
- Reducing expenditure on agricultural inputs.
- Diversifying sources of income.
- Reducing the risk of fire.
- Reducing and regulating surface water runoff.
- Improving crop production quality.
- Increasing animal productivity.
- Increasing groundwater storage.
- Improving income.
- Improving food security.
- Reducing conflict.
- Reducing the risk of natural disasters such as floods and torrential rains.
- Empowering women.
- Increasing the knowledge and awareness among the local community and technicians of land degradation and the importance of implementing sustainable land management practices to avoid and reverse degradation.

15.8 - Requirements for establishing and adopting the technique:

- Implementing various excavation works in 2016 (machinery, equipment, and labor) at a cost of 330 million Syrian pounds.
- Implementing various backfills in 2016 (machinery and equipment - gravel, cement and stones - labor) at a cost of 3,927 million Syrian pounds.
- Implementing concrete works (reinforced + standard + immersed) in 2016 (cement - iron - stones - building materials) - machinery and equipment - labor) at a cost of 2,520 million pounds.
- Installing pipes and valves in 2016 (metal pipes, valves, wrought iron) at a cost of 408 million Syrian pounds.
- Implementing the pipeline by installing polyethylene pipes at a cost of 586 million Syrian pounds.

The benefits of implementing this technique on-site are slightly positive compared to the preliminary expenses in the short term (1-3 years) and very positive compared to the maintenance costs in the long term (more than 10 years).

15.9 - Advantages and disadvantages of technique:

15.9.1 - Advantages of the technique from both land users' and technicians' perspective:

- Improving income and combating poverty.
- Improving soil structure and condition through the introduction of summer crops and crop diversification.
- Increasing agricultural production.
- Reducing water waste.
- Promoting tourism in the region.

15.9.2 - Disadvantages:

• The high preliminary expenses of the technique and the inability of the local community to bear these burdens without support from the government and international organizations.

15.9.3 - Recommendations for overcoming the disadvantages of the technique from the perspective of local community and relevant technicians:

• Relevant government agencies and international organizations should provide support to expand the application and dissemination of water harvesting and modern irrigation.

16- Afforestation/rehabilitation of the random Qadmus landfill:

Evaluation date: 29/4/2024

Evaluation based on:

• Field surveys of the technical site using the Sustainable Land Management (SLM) practice assessment form within the framework of the project " Strengthening National-level Institutional and Professional Capacities of Country Parties towards enhanced UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment.

(Member of the sub-working groups in the coastal area formed by Resolution No. 799/Q dated 5/9/2024 - Environment Directorate in Tartous Governorate).

• Interviews with specialists/technicians (Tartous Governorate - Solid Waste Directorate).

• Reports and studies (Evaluation of existing landfill sites in Tartous Governorate using GIS - Tishreen University).

This technique falls under the category of afforestation.

16.1- Description of the technique:

• The technique was implemented as part of the Al-Qadmus Landfill Rehabilitation Project, implemented by the Military Housing Foundation. Initially, the site of the Al-Qadmus landfill was evaluated according to a set of criteria and constraints. The unmet criteria, which resulted in negative environmental, social, and economic impacts, were addressed in a study conducted by Tishreen University in 2016.

• A plan was developed to study 9 random landfills in 2016, and the necessary appropriations were allocated for implementation during the years (2017-2018-2019).

• Closing the landfill for three years prior to the rehabilitation process to prevent receiving additional waste.

• Leveling, burying, and covering the landfill with agricultural soil.

• Planting the landfill with forest trees (bay laurel and fruit pine) over an area of 20 dunums.

16.2 - Location of the technique monitored and evaluated:

- Syrian Arab Republic, Tartous Governorate, Al-Qadmus District, Buwayb al-Hawa.
- Location coordinates: N35°07'37".8 - E36°07'35".26
- Type of land use: The random landfill in Al-Qadmus is located on state-owned land with an area of 20 dunums and is close to communities, agricultural lands, forest lands and water sources (wells and springs), which had negative impacts on the environment (water, soil and air) and on nearby communities due to bad odors, the spread of insects, pollution, the risk of fires and health threats, as the landfill is more than 50 years old. It was closed before the rehabilitation process for 3 years.
- Rainfall rate: 1001-1500 mm/year.
- Slope: 3-8% and up to 40%.
- Soil depth.
- Soil texture: silty and loamy.
- Soil pH: 4.6-5.5.
- Salinity: 0-4 DS/cm.
- Irrigation method: rainfed.
- Technique implementation date: rehabilitation of the random landfill was completed on 12/29/2022.

16.3 - Stakeholders benefiting from the technique:

- Government sector.
- Researchers.
- The local community, which responded positively to the landfill rehabilitation efforts.

16.4- Main objective of the technique:

- Rehabilitating degraded lands.
- Maintaining ecosystems.
- Improving biodiversity.
- Creating beneficial social impact.
- Reducing disaster risks (soil and water pollution).

16.5 - Main types of land degradation the technique addresses:

- Chemical soil degradation.
- Biological soil degradation.
- Water quality degradation.

16.6 - Main causes of land degradation at the site:

- Unsound human practices.

16.7 - On-site and off-site impacts of technique implementation:

- Reducing soil pollution.
- Reducing water pollution.
- Reducing the risk of natural disasters.
- Reducing sediment and silt.
- Increasing the quantity and quality of plant production.
- Reducing damage to public and private infrastructure.
- Increase knowledge and awareness among the local community and technicians of land degradation and the importance of implementing sustainable land management practices to avoid and reverse degradation.

16.8 - Requirements for establishing and adopting the technique:

Rehabilitating a landfill through afforestation is a complex process that involves several integrated stages, starting with assessment, planning, site preparation, and planting.

The total cost includes labor, machinery, transportation, and levelling costs, and it reached 98,391,800 Syrian pounds.
These costs are high and require the efforts of government agencies.

The benefits of implementing this technique on-site are negative compared to the preliminary expenses in the short term (1-3 years) and very positive in the long term (more than 10 years).

16.9 - Advantages and Disadvantages of the Technique:

16.9.1 - Advantages of the technique from both land users' and technicians' perspective:

- Restoring good appearance.
- Reducing health risks.

16.9.2 - Disadvantages:

- High costs.
- Potential negative impacts on groundwater in the absence of an effective drainage system, posing a risk to the environment and public health.

16.9.3 - Recommendations for overcoming the disadvantages of the technique from the perspective of local community and relevant technicians:

- Regular site monitoring for soil, water, tree growth, and contamination issues.
- The site can be used for public purposes such as a park or recreational area.

17- Conservation of agricultural techniques:

Evaluation Date: 4/5/2024

Evaluation based on:

- Field surveys of the technical site using the Sustainable Land Management (SLM) practice assessment form within the framework of the project " Strengthening National-level Institutional and Professional Capacities of Country Parties towards enhanced UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment.
(Member of the sub-working groups in the coastal region formed by Resolution No. 799/Q dated 5/9/2024 - General Commission for Scientific Agricultural Research in Lattakia).
- Interviews with specialists/technicians (Kasab Research Station - General Commission for Scientific Agricultural Research).
- Research studies.

This technique falls under the category of soil erosion control (plant management and water management), and soil structure improvement.

17.1 - Description of technique:

- The technique was implemented in 2015 on slopes planted with fruit trees of apples (40 trees/dunum) and almonds (64 trees/dunum) over an area of 100 dunums.
- Conservation agriculture technique was implemented on the slopes by using cover crops of legumes (vetches and beans) and managing crop residues by covering the soil surface with weed cuttings and cuttings from the vegetative part of the legume crop planted at the appropriate time and at soil level without disturbing the soil.
- The technique also requires mechanical control using weed clippers where herbicides were not used.

17.2 - Location of the technique monitored and evaluated:

- Syrian Arab Republic, Lattakia Governorate, Lattakia District, Kasab Subdistrict - Kasab Research Station.
- Location coordinates: N35°35'31" – E35°59'29"
- Type of land use: Agricultural land planted with fruit trees of apples and almonds, with an area of 100 dunums, most of which is rain-fed.
- Land degradation at the site is represented by soil erosion by water and manifested in the loss of topsoil, the formation of gullies, and decreased productivity. This results in the deposition of soil washed from the slopes onto nearby roads and low-lying areas, contamination of nearby water sources due to siltation, and decreased soil fertility.
- Rainfall rate: 1130 mm/year.
- The site is composed of slopes with varying degrees ranging from 0.23% to 45%.
- The soil is loamy-silty.
- Soil depth: 90-70 cm.
- Electrical conductivity: 0.97.
- Soil texture: medium loamy-silty.
- Soil pH: 6.95, slightly acidic.
- Salinity: 4-0 DS/cm.
- Technique implementation date: 2015.

17.3 - Stakeholders benefiting from the technique:

- Researchers.
- Government Sector.

17.4 - Main objective of the technique:

- Preventing/avoiding land degradation.
- Rehabilitating degraded lands.
- Improving production.
- Conserving ecosystems.
- Coping with drought.
- Improving biodiversity.
- Creating beneficial economic impact.
- Improving water use efficiency.

17.5 - Main types of land degradation the technique addresses:

- Soil erosion by water.
- Physical soil degradation.
- Biological soil degradation.
- Water quality degradation.

17.6 - Main causes of land degradation at the site:

- Soil loss due to water erosion caused by heavy rainfall and slopes.
- Unsound human practices such as cultivating the soil on slopes.

17.7 - On-site and off-site impacts of technique implementation:

- Reducing and regulating surface water runoff.
- Reducing soil erosion.
- Increasing the quantity and quality of plant production.
- Reducing expenditure on agricultural inputs.
- Improving income.
- Reducing labor burden.
- Increasing groundwater storage.
- Reducing soil pollution.
- Reducing water pollution.
- Reducing sediment and silt.
- Increasing knowledge and awareness among the local community and technicians of land degradation and the importance of implementing sustainable land management practices to avoid and reverse degradation.
- Reducing damage to public and private infrastructure.

17.8- Requirements for establishing and adopting the technique:

Applying conservation agriculture on slopes requires specific practices to conserve soil and prevent erosion through additional measures. In addition to the three principles of conservation agriculture (no-tillage, permanent mulching, and crop rotation), these measures ensure reducing the risk of erosion on slopes by implementing protection techniques such as terraces or stone walls and reducing surface runoff.

The total cost is divided into the preliminary expenses and maintenance costs over several items:

- The cost of trained labor for planting cover crops, mowing weeds, and applying soil protection techniques such as constructing terraces or stone walls.
- The cost of operating equipment and machinery.
- The cost of legume seeds.

These costs are high in case of terracing and just once, while maintenance costs are low.

Benefits of applying this technique on-site are positive if the terraces are already implemented in the short term (1-3 years) and positive in the long term (more than 10 years).

17.9 - Advantages and Disadvantages of the Technique:

17.9.1 - Advantages of the technique from both land users' and technicians' perspective:

- Low cost.
- No need for machinery.
- Eco-friendly.

17.9.2 - Disadvantages:

- Decreased crop yields in the early stages of adopting a conservation agriculture system compared to conventional agriculture.
- Emergence of weeds.
- Increased risks to agricultural production under conservation agriculture due to the effects of climate change .

17.9.3 - Recommendations for overcoming the disadvantages of the technique from the perspective of local community and relevant technicians:

- Educating farmers about the importance and mechanism of implementing conservation agriculture to mitigate land degradation.
- Selecting appropriate, fast-growing cover crops effectively reduces weed growth, with the potential to use biological and mechanical control and adopt crop rotation.
- Proper planning and implementation of terraces with an effective drainage system to mitigate the impact of excessive rainfall and flooding.

18-Mulching technique:

Evaluation date: 5 / 5 / 2024

Evaluation based on:

- Field surveys of the technical site using the Sustainable Land Management (SLM) practice assessment form within the framework of the project " Strengthening National-level Institutional and Professional Capacities of Country Parties towards enhanced UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment.

(Member of the sub-working groups in the coastal region formed by Resolution No. 799/Q dated 5/9/2024 - General Commission for Scientific Agricultural Research in Lattakia).

- Research reports and studies during (2016-2020).

This technique falls under the category of soil erosion control (plant management and water management), and soil structure improvement.

18.1 - Description of technique:

- The technique was implemented during 2019-2016.
- The technique is implemented within a research project entitled "**Reducing soil erosion on the slopes of Mazar Al-Qatria**".
- The technique is applied on slopes planted with olive trees at a rate of 40 trees per dunum, using leguminous cover crops.
- This technique falls under the category of soil fertility management and is implemented by covering the soil with mature, well-developed plants that contain organic matter and nutrients for the soil. These plants are turned into the soil when they are grown, before the flowering and production stages, when the vegetative mass is formed and is rich in soil nutrients.

18.2 - Location of the technique monitored and evaluated:

- Syrian Arab Republic, Lattakia Governorate, Lattakia Region, Fedio District - Mazar Al-Qatria Village - Research Station of the General Commission for Scientific Agricultural Research.
- Site coordinates: E: 35.9247403- N: 35.5167544
- Rainfall rate: 251-500 mm/year.
- Slope rate: 16-30%.
- Soil texture: medium loamy silty.
- Soil depth: >75 cm.
- Soil: moderately alkaline: 7.1-8.5 .
- Salinity: 0-4 DS/cm.

18.3 - Stakeholders benefiting from the technique:

- Government Sector.
- Researchers.

18.4 - Main objective of the technique:

- Preventing/avoiding land degradation.

18.5 - Main types of land degradation the technique addresses:

- Soil erosion by water.
- Physical soil degradation.
- Biological soil degradation.

18.6 - Main causes of land degradation at the site:

- Soil loss due to water erosion.
- Unsound human practices.

18.7 - On-site and off-site impacts of technique implementation:

- Reducing and regulating surface water runoff.
- Increasing groundwater storage.
- Reducing soil pollution.
- Reducing soil erosion.
- Reducing water pollution.
- Reducing sediment and silt.
- Increasing knowledge and awareness among the local community and technicians of land degradation and the importance of implementing sustainable land management practices to avoid and reverse degradation.
- Reducing expenditure on agricultural inputs.
- Improving income.
- Increasing the quantity and quality of plant production.
- Increasing soil water content.
- Diversifying sources of income.
- Improving food security.
- Reducing the risks of natural disasters such as floods and torrents.
- Reducing damage to public and private infrastructure

18.8 - Requirements for establishing and adopting the technique:

Implementing mulching with legumes requires careful planning and efficient resource management, particularly when choosing planting dates based on crop type and climate. It is often incorporated into a crop rotation with main crops, which enhances soil fertility and reduces agricultural pests.

Implementing the technique does not require specialized labor, as its agricultural processes are straightforward. Light soil preparation is required before planting the seeds. Drip or sprinkler irrigation systems can be used to meet water needs in areas of insufficient rainfall.

This technique is inexpensive and cost-effective. Costs include seed prices, pre-planting land preparation costs such as mowing or plowing, and labor costs depending on the size of the holding. Legumes are generally relatively disease-resistant, and pesticides can be used, which is an additional cost. Furthermore, the use of chemical fertilizers is minimal due to nitrogen fixation in the soil. Maintenance operations primarily involve periodic weed control.

Benefits of applying this technique on-site are slightly positive compared to establishment costs in the short term (1-3 years) and very positive for the soil and crop from an economic and environmental perspective in the long term (more than 10 years).

18.9 - Advantages and disadvantages of the technique:

18.9.1 - Advantages of the technique from both land users' and technicians' perspective:

- Low cost.
- Easy to apply.
- Eco-friendly.

18.9.2 - Disadvantages:

- Slow financial returns: although legume crops improve the soil, the economic returns may not appear immediately.

18.9.3 - Recommendations for overcoming the disadvantages of the technique from the perspective of local community and relevant technicians:

- Educating farmers about the importance and application of legume crops as soil cover.
- Developing scientific research in selecting the best legume crops to suit climatic conditions and prevailing soil characteristics.

19- Water Harvesting Technique/Semicircular bunds:

Evaluation date: 25/4/2024

Evaluation based on:

- Field surveys of the technical site using the Sustainable Land Management (SLM) practice assessment form within the framework of the project " Strengthening National-level Institutional and Professional Capacities of Country Parties towards enhanced UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment.
  (Member of the sub-working groups in the southern region formed by Resolution No. 799/Q dated 5/9/2024 - Environment Directorate in Quneitra Governorate).
- Interviews with technicians/specialists (Directorate of Agriculture in Quneitra).

This technique falls under the water management category.

19.1 - Description of the technique:

- The technique was implemented in 2009 by the Land Reclamation Branch in Quneitra.
- The main objective of the technique is to provide the necessary water for irrigation due to water shortages which force farmers to rely on tankers for irrigation. This is achieved by constructing crescent-shaped stone barriers to retain water during the rainy season, reducing surface runoff and thus preventing soil erosion.
- Semicircular bunds are crescents, or trapezoidal barriers made of earth or stone, directly facing the top of the slope. They are constructed at intervals that allow sufficient catchment space to supply the required runoff water. The water collects in front of the barrier where the plants are grown. These barriers are usually constructed in staggered rows. The diameter of the circle, or the distance between the two ends of the barrier, ranges from 1–8 m, while its height is between 30–50 cm. Excavating the soil at the top of the line during construction causes a slight depression in the soil level, where water stops running and collects at the line and is stored in the plant root zone. Furthermore, the slope increases, increasing the runoff coefficient. This technique can be used on flat land, but it can also be used on slopes of up to 15%. These ridges and barriers are mainly used for restoring natural pastures or for fodder production, but they can also be used for planting trees and shrubs and sometimes for growing field crops (such as Great Millet) and vegetables (such as watermelon).

19.2 - Location of the technique monitored and evaluated:

- Syrian Arab Republic, Quneitra Governorate, Quneitra District, Khan Arnabeh Subdistrict - Jaba Village.
- Location Coordinates: 19.31.35.56-49.81.33.09
- Current land use where the technique is applied: Agricultural land planted with olive trees.
- Irrigation method: Rainfed.
- Rainfall rate: 750-501 mm/year.
- Sloping: 8-3%.
- Soil texture: Medium-silty loam.
- Soil depth: 75-30 cm.
- Soil pH: 6.9-6.6.
- Salinity: 4-0 DS/cm.

19.3 - Stakeholders benefiting from the technique:

- Local land users.

19.4 - Main objective of the technique:

It provides water to plants by increasing soil moisture, reducing soil loss due to wind erosion, and reducing the physical and material burden on the land user incurred in transporting and purchasing water, thus:

- Preventing/avoiding land degradation.
- Improving production.
- Creating a beneficial economic impact.
- Creating a beneficial social impact.

19.5 - Main types of land degradation the technique addresses:

- Soil erosion by water.

19.6 - Main causes of land degradation at the site:

- Soil water loss.
- Increased frequency, severity, and duration of drought.

19.7 - On-site and off-site impacts of technique implementation:

- Increasing the quantity and quality of plant production.
- Improving income.
- Improving food security.
- Reducing soil erosion.
- Increasing knowledge and awareness among the local community and technicians of land degradation and the importance of implementing sustainable land management practices to avoid and reverse degradation.

19.8 - Requirements for establishing and adopting the technique:

- Rainwater harvesting is a simple method that has many advantages. It can be easily implemented, requires no significant costs, and can be implemented on a small scale in both wetter and drier regions with limited expertise or knowledge.
- Semicircular bunds require collecting stones from the site and creating arches around trees using labor with little or no experience.

The benefits of implementing this technique on-site are very positive compared to short-term establishment costs (1-3 years) and positive compared to long-term maintenance costs (more than 10 years).

19.9 - Advantages and Disadvantages of the Technique:

19.9.1 - Advantages of the technique from both land users' and technicians' perspective:

- Low establishment costs.
- Availability of raw materials.

19.9.2 - Disadvantages:

- Needs annual maintenance.

19.9.3 - Recommendations for overcoming the disadvantages of the technique from the perspective of local community and relevant technicians:

- Raising local community's awareness of the importance and mechanism of implementing water harvesting techniques.

20- Water harvesting technique/contour bunds:

Evaluation date: 29/4/2024

Evaluation based on:

- Field surveys of the technical site using the Sustainable Land Management (SLM) practice assessment form within the framework of the project " Strengthening National-level Institutional and Professional Capacities of Country Parties towards enhanced UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment.
  (Member of the sub-working groups in the southern region formed by Resolution No. 799/Q dated 5/9/2024 - Environment Directorate in As-Suwayda Governorate).
- Interviews with technicians/specialists (As-Suwayda Research Center).

This technique falls under the category of soil erosion control and water management.

○ 20.1 - Description of technique:

• The technique was implemented in 2021.

• The technique was applied over an area of 0.4 km² distributed across the entire site as part of a scientific study titled "The Impact of Water Harvesting with Contour bunds on Peach Trees in the Steep Slopes of Dahr al-Jabal Region".

• Contour bunds is a technique that stores surface runoff water in the root zone in a homogeneous manner along the line, which provides moisture during the dry season. It also mitigates the effect of the slope by breaking the length of the slope and reducing the speed of surface runoff, thus reducing erosion.

• The use of these technologies to fruit trees also contributes to improving productivity and increasing income for small farmers.

• Agricultural terraces are levelled and reinforced with stone walls to slow water flow and control erosion. These terraces are supplied with additional runoff from steeper, uncultivated areas between the terraces. They are usually equipped with drains to safely dispose of excess water. These systems are frequently used for growing trees and shrubs but are rarely used for growing field crops.

○ 20.2 - Location of the technique monitored and evaluated:

• Syrian Arab Republic, As-Suwayda Governorate, Dahr al-Baidar District, Fifth Taina City.

• Location coordinates: N 32°40'25.10" - E 36°42'43.53"

• Current land use where the technique is implemented: Agricultural land planted with peach trees at a rate of 160 trees per hectare. Note that the technique implementation has not changed the type of land use.

• The site is located on the western slope of Dahr al-Baidar, at an altitude of 1,700 meters above sea level, with an area of 4,000 square meters.

• Irrigation method: Rainfed.

• Rainfall rate: 600 mm/year.

• Sloping: 13%.

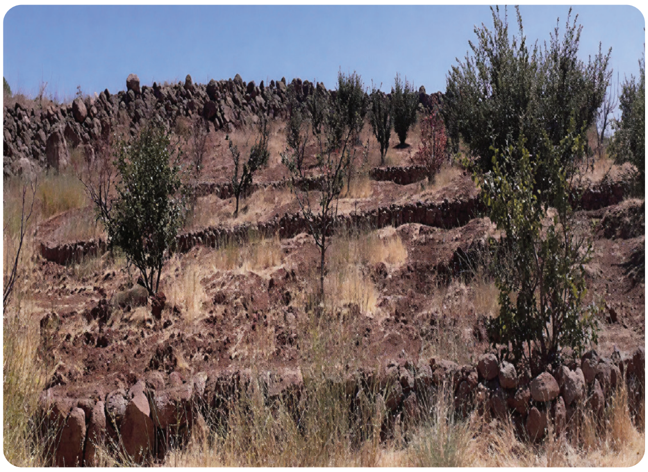
• The soil texture is very good, loamy, with a fine to medium granular structure in the surface layer, characterized by hardness when dry and fragile when moistened.

• Soil organic matter content: low <0.86%.

• Medium soil depth 75-30 cm.

• Low-pH soil 6.9-6.6.

• Salinity level: 4-0 DS/cm.



20.3 - Stakeholders benefiting from the technique:

- Government Sector.
- Researchers.

20.4 - Main objective of the technique:

Preserving soil and water by securing the water needs of trees and mitigating surface runoff, thus:

- Preventing/avoiding land degradation.
- Improving production.
- Creating a beneficial economic impact.
- Creating a beneficial social impact.

20.5 - Main types of land degradation the technique addresses:

- Soil erosion by water.
- Biological soil degradation.

20.6 - Main causes of land degradation at the site:

- Climate change and associated climate events, where rainfall is often of high intensity, causes surface runoff, especially in light of the severe slopes of the agricultural lands that keep pace with the topographical slope and the fragility of the structure.
- Soil loss through water.
- Unsound human practices, particularly farming parallel to the topographical slope, due to steep slopes and fragile structures.

20.7 - On-site and off-site impacts of technique implementation:

- Availability of irrigation water.
- Reducing soil erosion.
- Reducing water pollution.
- Increasing knowledge and awareness among the local community and technicians of land degradation and the importance of implementing sustainable land management practices to avoid and reverse degradation.
- Increasing production.
- Reducing expenditure on agricultural inputs.
- Improving income.
- Improving food security.
- Reducing surface water runoff.
- Reducing the risk of natural disasters.

20.8 - Requirements for establishing and adopting the technique:

- Four contour bunds were constructed, 40-50 m long, 20 cm high, and 30 cm wide at the base. The spacing between the bunds was 10-15 m. The slope angle did not change after applying the technique. These bunds were well covered with soil. A metal tank was placed in a prepared ground hole at the end of the field, at the bottom of the slope. The surface runoff water was collected in it, which was directed through earth guides.
- Implementing the technique requires local stones and skilled and experienced labor.

The benefits of applying this technique on-site are negative compared to short-term establishment costs (1-3 years) and positive compared to long-term maintenance costs (more than 10 years).

20.9 - Advantages and disadvantages of the technique:

20.9.1 - Advantages of the technique from both land users' and technicians' perspective:

- Providing water for irrigation.
- Reducing soil erosion.
- Improving productivity.

20.9.2 - Disadvantages:

- High preliminary expenses, especially if the primary stone materials are not available on-site.
- Requires periodic maintenance.

20.9.3- Recommendations for overcoming the disadvantages of the technique from the perspective of local community and relevant technicians:

- Raising local community awareness of the importance and mechanism of implementing water harvesting techniques.
- Providing technical and financial support through loans.
- Expanding technical capacity building and raising land users’ awareness of the importance of sustainable land management techniques in addressing land degradation issues.

21- Pasture Management Technique (Dune Stabilization):

Evaluation Date: 1/5/2024

Evaluation based on:

- Field surveys of the technical site using the Sustainable Land Management (SLM) practice assessment form within the framework of the project " Strengthening National-level Institutional and Professional Capacities of Country Parties towards enhanced UNCCD monitoring and reporting" implemented by the Ministry of Local Administration and Environment.

  (Member of the sub-working groups in the southern region formed by Resolution No. 799/Q dated 5/9/2024 - Branch of the General Authority for the Management, Development and Protection of the Badia in Rif Dimashq).
- Interviews with technicians/specialists (General Authority for the Management, Development, and Protection of Badia).
- Reports and Studies.

This technique falls under the category of soil erosion control, water management, and vegetation management.

21.1 - Description of the technique:

- Al-Naseriyah village is located within the fifth stability zone, and as a result of the village's location on the eastern side, it is exposed to strong westerly winds laden with impurities and dust under the influence of the passage of heavy trucks belonging to the General Company for Marble and Asphalt, which take more than 40 random roads to reach the gypsum sand quarry located southwest of the village. This results in the fragmentation of the soil and the formation of dust storms, which has turned the village of Al-Naseriyah into a desert as a result of the accumulation of dunes.
- To alleviate the suffering of the village of Al-Naseriyah, Al-Nasiriya Reserve was launched in 2010, with an area of 800 hectares east of Damascus, with 95,000 seedlings of Atriplex halimus and Salsola, in addition to 10,000 forest seedlings of tamarisk, linden, pine, sumac, and almonds. The technique was implemented in 2010 within the framework of the production plan of the General Authority for the Management, Development, and Protection of the Badia and the Pastoral Reserves Project.

21.2 - Location of the technique monitored and evaluated:

• Syrian Arab Republic, Rif Dimashq Governorate, Al-Qutayfah District, Jirud Subdistrict, Al-Nasiriyah 2 Village.

• Location coordinates: E: 36°48'55.3 - N: 33°52'19.5

• Current land use where the technique is applied: Pastures. Implementing the technique has not changed the type of land use.

• Irrigation method: Rainfed.

• Rainfall rate <250 mm/year.

• Nearly flat or undulating soil 0.5-2%.

• Soil texture: Weak, loamy, sandy.

• Soil organic matter content: Low, <0.86%.

• Topsoil: 15 – 30 CM.

• Slightly alkaline soil pH 7.1-8.5.

• High Soil salinity 8.1-16 ds/m.

21.3 - Stakeholders benefiting from the technique:

• The government sector.

• The local community, which has been positively responsive to the application of the technique.

21.4 - Main objective of the technique:

Stabilizing the dunes by creating a reserve, thus:

• Preventing/avoiding land degradation.

• Rehabilitating degraded lands.

• Preserving ecosystems.

• Creating beneficial economic impact.

• Reducing the risk of natural disasters such as dust storms, sandstorms, and the formation of dune.

• Adapting to climate change.

21.5 - Main types of land degradation the technique addresses:

• Wind erosion.

21.6 - Main causes of land degradation at the site:

• Climate change and associated climate events.

• The increasing frequency, intensity, and duration of droughts.

• Soil loss by wind.

• Unsound human practices, particularly overgrazing, firewood collection, and plowing.

21.7 - On-site and off-site impacts of technique implementation:

• Reducing the risk of natural disasters (dust storms and dune formation).

• Increasing plant production.

• Increasing animal productivity.

• Increasing knowledge and awareness among the local community and technicians of land degradation and the importance of implementing sustainable land management practices to avoid and reverse degradation.

21.8 - Requirements for establishing and adopting the technique:

Al-Nasiriyah 2 is a dune stabilization reserve that was established to reduce dust in the village by planting Atriplex halimus, Fourwing saltbush, and Salsola at a rate of 400 pastoral plants per hectare. This was implemented through:

• Implementing some mechanical works to prepare the reserve by constructing trenches and berms and digging two wells in the reserve to be used for watering the seedlings, using the necessary labor, machinery and equipment.

• Pastoral seedling production: 100,000 seedlings by labor working throughout the year, planting machinery and equipment, bags, seeds and seedlings, in addition to organic and inorganic fertilizers.

• Planting pastoral crops in April and November, which requires labor, machinery, and equipment.

The total cost has reached 113,150,000 SYP.

The benefits of applying this technique on-site are negative compared to the preliminary expenses in the short term (1-3 years) and positive in the long term (more than 10 years).

When compared to maintenance costs, the benefits of technique are considered positive in both the short and long term.

21.9 - Advantages and disadvantages of technique:

21.9.1 - Advantages of the technique from both land users' and technicians' perspective:

• Ease of application in such lands.

• Reducing soil erosion.

• Ease of monitoring plant conditions.

• Using local community labor.

• Availability of seedbeds.

21.9.2 - Disadvantages:

• Sand moving from other areas to cover newly planted seedlings.

• Severe droughts.

• Lack of short-term results.

21.9.3 - Recommendations for overcoming the disadvantages of the technique from the perspective of local community and relevant technicians:

• Increasing the berms around the planted sites.

• Using double-watering mechanisms for the seedlings.

• Selecting resistant varieties and increasing the number of seedlings per unit of area.

• Supporting the local community by providing interest-free loans to create job opportunities and improve the economic situation, which contributes to reducing encroachment on the reserve.

• Fencing the reserve to protect the vegetation cover and resident and migratory animal species.

Chapter 4:

Basic Land Quality indicators for Assessing and Monitoring Land Health and Productivity

The biophysical components of sustainable land management, consisting of natural elements **(soil, water, climate, topography, vegetation cover)** and natural processes **(nutrient cycle, energy transfer through food chains, decomposition, pollination, etc.)**, are important factors in maintaining the health, productivity, and resilience of ecosystems. Sustainable land management practices play a vital role in maintaining the balance and interaction of these components, based on a sound understanding and effective management of these components to ensure their sustainability for current and future generations.

Achieving this requires the use of tools to measure the state of biophysical components, track changes over time, and evaluate the effectiveness of sustainable land management practices in protecting land, mitigating degradation, and reversing its effects. Key indicators for land quality to assessing and monitoring land health and productivity help identify areas where management practices can be improved to ensure long-term sustainability and identify intervention areas and best practices.

These indicators include a wide range of qualitative and quantitative measures, including those related to **soil quality, water quality, forest and pasture quality, pollution, monitoring and assessment of nutrient stock and balance and their flows associated with different land management systems, the status and trends of yields, the status and trends of land cover change**, and other indicators that provide information that can be harnessed to measure, improve, and ensure the optimal implementation of sustainable land management practices.

Land degradation and desertification in Syria is one of the most significant challenges hindering sustainable development. Unsound human practices in exploiting natural resources, particularly overgrazing, firewood collection, desert cultivation, and cutting and burning forests, along with natural factors, particularly climate factors, are among the most significant drivers of land degradation and desertification in Syria. These factors threaten land resources and negatively impact their quality and health, thus affect their ability to provide environmental, economic, social, and spiritual services. The Syrian government has recognized the importance of limiting and reversing land degradation for decades, based on the link and impact of this on achieving food security and social and economic stability.

This work was developed through several levels and stages to be aligned with global efforts and trends in this field, especially in the monitoring and evaluation of land degradation in impacted or degradation-prone areas. This was accomplished by developing and using indicators that ensure the continuous tracking of the problem of land degradation and desertification. Such indicators provide an essential diagnostic tool to assess the status and trends of land degradation, identify its underlying causes, and analyze its existing and potential impacts, thereby facilitating prompt remedial actions before critical environmental thresholds are breached.

First: National indicators of land degradation and desertification in the Syrian Arab Republic:

Work on developing the National indicators for land degradation and desertification began in 2012, in collaboration between the Ministry of Local Administration and Environment and the Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD), with the participation of all relevant national authorities. The indicators were officially adopted in 2017. The completed national indicators covered the following key areas:

1 - Soil resources indicators :

1.1- Soil depth: it is the vertical dimension of the soil until reaching the layer that prevents root movement, and it is measured with a ruler after making a section in the soil.

Table 1:
Soil classification by depth.

Characteristic	Unit	Class			
		Deep	Medium-depth	Shallow	Very shallow
Soil depth	CM	+75	30-75	15-30	-15

(USDA, 1993)

1.2 - Soil texture: It is the relative size distribution of fine soil particles (mineral soil particles with an equivalent diameter of less than 2 mm). Its diameter is determined by the size of the soil particles. Soil texture is determined using the texture triangle.

Table 2:
Soil texture triangle

Charact-eristic	Unit	Class				
		Very good	Good	Medium	Weak	Very weak
Soil texture	Texture triangle	Clay loam, silt loam	Silt loam, silty clay loam, sandy clay loam	Sandy loam, loam silt, silty clay	Loamy sand, sandy clay	Clay, sand

(USDA, 1993)

1.3 - Soil pH: It is the degree of acidity or alkalinity of the soil. The pH number is defined as the negative logarithm of the concentration of active hydrogen ions, i.e. it is equal to: $pH = - Log_{10}[H^{+}]$

Table 3:
Soil pH Classification.

Description	pH level
Very strongly acidic	4.6 >
Strongly acidic	5.5- 4.6
Moderately acidic	6.5- 5.6
Slightly acidic	6.9- 6.6
Neutral	7
Slightly alkaline	8.5- 7.0
Strongly alkaline	> 8.5

FAO, 2008

○ **1.4 - Soil salinity:** refers to the concentration of the main ions (Sodium Na^{+}, Calcium Ca^{+2}, Potassium K^{+}, Magnesium Mg^{+2} , Chlorine Cl^{-}, Carbonate CO_3^{-2}, Bicarbonate HCO^{-3}, Sulfate SO_4^{-2}, and Nitrate NO_3^{-2}) in the soil; it is usually expressed as electrical conductivity.

Table 4:
classification of soil by salinity.

Charact-eristic	Unit	Soil salinity class			
		Non-saline	Moderately saline	Highly saline	Severely saline
Salinity	ds/m	0-4	4.1-8	8.1-16	+16

USDA,1992

Table 5:
Soil classification by the increase of salinity.

Characteristic	Unit	Class			
		Mild	Medium	High	Very high
Increase of salinity	ds/m/yr	2	2-3	3-5	+5

USDA,1992

○ **1.5 - Exchangeable sodium percentage (ESP):** The change in this percentage is a result of the toxic effect of sodium on some crops and soil specifications. It equals exchangeable sodium milliequivalents/100 grams of soil divided by the cation exchange capacity multiplied by 100.

Table 6:
Degree of soil degradationby salinity.

Characteristic	Unit	Degree of degradation			
		Non – slight	Medium	High	Severe
Exchangeable sodium percentage	%	0-8	8.1 - 15	15.1 - 30	+30
Increase in exchangeable sodium percentage	%	1	1.1 - 2	2.1 - 3	+3

Soil science unit – University of Girona 2004–USDA1992

○ **1.6 - Land slope:** it is of great importance in determining land use and its grazing capabilities. The degree of slope is also considered an important factor in soil erosion, whether by water or wind.

Table 7:
Classification of lands by the degree of slope.

Slope %	Class
Less than 0.05	Level
0.5 - 2	Nearly Level
3 - 8	Gently Slopping
9 - 15	Moderately Slopping
16 - 30	Hilly
31 - 45	Steep
More than 45	Very Steep

Sankari, 1988

○ **1.7 - Wind erosion:** it is one of the most widespread and damaging forms of desertification, resulting in the loss of fertile topsoil, the problems caused by sand moving, encroaching, and falling on residential areas, or its placement on roads and railways, in addition to its harmful impact on public health.

Table 8:
Degree of soil degradation by to the amount of windborne dust.

Windborne dust density, kg/h/100m			
Degree of erosion	8 m/s	12 m/s	16 m/s
Low	2	9 - 10	11 - 20
Medium	5	11 - 40	21 - 50
High	45541	41 - 50	51 - 200

Ganpeisov,1977

• Standards of field monitoring.

Table 9:
Field measurements for soil degradation by wind erosion.

Degradation standard			
Evaluation criteria	Degree of degradation		
	Low	Medium	High and severe
In non-agricultural lands			
Land covered with dunes %	30>	30 - 70	70<
Land covered by vegetation %	50 - 30	30 - 10	10>
In agricultural lands			
Large-scale soil removal in the area %	5>	5 - 10	10<
Loss rate of the main crop production in the region %	25>	25 - 50	50<

Degradation of the dry lands of Asia, 1998

• Formation of wind vortex pits.

Table 10:
Degree of soil degradation by the area affected by wind erosion.

Severe wind erosion	More than 10% of the land area is affected by vortex pits
Moderate wind erosion	5-10% of the land area is affected by vortex pit
Slight wind erosion	Less than 5% of the land area is affected by vortex holes

1988, Arab Organization for Agricultural Development

○ **1.8 - Water erosion:** One of the most important manifestations of this form of degradation is the loss of the fertile surface layer of soil and the transfer of large quantities of it to other locations, leaving behind rocky outcrops, shallow soil, or wastelands.
The eroded materials are deposited in specific areas behind dams or in agricultural fields, causing destruction and constituting another factor of degradation.

- **Field monitoring criteria.**

Table 11:
Field measurements of soil degradation by water erosion.

Degradation standard				
Evaluation criteria	**Value %**	**Degree of degradation**		
		Low	**Medium**	**High and severe**
In non-agricultural lands		Sheet erosion, soil excavation, and the beginning of gully formation	Plate erosion, few grooves, and numerous channel formations.	Plate erosion, large grooves, and many pits in a form of a grid
Removal of topsoil of the soil section	**%**	**<25**	**25 - 50**	**50<**
In agricultural lands				
Removal of topsoil for the soil section	**%**	**<25**	**25 - 50**	**50<**
Loss rate in crop production	**%**	**<25**	**25 - 50**	**50<**

Degradation of the dry lands of Asia, 1998

- **If quantitative data on eroded soil is available.**

Table 12:
Degree of soil degradation by the amount of soil lost by water erosion.

Loss of less than 25 tons/ha/year	**Slight water erosion**
Loss of 25-50 tons/ha/year	**Moderate water erosion**
Loss of 50-150 tons/hectare/year	**Severe water erosion**
Loss of more than 150 tons/hectare/year	**Very severe water erosion**

Arab Organization for Agricultural Development

○ **1.9 - Soil fertility decline:** Agricultural intensification and failure to adhere to agricultural guidelines lead to the loss of nutrients, thus soil fertility declines and large areas of agricultural land are lost. The loss of nutrients, especially in irrigated areas, also leads to a decline in the productive capacity of the land and its deterioration to varying degrees.

Table 13:
Concentration of major and minor elements in soil.

Elements	Concentration of major and minor elements in soil (mg/kg)				
	Very low	Low	Medium	High	Very high
Nitrates N-NO3	0 - 5	5 - 15	15 - 30	30 - 40	+40
Phosphorus (Olsen method)	0 - 3	3 - 8	8 - 14	14 - 20	+20
Potassium	0 - 85	85 - 150	150 - 250	250 - 450	+450
Iron	0 - 2	2 - 4	4 - 6	6 - 10	+10
Zinc	0 - 0.5	0.6 - 1	1 - 3	3 - 6	+6
Manganese	0 - 0.5	0.5 - 1.2	1.2 - 3.5	3.5 - 6	+6
Copper	0 - 0.1	0.1 - 0.3	0.3 - 0.8	0.8 - 3	+3
Boron	Less than 0.4	0.4 - 0.7	0.8 - 1.2	1.3 - 2	+2

Jones, 2001؛Bashour, 2001

1.10 - Soil pollution: Agricultural soil is exposed to numerous sources of pollutants, particularly heavy metals.

The nature of these pollutants varies depending on the prevailing agricultural systems and techniques applied.

This problem arises with the irrational use of chemical fertilizers and pesticides, treated and untreated wastewater, and saline and hard agricultural drainage water, which leads to the settling of pollutants either on the surface of the soil or within it.

- **Max concentration (mg/kg dry weight) of mineral elements allowed in agricultural and forest soil.**

Table 14:
Maximum concentration of mineral elements allowed in agricultural and forest soils.

Element	Agricultural soil	Forest soil
Arsenic	20	20
Cadmium	1	5
Chromium	100	250
Copper	100	375
Lead	100	150
Mercury	1	4
Nickel	60	125
Selenium	5	8
Zinc	200	700

Syrian Arab Organization for Standardization and Metrology No. 2665 of 2002

1.11 - Bulk density of soil: the mass of dry soil matter (at 105°C) to the volume of soil in its natural state. Its value ranges from 1.1 to 1.8 g/cm^3.

Table 15:
Classification of degradation according to the bulk density of soil.

Characteristic	Unit	Degree of degradation			
		No or slight deterioration	Moderate deterioration	Severe deterioration	Very severe deterioration
Bulk density	g/cm³	1.2	1.2 - 1.4	1.4 - 1.6	+1.6

Literature review: Assessment of desertification indicators, comparative analysis of indicators existing in the study site Agricultural University of Athens 2010

○ **1.12 - Soil waterlogging:** refers to the saturation of the soil with moisture, with the water level rising to the root zone, which leads to a decrease in agricultural productivity due to the inability of plants to breathe sufficiently.

Table 16:
Classification of deterioration by groundwater depth

Characteristic	Unit	Degree of degradation			
		No or slight deterioration	Moderate deterioration	Severe deterioration	Very severe deterioration
Waterlogging (groundwater depth)	cm	150	100 - 150	50 - 100	Less than 50

Literature review: Assessment of desertification indicators, comparative analysis of indicators existing in the study site Agricultural University of Athens 2010

○ **1.13 - Organic matter percentage:** Organic matter is of great importance to agricultural soil, second only to irrigation water, given our dry and semi-arid climate. This is due to the important nutritional elements it provides to plants and its regulatory effect on the soil.

Table 17:
Classification of soil by the percentage of organic matter

Characteristic	Soil testing method	Unit	Evaluation criteria		
			Low	Marginal	Adequate
Percentage of organic matter	Walkey-Black	%	<0.86	0.86 - 1.26	1.29<

FAO (1980)

Table 18:
Classification of soil by organic matter deficiency

Characteristic	Unit	Evaluation criteria			
Deficiency in organic matter	% in a year	Mild deterioration	Moderate deterioration	Severe deterioration	Very severe deterioration
		1	1 - 2.5	2.5 - 5	+5

Soil science unit – University of Girona −2004

○ 2 - Pasture Vegetation Indicators:

These indicators are based on methods for assessing pasture condition. Pasture condition assessment aims to determine the current state of the pasture's vegetation cover in terms of quantitative and qualitative values, compared to the maximum it could be if sound scientific management methods were adopted. According to this concept, the climax community is the best condition that natural environmental conditions can produce. Therefore, the deterioration or decline of the vegetation cover from the climax community stage (the vegetation peak) represents a decline in pasture quality and a decrease in its forage production.

○ 2.1 - Evaluation in terms of declining, increasing, and invasive plants:

An indicator of pasture condition based on declining, increasing, and invasive plants.

Table 19:
Classification of pasture conditions by the percentage of plant species.

Indicative types Pasture condition	Percentage of indicative species under different grazing conditions						
	Climax	light grazing	Moderate	Heavy grazing	Overgrazing	Intensive grazing	Ruined pasture
Declining species	80% or more	79 - 55 %	54 - 20 %	19 - 1 %	0%	0%	0%
Increasing species	20% or less	21 - 35 %	36 - 60 %	36 - 60 %	35% or less	Only traces	0%
Non-toxic invasive species	0%	1 - 10 %	10 - 20 %	21 - 39 %	61 - 85 %	90 - 95 %	Less than 90%
Toxic species	0%	0%	0%	1 - 3 %	4 - 5 %	5 - 10 %	More than 10%

○ 2.2 - Determine the quantitative values of species in terms of dominant, abundant, and frequent plants:

Table 20:
Abundance Index.

Abundance Description	Very rare	Rare	Not abundant	Abundant	Very abundant
Number of trees	0.001 / hectare and less	0.001 to 0.01/ hectare	0.01 to 1/ hectare	2 - 10 / hectare	11 - 25 and more / hectare
Number of upper shrubs	0.001 and less/m²	0.001 to 0.01/m²	0.01 to 0.1/m²	0.1 to 0.25/m²	More than 0.25/m²
Number of lower shrubs	0.002 and less/m²	0.002 to 0.02/m²	0.02 to 0.2/m²	0.2 to 2/m²	More than 2/m²
Number of shrubs	0.003 and less/m²	0.003 to 0.025/m²	0.025 to 0.25/m²	0.25 to 2.5/m²	More than 2.5/m²
Number of lower perennial herbaceous plants	0.005 and less/m²	0.005 to 0.05/m²	0.05 to 0.5/m²	0.5 to 5/m²	More than 5/m²
Number of upper perennial herbaceous plants	0.01 and less/m²	0.01 to 0.1/m²	0.1 to 1/m²	1 to 10/m²	More than 10/m²
Number of annuals	0.025 and less/m²	0.025 to 0.25/m²	0.25 to 2.5/m²	2.5 to 25/m²	More than 25/m²
Area of shrubs	cm² per 100 m² and more	1 cm² per 10 to 100 m²	1 cm² per 1 to 10 m²	1 to 10 cm² per 1 m²	More than 10 cm² per 1m²

Sankari, 1988

○ **2.3 - Evaluating pasture conditions based on vegetation coverage:** The French researcher Braun-Blanquet developed a very simple scale for evaluating vegetation coverage according to the following measurement table:

Table 21:
Classification of pasture conditions by vegetation coverage.

Coverage	Classification
Coverage of the species for more than 75% of the site area	Very good
Species coverage ranges from 50-75%	Good
Species coverage ranges from 25-50%	Average
Species coverage ranges from 5-25%	Weak
Species coverage is less than 5%	Very Weak
Low Species coverage	Rare
Very low Species coverage	Very Rare

○ 2.4 - Evaluating pasture conditions in terms of forage production and plant growth:

Table 22:
Pasture Condition Indicator in terms of forage production and plant climax.

Pasture condition	Climax plants %	Forage productivity %
Excellent	76 - 100	75 - 100
Good	51 - 75	50 - 75
Average	26 - 50	25 - 50
Deteriorating	0 - 25	0 - 25

3 - Water resources indicators:

3.1 - Groundwater Depth Change Indicator: This indicator represents the change in groundwater level. It aims to measure the extent of stress caused by land use on natural resources, especially groundwater.

Table 23: Groundwater depth change indicator

Indicator	Unit	Evaluation criteria		
Decrease in groundwater depth	m/year	Low	Medium	High
		<1	1 - 2	2<

ACSAD, 2014

3.2 - Water salinity indicator: expresses the water content of salts (NaCl, KCl, ...).

Table 24: Water Salinity Indicator.

Indicator	Unit	Valuation criteria			
Water salinity	ds/m	Low	Medium	High	Very high
		<0.25	0.25 - 0.75	0.76 - 2.25	2.25<

Source: Athur W. Houns, Water Quality Data Analysis

3.3 - Annual Dam Storage Indicator: This is the total amount of water stored in dams at the end of the rainy season to the total maximum design storage capacity of these dams as a percentage.

Table 25: Indicator of annual water storage in dams.

Indicator	Unit	Evaluation criteria			
AWSD	%	Low	Medium	High	Very high
		<3	5>AWSD>3	10>AWSD>5	10<

ACSAD, 2014

3.4 - Per capita share of available resources indicator: expresses the amount of water available annually for various uses relative to the population.

Table 26: Per capita share of available resources indicator.

Indicator	Unit	Evaluation criteria			
Per capita share of available resources	m3/cap/year	No stress	Stress	Scarcity	Absolute scarcity
		>1.700	1700 - 1000	1000 - 500	500>

Water barrier differentiation proposed by Falkenmark, 1989

3.5 - Water Deficit Percentage indicator: it expresses the percentage of water consumed compared to the water available.

Table 27: Water Deficit Percentage Indicator.

Indicator	Unit	Evaluation criteria		
Percentage of water deficit	%	Deficit	Optimal investment	Not fully utilizing available resources (development potential)
		Negative value	Value zero	Positive value

- **3.6 - Groundwater Deficit indicator:** Water deficit occurs as a result of groundwater resource depletion associated with poor water resource management when the amount of groundwater resources consumed is greater than the amount of groundwater resources available:

Table 28: Groundwater Resources Deficit indicator.

Indicator	Unit	Evaluation				
Groundwater resource deficit	%	Consumption > Groundwater Recharge	Recharge > Consumption >95% of recharge	95% Recharge >Consumption > 80% Recharge		
		Depletion	Safe extracting	Development potential	Depletion is limited to certain locations	No depletion

- **3.7 - Saltwater intrusion indicator:** This is specific to coastal areas and indicates the intensity of groundwater pumping for irrigation purposes.

Table 29: Saltwater intrusion indicator.

Indicator	Unit	Evaluation	
Saltwater intrusion indicator	None	No intrusion	Intrusion
		- SAR < value specified in the irrigation water specification - Na concentration < 300 mg/l (value specified in the irrigation water specification)	- SAR > value specified in the irrigation water specification - Na concentration > 300 mg/l (value specified in the irrigation water specification)

- **3.8 - Indicator of Treated Water Recycling Rate:** The amount of treated water, in a sector, reused as a percentage of the total amount of water consumed in that sector.

Table 30: Indicator of Treated Water Recycling Rate.

Indicator	Unit	Evaluation degrees			
Treated water recycling rate	%	Very positive	Positive	Negative	Very negative
		75 - 100	50 - 75	25 - 50	0 - 25

- **3.9 - Indicator of water use efficiency in irrigation:** The percentage of areas equipped with water-saving irrigation systems, also known as modern irrigation (sprinkler irrigation, drip irrigation, etc.) to the percentage of total irrigated land (modern irrigation + traditional irrigation)..

Table 31: Indicator of water use efficiency in irrigation.

Indicator	Unit	Evaluation degrees			
Water use efficiency in irrigation	%	Very positive	Positive	Negative	Very negative
		More than 25	25 - 15	15 - 5	Less than 5

- **3.10 - Shared Water indicator:** expresses the annual percentage a country has obtained from its share of transboundary waters.

Table 32: Shared Water Indicator.

Indicator	Unit	Evaluation degrees			
Shared water	%	Very positive	Positive	Negative	Very negative
		More than 60	60 - 50	50 - 40	Less than 40

- **4 - Climate indicators:**
- **4.1 - Temperature-precipitation indicator: The Amberger equation is applied to develop the climate environment map.**

$$Q2= \frac{2000P}{M^2-m^2}$$

Where:

Q2: Amberger thermal rain coefficient.

P: Annual precipitation rate in mm.

M: Average maximum temperature of the hottest month (absolute degree).

m: Average minimum temperature of the hottest month (absolute degree).

- **4.2 - Temperature indicator:** continentality is calculated based on the following GORZINSKY equation:

$$C=\frac{1.3*(M-m)}{\sin Q}\ 36.3$$

Where:

C: Continentality (percentage).

M-m : differential between the daily average maximum temperature of the hottest month and the daily average minimum temperature of the coldest month (Celsius).

Q: location latitude.

- **4.3 - Precipitation indicator:** A very simple index that relies only on the precipitation component and is called **the Standard Precipitation Index**. One of its advantages is that it requires a minimum of information, which is precipitation. It is simple and quick to calculate, and it can be calculated for any period, 3, 6, or 12 months. This indicator provides a qualitative insight into the shortage of precipitation and is considered more representative than using the average.

$$SPI=\frac{x_i-\bar{x}_i}{\sigma}$$

Where:

x_i: Total sequential precipitation for a period.

x : Average rainfall for a specific period of 3, 6, 12 months, a year or more.

σ : Standard deviation.

In order to identify the severity of drought, the following criteria are used:

From **0.00** to **0.99**	**Mild drought**
From **1.00** to **1.4**	**Moderate drought**
From **1.50** to **1.90**	**Extreme drought**
About **2.0**	**Severe drought**

- **4.4 - Drought indicator (R/ETO):** It is the ratio of the annual average precipitation to the total evapotranspiration (evaporation + transpiration).

$$\text{Drought R/ETO} = \frac{\sum R}{EPT}$$

R: Annual average precipitation (mm)

EPT : Total evapotranspiration during the year (evaporation + transpiration) (mm/year)

This is represented on a climate map as follows:

Table 33:
Classification of drought by the Amberger coefficient

< 0.03	Very dry area
0.03 - 0.2	Arid area
0.2 - 0.5	Semi-arid area
0.5 - 0.75	Moisture-deficit area

5 - Sensory indicators:

Changes in vegetation density are a tangible, visual indicator of the progress or decline of desertification, which is the loss of soil's biological and economic productive capacity.
Remote sensing data are used to determine vegetation density on land using the NDVI vegetation index, using the following relationship:

$$\Delta NDVI = \frac{NDVI2 - NDVI1}{NDVI1} \times 100$$

$NDVI\Delta$: NDVI Change.
$NDVI1\Delta$: NDVI 1 value at base date.
$NDVI2\Delta$: NDVI 2 value at comparison date.

To identify the deterioration or improvement of the vegetation cover, the following criteria can be adopted

Table 34:
Degree of deterioration and improvement by the change in the values of the plant index.

Negative change value %	Degree of deterioration
0 - 10	None
10 - 20	Very light
20 - 30	Light
30 - 40	Moderate
40 - 50	Severe
> 50	Very severe
Positive change value %	**Degree of improvement**
0 - 10	None
10 - 20	Very light
20 - 30	Light
30 - 40	Medium
40 - 50	Good
> 50	Very good

6 - Socio-economic indicators:

Socio-economic indicators are among the most significant indicators for monitoring the development of desertification and land degradation in the Arab region. This is due to their significance in managing natural resources and their impact on sustainability. Activating these indicators requires the contribution of local community actors, the activation of non-governmental organizations, and the participation of relevant government agencies.

Table 35: Socio-economic indicators.

No.	Indicator
6.1	Population density in rural areas on arable land
6.2	Private consumption expenditure
6.3	Percentage of expenditure on food
6.4	Inequality in household consumption expenditure rates
6.5	Percentage of potential arable land
6.6	Type of land holding
6.7	Number of hectares of actual cultivated land per farmer
6.8	Percentage of households relying primarily on agricultural income
6.9	Agricultural labor force
6.10	Value of production per hectare of agricultural land
6.11	Unemployment
6.12	Migration
6.13	Percentage of households benefiting from health services
6.14	Percentage of households benefiting from public services (telecommunications, roads, sanitation, electricity)
6.15	Illiteracy
6.16	Literacy rate
6.17	School enrollment rate (females-males)
6.18	Percentage of adults who have completed secondary school (25-64 years)
6.19	Dependency ratio (young and old)
6.20	Road network density
6.21	Number of hectares per tractor
6.22	Government spending on infrastructure in rural areas
6.23	Share / percentage of rural households' access to potable water
6.24	Percentage of households using alternative energy (solar energy, biogas, wind, etc.)
6.25	Percentage of households cutting wood fuel
6.26	Distance traveled by household members to obtain drinking water
6.27	Percentage of households using pastures
6.28	Percentage of households raising livestock
6.29	Average livestock productivity per head
6.30	Percentage of households relying primarily on rural handicrafts
6.31	Percentage of working women (agricultural, industrial, commercial, etc.)
6.32	Dependence on aid and assistance in public emergencies
6.33	Percentage of children under five in rural areas who are underweight
6.34	Percentage of rural children with special needs
6.35	Number of deaths due to drought, conflict, or other events
6.36	Infant mortality rate in rural areas per 1,000 live births

Second - Land Degradation Neutrality indicator:

Following the global community's adoption of the **2030 Agenda for Sustainable Development** in September 2015, which included 17 Sustainable Development Goals (SDGs) and 169 targets (United Nations, 2015).
The twelfth session of the Conference of the Parties (COP12) to the United Nations Convention on the Law of the Sea (UNCCD) in October 2015 endorsed Target 15.3, which aims to **"combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world."** by 2030, and called on all country parties to **"formulate voluntary national targets for the implementation of land degradation neutrality (LDN) and include them in their national action programs (NAPs)."**

The Syrian Arab Republic joined the Land Degradation Neutrality Program at the end of 2016, and it was completed in 2019. **Through this program, the following were established:**

- Potential voluntary targets for neutralizing the effects of land degradation in the Syrian Arab Republic in the field of (agricultural lands - pastures - forests - water and wetlands - biodiversity - urban lands).

- Transitional projects towards achieving land degradation neutrality goals in the Syrian Arab Republic.

- Calculating Indicator 1 of SDG 15 and its Target 3 Indicator (15.3.1) during 2000-2015.

Indicator (15.3.1) expresses the percentage of degraded land in a country out of the total area of the country. To calculate this indicator, the United Nations Convention to Combat Desertification (UNCCD) has identified three basic sub-indicators (changes in land cover, land productivity, and soil organic carbon stocks) and left room for different countries to propose additional indicators to calculate this indicator, each country by its specificity. Due to the significance of the issue of drought to land resources in Syria, an additional indicator, the drought indicator, was adopted alongside the three basic sub-indicators.

The results of the study of indicators in the Syrian Arab Republic during the period 2015-2000 showed:

- **Land Cover and its Change indicator:** The amount of negative land cover changes in Syria was 3.91%, mostly negative changes in agricultural and forest lands, with a significant increase in urban areas, which reached more than 50%.
Accordingly, based on this indicator, approximately 4% of the Syrian Arab Republic's land cover has changed negatively.

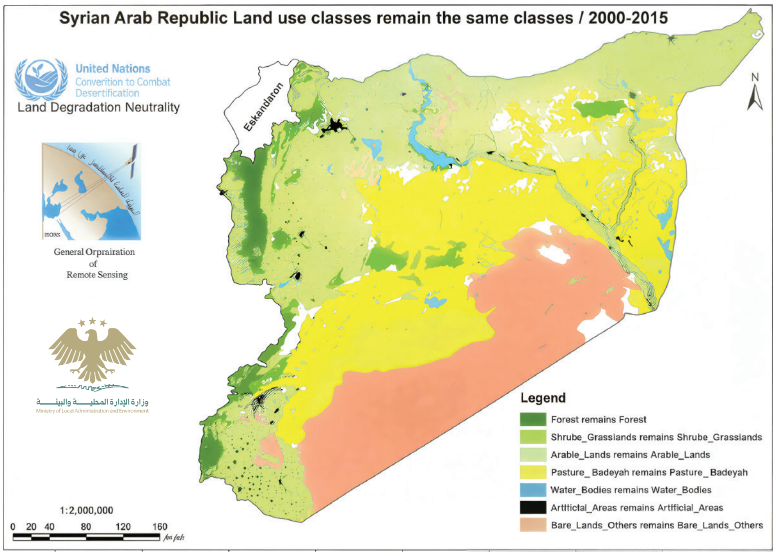


Figure 3:
Map of land cover changes in the Syrian Arab Republic between 2000-2015.

Land Productivity Dynamic Indicator:

The results came as follows:

I - **6.84%** of the country's land fell into a category of severe productivity decline **(productivity decline).**

II - **16.99%** of the country's land fell into a category of moderate productivity decline **(beginning of productivity decline).**

III - **25.10%** of the country's land fell into a category of mild productivity decline **(stable land exposed to stress).**

IV - **42.95%** of the country's land fell into a category of stable land **(stable land not exposed to stress).**

V - **8.12%** of the country's land fell into a category of increasing productivity **(improving productivity).**

Accordingly, based on this indicator, approximately 40% of the lands of the Syrian Arab Republic are at some level (light, medium or high).

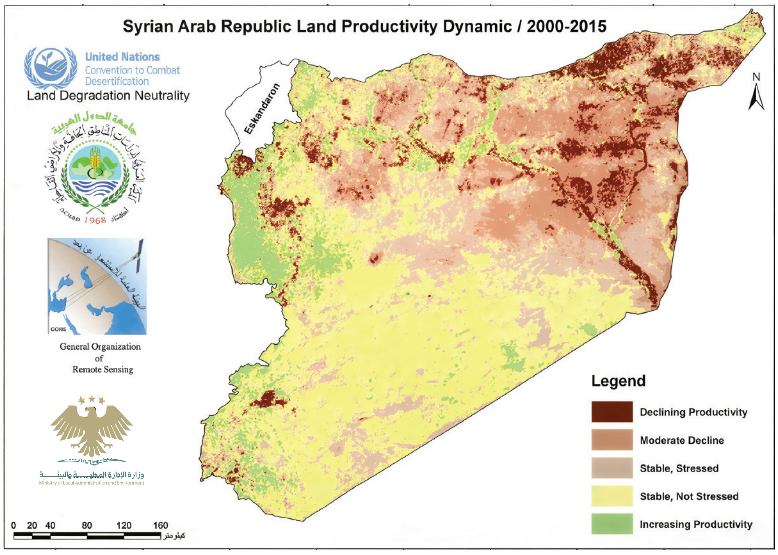


Figure 4:
Land productivity dynamic in the Syrian Arab Republic during 2000-2015.

○ Soil organic carbon content change indicator (0-30 cm):

This indicator is calculated primarily based on land cover/land use changes in the Republic's lands and was estimated at approximately 800,000 tons of soil organic carbon decrease between 2000-2015. It was also estimated by the United Nations Convention to Combat Desertification based on a mathematical model based on numerous data, including land use, at approximately 1,000,000 tons between 2000-2015.

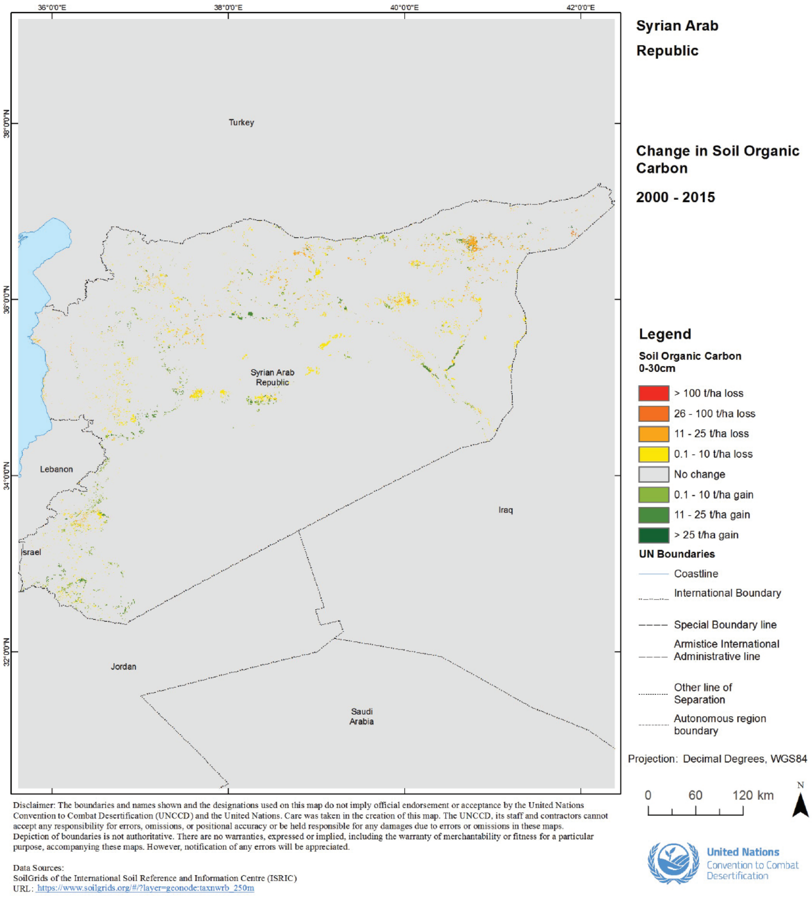


Figure 5:
Map of changes in soil organic carbon (0-30 cm) in Syria between 2000-2015.

○ Vegetation Health indicator (VHI):

The results of this indicator showed that plant health and drought conditions change from year to year depending on the climatic conditions that the lands of the Syrian Arab Republic are exposed to from year to year. The driest years were 2008, then 2012 and 2014, and the best years were 2003, then 2007 and 2006.

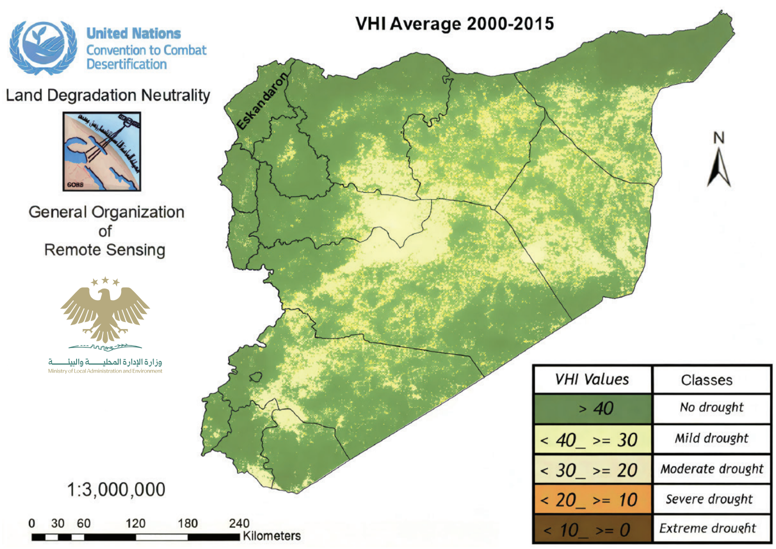


Figure 6:
Map of VHI average values for the period 2000-2015 for the date April 22


UNDP Syria – Adeeb Alsayed

Chapter 5:

Sustainable Land Management

Implementation and Challenges

Sustainable land management is critical to protecting the land itself and achieving long-term agricultural productivity, environmental health, and social and economic benefits.

By implementing strategies such as agroforestry, conservation, and water harvesting, communities can improve food security, mitigate environmental impacts, and build resilience to climate change. Sustainable land management serves urgent agricultural needs while ensuring reliable supplies of resources for future generations, which makes it a critical component of global sustainable development initiatives.

Challenges of implementing sustainable land management:

Addressing the challenges of sustainable land management requires multi-pronged approaches including education, financial support, improving and developing legislative structures, and community engagement to ensure the acceptance and sustainability of sustainable land management practices.

What are the challenges of implementing sustainable land management?

- **Knowledge and Training:**
  Farmers need education and training to understand and effectively adopt sustainable land management techniques and acquire the knowledge and skills necessary to implement them.
  For example, many may not know how to use organic fertilizers, mulching, crop rotation, or agroforestry to improve soil health and productivity.
  They may also lack access to reliable information sources, extension services, or training opportunities that can help them learn and adopt new practices.

- **Lack of awareness:**
  Farmers and land users may not be aware of the benefits of sustainable land management practices.

- **Lack of incentives and support:**
  Farmers and land users may not have sufficient incentives or support to adopt or maintain sustainable land management practices.
  For example, they may face high initial costs, low returns, or long payback periods for investing in such practices.
  They may also lack access to credit, insurance, subsidies, or markets that can reduce their risks and increase their profits.

- **Policy support:**
  Successful implementation depends on supportive policies from governments and institutions.
  Farmers and land users may not be sufficiently involved and empowered in decision-making processes that affect their land-use choices

- **Cultural and social barriers:**
  Resistance to change and traditional farming practices can hinder the adoption of new sustainable land management technologies.

- **Land suitability planning:**
  it also represents a challenge for implementing sustainable land management. This planning involves assessing multiple factors such as soil quality, topography, infrastructure availability, and legal considerations.
  It also requires balancing competing interests and addressing conflicting land use requirements.

By adopting sustainable land management practices:
farmers and land users can mitigate soil degradation, conserve soil moisture, and improve primary production.
These practices not only contribute to the long-term sustainability of agricultural systems but also **enhance biodiversity conservation and resilience to climate change.**

Steps to sustainable land management practices adoption and dissemination.

Climate change adaptation and mitigation programs and natural resource management are of great significance for increasing productivity in the broader agricultural sector in Syria.
Several projects focus on the environment, natural resource management, and adaptation to climate change.

Severe land degradation, including soil erosion caused by excessive water runoff, inappropriate agricultural practices, and overgrazing, is a major cause of declining food security in Syria.
This situation is exacerbated by the impact of climate change and compounds the socioeconomic challenges facing sustainable production and nutrition.

Up-to-date information on the status of national natural resources is scarce and fragmented, yet the need for evidence-based decision-making is critical for the protection and sustainable use of Syria's natural resources.

Since the Syrian Arab Republic joined the Convention to Combat Desertification and developed the National Plan to Combat Desertification, the Ministry of Local Administration and Environment and the Ministry of Agriculture and Agrarian Reform have been implementing a resilience strategy, enhancing adaptation to climate change, and promoting sustainable agricultural systems with a focus on sustainable land management.

The strategy is being implemented at the national level.

- **First - Information needed to make sound decisions:**

In order to manage natural resources, the information necessary to make sound decisions must be provided, which requires the development of basic studies, including:

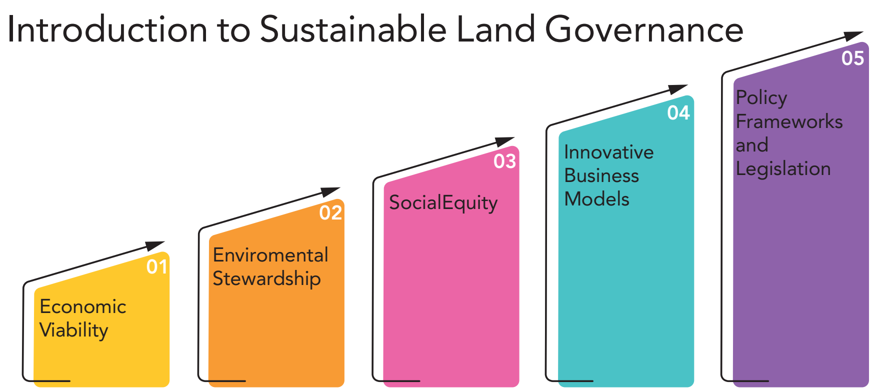
- Land cover change analysis for agriculture, forests, pastures, and urban areas.
- Disaster risk mapping.
- Water and wind erosion risk assessment.
- Pasture monitoring and assessment.
- Aboveground biomass assessment and change.
- Monitoring frameworks for integrated watershed initiatives.
- Development of a land resources information system.
- Mitigating soil degradation and promoting soil development.

- **Second - Finding a harmonious balance between economic feasibility, environmental stewardship, and social justice:**

In the field of land management, the pursuit of sustainability is a multifaceted endeavor that requires a harmonious balance between economic viability, environmental stewardship, and social justice. The concept of sustainable land management emerges as a central strategy in this endeavor, aiming to ensure that land resources are used and managed in ways that contribute to long-term social wellbeing and environmental health.

- **Economic viability:**

The principle of economic viability lies at the heart of sustainable land management, ensuring that land use contributes to economic growth while preserving the value of the land for future generations. For example, adopting agroforestry practices allows farmers to diversify their income by growing crops and trees simultaneously, increasing resilience to market fluctuations.

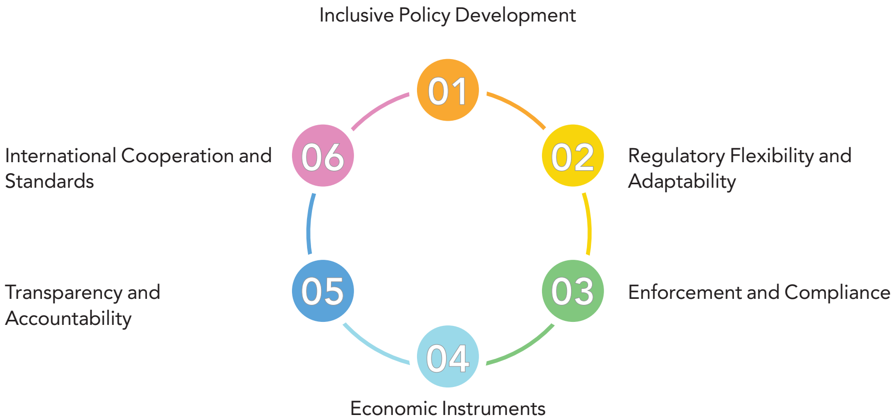


- **Environmental stewardship:** Environmental stewardship is another cornerstone, calling for practices that protect and enhance the natural resources of land.
  Examples include implementing conservation agriculture, which minimizes soil disturbance, maintains permanent soil cover, and promotes crop rotation, thereby enhances biodiversity and reducing soil erosion.
- **Social Justice:** Ensuring fair land management systems is essential for the stability and prosperity of communities.
  This involves protecting the land rights of indigenous peoples and local communities, as demonstrated by community land management programs that empower locals to make decisions to do with land use and conservation.

- **Third - Policy and legislative frameworks:**
  Effective policy and legislative frameworks are critical to enforcing sustainable land management. This includes laws regulating land use, protecting natural habitats, and encouraging responsible land investment.
  The success of such legislation can be seen in countries that have implemented strict zoning laws to prevent overdevelopment and preserve green spaces.
  By integrating these perspectives, sustainable land management can transform the way land is viewed and used, ensuring that it serves not only the needs of the present but also the aspirations of future generations.
  The examples presented illustrate the practical application of these principles and demonstrate the tangible benefits that can be achieved through concerted efforts to manage land sustainably.
  The role of policy frameworks and regulatory mechanisms must be emphasized. These structures serve as the backbone for ensuring that land use and management are aligned with broader economic, environmental, and social objectives.

  They provide the necessary controls and balances to prevent the exploitation and degradation of land resources while facilitating equitable access and benefit-sharing.
  The most important of these frameworks are:

Policy Frameworks and Regulatory Considerations



- **1.Inclusive Policy Development:**
  Policy formulation must involve a wide range of stakeholders, including indigenous communities, local farmers, private sector entities, and civil society organizations.
  For example, the Community Land Trust model demonstrates how an inclusive policymaking process can empower local communities to manage land sustainably.

- **2.Regulatory flexibility and adaptability:**
  Systems must be dynamic to adapt to changing conditions.
  Urban zoning laws often require revision to accommodate new sustainable development practices such as green buildings and urban agriculture.

- **3.Implementation and Compliance:**
  Effective implementation mechanisms are critical.
  Agricultural policy can also provide a good example of how to ensure compliance through cross-compliance mechanisms, which link subsidies to adherence to environmental standards, as is the case in the European Union.

- **4.Economic instruments:**
  Fiscal policies and economic instruments such as taxes, subsidies, and grants play a pivotal role.
  Payment for ecosystem services schemes motivate landowners to conserve land in ways that provide environmental benefits.

- **5.Transparency and Accountability:**
  Ensuring transparent decision-making processes and accountability of officials is essential to maintaining public trust.
  The Extractive Industries Transparency Initiative (EITI) sets a global standard for transparency in the oil, gas, and mining sectors.

- **6.International cooperation and standards:**
  Land management often transcends national borders, requiring international cooperation.
  The Voluntary Guidelines on the Responsible Governance of Tenure, endorsed by FAO, are a testament to the importance of international frameworks in guiding national policies.

It has thus become clear that strong policy frameworks and regulatory considerations are not merely secondary components but essential ones in setting sustainable land management solutions. They shape land use patterns and have the potential to stimulate or hinder progress toward sustainability goals.

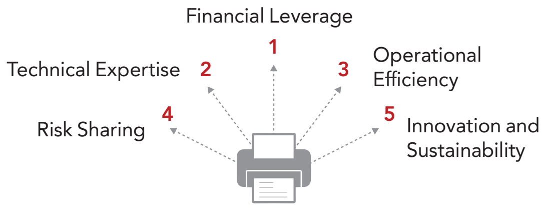
Fourth - The role of partnerships between the public and private sectors:

Innovative business models are developed to support sustainable land management. These models often involve public-private sector partnerships, where government agencies collaborate with private sector entities to finance and manage sustainable land management projects. One example is the creation of green bonds, which investment instruments specifically designed to support environmental projects, including sustainable land management.

Public-private partnerships are contractual arrangements between one or more government entities and a private sector company on specific projects, whereby the private partner directly supplies the government with assets and services traditionally provided by the public sector. Thus, the private sector has a greater role in planning, financing, designing, building, operating, and maintaining public services.

In the pursuit of sustainable land management solutions, collaboration between public entities and private sector participants is pivotal. This collaboration benefits from the strengths of both sectors, such as the public sector's mission to protect the public interest and the private sector's ability to innovate. The convergence of these two fields facilitates the creation of robust business models that address the complexities of land management **by:**

The Role of Public-Private Partnerships:



1.Financial Leverage:

Private investment can increase the financial resources available for land administration projects. For example, the government may partner with a private company to finance the development of a land registration system, with the private company contributing capital in exchange for a share of the system's future revenues.

2.Technical expertise:

Private-sector partners often bring advanced technique and expertise to the table. One example is the use of blockchain techniques by a group of technique companies to enhance the transparency and security of land transactions.

3.Operational Efficiency:

Private sector operational practices can streamline land administration processes, reduce costs, and improve service delivery. An example of this is the joint project to digitize land records, where a private company's expertise in data management accelerates the digitization process.

4. Risk Sharing:

Public-private partnerships allow for sharing risks associated with land management initiatives. This is evident in agreements whereby the private entity assumes responsibility for the environmental risks of infrastructure development on restored land.

5.Innovation and Sustainability:

Collaborations can lead to innovative solutions that make land management systems more sustainable. For example, a partnership that develops urban green spaces not only enhances land value but also contributes to environmental sustainability.

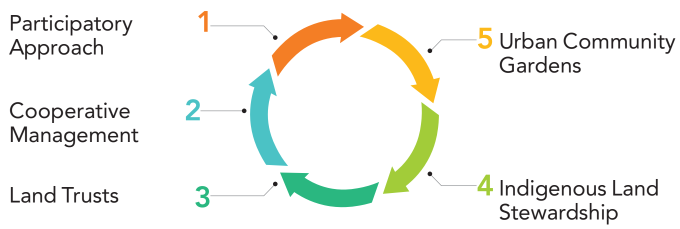
Through these multifaceted roles, these partnerships play an instrumental role in advancing land management toward more sustainable and equitable horizons.

The interplay between public oversight and private sector dynamism also creates fertile ground for innovative solutions that can transform the land management landscape.

- **Fifth - The role of local communities in sustainable land management:**

In the pursuit of sustainable land management, the role of local communities cannot be overstated. These grassroots entities possess a deep understanding of their lands, which is crucial for developing effective and culturally sensitive management models.
By leveraging traditional knowledge and fostering community participation, these models aim to achieve ecological balance and equitable resource distribution **through:**

Community-Based Models for Land Stewardship



- **1.Adopting a participatory approach:**
This model thrives on the active participation of community members in decision-making processes. For example, Community Forest Management (CFM) in Nepal is a prime example where local users form groups to manage forest resources, leading to improved forest conditions and livelihoods.

- **2.Cooperative land management:**
Here, land is collectively managed by a group of individuals who share the benefits.
The Mujeres Unidas cooperative in Honduras embodies this, with women collectively owning and cultivating land, enhancing food security and empowering female farmers.

- **3.Land Trusts:**
These are non-profit organizations that aim to conserve land for the public good, by working with local farmers to preserve landscapes and biodiversity.

- **4. Indigenous Land Management:**
Indigenous communities have practiced sustainable land management for centuries.
Local people enjoy legal autonomy over their lands, allowing them to manage their resources sustainably while preserving their cultural heritage.

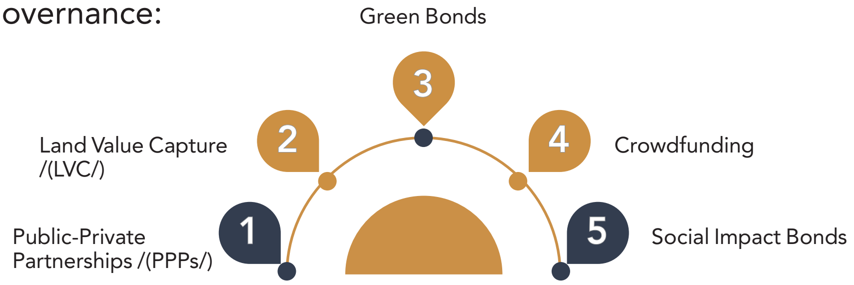
- **5.Urban Community Gardens:**
These initiatives transform urban spaces into green areas managed and cared for by local residents. Berlin's Prinzessinnengarten not only provides space for urban agriculture but also serves as a community hub for education and social interaction.

Through these diverse models, communities are empowered to take ownership of their lands, ensuring their health and productivity for future generations.
Each model offers a unique set of benefits that address the specific needs and dynamics of the community it serves, demonstrating the diversity and potential of community-based management in achieving sustainable land management.

- **Sixth - Innovative financing in sustainable land management:**

In the pursuit of sustainable development, the financial mechanisms underlying land management play a pivotal role. These mechanisms are not merely tools for allocating resources but are also instrumental in shaping the social and economic landscape. They influence how land is used, who benefits from it, and how its value is maximized for the public good. This can be achieved through the **following steps:**

Innovative Financing in Land Governance:



- **1.Public-Private Partnerships:**

The primary approach involves public-private partnerships, where the organizational prowess of the public sector converges with the efficiency of the private sector. For example, in developing industrial parks, the government may provide land and infrastructure, while private entities finance construction and management, creating a symbiotic relationship that fosters economic growth.

- **2.Land Value Capture:**

Land value capture strategies ensure that the increase in land value resulting from public investments and policy decisions is shared with the community.
An example of this is the use of tax increment financing, where increases in future tax revenues resulting from the development of an area are used to finance the initial costs of that development.

- **3.Green bonds:**

These are instruments designed to finance projects with environmental benefits, including sustainable land use.
A city may issue green bonds to investors to finance the restoration of abandoned urban areas and their conversion into green spaces, with returns tied to the environmental success of the project.

- **4. Crowdfunding:**

This grassroots approach harnesses the collective power of individuals to finance land-related projects.
A community may crowdfund to purchase a plot of land to protect it from deforestation, demonstrating a direct democratic tool for land conservation.

- **5.Social Impact Bonds:**

These bonds are a form of results-based financing where the government only repays investors if the project achieves the intended social outcomes.
For example, bonds may be issued to finance a land rehabilitation program, with repayment contingent on the program's success in improving land productivity.

Through these innovative financing models, land management can transcend traditional boundaries, align economic incentives with sustainable practices, and ensure the benefits of land use are distributed equitably. The success of these models depends on strong legal frameworks, transparent governance, and the active participation of all stakeholders.

- **Seventh - Technique-driven solutions in sustainable land management for land management:**
The advent of technique has ushered in an era of unprecedented efficiency and accuracy. The combination of innovative software and powerful data analytics has resulted in a suite of solutions that not only streamline land management processes but also enhance decision-making capabilities. Grounded in the principles of sustainability, these solutions offer a multifaceted approach to land resource management, ensuring their effective use for the benefit of current and future generations. The most important of **these solutions include:**

Technology-Driven Solutions for Land Management:

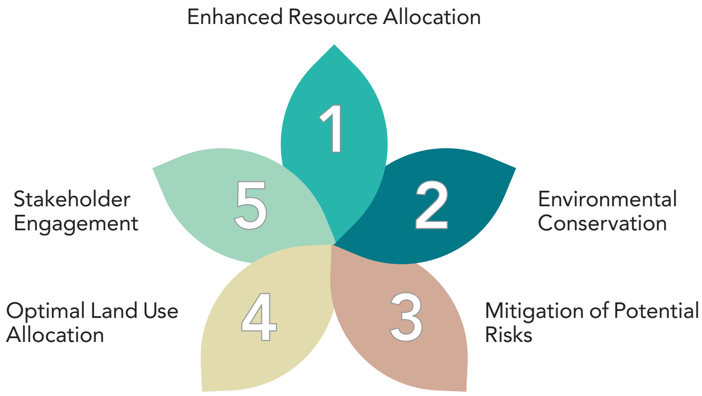
- **1.Precision Agriculture:**
Using satellite imagery and IoT sensors, farmers can now practice precision agriculture, allowing for precise monitoring and management of crop health at the micro-level.
For example, drones equipped with multispectral cameras can identify areas that require more irrigation or fertilization, leading to more efficient use of resources.
- **2.Land Registration and Titling:**
Blockchain technique is revolutionizing land registration and titling, providing a secure and transparent system for registering land ownership. In Sweden, Lantmäteriet (the Swedish Mapping, Cadastre, and Land Registry Authority) is piloting a project that uses blockchain technique to process land transactions, significantly reducing the risk of fraud and speeding up the registration process.
- **3.Urban Planning Tools:**
Advanced geographic information systems (GIS) are useful in urban planning. They enable planners to visualize and analyze urban growth patterns, infrastructure needs, and environmental impacts. An example is the Virtual Singapore Project, a dynamic 3D city model and collaborative data platform, encompassing the geography, buildings, infrastructure, and landscape of Singapore.
- **4. Sustainable Land Use Monitoring:**
Remote sensing techniques are essential for monitoring land use changes and ensuring sustainable practices. Global Forest Watch, an online platform, uses satellite techniques and open data to monitor deforestation in near real time, enabling governments and stakeholders to take timely action.
- **5.Community Engagement Platforms:**
Digital platforms facilitate community participation in land management decisions. In Nairobi, Kenya, the Kibera Mapping Project is empowering residents of Kibera, one of the world's largest slums, by mapping previously unmapped areas and providing residents with the tools to express their concerns and needs.

By harnessing these technological advances, land management stakeholders are better equipped to manage land resources sustainably and ensure they contribute positively to economic development, environmental conservation, and social justice. These examples demonstrate the transformative impact that technique-driven solutions can have on land management, paving the way for a more sustainable and equitable future.

- **Eighth - How to improve land use and avoid potential problems:**

Land suitability planning plays a critical role in ensuring efficient land use and mitigating potential problems.By accurately assessing land suitability for various purposes, individuals and organizations can make informed decisions that align with their needs and goals.
However, this process is not free of challenges.

How to Improve Land Use and Avoid Potential Problems:



- **1.Enhanced resource allocation:**

Land suitability planning allows for the optimal allocation of resources based on the specific requirements of different land uses.
For example, agricultural land can be allocated for agricultural activities, while residential areas can be planned to accommodate housing needs. This targeted approach ensures the efficient use of resources such as water, energy, and infrastructure.

- **2.Environmental Conservation:**

Land suitability assessment helps conserve natural resources and protect the environment. By identifying environmentally sensitive areas, land planners can implement measures to protect biodiversity, prevent soil erosion, and maintain water quality.
This approach promotes sustainable development and ensures the long-term survival of ecosystems.

- **3.Mitigation of Potential Risks:**

Land suitability planning enables the identification and mitigation of potential risks associated with land use.
For example, areas prone to flooding or landslides can be designated for recreational purposes rather than residential or commercial development.
By avoiding high-risk areas, the impact of natural disasters can be minimized, ensuring the safety of residents and reducing property damage.

- **4.Optimal Land Use Allocation:**

Through land suitability planning, land can be allocated based on its inherent characteristics and suitability for specific purposes.
This approach maximizes the potential of each plot of land, leading to efficient land use patterns.
For example, areas with fertile soil and favorable climatic conditions can be allocated for agricultural activities, while areas with good connectivity can be used for commercial purposes.

- **5.Stakeholder Engagement:**

Land suitability planning involves engaging various stakeholders, including local communities, government agencies, and environmental organizations.
This collaborative approach ensures that the diverse needs and perspectives of different groups are considered, leading to more inclusive and sustainable land use decisions.

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Chapter 6:

Success Stories and Lessons Learned in Sustainable Land Management

- **First - Success stories and lessons learned:**

In land management, the adoption of innovative business models has been pivotal in advancing sustainable solutions.

These models have proven effective not only in addressing the complexities of land rights and use, but also in ensuring economic viability and environmental stewardship.

The following narratives explore the multifaceted experiences of various stakeholders and highlight the transformative impact of these models.

Success Stories and Lessons Learned:

- **1.Community engagement in land restoration:**

Success Story: In semi-arid areas of Kenya, a community-based approach to land restoration has revived native plants and animals. By engaging local communities in decision-making, the initiative saw a 70% increase in agricultural productivity.

Lesson learned: The main idea was the importance of aligning economic incentives with conservation goals to motivate community participation.

- **2.Technique-driven land registration:**

Success Story: Rwanda's implementation of a blockchain-based land registration system has streamlined property transactions, reduced disputes, and increased transparency.

Lessons learned: This case highlighted the potential of techniques to enhance trust in land management systems, although it also highlighted the need for strong legal frameworks to support technological solutions.

- **3.Public-private partnerships for urban development:**

Success Story: In Singapore, partnerships between the government and private developers have transformed unused state land into thriving mixed-use areas, balancing commercial success with public benefit.

Lessons learned: Success hinges on clear communication and well-defined roles and responsibilities, ensuring that both public and private entities benefit from the collaboration.

These examples illustrate the profound impact that well-structured business models can have on land management. They are beacons guiding future initiatives toward sustainable practices that respect the complex balance between human activity and the natural environment. From these case studies, the enduring lesson becomes clear:

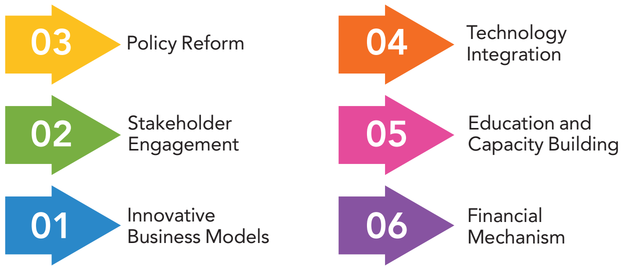
When governance is approached holistically, with an emphasis on inclusivity and innovation, land delivers the greatest value for all.

- **Second - Scaling up sustainable practices:**

In the pursuit of sustainable land management, scaling up scalable practices is critical. This requires a multifaceted approach that not only addresses immediate land management needs but also anticipates future challenges and opportunities. Integrating innovative business models, engaging stakeholders, and reforming policies are critical components of this endeavor. By fostering a collaborative environment, stakeholders can collaborate to find economically viable and environmentally sound solutions.

Key among these are the **following**:

Scaling Sustainable Practices:



- **1.Innovative business models:**

transform waste into wealth, creating closed-loop systems that reduce environmental impact.

For example: an agroforestry company might implement a model where crop waste is converted into biochar, enhancing soil fertility and carbon sequestration.

- **2.Stakeholder engagement:**

Ensuring local communities participate in decision-making processes leads to more resilient and inclusive outcomes.

An example of this: is participatory land resource mapping, which enables indigenous communities to sustainably manage their ancestral lands.

- **3.Policy reform:**

Aligning national policies with sustainable land management practices can bring about systemic change.

Providing tax incentives to companies that adopt green practices can spur a shift toward sustainability.

- **4.Technique Integration:**

Leveraging techniques in precision agriculture can improve resource utilization and reduce the environmental footprint.

For example:drones can be used to monitor crop health and apply inputs with pinpoint precision, reducing waste and increasing yields.

- **5.Education and Capacity Building:**

Training programs focused on sustainable land management can provide stakeholders with the necessary skills and knowledge.

An agricultural cooperative may offer workshops on organic farming techniques, promoting sustainable practices among its membersl.

○ 6.Financial Mechanisms:

Innovative financing, such as green bonds, can provide the capital needed for large-scale sustainable land management projects.
A municipality might issue a green bond to finance the restoration of degraded lands, create jobs, and improve ecosystem services.

Bringing these threads together, **a fabric of sustainable land management** emerges, a fabric robust **enough to withstand the pressures of a growing population and the uncertainties associated with climate change**.
The path forward is clear: by scaling up sustainable practices, **we can ensure the health and productivity of our lands for future generations.**

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