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SECTOR ENVIRONMENTAL GUIDELINE: CROP PRODUCTION

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LIST OF ACRONYMS

ADS	Automated Directives System
AFOLU	Agriculture, Forestry, and Other Land Use
AIDS	Acquired immunodeficiency syndrome
AOR	Agreement Officers' Representatives
BEO	Bureau Environmental Officer
CBO	Community-based organization
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
COR	Contracting Officers' Representatives
CRM	Climate risk management
CSA	Climate-smart agriculture
EA	Environmental Assessment
ECOS	Environmental Compliance Support Contract
EIA	Environmental Impact Assessment
EJ	Exajoule
EMMP	Environmental Mitigation and Monitoring Plan
EPA	Environmental Protection Agency
ESDM	Environmentally Sound Design and Management
ESIA	Environmental and Social Impact Assessment
FAO	The Food and Agriculture Organization of the United Nations
FIES	Food Insecurity Experience Scale
4R	Four Rs (Right source, Right rate, Right time, Right place)
GAP	Good Agricultural Practices
GBV	Gender-based violence
GDP	Gross domestic product
GFSS	Global Food Security Strategy
GHG	Greenhouse gas
GWP	Global warming potential
HIV	Human immunodeficiency virus
ICOMOS	International Council on Monuments and Sites
IEE	Initial Environmental Examination

IFC	International Finance Corporation
ILO	International Labor Organization
IP	Implementing partner
IPCC	The Intergovernmental Panel on Climate Change
IPM	Integrated Pest Management
ISFM	Integrated Soil Fertility Management
IUCN	International Union for Conservation of Nature
LOP	Life of project
LULUC	Land Use and Land-Use Change
MEL	Monitoring, evaluation, and learning
MEO	Mission Environmental Officer
N_2O	Nitrous oxide
NGO	Non-governmental organization
NH_3	Ammonia
NMVOC	Non-methane volatile organic compound
NRM	Natural Resource Management
OECD	Organisation for Economic Co-operation and Development
OSHA	Occupational Safety and Health Administration
PERSUAP	Pesticide Evaluation Report and Safer Use Action Plan
PM	Particulate matter
PPE	Personal Protective Equipment
REA	Regional Environmental Advisor
REFS	Bureau for Resilience, Environment, and Food Security
SEG	Sector Environmental Guideline
SEP	Stakeholder engagement plan
SIA	Social Impact Assessment
SO_2	Sulfur dioxide
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
USGS	United States Geological Survey
WHO	World Health Organization
WQAP	Water Quality Assurance Plan
WUA	Water User Association

PREFACE: 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 SEGs overall, is to support environmentally sound design and management (ESDM) of USAID development activities by providing concise, plain-language information about:

- The potential for beneficial impacts from well-managed crop production 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 vulnerability of activities to climate change; and
- 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 (MEO/REA/BEOs), Agricultural Officers, and implementing partner (IP) staff engaged in implementation of crop production 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 crop production by all actors.

Environmental Compliance Applications. USAID's mandatory life-of-project (LOP) environmental 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 CFR 216 (Reg. 216).

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

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

The SEGs directly support environmental compliance by providing information essential to assessing the potential impacts of activities as well as to the identification and detailed design of appropriate mitigation and monitoring measures.

*However, the SEGs 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 Crop Production SEG replaces the previous Crop Production SEG (updated in 2019).

Development Process and Limitations. This update substantially restructures the Crop Production SEG to align with other documents in the SEG series. In developing this document, content in predecessor guidelines has been retained when applicable. In addition, 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.

Please note that the *SEGs* are not a substitute for detailed sources of technical information or design manuals. Users are expected to refer to the accompanying list of references and other resources for additional information.

Comments and Corrections. Sectors are constantly evolving, and therefore, these guidelines are a reflection of the sector at their time of development. Comments, corrections, and suggested additions are welcome. Please 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 crop production activities. The impacts and mitigation measures described in the Crop Production SEG are intended to be used as a reference when completing 22 CFR 216 requirements. Specifically, the impacts described can be used as reference when completing USAID's EIA process, described below in Figure 1, or Initial Environmental Examination (IEE) for USAID Crop Production Activities.

After impacts have been assessed through the EIA Process, the mitigation measures described for each impact in the SEG can be used as a resource in developing Environmental Mitigation and Monitoring Plans (EMMPs) for USAID Crop Production Activities.

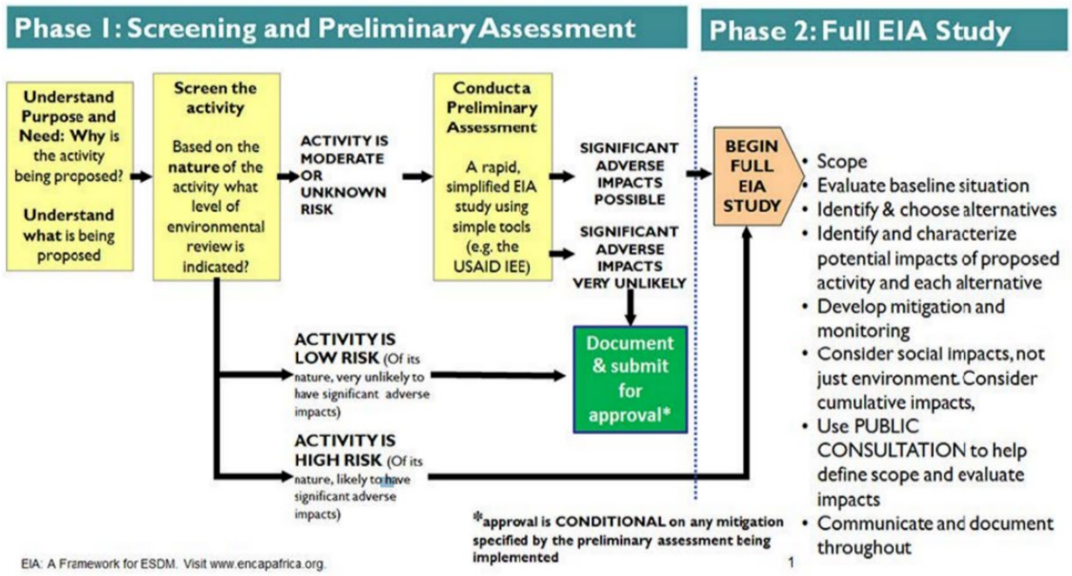

Figure 1. EIA Process (USAID 2019b).

The structure of this document is as follows:

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

Chapter Two: Sector Description briefly describes the different crop production sectors.

Chapter Three: Environmental Impacts summarizes the environmental impacts and mitigation measures that are associated with crop production.

Chapter Four: Climate Change Mitigation and Adaptation describes the potential impacts of crop production to climate change and the impacts that climate change has on crop production along with adaptation and mitigation practices.

Chapter Five: Human Health Impacts associated with crop production including human health, wildlife health, and the health of crop production animals are discussed.

Chapter Six: Social Considerations that should be evaluated when conducting crop production practices are explained.

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1. HOW TO USE THIS DOCUMENT

Crop production is the branch of agriculture that pertains to growing crops for use as food, fiber, feed, and fuel, and includes crop planting, harvesting, and storage. Agricultural production[1], including crop production, is an essential activity globally for providing food, reducing malnutrition, employing approximately one-fourth of the world's labor force through both formal and informal job markets, and contributing approximately 10 percent of the world's GDP globally (Roser 2013, The Global Economy 2023). Investments in sustainable crop production and market systems support the following three Global Food Security Strategy (GFSS) goals, as described in Feed the Future (2022):

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

Effective management of croplands offers a range of benefits, including improved yields, land and water quality, economic stability, and enhanced biodiversity. However, improper management of crop production can lead to adverse environmental, economic, and social consequences. For instance, the conversion of land to cropland has led to widespread deforestation, reduced biodiversity in landscapes, and lost habitats globally.

1.1. GOALS AND OBJECTIVES OF THE DOCUMENT

The goal of the Crop Production Sector Environmental Guideline (SEG), a part of the USAID SEG series, is to provide information essential to assessing the potential impacts of crop production activities and to identify appropriate mitigation and monitoring measures to address impacts. 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 crop production sector. Site-specific context should be taken into consideration when using the Crop Production SEG; additional or modified impacts and mitigation measures may be required.

This document presents considerations for developing economically, socially, and environmentally sustainable crop production systems. Each section describes beneficial and adverse environmental impacts of crop production systems and provides mitigation measures to avoid or limit adverse impacts. Adherence to mitigation measures described herein will enhance the sustainability of crop production activities. When designing activities, concurrently analyzing all impacts discussed in subsequent sections of this document will lead to more sustainable outcomes.

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

1.2. ACTIVITY DESIGN GUIDANCE FOR SUSTAINABLE CROPLAND SYSTEMS

Activity design guidance for crop production are included at the beginning of each chapter throughout the document and are intended to provide important overarching factors for consideration in designing

[1] Agricultural production encompasses both crop and livestock production.

BOX 1. CLIMATE-SMART AGRICULTURE

Climate-smart agriculture (CSA) is an approach encouraging the use of green and climate resilient crop production practices. CSA has three main objectives (FAO n.d.b):

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

Generally speaking, CSA practices have multiple beneficial environmental impacts. Adoption of specific CSA practices, however, is dependent on local socioeconomic, environmental, and climate change factors. Examples of CSA crop production practices include:

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

Please see the GFSS Activity Design Guidance for Climate-Smart Agriculture and Food Systems for more information: https://pdf.usaid.gov/pdf_docs/PA00ZX7D.pdf

crop production activities. The factors should be assessed with respect to the objectives and context of the activity prior to decision making in the activity design process. For example, crop choice 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 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 2022d).

In addition to the activity design guidance provided in each chapter, the GFSS Technical Guidance provides guidance on essential key concepts and best practices for activity design (Feed the Future 2022). These guidelines may be accessed here: https://agrilinks.org/activities/guidance-and-tools-global-food-security-programs-fy-2022-2026.

1.3. INDICATORS FOR MEASURING IMPACTS

Choosing metrics for measuring environmental impacts is important for adaptive management—that is, to assess effectiveness or impacts during the life of the project and make changes to ensure that programmatic and environmental goals are achieved. Discussions of indicators for measuring crop production impacts are also included as possible 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 lifecycle. While not specific to crop production, there is general guidance on sustainable food and agriculture (including crop production) from The Food and Agriculture Organization of the United Nations (FAO)[2] and specific guidance on how to deal with water issues, climate change challenges, and sustainability and productivity growth goals from the Organisation for Economic Co-operation and Development (OECD).[3]

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

- 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 to 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

Chapter 2 introduces the importance of the crop production sector to the livelihoods, culture, and resilience of communities. Considerable heterogeneity within croplands exists, consequently, the unique characteristics of any given crop production system should be carefully considered when evaluating impacts and mitigation measures, as briefly described in Section 2.3.

2.1. IMPORTANCE OF CROP PRODUCTION

Agriculture and agricultural development, including crop production, are powerful tools to help end poverty, boost prosperity, and feed a growing population. There are estimated to be more than 550 million farms globally, the majority of which are smallholder farms (below two hectares) (Ritchie and Roser 2022). Approximately one-third of the world's food is produced by smallholders, even though smallholders tend to be some of the poorest farmers with the lowest labor productivity (Lowder, Sanchez and Bertini 2021, Ritchie 2021). The share of smallholder farms compared to larger farms varies greatly by country. For example, in sub-Saharan Africa and Asia, approximately 80 percent of crop production is managed by smallholders, making it a major source of income and subsistence (FAO, Smallholders and Family Farmers 2012).

[2] FAO guidance for Sustainable Food and Agriculture is publicly available online.
[3] The following OECD guidance is publicly available online:
- Water and agriculture;
- Climate change and food systems; and
- Agricultural productivity and innovation.

Programming across the crop production value chain to address hunger, malnutrition, and poverty has been and remains a core focus for USAID. USAID:

- **Leads the U.S. Government's global hunger and food security initiative, Feed the Future,** in collaboration with 10 other U.S. Government agencies and departments.
- **Invests in cutting-edge scientific and technological agricultural research** to develop stronger seeds and greener fertilizers so farmers can grow more.
- **Develops agricultural markets**, expanding trade and using mobile phones to provide real-time prices so farmers can sell what they grow at a profit.
- **Helps farmers access capital** so they can expand their farms and buy equipment.
- **Offers extension services** so farmers can learn the best techniques to grow and store their crops (see Figure 2).
- **Develops sustainable agriculture strategies** so countries can feed their populations without depleting their natural resources.
- **Reduces food insecurity among vulnerable populations and helps build resilience in communities facing chronic poverty and recurrent crises** such as drought via development food assistance activities under the Food for Peace program.

Figure 2. **USAID supports training activities in Asia to scale up adoption and use of agricultural technologies. Better farming technologies, if introduced properly, can lead to improved harvests and reduced poverty.** *Source: Richard Nyberg, USAID*

2.2. CROP PRODUCTION DEFINITION

There are many definitions for crop and food production, which can include everything from primary production (e.g., the growing of crops and plants) to the entire food supply chain from upstream inputs through consumption, as shown in Figure 3.

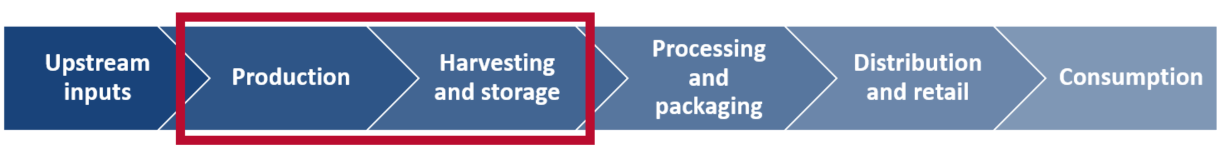

Figure 3. The Food Production Pathway.

Crop production is defined in this document as the practices related to primary production (e.g., the growing or production of crops and plants) and harvesting and storage, represented by the red box in Figure 3. The types of activities associated with primary production can include land conversion to agricultural land, land preparation (e.g., tillage, burning or other practices), seed planting, crop nutrition, pest management, and water management. The types of activities associated with harvesting and storage can include plant harvesting, crop drying, and storage (which may be on farm).

As shown in Figure 3, there are numerous additional important stages related to food production, such as upstream, or pre-farm activities (e.g., plant breeding, genetics, crop science, and agricultural chemical production), and post-production activities such as processing and packaging, distribution, marketing, retail, and consumption, as well as a wide range of cross-cutting issues (food loss and waste, water usage, access and availability, farm management, agricultural laws and regulations, policy impacts, cultural practices, land tenure, education and outreach, nutrition, food safety, mechanization, and natural resource management (NRM)). While important, these topics are considered outside the scope of this SEG and will not be covered. Resources for evaluating the impact of these activities are provided in Section 2.2.3 below.

2.2.1. CROP PRODUCTION RESOURCE USE

Primary crop production and harvesting, transport, and storage are the focus of this SEG due to their disproportionately large resource needs and impacts compared to other stages of the food production pathway.

Growing crops requires large quantities of land, water, pesticides, fertilizers, and energy, including fuel and electricity.

- Globally, permanent and temporary croplands cover 1,200–1,500 million hectares of land, accounting for approximately 11 percent of habitable land surface (Ritchie, Rosado and Roser 2022).
- Crop production is responsible for approximately 73 percent of all freshwater withdrawals globally (Halpern, et al. 2022).
- In 2021, approximately 3.5 million metric tons of pesticide active ingredients (including herbicides, fungicides, insecticides, and others) and more than 200 million metric tons of synthetic fertilizers (including nitrogen, phosphate, and potassium) were applied to croplands globally (FAO 2023, FAO 2022).
- Energy use for primary crop production, harvesting, and storage are estimated to use approximately 12 exajoules (EJ) per year globally, comprising a lower percentage of energy use in the food supply chain in high gross domestic product (GDP) (approximately 11 percent) countries and a higher percentage in low GDP countries (approximately 15 percent) (Day 2011).

2.2.2. GLOBAL SIGNIFICANCE OF CROP PRODUCTION IMPACTS

In addition to requiring high levels of inputs, primary crop production and harvesting, transport, and storage can also result in a wide range of impacts, including reduced water availability and quality, reduced soil health, air pollution, biodiversity loss, production of greenhouse gases (GHGs), and other social and environmental impacts, as discussed in Chapters 3 through 6.

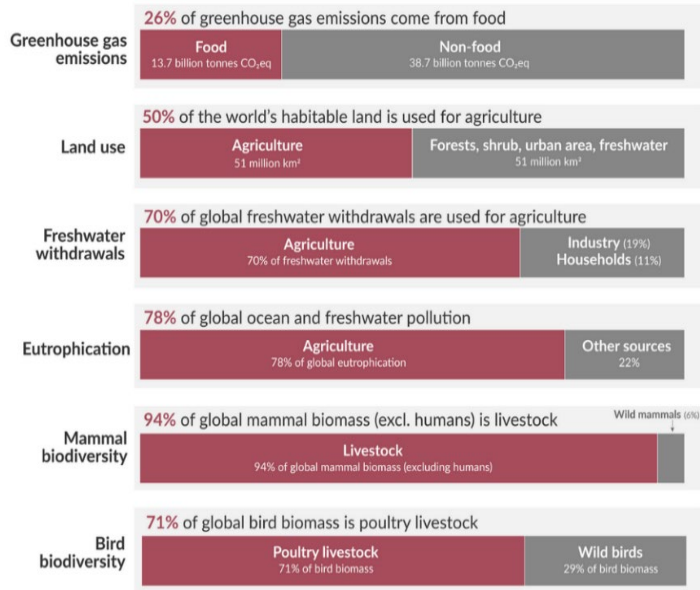

Figure 4. Global impacts of primary food production (Ritchie, Rosado and Roser 2022).

As shown in Figure 4, and further explored in later sections, agriculture (including both crop and livestock production) has disproportionate environmental and climate impacts compared to other industrial sectors. As such, input use and impacts from crop production activities should be carefully controlled through thoughtful mitigation.

Figure 5 further delineates the 26 percent of global GHG emission from food in Figure 4 above. As shown in Figure 5, crop production (e.g., the categories "Land use for human food" and "Crop production") is the second largest source of food-related GHG emissions, comprising 35 percent of GHG emissions related to food production (i.e., 8% plus 27%), whereas emissions for animal production (e.g., emissions from fisheries and livestock production (31%), pastures, and rangelands (16%)) comprises 47 percent of emissions, and the later stages of supply chain (e.g., processing, transport, packaging, and retail) comprise 18 percent of emissions (Ritchie 2019, Halpern, et al. 2022).

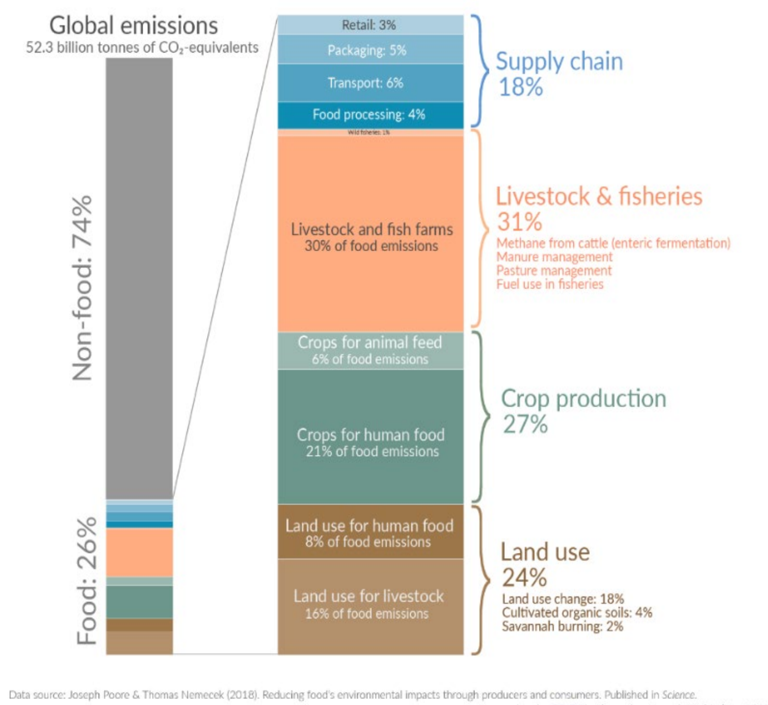

Figure 5. Global greenhouse gas emissions from food production (Ritchie 2019).

2.2.3. RESOURCES FOR CROP PRODUCTION CHAIN STAGES OUTSIDE OF PRIMARY PRODUCTION

- Poore, J. and T. Nemecek. 2018. "Reducing Food's Environmental Impacts Through Producers and Consumers." Science, 360, no. 6392: 987–992. DOI:10.1126/science.aaq0216. https://www.science.org/doi/10.1126/science.aaq0216.
- USAID. 2013. "Resource Efficient and Cleaner Production Briefing and Resource Guide for Micro & Small Enterprises: Food Processing." https://www.usaid.gov/sites/default/files/2022-05/USAID_MSE_Sector_Guideline_Food_Processing_2013.pdf.

2.3. GENERAL CONSIDERATIONS FOR CROP PRODUCTION IMPACTS

Just as the world produces a broad range of crops using a wide range of methods, there is also considerable heterogeneity in the types and amounts of inputs required and impacts and risks associated with crop production, all of which are influenced by (1) production scale, (2) methods and intensity, (3) specific crops grown, (4) local climates, and (5) geographic location.

For example, it is not surprising that rice paddies require different inputs, are sensitive to different risks, and result in different impacts from those associated with growing bananas, fields of wheat, or cocoa beans. Additionally, growing corn in Nigeria requires different inputs, is sensitive to different risks, and results in different impacts than growing corn in India, Brazil, or the Philippines.

Figure 6 shows the on-farm GHG footprint (e.g., the kg of CO_2e produced on-farm per metric ton of crop) of 26 different crops grown in 36 countries over four years as an example of crop-, location-, and production-specific differences in impacts (Lam, et al. 2021). Figure 6 also shows that the emissions per metric ton of crop vary significantly both within and between crops. The number in parentheses on the axis is the number of data points per crop. The variability diagrams show the fifth percentile, first quartile, median, third quartile, and 95th percentile of the footprints. The "Xs" represent the average

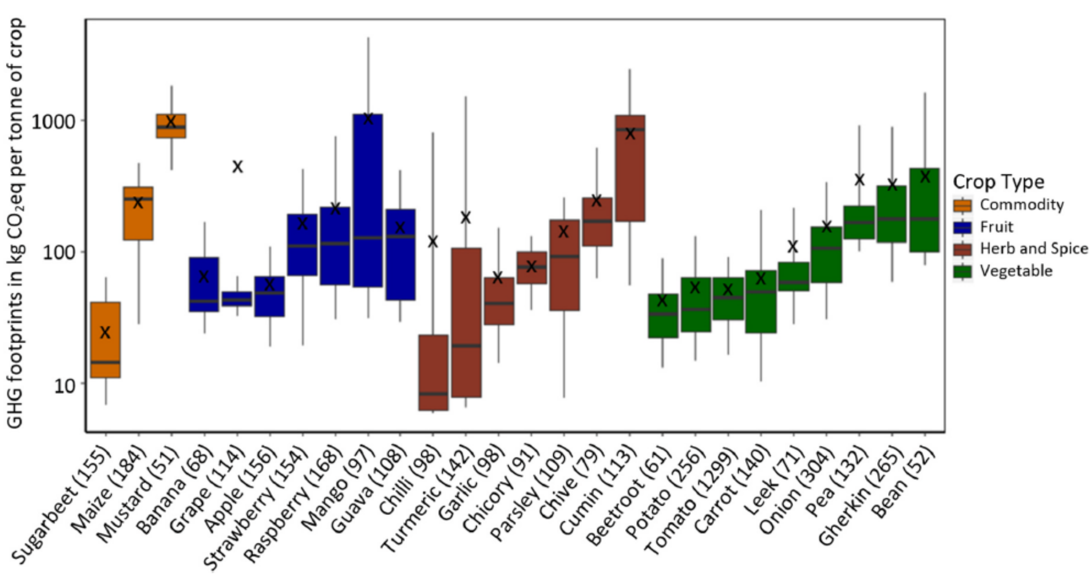

Figure 6. GHG footprints for 36 crops in kg CO_2e per metric ton of crop produced (Lam, et al. 2021).

GHG footprints. The height of the “box” for each crop shows the range of emissions associated with production of the crop; the taller the box, the larger the range of emissions.

As shown in Figure 6, sugar beets have the lowest mean footprint of 25 kg CO_2e per metric ton, and mangos have the highest mean footprint of 1,028 kg CO_2e per metric ton.

While fertilizer application is the largest contributor to GHG emissions, it is also the largest influencing factor for crop yield. According to the author, annual variability in GHG emissions is mainly due to differences in production area and production year. Other causes of variability in GHG emissions include local environments and biophysical conditions, specific varieties grown, differences in efficiency, and production methods. The use of climate-smart production methods can decrease both GHG emissions and other negative environmental impacts. See Chapter 4 for more details.

This SEG focuses on the unifying managed crop production inputs (including the general environmental, climate, social, and health risks and impacts associated with their production) that are required by all crops regardless of the crop type or where or how they are grown. For this SEG, required crop inputs have been divided into two broad categories: unmanaged inputs that are part of the Earth’s biophysiology (and will not be considered in this SEG) and managed inputs. See Table 1 below for the list of unmanaged and managed crop inputs.

TABLE 1. MANAGED AND UNMANAGED CROP PRODUCTION INPUTS

UNMANAGED (BIOPHYSICAL) INPUTS	MANAGED INPUTS
• Light, usually sunlight • Physical environment (e.g., temperature range, day length, soil type, soil moisture content)	• Plant starting material, such as seeds, spores, rhizomes, tubers, or cuttings • Physical location to grow plants, usually land • Water • Essential plant nutrients, either from soil or applied or both • Labor, including animal, human, and/or machine

While this SEG provides general guidance in terms of crop production, it does not provide specific guidance for individual projects. Users may need to conduct further research on the risks and impacts for their specific projects.

3. ENVIRONMENTAL IMPACTS

Crop production is intimately connected to the global and local environment. In addition to the required inputs described above, successful crop production is dependent on a balanced climate system and healthy ecosystems that provide essential services, such as pollination, pest control, soil structure and fertility, water quality and quantity, and nutrient cycling (Power 2010). For this reason, successful crop production requires careful seed selection and using appropriate production methods.

Included in Box 2, below, are general environmental considerations for crop production activity design that should be evaluated at activity inception to minimize environmental risks. Given the variability in crop types and production environments, these considerations are not comprehensive, and, consequently, users should seek additional guidance and/or research for their environment. A holistic review of project context should be conducted to assess all potential environmental impacts.

BOX 2. SAMPLE ENVIRONMENTAL CONSIDERATIONS FOR ACTIVITY DESIGN

Decreased Water Quality and Supply

- Location of water resources in and around the project area and potential for contamination
- Comparison of water availability for irrigation and/or local precipitation rates and timing with temporal and crop-specific water needs of proposed plants in project
- Capacity for using locally adapted drought-tolerant plants and low water crop production methods
- Other competing users of water resources, including ecosystem services, businesses, and communities

Land Degradation

- Selecting production methods that result in minimal land disturbance and do not leave bare land
- Opportunities to improve yields while minimizing inputs
- Opportunities to improve soil health through residue and integrated fertility management
- Ability to utilize and improve marginal or underutilized lands for crop production

Reduced Air Quality

- Selecting production methods that result in minimal land disturbance or do not leave land bare
- Whether farm equipment is well maintained
- Using best practices when applying agrochemicals and manure

Damaged Habitat and Reduced Biodiversity

- Presence of ecologically sensitive areas in the project area
- Potential impacts of the project on local wildlife or native vegetation and their habitats
- Opportunities to minimize conversion of other lands to cropland, especially native and biodiverse lands

When following Good Agricultural Practices (GAPs), crop production can have beneficial impacts on the environment through enhanced nutrient cycling and promoting ecosystem health. See Box 3 for more information about GAPs. Described below are general potential beneficial impacts of crop production on the environment. These impacts include the following:

- **Wildlife habitat provision:** Diversified cropland production and landscape management can provide habitats and food sources for wildlife (Kremen 2020). Agroecological practices, such as agroforestry, the use of pollinator-friendly plants, windbreaks, hedgerows, riparian buffers, and natural habitat patches, provide refuge and food for birds, insects, and an array of wildlife species.

These types of practices can be particularly beneficial for biodiversity preservation when practiced on otherwise degraded or abandoned lands, as ecosystems are fortified through improved soil health and increased plant biomass production.

- **Soil conservation/soil health:** Through comprehensive soil management, well-managed croplands contribute to the overall well-being of ecosystems. By following climate smart and sustainable agricultural practices, croplands can effectively combat soil degradation, reduce erosion, and enhance soil carbon content and fertility. Techniques like crop rotation, cover cropping, and organic matter incorporation (composting) contribute to improved soil structure and nutrient retention, ultimately fostering better conditions for plant growth. Moreover, these practices increase soil moisture retention and safeguard against extreme weather conditions such as flooding during heavy rainfall events and droughts.

- P**reservation of landraces/locally adapted species:** Cropland systems that cultivate a wide array of locally adapted, open-pollinated species safeguard genetic diversity as compared to monoculture seeding practices. Landraces, which are traditional crop varieties that have naturally adapted to local conditions over generations, play a significant role in preserving this diversity. As these subspecies possess unique genetic traits for resilience, adaptability, and nutritional value, a diversified cropland system is inherently more resilient to stress from changing climate patterns and pest and disease transmission, though may suffer from yield losses. Landraces can also be used in larger plant breeding schemes to develop new, locally adapted varieties with specific combinations of desired traits.

BOX 3. GOOD AGRICULTURAL PRACTICES (GAPs)

Generically, GAPs are specific methods that should produce food that is safe and wholesome for consumers. Their scope includes (but is not limited to) water quality, manure and compost use, worker health and hygiene, and prevention of contamination from wildlife, domestic animals, and livestock. Increasingly, GAPs also address environmental stewardship, fair labor practices, and carbon footprint reduction (FAO 2016).

There is not a single global, universal set of GAPs, but rather multiple schemes, some of which compete within a given market. While there are significant commonalities across GAPs for different crops, there is also significant crop-specificity owing to differences in cultivation, harvest, and processing for different crops.

The remainder of this chapter describes the environmental impacts of crop production and offers mitigation measures to address them. These impacts include the following:

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

3.1. DECREASED WATER AVAILABILITY AND QUALITY

In agricultural communities, crop 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 cropland productivity, dictating what can be grown and yields. Crop production can adversely impact local water availability and quality through the depletion of water supplies and reducing water quality.

3.1.1. DEPLETION OF WATER SUPPLIES

Agriculture is the largest consumer of freshwater globally and demand is projected to increase as production increases to feed a growing population. Even in regions with abundant water resources, overdrawing surface or groundwater is commonly associated with crop production (FAO 2012). Of particular concern are those regions that are considered water stressed or where water withdrawals exceed water supply, as seen in Figure 7 below.

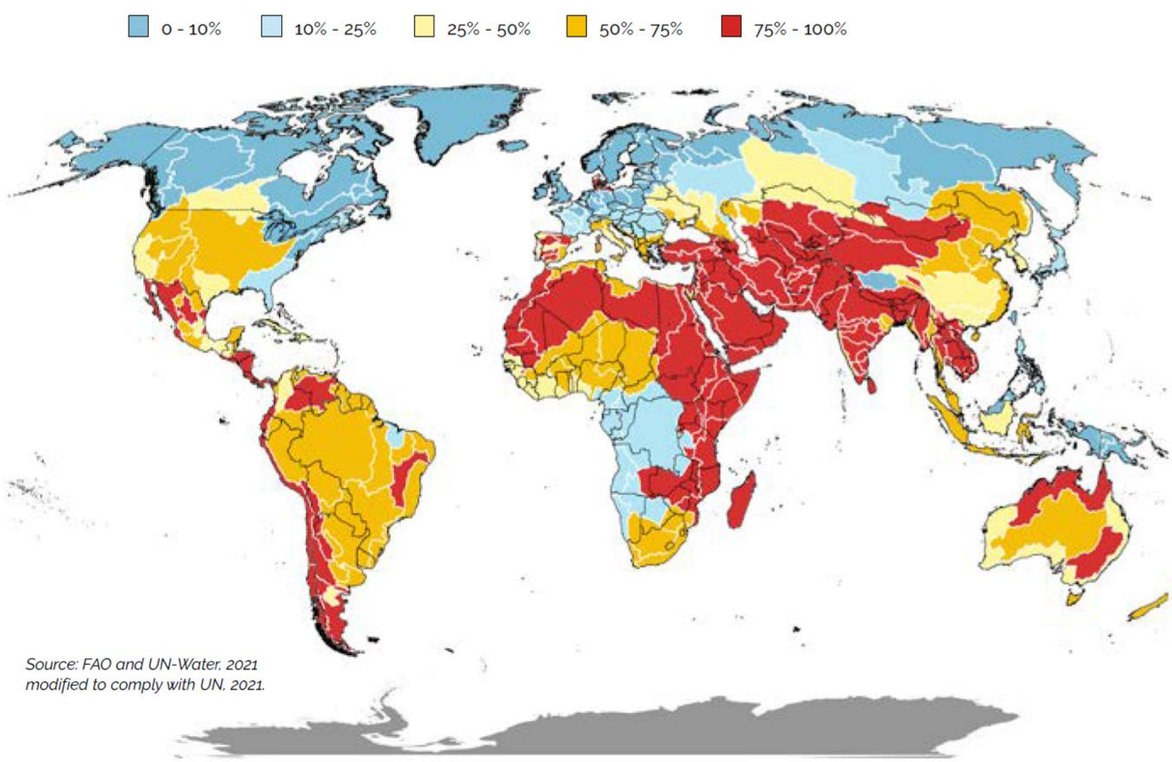

Figure 7. Level of water stress due to the agricultural sector by basin, 2018 (FAO 2021).

Unsustainable water withdrawals from streams and groundwater for irrigation may lead to changes in the hydrology of streams including changes to flow regimes, flood regimes, and water table depth. Diverting water for irrigation leaves less water for downstream ecosystems, including wetlands, mangroves, and coastal estuaries.

As a result of poor irrigation system design, poor water management, and poor irrigation site choice (e.g., sloping lands that increase runoff), scarce water resources may be used inefficiently. Lack of irrigation system maintenance, poor water quality, inadequate filtration, and poor or inefficient system operation, can all lead to decreases in irrigation distribution uniformity and crop yields. There may be significant loss via leakage and evaporation from canals and storage dams, as well as poor water management by farmers within the scheme; these problems are particularly acute under arid or semi-arid conditions.

For additional information about water management and stress, please see the USAID SEG for Water Supply and Sanitation.

MITIGATION MEASURES FOR DECREASED WATER AVAILABILITY

A variety of mitigation methods exist for addressing decreased water availability. Conserving soil moisture by using climate smart and sustainable agricultural practices can reduce the use of surface and groundwater. Such practices include conservation tillage, cover cropping, crop rotation, mixed cropping, and green manuring (CTCN n.d., NRCS 2021). In addition, planting drought-tolerant crops and locally adapted varieties can result in producing higher yields that require less water than the alternative water intensive crop varieties. Producers may also use harvested rainwater and floodwater to water crops.

Irrigating crops with the consideration of local freshwater supplies as well as using alternative irrigation methods such as subsurface drip irrigation decreases freshwater consumption in agriculture.

3.1.2. REDUCED WATER QUALITY

Global gains in crop production and yield are largely due to the application of synthetic and organic fertilizers and pesticides. Over-application of these agrochemicals can lead to runoff into surface waters or leaching into groundwater, particularly in sandy soils (Mateo-Sagasta, et al. 2017). Approximately 260 km^3 of agricultural drainage water is discharged into the environment every year globally (FAO 2021). This agricultural effluent can contain organic and synthetic fertilizers, pesticides, soil particles, and other contaminants that can result in reduced water quality and other negative environmental impacts.

FERTILIZERS

To date, agriculture has resulted in the input of approximately 560 million metric tons of phosphorus into water bodies globally (FAO 2021). These excess nutrients from fertilizers, particularly nitrogen and phosphorus, can cause nutrient loading in local water bodies, resulting in excessive algal growth, which can cause toxic blooms, starve aquatic environments of oxygen, and damage ecosystems (Glibert and Burford 2017). High concentrations of nitrate in potable water supplies also represent a potential health hazard, especially for children (see Chapter 5 for more details). Box 4 includes information about USAID procedures relating to fertilizers.

Organic fertilizers, such as animal manures, can similarly reduce water quality and may additionally introduce contaminants such as enteric bacteria and possibly other pathogenic organisms. See the Livestock SEG for more information about manure management.

BOX 4. FERTILIZERS AND USAID ENVIRONMENTAL PROCEDURES

Procurement and use of fertilizers in USAID activities must comply with ADS Chapter 312 (Eligibility of Commodities) and ADS Reference 312mad Fertilizer Financing Guidance. Additionally, any purchase of ammonium nitrate or calcium ammonium nitrate fertilizer with USAID funding must receive prior approval from the USAID/REFS Chief Scientist and is subject to various specific standards (see USAID Guidance for Procuring Ammonium Nitrate Fertilizer) due to the risk of ammonium nitrate and calcium ammonium nitrate being used to create improvised explosive devices.

MITIGATION MEASURES FOR REDUCED WATER QUALITY FROM FERTILIZERS

Careful application of organic and synthetic fertilizers can result in high crop yields with minimal environmental impacts. Following the "4Rs" (see below) of nutrient stewardship framework to determine the appropriate application rates and dosages of fertilizers can reduce the potential for negative impacts. The 4R framework includes (4 Nutrient Stewardship n.d.):

- **Right source:** Consider the nutrient content of the soil and fertilizer source. Will the fertilizer used meet nutrient requirements?
- **Right rate:** Consider the crop nutrient demands and yield goals. Match fertilizer dosage to crop needs. Calibrate all equipment properly.
- **Right time:** Fertilize during peak crop demand. Plan according to the weather patterns.
- **Right place:** Consider field conditions such as soil type, slope, and proximity to surface water when choosing where to apply fertilizers.

Other practices include using climate smart and environmentally sound crop production practices, such as cover crops and reduced tillage, that can stabilize nutrients in the soil and reduce fertilizer runoff into water catchment areas.

PESTICIDES

Approximately 940 thousand metric tons of pesticides entered water catchment areas, including oceans, rivers, and aquifers in 2015, the majority of which were herbicides (Maggi, Tang and Tubiello 2023). Pesticides and metabolites can be transported from their initial areas of application and enter the water cycle through multiple entry points, including volatilization, leaching, and runoff. Once these chemicals enter the water cycle, they can be distributed at even further distances from their original application site. See Figure 8 for a depiction of how pesticides may migrate away from the project site through water cycling.

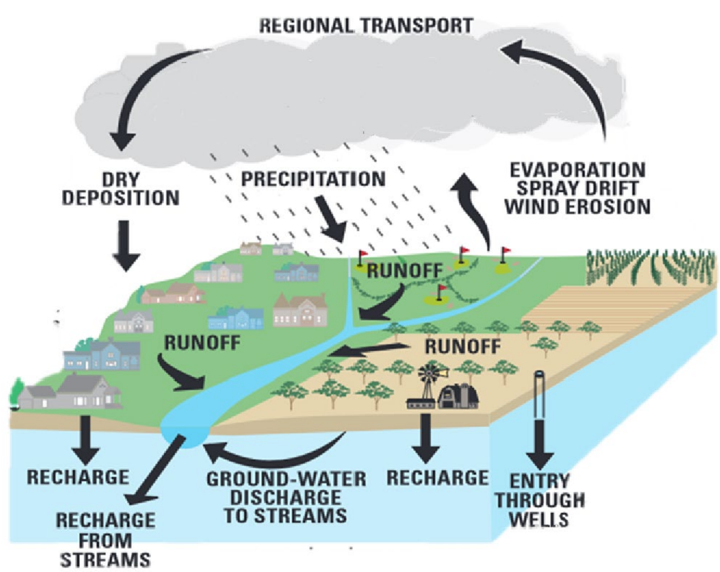

Figure 8. Methods for pesticide transport in the water cycle (USGS 1995).

Pesticides contamination of water can reduce crop yields and damage ecosystems and may pose a risk to community health (see Chapter 5: Human Health Impacts for more details). For a more detailed discussion of pesticide contamination of waterways and impacts on ecosystems and human health, see the Pest Management SEG.

MITIGATION MEASURES FOR REDUCED SOIL AND WATER QUALITY FROM PESTICIDES

Chemical pesticide use and reliance is not the most effective or sustainable pest management method. Consider managing pests through integrated pest management (IPM) techniques or through production methods that limit pests (e.g., crop rotations). See the Pest Management SEG for additional information on IPM.

If pesticides must be used, careful selection and application of pesticides can minimize both crop loss and environmental impacts. To minimize potential environmental impacts, consider the toxicity of the pesticides and those with the fastest degradation rates. In addition, examining local weather conditions is recommended, as pesticide drift increases with high winds and rain after application, which can lead to pesticide leaching and runoff (Tudi et al. 2021). It is also important to consider how soil types and pesticide chemical properties may influence pesticide fate in the environment. For instance, sandy soils with high levels of permeability will result in faster leaching rates, as will highly soluble pesticides with slow degradation rates (Bošković, et al. 2020, Tudi, et al. 2021).

Box 5 below includes a description of USAID's Pesticide Procedures. Please see the Pest Management SEG for more information about safer and effective use of pesticides.

BOX 5. USAID PESTICIDE PROCEDURES

Any USAID-funded and supported activities require the preparation of 216 regulation documentation such as a Pesticide Evaluation Report and Safer Use Action Plan (PERSUAP) or Environmental Assessment (EA) for use of pesticides or chemicals. The PERSUAP considers how the proposed pesticide/chemical may impact non-target organisms.

Examples of best management practices that may be implemented for pesticide use related to environmental impacts include but are not limited to the following:

- Always use the least toxic pesticides.
- Insecticides that are recommended should have no effect on non-targeted flora and fauna.
- In cases where non-selective herbicides are used, these should be used in such a way that spray and spray drift does not reach non-target flora, fauna, or any protected areas or organic farms.
- Correct pesticide application rates must be used, and pesticides must not be applied while it is raining or about to rain so that there is no runoff or leaching into water systems.
- Use of pesticides that are prone to leaching must be minimized and considered as a main factor for pesticide selection.
- Physical environmental conditions should be considered when selecting pesticides. For example, lower pesticide rates are usually used on sandy soils compared with loams and clay soils.

REDUCED WATER QUALITY CAUSED BY SOIL EROSION

Soil erosion (including both wind and water erosion) is estimated to remove 20–37 billion metric tons of topsoil annually (FAO 2021). Eroded topsoil from agricultural fields can be carried by runoff or wind into water bodies. Once in slower-moving water, soil particles (or sediment) settle, altering the composition of the bottom terrain, water chemistry, and depth. Very fine particles (silt) may remain in suspension, resulting in high turbidity, which also has adverse impacts on aquatic life and human use. Upland crop production areas, particularly those with steeper slopes and exposed soil, are especially vulnerable to erosion (FAO and ITPS 2015).

MITIGATION MEASURES FOR IMPACTS TO WATER QUALITY FROM SOIL EROSION

Mitigation of soil erosion to prevent contamination into water bodies can be achieved by a variety of measures:

- Limit soil disturbance by using methods that limit topsoil exposure, such as reducing tillage and planting cover crops like grasses, grains, or clovers, and limiting fallow periods (e.g., periods where soil is bare).
- Utilize either crop cover, grass cover, stubble cover, or unplowed surfaces for post-harvest cropped land when possible to prevent eroded soil from reaching water bodies.
- Create fine seedbeds very close to sowing.
- Construct terraces or soil bunds to control erosion in sloped areas.
- Plant vegetative buffers along edge-of-field areas (riparian buffers) as a filter for excess soil nutrients and pesticide residues otherwise carried to surface waters by surface runoff and by subsurface flows.

3.2. LAND DEGRADATION

Healthy landscapes and soils are critical to the success of crop production, however unsustainable crop production practices have the potential to irreparably damage lands. Drivers of land degradation impacts from crop production discussed include land conversion and soil degradation.

3.2.1. LAND CONVERSION

Agriculture is the largest user of habitable land globally. Cropland production is estimated to use between 1,200 -1,500 million hectares (or 12 -15 million km^2) of land, approximately 12 percent of habitable land (Potapov, et al. 2021, Ritchie and Roser 2019). Given its large footprint, it is not surprising that agriculture is the major driver of land conversion globally. Table 2 below shows the estimated annual increase in cropland acres between 2004 and 2016 by region, where Africa shows the overall highest conversion rate. Approximately half of the land converted during this period was natural vegetation and forests/tree cover, hindering sustainability goals of protecting terrestrial ecosystems (Potapov, et al. 2021).

TABLE 2. MAP-BASED ANNUAL CROPLAND AREA CHANGE (Potapov, et al. 2021)

Region	2004-2007 (MHa $year^{-1}$)	2008-2011 (MHa $year^{-1}$)	2012-2015 (MHa $year^{-1}$)	2016-2019 (MHa $year^{-1}$)
Africa	1.7	2.4	3.7	3.9
Southwest Asia	1.8	1.2	1.8	1.7
Australia and New Zealand	0.3	0.1	0.3	0.2
Southeast Asia	0.4	0.5	1.1	1.0
Europe and North Asia	-1.2	0.1	0.7	0.2

Region	2004-2007 (MHa year-1)	2008-2011 (MHa year-1)	2012-2015 (MHa year-1)	2016-2019 (MHa year-1)
North and Central America	-0.5	0.1	1.0	0.6
South America	2.7	2.0	2.3	1.5
World	5.1	6.3	10.9	9.0

Looking specifically at forest land conversion, between 2000 and 2018, cropland expansion was responsible for approximately half of forest conversion, the majority of which occurred in tropical biomes, which can be especially rich in biodiversity (FAO 2020). Figure 9 below presents a breakdown of agricultural deforestation drivers by world region.

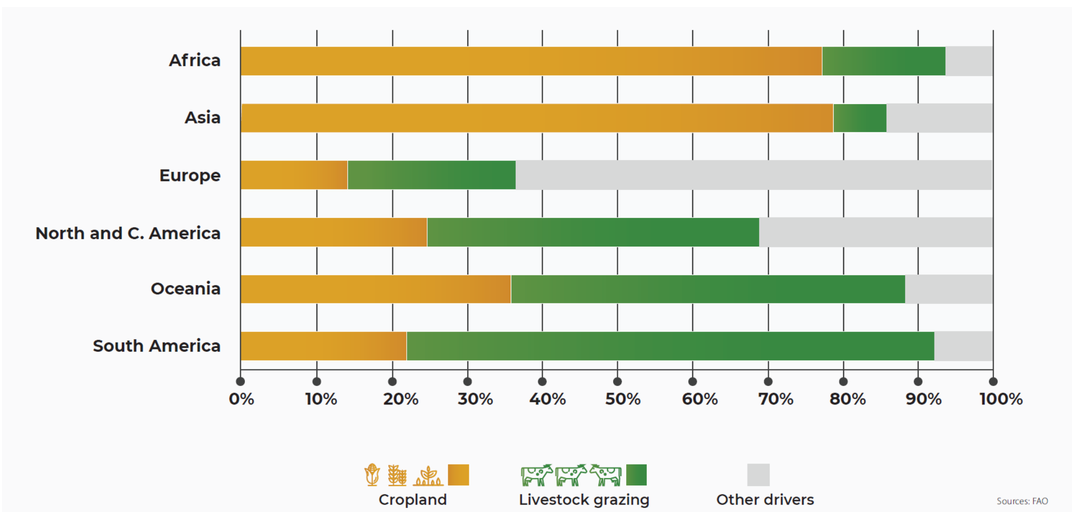

Figure 8. Regional differences in deforestation drivers 2018–2020 (FAO 2020).

Land conversion, particularly from natural lands or areas with high levels of biodiversity, can result in numerous negative environmental impacts. These include loss of biodiversity, reduction or loss of ecosystem services, reduced resilience, habitat fragmentation, increased soil erosion, destruction of carbon sinks, release of GHGs, decreased rainwater infiltration into soils and aquifers, changes in the soil microbiome, and increased soil temperatures, as discussed in previous parts of Chapter 3 and Chapter 4.

MITIGATION MEASURES FOR LAND CONVERSION

Land conversion may be avoided by:

- Intensifying or increasing production on existing lands, with the caveat that intensification itself may increase negative environmental impacts (e.g., intensification may require additional water, energy, or fertilizer inputs).

- Selecting intensification practices that maximize efficiency and minimize potential environmental impacts (e.g., using drip irrigation vs. field flooding).
- Selecting locally adapted crop species and varieties; this can increase yields and reduce pressure to convert land.

If land conversion must occur:

- Prioritize degraded, abandoned, or underutilized lands over natural lands or lands with high levels of biodiversity.
- Consider the larger landscape context when selecting land to convert to ensure that conversion has minimal impact on protected areas, native lands, or other areas of high biodiversity (e.g., sharing vs. sparing landscapes) (Balmford 2021).

3.2.2. SOIL EROSION AND DEGREDATION

Soil is a diverse ecosystem comprising organisms that perform important functions such as nutrient cycling, soil structure maintenance, carbon transformation and sequestration, and the regulation of pests and diseases. Soil and soil functions support terrestrial ecosystems and crop production by providing necessary nutrients and structure for plant growth. Box 6 includes additional facts on soil erosion.

Crop production practices can degrade soil health including through erosion (FAO n.d.a). Examples include:

- Farm equipment, heavy animal use, and repeated trampling can result in compaction, causing soil crusting and surface sealing, impeding rainfall infiltration resulting in reduced water availability to plants, increased surface runoff, and reduced groundwater recharge.

- Practices that disturb soil, like land clearing and tillage, or fallow periods where soil is left bare between growing seasons, exacerbate soil erosion, especially on sloped lands with silty soils. As soil erosion progresses and organic matter diminishes, the capacity for soil to grow crops and absorb rainfall decreases.

- Intensive cropping without balancing soil fertility depletes the soil of essential nutrients and soil organic matter (e.g., nitrogen, phosphorus, potassium, calcium, sulfur, and carbon), damaging soil ecosystems, degrading soil quality, and reducing productivity. Conversely, over-fertilization can contribute to soil acidification, lowering the availability of trace elements and adversely affecting the development of nitrogen-fixing legumes.

- Pesticides and pesticide degradation products can "stick" (also called adsorb) to soil particles and potentially negatively impact soil organisms and soil health for years after application. Please see the SEGs for Integrated Pest Management and Pest Management.

BOX 6. SOIL EROSION FACTS

- ✓ Soil is a finite resource. It can take up to 1,000 years to produce just 2–3 cm of soil.
- ✓ Agriculture soils erode 100–1,000 times faster than natural erosion rates.
- ✓ Approximately 33% of the Earth's soils are already degraded, and more than 90% could become degraded by 2050 (FAO and ITPS, 2015; IPBES, 2018).
- ✓ Soil erosion can decrease crop yields by 50%.

(Adapted from FAO, n.d., "Global Symposium on Soil Erosion, Key Messages")

- Over-irrigation in poorly drained soils where water cannot penetrate deeply may lead to waterlogging. When soils are waterlogged, air spaces in the soil are filled with water, and plant roots essentially suffocate for lack of oxygen (Mingyang 2017). Subsequently this may lead to soil salinization, where irrigation water mobilizes naturally occurring salts in the soil to the point it becomes inhospitable to vegetative growth. When excessive, saline soils force farmers to abandon fields. For more information about soil salinization, refer to the USAID SEG for Dryland Agriculture.

MITIGATION MEASURES FOR SOIL EROSION AND DEGRADATION

Recommended mitigation measures for soil erosion and degradation include the following:

- Minimize soil disturbances, avoid leaving soils bare, and use climate smart and sustainable crop production practices, when appropriate. Reduce soil compaction through practices such as reducing tillage, minimizing physical trampling, particularly when the field is wet, and, when necessary, subsoiling to eliminate compaction. Use of draft animals for plowing tends to have a lower risk of soil compaction and over-tillage than use of machinery, though animal traction also tends to require higher farmer time and labor input.
- Protect soils from water and wind erosion by using wind barriers, reduced tillage, cover crops, conservation cover, and other practices mentioned in Section 3.1.2 above.
- Characterize soils and practice integrated soil fertility management (ISFM). Managing and conserving soil begins with characterizing soils, including primary (N, P, K) nutrient levels, structure, depth, pH, salinity, organic matter, and other factors mentioned throughout this section. Only amend soils as needed using the 4R principles to avoid under- or over-fertilization. Minimize pesticide use, use the least toxic pesticides possible, and practice best practices if pesticide use is required. Use efficient irrigation and drainage systems to avoid waterlogging and salinization of soils.

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.). Common air pollutants produced from crop production include nitrogen compounds (N_2O, NH_3, and NO_x), SO_2, CO, non-methane volatile organic compounds (NMVOC), and particulate matter (PM10, PM2.5, black carbon, and organic carbon) (Crippa, Solazzo, et al. 2022). There are multiple crop production activities that result in air pollutants, these include:

- **Soil Disruption:** Plowing, tilling, and other soil management practices cause dust emissions that can exacerbate respiratory problems in humans and impact air quality in surrounding areas.
- **Fertilization:** The use of nitrogen-based fertilizers and manure can lead to significant emissions of ammonia and nitrogen oxides. Ammonia can react with other pollutants in the atmosphere to form fine particulate matter (PM2.5).
- **Pesticide Use:** Pesticides can release volatile organic compounds that can contribute to the formation of ground-level ozone and smog.
- **Farm Equipment Use**: The diesel equipment and diesel fuel available in developing areas typically generate high levels of particulate matter or soot that contain carcinogenic compounds

and toxins such as arsenic, selenium, cadmium, and zinc. Particulate emissions increase when equipment is poorly maintained or excessively worn.

- **Agricultural Burning:** Burning crop residues or converting land for crop production through burning can release a range of pollutants, including particulate matter, black carbon, and other harmful gases, into the atmosphere.
- **Rice Production:** While amounts vary by system, rice paddies produce methane and N_2O emissions.

Reduced air quality negatively impacts ecosystems and human health, increases mortality, and reduces crop yields (Crippa, Solazzo, et al. 2022).

MITIGATION MEASURES FOR REDUCED AIR QUALITY

Implementing climate-smart and environmentally sound agricultural practices can reduce air quality impacts. Minimizing soil disturbances and avoiding leaving soils bare can reduce production of dust and particulate matter. Using best practices with fertilizer, manure, and pesticide use can reduce the production of ammonia and nitrous oxides that result from application. Maintaining farm equipment can reduce both fuel use and particulate matter production. Eliminating or reducing burning as a crop residue management practice and eliminating or reducing land conversion by burning are recommended. Using best practices for rice production can minimize methane and N_2O emissions.

3.4. DAMAGED HABITATS AND REDUCED BIODIVERSITY

Productive cropland relies on diverse healthy ecosystems. Microbes feed plants, plants stabilize soil, and diverse creatures pollinate and control pests. Intensified and/or poorly planned crop production, however, can disrupt this delicate balance through habitat damage and biodiversity loss. Drivers of this impact include:

- **Habitat loss and degradation:** As described above in Section 3.2.1, land conversion for crop production results in numerous negative biodiversity impacts. Habitat destruction, including habitat loss and fragmentation, is the greatest driver of biodiversity loss. The tropics, containing the highest levels of biodiversity, have experienced the most ecosystem degradation due to agricultural expansion on the planet. For instance, between 1980 and 2000, approximately 7.5 million hectares of tropical forest in Southeast Asia were lost to plantations, primarily for oil palm (Gibbs, et al. 2010).

  Along with causing direct injury to species during land conversion processes, habitat destruction can also isolate animal populations, alter microclimates at forest edges, and disrupt ecosystem services. Agriculture is estimated to threaten 62 percent of species on the IUCN Red List (Maxwell, et al. 2016).

  As discussed in previous sections, in addition to habitat loss, crop production can also negatively impact aquatic and terrestrial habitats through soil degradation, hydromodification, sedimentation, and agrochemical contamination. Some pesticides may be especially hazardous to wildlife and pollinators. Please see the Pest Management SEG for more information about the impact of pesticides on non-target ecosystems.

- **Landscape simplification**: Cropland production can result in landscape simplification where once widely diverse, heterogeneous landscapes become increasingly homogeneous with fewer crop types and non-crop habitats. A monoculture system significantly reduces the diversity of plant species, which in turn, limits the range of insect and bird species that the ecosystem can support. This lack of diversity reduces ecosystem function by eliminating biological controls that typically prevent the overpopulation of a single species. In addition, landscape homogenization reduces necessary nutrient cycling, potentially increasing the need for fertilizer application. Landscape simplification can also reduce the populations of critical pollinators.

- **Spread of invasive species and pests:** Without careful consideration, the introduction of new plants into monocropping, agroforestry, cover crops, hedges, windbreaks, or riparian buffers can present risks to native species and ecosystems. Lacking natural predators or environmental conditions that prevent spread, new plants can become invasive, growing beyond where they are originally planted. Invasive species can adversely affect ecosystem services in several ways, including harming populations of important pollinators or nitrogen-fixing organisms, spreading diseases to native organisms, interbreeding with native species, out-competing native species for resources, and overconsuming native species.

  Monoculture farming may also increase the prevalence of invasive species when alien species, including species of insects and fungi, are introduced deliberately for biological control or other management purposes.

MITIGATION MEASURES FOR BIODIVERSITY IMPACTS

Many of the sustainable or climate-smart agricultural practices previously discussed can also mitigate adverse impacts to biodiversity from crop production. These include:

- Reduce the overall land footprint required for food production through intensification and reusing abandoned land.
- Minimize encroachment into high-biodiversity areas to preserve vital habitats.
- Practice integrated pest management and proper agrochemical use to reduce the ecological harm caused by chemical inputs. As non-indigenous pests, weeds, plants, insects, fungi, bacteria, viruses, and other agents can severely interrupt the production of crops and spread disease, use of local species for biological pest control is preferable wherever possible.
- Create designated wildlife refuges within agricultural landscapes as sanctuaries for native species.
- Grow vegetative buffers around fields; this creates wildlife corridors and protects wildlife from agrochemical exposure.
- Utilize diverse field production strategies, such as polycropping and agroforestry, that offer a variety of niches for species to inhabit. (See Box 7 as an example).

BOX 7. CASE STUDY: SHADE COFFEE

While most coffee is cultivated in full or high sun monocultures, USAID is increasingly supporting the cultivation of coffee under tall shade trees. Shade-grown coffee is an alternative to coffee monoculture that supports high biodiversity and preserves important ecosystem services. By protecting the coffee plants and ecosystem from solar radiation and maintaining high species diversity, tall shade trees preserve soil integrity, decrease surface water runoff, increase carbon sequestration, and promote critical ecological processes such as biological pest control, pollination, and nutrient cycling.

3.5. SUMMARY TABLE OF MITIGATION MEASURES

Mitigation and monitoring methods depend on both impacts and indicators. Table 3 below summarizes the common environmental impacts for crop production systems and associated mitigation measures described above.

TABLE 3. SUMMARY OF ADVERSE ENVIRONMENTAL IMPACTS AND MITIGATION STRATEGIES

POTENTIAL ENVIRONMENTAL IMPACTS	ACTIVITY	MITIGATION STRATEGIES
DECREASED WATER AVAILABILITY AND QUALITY		
Water depletion	• Irrigation • Growing ill-adopted crops • Inefficient water management • Production methods ill-suited to local conditions	• Use efficient irrigation methods, potentially including drip irrigation. • Maintain irrigation equipment. • Use water- and moisture-efficient production practices, including mulching, cover crops, and reduced tillage. • Harvest rainwater and floodwater to reduce draw on surface and groundwater. • Select crops needing low water that are appropriate for local conditions. • Promote crops/varieties and approaches that are proven in practice appropriate to the agro-ecological zone and farmer capabilities.

Reduced water quality	• Application of farm chemicals (fertilizers, pesticides)
	• Application of organic fertilizers (livestock manure)
	• Erosion resulting in the siltation of water bodies
		• Take local hydro-environmental conditions into account during project development.
		• Minimize agrochemical and manure application rates.
		• Follow best practices for pesticide use to minimize application amounts, leaching, volatilization, and drifts of pesticides. See the Pest Management SEG.
		• Minimize overfertilization by using the 4R approach.
		• Minimize leaching by using:
		  ○ Efficient irrigation methods.
		  ○ Water and moisture efficient production practices.
		• Implement erosion control practices such as cover crops and reduced tillage.
		• Minimize leaching by maintaining field buffers, borders, and riparian buffers.
		• Carry out land leveling (requires engineering oversight).
		• Keep irrigation canals clear
		• Prevent and manage soil waterlogging.

LAND DEGREDATION		
Soil compaction	• Conventional tillage • Trampling • Heavy farm equipment use	• Minimize soil disturbance and field passes, including using minimal tillage. • Do not undertake deep tillage, deep plowing, subsoiling, or ripping. • Minimize physical trampling, especially when fields are wet.

POTENTIAL ENVIRONMENTAL IMPACTS	ACTIVITY	MITIGATION STRATEGIES
		• Amend soil as indicated based on properties.
Soil erosion	• Conventional tillage • Fallow/bare land between growing seasons without vegetation coverage • Flooding or poor water management	• Implement erosion control practices such as cover crops, reduced tillage, maintaining field buffers and borders, wind breaks, and/or riparian buffers. • Minimize soil disturbance and field passes, including using minimal tillage. • Do not undertake deep tillage, deep plowing, subsoiling, or ripping. • Amend soil as indicated based on properties. • Use water and moisture efficient production practices.
Soil fertility loss	• Land use change or land clearing • Over- or under-application of farm chemicals (fertilizers, pesticides) or other soil amendments • Inappropriate irrigation resulting in soil waterlogging or soil salinization • Overextraction from soils without replenishing nutrients • Conventional tillage with fallow periods/bare soils	• Characterize soils and amend based on properties including soil organic matter, nutrient balance, salinity, acidity, alkalinity, specific ion toxicity, and sodicity. • Use fertilizers consistent with 4R principles and within an Integrated Soil Fertility Management (ISFM) framework. • Follow best practices for pesticide use to minimize application amounts, leaching, volatilization, and pesticide drifts. See the Pest Management SEG. • Use efficient irrigation methods, potentially including drip irrigation. • Maintain soil organic matter by undertaking manuring, composting, or sustainable crop rotations as needed. • Implement erosion control practices such as cover crops, reduced tillage, maintaining field buffers and borders, wind breaks, and/or riparian buffers. • Minimize soil disturbance and field passes, including using minimal tillage.
Land conversion	• Land use change or land clearing to increase available land for crop production • Conversion of natural lands or lands with high levels of biodiversity to croplands	• Minimize agricultural land expansion by using sustainable intensification. • Plant locally adapted crop species and varieties to increase yields and reduce the need to convert lands. • Rehabilitate and prioritize using degraded, abandoned, or underutilized lands over converting natural lands. • Support shifting cultivation only in sustainably managed forests or landscapes. • Consider larger landscape context when selecting lands to convert minimize overall impacts.
REDUCED AIR QUALITY		
Reduced air quality	• Farm equipment use • Application of farm chemicals (fertilizers, pesticides) • Crop burning • Land conversion by burning • Rice production	• Minimize soil disturbance, including using climate-smart practices including minimal tillage, cover crops, and wind breaks. • Use fertilizers consistent with 4R principles and within an ISFM framework. • Follow best practices for pesticide use to minimize application amounts, volatilization, and pesticide drifts. See the Pest Management SEG.

POTENTIAL ENVIRONMENTAL IMPACTS	ACTIVITY	MITIGATION STRATEGIES
		• Maintain farm equipment. • Promote alternatives to burning crop residue and farm waste. • Reduce land conversion or ensure conversion does not occur through burning. • Use best practices in rice production to minimize methane and N_2O emissions.
DAMAGED HABITATS AND REDUCED BIODIVERSITY		
Habitat loss and degradation	• Land conversion • Soil erosion • Application of farm chemicals (fertilizers, pesticides) • Irrigation • Introduction of non-native species	• Use sustainable intensification of agricultural lands to reduce pressure for land conversion. • Minimize land conversion, especially from native lands and lands with high levels of biodiversity. • Use climate-smart crop production practices to minimize environmental impacts of crop production, including from irrigation, farm chemical use, soil and water degradation, and soil erosion. • Ensure that introduced species are not invasive and use local species whenever possible.
Landscape simplification	• Monoculture crop production • Land conversion • Application of farm chemicals (fertilizers, pesticides)	• Ensure there are spaces that support biodiversity in or around fields, such as wildlife refuges, vegetative buffers, and agroforestry. • Practice climate-smart and environmentally sound crop production practices that increase biodiversity including crop rotations, intercropping, cover crops, and strip cropping. • Use fertilizers consistent with 4R principles and within an ISFM framework. • Follow best practices for pesticide use to minimize application amounts, volatilization, and pesticide drifts. See the Pest Management SEG.
Extinction/Loss of local varieties	• Monoculture crop production • Land conversion • Application of farm chemicals (fertilizers, pesticides) • Introduction of non-native species	• Use climate-smart crop production practices to minimize environmental impacts of crop production, including from irrigation, farm chemical use, soil and water degradation, and soil erosion. • Minimize land conversion, especially from native lands, and consider strategies that support local varieties and landraces. • Research any introduced species to prevent introduction of invasive species. • Encourage saving and preserving local varieties and landraces, including at seed banks. • Support local formal and informal breeding programs that preserve local genetics and varieties. • Encourage replanting and introducing local species and varieties.

3.6. RESOURCES FOR ENVIRONMENTAL IMPACTS

DECREASED WATER QUALITY AND SUPPLY

- FAO. 2012. "Coping With Water Scarcity: an Action Framework For Agriculture And Food Security." https://www.fao.org/3/i3015e/i3015e.pdf.
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LAND DEGRADATION

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REDUCED AIR QUALITY

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4. CLIMATE CHANGE MITIGATION AND ADAPTATION

This chapter explores the impacts of climate change on crop production and the contributions of crop production to climate change and proposes mitigation and adaptation measures to address them. See Box 8 below for the 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 (CRM) process (USAID 2017b).

BOX 8. CLIMATE CHANGE MITIGATION AND ADAPTATION DEFINITIONS

Mitigation refers to actions that reduce, avoid, or sequester carbon dioxide (CO_2) and other greenhouse gases, identified as the main cause of anthropogenic climate change (USAID 2022a). Preventing dangerous anthropogenic interference with the global climate system requires mitigation efforts by both developing and developed countries (USAID 2017b).

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 2022b). Adaptation is both a response to experienced climate changes and a preparation for projected future climate impacts.

Climate change impacts fall under 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 crop production activities.

Crop production both contributes to and is impacted by climate change. Crop production generates GHGs that contribute to climate change, and climate change impacts can reduce crop yields and production quality. As described previously, crop production is responsible for approximately 8 percent of global GHG emissions, comprising approximately 35 percent of all food-related GHG emissions (Ritchie 2019). Climate change also results in both direct and indirect risks to crop production activities, such as by increasing temperatures and temperature variability, changing precipitation patterns, and greater frequency of extreme events (IPCC 2022). Therefore, climate change risks and impacts should be assessed at the inception of the activity design.

4.1. ACTIVITY DESIGN GUIDANCE FOR CLIMATE RISK AND GHG EMISSIONS

Box 9 below 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 9. SAMPLE CLIMATE CHANGE CONSIDERATIONS FOR ACTIVITY DESIGN

Impacts of Future Climate Trends on Crop Production

Changes in precipitation

- Selecting drought-tolerant species and varieties and production methods that conserve water, such as reduced tillage.
- Comparison of water availability for irrigation and/or local precipitation rates and timing with temporal and crop-specific water needs of proposed plants in project.
- Understanding local flood plains and how excess water will be managed on fields in cases of extreme rainfall or flooding.
- Understanding how to minimize 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 (e.g., windmills, overhead air misters) to protect and stabilize against extreme temperatures.
- Adjusting planting or harvesting timing depending on expected timing of temperature changes.

Extreme weather events

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

GHG emissions from crop production

- Selecting climate-smart and environmentally sound crop production practices that reduce emissions and increase carbon sequestration.
- Using best practices when applying agrochemicals and manure.
- Improving yields while minimizing inputs.
- Selecting production methods that result in minimal land disturbance or do not leave land bare.
- Using efficient, well-maintained farm equipment, including irrigation methods.

4.2. CLIMATE CHANGE RISKS TO CROP PRODUCTION

Climate change can significantly adversely affect crop production and is generally expected to challenge our ability to meet the growing demand for food, fiber, feed, and biofuels. However, some of the impacts may be beneficial. The types of risks posed by climate change include the following:

- **Crop yields and nutrition** may be influenced by the increased amount of CO_2 in the atmosphere. For example, plants such as wheat and soybeans, as well as many pasture grasses and forage species (e.g., alfalfa, clover, fescue), grow better when CO_2 levels are elevated. Other plants may have negligible growth responses to higher atmospheric CO_2 levels, such as corn and millet. Rising CO_2 levels have also been tied to the decrease of protein and micronutrients in crops.
- **Growing season precipitation** may increase or decrease (depending on location), as may the intensity of precipitation events. Reduction in precipitation could result in more frequent drought conditions and loss of yields, while some areas may experience increased precipitation and flooding. Crops also depend on the timing of precipitation, meaning that water stress during a critical growth phase may be detrimental to yields. Excessive rains and flooding also create problems for farmers when extreme flooding submerges crops or delays harvest, resulting in potentially devastating losses both in field and post-harvest during drying or storage.
- **Higher temperatures** could result in a longer growing season and earlier seeding times for most crops. Earlier seeding could mean increased yields in regions where there is adequate soil moisture due to greater crop growth during spring rains. Higher temperatures or changes in precipitation may influence the length of growing seasons or the types of pests found in fields, which subsequently influences crop selection. However, higher temperatures and longer dry spells between rain events can increase drought severity and frequency. Water-stressed areas may expand while increased demands on available water resources will affect water quality and quantity on a seasonal basis. Water storage systems may become important for farmers in areas experiencing water scarcity for the first time.
- **The effects of climate change on insects and pathogens** are likely to be mixed. However, overall, climate change will likely increase the number of outbreaks of a wider variety of insects and pathogens in most locations and see the expansion of pests into new areas.
- **Warmer air and soil temperatures** resulting from climate change may increase soil microbial activity, speeding up the natural breakdown of organic matter. If organic matter breaks down faster than the crops can use the available nutrients, soil fertility decreases. However, a longer growing season with more vegetative mass may offset the increased breakdown of organic matter.
- **The predicted increase in drought conditions, precipitation, floods, heavy winds, and other extreme weather events** is expected to increase the risk of soil erosion. It may be necessary to ensure adequate ground cover at key periods throughout the growing season.

Figure 10. Innovations like this solar-powered water system can be used in communities where climate change threatens water availability. *Photo Credit: Bimala Rai Colavito, USAID*

CLIMATE CHANGE ADAPTATION AND RESILIENCE OPTIONS

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 land for crop production may be enhanced through active restoration and conservation activities. Cover crops can absorb CO_2 from the atmosphere through the soil while simultaneously making crops more resilient to climate change and enhancing the health of the soil. With healthier soil, water infiltration will improve, making soil less vulnerable to erosion from wind and water.

These services will be even more important as the incidence and severity of extreme events like storms and droughts increase with climate change. Expanding the adaptive capacity of crop production through cover crops can be supported through policy changes and crop insurance incentives (Greene 2022).

Planning for climate change requires an understanding of the unique characteristics of agricultural ecosystems and crop types with specific consideration of differential sensitivities to climate shifts. Due to the dynamic and varying nature of crop production, to analyze adaptive capacity, it is essential to take a site-specific approach.

General approaches to planning for climate change include water source and crop diversity, use of drought- and heat-tolerant crops, and promoting water conservation. Lack of support from government agencies and organizations and a lack of awareness have been key factors leading to a reduction of adaptative capacity in crop production; therefore, government engagement should be encouraged. An altered local climate can drive changes to crop production as well as the goods and services the crops provide to communities. Climate change impacts may additionally be worsened if other non-climate stressors (e.g., land clearing for infrastructure development) make crop production more sensitive.

Climate risk management (CRM) offers a method through which project designers and implementers can screen activities for climate risks and develop responses to address those risks and build resilience. CRM options exist to help reduce the impact that climate change can have on crop production. Measures that improve sustainable crop production, such as soil conservation and restoration, crop rotation, reduced tillage systems, and planting cover crops, can boost resilience of agricultural systems to climate change impacts.

Additional efforts can be made to study the relationship between climate change and ecosystem health, sensitive species, or pests and diseases to further understanding of climate impacts in specific regions. Finally, engaging local communities is critical in ensuring that climate adaptation is aligned with improved food security, human health, and livelihood protection.

Table 4 on CRM table below contains more specific information on the specific climate risks across crop production projects as well as measures to manage these risks.

TABLE 4. COMMON MITIGATION AND MONITORING MEASURES FOR CLIMATE RISKS

CLIMATE CHANGE STRESSORS	CLIMATE RISKS	RISK MITIGATION MEASURES	MONITORING
Changing precipitation patterns and seasonality	• Changes in seasonality resulting in longer growing seasons, resulting in increased timeline for pest reproduction. • Increased prevalence of pests and diseases that can affect crops due to changing climate conditions. • Changes in seasonality resulting in accelerated crop maturity and altered crop productivity. • Changes to the types of crops that have been historically produced in the region. • Earlier greening, leaf emergence, and fruit set in temperate and boreal climates due to changes in seasonality (particularly temperature regimes), potentially resulting in lower yields. • Exacerbation of invasive species that can affect crops through crowding out pressure.	• Enhance capacity to monitor, forecast, interpret, and communicate weather and climate information. • Provide information to farmers to guide decision-making on investments for crops and methods to anticipate and adapt to changing climate conditions. • Provide capacity-building. Local capacity strengthening to support farmers in understanding and responding to changing climate conditions and seasonality. • Invest in research to determine how changing climate conditions will affect crop suitability and help inform identification of alternative crops. • Invest in research to determine how changing climate conditions will affect pests and diseases and help inform pest and disease management. • Encourage and enable alternatives to monoculture planting to reduce susceptibility to catastrophic losses from pests and disease.	• Documented consideration of changing climate conditions in project design. • Documented improvements in climate information and information communication to farmers. • Developed and implemented local capacity strengthening and capacity-building plans. • Documented research investments.
Increasing incidence and severity of storms (e.g., intense rainfall and high wind events) as well as extreme events (e.g., flooding, landslides, and wildfires)	• Damage to agricultural infrastructure. • Damage to transportation routes, disrupting delivery of input materials, labor access, and transport to market, as well as interference with production and distribution. • Damage to crops, reduced productivity and yields, and increased economic losses from high winds and waterlogging; submergence of crops and delayed harvests due to extreme flooding.	• Evaluate crop resilience to storms and other extreme events. • Provide timely weather information to farmers using results of monitoring from early warning systems. • Construct or retrofit agricultural infrastructure to improve resilience to extreme events. • Assess potential risk to agricultural production transportation routes and identify or develop alternate routes and	• Documented consideration of extreme weather events in project design. • Documented improvements in climate information and information communication to farmers. • Documented consideration of alternate transportation routes and methods. • Develop and implement local

CLIMATE CHANGE STRESSORS	CLIMATE RISKS	RISK MITIGATION MEASURES	MONITORING
	• Eroded soil and depleted soil nutrients. • Intense rainfall resulting in agricultural runoff, affecting surrounding water quality. • Impacts to health and well-being of the agriculture workforce.	transportation options. • Identify fields that are prone to flooding and exposed to impacts from extreme events. • Identify measures to minimize runoff and buffer zones and plantings to protect from flooding and high winds. • Promote crops that can withstand temporary inundation during storm events. • Increase training and investment in more flood-resilient agricultural practices. • Design and implement emergency preparedness and response plans for workers.	capacity-strengthening plans. • Documented research investments. • Documented emergency preparedness and response plans are available and posted.
Increasing air temperatures and incidence and severity of heat waves	• Temperature fluctuations that can increase presence of disease-carrying pests as habitats change. • Reduced water availability for crops due to increased evaporative demand from higher temperatures. • Changes in temperature can affect growth times and lead to pollinator disruption. • Increased temperatures and shifting moisture conditions, making it challenging for seeds to germinate. • Long-term increase in annual mean temperature, exacerbating the potential for heat stress among agricultural workers. • Reduced snow cover and receding glaciers in mountainous areas that feed rivers, leading to reduced water availability for crops. • Reduced labor productivity and impacts to health and well-being of the workforce	• Evaluate crop resilience to increasing air temperatures. • Provide timely weather information to farmers using results of monitoring from early warning systems. • Promote crops with increased heat tolerance. • Increase training and investment in more heat-resilient agricultural practices. • Encourage and enable alternatives to monoculture planting to reduce susceptibility to catastrophic losses from pests and disease. • Design and implement health and safety plans for workers.	• Documented consideration of extreme weather events in project design. • Documented improvements in climate information and information communication to farmers. • Documented consideration of alternate transportation routes and methods. • Developed and implemented local capacity-strengthening plans. • Documented research investments. • Documented emergency preparedness and response plans available and posted.

CLIMATE CHANGE STRESSORS	CLIMATE RISKS	RISK MITIGATION MEASURES	MONITORING
	caused by extreme heat events (e.g., heat stress and exhaustion).		
Increasing incidence and severity of droughts	• Reduced access to water for irrigation. • Increased likelihood of wildfires, which can pose major risks to agricultural sites and harm the health of the agricultural workforce. • Reduced crop yields from drought. • Lost topsoil and reduced soil fertility from prolonged drought and extreme events.	• Evaluate crop resilience to drought. • Provide timely weather information to farmers using results of monitoring from early warning systems. • Promote crops with improved drought tolerance. • 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 through practices, such as minimum tillage and canopy management. • Promote and enable efficient water monitoring and management systems. • Design and implement health and safety plans.	• Documented consideration of increasing drought risks in project design. • Documented improvements in climate information and information communication to farmers. • Developed and implemented local capacity-strengthening plans. • Documented health and safety plans, including provision of breaks and water, are available and posted.
Sea level rise	• Increased incidence of saltwater intrusion, contaminating water supplies. • Increased soil salinization, reducing crop productivity. • Increased erosion, inundation, and storm surge, which can damage crops in coastal areas. • Increased erosion, inundation, and storm surge, which can damage agricultural infrastructure and transportation routes in coastal areas, disrupting delivery of input materials, labor access, and transport to market, as well as interfering with production and distribution.	• Construct or retrofit coastal agricultural infrastructure to account for rising sea levels and increased storm surge. • Develop maps showing overlap between agricultural areas and likely extent of sea level rise under future climate scenarios; communicate findings to farmers and decision-makers. • Evaluate crop resilience to increased soil and water salinization. • Promote crops with improved salt tolerance. • Implement saltwater-resilient buffer zones. • Increase training and investment in improved agricultural practices to address increasing	• Documented consideration of sea level rise risks in project design. • Documented development and communication of sea level rise maps. • Developed and implemented local capacity-strengthening plans. • Documented health and safety plans, including consideration of increased storm surge risks.

CLIMATE CHANGE STRESSORS	CLIMATE RISKS	RISK MITIGATION MEASURES	MONITORING
	• Increased storm surge and flooding, which can impact the health and well-being of the agricultural workforce, both from direct impacts (e.g., drowning) as well as increased incidence of vector- and water-borne diseases.	salinity, such as alternating use of cover crops and using inputs with lower salt content. • Design and implement health and safety plans for workers.	

4.3. CROP PRODUCTION CONTRIBUTIONS TO CLIMATE CHANGE

Agriculture generates emissions that contribute to climate change but can also be affected by climate change. Each stage of the crop production value chain releases GHGs into the atmosphere.

N_2O emissions from agricultural soils resulting from fertilizer use make up about one-third of primary production of cropland agriculture GHG emissions, followed by crop burning and deforestation. The remaining portion of emissions comprises rice cultivation and CO_2 emissions from cropland soils.

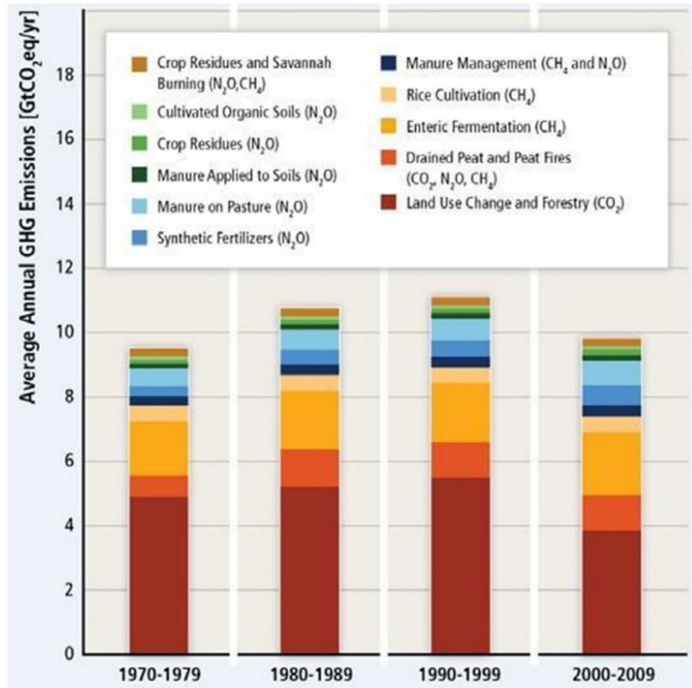

Figure 11. Contributions of agricultural and land-use activities to agricultural sector emissions (IPCC 2014).

When looking specifically at GHG emissions across all segments of the food production value chain (including crop and livestock production) from primary production through end of life, approximately 70 percent of GHG emissions occur during primary production and from land use change. This indicates that while post-production emissions are important, the most significant emissions occur during primary production. Thus, it is important for emission reduction activities to focus on reducing land use change and mitigating emissions during primary production. At the farm level, GHG emissions and soil carbon sequestration rates can vary significantly depending on the crops grown, production practices employed, and other factors such as weather, topography, and hydrology.

Some countries, particularly in Africa, still have relatively low agricultural emissions, as shown below in Table 5. Asia has the largest share of food system-related GHG emissions in absolute terms but the lowest per capita GHG emissions from the food system. See Table 5 for the GHG emissions from the food system.

TABLE 5. SHARE OF GHG EMISSIONS FROM THE FOOD SYSTEM (INCLUDING LULUC)[a] FOR WORLD REGIONS (Crippa, Solazzo, et al. 2021)

Location	Total GHG Emissions (from food systems), Gt CO_2e 2015	Per capita GHG emissions from food system (t CO_2e/yr), 2015
World	52	2.4
Africa	4.7	2.8
Asia	24	1.8
Europe	4.2	2.4
Latin America[b]	4.5	4.7

Location	Total GHG Emissions (from food systems), Gt CO_2e 2015	Per capita GHG emissions from food system (t CO_2e/yr), 2015
North America	7.3	5.2
Oceania	0.7	8.2
Russia[c]	6.6	2.2

[a] LULUC = Land Use and Land-Use Change
[b] Including Central and South America
[c] Including Russia, Ukraine, Central Asia, the Middle East, and Turkey
Total GHG emissions (including CO_2, CH_4, N_2O and F-gases) are expressed as CO_2e calculated using the GWP100 values used in the IPCC AR5, with a value of 28 for CH_4 and 265 for N_2O.

Although minor for each individual farmer, cumulatively, GHG emissions from agriculture can be significant on a regional, national, or global scale. In the last half-century, GHG emissions originating from Agriculture, Forestry, and Other Land Use (AFOLU) have nearly doubled, with forecasts indicating a continued rise of at least 28 percent between 2010 and 2050 (WRI 2019, FAO 2017). Growth in agricultural emissions is anticipated to be greatest in Asia and sub-Saharan Africa. In sub-Saharan Africa alone, food demand is projected to grow by 216 percent between 2010 and 2050, while global food calorie demand is only projected to grow by 55 percent during that period. The production of vegetable oils and animal products (i.e., products with a high GHG intensity) are expected to grow the most among agricultural outputs (WRI 2019).

Agriculture can also reduce an area's resilience to climate shocks and stressors in a range of ways. In cases where conversion of land to agriculture contributes to desertification, deforestation, or forest degradation, the system can become more vulnerable to climate-related impacts, such as increasing temperatures, droughts, extreme precipitation and wind events, and floods. In particular, the conversion of biodiverse land to monoculture, or single-species, farms reduces the land's capacity to buffer environmental stress, but also affects the water cycle through impacting water-vegetation interactions (Levia 2020). Intensive farming (such as overgrazing) and poor soil management practices can contribute to soil degradation that facilitates erosion and flooding. As land and soil degrade, their resilience against water and soil runoff is diminished. Drawing water for irrigation further contributes to water stress, as climate conditions drive drought and precipitation variability in some regions. Overdrawing water resources is expected to be an especially large concern as temperatures rise and result in further water demand for irrigation.

Table 6 below conveys the GHG emissions and reduced sequestration sources associated with the two stages of the crop production life cycle included in this SEG, as well as suggests actions to increase carbon sequestration and mitigate GHG emissions.

TABLE 6. MITIGATING GHG EMISSIONS FROM CROP PRODUCTION

ACTIVITY	GHG EMISSIONS OR REDUCED SEQUESTRATION SOURCE	EMISSIONS MITIGATION MEASURES
PRIMARY PRODUCTION		
Conventional tillage	Reduced soil carbon sequestration and CO_2	• Apply no till, reduced till, or mulch till practices.

ACTIVITY	GHG EMISSIONS OR REDUCED SEQUESTRATION SOURCE	EMISSIONS MITIGATION MEASURES
	emissions from equipment use	
Fallow/bare land between growing seasons	Reduced soil carbon sequestration	• Promote use of cover crops.
Synthetic nitrogen fertilizer use	N_2O emissions from fertilizer volatilization	• To adequately mitigate N_2O emissions from synthetic fertilizer use, follow the 4Rs approach: use the right fertilizer at the right time with the right application method and at the right rate. • Use enhanced efficiency fertilizers. • Rotate with legumes or nitrogen-fixing plants that need less fertilizer. • Use green fertilizers or till in crop residue. • Use appropriately managed manure as fertilizer.
Rice production	Methane and N_2O emissions	• Alternate wet-dry or grow dryland rice. • Choose low emissions rice production methods.
Farm equipment use	Tailpipe GHG emissions associated with fuel and energy usage	• Choose practices that require fewer field passes. • Reduce idling of vehicles. • Invest in more efficient vehicles. • Use precision agriculture.
Application of farm chemicals (fertilizers, pesticides)	Loss of beneficial nitrogen-fixing bacteria in soil	• Follow best practices and use precision agriculture.
Land se change / land clearing	Reduced soil carbon and biomass sequestration	• Sustainably increase production on existing land to meet needs and avoid additional land clearing.
Unsustainable management practices	Reduced soil carbon sequestration and soil fertility	• Use agroforestry practices, intercropping, sustainable crop rotation practices, and avoid monoculture.
Fuel use for irrigation	Tailpipe GHG emissions associated with vehicle and pumping activities	• Use water-efficient irrigation (such as drip irrigation). • Maintain irrigation equipment. • Employ energy efficient water pumps. • Ensure that water extraction and storage is efficient. • Use practices that minimize evaporation and conserve soil moisture (such as cover crops).
POST-HARVEST ACTIVITIES		
Crop burning	Carbon dioxide, methane, nitrous oxide, and other air pollutant emissions from combustion, decreased soil carbon, and biomass	• Till in crop residue as opposed to burning. • Use other management practices.

ACTIVITY	GHG EMISSIONS OR REDUCED SEQUESTRATION SOURCE	EMISSIONS MITIGATION MEASURES
	sequestration	
Post-harvest storage and processing	GHG emissions from fuel and energy use and chlorofluorocarbons from refrigerant leakage	• Ensure best management practice for storage and drying. • Manage pests in stored products. • Use efficient drying methods of products. • Use energy efficient warehouses, tanks, and refrigerators. • Minimize distance to storage or processing facilities. • Use energy efficient or renewable energy processing equipment. • Use proper waste disposal methods.
OVERARCHING VALUE CHAIN		
Transportation	GHG emissions from fuel and energy use	• Manage logistics to minimize distance traveled. • Use electric vehicles as well as more efficient vehicles. • Use less emissive transportation modes (e.g., train versus trucks or airplanes).

4.4. RESOURCES FOR CLIMATE CHANGE IMPACTS

- FAO. 2017. "Climate Smart Agriculture Sourcebook." https://www.fao.org/climate-smart-agriculture-sourcebook/production-resources/module-b1-crops/b1-overview/en/.
- USAID. 2022. "Climate-Smart Agriculture and Food Systems: U.S. Government's Global Food Security Strategy Activity Design Guidance." https://pdf.usaid.gov/pdf_docs/PA00ZX7D.pdf.
- USAID. 2022. "USAID Climate Strategy: 2022–2030." https://www.usaid.gov/policy/climate-strategy.
- USAID. n.d. "Climate Change in USAID Country/Regional Strategies: A Mandatory Reference for ADS Chapter 201." https://www.usaid.gov/about-us/agency-policy/series-200/references-chapter/201mat.
- USAID. n.d. "Climate Risk Management for USAID Projects and Activities: A Mandatory Reference for ADS Chapter 201." https://www.usaid.gov/about-us/agency-policy/series-200/references-chapter/201mal.
- USAID. n.d. *USAID ClimateLinks*. http://www.climatelinks.org/.

5. HUMAN HEALTH IMPACTS

Household agricultural production has significant and direct connections to dietary habits and nutrition. 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.

The main ways in which crop production can influence nutrition include:

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

- **Diversified diets.** Local crop production may provide access to a wide spectrum of nutrient-rich foods, reducing dependence on single staple crops, and promoting cultural culinary traditions rooted in a variety of locally adapted crops. This strategy fosters better nutritional outcomes and is often more resilient to climate changes and market fluctuations.

- **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. Growing crops with sufficient content of essential micronutrients improves the nutritional quality of food supply and provides farming households with health benefits. 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, agriculture activities in drylands should be designed to account for potential context-specific health risks to the activity. Box 10 below includes potential health considerations for crop production activity design. These factors should be assessed at the inception of the activity and considered in the decision-making process to address potential context-specific health 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 health risks should be conducted prior to decision-making for the activity design.

BOX 10. SAMPLE HUMAN HEALTH CONSIDERATIONS FOR ACTIVITY DESIGN

Community Health

- Proximity and access to medical services.
- Proximity to wells or other drinking water sources and fishing sites to minimize runoff impacts

Occupational Health

- Proximity and access to medical services, including treatment for poisoning.
- Presence of hazards such as ladders, heavy machinery, agrochemicals, etc.
- Number of high temperature days during the project lifetime.

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 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 the following:

Community Health Indicators

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

Occupational Health Indicators

- Rate of workers attending training
- Rate of equipment maintenance

Figure 12. Through improved cropping practices, the nutritional content of foods can be improved, leading to better health outcomes. *Source: Morgana Wingard, USAID*

The remainder of this chapter includes a discussion of 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.

5.1. COMMUNITY HEALTH IMPACTS

Communities surrounding crop production 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, 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.

- **Respiratory Hazards.** According to the Environmental Protection Agency (EPA), fine particulate matter 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.).

- **Food Safety Concerns**. Food safety and quality is critical to public health. Safety and quality can be compromised in many ways including but not limited to:

  - Pathogens introduced by unsanitary production, harvest, handling, and/or storage practices. Examples include contaminated irrigation water, use of green manure, lack of appropriate sanitary facilities for farm workers, and rodents in stored commodities.
  - Chemical contamination resulting from poor pesticide choices and use practices (e.g., aspergillus molds causing aflatoxin contamination, and heavy metals in soil).
  - Physical contaminants such as stones and twigs. See Box 11 for information on food safety regulations.

BOX 11. CODEX ALIMENTARIUS

In setting food quality/safety standards, many developing country governments rely heavily on the Codex Alimentarius. The Codex Alimentarius is a collection of food safety standards, guidelines, and codes of practice adopted by the Codex Alimentarius Commission, which is the governing body of the Joint FAO/World Health Organization (WHO) Food Standards Programme.

See https://www.fao.org/fao-who-codexalimentarius/en/ for more information.

- **Disease Transmission:** Irrigation 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 in humans.

- **Community Agrochemical Exposure**. Water pollution from agrochemicals such as pesticides and fertilizers can have direct acute and long-term impacts to human health. Agricultural activities can contaminate drinking water with nitrates, pesticides, and soil sediments (FAO 2021).

  Infants who ingest water contaminated with nitrates from agricultural runoff may develop methemoglobinemia, also known as blue baby syndrome. Nitrate exposure has also been linked to pregnancy loss, birth defects, infant mortality, cardiorespiratory issues, gastrointestinal issues, cancer, thyroid disruption, and other health disorders (UNEP 2021).

Residents of farming communities are commonly exposed to pesticides through spray drift, contact with treated areas, and via drinking water, but exposure may also occur through mishandling such as improper storage or improper disposal. Families of agricultural farm workers may additionally be exposed to pesticides from residues that remain on the clothing or skin of agricultural workers (AFOP n.d.). Acute pesticide poisoning can be fatal and chronic subacute exposure can cause chronic diseases such as cancer, reproductive and developmental harm, and damage to organs and the nervous system. According to the United Nations Environment Programme (UNEP), approximately 385 billion non-fatal pesticide poisonings and approximately 11,000 deaths occur every year (UNEP 2021).

Certain fertilizers, such as ammonium nitrate and calcium nitrate, are highly explosive. Storing these materials near communities may put residents at undue risk of harm. Please refer to the USAID Guidance for Procuring Ammonium Nitrate Fertilizer for additional guidance on safe storage of these materials.

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:

- **Accidents/Injuries**. In the workplace, farm workers and post-harvest food processors are typically at risk of heat exposure, falls, musculoskeletal injuries, limb loss, unsanitary conditions, exposure to pesticides, and other risks. The agriculture sector has one of the highest rates of worker preventable hearing loss with machinery, motorized hand tools (e.g., chainsaws), squealing pigs, and guns representing some of the most typical sources (OSHA n.d.).

  Heat stroke is an ongoing problem in the crop production sector as farm work is mostly performed outdoors. With the increasing effects of climate change, heat stroke incidents are exacerbated. Farm managers often disregard heat exhaustion as a labor hazard, leaving laborers to handle the issue themselves. Severe heat stress can be fatal, but it can be reduced with proper safety standards and procedures as well as awareness. Child workers are particularly vulnerable, as they cannot sweat as much as adults and are therefore more likely to experience heat stress (FAO 2018).

- **Worker Agrochemicals Exposure.** Agricultural farm workers are the group in the crop production value chain who experience the highest pesticide- and fertilizer-related risks. Exposure may occur while mixing, loading, transporting, storing, or applying agrochemicals. Fertilizer contact with bare hands may cause skin irritation, and ingestion may be poisonous. Inappropriately stored fertilizer can release toxic fumes. Occupational exposure to fertilizers from inhalation of ammonia from manure and/or ammonium nitrate fertilizers is reported to lead to chronic irritation to the respiratory tract and irritation and burns to the mouth, lungs, and eyes (UNEP 2021).

  Highly toxic pesticides are a leading mechanism for suicide deaths in low- and middle-income countries where pesticides are readily available to small-scale farmers and their families.

Globally, pesticide ingestion accounts for 14–20 percent of global suicides (WHO 2020). Notably, a number of studies have demonstrated that if highly toxic pesticides are unavailable, the death rate drops significantly and tens of thousands of lives are saved (Gunnell, et al. 2017). Studies have shown that the unavailability of highly toxic pesticides had very little impact on harvest, and national bans on highly hazardous pesticides is a cost-effective intervention for suicide prevention as there are many other ways to manage pests that are less toxic (Lee, et al. 2021). See Box 12 for additional information.

BOX 12. 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 2023). The WHO and FAO have since published guidance for pesticide regulation to prevent suicide, available here: https://www.who.int/publications/i/item/9789240066700.

MITIGATION MEASURES FOR OCCUPATIONAL HEALTH IMPACTS

Workers should receive training on safe and appropriate use of agrochemicals and machinery, including an understanding of the existing health and environmental hazards, instructions for appropriate use and handling, proper use of personal protective equipment (PPE) (including hearing protection as appropriate) and first aid measures, as well as operator and bystander safety. Unsafe occupational health practices are heightened when national labor standards are poorly developed or enforced, thus enforcing safety standards at the policy level is essential.

All tools, including hand tools and machinery, should be maintained in good condition. Farmers should always wear appropriate PPE when handling agrochemicals or using heavy machinery. Agrochemicals and farm tools should always be used per the manufacturers' instructions. Where agrochemicals or equipment are directly provided by a project or directly controlled by a project, PPE should be provided and its use enforced. Hazardous materials including agrochemicals, fuels, and oils should be stored separately in nonflammable, well-ventilated tanks/structures away from food, seeds, and animal feeds and away from any surface waters or drinking water supplies. Least toxic pesticides or nonchemical controls should always be used first.

Thirst is not a reliable indicator of the body's need for hydration (FAO 2018). The U.S. Occupational Safety and Health Administration recommends that workers exposed to hot and humid conditions drink water every 15 minutes (OSHA n.d.). The fluids provided should be enough (ranging between 2 liters to 15 liters per day, depending on the temperature and duration of work) and relatively cool, while drinking small quantities of water frequently (FAO 2018). Workers should receive training about the signs of heat stress and should be encouraged to rest in a shady location as needed.

5.3. SUMMARY TABLE OF MITIGATION MEASURES RELATING TO HEALTH IMPACTS

Mitigation methods will depend on both impacts and indicators. Table 7 below summarizes the common human health impacts for the crop production systems and associated mitigation measures described above.

TABLE 7. SUMMARY OF ADVERSE HUMAN HEALTH IMPACTS AND MITIGATION STRATEGIES

ACTIVITY	POTENTIAL HEALTH IMPACTS	MITIGATION STRATEGIES
COMMUNITY HEALTH		
Respiratory hazards	Agricultural operations may generate large amounts of particulate matter, which may be hazardous to sensitive groups and increase rates of asthma in surrounding areas.	• Build capacity for community health services and health education. • Control PM emissions, through strategies discussed in Chapter 3.
Food safety	Food quality may be compromised by pathogens, physical and chemical contaminants.	• Promote proper manure management in mixed crop-livestock production systems. • Identify any host country laws and regulations and/or international laws and regulations regarding food safety and storage. • Follow host country regulations and pesticide label instructions for proper application of pesticides.
Disease Transmission	Health risks such as cholera, diarrhea, exposure to bacteria, Lyme disease, and typhoid can be caused by poor irrigation management.	• Maintain irrigation drainage to prevent pollution and spread of disease • Cover tanks containing standing water • Monitor and enforce water quality standards • Ensuring that irrigation operations match demand for irrigated amounts
Community agrochemicals exposure	Community members may be exposed to agrochemicals due to runoff, drift, or misapplication. Related illnesses include blue baby syndrome, skin irritation, adverse reproductive effects, fatigue, and cancers. Certain fertilizers like calcium and ammonium nitrate are explosive.	• Build capacity for community health services, including poison control. • Limit off-farm transport of agrochemicals through methods discussed in Chapter 3 (Environmental Impacts). • Store fertilizers and pesticides correctly and away from homes and drinking water supplies. See USAID Pest Management SEG and Africa Bureau Fertilizer and Soil Fertility Factsheet. • Use alternative fertilizers to ammonium or calcium nitrate. See USAID Guidance for Procuring Ammonium Nitrate Fertilizer.
OCCUPATIONAL HEALTH		
Accidents/Injuries	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 PPE use. • Provide ample amounts of fluids for workers. • Keep records of trainings on labor safety including number of people who attended. • Institute procedures for documenting and reporting chemical exposures, accidents, and incidents. • Identify any host country laws and regulations and/or international laws and regulations regarding labor safety.
Worker agrochemical exposure	Farm workers are the group most directly exposed to high	• Conduct safety trainings for workers that include information on proper PPE use and

ACTIVITY	POTENTIAL HEALTH IMPACTS	MITIGATION STRATEGIES
	concentration pesticides and fertilizers. Workers may be exposed at any point during the pesticide lifetime. Highly toxic pesticides are a leading mechanism for suicide among farm workers and family members.	safe handling procedures. • Use PPE when applying and working with agrochemicals. • Keep records of trainings on agrochemical safety including number of people who attended. • Institute procedures for documenting and reporting chemical exposures, accidents, and incidents. • Always choose least toxic pesticides to limit availability of deadly substances.

5.4. RESOURCES FOR HEALTH IMPACTS

- Integrated Plant Protection Center. 2020. "Pesticide Risk Reduction: An International Guideline." https://pesticide-risk-reduction.github.io/international-pesticide-guideline/.
- OSHA. n.d. "Agricultural Operations: Hazards and Controls." https://www.osha.gov/agricultural-operations/hazards.
- 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: U.S. Government's Global Food Security Strategy 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 Pesticides Use Sector Environmental Guidelines." https://www.usaid.gov/sites/default/files/2022-05/SectorEnvironmentalGuidelines_SaferPesticides_2003.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 OVERVIEW

In developing countries, the crop production sector significantly contributes to local, regional, and national economic development. The revenue from crop production can further drive development by leading to improved infrastructure and access to public services such as education and health care. The crop production sector also provides employment opportunities for those directly and indirectly engaged with production. However, the potential exists for adverse and unintended negative social impacts as a result of crop production projects. USAID is committed to integrating stakeholders' voices, concerns, perspectives, and values as a form of acquiring feedback and input on a proposed project to identify potential social impacts early on and make sound decisions during the design and planning phase. As indicated in the adjacent textbox, per ADS 201, USAID requires an initial screen of potential 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.

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.[4] 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

[4] 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.

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 13 lists social considerations relevant to crop production projects that should be examined more closely by Missions and/or IPs when planning for and designing crop production projects to better understand potential social impacts. These factors should be assessed at the inception of the activity and used 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.

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BOX 13. SAMPLE SOCIAL CONSIDERATIONS FOR ACTIVITY DESIGN

Community Vulnerabilities

- Existing social sensitivities and conflicts in the community
- People or groups who are in potentially vulnerable, marginalized, and/or underrepresented conditions
- Potential for unequal benefit and cost distribution of crop production among community members
- Potential lack of arable land for farmers and landowners
- Existing impacts of intensive crop production on smallholders in the region

Existing Customs and Practices

- Prevalence of customary land tenure arrangements in the community and their potential impacts on new cropland activities
- Existing land tenure practices and traditions and their efficacy
- Stakeholder views and perspectives regarding crop growing in their region
- Impacts of proposed activities on existing crop production arrangements
- Potential impacts of proposed activities on existing communal crop production arrangements

There are a variety of indicators that can be used as part of a monitoring, evaluation, and learning (MEL) framework/approach for social considerations in crop production programming. In general, when developing social indicators, they 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 crop production value chain.
- Who is exercising power or making decisions in cropping systems
- Proportion of total adult population with secure tenure rights to land, with (a) legally recognized documentation; and (b) who perceive their rights to land as secure.

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

- IFPRI. 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.
- MCC. 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 8 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 8: USAID 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.

	PRINCIPLE	DESCRIPTION
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.
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.

	PRINCIPLE	DESCRIPTION
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 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 for crop production 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).

In order to ascertain whether a crop production 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 2023). 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).[5] Furthermore, prior to project implementation, it is important to carry out a Social Impact Assessment while including broad and in-depth stakeholder consultations to become aware of the existence of the cultural resources in or nearby the proposed project site.

6.1.2. LAND TENURE, DISPLACEMENT, AND RESETTLEMENT

While small scale crop production projects will likely not necessitate large stretches of land to undertake a project such as a large-scale crop production 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. 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. 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.

[5] 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.

Furthermore, crop production activities can create an economic incentive to convert nearby land to alternate, higher value uses (e.g., for cultivation of a cash crop). Particularly when the ownership arrangements of land tenure are insecure, this can result in landowners converting land farmed by tenant smallholders to commercial farming use or in smallholders being otherwise dispossessed of their land. It may also result in land conversion, so that households and communities lose access to the land and its services as discussed in Box 15.

BOX 14. DECREASE IN ECOSYSTEM SERVICES FROM LAND USE CHANGE

Interlinkages may be found among conflict dynamics, land tenure, and disruption to local or traditional livelihoods and are explored below within the context of the loss of ecosystem services. Land conversion for crop production may mean that households and communities lose the ability to gather fuelwood, graze animals, harvest non-timber forest products, and/or engage in other uses of the land that are important to food security and/or livelihood. These are examples of the loss of ecosystem (provisioning) services provided by the land. Other ecosystem services that may be lost due to land conversion include, among others, flood control, purification of surface waters, and groundwater recharge. Loss of these ecosystem services may in turn impact human livelihood and well-being.

Land conversion may also result in increased abstraction of water for agriculture, adversely affecting other users and adversely affecting ecosystem services provided downstream.

Social impacts resulting from loss of ecosystem services and appropriation of natural resources may fuel land-use conflicts, for example, between smallholders/communities and commercial farmers and between pastoralists and agriculturalists, among many others.

Agricultural intensification may also result in increased abstraction of water and loss of ecosystem services provided by a landscape that was previously less intensively cultivated.

Moreover, insecure land tenure also means that farming systems and practices that focus on sustaining land productivity over the long term, or that require time to deliver benefits (e.g., agroforestry), will frequently find little acceptance if farmers have no assurance that they will benefit from their investments of money and labor. Strengthening insecure land tenure "does not by itself guarantee increases in agricultural productivity or access to capital, particularly in the short run, but it is an essential component of a strategy to raise productivity in the long term" and may significantly increase the probability and intensity of conservation efforts by smallholders (Boudreaux and Sacks 2009).

Land tenure issues may lead to CDR. In the context of crop production 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 crop production 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 made during project design and implementation invariably have the potential to influence people's health, well-being, and safety. Assessing and managing potential social impacts relating to health, well-being, and safety is multilayered and requires a careful and sustained effort (USAID 2017a). For example, it is important to consider the impacts of introducing pesticides to a project, regardless of the size. Local communities and those who are applying the pesticide risk being affected by pesticide-related illnesses and conditions such as headaches, skin irritation, adverse reproductive effects, and fatigue. These illnesses may especially impact children and older people on a disproportionate level due to their increased vulnerability to illnesses. In addition, pesticide runoff can contaminate drinking water supplies for local communities leading to negative community health impacts. Such impacts to water may force local community members, especially women, to travel farther in search of clean drinking water. Search of clean drinking water may risk the safety of women if they need to travel to unfamiliar or unsafe locations, leading to an increase in the risk of gender-based violence (GBV).

International best practices, namely IFC Performance Standard 4: Community Health, Safety, and Security, provide additional guidance on potential social impacts on health and well-being (IFC 2012).

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 crop production 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 crop production project may exacerbate the underlying conflict dynamics. There may be historical grievances that come to light due to proposing a crop production 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.[6]

6.1.5. LABOR

Crop production 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.[7] 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

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

[7] 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).

in trafficking in persons, procuring commercial sex acts, or using forced labor. Please refer to the references in the footnote.[8]

Furthermore, since crop production projects may sometimes rely upon the use of heavy machinery, be exposed to extreme heat regarding working conditions, workers may be at risk to an array of occupational risks and hazards. Individual projects should ascertain the occupational health and safety risks to workers and design mitigation measures. Follow guidance in the footnote.[9]

> ***Note:*** *For key concepts and best practices for youth integration in crop production programming, see* Global Food Security Strategy Technical Guidance for Youth.

6.2. OTHER SOCIAL CONSIDERATIONS

This section discusses important social considerations for crop production activities. These considerations may have significant impacts on crop production activities and should be assessed in the project area community and factored into decision-making throughout the project life cycle.

6.2.1. LOCAL COMMUNITY

When planning and designing crop production projects, the local community in which the project will be embedded must be taken into consideration. This consideration can be achieved prior to assessing potential social impacts by undertaking a desktop review, conducting field visits, and/or engaging stakeholders to ascertain community characteristics such as demographics, socioeconomic composition, and political, institutional and legal frameworks.[10] Although the particulars of identifying social impacts for crop production projects will depend upon the project being proposed, its site location, and the local context, undertaking stakeholder engagement early on will ensure a better understanding of how the proposed project may affect the local community. If stakeholders voice concerns about potential negative social impacts due to a proposed crop production project, the social impacts may be assessed, and mitigation and monitoring measures should be designed. If social impacts are considered significant and/or irreparable, a Social Impact Assessment (SIA) may be considered, or the project may be up for reconsideration in its entirety.

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[8] 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".

[9] 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).

[10] For more information on local community, please see World Bank | Responsible Agricultural Investment (RAI) Knowledge Into Action Notes.

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 2022c). 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 crop production 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[11] 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).

Community participation, through stakeholder engagement and consultation is critical for the sustainability of irrigation schemes. This may involve, for instance, engaging water users in the decision-making processes for the planning and implementation of irrigation projects. Water User Associations (WUAs) can enhance community participation in irrigation projects. A WUA is an organization for water management comprising a group of small and large-scale water users, such as irrigators, who pool their financial, technical, material, and human resources for operation and maintenance of a local water system, such as a river or water basin. The WUA is usually run out of a nonprofit structure, and membership is typically based on contracts and/or agreements between the members and the WUA. Establishing WUA committees must reflect the interests and inputs of the irrigation scheme users (Yami 2013).

6.2.3. GENDER EQUALITY

Gender considerations may need to be examined when planning and designing crop production projects and evaluating potential social impacts. Women are often involved in crop production projects and the management of agricultural products, but they do not always benefit from the project equally compared to men. Crop production activities can create or exacerbate wide disparities for women and other marginalized community members' access to and control over productive resources, service delivery,

[11] 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 Co-Creation at USAID.

and market opportunities (Chapados, et al. 2012). Therefore, USAID staff and IPs must be cognizant that social impacts may be gender-differentiated.

USAID seeks to improve people's lives by advancing gender equality; to empower women and girls to participate fully in and equally benefit from the development of their societies on the same basis as men; and to 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 Automated Directives System (ADS) 205, which seeks to integrate gender and equality into the program cycle.[12]

Furthermore, it is important to assess gender considerations to avoid the potential to exacerbate underlying conditions, beliefs, or value systems that perpetuate gender-based violence (GBV). GBV should be prevented, as this represents a significant social impact. USAID has resources to evaluate the potential for GBV and how to address this social issue. Please see the resource linked in the footnote.[13] Moreover, USAID has several guidance documents regarding gender considerations. Please see the resources linked in the footnote.[14]

Another factor to consider is that crop production interventions may increase the economic incentive that smallholder households and farming communities take children—particularly girls—out of school to provide farm labor. According to the International Labor Organization (ILO), in farming, women and children are often responsible for operating machinery, using sharp tools, and spraying chemicals, and they are often more likely to experience amputations, cuts and burns, pesticide poisoning, and other adverse health impacts. Therefore, USAID actively seeks to combat child labor.

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

6.2.4. DISRUPTION TO LOCAL OR TRADITIONAL LIVELIHOODS

The siting and placement of a proposed project may affect local or traditional livelihoods. Even though a crop production project may be on a small scale, it may entail land use change to some degree, which may affect local community members. For example, farmers may lose acreage, or businesses may suffer reduction in income if their customers are impeded from accessing shops or businesses, which could cause negative economic impacts.

The nature and range of social impacts may not be immediately apparent during the planning phase for crop production projects; hence, the need to start engaging stakeholders as early as possible in the project life cycle (i.e., at the program design stage and throughout project implementation). Particular attention should be paid to marginalized and underrepresented groups and/or people in vulnerable situations in order to not put them in a position of increased socioeconomic vulnerability. The potential

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[12] For further information, please visit ADS Chapter 205 | Integrating Gender Equality and Women's Empowerment in USAID's Program Cycle.

[13] See Foundational Elements for Gender-Based Violence Programming in Development.

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

for adverse impacts on community members' livelihoods needs to be addressed at the local level and often 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 economic conditions of rural communities that are particularly disadvantaged and poor. A Livelihoods Restoration Strategy may also be necessary where comparable economic opportunities are not readily available to the affected populations (Asian Development Bank 2017).

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

The social impacts discussed in Table 9 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 9. SUMMARY OF ADVERSE SOCIAL IMPACTS AND MITIGATION MEASURES

SOCIAL IMPACT	MITIGATION MEASURES	MONITORING MEASURES
Gender Equality Children, especially girls, may be taken out of school to provide farm labor. Women often have less ownership of land despite representing a significant portion of agricultural labor. Water contamination from pesticides for crop production may lead to women traveling to unfamiliar locations to fetch drinking water. This may risk their safety, leading to an increase in the risk of gender-based violence (GBV).	• Establish a Stakeholder Engagement Plan (SEP) during the planning and the design phase to acquire feedback and sustain stakeholder engagement throughout the project life cycle. • Follow guidance from USAID's Gender Equality and Female Empowerment Policy. ◦ Prohibit children of providing agricultural labor during school hours as a condition of crop production activity. • Identify host country laws and regulations and/or international laws or regulations regarding child labor. • Ensure women have legal rights to own, inherit, and transfer land. • Educate local administration officials on women's land rights and how to promote and enforce these rights. • Establish women-led "community protection groups" to ensure that individuals feel safe traveling to remote or isolated geographical areas.	• Review the Stakeholder Engagement Plan (SEP) and continue to integrate feedback from women and girls on a periodic basis. • Keep records of the women-led community protection groups. • Keep a log on the trips taken with the women led community protection groups to ensure that women have access to natural resources in a manner that does not pose a risk of GBV. • Review the GRM and address any grievances and complaints in a timely manner. • Keep a log of the number of participants attending the awareness-building workshops on GBV. • Keep a log on how often the code of conduct is communicated regarding new laborers and the number of participants. • Keep a log of all

SOCIAL IMPACT	MITIGATION MEASURES	MONITORING MEASURES
		workshops and trainings that have been conducted with new laborers regarding building awareness on the issue of GBV.

Cultural Heritage
Land conversion may lead to repurposing of sites of historic or religious/sacred significance.
	• Establish a Stakeholder Engagement Plan (SEP) during the planning and the design phase to acquire feedback and sustain stakeholder engagement throughout the project life cycle.
	• Identify cultural sites in the design stage by visiting sites and conducting community consultation, including with Indigenous Peoples and other people or groups who are in potentially vulnerable, marginalized, and/or underrepresented conditions.
	• Observe host countries' specific legal requirements that apply when projects may impact sites of cultural significance.
	    • Conduct noninvasive techniques such as desktop review and remote sensing to assure that the site being proposed does not possess cultural heritage resources.
	• Follow guidance from the USAID Guide to Encountering and Working with Cultural Heritage (USAID 2023).
		• Review the Stakeholder Engagement Plan (SEP)on a periodic
		• Continue to conduct community consultation meetings to avoid disruption to cultural heritage sites.
		    • Keep a log on stakeholder's complaints and review how the complaints are being addressed.
		• Conduct follow-up activities with local and/or national cultural heritage organizations that may have been in charge of relocating the cultural heritage resources to ensure that they were placed in a new and safe location (such as a museum).
		• Review the relocation plans for cultural heritage objects.

Land Tenure, Displacement, and Resettlement Crop production activities can create an economic incentive to convert land to alternate, higher value uses such as farming cash crops. This may dispossess land from tenant smallholders. Due to loss of land ownership, smallholders may be coerced to clear other areas, contributing to deforestation, to acquire new pastures or land to grow feed. Some communities, including people or groups who are in potentially	• Establish a Stakeholder Engagement Plan (SEP) for continued community consultation • Conduct stakeholder engagement during planning and design phase to understand local land tenure insecurity and determine whether impacts of insecure tenure may be a concern in the context of crop production activities. • If land tenure is a concern, conduct mitigation strategies such as supporting smallholders in obtaining formal land title and formalizing informal land usage	• Review the SEP on a periodic basis • Keep a log of all potential land tenure use and tenure changes and the stakeholders it may be impacting. • Periodically review the log on land use and land tenure changes and stakeholders impacted. • Undertake ongoing stakeholder engagement. • Refer to the guidance on monitoring in the Biodiversity Conservation SEG.

SOCIAL IMPACT	MITIGATION MEASURES	MONITORING MEASURES
vulnerable, marginalized, and/or underrepresented conditions, may lose access to the land due to land conversion, affecting their ability to graze animals, gather fuel wood, etc. In some cases, it may lead to homelessness, inability to access jobs, food insecurity, impoverishment, social conflict, and violence.	rights. • Consider alternatives in the design phases to avoid and minimize impacts to people or groups who are in potentially vulnerable, marginalized, and/or underrepresented conditions. • Include participatory identification and mapping of areas important to people or groups who are in potentially vulnerable, marginalized, and/or underrepresented conditions for hunting, gathering, and/or agricultural activities in the Stakeholder Engagement Plan. • Prevent deforestation and practice reforestation to reduce deforestation impacts.	
Health Well-Being and Safety Local communities may be exposed to pesticides through runoff due to the crop production activities. Pesticide-related illnesses include headaches, skin irritation, adverse reproductive effects, and fatigue. Children and the elderly may be more vulnerable to contracting such illnesses. Crop fertilizer contact with bare hands may cause skin irritation and ingestion may be poisonous. Mixed farming systems that involve livestock production may pose health risks associated with manure contamination into bodies of water. Children are especially at risk for contracting illnesses related to water contamination.	• Establish a Stakeholder Engagement Plan (SEP) for continued community consultation • Engage in Safer Pesticide Use. See Pest Management SEG. • Establish a SEP during the planning and the design phase to acquire feedback and sustain stakeholder engagement throughout the project life cycle • Educate community members and farm workers on pesticide-, manure-, and fertilizer-related illnesses and preventable measures. • Build capacity for community health services and health education. • Promote integrated pest management. • Promote proper manure management in mixed crop-livestock production systems.	• Review the SEP on a periodic basis and ensure participation of older people as well as children who are accompanied by their parent or legal guardian to better understand how they are being impacted and to monitor the mitigation of the impacts that may be causing the illnesses. • Keep a log of the number of stakeholders who have been treated for skin irritation at the local clinic. • Keep a log of the number of community members who have attended the capacity training workshops for correct application of pesticide use.
Conflict Dynamics A project may unintentionally cause conflict in the local community regarding loss of land tenure or competition for resources due to land use conversion.	• Establish a Stakeholder Engagement Plan (SEP) for continued community consultation • Undertake a conflict dynamics analysis. • Establish a SEP during the planning and the design phase to	• Review the SEP on a periodic basis • Conduct stakeholder engagement on an ongoing basis using a combination of methods such as village meetings or community surveys prior to and throughout project implementation.

SOCIAL IMPACT	MITIGATION MEASURES	MONITORING MEASURES
	acquire feedback and sustain stakeholder engagement throughout the project life cycle. • Consult with community leaders, government officials, members of civil society, women's groups, church groups, non-governmental organizations (NGOs), and community-based organizations (CBOs) (among other stakeholders) to understand existing conflicts and tensions. See https://www.usaid.gov/safeguarding-and-compliance/partners/child-safeguarding/FAQs	
Labor Farm workers and post-harvest food processors are exposed to several safety, health, environmental, biological, and respiratory hazards. Hazards include pesticide exposure, falls, heat exposure, and other risks Occupational health and unfair labor practices are heightened when national occupational labor standards are poorly developed or enforced. Enterprises may not provide equal employment opportunities for women and marginalized and underrepresented groups and/or people in vulnerable situations.	• Establish a stakeholder engagement plan (SEP) during the planning and the design phase to acquire feedback and sustain stakeholder engagement throughout the project life cycle. • Follow Guidance as per ILO 155 (ILO 1981) • Address occupational and community health and safety • Address occupational and community safety and health risks presented by supported activities, for example, those presented by use of equipment, fertilizer, and pesticides. • Consider the risks presented to more people or groups who are and marginalized and underrepresented groups and/or people in vulnerable situations such as children, women, and individuals with weakened immune systems; • I identify and follow host country laws and regulations and/or international occupational health and safety standards that apply. • Conduct safety trainings for workers. • Identify host country laws and regulations and/or international laws or regulations regarding labor safety. • Solicit worker (both men and women) input to fully understand	• Review the SEP on a periodic basis • Institute procedures for documenting and reporting chemical exposures, accidents, and incidents. • Keep records of trainings on labor safety, including the number of people who attended, and marginalized and underrepresented groups and/or people in vulnerable situations • Conduct monthly reviews to monitor gender equality in the workplace. • Conduct monthly reviews to monitor social inclusion in the workplace.

SOCIAL IMPACT	MITIGATION MEASURES	MONITORING MEASURES
	skills and discuss which tasks workers are comfortable performing and which tasks they are uncomfortable performing.	

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