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# SECTOR ENVIRONMENTAL GUIDELINE: DRYLAND AGRICULTURE

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## LIST OF ACRONYMS

| | |
|---|---|
| 4Rs | Right Source, Right Rate, Right Time, and Right Place |
| AI | Aridity Index |
| AIDS | Acquired Immunodeficiency Syndrome |
| AOR | Agreement Officer's Representative |
| BEO | Bureau Environmental Officer |
| CA | Conservation Agriculture |
| CO | Carbon Monoxide |
| $CO_2$ | Carbon Dioxide |
| COR | Contracting Officer's Representative |
| CSA | Climate-Smart Agriculture |
| CTCN | Climate Technology Centre and Network |
| EA | Environmental Assessment |
| ECOS | Environmental Compliance Support |
| EIA | Environmental Impact Assessment |
| ESDM | Environmentally Sound Design and Management |
| FAO | Food and Agriculture Organization of the United Nations |
| GBV | Gender-Based Violence |
| GDP | Gross Domestic Product |
| GHG | Greenhouse Gas |
| HIV | Human Immunodeficiency Virus |
| ICOMOS | International Council on Monuments and Sites |
| IFC | International Finance Corporation |
| ILO | International Labor Organization |
| IPCC | Intergovernmental Panel on Climate Change |
| IPM | Integrated Pest Management |
| IUCN | International Union for Conservation of Nature |
| LOP | Life of Project |
| LSMS | Living Standards Measurement Study |
| K | Potassium |
| MEO | Mission Environmental Officer |
| N | Nitrogen |
| $N_2O$ | Nitrous Oxide |
| NRCS | Natural Resources Conservation Service |
| P | Phosphorus |
| PET | Potential Evapotranspiration |

| | |
|---|---|
| PM | Particulate Matter |
| PPE | Personal Protective Equipment |
| REA | Regional Environmental Advisor |
| RWH | Rainwater Harvesting |
| SEG | Sector Environmental Guideline |
| SEP | Stakeholder Engagement Plan |
| SLM | Sustainable Land Management |
| $SO_2$ | Sulfur Dioxide |
| UN REDD | United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries |
| UNCCD | United Nations Convention to Combat Desertification |
| UNDP | United Nations Development Programme |
| UNECE | United Nations Economic Commission for Europe |
| UNESCO | United Nations Educational, Scientific, and Cultural Organization |
| USAID | United States Agency for International Development |
| USDA | United States Department of Agriculture |
| WASH | Water, Sanitation, and Hygiene |
| WHO | World Health Organization |

# ABOUT THIS DOCUMENT AND THE *SECTOR ENVIRONMENTAL GUIDELINES*

**This document presents one sector of the Sector Environmental Guidelines** (SEGs) prepared for the United States Agency for International Development (USAID) under the Agency's Environmental Compliance Support (ECOS) contract. SEGs for all sectors are accessible at https://www.usaid.gov/environmental-procedures/sectoral-environmental-social-best-practices/sector-environmental-guidelines-resources.

**Purpose.** The purpose of this document and the *Sector Environmental Guidelines* overall is to support environmentally sound design and management (ESDM) of USAID development activities by providing concise, plain-language information regarding the following:

- The potential for beneficial impacts from well-managed dryland agricultural systems
- The typical adverse environmental impacts of activities in the sector
- How to prevent or otherwise mitigate adverse impacts, both in the form of general activity design guidance and specific design, construction, and operating measures
- How to minimize the vulnerability of activities to climate change
- More detailed resources for further exploration of these issues

**Audience.** This SEG is intended mainly for USAID Agreement and Contracting Officers' Representatives (A/CORs); USAID Mission, Regional, and Bureau Environmental Officers and Advisors; Agricultural Officers; and Implementing Partner staff engaged in the implementation of dryland agricultural programs, activities, and actions. However, this SEG, like the entire SEG series, is not specific to USAID's environmental procedures. SEGs are written generally and are intended to support ESDM of dryland agriculture by all actors.

**Environmental Compliance Applications.** USAID's mandatory life-of-project (LOP) environmental compliance procedures require that the potential adverse impacts of USAID-funded and managed activities be assessed prior to implementation via the Environmental Impact Assessment (EIA) process defined by 22 Code of Federal Regulations (CFR) 216 (Regulation 216).

They also require that the environmental management/mitigation measures ("conditions") identified by this process be written into award documents, implemented over the LOP, and monitored for compliance and sufficiency.

The procedures are USAID's principal mechanism to ensure ESDM of USAID-funded and managed activities and thus protect environmental resources, ecosystems, and the health and livelihoods of beneficiaries and other groups. They strengthen development outcomes and help safeguard the environment.

The *Sector Environmental Guidelines* directly support environmental compliance by providing information that is essential to assessing the potential impacts of activities and identifying and designing appropriate mitigation and monitoring measures.

*However, the* Sector Environmental Guidelines ***are not*** *specific to USAID's environmental procedures. They are generally written and are intended to support ESDM of these activities by all actors, regardless of the specific environmental requirements, regulations, or processes that apply, if any.*

**Guidelines Superseded.** This updated *Dryland Agriculture Sector Environmental Guideline* replaces the previous *Dryland Agriculture Sector Environmental Guideline* (prior to 2003 and 2014).

**Development Process and Limitations.** This updated document substantially restructures the guideline to align with other documents in the SEG series. In developing this document, content in predecessor guidelines has been retained when applicable. In addition, the consideration of social and economic impacts of sector activities, occupational and community health impacts from the sector, and a more substantial assessment of climate change adaptation and mitigation considerations for the sector have been included. Furthermore, statistics have been updated, references verified, and new references added.

Note that the *Sector Environmental Guidelines* are not a substitute for detailed sources of technical information or design manuals. Users are expected to refer to the accompanying list of references for additional information.

**Comments and Corrections.** Sectors are constantly evolving and, therefore, these guidelines are a reflection of the sector at the time of development. Comments, corrections, and suggested additions are welcome. Provide feedback via email at environmentalcompliancesupport@usaid.gov.

**Document Structure**

The SEG introduces practices and information that can be used to address management of environmental and social impacts from dryland agricultural activities. The impacts and mitigation measures described in the *Dryland Agriculture Sector Environmental Guideline* are intended to be used as a reference when completing 22 CFR 216 requirements. Specifically, the impacts described can be used as references when completing USAID's EIA process, described in Figure 1, or the Initial Environmental Examination for USAID Dryland Agricultural Activities. After the impacts have been assessed through the EIA process, the mitigation measures described for each impact in the SEG can be used as a resource for developing Environmental Mitigation and Monitoring Plans for USAID Dryland Agricultural Activities.

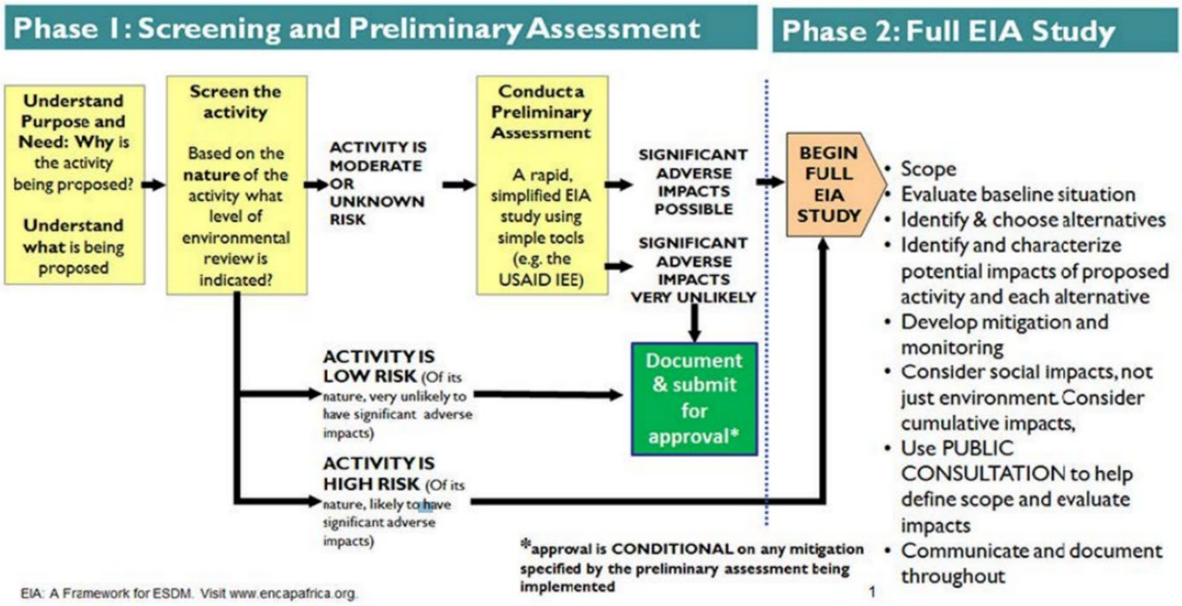


**Figure 1. EIA process (USAID 2019b)**

The structure of the document is as follows:

**Chapter One: How to Use the Document** provides a brief introduction to the purpose of the document and the topics to be covered.

**Chapter Two: Sector Description** briefly describes the different dryland agricultural sectors.

**Chapter Three: Environmental Impacts** summarizes the environmental impacts and mitigation measures that are associated with dryland agriculture.

**Chapter Four: Climate Change Mitigation and Adaptation** describes the potential impacts of dryland agriculture on climate change and the impacts that climate change has on dryland agriculture, along with adaptation and mitigation practices.

**Chapter Five: Human Health Impacts** associated with dryland agriculture are discussed.

**Chapter Six: Social Considerations** that should be evaluated when conducting dryland agricultural practices are explained.

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# 1. HOW TO USE THIS DOCUMENT

Drylands are ecosystems, such as rangelands, grasslands, and woodlands, which cover more than 40% of global land area and are characterized by extremely limited water availability and high temperature fluctuations (FAO 2020). Subsistence food production is a predominant livelihood activity in drylands. Almost half of the world's agricultural production is in drylands (European Commission 2019). Investments in sustainable drylands management and agricultural market systems support the following three Global Food Security Strategy goals, as described in Feed the Future (2022):

1. Inclusive and sustainable agriculture-led economic growth
2. Strengthened resilience among people and systems
3. A well-nourished population, especially women and children

Dryland ecosystems are particularly vulnerable to impacts from climate change and agricultural practices. As such, the combination of current unsustainable agricultural practices, such as conventional tillage, irrigation and overgrazing, and climate change impacts are resulting in competition for resources, low productivity, low income, high rates of poverty, and increased food insecurity in dryland areas (FAO 2020). Given these pressures, the effective management of drylands is especially critical and can result in sustained productivity, increased profits, and improved food security while reversing and preventing water stress, soil erosion, and desertification. This document expands on the guidance provided by the Livestock and Crop Production Sector Environmental Guidelines to present the unique risks and opportunities present when engaging in agricultural activities in dryland environments.

## 1.1. THE GOALS AND OBJECTIVES OF THE DOCUMENT

The goals of the Dryland Agriculture Sector Environmental Guideline, a part of the USAID Sector Environmental Guidelines (SEGs) series, are to provide information that is essential to assessing the potential impacts of dryland agricultural activities and identify appropriate mitigation and monitoring measures. However, this SEG is not specific only to USAID's environmental procedures. It is written to support broad environmentally and socially sustainable approaches to the dryland agriculture sector. Site-specific context should be taken into consideration when using the Dryland Agriculture SEG. Additional or modified impacts and mitigation measures may be required.

This document presents considerations for developing economically, socially, and environmentally sustainable dryland agriculture. Each section describes considerations for the impacts of dryland agriculture and provides mitigation measures to avoid, minimize, and reduce the adverse impacts of dryland agriculture. Adherence to the mitigation measures described herein will enhance the sustainability of dryland agricultural activities. Concurrent analysis of all impacts discussed in subsequent sections of this document while designing activities will lead to more sustainable outcomes.

The SEG can assist USAID stakeholders in developing compliance documentation, project development questions, and environmental impact assessments.

## 1.2. ACTIVITY DESIGN GUIDANCE FOR SUSTAINABLE CROPLAND SYSTEMS

### BOX 1. CLIMATE-SMART AGRICULTURE

Climate-smart agriculture (CSA) is an approach that encourages the use of greenhouse gas (GHG)-friendly crop production practices. CSA has three main objectives:

1. Sustainably increasing agricultural productivity and incomes.
2. Adapting and building resilience to climate change.
3. Reducing and/or removing GHG emissions.

Generally speaking, CSA practices have multiple beneficial environmental impacts, which can include soil and water conservation and reduced agricultural input needs. Determining whether to adopt a specific CSA is site specific and depends on local environmental, socioeconomic, and climate change factors. Examples of CSA crop production practices include the following:

- Reduced or no tillage
- Conservation cover/cover crops
- Sustainable crop rotations
- Nutrient management
- Field borders/filter strips/riparian buffers
- Agroforestry

See Global Food Security Strategy Activity Design Guidance for Climate-Smart Agriculture and Food Systems for more information at https://pdf.usaid.gov/pdf_docs/PA00ZX7D.pdf.

The activity design guidance sections for dryland agriculture that are included at the beginning of each chapter are intended to supplement the Livestock and Crop Production SEGs by providing important overarching factors for consideration in designing dryland agricultural activities. The factors should be assessed with respect to the objectives and context of the activity prior to decision-making during the activity design process.

For example, the choice of crop should be selected by considering which crops are appropriately adapted to the local environment, their potential beneficial and adverse impacts in the local community, and the feasibility of implementing best practices in the community of interest. Additionally, activity design should integrate climate-smart agriculture (CSA) practices where possible (see Box 1). Considerations that are specific to climate change, the environment, human health, and social impacts are included in their respective chapters throughout the document and should be referenced throughout the activity design process.

Project design should include local stakeholders as appropriate to ensure locally led development and site-pertinent sustainable implementation. Sustainable development depends on local actors leading efforts to improve their communities and working inclusively and collectively to see those efforts through. Ultimately, the capacity of local actors is a key determinant of the success of USAID and its partners in achieving and sustaining humanitarian and development gains around the world (USAID 2022a).

In addition to the activity design guidance provided in each chapter, the Global Food Security Strategy Technical Guidance provides information on essential key concepts and best practices for activity design (Feed the Future 2022). These guidelines may be accessed at Guidance and Tools for Global Food Security Programs Fiscal Years 2022–2026.

## 1.3. INDICATORS FOR MEASURING IMPACTS

Choosing metrics for measuring environmental impacts is important for adaptive management—that is, to assess the effectiveness or impacts during the life of the project and make changes to ensure that programmatic and environmental goals are achieved.

Similar to the Crop Production and Livestock SEGs, discussions of indicators for measuring impacts are also included throughout the chapters of this SEG. Existing resources and conditions should be assessed prior to project implementation to establish a baseline and select relevant indicators to monitor throughout the project life cycle.

For determining the appropriate metric or assessment framework for measuring environmental impacts, the following should be considered. Note that environmental impacts are multidimensional in nature, and a holistic approach to measuring and addressing all environmental impacts should be prioritized in USAID activities:

- Determine the resources (i.e., time and funding) available to develop an evaluation program.
- Determine the length of time that the evaluation program should be implemented in relation to the proposed project.
- Determine the focal environmental resource concern(s) to be measured (e.g., water usage, water quality, crop yield, soil fertility, topsoil loss).
- Develop a framework for measuring the impact on the resource:
    - What will be measured?
    - What is the spatial scale of the assessment?
    - Who will conduct the assessment?
    - How will the assessment be prepared?
- Determine how the outcome of the assessment will be used during project implementation.

# 2. SECTOR DESCRIPTION

Drylands are ecosystems where at least 150% more water is lost from evaporation than is gained from precipitation, making them some of the driest places on earth (IUCN 2017a). Located around the world and covering approximately 41% of global land area, (6.1 billion hectares), the largest drylands are located in Africa and Asia (FAO 2019).

Despite their low moisture content, drylands contain 35% of the world's biodiversity hot spots; are key regulators of global water, carbon, and nitrogen cycles; and are also home to approximately 2 billion people, 90% of whom live in developing countries (FAO 2019). See Figure 2 for more details.

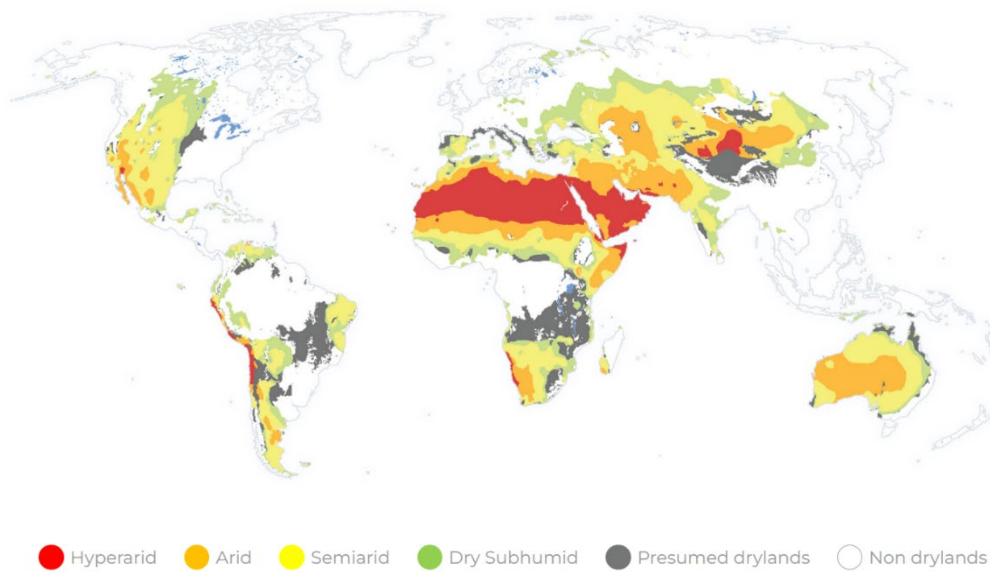


**Figure 2. Global Distribution of Drylands (FAO 2019)**

Drylands can be divided into subcategories based on both their aridity index (AI),[1] which indicates how dry they are, and their land use category. From wettest to driest, AI categories include the following:

- Dry subhumid: AI 0.5 < 0.65 (9.9% of land area)
- Semi-arid: AI 0.2–0.5 (17.7% of land area)
- Arid: AI 0.05–0.2 (12.1% of land area)
- Hyper-arid: AI < 0.05 (7.5% of land area)

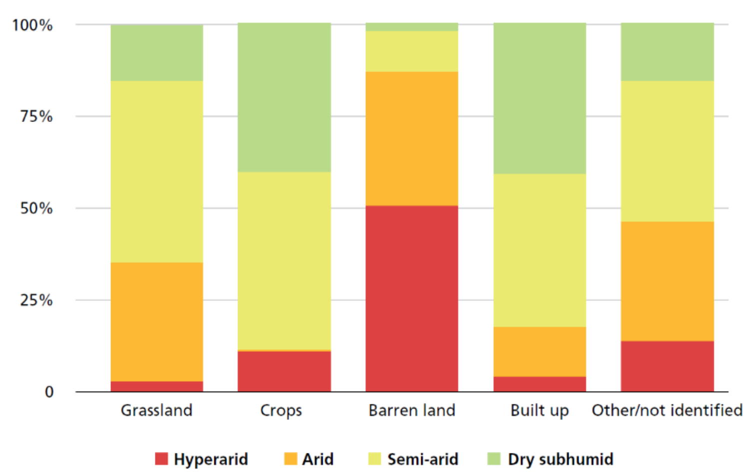


**Figure 3. Distribution of Non-Forested Lands in Drylands (FAO 2019)**

[1] Aridity index = Precipitation/Potential evapotranspiration (PET).

Generally, the lower the moisture content (e.g., hyper-arid and arid lands), the higher the percentage of desert and barren lands. For example, the Sahara and Arabian deserts combined account for more than half of global hyper-arid areas. In contrast, dry subhumid and semi-arid areas account for 93 percent of dryland forests and 90% of cropland, respectively (FAO 2019).

Grasslands used for livestock are distributed among dry-subhumid, semi-arid, and arid areas, as shown in Figure 3 (FAO 2019).

## 2.1. CHARACTERISTICS OF DRYLAND AGRICULTURE

Agriculture in drylands supports approximately 44% of global croplands and 50% of global livestock populations (UNCCD 2018). Traditionally, agricultural practices adopted in drylands are suited to their environmental conditions. The following are some key characteristics of drylands and dryland agricultural practices.

- **Variable weather:** Drylands are prone to extreme weather, including natural fires, dramatic changes in temperature, strong winds, flooding, and drought. While water management is a challenge in all drylands, limited water access is one of the greatest constraints for productive crops in developing countries (Singh, et al. 2015). Precipitation in drylands is highly variable year-to-year and unevenly distributed, making agricultural production difficult to plan.

  As the climate of drylands continues to become drier over time, rainfall patterns become more uncertain with higher variability, which makes planning efforts more difficult (UNCCD 2018).

- **Low-quality soils:** Dryland soils are generally shallow, salty, and have high evaporation rates. Lack of moisture, limited vegetation, and limited soil microbes and organisms result in dryland soils having slow organic matter accumulation rates, as well as slow decomposition rates. Given the sparse vegetation cover (and thus low root density), dryland soils are also particularly susceptible to erosion and degradation, including in response to human activities such as tillage and grazing. Despite these characteristics, dryland soils store approximately one third of the global soil organic carbon supply (IUCN 2019).

- **Highly specialized flora and fauna:** Native dryland species have evolved four main strategies to adapt to harsh dryland conditions: (1) escape (e.g., through migration), (2) evade (e.g., deep rooting plants), (3) resist (e.g., cacti that store water), and (4) endure (e.g., frogs that go dormant during drought conditions) (UNCCD 2017).

  Natural vegetation varies across drylands, including ecosystems such as barren plains, grasslands, shrublands, savannahs, and dry woodlands. Plants that evolved in drylands are typically able to survive high temperatures and high levels of solar radiation, periods of drought, and irregular rainfall, which are common characteristics of drylands. They are adapted to arid soils and display high water use efficiency.

  Drylands contain unique microbial ecosystems called "biocrusts," where various combinations of cyanobacteria, fungi, lichens, and mosses are the dominant ground cover that occur on or within millimeters of the soil surface (UNCCD 2018). Biocrusts are estimated to cover approximately 30% of global dryland surface areas and are thought to protect soil while also mediating water, nutrients, and gas cycles (Chen, et al. 2020).

Drylands contain a wide range of animals, including insects, amphibians, birds, reptiles, and mammals, all of which are adapted to dryland conditions. Many dryland animals, including large mammals, "escape" hostile conditions by migrating to other areas; thus, typical dryland fauna include many migratory species (IUCN 2012). Dryland animals also play important roles in ecosystems (UNCCD 2018). For example, termites play a vital role in recycling biomass in savannas and mammals provide multiple services, such as nutrient recycling through manure production, population control as predators, and as seed dispersers (Lacher, et al. 2019).

Traditionally, nomadic pastoralists in dry areas have farmed livestock that is well adapted to drought conditions, have high resilience to local vector-borne diseases, and are able to gain nourishment from local arid-adapted pastures.

- **Cultures and livelihoods in drylands:** In a similar manner, traditional nomadic cultures have also followed migratory patterns to ensure access to sufficient resources for their livestock and other needs. For centuries, human societies in dryland environments have adapted to the challenges of climactic variability and water scarcity, including through pastoral nomadism, planting drought-resistant crops, or harvesting water or using selective irrigation (Hoffmann, et al. 2022, UNCCD 2018).

  Migrating with livestock herds allows individuals or groups to reduce the likelihood of over-extracting or degrading limited local resources while also tracking additional resources along different landscapes (Hoffmann, et al. 2022). For example, the Sukuma tribe in Tanzania identifies and sets aside areas in a system known as "*ngitili* for private or communal grazing or fodder reserves" to rely on during periods of drought (UNCCD 2018).

  Although human societies have adapted to dryland conditions, these lifestyles are still vulnerable to unpredictable changes. Sustainable management practices that have sustained these societies are declining due to the impacts from climate change, demographic changes, informal land tenure, limited resource rights, and increased competition for limited resources (UNCCD 2018, Tugjamba, Walkerden and Miller 2023).

## 2.2. DRYLANDS FRAGILITY

The unique, water-constrained ecosystems found in drylands make them particularly vulnerable to disturbances, including from climate change and human activities, such as land use conversion and agricultural practices (Solowey, et al. 2013).

Desertification refers to land degradation that specifically occurs in drylands. Ecosystems become progressively more desert-like as land becomes barren, soil health diminishes, water resources are stressed, and temperatures become hotter,

**BOX 2. The United Nations Convention to Combat Desertification (UNCCD)**

UNCCD is the only internationally, legally binding framework to address the current problems of desertification. The current UNCCD 2018–2030 Strategic Framework aims to achieve land degradation neutrality to restore the productivity of degraded lands and reduce drought impacts on vulnerable populations (UNCCD n.d.a).

resulting in a decreased ability of ecosystems to provide goods and services (FAO Soils Portal n.d.). Desertification is naturally occurring but may be accelerated by poor land management practices. Some areas are more prone to desertification than others (see Figure 4).

According to the UN Convention to Combat Desertification (UNCCD), 70% of global lands are already degraded or are considered threatened by desertification, affecting the livelihoods of approximately 1 billion people (UNCCD n.d.a). Desertification acts as both a cause and a consequence of poverty because vulnerable populations who rely on the land for livelihoods can overexploit their food, energy, housing, and income resources, which, in turn, negatively affects the drylands themselves (UNCCD n.d.a). Thus, farmers often must seek a living in more fertile landscapes or cities, which leads desertification to become the root of many socioeconomic and political problems (UNCCD n.d.a). See Box 2 for more information about the UNCCD.

Impacts that may advance desertification will be described in Chapter 3: Environmental Impacts and Chapter 4: Climate Change Mitigation and Adaptation of the SEG.

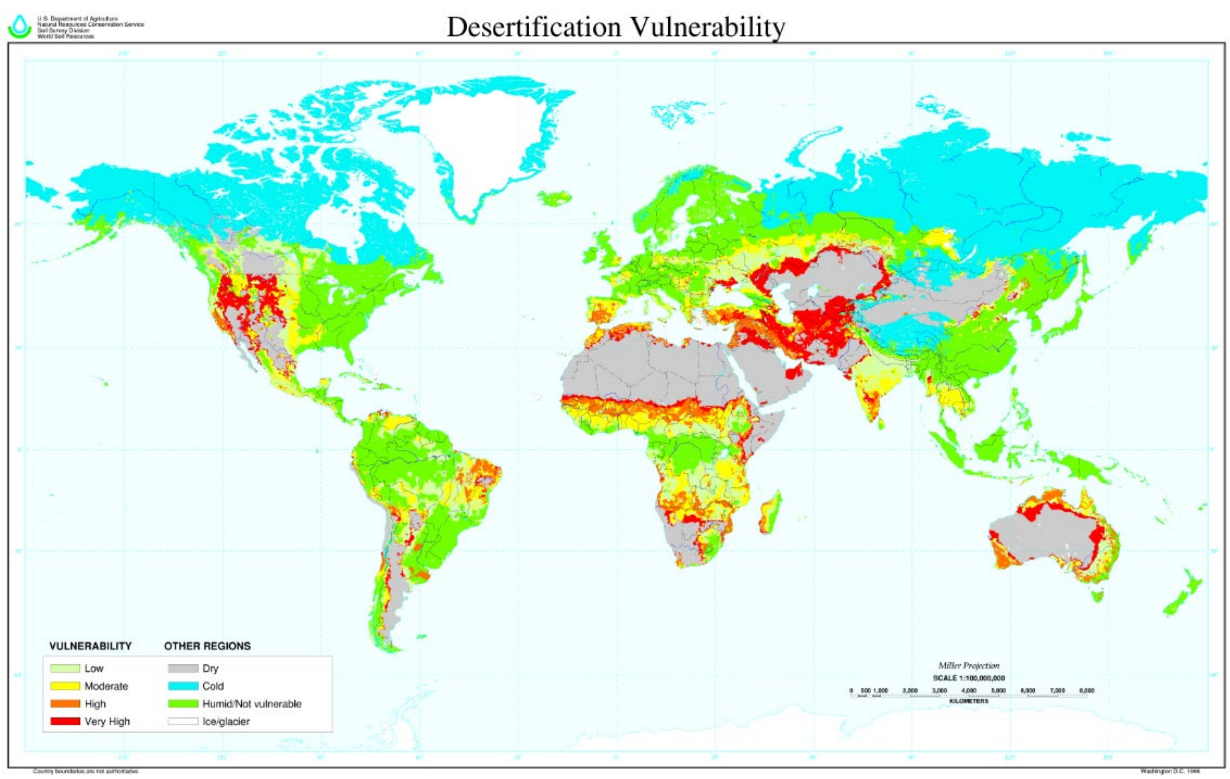


**Figure 4. Global Desertification Vulnerability (Tufts University 2020)**

## 3. ENVIRONMENTAL IMPACTS

Dryland ecosystems are characterized by their fragility and limited capacity to sustain life. In these arid regions, ecosystem resources are already under significant stress, making them less resilient to the environmental impacts resulting from agricultural activities. For example, the limited organic content and essential plant nutrients in dryland soils negatively affect both water use efficiency (thus further increasing the water needs of plants) and crop yields. When sufficient plant nutrients are not available, a negative feedback loop is established with higher water requirements and low yields, which can result in the conversion of additional acres to boost overall crop production. For this reason, successful crop and animal production in drylands requires careful seed and animal selection and using appropriate production methods.

Included in Box 3 are potential environmental considerations for dryland agricultural activity design, which should be evaluated at activity design inception to minimize environmental risks. Note that these considerations are not comprehensive and are intended to be supplementary to those in the Crop Production and Livestock SEGs. A holistic review of project context should be conducted to assess all potential environmental impacts.

**BOX 3. SAMPLE ENVIRONMENTAL CONSIDERATIONS FOR ACTIVITY DESIGN**

The specific local conditions must be considered regarding the following:

- Soils (and their susceptibility to degradation)
- Water quality and availability
- Topography and geohydrology (the slope of the land and geology with respect to catchments)
- Choice of crop/livestock and their suitability to the local climate
- Costs involved or the ease with which the project can be managed and sustained

Conversely, well-designed agricultural activities can increase environmental quality and boost ecosystem resilience. While the intent of this document is mitigating potential adverse impacts of agriculture, described below are some potential beneficial impacts of dryland agriculture.

- **Land restoration:** Through comprehensive soil and water management, agriculture has the potential to restore degraded land and improve the well-being of dryland ecosystems. By improving soil moisture retention, optimizing nutrient cycling, and increasing soil carbon content and fertility, agriculture can create a conducive environment for plant growth, effectively combating desertification. Strategically managed livestock, such as cattle and sheep, can boost marginal land productivity. Their hooves can break up compacted soil, promoting aeration and water infiltration, while their droppings return valuable nutrients, such as nitrogen and phosphorus, back to the land. Additionally, sustainable agricultural methods serve as a protective buffer against the impacts of extreme weather events, such as floods during heavy rainfall events and prolonged droughts. These practices, called sustainable land management (SLM) practices, are discussed in more detail in Section 3.6. See Box 4 for a case study about land restoration in drylands.

- **Habitat provision:** Biodiversity can benefit from moderate agricultural disturbance, creating new niches for a wider array of species. Diversified cropland practices and landscape management offer valuable habitats and food sources for wildlife, particularly when employing agroecological techniques, such as agroforestry, pollinator-friendly plantings, windbreaks, hedgerows, riparian buffers, and natural habitat patches (Kremen 2020). These approaches provide sanctuary and sustenance for various wildlife species, even more so when applied to degraded or abandoned lands, which can experience strengthened ecosystems through improved soil health and increased plant biomass production. In semi-arid, grassland ecosystems, livestock grazing is vital for preserving semi-natural habitats that support both livestock and wild species, offering essential ecosystem services (Steinfeld, et al. 2010). Furthermore, water sources established for livestock can enhance water availability for nearby wildlife, particularly during drought periods, as observed in the Chaco ecosystem of South America (Zavala 2022).

- **Preservation of locally adapted species:** Agriculture prioritizes the cultivation of locally adapted crop species, especially open-pollinated species and traditional landraces, and the preservation of indigenous livestock breeds plays a pivotal role in promoting genetic diversity within an ecosystem while simultaneously safeguarding these invaluable species. Landraces, shaped by generations of natural adaptation to local conditions, are particularly instrumental in preserving genetic diversity as they carry unique traits related to resilience, adaptability, and nutritional value. Similarly, locally adapted livestock breeds may be more resilient to variable weather and resource availability, delivering essential ecosystem services and ensuring the continued well-being of communities that are reliant on these animals for sustenance and livelihoods (Hall 2019).

**BOX 44. CASE STUDY: SAHEL GREAT GREEN WALL**

The Great Green Wall Initiative in the Sahel is an African-led initiative to restore degraded land and combat desertification in the Sahel region. The project aims to sequester 250 million tons of carbon and create 10 million jobs by 2030 through the restoration of 100 million hectares of degraded land across the African continent. The goal is to create a mosaic of green and productive landscapes across 11 countries that will benefit people and nature alike (UNCCD n.d.b).

Since inception in 2007, the Great Green Wall has planted 12 million drought-resistant trees in Senegal and rehabilitated 28 million hectares of degraded land across Nigeria, Ethiopia, Burkina Faso, and Niger (The Great Green Wall n.d.).

The remainder of this chapter describes potential adverse impacts from dryland agriculture and offers mitigation measures to address them. Additionally, Section 3.6 introduces SLM practices that have been proven to be especially effective in dryland agroecosystems. The adverse impacts highlighted in this chapter are summarized from the Crop Production and Livestock SEGs, with added details about the risks present in dryland environments. These impacts include the following:

- Reduced water availability and quality
- Land degradation
- Reduced air quality
- Habitat loss and reduced biodiversity

## 3.1. REDUCED WATER AVAILABILITY AND QUALITY

Agricultural production and the water cycle are intricately intertwined. While crops influence everything from evapotranspiration rates to soil moisture dynamics, water availability and quality is a main determinant of agricultural productivity, dictating what can be grown and the yields. This connection is particularly crucial in dryland areas, where water stress and unpredictable rainfall are common. In such environments, managing water effectively becomes vital not just for successful food production but also for maintaining the health of the entire ecosystem. Mechanisms in which dryland agriculture may reduce water availability and quality include the following:

- **Depletion of water supplies:** Agriculture, especially irrigated crop production and intensive livestock watering, can exert significant pressure on already scarce water resources in drylands. Water withdrawals from streams and groundwater for agriculture limits the availability of groundwater, making this practice unsustainable because it does not take into consideration other water users, including local communities and wildlife as further discussed in Chapter 5: Human Health Impacts. Agricultural practices that divert water may induce drought in downstream ecosystems, increasing the risk of fires and accelerating desertification in these areas.

  The challenge of water depletion is further exacerbated by the fact that dryland soils inherently struggle to retain water efficiently. Limited shade and vegetative cover results in increased solar radiation and low humidity in drylands, increasing the rate of soil moisture loss. Additionally, soils affected by crusting or compaction may experience limited infiltration, hindering groundwater recharge. See Section 3.2 for more information. For additional information about water management and stress, see the Water Supply and Sanitation SEG.

- **Reduced water quality:** Agricultural effluent can contain contaminants, such as agrochemicals, soil particles, and harmful micro-organisms, which can enter the water cycle through improper application or storage. Due to their low moisture content and high incidence of runoff, dryland soils are at an increased risk of erosion. Additionally, dryland soils with limited infiltration and/or low organic matter may be particularly poor at filtering agricultural effluent, increasing the risks for contamination from agricultural activities. In drylands, where water resources are limited, the concentration of these chemicals can become higher due to reduced dilution, leading to increased nutrient enrichment and contamination.

  These contaminants can have non-target effects, such as eutrophication of water bodies, acute or chronic toxicity to aquatic organisms, sedimentation, and altered flow regimes. Contamination of drinking water from agricultural activities may also lead to adverse human health outcomes. See Chapter 5: Human Health Impacts for more information.

### MITIGATION MEASURES FOR REDUCED WATER QUALITY AND SUPPLY

Conserving soil moisture by using climate-smart and sustainable agricultural production methods, such as conservation tillage, mixed cropping and interplanting, mulching, and manuring, can reduce the demand for water in crop production (CTCN n.d., NRCS 2021). Maintenance of vegetation in drylands can improve the ability of water to infiltrate soils, increasing groundwater supplies, and preserve air humidity (FAO n.d.).

Choosing drought-tolerant, locally adapted varieties of crop breeds can reduce the strain of local water resources. Using water-efficient irrigation methods (e.g., subsurface drip irrigation) and/or harvesting rainwater and floodwater can help conserve local freshwater supplies. Refer to the Crop Production SEG for additional guidance about irrigation activities.

Prior to any agrochemical use, the soil types, product formulation and toxicity, application method, and timing of applications should be considered to prevent water contamination. Pesticides should only be used as a last resort and only as part of an integrated pest management (IPM) strategy. Where pesticide use is necessary, the least toxic pesticides should be selected for use first and used in accordance with the product label. See the Pest Management SEG for more information about best practices for pesticide use. Additionally, practices such as growing vegetative buffers may limit the transport of farm contaminants.

Projects involving the creation of new water sources or changes in the use of existing water sources should consider their impacts on the landscape, including whether the new source would be in a sensitive ecosystem. In addition, conducting thorough accounts for the uses of existing water supplies to ensure that existing uses (especially those for human consumption) are accounted for and maintained can assure that possible losses at existing sources are mitigated.

## 3.2. LAND DEGREDATION

As described previously, the low quality of dryland soils both affects dryland agriculture productivity and increases vulnerability to the adverse impacts from dryland agriculture. Drivers of land degradation impacts from dryland agriculture include the following:

- **Soil erosion and degradation:** Soil functions as a complex ecosystem that is essential for sustaining terrestrial life and agricultural production by facilitating nutrient cycling, maintaining structure, and regulating pests and diseases. However, certain agricultural practices can degrade soil health. These practices include compaction, leading to reduced water infiltration and increased runoff; disruption of biocrusts from activities such as land clearing and tillage, which diminishes organic matter and soil fertility and increases soil erosion; and intensive cropping or grazing that depletes essential nutrients and organic matter. Excessive use of pesticides and fertilizers can also negatively affect soil organisms and long-term soil health. Additionally, the overuse of fire for nutrient cycling can change nutrient availability (UNCCD 2018).

  Slope, topsoil depth, and soil type all affect the potential for soil degradation and dictate the appropriate conservation measures essential for controlling it. Balancing agricultural practices to maintain soil health is crucial for sustainable agricultural production and ecosystem support.

- **Poor irrigation management:** Overapplication of irrigation without proper drainage may lead to waterlogging and subsequently soil salinization and sodification. Soil salination occurs where irrigation water draws naturally occurring salts upward into the root zone of soils. Topsoil then becomes too saline to support vegetation and is increasingly degraded. Soil salinization is nearly irreversible. Vulnerability to soil salinization depends on factors such as mineral content, topography, and the salinity of the irrigation water used (Stavi, Thevs and Priori 2021). Refer to Box 5 for more information about the extent and impacts of salinization.

Dryland soils with high clay content are also at risk of crust formation. Similar to salinization, waterlogging from irrigation can also mobilize clay to the top layers of soil, which, when exposed to sunlight and dried, forms impermeable clay crusts (Solowey, et al. 2013). Water cannot infiltrate the clay crusts, making the soils conducive to runoff, flooding, and impenetrable for plant seedlings.

**BOX 55. WATERLOGGING AND SALINIZATION**

While certain crops exhibit a greater tolerance than others, salty soils negatively affect yields for all crops. Additionally, stress on crops due to high soil salinity decreases water efficiency, leading to increased irrigation demand (FAO 2022).

In many cases, high salinity will lead to land abandonment. About 0.3 to 1.5 million hectares of arable farmland go out of production worldwide each year due to salinity problems (Harper, et al. 2021). Productivity losses from salt-induced soil degradation are estimated at USD27.3 billion per year (Qadir, et al. 2014).

- **Overgrazing and bush encroachment:** The loss of vegetation cover from overgrazing is an important driver of reduced soil fertility and erosion. Overgrazing both reduces the density of vegetation and increases the favorability of annual grasses, which have less capacity to hold soil and only support grazing following rain. Counterintuitively, overgrazing and reduced brush fires may also lead to bush encroachment in which invasive bushy trees, often thorn trees, form impenetrable thickets, decreasing the productivity of the land. Land surrounding boreholes is especially prone to trampling and overgrazing (Abdi, Glover and Luukkanen 2013).

### MITIGATION MEASURES FOR LAND DEGREDATION

Land should be used only within its carrying capacity. Characterizing soil, including primary (nitrogen, phosphorus, and potassium) nutrient levels, structure, depth, pH, salinity, organic matter, and other mentioned factors can help to begin to manage and conserve soil. Practicing integrated soil fertility management, as discussed in the Crop Production SEG, can also help conserve soil quality. Grazing on land according to rangeland capacity can have positive impacts on grassland ecosystems by breaking up crusted soils to improve conditions for seed establishment. Mixed livestock-cropping systems can boost soil health and productivity through the incorporation of livestock waste.

Using climate-smart and sustainable crop production practices when appropriate can help minimize soil disturbances. Using the least toxic pesticides possible and following best practices can minimize the harmful impacts of pesticide use on cropland. Utilizing efficient irrigation and drainage systems and avoiding the use of saline irrigation water can help to reduce waterlogging, salinization, and the crusting of soils. See the Crop Production SEG for more information about irrigation management.

## 3.3. REDUCED AIR QUALITY

Air quality and crop production have an interconnected relationship; crop production can reduce air quality, and poor air quality can reduce crop yields (UNECE n.d.).

- **Chemical pollutants and particulate matter:** Common air pollutants produced from crop production include nitrogen compounds ($N_2O$, $NH_3$, and $NO_x$), sulfur dioxide ($SO_2$), carbon monoxide (CO), non-methane volatile organic compounds, and particulate matter (PM10, PM2.5, black carbon, and organic carbon) (Crippa, et al. 2022). Widespread fires, especially those that are made more intense by poor management practices, may generate large amounts of air pollutants, including PM, CO, and nitrogen oxides. Livestock production with ruminant animals, especially intensive production schemes, may generate large amounts of methane. See Section 4 for more information.

- **Dust:** Dryland topsoils are generally dry and thin, making them prone to wind erosion and dust generation. Practices that remove vegetative cover and disrupt soil aggregates, such as extensive trampling, plowing, or tilling, cause dust that can affect air quality in the surrounding areas and exacerbate respiratory problems in humans. Drylands in Mediterranean climates, or those which experience wet winters and dry summers, are at elevated risk (Muckel 2004).

### MITIGATION MEASURES FOR REDUCED AIR QUALITY

Practicing climate-smart and environmentally smart agricultural practices can reduce air quality impacts. Minimizing soil and/or biocrust disturbance and avoiding leaving soil bare can reduce the production of dust and PM. Installing wind breaks and following practices that conserve soil humidity can decrease the risk of erosion and dust formation. Following best practices with fertilizer, manure, and pesticide application can reduce the production of ammonia and nitrous oxides from agriculture. Proactive brush management through techniques such as mechanical clearing and strategic grazing can further decrease the amount of combustible material available for large fires.

## 3.4. HABITAT LOSS AND REDUCED BIODIVERSITY

Productive cropland relies on diverse, healthy ecosystems. Microbes feed plants, plants stabilize soil, and diverse creatures pollinate and control pests. In drylands, especially, native species are highly specialized to both adapt and contribute to their environments. Intensified and/or poorly planned crop production, however, can disrupt this delicate balance through habitat damage and biodiversity loss. Drivers of this impact include the following:

- **Removal of wildlife:** Removal of wildlife for dryland agriculture, including the direct elimination of ungulates that compete with livestock, or wildlife predators that may prey on livestock, significantly contributes to habitat loss and diminished biodiversity. Many farmers perceive that wildlife compete for resources, such as grazing land and water. Consequently, landowners often remove wildlife to protect their livestock and maximize agricultural yields. However, this can disrupt ecological processes and result in cascading effects in the ecosystem, including overgrazing, soil erosion, and changes in vegetation composition (Gordon 2018).

  In addition, agricultural activities may involve converting wildlife habitats to croplands or rangeland. Land conversion often includes practices such as fencing or clearing of native vegetation, which may destroy vital habitats or lead to the disruption of natural wildlife behaviors (Pacifici, et al. 2023).

- **Transmission of invasive species, pests, and diseases:** Dryland agricultural practices can inadvertently lead to the transmission of invasive species, pests, and diseases, posing a significant threat to both agricultural systems and natural ecosystems. Without proper quarantine measures, livestock diseases can proliferate and transfer to wildlife and vice versa. Proximity between livestock populations and wildlife can additionally lead to the emergence of pathogens that adversely affect human health (Jori, et al. 2021).

Non-native crop varieties introduced for agriculture often lack natural predators or environmental conditions that limit spread and, therefore, they can quickly become invasive. Invasive species can adversely affect ecosystem services in many ways, including harming populations of important predators and nitrogen-fixing organisms, spreading diseases to native organisms, interbreeding with native species, outcompeting native species for resources, overconsuming native species, and adversely shifting the natural fire regime by altering fuel properties.

Monocropping can also create conditions that are conducive to pest infestations and disease outbreaks as pests and diseases can quickly spread to neighboring crops, natural vegetation, and wildlife, causing economic losses and ecological imbalances.

- **Deforestation:** Dryland forests are important reservoirs of biodiversity, hosting species that are uniquely adapted to arid and semi-arid environments. These forests are essential for the conservation of rare and endemic species, promoting genetic diversity and supporting overall ecosystem health. Dryland forests additionally provide invaluable ecosystem services, such as soil retention, water filtration, flood control, maintenance of humidity, and the provision of shade. Dryland forests provide protection against drought and desertification (FAO n.d.).

  Deforestation for dryland agriculture thus poses a significant threat to biodiversity. When forests are cleared for agricultural activities, it removes vital carbon sinks and destroys critical habitats. Dryland deforestation may lead to the displacement or loss of species and reduce ecosystem services, such as pollination and nutrient cycling. Moreover, the loss of dryland forests exacerbates soil erosion, disrupts water cycles, and contributes to climate change (IUCN 2017a).

### MITIGATION MEASURES FOR HABITAT LOSS AND REDUCED BIODIVERSITY

There are many methods that can be implemented to mitigate habitat loss and preserve biodiversity in dryland agriculture. Implementing stringent sanitary measures is crucial to reduce disease transmission among both domesticated animals and wildlife, thereby preventing potential outbreaks that could lead to biodiversity loss. Regular veterinary inspections and health monitoring can also contribute to early detection and timely management of diseases in livestock, ensuring the overall health of the agricultural ecosystem. In addition, keeping domesticated animals separate from wildlife is another effective strategy that reduces the risk of disease transmission.

Emphasizing the use of locally adapted breeds and varieties also enhances crop and ecosystem resilience, promoting biodiversity while maintaining agricultural productivity. In addition, refraining from clearing trees and vegetation for dryland agriculture is essential for safeguarding habitats and supporting diverse ecosystems.

## 3.5. SUMMARY OF IMPACTS AND MITIGATION MEASURES

Mitigation and monitoring methods are dependent on both impacts and indicators for the specific project. Table 1 summarizes the common environmental impacts from agriculture and the associated mitigation measures discussed above. Additionally, Table 1 incorporates the environmental impacts discussed in the Crop Production and Livestock SEGs because they are still important to mitigate in drylands despite not being extensively discussed here. In lieu of a full discussion, Table 1 presents the relevant characteristics of drylands, which may influence the scope of environmental impacts from agriculture and should be considered as part of mitigation strategy development.

**TABLE 1. SUMMARY OF ADVERSE ENVIRONMENTAL IMPACTS AND MITIGATION STRATEGIES**

| POTENTIAL ENVIRONMENTAL IMPACT | ACTIVITY | CONSIDERATIONS FOR DRYLANDS | MITIGATION STRATEGIES |
|---|---|---|---|
| *As applicable, implement relevant sustainable land management (SLM) practices as described in Section 3.6.* | | | |
| WATER AVAILABILITY AND QUALITY | | | |
| Water depletion | • Irrigation<br>• Growing ill-adopted crops<br>• Wells and boreholes used for livestock<br>• Inefficient crop water management<br>• Production methods ill-suited to local conditions | Dryland agroecosystems are limited by water quantity and irregular supply. Soils have difficulty retaining moisture. Water resources are strained because many users depend on them. | • Use efficient irrigation methods, potentially including drip irrigation.<br>• Use water- and moisture-efficient production practices, including mulching, cover crops, and reduced tillage.<br>• Harvest rainwater and floodwater to reduce the draw on surface water and groundwater.<br>• Select crops with a low need for water that are appropriate for local conditions.<br>• Promote crops/varieties and approaches that are proven in practice to be appropriate for agroecological zones and farmers' capabilities. |
| Reduced water quality | • Application of farm chemicals (fertilizers, pesticides)<br>• Application of organic fertilizers (livestock manure)<br>• Management of livestock<br>• Use of livestock pesticides and veterinary drugs | Dryland soils may have low organic matter, which leads to poor filtering of agricultural effluent and can further lead to agricultural activity contamination. Water resources are strained because many users depend on them. | • Take local hydro-environmental conditions into account during project development.<br>• Follow best practices for pesticide use to minimize application amounts, leaching, volatilization, and drifts of pesticides. See the Safer Use Pesticides SEG.<br>• Minimize overfertilization by using the 4Rs approach (Right Source, Right Rate, Right Time, and Right Place) approach. See the Crop Production SEG.<br>• Minimize leaching through the use of the following:<br>  ○ Efficient irrigation methods<br>  ○ Water- and moisture-efficient production practices<br>  ○ Maintaining field buffers, borders, and riparian buffers<br>• Implement erosion control practices, such as cover crops and reduced tillage.<br>• Carry out land leveling (requires engineering oversight).<br>• Prevent and manage soil waterlogging.<br>• Separate water supplies for people and livestock.<br>• Conduct water quality monitoring to signal any changes in quantity or quality for human consumption. |

| POTENTIAL ENVIRONMENTAL IMPACT | ACTIVITY | CONSIDERATIONS FOR DRYLANDS | MITIGATION STRATEGIES |
|---|---|---|---|
| | | | • Implement practices for manure management. More details on management strategies can be found in the Livestock SEG. |
| LAND DEGREDATION | | | |
| Soil compaction | • Conventional tillage<br>• Trampling<br>• Heavy farm equipment use<br>• Waterlogging and sealing from irrigation | Clay dryland soils under irrigation may be especially prone to surface sealing in which water cannot reach the root zone for vegetation. | • Minimize soil disturbances and field passes, including through the use of minimal tillage.<br>• Do not undertake deep tillage/deep plowing/subsoiling/ripping.<br>• Minimize physical trampling, especially when fields are wet.<br>• Amend soil, as indicated, based on properties. |
| Soil erosion | • Conventional tillage<br>• Bare land between growing seasons without vegetation coverage<br>• Flooding or poor water management<br>• Vegetation loss from overgrazing<br>• Overpopulation of animals<br>• Concentrated grazing and trampling near wells and boreholes | Low organic matter content, low moisture levels, high winds, limited vegetation, and high incidence of runoff make dryland soils particularly susceptible to erosion. | • Implement erosion control practices, such as cover crops, reduced tillage, maintaining field buffers and borders, wind breaks, and/or riparian buffers.<br>• Minimize soil disturbances and field passes, including through the use of minimal tillage.<br>• Do not undertake deep tillage/deep plowing/subsoiling/ripping.<br>• Amend soil, as indicated, based on properties.<br>• Use water- and moisture-efficient production practices.<br>• Develop grazing management plans that incorporate education and training for project partners to understand the impacts and ways to avoid sensitive resources.<br>• Consider the carrying capacity of lands to stock appropriate numbers of animals in order to avoid overpopulation and degradation of resources.<br>• If funding is available, consider fencing or physical barriers for sensitive soil areas. |
| Soil fertility loss | • Land use change/land clearing<br>• Over- or under-application of farm chemicals (fertilizers, pesticides) or other soil amendments<br>• Inappropriate irrigation, | Dryland soils have a limited supply of fertile topsoil and a low capacity to regenerate topsoil. Soils are prone to salinization, sodification, and waterlogging from irrigation. | • Characterize soils and amend them based on their properties:<br>  ○ Manage soil organic matter, nutrient balance, salinity, acidity, alkalinity, specific ion toxicity, and sodicity.<br>• Use fertilizers consistent with the 4Rs approach and within an integrated soil fertility management framework.<br>• Follow best practices for pesticide use to minimize application amounts, leaching, volatilization, and drifts of pesticides. See the Safer Use Pesticides SEG. |

| POTENTIAL ENVIRONMENTAL IMPACT | ACTIVITY | CONSIDERATIONS FOR DRYLANDS | MITIGATION STRATEGIES |
|---|---|---|---|
| | resulting in soil waterlogging or the salinization of soils<br>• Overextraction from soils through excessive cropping or overgrazing without replenishing nutrients<br>• Conventional tillage with fallow periods/bare soils | | • Use efficient irrigation methods, potentially including drip irrigation. See the Crop Production SEG.<br>• Maintain soil organic matter by undertaking manuring, composting, or sustainable crop rotations as needed.<br>• Implement erosion control practices, such as cover crops, reduced tillage, maintaining field buffers and borders, wind breaks, and/or riparian buffers.<br>• Minimize soil disturbances and field passes, including through the use of minimal tillage.<br>• Develop grazing management plans that incorporate education and training for project partners to understand the impacts and ways to avoid sensitive resources.<br>• Consider the carrying capacity of lands to stock the appropriate number of animals in order to avoid overpopulation and degradation of resources. |
| Land conversion | • Land use change/land clearing to increase available land for grazing or crop production<br>• Conversion of natural lands or lands with high levels of biodiversity | Drylands have limited soil, water, and vegetation resources, making these areas especially vulnerable to desertification from land conversion. | • Minimize agricultural land expansion by using land within its carrying capacity.<br>• Plant locally adapted crop species and varieties to increase yields, reducing the need to convert lands.<br>• Rehabilitate and prioritize using degraded, abandoned, or underutilized lands over converting natural lands.<br>• Support shifting cultivation only in sustainably managed forests/landscapes.<br>• Consider the larger landscape context when selecting lands to convert in order to minimize the overall impacts. |
| Loss of rangeland production and fertility | • Stationary livestock<br>• Overpopulation of livestock<br>• Suppression of natural brush fires | Drylands have limited vegetation and topsoil resources. Drylands are also prone to brush encroachment in which overgrazing changes the favorability of woody shrubs, leading to lost land productivity. | • Application of sustainable grazing practices and education for project partners to understand impacts and mitigate overgrazing effects.<br>• Projects should consider the carrying capacity of rangelands to determine the livestock numbers and types suitable for the grazing area.<br>• Seasonal grazing in sensitive areas or seasons should be employed to reduce or mitigate the impacts. |

| POTENTIAL ENVIRONMENTAL IMPACT | ACTIVITY | CONSIDERATIONS FOR DRYLANDS | MITIGATION STRATEGIES |
|---|---|---|---|
| REDUCED AIR QUALITY | | | |
| Chemical pollutants and particulate matter | • Wind erosion<br>• Farm equipment use<br>• Application of farm chemicals (fertilizers, pesticides)<br>• Crop burning<br>• Land conversion by burning | Sparse vegetation and open landscapes allow pollutants to be transported farther or linger longer. Poor air quality may further stress vulnerable crops and reduce yields. | • Minimize soil disturbances, including through the use of climate-smart practices, as well as minimal tillage, cover crops, and windbreaks.<br>• Use fertilizers consistent with the 4Rs approach and within an integrated soil fertility management framework.<br>• Follow best practices for pesticide use to minimize application amounts, volatilization, and drifts of pesticides. See the Safer Use Pesticides SEG.<br>• Promote alternatives to burning crop residue and farm waste.<br>• Reduce land conversion or ensure that conversion does not occur through burning. |
| Dust generation | • Wind erosion<br>• Vegetation loss<br>• Leaving soils bare | Soils that are dry and thin will be prone to dust generation and are easily carried by winds. | • Minimize soil disturbances, including through the use of climate-smart practices, including minimal tillage, cover crops, and windbreaks.<br>• Minimize soil and/or biocrust disturbances and avoid leaving soil bare.<br>• Reduce land conversion or ensure that conversion does not occur through burning. |
| DAMAGED HABITATS AND REDUCED BIODIVERSITY | | | |
| Habitat loss and degradation | • Land conversion<br>• Soil erosion<br>• Application of farm chemicals (fertilizers, pesticides)<br>• Irrigation<br>• Introduction of non-native species | Habitat loss on drylands can cause cascading effects in the ecosystem, including overgrazing, soil erosion, and changes in vegetation composition. | • Use sustainable intensification of agricultural lands to reduce the pressure for land conversion.<br>• Minimize land conversion, especially from native lands and lands with high levels of biodiversity.<br>• Use climate-smart crop production practices to minimize the environmental impacts of crop production, including from irrigation, farm chemical use, soil and water degradation, and soil erosion.<br>• Ensure that the species introduced are not invasive and use local species whenever possible. |
| Extinction/Loss of local varieties and breeds | • Monoculture crop production<br>• Land conversion | Local species are highly specialized and resilient to the natural variability present in | • Use climate-smart agricultural practices to minimize the environmental impacts on local species.<br>• Minimize land conversion, especially from native lands and |

| POTENTIAL ENVIRONMENTAL IMPACT | ACTIVITY | CONSIDERATIONS FOR DRYLANDS | MITIGATION STRATEGIES |
|---|---|---|---|
| | • Application of farm chemicals (fertilizers, pesticides)<br>• Introduction of non-native species | drylands. Loss of diversity of livestock breeds and crop varieties, including the loss of genetics and phenotypes, as well as the loss of culturally important species. | land that supports local varieties and landraces.<br>• Research any introduced species to prevent the introduction of invasive species.<br>• Encourage saving and preserving local varieties and landraces, including at seed banks.<br>• Support local formal and informal breeding programs that preserve local genetics and varieties.<br>• Encourage replanting and introducing local species and varieties. |
| Removal of wildlife | • Fencing<br>• Land clearing<br>• Habitat destruction<br>• Pesticide use | Wildlife in drylands perform vital ecosystem functions, such as soil aeration and nutrient cycling. Interference with wildlife may decrease the productivity of agricultural operations and the health of surrounding ecosystems. | • Plan projects such that the livestock species chosen for activities will not outcompete or require the removal of wildlife species in the general vicinity.<br>• Implement prevention and compensatory mitigation strategies, such as the following:<br>○ Use corrals or small enclosures or guard animals to deter predators.<br>○ Employ compensatory mitigation programs to offset losses due to predation. |
| Transmission of invasive species, pests, and diseases | • Introduction of native species<br>• Monoculture crop production<br>• Soil disturbances, such as grazing or tilling<br>• Concentrated livestock operations<br>• Mingling of livestock and wildlife | Dryland agriculture's fragility and limited resilience make them especially vulnerable to invasive species, pests, and diseases. Stressed crops and livestock may be especially prone to pests and disease. | • Develop an invasive species/noxious weed management strategy that includes the prevention of establishment of invasive species during the design phase and strategies for detection and mitigation of invasive species.<br>• Clean, inspect, and quarantine livestock, livestock products, feed, and equipment.<br>• Develop monitoring programs based on the consideration of ecology, climate, and available resources.<br>• Develop management plans for early detection and eradication of invasive species to prevent social, ecological, and economic damage.<br>• Practice climate-smart and environmentally sound crop production practices that increase biodiversity, including crop rotations, intercropping, cover crops, and strip cropping. |

## 3.6. SUSTAINABLE LAND MANAGEMENT PRACTICES

SLM practices aim to prevent and mitigate the impacts associated with inappropriate agriculture in drylands by managing agroecosystems for sustained productivity, increased profits, and improved food security while reversing and preventing water stress, soil erosion, and desertification. There is no single solution that can be used to solve the many challenges that face small-scale dryland crop farmers; stakeholders need to design the most appropriate sustainable practices for their specific climatic, geographical, and socioeconomic conditions.

Some SLM approaches that have had excellent success with enhancing rain-fed and irrigated crops in arid, semi-arid, and subhumid conditions are listed below. Conservation agriculture, rainwater harvesting, agroforestry, and the use of cross-slope barriers to reduce rainfall runoff and soil erosion are discussed in more detail.

1. **Conservation agriculture** combines minimum soil disturbance (ripper tillage or no-tillage) with permanent soil cover (e.g., mulches) and crop rotation to reduce soil moisture losses and enhance dryland agriculture.
2. **Integrated soil fertility management** uses supplementation with a variety of organic and inorganic plant nutrients to enhance dryland agriculture. See the Crop Production SEG for more information.
3. **Rainwater harvesting** aims to improve the use of rainfall, making it available for agricultural or domestic uses in areas where rainfall is the primary limiting factor.
4. **Smallholder irrigation management** aims to achieve higher water use efficiency through more efficient water collection and abstraction, water storage and distribution, and using drip or micro-spray applications, which have low wastage. See the Crop Production SEG for more information.
5. **Cross-slope barriers** use soil bunds, stone lines, vegetative strips, and so forth to reduce rainfall runoff velocity and soil erosion.
6. **Agroforestry** integrates the many benefits of trees to enhance soil and water resources. Trees provide fuel and fodder products, while various fruits and their oils can be directly used as food. The deep roots of trees bring moisture and nutrients to the surface, while their branches funnel water to the patch of shade around the trunk, creating localized patches of shelter and pasture. Trees play an important role in combating desertification and mitigating climate change.
7. **Integrated crop and livestock management** optimizes the use of crop and livestock resources through the beneficial interactions between them.
8. **Sustainable forest management** in drylands encompasses the administrative, legal, technical, economic, social, and environmental aspects of the conservation and use of dryland forests. See the Forestry SEG for more information.

### 3.6.1. CONSERVATION AGRICULTURE

Case studies from many parts of the world[2] show how combining minimal tillage, the use of organic mulches (e.g., crop stubble), and crop rotation can improve the carbon sequestration and water retention ability of the soil, support soil health, and raise dryland agriculture sustainably and profitably. Known as conservation agriculture, this approach meets all three of the SLM goals of improved production, livelihoods, and environmental health.

Key aspects of conservation agriculture include the following:

- Minimal soil disturbance: zero or reduced tillage (using ripper furrowing instead of ploughing)
- Permanent soil covering (e.g., crop residues and organic mulches)
- Crop rotation
- Direct planting of crop seeds into mulch
- Labor-intensive weed control and minimal use of herbicides
- IPM in place of pesticides

The benefits of this approach are seen in increased crop yields and reliability and the reduced risk of crop failure. For farmers, there are the benefits of increased farm income and lower farm inputs (e.g., fuel, machinery costs, repairs, fertilizer), reduced labor requirements (unless hand weeding is done), and improved food and water security.

### 3.6.2. RAINWATER HARVESTING

Rainwater harvesting (RWH) technologies aim to enhance agricultural production and minimize the effects of seasonal variations in water availability in dryland areas. They are especially effective in semi-arid regions that are prone to droughts. RWH can be done at various scales—from increasing the catchment for individual plants to small dams.

- **Micro-catchments:** Holes, pits, basins, or bunds constructed to collect surface runoff over a small catchment up to 10 times larger than the cropping area. This can be done as a component of conservation agriculture, agroforestry, or fertility management using compost, manure, and/or mineral fertilizers.
- **Macro-catchments:** Check dams, water diversion channels, or large earth canals can provide water for crops or pasture through the diversion of storm floods from gullies, ephemeral streams, and roads directly onto the agricultural field. This can harvest rainwater over an area up to 1,000 times larger than the cropping area. To improve its efficiency, soil surface structure and vegetation cover are manipulated so that evaporation from the soil surface and surface runoff is reduced, infiltration is enhanced, and water availability in the root zone is increased.

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[2] These include the rice-wheat areas of the Indo-Gangetic Plains (South Asia), the irrigated maize-wheat systems of northwest Mexico, and the croplands in semi-arid Zimbabwe, Zambia, Malawi and Kenya (Aagaard 2010, Hobbs, Sayre and Gupta 2007, Liniger, et al. 2011, Mele and Carter 1999, Mupangwa, Twomlow and Walker 2007).

- **Small earth dams:** Small earth dams collect and store runoff from hillsides, roads, rocky areas, open rangelands or furrows below terrace banks. They can be used for irrigation, livestock, or domestic use during dry periods.
- **Sand dams:** Sand dams can store up to 20 million liters of water, providing a year-round supply of clean water for up to 1,000 people. They have extremely low operations and maintenance costs and, by storing water underground, they are protected from evaporation. Sand dams are comprised of a steel-reinforced concrete (rubble stone masonry) wall built across a seasonal sandy riverbed. Sand and silt carried downstream during the rainy season accumulates behind the dam, while the finer suspended clay particles wash over the dam wall. Within one to four rainy seasons, the dam fills with sand and trapped water, with up to 40% of the volume comprising water stored between the sand particles. Water can be extracted from the dam via traditional scoop holes, or an infiltration gallery leading to a tank or well.
- **Roof catchments:** Water collected off roofs (tiled or corrugated iron) and stored in plastic can be a source of water for domestic use.

### 3.6.3. CROSS-SLOPE BARRIERS

Cross-slope barriers are developed on sloping lands in the form of earth or soil bunds, stone lines, and/or vegetation in order to reduce steepness or the length of a slope. They are used to reduce runoff velocity and soil loss, thereby contributing to soil, water, and soil nutrient conservation. Terraces develop gradually behind the bunds due to soil movement from the upper to the lower part of the terrace.

While cross-slope barriers are primarily intended to reduce soil erosion, they also ease cultivation or agroforestry between the barriers, which are usually developed along contours. Cross-slope barriers also contribute to effective water management by enhancing infiltration and irrigation opportunities.

### 3.6.4. AGROFORESTRY

Agroforestry involves practices in which trees are deliberately integrated with agricultural crops and/or livestock for a variety of soil and water management benefits and services. Many agroforestry approaches are traditional land use systems. They can involve a spatial mixture of crops with trees or a temporal sequence (e.g., to improve fallows) and include alley cropping, farming with trees on contours, perimeter fencing with trees, multistory cropping, relay cropping, intercropping, or multiple cropping.

Agroforestry is extremely useful on drylands, especially when indigenous trees that are well adapted to the local soil/climatic conditions are used to enhance dryland agriculture and improve resilience to environmental change. Agroforestry can help to diversify food and income sources, simultaneously improving food and water security, and improving resilience to climate shocks.

### 3.6.5. INTEGRATE CROP AND LIVESTOCK MANAGEMENT

Integrating crops and livestock create valuable synergies and allow the optimal use of resources on drylands. Manure can be used to enhance soil fertility, while crop residues and byproducts can provide supplementary feed for animals. Shifting night enclosures can be used to fertilize the fields directly with urine and manure. Manure collection can be made more efficient by enclosing animals at night, and this also serves as protection. In Togo, people use a so-called *fosse fumiere*, an enclosure for goats and sheep centered over a circular pit which collects the droppings and urine. Animals are fed in the fosse, so that the pit gradually fills with chopped organic matter and manure.

Integrated crop-livestock production systems can also have unique environmental impacts that should be carefully mitigated. See the Livestock SEG for more information.

## 3.7. RESOURCES FOR ENVIRONMENTAL IMPACTS

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# 4. CLIMATE CHANGE MITIGATION AND ADAPTATION

This chapter explores the impacts of climate change on dryland agriculture and the contributions of dryland agriculture to climate change and proposes mitigation and adaptation measures to address them. See Box 6 for definitions of climate change mitigation and adaptation. This chapter also includes considerations for addressing project-specific climate change impacts in the design of USAID activities.

**Note:** USAID Activities must assess, address, and adaptively manage climate risks through a climate risk management process (USAID 2017).

**BOX 66. CLIMATE CHANGE MITIGATION AND ADAPTATION DEFINITIONS**

**Mitigation** refers to actions that reduce, avoid, or sequester $CO_2$ and other greenhouse gases, which are identified as the main cause of anthropogenic climate change (USAID n.d.a). Preventing dangerous anthropogenic interference with the global climate system requires mitigation efforts by both developing and developed countries (USAID 2017).

**Climate adaptation** comprises actions taken to assess, address, and adaptively manage the risks associated with climate change impacts to reduce vulnerability and/or avoid harm (USAID 2022c). Adaptation is both a response to experienced climate changes and the preparation for projected future climate impacts.

Climate change impacts fall within the spectrum of environmental impacts and should thus be considered a subsection of Chapter 3. However, climate change impacts are included in a separate chapter as they are extensive in their own regard and are integral to consider in dryland agricultural activities.

Dryland agriculture relates to climate change, both in terms of the risks that climate change impacts can pose for agricultural productivity and in terms of the greenhouse gas (GHG) emissions that agriculture generates, which contribute to climate change. Current data indicate that climate change is already affecting biodiversity, carbon balance, water availability, and ecosystem services in dryland areas. The threat of increasing global temperatures, higher climatic variability, and the possibility of more frequent and prolonged droughts will cause changes in soil, vegetation, and water availability, which, in turn, will continue to affect all aspects of dryland agriculture (IPCC 2022). Therefore, climate change risks and impacts should be assessed at the inception of activity design.

Box 7 includes sample considerations that should be factored into the decision-making process for activity design to address potential context-specific climate change risks to the activity and potential contributions of the activity toward climate change. These factors are not exhaustive, and all project-specific context should be considered in assessing climate change impacts.

## BOX 77. SAMPLE CLIMATE CHANGE CONSIDERATIONS FOR ACTIVITY DESIGN

### Impacts of Future Climate Trends on Dryland Agriculture

*Changes in precipitation*

- Selecting drought-tolerant species and varieties and production methods that conserve water, such as reduced tillage.
- Comparison of water availability and/or local precipitation rates and timing with the temporal and water needs of proposed project activities.
- Understanding local floodplains and how excess water will be managed on fields in cases of extreme rainfall or flooding.
- Understanding how to minimize the field impacts of soil erosion, mudslides, or other land disturbances due to extreme rainfall or drought events.

*Changes in temperature*

- Selecting temperature-tolerant species and varieties and production methods that stabilize or protect against extreme changes in temperature.
- Changing landscaping or using mechanical methods (i.e., windmills or overhead air misters) to protect and stabilize against extreme temperatures.
- Adjusting planting or harvesting timing, depending on the expected timing of temperature changes.

*Extreme weather events*

- Understanding local geography and potential risks from extreme weather events (e.g., saltwater inundation, flooding).
- Selecting areas for production and farm infrastructure that are most likely to be protected from extreme weather events.

### GHG Emissions from Dryland Agriculture

- Selecting climate-smart and environmentally smart production practices that reduce emissions and increase soil carbon sequestration.
- Potential emissions based on proposed herd size and animal weight.
- Selecting production methods that result in minimal land disturbance or do not leave land bare.

## 4.1. CLIMATE CHANGE RISKS TO DRYLAND AGRICULTURE

Drylands are affected by the impacts of climate change, with some areas experiencing increased aridity and increased variability in temperature. Climate change projections indicate that increased temperatures and reduced moisture will affect dryland areas in varying manners, depending on the local ecosystems and environments. For example, while the geographic extent of some drylands is expected to increase in size, the extent of others is expected to decrease. It is anticipated that these changes will affect the location and regional distribution of sequestered carbon (Hanan, et al. 2021, IPCC AR6 2021). Furthermore, as dryland ecosystems and farming systems are limited by water, they are particularly vulnerable to the impacts of climate change.

The most significant impacts of climate change on dryland agriculture include (UNCCD 2022, FAO 2019):

- Increased water stress in plants, resulting in lower crop productivity (reduced yield or crop failure)
- Higher irrigation water demand, which can result in increased salinization
- Increased risk of soil erosion and desertification; as soils become drier, they will become more vulnerable to desertification
- Changes in the nutritional value of grasslands and lowered carrying capacity for livestock; elevated carbon dioxide ($CO_2$), raised temperatures, and increasingly unpredictable precipitation could favor fast-growing, nutrient poor, weedy plants in dryland regions
- Reduced conception rates, reduced growth rates, and increased mortality of livestock due to increasing thermal stress
- Increased climate variability and extreme droughts, leading to livestock or crop losses, or both
- Significant increases in water requirements for livestock to combat heat stress
- Increased negative health impacts on farmers and ranchers from heat stress and lack of water resources
- Increased risk of conflict from competition for scarce water and other resources

While determining the exact effects of climate change on dryland agriculture is difficult, it is likely that a decline in rainfall on drylands will lead to lower production, regardless of how well the land is managed. For poor subsistence farmers who have limited opportunities to adapt and apply other livelihood options, the impacts of climate change are likely to be significant at the household level.

### BUILDING RESILIENCE AND ADAPTING TO CLIMATE CHANGE

To plan for expected climate change impacts, project designers should review historical records, recent trends, and future projections about the local climate and assess which mitigation and adaptation measures are necessary to implement. The project type should inform the timescale for projections. Future projections should also take into consideration environmental thresholds that, if surpassed, could cause rapid ecosystem change.

The **adaptive capacity** of many drylands is being reduced by land degradation. Adaptive capacity may be enhanced through active restoration and conservation activities to provide a natural buffer against desertification and erosion and enhance ecosystem services. As discussed above, dryland systems are highly vulnerable to interannual climate fluctuations and the effects of long-term climate change. In addition to improving the adaptive capacity of the drylands themselves, support programs should be established to strengthen the adaptive capacity and resilience of people who are dependent on dryland agriculture. These programs should address the risks from both slow-onset climate change and unforeseen shocks through the following:

- Diversifying livelihood options.
- Providing access to, and tenure over, as many natural resources as possible (e.g., water, grazing, land, woodlands, indigenous natural products).
- Providing land tenure and embracing an on-farm contract grower approach.
- Being sensitive to the importance of social connectivity in rural communities (e.g., how the extended family can play an important role in helping people cope with natural hazards exacerbated by climate change, such as floods and drought).
- Designing projects that are suited to and appropriate for the soil, climate, and social conditions that prevail in an area, using crops and livestock varieties that are suited to and appropriate for dryland conditions.
- Ensuring environmental integrity—avoiding any unnecessary pollution, biodiversity loss, and land degradation. Healthy ecosystems provide a safety net for rural livelihoods and for medium- and long-term sustainability.

Climate risk management offers a method through which project designers and implementers can screen activities for climate risk and develop responses to address risks and build resilience. Measures that improve drylands, such as biodiversity conservation and restoration, can boost the resilience of drylands to climate change impacts. Studies can also be conducted on the relationship between climate change and dryland ecosystem health, sensitive species, or pests and diseases to further understanding of climate impacts in specific regions. Finally, engaging local communities is critical to ensuring that climate adaptation is aligned with improved food security, human health, and livelihood protection.

Table 2 summarizes the climate risks posed to dryland agricultural projects and the climate stressors that drive them and provides mitigation measures to address the risks.

**TABLE 2. CLIMATE RISKS TO DRYLAND AGRICULTURAL ACTIVITIES**

| CLIMATE CHANGE STRESSORS | CLIMATE RISKS | RISK MITIGATION MEASURES |
|---|---|---|
| Increasing incidence and/or severity of high wind events and/or dust storms | • Damage to agricultural/irrigation equipment, disrupting operations<br>• Damage to or the blockage of transportation routes, disrupting the delivery of materials, labor access, production, and distribution<br>• Siltation and dust accumulation blocks canals, reducing reservoir storage capacity and irrigation water<br>• Damage to crops and/or soil erosion, impacting future crop productivity | • Select climate-resilient crop and livestock varieties.<br>• Implement erosion control practices, such as cover crops, reduced tillage, maintaining field buffers and borders, wind breaks, and/or riparian buffers. |
| Increasing incidence and/or | • Damage to agricultural/irrigation equipment, disrupting operations | • Select climate-resilient crop and livestock varieties. |

| CLIMATE CHANGE STRESSORS | CLIMATE RISKS | RISK MITIGATION MEASURES |
|---|---|---|
| severity of intense rainfall events and/or flooding | • Damage to or the blockage of transportation routes, disrupting the delivery of materials, labor access, production, and distribution<br>• Risks to the health and safety of workers due to direct flooding impacts, as well as vector- and water-borne diseases<br>• Damage to crops and livestock from flash floods or ongoing erosion<br>• Contamination of soil/water due to runoff, potentially affecting community health and safety (e.g., increased disease incidence) | • Provide timely weather information to farmers using the results of monitoring from early warning systems.<br>• Construct or retrofit agricultural infrastructure to improve resilience to extreme events.<br>• Assess the potential risk to agricultural production transportation routes and identify or develop alternate routes and transportation options.<br>• Identify fields that are prone to flooding and exposed to impacts from extreme events.<br>• Identify measures to minimize runoff and utilize buffer zones and plantings to protect from flooding and high winds.<br>• Promote crops that can withstand temporary inundation during storm events.<br>• Locate pens outside of flood-prone areas away from crops and provide shelter during storm events.<br>• Increase training and investment in more flood-resilient agricultural practices.<br>• Design and implement emergency preparedness and response plans for workers. |
| Increasing incidence and/or severity of wildfires | • Increased livestock mortality or damage to herd health, both directly from fire and from poor air quality due to fires.<br>• Damage to agricultural/irrigation equipment, disrupting operations<br>• Damage to or the blockage of transportation routes, disrupting the delivery of materials, labor access, production, and distribution<br>• Reduction of vegetative cover, increasing runoff and erosion and reducing soil fertility | • Provide timely weather information to farmers using the results of monitoring from early warning systems.<br>• Construct or retrofit agricultural infrastructure to improve resilience to extreme events.<br>• Assess the potential risk to agricultural production transportation routes and identify or develop alternate routes and transportation options.<br>• Remove brush mechanically or by grazing livestock.<br>• Set controlled fires under preferable conditions to reduce brush. |
| Increasing air temperatures and incidence and/or severity of heat waves | • Hotter working conditions affecting worker/community health (e.g., due to heat stress, vector-borne disease)<br>• Shifts in geographic suitability and the distribution of some crops and species<br>• Higher irrigation water demand, potentially resulting in increased salinization<br>• Reduced nutritional value of grasslands, lowering the carrying capacity for livestock | • Select climate-resilient crop and livestock varieties.<br>• Provide timely weather information to farmers using the results of monitoring from early warning systems.<br>• Locally adapted, heat-tolerant breeds and varieties.<br>• Increase training and investment in more heat-resilient agricultural practices.<br>• Provide livestock with shade and a reliable source of water during extreme heat events. |

| CLIMATE CHANGE STRESSORS | CLIMATE RISKS | RISK MITIGATION MEASURES |
|---|---|---|
| | • Increased thermal stress on livestock, resulting in reduced conception rates, reduced growth rates, and increased mortality<br>• Increased negative health impacts (e.g., heatstroke, dehydration) on farmers and ranchers from heat stress<br>• Increased water stress in plants, resulting in lower crop productivity and potentially disrupting food security and livelihoods | • Encourage and enable alternatives to monoculture planting to reduce susceptibility to catastrophic losses from pests and disease.<br>• Design and implement health and safety plans for workers. |
| Increased aridity and reduced moisture and/or increasing incidence and/or severity of droughts | • Reduced access to water for dryland agricultural activities<br>• Increased likelihood of conflict for water resources<br>• Increased water stress in plants, resulting in lower crop productivity and potentially disrupting food security and livelihoods<br>• Increased risk of soil erosion and desertification as soils become drier<br>• Increased negative health impacts on farmers and ranchers from lack of water resources<br>• Increased chance of wildfires, resulting in the risks identified above | • Select climate-resilient crop and livestock varieties.<br>• Provide timely weather information to farmers using the results of monitoring from early warning systems.<br>• Promote drought-tolerant breeds and varieties.<br>• Increase training and investment in improved agricultural practices with increased drought resilience, such as enhanced storage and access to irrigation water; more efficient water delivery systems; improved irrigation technologies; more effective water harvesting; and agronomy that increases soil water retention.<br>• Provide alternative water sources for livestock during drought conditions.<br>• Promote and enable efficient water monitoring and management systems.<br>• Design and implement health and safety plans. |
| Increasing variability of precipitation | • Reduced nutritional value of grasslands, lowering the carrying capacity for livestock<br>• Shifts in geographic suitability and distribution of some crops and species<br>• Increased water stress in plants, resulting in lower crop productivity and potentially disrupting food security and livelihoods | • Select climate-resilient crop and livestock varieties.<br>• Provide timely weather information to farmers using the results of monitoring from early warning systems.<br>• Promote drought-tolerant breeds and varieties.<br>• Increase training and investment in improved agricultural practices with increased drought resilience, such as enhanced water storage and more effective water harvesting, and agronomy that increases soil water retention.<br>• Follow CSA practices, which increase humidity.<br>• Promote and enable efficient water monitoring and management systems. |

## 4.2. CONTRIBUTION OF DRYLAND AGRICULTURE TO CLIMATE CHANGE

Despite their limited sequestration abilities, drylands are significant players in the global carbon cycle and are crucial for mitigating the GHGs that are causing climate change. Drylands contain about 30% of global soil carbon in aboveground and belowground biomass, and surface-layer soil carbon (top 30 centimeters of soil) (Hanan, et al. 2021). Global dryland carbon stock estimates suggest that aboveground and belowground biomass in the drylands represent approximately 22% and 38% of global totals in these pools, respectively (Hanan, et al. 2021). As such, dryland conversion and degradation (e.g., from unsustainable agricultural practices and overgrazing) not only negatively affect ecosystems and reduce land productivity, but they also contribute to climate change by reducing soil carbon accumulation and releasing $CO_2$ into the atmosphere. The main emissions sources from dryland agriculture come from the following:

- Use of fossil fuels for farming equipment
- Land conversion
- Intensive tillage practices
- Animal manure and urine and enteric fermentation in ruminant animals
- Overgrazing
- Soil and ecosystem degradation

Livestock production results in methane and nitrous oxide emissions from urine and manure production and methane emissions from enteric fermentation in ruminant animals, with most livestock GHG emissions coming from cattle production (IPCC 2006, Rivera and Chará 2021). For a more detailed discussion of emissions from livestock production, see the Livestock SEG.

Conversely, through carbon sequestration and reducing emissions, dryland agricultural systems can combat climate change. For an in-depth discussion of agricultural emissions mitigation, refer to the Crop Production and Livestock SEGs. Examples of practices that are well suited for drylands that enhance soil carbon sequestration are provided in Table 3.

**TABLE 3. SOME AGRICULTURAL PRACTICES THAT ENHANCE CARBON SEQUESTRATION (FAO 2004)**

| CONVENTIONAL PRACTICE | RECOMMENDED PRACTICE MODIFICATION |
|---|---|
| Deep plough/conventional tillage | Ripper furrowing, reduced till or no-till |
| Crop residue removal or burning | Crop residues returned to soil as mulch |
| Summer or winter fallow | Growing cover crops |
| Regular synthetic fertilizer use | Judicious use of fertilizers, integrated nutrient management, and soil site-specific management |
| No water management | Water management/conservation, irrigation, drip irrigation, and water table management |
| Fence-to-fence cultivation | Conversion of marginal lands to nature conservation |
| Monoculture | Improved farming systems with intercropping and crop rotations |
| Fields without trees | Agroforestry with trees integrated into fields, especially if local varieties of tress are used |

| CONVENTIONAL PRACTICE | RECOMMENDED PRACTICE MODIFICATION |
|---|---|
| Flood, open channel, or broad water irrigation using fossil fuels | Precise drip or water-saving irrigation using gravity, solar energy, or other renewable energy |
| Continuously grazing animals in one area | Rotational grazing to increase plant growth for improved grazing and increased soil carbon sequestration |
| Growing non-native, non-adapted species | Using regionally adapted species requiring less water |
| Land use and water management within political boundaries | Cross-boundary, integrated watershed management |

## 5. HUMAN HEALTH IMPACTS

Dryland agriculture produces more than half of the world's food production, providing important nutritional and dietary benefits; however, many people living in drylands are malnourished and poor (d'Arros Hughes 2021). This chapter discusses the beneficial and adverse crop production health impacts and their mitigation measures, as well as potential factors to consider when assessing project-specific health impacts. Additional resources for health risks can be found at the end of the chapter. The main pathways through which dryland agriculture can influence nutrition and diet include the following:

- **Income from agriculture:** Increased household income from any activity, including agriculture, can alter the amount, composition, and quality of food consumed, and facilitate the purchase of health and nutrition-related goods and services.

- **Food and nutrition security:** Local food production may provide access to a wide spectrum of nutrient-rich foods and promote cultural culinary traditions. Local food production, especially with locally adapted breeds and varieties, is often more resilient to drought and market fluctuations, fostering better nutritional outcomes.

- **Biofortification:** Biofortification is the process of improving the nutritional quality of food crops through agronomic practices, conventional plant breeding, or other biotechnology (WHO n.d.). Farming practices that focus on soil health improve nutrition because soil quality affects the composition and health of plants. Biofortification may be particularly important in the context of climate change as new research indicates that higher levels of atmospheric $CO_2$ may lead to lower nutrient levels, including zinc, iron, and protein.

While dryland agriculture offers many benefits, it may also pose adverse human health impacts and safety concerns for both community members and farm workers. Therefore, agricultural activities in drylands should be designed to account for potential context-specific health risks to the activity. Box 8 includes potential health considerations for crop production activity design, which should be assessed at the inception of the activity and utilized in the decision-making process. These considerations are not comprehensive and are meant to provide examples of important, project-specific design context. A holistic review of project-specific health risks should be conducted prior to decision-making for the activity design.

### BOX 88. SAMPLE HUMAN HEALTH CONSIDERATIONS FOR ACTIVITY DESIGN

**Community Health**

- Proximity to wells or other drinking water sources and fishing sites
- The role of animal source foods in tackling acute and persistent malnutrition and tradeoffs in production system environments
- Proximity and access to medical services
- Prevalence of zoonotic and vector-borne diseases and their impacts on health

**Occupational Health**

- Exposure to toxins in the production environment and its impacts on health
- Proximity and access to medical services, including poison control
- Exposure to hazards, such as ladders, heavy machinery, high temperatures, agrochemicals, and so forth

Indicators for community human health can be found in the Feed the Future Indicator Handbook (USAID 2019a). Indicators for occupational health can be found in the Occupational Safety and Health Administration (OSHA) guidelines for Using Leading Indicators to Improve Safety and Health Outcomes (OSHA 2019). Leading indicators measure events that precede workplace incidents; they are recommended to inform preventative action for occupational safety. Indicators will be project-specific and should be defined during the project design stage. Some examples of indicators include those listed below:

### Community Health Indicators

- Prevalence of moderate and severe food insecurity based on the Food Insecurity Experience Scale
- Yield of crop production systems

### Occupational Health Indicators

- Rate of workers attending training
- Rate of equipment maintenance

The remainder of this chapter includes a discussion of adverse health impacts from dryland agriculture and potential mitigation measures. Like other chapters of this document, the impacts highlighted below build on those explored in the Crop Production and Livestock SEGs, with added context and considerations for dryland agriculture production. Additional resources for health risks can be found at the end of the chapter.

## 5.1. COMMUNITY HEALTH IMPACTS

Communities surrounding agricultural projects are especially vulnerable to adverse health impacts. Impacts such as respiratory problems due to pesticide drift and drinking water contamination from fertilizer and/or pesticides can cause fatigue, infant methemoglobinemia (blue baby syndrome), and skin irritation. Children and the elderly may be more vulnerable to contracting such illnesses due to their less robust immune systems. The health impacts from crop production projects to which communities are exposed are summarized below:

- **Water access and quality:** The same aquifers that supply water for animals and agriculture in drylands often also provide water for human consumption, so water shortages and contamination from livestock and crop production can negatively affect the drinking water supply. Globally, 1–2 billion people lack sufficient access to water. Of these, most live in drylands, so adverse impacts on water sources from agriculture can further strain water access (Stringer, et al. 2021).

  Improper management of livestock manure, carcasses, runoff, and agricultural chemicals, such as pesticides from livestock and crop production farms, can contribute to decreased water quality. This can limit access to clean water, sanitation, and hygiene (WASH), which has significant human health and social impacts, particularly for women and girls. Insufficient access to WASH services has contributed to the deaths of more than 297,000 children annually, who die from diarrheal diseases each year. Unsafe water also contributes to child malnutrition and physical and mental underdevelopment (UN Water 2021). See the Water and Sanitation SEG for additional information.

- **Food security threats:** Under dryland agricultural projects, food crops are particularly vulnerable to dry spells that severely affect crop productivity (Thalheimer, et al. 2019). Such drought events, exacerbated by climate change, can threaten food security for those who rely on dryland agricultural crops. Low agricultural productivity can also produce less nutritious food (USDA n.d.). Additionally, warming temperatures from climate change can contribute to food spoilage, particularly in areas where cold chain storage is not available (UNEP 2023).

- **Disease transmission:** Dryland agricultural projects may increase the capacity for disease transmission. Stagnant or low-flow water bodies, such as clogged irrigation canals or waterlogged fields and rivers, can breed malaria-carrying mosquitoes and the snails that transmit schistosomiasis. Lowered water tables in arid regions can increase the incidence of sandflies, which transmit leishmaniasis. Using polluted wastewater for irrigation can spread roundworms and tapeworms to both livestock and humans.

  Poor livestock production practices, such as poor quarantine, overcrowding, and poor management of carcasses, can introduce health hazards to humans, including exposure to bacteria, prions, chemical contaminants, and air-borne particles. Many zoonotic diseases can be directly passed to humans, such as pathogenic avian influenza, foot and mouth disease, African swine fever, or lumpy skin disease (Miller and Flory 2018). Livestock can also be a vector for ticks, fleas, lice, and other arthropod-borne pathogens, which can spread typhus and Lyme disease (WHO 2020a).

- **Community respiratory problems:** Dust storms can transport PM, pollutants, and allergens over thousands of kilometers, affecting the health of the surrounding communities (Goudie 2014). Agricultural activities, which do not properly control for the generation of dust, may exacerbate this risk. According to the U.S. Environmental Protection Agency (EPA), fine PM with a diameter of less than 2.5 micrometers (PM 2.5) is particularly harmful to health as the particles can penetrate deep into the lungs and cause cardiovascular and respiratory diseases, such as asthma, especially in vulnerable groups, such as children and the elderly (EPA n.d.).

## 5.2. OCCUPATIONAL HEALTH IMPACTS

Agriculture is the third most dangerous sector for work-related fatalities, illnesses, and injuries. Nearly 200,000 fatalities and millions of injuries occur each year. Farm work is physically demanding and often exacerbated by poorly designed/maintained tools, difficult terrain, exposure to extreme weather conditions, and poor worker health (ILO n.d.). Key occupational health risks are described below:

- **Worker respiratory problems:** Respiratory irritants, such as pesticide vapors, dust, ammonia from manure pits, and mold from crops, can lead to health problems for farm workers, such as asthma. Occupational inhalation exposure to ammonia from manure and/or ammonium nitrate fertilizers is reported to lead to chronic irritation of the respiratory tract, which is known as farmer's lung (UNEP 2021).

- **Safety hazards:** Agriculture is the third most dangerous sector for work-related fatalities, illnesses, and injuries. In the workplace, farm workers and post-harvest food processors are typically at risk of heat exposure, falls, musculoskeletal injuries, loss of limbs, unsanitary conditions, exposure to pesticides, hearing loss from machinery and animal noise, and other risks (ILO n.d.).

  On drylands where water resources are limited, infectious diseases from contaminated groundwater and surface water may become more prevalent, affecting the health of farmers. Additionally, mulch applied to crops as an adaptation strategy to counter water scarcity may harbor some pests and diseases (Talukder, et al. 2021).

Along with previously mentioned safety hazards, suicide via pesticide ingestion is a severe public health issue, especially in the rural areas of developing countries. Highly hazardous pesticides, the most common being organophosphorus pesticides, may be used to self-poison because of their lethal components (WHO and FAO 2023). Globally, pesticide ingestion accounts for 14% to 20% of global suicides (WHO 2020b). Notably, a number of studies have demonstrated that if highly toxic pesticides are unavailable, the death rate drops without significant impacts on crop yields (Gunnell, et al. 2017, Lee, et al. 2021). See Box 9 for additional information.

**BOX 9. PESTICIDE REGULATION TO PREVENT SUICIDE**

In May 2023, the World Health Assembly adopted a global resolution to scale up efforts to curb the harmful impact of chemicals, waste, and pollution on human health, including toxic pesticides and their impact on suicides (WHO and FAO 2023). WHO and the Food and Agriculture Organization of the United Nations (FAO) have since published guidance regarding pesticide regulation to prevent suicide, which is available at https://www.who.int/publications/i/item/9789240066700.

- **Heat stress:** Heat stress and heat stroke are an ongoing problem in the crop production sector as farm work is mostly performed outdoors. Farmers in arid regions are especially at risk of heat stress due to the lack of shade and limited water supply. Increased temperatures due to climate change will likely exacerbate this, with regions such as Sub-Saharan Africa and Southeast Asia potentially facing productivity losses between 30% and 50% (El Khayat, et al. 2022, de Lima, et al. 2021). Severe heat stress can be fatal; however, it can be reduced with proper safety standards and procedures, as well as awareness. Child workers are particularly vulnerable because they cannot sweat as much as adults and are therefore more likely to experience heat stress (FAO 2018).

## 5.3. SUMMARY TABLE OF MITIGATION MEASURES

Mitigation and monitoring methods will depend on both impacts and indicators. Table 4 summarizes the common human health impacts from dryland agriculture and the associated mitigation measures. Like other mitigation tables in this document, Table 4 builds on the impacts discussed in the Crop Production and Livestock SEGs.

**TABLE 4. SUMMARY OF ADVERSE HUMAN HEALTH IMPACTS AND MITIGATION STRATEGIES**

| ACTIVITY | POTENTIAL HEALTH IMPACTS | MITIGATION STRATEGIES |
| --- | --- | --- |
| COMMUNITY HEALTH | | |
| Community Respiratory Problems | Agricultural operations may generate large amounts of PM, which may be hazardous for sensitive groups and increase the rates of asthma in surrounding areas. Drylands | • Build capacity for community health services and health education.<br>• Control PM emissions through the strategies discussed in Section 3. |

| ACTIVITY | POTENTIAL HEALTH IMPACTS | MITIGATION STRATEGIES |
|---|---|---|
| | have more dust as they are dependent on rainfall. Farmers can breathe in dust, which can affect their respiratory system. | |
| Food Security Threats | Food quality may be compromised by pathogens, and physical and chemical contaminants. | • Promote proper manure management in mixed crop-livestock production systems.<br>• Identify any host country laws and regulations and/or international laws or regulations regarding food safety and storage.<br>• Follow host country regulations and pesticide label instructions for the proper application of pesticides.<br>• Promote locally adapted breeds and varieties that may be more resilient to extreme weather. |
| Community Agrochemical Exposure | Community members may be exposed to agrochemicals due to runoff, drift, or misapplication. Related illnesses include infant methemoglobinemia (blue baby syndrome), skin irritation, adverse reproductive effects, fatigue, and cancer.<br><br>Certain fertilizers, such as calcium and ammonium nitrate, are explosive. | • Build capacity for community health services, including poison control.<br>• Limit off-farm transport of agrochemicals through the methods discussed in Section 3.<br>• Store fertilizers and pesticides correctly and away from homes and drinking water supplies. See the USAID Safer Use Pesticides SEG and the Africa Bureau Fertilizer Factsheet.<br>• Use alternative fertilizers to ammonium or calcium nitrate. See USAID Guidance for Procuring Ammonium Nitrate Fertilizer. |
| Water Access and Quality | Agrochemicals and manure may contaminate local freshwater sources, decreasing the availability of drinking water for community members and increasing cases of pesticide and manure exposure. | • Store fertilizers and pesticides correctly and away from homes and drinking water supplies. See the USAID Safer Use Pesticides SEG and the Africa Bureau Fertilizer Factsheet.<br>• Educate community members and farm workers on pesticide and fertilizer-related illnesses and preventable measures.<br>• Minimize overfertilization by using the 4Rs approach. See the Crop Production SEG.<br>• Maintain field buffers, borders, and riparian buffers to minimize leaching.<br>• More details on manure management strategies can be found in the Livestock SEG. |

| ACTIVITY | POTENTIAL HEALTH IMPACTS | MITIGATION STRATEGIES |
|---|---|---|
| Disease Transmission | Health risks, such as cholera, diarrhea, exposure to bacteria, and typhoid, can be caused by poor livestock management. Agricultural activities, such as irrigation or livestock rearing, may increase the prevalence of disease-carrying vectors, such as mosquitoes or ticks. | • Practice adequate personal hygiene.<br>• Maintain clean, well-organized animal housing areas.<br>• Monitor animal health status.<br>• See USAID's One Health approach to address the connections between human health and animal production.<br>• More details on manure management strategies can be found in the Livestock SEG. |
| OCCUPATIONAL HEALTH | | |
| Worker Respiratory Problems | Farmers are exposed to numerous respiratory irritants, such as mold, agrochemicals, and ammonia PM. | • Use personal protective equipment (PPE) when applying and working with agrochemicals.<br>• Provide respirators or other appropriate PPE for activities that generate large amounts of PM.<br>• Control PM emissions through the strategies discussed in Section 3. |
| Safety Hazards | Farm workers and post-harvest food processors are exposed to many safety, environmental, biological, and respiratory hazards. Hazards include falls, machinery accidents, and heat exposure. | • Conduct safety trainings for workers that include information on machine accidents, heat stress, and the use of PPE.<br>• Use PPE when applying and working with agrochemicals.<br>• Keep records of trainings on labor safety and on the number of people in attendance.<br>• Institute procedures for documenting and reporting chemical exposures, accidents, and incidents.<br>• Identify any host country laws and regulations and/or international laws or regulations regarding labor safety.<br>• Always choose the least toxic pesticides to limit the availability of deadly substances. |
| Heat Stress | Farm workers are at high risk for heat-related illnesses due to the hot, arid environment and the strenuous nature of their work. | • Provide ample amounts of fluid for workers.<br>• Institute procedures for documenting and reporting heat-related illnesses.<br>• Workers should receive training about the signs of heat stress and should be encouraged to rest in a shady location as needed. |

## 5.4. RESOURCES REGARDING HUMAN HEALTH IMPACTS


- Integrated Plant Protection Center. 2020. "Pesticide Risk Reduction: An International Guideline." https://pesticide-risk-reduction.github.io/international-pesticide-guideline/.
- International Finance Corporation (IFC). 2012. "Performance Standard 4: Community Health, Safety, and Security." *IFC*. https://www.ifc.org/content/dam/ifc/doc/2010/2012-ifc-performance-standard-4-en.pdf.
- OSHA. n.d. "Agricultural Operations | Hazards and Controls." https://www.osha.gov/agricultural-operations/hazards.
- USAID. 2020. "USAID/BHA Emergency Application Guidelines Pharmaceutical & Medical Commodity Guidance." https://www.usaid.gov/sites/default/files/documents/USAID-BHA_PMC_Guidance_October_2020.pdf.
- USAID. 2022. "Africa Bureau Fertilizer and Soil Fertility Factsheet." https://www.usaid.gov/sites/default/files/2023-05/FinalFertilizerFactsheetShort12142022.pdf.
- USAID. 2022. "Diets and Food Safety - GFSS Activity Design Guidance." https://pdf.usaid.gov/pdf_docs/PA00ZVFF.pdf.
- USAID. 2023. "Guidance for Procuring Ammonium Nitrate Fertilizer." https://www.usaid.gov/sites/default/files/2023-05/USAID%20Ammonium%20Nitrate%20Fertilizer%20Guidance%20and%20Storage%20Addendum_020123_Final.pdf.
- USAID. 2023. "USAID Safer Use Pesticides Sector Environmental Guideline." https://www.usaid.gov/sites/default/files/2022-05/SectorEnvironmentalGuidelines_SaferPesticides_2003.pdf.
- USAID. n.d. "22 CFR 216 Agency Environmental Procedures." https://www.usaid.gov/our_work/environment/compliance/22cfr216.
- USAID. n.d. "Agricultural Commodity Eligibility and Requirements Relating to Quality and Safety: A Mandatory Reference for ADS Chapter 312." https://www.usaid.gov/sites/default/files/documents/1876/312mac.pdf.
- USAID. n.d. "Pharmaceuticals: An Additional Help Document for ADS Chapter 312." https://2017-2020.usaid.gov/sites/default/files/documents/1864/ADS-312-additional-help-508.pdf.
- WHO. 2023. "International code of conduct on pesticide management: guidance on use of pesticide regulation to prevent suicide." https://www.who.int/publications/i/item/9789240066700.

# 6. SOCIAL IMPACTS

> **Social Impact Risk Initial Screening (SIRS) Tool**
> Per the June 2024 update to ADS Chapter 201 Program Cycle Operational Policy, USAID design teams must conduct an initial screening of the social impact of their Activities and Programs using the Social Impact Risk Initial Screening and Diagnostic Tools (ADS 201mbf) (USAID 2024a). The Social Impact Risk Initial Screening (SIRS) Tool is intended to help USAID design teams plan for, mitigate, and monitor potential adverse social impacts from USAID Activities and Programs (USAID 2024b). The Tool consists of 10 questions designed to kickstart mandatory analytical thinking about a variety of different potential adverse social impacts and help identify when additional social safeguarding is needed. Additional social safeguarding may include redesigning Activity/Program components or concepts, identifying social impact mitigation measures, or conducting additional analyses, such as a Social Impact Assessment. When filling out the Tool, design teams should only check "no" when they are highly certain that there is no potential for an adverse impact. The complexity of the process for completing the Tool will vary based on the severity of social impacts posed by the Activity/Program.

Approximately 40% of the world's land environment is made up of drylands, supporting about 2 billion people who are in developing countries (IUCN 2017b). Food products from irrigated and rain-fed farming, as well as pastoralism, not only contribute to food security, they also support the economic livelihoods of developing countries' populations. Approximately 500 million pastoralists rely on livestock as a source of income, social capital, and as collateral or a safety net during challenging times, hence they are key to community resilience (FAO 2016). Small-scale producers can benefit from income-generation opportunities, such as participation in local and regional food markets. Dryland agricultural products can provide sustainable incomes at the household level, which is increasingly important for unpredictable economic shifts. In addition, drylands sustain diversified incomes as they support mixed crop-livestock production. There are beneficial sociocultural impacts from animals, especially livestock, in drylands projects. For example, populations in several developing countries participate in dowry practices in which cattle are given as compensation to the family of the bride, also known as "the bride price." Livestock are also associated with religious and spiritual beliefs in many countries. In the Hindu religion, cows are considered as a sacred symbol (Alders, et al. 2021).

USAID's visions, policies, and strategies call for a participatory process that safeguards against doing harm to its beneficiaries. This process includes ensuring meaningful stakeholder engagement from government, communities, and individuals to assure that USAID's international development efforts benefit all members of society, particularly marginalized and underrepresented groups and/or people in vulnerable situations.

Stakeholder engagement is critical for ensuring that USAID maintains accountability to program participants by ensuring the active participation of local communities, developing mitigation measures that include participants' voices, as well as ensuring that affected individuals and communities can communicate their concerns through USAID's Accountability Mechanism[3]. Given the importance of stakeholder engagement for fostering a successful project, the project may benefit from sustaining this engagement throughout the entire project life.

Just as environmental compliance measures under 22 Code of Federal Regulations (CFR) 216 seeks to avoid, minimize, and mitigate impacts, including with crop production projects, social impacts should be assessed to determine whether there has been a change from baseline conditions for individuals and communities resulting from a USAID project (USAID n.d.a). Furthermore, there may be pre-existing adverse conditions in a local community prior to a USAID-funded activity, which should be taken into consideration to maximize benefit sharing so that proposed USAID-funded activities minimize unintended social consequences, such as impacts on a person's livelihood, economic activities, traditional vocations, land or property rights, access to natural resources, culture and customs, and health and well-being.

Box 10 lists potential social considerations for dryland agricultural activity design. These factors should be assessed at the inception of the activity and utilized in the decision-making process to address potential context-specific social risks to the activity. These considerations are not comprehensive and are meant to provide examples of important project-specific design context. A holistic review of project-specific social risks should be conducted prior to decision-making in the activity design phase.

There are a variety of indicators that can be used as part of a monitoring, evaluation, and learning framework/approach for social considerations in dryland agricultural programming. In general, when developing social indicators, these should be tailored to the activity and consider both quantitative and qualitative indicators. The following are several examples of indicators for social impacts:

- Whether and where women, men, girls, and boys benefit along a particular agricultural value chain
- Who is exercising power or making decisions in agricultural systems
- Proportion of the total adult population with secure tenure rights to land with (1) legally recognized documentation, and (2) who perceive their rights to land as being secure

Examples of frameworks that may be used for the development of social indicators include the following:

- International Food Policy Research Institute. 2019. "Reach, benefit, empower: Clarifying gender strategies of development projects." https://www.ifpri.org/blog/reach-benefit-or-empower-clarifying-gender-strategies-development-projects.
- World Bank. n.d. "Living Standards Measurement Study (LSMS)." https://www.worldbank.org/en/programs/lsms#:~:text=The%20Living%20Standards%20Measurement%20Study%20%28LSMS%29%20is%20the,quality%20of%20microdata%20to%20better%20inform%20development%20policies.

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[3] The USAID Social, Economic, and Environmental Accountability Mechanism (SEE-AM) is expected to be formally launched in summer 2024. The SEE-AM offers communities and project participants to report adverse social, economic, or environmental impacts caused by USAID-funded activities. Complaints and questions can be submitted to disclosures@usaid.gov.

- Millennium Challenge Corporation. 2023. "Guide to the MCC Indicators for Fiscal Year 2024." https://www.mcc.gov/resources/doc/guide-to-the-indicators-fy-2024/#land-rights-and-access-indicator.

Furthermore, there are nine social impact principles based upon the USAID Voluntary Social Impact Principles Framework that provides further guidance, discussed below.

## 6.1. KEY SOCIAL IMPACTS

This section is organized according to the principles presented in USAID's Voluntary Social Impacts Principles Framework. The Voluntary Social Impact Principles Framework encompasses nine principles for considering and assessing potential social risks and social impacts across USAID programs, projects, and activities. Table 5 summarizes the nine principles. For additional information on the nine Principles see the USAID Voluntary Social Impact Principles Framework. The subsequent sections present an illustrative list of potential social impacts pertaining to crop production projects that Missions and/or Implementing Partners (IPs) should consider.

**TABLE 5. USAID VOLUNTARY SOCIAL IMPACT PRINCIPLES**

| PRINCIPLE | | DESCRIPTION |
|---|---|---|
| 1 | Indigenous Peoples | Indigenous Peoples are a distinct cultural, linguistic, and social group with historical continuity, collective attachment to surrounding natural resources, and/or commitment to maintaining ancestral systems. Specific actions are required of USAID programs involving Indigenous Peoples. |
| 2 | Cultural Heritage | Cultural heritage is part of every culture and is found all over the world. It includes archaeological sites, historic buildings, artifacts, and natural environments inherited from past generations as well as intangible knowledge and practices. Working in areas with cultural heritage or on cultural heritage projects can have consequences beyond just destruction of an important resource and can also offer potential means of positively engaging with communities. |
| 3 | Land Tenure, Displacement, and Resettlement | Land tenure is associated with acquiring and managing rights to land. Land use change may lead to compulsory displacement and resettlement (CDR), and/or the loss of access and/or use of land and natural resources, which should be avoided and minimized to reduce social impacts on affected landholders, tenants, community members, and pastoralists, among other groups. Failure to account for, and respect, the land and resource rights of local community members can cause costly delays, work stoppages, protests, and, in some cases, violence. USAID may face legal actions and suffer financial, brand, or reputational harm. |

| PRINCIPLE | | DESCRIPTION |
| --- | --- | --- |
| 4 | Health, Well-Being, and Safety | Health, Well-being, and Safety is safeguarding against potential physical, psycho-social, and health impacts among project staff, program participants, and communities where AID actions are implemented. Individual USAID actions must account for potential occupational health and safety risks, as well as potential uneven socio-economic gains across affected communities/program participants, to avoid unintended consequences. |
| 5 | Working with Security Personnel | Cognizance of the unique challenges involved in engaging security personnel, working with security personnel prioritizes a rights-based approach to ensure respect for, and safety of, individuals and local communities. Without transparent and accountable oversight of rule of law, the risks of potential human rights violations increase. |
| 6 | Conflict Dynamics | Attentiveness to the operational context in relation to past and present conflicts as well as sensitivity around the role that a USAID action has in shaping the conflict landscape. Poor understanding of conflict dynamics increases the possibility of contributing to or exacerbating conflict. |
| 7 | Inclusive Development | Inclusive development is an equitable development approach built on the understanding that every individual and community, of all diverse identities and experiences, is instrumental in the transformation of their own societies, which means providing them with the opportunity to be included, express their voices, and exercise their rights in activities and public decisions that impact their lives. Inclusion is key to aid effectiveness. Nondiscrimination is the basic foundation of USAID's inclusive development approach. |
| 8 | Environmental Justice | Environmental Justice (EJ) is the fair treatment and meaningful engagement throughout the project life cycle of marginalized and underrepresented groups and/or people in vulnerable situations, with respect to environmental and/or health impacts and implementation and enforcement of environmental laws. It includes the protection of marginalized and underrepresented groups that may face enhanced vulnerability due to environmental harms caused by any action or activity. Marginalized and underrepresented groups and/or people in vulnerable situations may include (but are not limited to): Indigenous Peoples, LGBTQI+ persons, persons with disabilities, children and other youth, older persons, women, low-income populations, and all disadvantaged and marginalized communities across race, color, gender, or national origin. |
| 9 | Labor | The Labor principle focuses on advancing worker empowerment, rights, and labor standards through programming, policies, and partnerships to advance sustainable development outcomes. USAID recognizes the high risk of labor abuses that may result from programming, and, thus, USAID works to establish and strengthen labor protections (including social protections) that |

| PRINCIPLE | DESCRIPTION |
| --- | --- |
| | align with internationally recognized worker rights. This principle includes the promotion of safe and healthy work environments; respecting the principles of freedom of association and collective bargaining; the elimination of forced labor and the worst forms of child labor; and the protection from discrimination at work. |

### 6.1.1. CULTURAL HERITAGE

Cultural heritage is part of every culture and is found around the world. Working in areas with cultural heritage resources can have consequences beyond just the destruction of an important cultural site. It is important to assess cultural heritage when planning dryland agriculture projects as there may be unintended impacts. Cultural heritage refers to monuments (e.g., architecture, sculptures, elements, or structures of an archaeological nature), groups of buildings, and sites (e.g., archaeological sites, burial sites, areas of human-made and natural features) that are of outstanding universal value from a historical, artistic, scientific, aesthetic, ethnological, or anthropological point of view. Examples of this tangible type of cultural heritage also include moveable objects (including artifacts, paintings, coins, manuscripts, and sculpture), underwater resources or sites (including shipwrecks, ruins, and submerged landscapes), and paleontological remains. In addition to tangible resources, cultural heritage includes intangible resources, which may be aspects of culture, knowledge, history, customs, beliefs, and traditions that may be invisible or not apparent and are often unseen by people who are not of that culture. The United Nations Educational, Scientific and Cultural Organization (UNESCO) states that intangible heritage can include oral traditions and expressions, folklore, beliefs, language, knowledge, performing arts, social practices, rituals, festive events, and traditional craftsmanship (UNESCO 2011, UNESCO 1972). For example, a local community may consider the site where a dryland agricultural project is being proposed to be a culturally significant landscape or it could be a burial site which is sacred to the local community members. Furthermore, a local community may depend upon ancestral customs, traditions or practices, regarding how to undertake dryland agriculture in the geographical region which needs to be preserved for the local community's very survival. Such traditional practices may date back hundreds or thousands of years and, if disturbed (due to a proposed project), could cause an unintended impact or impacts not only to cultural heritage (by losing traditional practices) but also by causing indirect social impacts such as the disruption of traditional livelihoods and local or traditional knowledge.

In order to ascertain whether a dryland agriculture project may have unintended impacts on cultural heritage, USAID has released a resource on the potential positive and negative impacts for cultural heritage resources as the result of USAID programming (USAID 2023a). In addition, several resources are available from the U.S. National Park Service, the International Council on Monuments and Sites, UNESCO, and the International Finance Corporation (IFC) (see footnote).[4] Furthermore, prior to project implementation, it is important to carry out a Social Impact Assessment while including broad

[4] See National Park Service (NPS) | National Heritage Area Feasibility Study Guidelines, ICOMOS | Guidance on Heritage Impact Assessments for Cultural World Heritage Properties, UNESCO | List of World Heritage Sites in Danger, and IFC | Performance Standard 4: Community Health, Safety, and Security.

and in-depth stakeholder consultations to become aware of the existence of the cultural resources in or nearby the proposed project site.

In order to ascertain whether a proposed dryland agricultural project may have unintended impacts on cultural heritage, several resources are available from the U.S. National Park Service, the International Council on Monuments and Sites (ICOMOS), UNESCO, and the International Finance Corporation (IFC) (see footnote). Furthermore, it is important to engage early on with stakeholders through consultations to become aware of the existence of the cultural heritage resources in or near the proposed project site.

### 6.1.2. LAND TENURE, DISPLACEMENT, AND RESETTLEMENT

While dryland agriculture projects will likely not necessitate large stretches of land to undertake a project such as a large-scale dryland agriculture project, it is nevertheless important to be cognizant of the social implications that may come about due to land use change. In particular, land use change may have repercussions for land use access, access to land resources, and implications on land tenure and resource claims and rights, due to the siting or placement of projects.  Consequently, land use change and the associated repercussions should be assessed early on during the design phase when a project is being proposed.

Land tenure is associated with acquiring and managing rights to land. Loss of access to land and/or resources, changes to the use of land and resources, and/or CDR is to be avoided or minimized to reduce the risk of impoverishment of the affected landholders, tenants, local community, and pastoralists. Failure to account for the land and resource rights of local people can cause costly delays, work stoppages, protests, and, in some cases, violent conflict.

Land tenure is the relationship that individuals and groups of people hold with respect to land and related resources. "Land tenure rules define the ways in which property rights to land are allocated, transferred, used, or managed in a particular society" (UN REDD Bangladesh Office 2017). Land tenure issues can be complicated in areas that may not have a formal system of land ownership or of documentation of land ownership. Traditional rights of use (e.g., for hunting and/or gathering) may be allocated at the local level without a legal registration system. These alternate forms of land tenure and land use when assessing impacts, designing mitigation measures, and determining compensation must be considered. These projects should be assessed for the risk of the impingement of use rights.

Dryland agricultural projects may also rely on large-scale irrigation schemes that may have impacts at the local level. Additionally, at the watershed level, it is important to have a clear understanding of the project footprint, scale, and scope when assessing irrigation scheme interventions. including addressing local social impacts (e.g., access).

As an example of social impacts, for a small-scale dryland agricultural project, smallholders may lose ownership of land due to a proposed dryland agricultural project because of the lack of clear property rights because the smallholders hold customary rights and not legal rights to the land. Therefore, the lack of legal rights to the land may render the smallholders ineligible for financial compensation. The loss of land can negatively affect smallholders because they rely on the land for subsistence from the consumption of crops or livestock. A negative impact, such as the one described herein, can be avoided by comprehending land tenure, which should be assessed and addressed early on at the site level.

Land tenure issues may lead to CDR. In the context of dryland agriculture projects, there may be a potential social impact of economic displacement, rather than physical displacement or involuntary resettlement due to the smaller footprint of the dryland agriculture project; however, economic displacement may affect local community members. Economic displacement is an impact that should be avoided, minimized, or mitigated.

Economic displacement may occur when a business moves from a valuable location, a worker must travel a greater distance to get to his or her place of employment, or an individual or business loses access to natural resources that provide an economic or survival benefit. Displacement can also have social implications by disrupting or dispersing communities, fracturing social networks, or reducing access to important cultural heritage resources and sites. Resettlement to alternative sites can have negative social impacts on both the resettled population and the established community at the new site, with one or both groups subject to discrimination, prejudice, social conflicts, and/or violence.

There may also be physical displacement. When there is the potential for partial or total physical displacement, economic displacement, or resettlement, the social impacts must be assessed and addressed in an Environmental and Social Impact Assessment (ESIA). USAID's Environmental Compliance Procedures (22 CFR 216) identify resettlement as a class of action with a "significant effect" on the environment and therefore requires, as appropriate, either an EA or Environmental Impact Statement (EIS).

USAID has implemented guidelines that cover CDR that may result from USAID programs (USAID 2016a). Given the importance of stakeholder engagement, an important first step is to review the Agency's social assessment-related resources, including the Environmental Compliance Factsheet: Stakeholder Engagement in the Environmental and Social Impact Assessment Process (USAID 2016b). Specific guidelines that USAID and its partners should follow to avoid, minimize, and mitigate CDR risks include the following:

- Understand the legal and institutional contexts.
- Identify all legitimate landholders and relevant risks.
- Develop a Resettlement Action Plan and a Livelihood Action Plan (LAP) if physical displacement is unavoidable.
- Promote informed and meaningful engagement.
- Improve livelihoods and living standards.
- Provide additional protections for marginalized and underrepresented groups and/or people in vulnerable situations, especially women and Indigenous Peoples (USAID 2024c).

The USAID CDR guidelines are consistent with leading international standards on land and resource tenure, including IFC Performance Standard 5, Land Acquisition and Involuntary Resettlement, and Environmental and Social Standard 5 in the World Bank Environmental and Social Framework (USAID n.d.b, USAID 2016c, USAID 2016a, IFC 2012, World Bank 2017).

Resettlement must consider not only the impacts on displaced people but also the impacts on the communities to which the displaced people are resettled. Failure to address the issues of all stakeholders can lead to many challenges, including adverse impacts on project-affected groups and individuals, delays in project implementation, possible cancellation of the project, protests, conflict, and/or violence.

### 6.1.3. HEALTH, WELL-BEING, AND SAFETY

Specific choices around project design and implementation invariably have the potential to influence health, well-being, and safety. Assessing and managing the potential social impacts related to health, well-being, and safety and requires a careful and sustained effort. For example, for dryland agricultural projects, it is important to consider the impacts of medium-sized to larger scale irrigation schemes. Poor irrigation can increase the incidence of vector-borne water-related diseases, such as malaria in local communities. In addition, contaminated drinking water may force local community members, especially women, to travel farther in search of clean drinking water. This may risk the safety of women as they may have to travel to remote, unfamiliar, or unsafe locations to fetch drinking water, and may lead to an increase in the risk of conditions that may lead to gender-based violence (GBV).

Furthermore, the linkages between increased human immunodeficiency virus (HIV) prevalence and development projects in the developing world are well documented and are due largely to the presence of mostly male migrant workers (UNDP 2012) who engage in seasonal agricultural activities. USAID staff and Implementing Partners must consider the fact that, in areas with high HIV and acquired immunodeficiency syndrome (AIDS) prevalence, the labor force may become depleted as both men and women may be unable to engage in agricultural activities (either because they are infected or because they are caring for others who are infected). Therefore, the potential for increasing the risk of communicable disease, such as HIV/AIDS, in a dryland agricultural project should be avoided, minimized, or mitigated.

### 6.1.4. CONFLICT DYNAMICS

USAID's projects are often implemented in fragile or conflict-affected environments. USAID's work encompasses investments in conflict prevention and mitigation, stabilization, and peace building, parallel to investments in other sectors. Understanding conflict dynamics and how a dryland agriculture project affects or is being affected by these dynamics is an essential component of being conflict aware and conflict sensitive (USAID 2024c).

For example, local communities may have a heightened awareness of the distribution of resources, as well as the roles and responsibilities of the people involved in the distribution of those resources, and a proposed dryland agriculture project may exacerbate the underlying conflict dynamics. For example, water is the principal factor limiting crop yield and primary production on rangelands in dryland agriculture, and local communities that may already be competing for this limited natural resource may already be experiencing social conflict. There may be historical grievances that come to light due to proposing a dryland agriculture project to benefit one group of people over another, or due to siting and placement of the project, which may exclude one group over another, thus exacerbating local tensions. Therefore, conflict dynamics at the site level should be understood during the design phase by means of engaging stakeholders in a participatory approach and assessing conflict dynamics. Additional resources and guidance on conflict dynamics may be found in the footnotes.[5]

#### 6.1.5. LABOR

Dryland agriculture is a labor-intensive sector and hence involves workers. Each project implementer should be aware of the International Labor Organization's (ILO) conventions that the host country has signed.[6] Adherence to ILO's core labor standards is essential. The ILO core labor standards address freedom of association, collective bargaining, abolition of forced labor and the worst forms of child labor, minimum age, equal remuneration, discrimination, and the protection of children and young persons. Even for countries that do not adopt one or more standards, they are fundamental to the protection of the workforce. USAID's Agency-Wide Counter-Trafficking in Persons Code of Conduct has the goal of prohibiting USAID contractors, subcontractors, grantees, and sub-grantees from engaging in trafficking in persons, procuring commercial sex acts, or using forced labor. Please refer to the references in the footnote.[7]

Furthermore, dryland agriculture projects expose workers to occupational risks and hazards such as heat exposure due to rising temperatures caused by global warming. Individual projects should ascertain the occupational health and safety risks to workers and design mitigation measures. Follow guidance in the footnote.[8]

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[5] See USAID | Technical Publications on Conflict Management and Mitigation and USAID | Voluntary Social Impact Principles Framework.

[6] Per IFC Performance Standard 2, this Performance Standard recognizes that "the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers and must respect several International Labor Organization (ILO) Conventions, including ILO Convention 87 on Freedom of Association and Protection of the Right to Organize; ILO Convention 98 on the Right to Organize and Collective Bargaining; ILO Convention 29 on Forced Labor; ILO Convention 105 on the Abolition of Forced Labor; ILO Convention 138 on Minimum Age (of Employment); ILO Convention 182 on the Worst Forms of Child Labor; ILO Convention 100 on Equal Remuneration; ILO Convention 111 on Discrimination (Employment and Occupation); UN Convention on the Rights of the Child, Article 32.1; and the UN Convention on the Protection of the Rights of All Migrant Workers and Members of their Families." See Section 1: Purpose of this Policy (ifc.org).

[7] For more information, please see Alliance 8.7 | Ending Forced Labour, Modern Slavery, Human Trafficking and Child Labour, DOL | Comply Chain: Business Tools for Labor Compliance in Global Supply Chains, ILO | Convention 189: Domestic Workers Convention, Rainforest Action Network | Workers' Rights and Environmental Justice, Responsible Sourcing Tool | Is Forced Labor Hidden in Your Global Supply Chain?, The White House | Memorandum on Advancing Worker Empowerment, Rights, and High Labor Standards Globally, United Nations | Promote Sustained, Inclusive and Sustainable Economic Growth, Full and Product Employment and Decent Work for All, and USAID | ADS Chapter 225: Program Principles for Trade and Investment Activities and the "Impact on U.S. Jobs" and "Workers' Rights".

[8] For more information, please see ILO | C184: Safety and Health in Agriculture Convention, World Bank | Guidance Note for Borrowers: ESS2: Labor and Working Conditions, ILO. n.d. "Introduction to International Labour Standards," ILO | Protocol 155 - Protocol of 2022 to the Occupational Safety and Health Convention, ILO Convention 100 on Equal Remuneration, ILO Convention 111 on Discrimination (Employment and Occupation), UN Convention on the Rights of the Child, Article 32.1 "UN Convention on the Protection of the Rights of all Migrant Workers and Members of their Families," and Section 1: Purpose of this Policy (ifc.org).

## 6.2. OTHER SOCIAL CONSIDERATIONS

### 6.2.1. LOCAL COMMUNITY

When planning and designing dryland agricultural projects, the local community in which the project will be embedded should be assessed. This assessment may be addressed prior to assessing potential social impacts by means of undertaking a desktop review of the characteristics of the community, such as demographics; socioeconomic composition; and political, institutional, and legal frameworks, as well as through field visits and stakeholder engagement. Although the particulars of identifying social impacts for dryland agricultural projects depends on the site location, and local context, undertaking stakeholder engagement early on is necessary to improve the understanding of how the proposed project may affect the local community. If stakeholders in a local community voice concerns regarding potential negative social impacts due to a proposed project, the social impacts may be assessed, and mitigation and monitoring measures designed. Management measures should be commensurate with the degree of the identified adverse social impacts. In cases where social impacts from project activities are deemed to adversely affect the lands, rights, and livelihoods of individuals and communities, implementation of the project should be reconsidered (i.e., potentially ended). If/when the project is under implementation, the local community is adversely impacted, implementation of the project may need to be curtailed until adequate management measures have been designed and implemented to mitigate the identified impacts.

A lack of appreciation of local or traditional knowledge of land management on drylands, as well as a disregard for their priorities as resource users, has led many development interventions to fail or to be rejected by local communities. In view of this, it is important for project implementers and evaluators to assess the degree to which a project has encouraged stakeholder engagement in decision-making and whether indigenous local knowledge has been consulted.

Environmental compliance should assess the degree to which communities have access to project benefits and the degree to which agricultural projects and programs are designed to improve household food security. Without benefit sharing, the long-term sustainability of a project is doubtful.

### 6.2.2. THE ROLE OF STAKEHOLDER ENGAGEMENT

Stakeholder engagement provides a systematic approach to Missions and Implementing Partners to acquire stakeholders' input, information, feedback, local and traditional knowledge, local perspectives, and concerns early on, during the design and planning phase, well before the assessment of the social impacts phase, as well as should be sustained throughout the entire project life cycle (USAID 2022b). Stakeholders may be groups or individuals from the private or public sector, as well as individuals who may be considered an affected party along with those who may have interests in a project or the ability to influence its outcome, either positively or negatively. Members of civil society organizations may also be considered such as youth groups, church groups, or women's clubs. Special attention should be paid to marginalized and underrepresented groups and/or people in vulnerable situations because they may be inequitably affected by a project.

Stakeholder mapping, engagement, and consultation are key steps in the planning process of dryland agricultural projects and will also be crucial in identifying opportunities for the inclusion of marginalized and underrepresented groups and/or people in vulnerable situations (USAID 2016b). Stakeholder engagement should be a broad, inclusive, and continuous process. The benefit of beginning the stakeholder engagement process early on and sustaining it throughout the entire project life cycle is that it may allow for the co-creation[9] of positive benefits, for example identifying mitigation measures regarding the social impacts based on traditional knowledge from local community members, through adaptive management. Information on best practices for stakeholder engagement is available in the USAID document entitled Environmental Compliance Factsheet: Stakeholder Engagement in the Environmental and Social Impact Assessment (ESIA) Process (USAID 2016b).

### 6.2.3. GENDER EQUALITY

When planning and designing dryland agricultural projects and during the process of evaluating potential social impacts, gender issues may need to be considered. Women oftentimes are involved in dryland agricultural projects yet do not always benefit from the project equally. Therefore, social impacts are gender differentiated and can affect men and women in different ways.

USAID seeks to support gender equality with the following goals: (1) improve the lives of people by advancing gender equality; (2) empower women and girls to participate fully in, and equally benefit from, the development of their societies on the same basis as men; and (3) secure equal economic, social, cultural, civil, and political rights regardless of gender. USAID policy requires that a Gender Analysis "be integrated in strategic planning, project design and approval, procurement processes, and measurement and evaluation" as part of ADS 205: Integrating Gender Equality and Women's Empowerment in USAID's Program Cycle, which seeks to integrate gender and equality into the program cycle (USAID 2023b).

In developing countries, rural women are generally responsible for caring for small livestock and vegetable gardens, and gathering fuel, fodder, water, and wild foods. Women are often responsible for providing households with food; however, few own land. Men are still largely responsible for land management, decision-making, and the planning of farming activities. Both formal and customary land policies seldom account for the impacts on women. Despite this, men increasingly leave degraded areas to look for jobs in urban areas or as migrant laborers, leaving women to assume the main responsibilities on the farm. Increasing opportunities for women can have a powerful impact on productivity and agriculture-led growth, also leading to economic gains (USAID 2016d).

Furthermore, assessing gender considerations can help to avoid the potential of exacerbating underlying conditions, beliefs, or value systems that perpetuate gender-based violence (GBV). GBV should be prevented as this has a significant social impact. See the USAID resource indicated in the footnote for

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[9] USAID defines co-creation as a process that "brings people together to collectively design solutions to specific development challenges. Time limited and participatory, partners, potential implementers, and end-users define a problem collaboratively, identify new and existing solutions, build consensus around action, and refine plans to move forward with program and projects." For additional information see USAID | Co-Creation at USAID.

evaluating the potential for GBV and addressing its impacts.[10] The additional USAID resources linked in the footnote can provide additional guidance on gender considerations.[11]

***Note:*** *For key concepts and best practices for gender integration in dryland agricultural programming, see* Global Food Security Strategy Technical Guidance: Advancing Gender Equality and Female Empowerment.

### 6.2.4. LOCAL OR TRADITIONAL LIVELIHOODS

The nature and range of social impacts may not be immediately apparent during the planning phase for dryland agricultural projects; hence, stakeholder engagement should begin early in the project life cycle and particular attention should be paid to vulnerable, marginalized, and/or underrepresented groups in order not to put them in a position of increased socioeconomic vulnerability. The potential for adverse impacts on community members' livelihoods needs to be assessed at the local level and often needs to be addressed on an individual basis.

A Livelihood Action Plan that entails a sustainable livelihoods approach may be useful when completing a social impact assessment for a project that may affect the rural poor in the context of proposed dryland agricultural projects. A livelihoods restoration strategy may also be necessary to avoid adversely affecting stakeholders in areas where comparable economic opportunities are not readily available (Asian Development Bank 2017).

### 6.2.5. GOVERNANCE

Good governance is essential for achieving an agriculture-for-development agenda, including both formal and customary governance structures. Governance problems, such as inappropriate fertilizer and pesticide subsidies and the misappropriation of funds, are a major reason that many agricultural projects fail; however, good governance can also be a factor in success.

User or management committees are informal governance structures frequently used to support local-level participation in an activity and improve sustainability. Appropriately applied, management committees function as oversight and ruling bodies for local-level operations and maintenance of assets. When properly structured, they can greatly improve the efficiency of repairs, increase the effectiveness of the infrastructure intervention, reduce cost, and build community cohesion as additional positive outcomes of the activity. However, when they are improperly structured, or lack the proper stakeholder participation, they can undermine the objectives of the program. For example, user committees for water control structures are critical to equitable allocation of resources and for ensuring repair; however, those user committees frequently do not, or cannot, determine how to integrate upstream landowners. Without the inclusion of upstream farmers, water quality and watershed

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[10] See USAID | Foundational Elements for Gender-Based Violence Programming in Development.

[11] See USAID | Gender Equality and Female Empowerment Policy, USAID | Gender Equality and Women's Empowerment 2020 Policy, USAID | USAID Websites with Related Gender Resources, and USAID | Integrating Gender into Workplace Policies.

integrity can easily be degraded by hillside agriculture that washes massive amounts of topsoil into the streams, which collects behind dams, rendering them useless.

Other more formal governance structures, particularly at the local level, can make big strides in the environmental soundness and sustainability of the overall project. For example, *dinas* (or social contracts) were emphasized as part of a traditional but legally recognized governance system for farmers in a Madagascar Food for Peace Program. New *dinas* were developed with the user committees to strengthen their governance over the asset. Dinas were drafted to identify taxes for the use of the structure, dictate repair schedules and participation, and even identify punishable infractions. This formal, yet locally relevant, governance component added strength and legitimacy to the environmental mitigation measures in place for the project.

## 6.3. SUMMARY TABLE OF SOCIAL IMPACTS, MITIGATION MEASURES AND MONITORING MEASURES

The social impacts discussed in Table 6 are for illustrative purposes only and do not provide an exhaustive list because the social impacts identified for solid waste projects and activities will depend on the site location and the specifics of a proposed project, as well as the local context, among other factors. The mitigation and monitoring measures also are described in the subsections below and are not an exhaustive list.

**TABLE 6. SUMMARY OF ADVERSE SOCIAL IMPACTS AND MITIGATION MEASURES**

| SOCIAL IMPACTS | MITIGATION MEASURES | MONITORING CONSIDERATIONS |
|---|---|---|
| **Gender Equality**<br>Women often have less ownership of land despite comprising a significant portion of agricultural labor.<br><br>Water contamination from poor irrigation or lack of water from drought may lead to women traveling to unfamiliar locations to fetch drinking water. This may pose a risk to their safety, leading to an increase in the risk of Gender-Based Violence (GBV).<br><br>Marginalization of women when an irrigation project is developed. | • Draft a Stakeholder Engagement Plan (SEP) early in the project life cycle and sustain it throughout the project<br>• Undertake gender analysis (mandatory for USAID activities per USAID ADS 205) during the Environmental and Social Impact Assessment process to understand how the beneficial and adverse impacts of crop production may accrue differentially to women.<br>• Ensure that women have legal rights to own, inherit, and transfer land.<br>• Educate local administrative officials on women's land rights and how to promote and enforce these rights.<br>• Review USAID's Gender Equality and Female Empowerment Policy (USAID 2023a). | • Review the SEP for the dryland agricultural activity periodically and integrate feedback from women and girls on an ongoing basis.<br>• Analyze the attendance of participants who have engaged in the awareness-building workshops on GBV.<br>• Review the SEP periodically.<br>• Assess the number of participants who attended the women's only focus group.<br>• Revisit the results of the design charrette and undertake a systematic approach to continually integrate the results into the design and implementation of the irrigation project. |

| SOCIAL IMPACTS | MITIGATION MEASURES | MONITORING CONSIDERATIONS |
|---|---|---|
| | • Establish women-led "community protection groups" to ensure that individuals feel safe traveling to areas on which they depend.<br>• Offer awareness-building workshops on GBV.<br>• Establish an SEP.<br>• Conduct focus groups that are for women and girls only.<br>• Co-design the project by means of using innovative approaches to planning (e.g., undertaking a design charrette with women). | |
| **Cultural Heritage**<br>The loss of land ownership by marginalized and underrepresented groups and/or people in vulnerable situations may lead to the repurposing of sites of historic or religious/sacred significance.<br><br>Loss of customary or traditional dryland agricultural practices (which leads to the loss of traditional or local knowledge) due to a project: Traditional pastoralists have been undertaking customary forms of dryland agriculture; however, because of the pressure to plant cash crops due to the increasing pressure of agricultural subsidies, their traditions and traditional knowledge is being lost. | • Set up a Stakeholder Engagement Plan (SEP) with traditional pastoralists.<br>•<br>• Identify cultural heritage sites during the design stage by visiting sites and conducting community consultations.<br>• Design to avoid conducting dryland agricultural activities on cultural heritage sites.<br>• Avoid the relocation of tangible cultural heritage resources, such as artifacts or structures considered to be local cultural heritage.<br>• Observe host countries' specific legal requirements that apply when projects may affect sites of cultural significance.<br>• Design and implement a mitigation approach informed by appropriate consultations.<br>• Conduct desktop review and, if feasible, remote sensing to ensure that the site being proposed does not possess cultural heritage resources.<br>• Undertake focus groups wherein participants will develop community maps of the areas that hold traditional importance.<br>• Engage in the co-design of the project, leveraging local and traditional knowledge to | • Periodically review the SEP.<br>• Continue to conduct community consultation meetings to avoid the disruption of cultural heritage sites.<br>• Keep a log of stakeholders' complaints and review how the complaints are being addressed.<br>• Conduct follow-up activities with local and/or national cultural heritage organizations and institutions.<br>• Review relocation plans for cultural heritage objects.<br>• Review and update the SEP on a periodic basis.<br>• Review the results from the focus groups.<br>• Assess the number of "value added" traditional crops. |

| SOCIAL IMPACTS | MITIGATION MEASURES | MONITORING CONSIDERATIONS |
|---|---|---|
| | maximize benefits and decrease negative impacts.<br>• Engage in focus groups to explore alternatives as to how value can be added to traditional crops in order to minimize the repercussions of the cash crops. | |
| **Land Tenure, Displacement, and Resettlement**<br>Smallholders, including marginalized and underrepresented groups and/or people in vulnerable situations, may lose ownership of the land, thus affecting their ability to graze animals, gather fuel wood, and so forth.<br><br>Smallholders may not be able to keep their land or receive compensation for their land due to the lack of formal property rights.<br><br>In some cases, it may lead to landlessness, an inability to access jobs, food insecurity, impoverishment, social conflict, and violence. | • Conduct stakeholder engagement during the planning and design phase to understand local land tenure insecurity and determine whether the impacts of insecure tenure may be a concern in the context of dryland agricultural activities.<br>• Establish an SEP for continued community consultation.<br>• If land tenure is a concern, conduct mitigation strategies such as supporting smallholders in obtaining formal land title and formalizing informal land usage rights.<br>• Keep a log of all potential land tenure use and tenure changes and the stakeholders who may be affected in a report.<br>• Consider alternatives during the design phase to avoid and minimize impacts to vulnerable, marginalized, and underrepresented groups.<br>• Include participatory identification and mapping of areas that are important to marginalized and underrepresented groups and/or people in vulnerable situations for hunting, gathering, and/or agricultural activities. | • Review and update the SEP periodically.<br>• Periodically review the reports on land use and land tenure changes and the stakeholders affected.<br>• Undertake ongoing stakeholder engagement.<br>• Refer to the guidance on monitoring in the Biodiversity Conservation SEG. |
| **Health, Well-Being, and Safety**<br>Local communities near dryland agricultural activities may be exposed to water-borne illnesses due to poorly planned irrigation schemes. Water-related illnesses | • Draft an SEP early on during the project.<br>• Educate community members and farm workers on water-related illnesses and prevention measures.<br>• Conduct awareness-building and educational workshops that communicate the risks from | • Continue to sustain the SEP throughout the project.<br>• Monitor irrigation water regularly.<br>• Institute procedures for documenting and reporting cases of water-borne illnesses.<br>• Keep records of trainings on heat stress prevention and treatment. |

| SOCIAL IMPACTS | MITIGATION MEASURES | MONITORING CONSIDERATIONS |
|---|---|---|
| include malaria, bilharzia, and river blindness.<br><br>Poor water quality from irrigation schemes can increase incidences of poisoning and health impacts, especially in children or older people, because the water source that they once depended on has become contaminated by herbicides and pesticides that are recently being used due to a proposed project.<br><br>Due to increased temperatures and incidences of drought from climate change, farmers and ranchers may be affected by heat stress. | drinking water that is in close contact with irrigation systems.<br>• Build capacity for community health services and health education.<br>• Promote better irrigation practices.<br>• Train farmers and ranchers on methods to prevent and treat heat stress. | • Keep records on the number of participants who attend the capacity-building workshops on the risks of drinking water that is in close contact with the irrigation schemes.<br>• Appoint safety representatives or form health and safety committees. |
| **Conflict Dynamics**<br>A project may unintentionally cause conflict in the local community regarding the loss of land tenure or competition for resources, especially water, due to poorly planned irrigation systems. | • Consult Technical Publications on Conflict Management and Mitigation.<br>• Undertake stakeholder engagement at the beginning of the project life cycle.<br>• Establish an SEP.<br>• Consult with community leaders, government officials, members of civil society, women's groups, church groups, non-governmental organizations, and community-based organizations, among other stakeholders, to understand existing conflicts and tensions.<br>• Undertake a social baseline study. | • Review and update the SEP periodically.<br>• Integrate the results of the conflict dynamics assessment into the SEP.<br>• Conduct stakeholder engagement on an ongoing basis through different mixed-methods approaches, such as village meetings or community surveys prior to and throughout project implementation. |
| **Labor**<br>Farm workers are exposed to several safety, health, environmental, biological, and respiratory hazards. Hazards include pesticide exposure, falls, heat exposure, and other risks. | • Draft an SEP early on during the project.<br>• Address occupational safety in the pre-implementation Environmental and Social Impact Assessment process (e.g., USAID Initial Environmental Examinations and Environmental | • Institute procedures for documenting and reporting chemical exposures, accidents, and heat stress.<br>• Keep records of trainings on labor safety.<br>• Conduct monthly reviews to monitor gender equality in the workplace.<br>• Keep records of trainings on heat |

| SOCIAL IMPACTS | MITIGATION MEASURES | MONITORING CONSIDERATIONS |
|---|---|---|
| Occupational health and unfair labor practices are heightened when national occupational labor standards are poorly developed or enforced.<br><br>Enterprises may not provide equal employment opportunities for women and marginalized and underrepresented groups and/or people in vulnerable situations and/or may engage in the worst forms of child labor. | Assessments). The process should specifically address labor safety and health risks presented by dryland agricultural activities, such as the use of equipment, fertilizers, and pesticides.<br>• Follow Guidance as per ILO 155 (ILO 1981).<br>• Follow Guidance as per the U.S. Department of Labor's annual "Findings on the Worst Forms of Child Labor" and "List of Goods Produced by Child or Forced Labor" (U.S. Department of Labor 2022a) (U.S. Department of Labor 2022b)<br>• Conduct worker safety training.<br>• Identify any host country laws and regulations and/or international laws or regulations regarding labor safety.<br>• Solicit workers' (both men and women) input to fully understand capabilities.<br>• Discuss which tasks workers are comfortable performing and which tasks they are uncomfortable performing.<br>• Offer all roles to all potential workers and provide training to women through partnerships with educational institutions. | stress prevention and treatment.<br>• Appoint safety representatives or form health and safety committees. |

## 6.4. RESOURCES FOR SOCIAL CONSIDERATIONS

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