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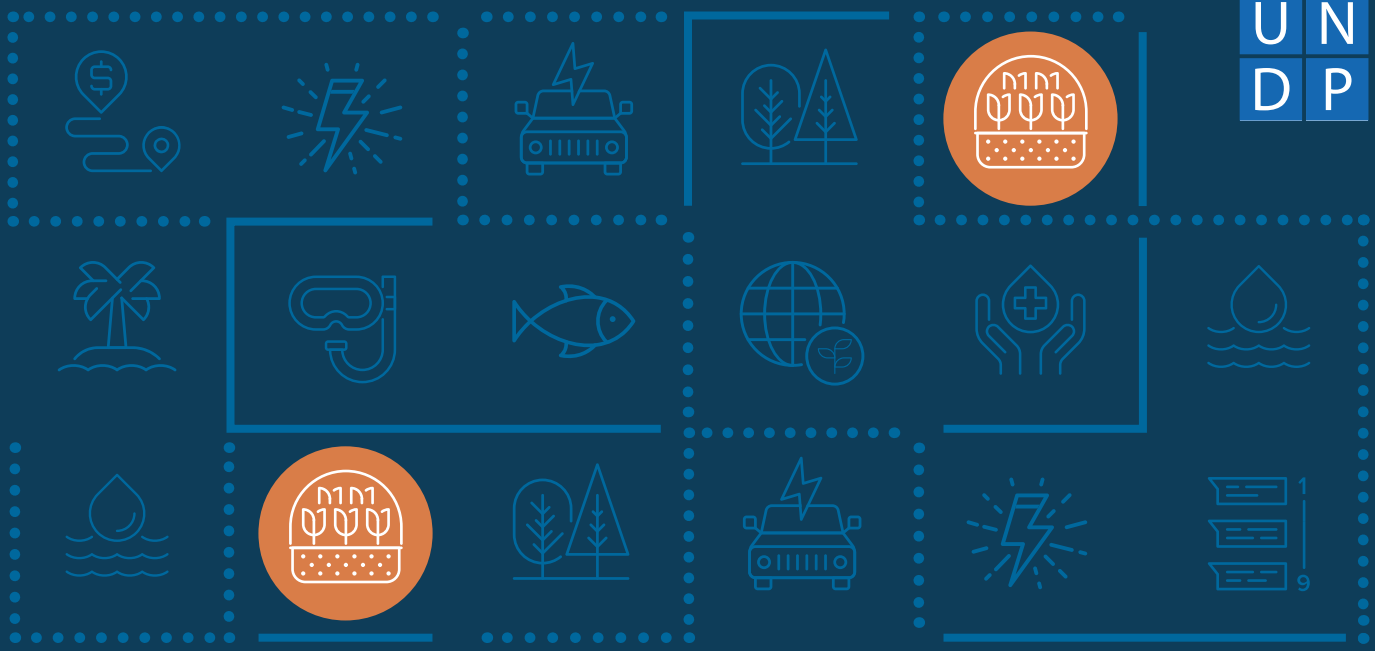
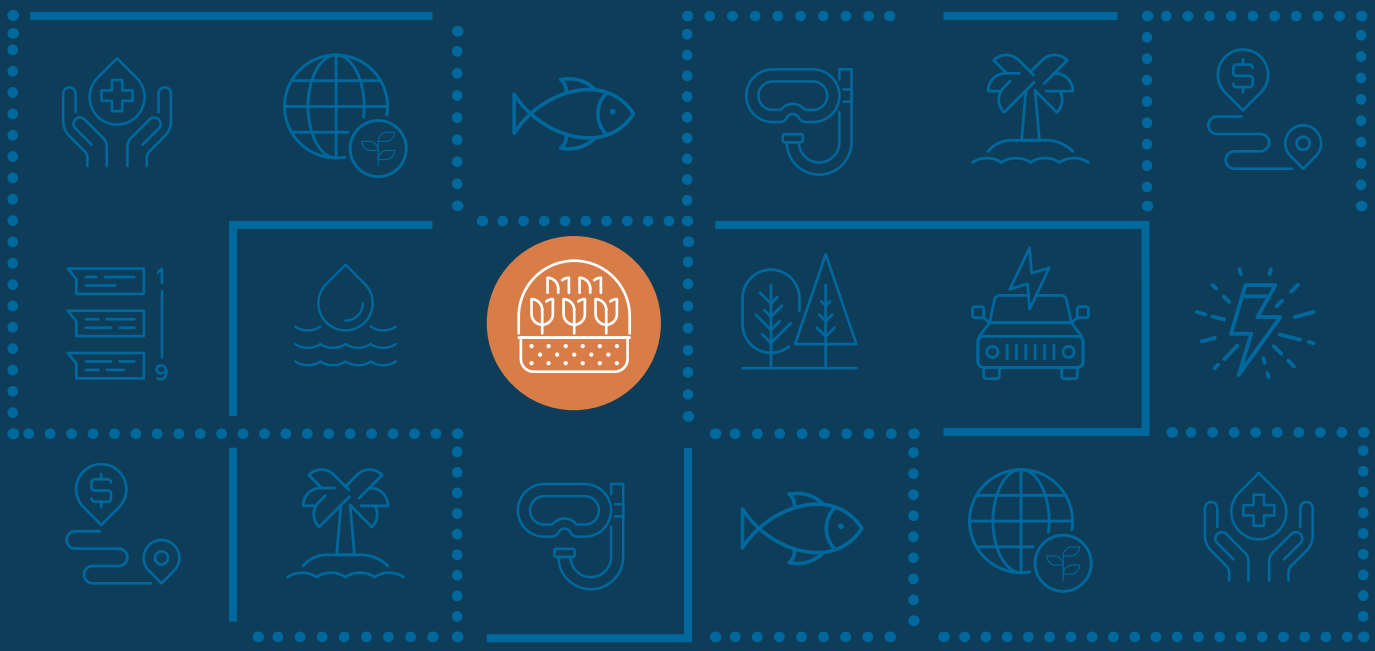


GUIDEBOOK

on the methodology for financial assessments to address climate change

CHAPTER VIII: AGRICULTURE SECTOR

(adaptation to climate change)



2026

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About this publication

This methodology is an update to the first financial assessment methodology, which was released in 2009. The objective of this methodology is to support countries to implement their climate targets and to identify, reallocate, mobilize and manage the required financial resources and to create a fiscal framework conducive for climate action.

The update to this methodology was developed under UNDP's Climate Promise by the *Pledge to Impact* Programme. Delivered in collaboration with a wide variety of partners, the initiative has supported over 120 countries to enhance and implement Nationally Determined Contributions (NDCs) under the Paris Agreement. From Pledge to Impact is generously supported by the governments of Germany, Japan, United Kingdom, Sweden, Belgium, Spain, Iceland, the Netherlands, Portugal and other UNDP core contributors. This programme underpins UNDP's contribution to the NDC Partnership.

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About this Guidebook

As countries identify their national climate change targets—notably through Nationally Determined Contributions (NDCs) under the Paris Agreement—the need exists to break down targets into concrete steps of action, determine a financial framework to implement actions and achieve targets, and identify policy measures to facilitate the necessary changes that support low-emission development and a low-carbon future.

A key component to support this transformation is through assessing national investment flows and financial flows to address climate change. Many countries have used this method to articulate an effective and appropriate national response to climate change.

This Guidebook responds to the needs of countries to have a clear approach to support the implementation of national climate targets in the context of sustainable development that duly accounts for their national circumstances, capacities and resources.

Between 2008 and 2024, 60 investment flow and financial flow assessments were conducted worldwide, with more than 1,000 national stakeholders engaged in the technical and political aspects of the assessments. Since the adoption of the Paris Agreement and the development of NDCs, the methodology has helped countries utilize financial assessments to develop a pathway to NDC implementation.

While this methodology was first developed in 2008, an update has taken place in 2025. This Guidebook is a living document, which will continue to be improved based upon the experiences of those using it. Over the years, the methodology to carry out financial assessments to address climate change has been continually reviewed and updated regarding its user friendliness, feasibility of implementation and sectoral scope. Comments are invited. Please send feedback to Susanne Olbrisch (susanne.olbrisch@undp.org).

For more information, visit https://climatepromise.undp.org/tags/investment-and-financial-flows-assessments.

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List of acronyms and abbreviations

BS	Baseline scenario
CBD	Convention on Biological Diversity
CDM	Clean Development Mechanism
CO_2	Carbon dioxide
FDI	Foreign direct investment
FF	Financial Flow
GCF	Green Climate Fund
GEF	Global Environment Facility
GHG	Greenhouse gas
IF	Investment Flow
IPCC	Intergovernmental Panel on Climate Change
ISIC	International Standard Industrial Classification
LT-LEDS	Long-term Low-Emission Development Strategy
LULUCF	Land Use, Land-Use Change and Forestry
NAP	National Adaptation Plan
NDC	Nationally Determined Contribution
NGO	Non-governmental organization
O&M	Operation and maintenance
ODA	Official Development Assistance
SNA	System of National Accounts
UN FAO	United Nations Food and Agriculture Organization
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
V&A	Vulnerability and adaptation
WHO	World Health Organization

Chapters I and II of this guide provide methodology on how to carry out a financial assessment. This chapter provides additional information needed to carry out a financial assessment in the **agriculture sector**. To avoid repetition, some of the information provided in Chapter II that is relevant to all sectors is not included in this chapter. Careful reading of Chapter II before this chapter is highly recommended.

8.1. Introduction

Agricultural production is heavily dependent on climate and water resources and consequently is sensitive to changes in climate. Moreover, most rural populations in developing countries rely primarily upon agriculture for their livelihoods. Although agricultural communities have a long history of adapting to climatic variability and extreme weather events, significant changes in climate and CO_2 concentrations are expected to affect agricultural yields and income levels and could exacerbate existing problems relating to malnutrition and food security.

Climate change has a direct impact on agricultural production through a variety of mechanisms, including: a) changes in temperature and precipitation; b) increases in the atmospheric concentration of CO_2; c) changes in the frequency and intensity of extreme events (heat stress, drought, flooding, fire and windstorms); d) altered weed, insect and disease incidence; and e) sea level rise. These impacts affect, for example, crop growth, development, yields, water needs and nutritive value. Similarly, they affect animal health through impacts on pasture[1] availability, animal[2] carrying capacity and productivity.[3]

Climate change also affects agriculture indirectly through its effects on other sectors. Such effects include, for example, reductions in freshwater supplies due to decreases in snowpack, increased evaporation from reservoirs and increased demand in other sectors, loss of productive coastal acreage due to sea level rise and salt water intrusion, and reductions in labour supply due to the spread of human diseases.

The impacts of climate change on agricultural systems are highly site-specific. The vulnerability of any particular agricultural system depends on the character, magnitude and rate of the climatic changes expected, the sensitivity to climatic changes of the agricultural and socio-economic system and the ability of systems to cope with changing conditions (i.e., to adapt).

The implementation of adaptation measures depend on the degree of active management employed and the value of adaptive management adjustments versus their costs. Agricultural systems that are already stressed due to limited water supply, biodiversity loss, land degradation, disease susceptibility and pest infestation and/or air pollution are particularly sensitive to climate change and least able to adapt (and many of the existing stressors are likely to be exacerbated due to climate change). The adaptive capacity of agricultural systems also depends on economic, social, technological, informational and institutional variables, including wealth, human capital, information and technology, material resources, infrastructure and institutional support. Smallholder and subsistence farmers and pastoralists are the most vulnerable groups given their limited adaptive capacity and sensitivity to changes in climate and extreme events.

Adaptation measures for the agriculture sector are generally of two types: 1) field-level measures;[4] and 2) research, education, assistance, infrastructure and institutional measures.[5]

[1] Pasture is land with low-growing vegetation used for grazing of livestock as part of a farm, or in ranching or other unenclosed pastoral systems. The term encompasses both unmanaged (unimproved) and managed (improved) grazing lands.

[2] The term "animals" is used here to encompass both livestock and poultry, i.e., all animals raised for food, fibre or labour.

[3] Martin Perry, *et al.* (eds.) (2007). "Climate Change 2007: Impacts, Adaptation and Vulnerability," Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press.

[4] These measures are often referred to as "farm-level measures" in vulnerability and adaptation literature. The term "field-level" is used here to encompass forms of agriculture that are not associated with farms, such as extensive agricultural systems, shifting cultivation, nomadic pastoralism and home gardens and animals.

[5] These measures are adapted, with modifications, from UNFCCC (2007). "Investment and Financial Flows to Address Climate Change"; UNFCCC (2007). Climate Change: Impacts, Vulnerabilities and Adaptation in Developing Countries; and Martin Perry, *et al.* (eds.), op. cit.

Examples of **field-level measures** are described below.[6]

- Land use and enterprise change, i.e. change crop (cotton to wheat) or animal species change (cattle to goats), or enterprise mix (pastures for agroforestry). In addition, current land uses, such as cropping, may turn unsustainable due to climate change. In some cases, individuals may choose to abandon agriculture altogether and migrate to a city or another country to pursue alternative employment opportunities.

- Change in variety, e.g., to include varieties of crops and breeds which are more heat, drought and/or CO_2 tolerant.

- Change in management practices regarding crops, pastures or animals. This includes changing the timing of crop planting and/or harvesting, as well as the amounts, types and timing of soil amendments and fertilizer use. Adaptations in extensive systems include altering animal stocking rates, altering the timing of seasonal migrations, integrating crop and animal systems, using supplementary feeds, etc. Adaptations in intensive systems include altering feeding practices, changing the degree of confinement/housing, changing the housing infrastructure, etc. The timing of "harvesting" products (milking cows, shearing sheep, slaughtering cattle and pigs) can be altered as well.

- Restoration of soils that have been degraded by climate change and change in moister management and irrigation. Climate change can increase crop water needs, decrease water availability, decrease soil moisture holding capacity and increase flooding, water logging, saltwater intrusion and erosion. Adaptation may involve using irrigation (which may, for instance, require investing in irrigation facilities, equipment or dam construction), improved rainwater harvesting and water storage, changing drainage management regimes, changing plantings to reduce water needs (or increase water use) and/or altering tillage and residue management practices to conserve water and reduce erosion. Mechanisms aimed at saltwater intrusion protection may also be needed.

- Changes in pest and disease management. Climate change is likely to exacerbate pest, disease and weed management problems. Adaptation could involve wider use of integrated pest and pathogen management, preventative veterinary care, development and use of varieties and species resistant to pests and diseases, adjusting harvesting schedules and expanding and/or improving quarantine capabilities, outbreak monitoring programmes and prescribed burning practices.

- Fire management. Pastures, and to some extent croplands, are vulnerable to climate change-induced increases in fire risk. Adaptive actions include, for example, salvaging dead wood, landscape planning to minimize fire damage and adjusting fire management systems.

Examples of measures that fall under **research, education, assistance, infrastructure and institutional** are described below.

- Research and development programmes funded by public and private bodies, (e.g., agronomic and engineering research on crop varieties or animal management practices that are well suited to altered climatic conditions in a particular region). R&D may also aim at developing new crop cultivars and animal breeds through selective breeding and genetic modification.

- Extension and training. Public resources can be allocated to agricultural extension and training programmes to disseminate information about, and training in, adaptation practices and to encourage their adoption.

[6] For a full list of options, see B.A. McCarl (2007). Adaptation Options for Agriculture, Forestry and Fisheries," A Report to the UNFCCC Secretariat Financial and Technical Support Division.

- Forecasting, early warning, and disaster management programmes. This includes improved and/or expanded seasonal weather forecasting, improved and/or expanded early warning systems and improved and/or expanded disaster management to facilitate recovery.

- Transitional assistance. Climate change may require that current land uses be changed and may cause migration from rural to urban areas. Such responses may require, or significantly benefit from, assistance in a variety of forms, including financial support (e.g., loans and grants), marketing and insurance assistance, relocation assistance, temporary food aid and shelter and employment assistance.

- Infrastructure development. Both public and private infrastructure investment may be needed in the agriculture sector and others to support agricultural adaption measures. This may include alternations of, and new, food processing and transport facilities to support the production of new crop and animal varieties, altered and new freshwater supply infrastructure and construction of coastal protection infrastructure, among others.

8.2 Application of the financial assessment methodology to adaptation in the agriculture sector

This section describes how the financial assessment methodology described in Chapter II would be applied to assess investment and financial flows to implement a national target (NDC, LT-LEDS, other) in the agriculture sector.

As described in Chapter II, the financial assessment involves a series of steps, which are:

Step 1. Establish key parameters of the assessment.

Step 2. Compile historical IF, FF and O&M cost data (and subsidy cost data if included explicitly) and other input data for scenarios.

Step 3. Define baseline scenario.

Step 4. Identify annual IF, FF and O&M costs (and subsidy costs if included explicitly) for the baseline scenario.

Step 5. Define target scenario.

Step 6. Identify annual IF, FF and O&M costs (and subsidy costs if included explicitly). for the target scenario

Step 7. Calculate the changes in IF, FF and O&M costs (and in subsidy costs if included explicitly) needed to implement target scenario.

Step 8. Identify policy implications.

Step 1.

Establish key parameters of the assessment.

Define detailed scope of the sector.

In this step, the precise subsectors of the agriculture sector that are to be considered for a financial assessment must be defined based on the national target that is being assessed (NDC, LT-LEDS, other). The agriculture sector includes both production and processing[7] of food crops (food for humans and fodder), animals and their products, floral crops and nursery plants, biofuel crops (e.g., maize, sorghum, switchgrass)[8] and other non-food crops (e.g., oilseeds, gums and resins, sweeteners, beverage crops such as coffee, tea and cacao, tobacco, fibres such as cotton, silk, hemp, construction crops such as bamboo, hemp, pharmaceutical, herbal and aromatic plants). Crops may be classified as perennial or annual, and both cropping systems and animal systems may be classified as an intensive or extensive production system.

Countries may choose to limit the analysis in several ways, for example, by:

- including only some agricultural subsectors or even some production stages or processes within a given subsector (e.g., oilseed production or edible oil production);
- considering some specific crops or animal species or breeds only; and
- focusing on specific agro-ecological regions, rather than the entire country.

Which subsectors are included will depend on the national target being assessed. Other factors to consider are listed below.

- National circumstances will determine to a large extent the selection of subsectors, taking into account the contribution of the subsector to present and future food supplies and food security and their contribution to the national economy and potential for economic growth.
- The vulnerability of the subsector (including crops and processing) and productivity changes due to climate change (including current stressors) should be considered.
- Opportunities for effective adaptation[9] and their relationship to national and sectoral development plans should be taken into account.
- Finally, selection should also depend on data availability, the structure of national government entities in which data reside and the scope of related assessments that have been completed, especially analysis of adaptation options for the National Communications, National Adaptation Plans (NAPs) and other adaptation assessments that have been completed.

[7] In general, production encompasses all activities up through harvest or until slaughter, while processing encompasses all activities from just after harvest, or just before slaughter, until the product reaches market. With "on-farm" consumption, production is extended through both harvest and slaughter.

[8] Production of woody biofuel crops is covered in the forestry adaptation chapter. However, countries may choose to also include woody crops here, especially if they choose to include agroforestry as an agriculture adaptation option, although care must be taken to avoid double counting of investment and financial flows.

[9] It is assumed that countries have already undertaken a thorough assessment of the impacts of climate change on agriculture and of adaptation options.

In some cases, climate change may have favourable effects for the agricultural sector, e.g., reduced frost incidence leading to higher crop yields or favouring the adoption of more profitable crops or varieties. While these kinds of impacts are well documented for industrialized countries, little evidence exists on their relevance and incidence for developing countries. Furthermore, even if some beneficial effects may be brought by climate change, under a target scenario, countries may face incremental costs (rather than net benefits) for specific types of investments or financial flows. For all of the above, it is up to a country to identify climate change impacts that lead to reduced investment and financial flows (i.e., that yield net benefits rather than net incremental costs), if any. For example, reduced frost incidence may reduce the need for farmer compensation programmes in a target scenario.

Important linkages between adaptation measures adopted in the agriculture sector and impacts on other sectors should be noted, particularly when the financial assessments take a sector-by-sector approach (rather than a macro analysis in which cross-sector impacts would typically be acknowledged). This implies the need to avoid double-counting of investment and financial flows (e.g., if one infrastructure investment has impacts both for agriculture and other sectors considered in the assessment) and consider how adaption measures may cause damage to other sectors. Particular attention should be given to potential overlaps with the water, energy, coastal management, transport, fisheries and forestry sectors, as well as to the treatment of the inputs used to implement agriculture adaptation options. The agriculture sector is linked to the water management sector, for example, through investments in infrastructure such as canals. If one adaptation measure in the agriculture sector involves such investments, care should be taken to not compute them twice (in both sectors). A convention on how to allocate such investments among sectors should be mentioned. Another key sector where overlapping may arise is the energy sector (e.g., due to biofuel production).

Specify base year and assessment period.

The most recent year for which historical data is available is recommended as the base year (e.g., 2025). The assessment period should match the time horizon of the target that is being assessed. NDCs often have a time horizon until 2030, LT-LEDS often until 2050. The assessment period should have a considerable length to be sufficiently able to take into account the long lifetimes of infrastructure in the sector.

Identify the target to be assessed and mitigation measures.

National targets that are being assessed are often general and visionary and not detailed enough to directly use them for a financial assessment. Therefore, the first step is to break down the overall national target into concrete measures and steps of action that can be used for the financial assessment. Breaking down the national target often includes technical and political considerations, therefore, it is key to do this step in close consultation with national policymakers to ensure their ownership of and buy in to the measures that are being identified. During this process previous analysis of the national agriculture sector should be considered, including sectoral plans, National Communications, national adaptation plans, etc. Also, aspects such as technical and logistical feasibility and sectoral acceptability of the options should be acknowledged.

To prioritize adaptation measures, consideration should be given to key criteria such as: potential economic, social and non-GHG environmental benefits and costs of the options (for example: agroforestry may not only help minimize erosion, but also increase yields; crop or agricultural practice changes may not only reduce vulnerability due to increased drought, but also help diversify and increase income), cost effectiveness, economic importance of crops and agro-ecological systems involved and replication potential. The criteria used for prioritization should be indicated.

It is also recommended that co-benefits of adaptation measures be discussed explicitly. This does not call for detailed quantification of impacts but requires summarizing the types and relative importance and magnitudes of those benefits.

Table 8.1 presents a list of adaptation options,[10] including field-level as well as research, education, assistance, infrastructure and institutional options. The adaptation options should be eventually defined at a more detailed level than those listed in Table 8.1 so that investment and financial flows and O&M costs can be identified in Steps 4 and 6. For example, if an expanded seasonal weather forecasting system is a selected adaptation option for improved (less vulnerable) crop production, the scope and scale of the forecasting system should be specified, including equipment and labour needs. The result of this identification and prioritization exercise would be a list of mitigation options.

Table 8.1: Agricultural adaptation measures

Type of measure	Subsector of the agriculture sector	Adaptation measure
Field-level	Crop production (including production of human food crops, fodder, industrial crops and biofuels)	Change crop species/varieties
		Change crop management
		Moisture management/irrigation
		Pest and disease management
		Fire management
		Land-use or enterprise choice change
	Animal production (including both animal management and grazing land management)	Change animal species/breeds
		Change in animal management practices
		Change in pasture management practices
		Moisture management and irrigation
		Pest and disease management
		Management of natural areas
		Fire management
		Land-use or enterprise choice change
Research, education, assistance, infrastructure and institutional programmes	Sector-wide	Research, development and demonstration (e.g., of new crops, varieties, practices)
		Extension and training
		Forecasting, early warning and disaster management
		Transitional assistance
		Trade policy
		Infrastructure development
		Other institutional development (integration of adaptation strategies, capacity building and improved management and governance systems)

Source: Elaborated by the authors.

[10] Further examples: Martin Perry, *et al.* (eds.), op. cit.; B.A. McCarl (2007), op. cit.

Select analytical approach.

Before defining the baseline and target scenarios and identifying associated IF, FF and O&M costs, an analytical approach needs to be selected (i.e., estimation methods or models). Although there are numerous models for assessing the impacts of climate change on agriculture and the adaptive capacity of various cropping systems and technological feasibility of various adaptation options,[11] they will typically not be directly applicable to generate specific scenarios and cost information. As a result, the assessment team will have either to apply its own analytical approach or adapt an existing one. The selection will necessarily be based on existing capabilities, data and experience.

Adaptation options and their costs, appropriateness and feasibility are highly site specific. Given national experience of adapting the agriculture sector to climate variability, adaptation options may include extensions or intensifications of existing risk management or production enhancement activities. Therefore, the richest sources of understanding and expertise are likely to reside with in-country agricultural practitioners and other local experts whose insights should be sought.

Even if there is previous experience with the application of a given model, it is unlikely that it will cover all the information and projection needs of a financial assessment. For this reason, a simple, transparent, ad-hoc spreadsheet-based approach, relying on disaggregate in-country information and knowledge of the agriculture sector and trends is recommended. The Reporting Guidelines contains a set of excel spreadsheets that can be used to collect information, establish the scenarios and calculate the results.

It is important to consider in-country expertise and experience with the agronomic applicability, costs, feasibility and cultural acceptance of adaptation options in the sector, together with sectoral plans and projections for agricultural production, imports and exports. Previous work on baseline development for vulnerability and adaptation (V&A) assessments (e.g., conducted for National Communications) should be utilized.[12] V&A assessments do not include an adaptation scenario, however, information about adaptation options that resulted from V&A assessments (e.g., the range of temperatures that a crop variety will tolerate) should be utilized as well.

[11] UNFCCC's (2005) "Compendium on Methods and Tools to Evaluate Impacts of, and Vulnerability and Adaptation to, Climate Change" contains a list with descriptions of agriculture sector models for assessment of vulnerability and adaptation.

[12] Although V&A baselines have evolved from simple scenarios of population and economic growth to more comprehensive socio-economic scenarios, they tend to be for longer periods than is used in this methodology and are constructed for assessing the impacts of climate change rather than the costs of adaptation measures.

Step 2.

Compile historical IF, FF, O&M cost data (and subsidy cost data if included explicitly), and other input data for scenarios.

Compile historical annual IF and FF data, disaggregated by investment entity and source.

The methodology recommends that countries compile 10 years of historical investment and financial flows data, i.e., for the base year and the previous nine years. At a minimum, countries should collect at least three years of data, i.e., for the base year and two years during the previous decade. Data should be compiled for each investment type and should be annual, disaggregated by investment entity, and, if possible, by funding source, and be divided into investment flows and financial flows (see Chapter II, Table 2.3: 'Template for one year of historical investment and financial flows data').

In the agriculture sector, investment flows would include assets such as machinery (e.g., mechanized ploughs, planters, harvesters, milking machines), wells and irrigation equipment, buildings (e.g., animal housing, greenhouses) and food processing facilities (e.g., slaughtering facilities, sugar production facilities, canning facilities). Investment flows would also include assets for research, education, assistance and institutional adaptation programmes (e.g., meteorological equipment, vehicles). Financial flows would include non-asset investments, such as those involved for the development of programmes in the research and development, education, assistance and institutional fields (e.g., labour costs, services).

The necessary investment and financial flows data and information sources will likely reside in several domestic locations (e.g., teams involved in V&A assessments, national communications, industry and ministry records and plans, statistical agencies, extension agencies, research institutions, national accounts) and eventually with international organizations if international aid is relevant for the development of R&D and extension programmes (e.g., CGIAR, an agricultural research group). Note that the definition of the agriculture sector and its subsectors will vary among data sources, so expert judgement may be required to reconcile datasets and extract data needed from aggregated and/or disaggregated categories.

As an example of the different levels of aggregation usually encountered, it is worth considering that the United Nations System of National Accounts (SNA) uses the International Standard Industrial Classification of All Economic Activities (ISIC; a United Nations system for classifying economic data), in which crop and animal production is included in Section A (agriculture, forestry and fishing) and the processing of agricultural products is included in Section C (manufacturing). This means, for example, that the production of cattle is in Section A of the ISIC, but the processing of meat and dairy products is in Section C. Even at the most disaggregated level in the ISIC system (the "class" level), multiple agricultural activities are combined so that investment information for each activity cannot be separated without making assumptions and/or using supplementary information. For this reason, National Communications and V&A analyses offering adaptation options cost data and sectoral sources offering the most disaggregate level of data should be given priority to be able to cost the adaptation options at the relevant level (i.e., investment type and programme). If disaggregate data are not available, national accounts data may have to be used specifying the assumptions and criteria used to make cost estimates for individual adaptation measures or programmatic expenditures.

Apart from local information sources, it is worth mentioning that Food and Agriculture Organization of the United Nations (FAO) databases are useful data sources too. FAO agricultural databases are described below under "Compile other input data for scenarios."

Table 8.2: Structure of ISIC section A: Agriculture, forestry and fishing

Divisions	Groups	Classes
01 - Crop and animal production, hunting and related service activities	011 - Growing of non-perennial crops	0111 - Growing of cereals (except rice), leguminous crops and oil seeds
		0112 - Growing of rice
		0113 - Growing of vegetables, melons, roots and tubers
		0114 - Growing of sugar cane
		0115 - Growing of tobacco
		0116 - Growing of fibre crops
		0119 - Growing of other non-perennial crops
	012 - Growing of perennial crops	0121 - Growing of grapes
		0122 - Growing of tropical and subtropical fruits
		0123 - Growing of citrus fruits
		0124 - Growing of pome fruits and stone fruits
		0125 - Growing of other tree and bush fruits and nuts
		0126 - Growing of oleaginous fruits
		0127 - Growing of beverage crops
		0128 - Growing of spices, aromatic, drug and pharmaceutical crops
		0129 - Growing of other perennial crops
	013 - Plant propagation	0130 - Plant propagation
	014 - Animal production	0141 - Raising of cattle and buffaloes
		0142 - Raising of horses and other equines
		0143 - Raising of camels and camelids
		0144 - Raising of sheep and goats
		0145 - Raising of swine/pigs
		0146 - Raising of poultry
		0149 - Raising of other animals
	015 – Mixed farming	0150 - Mixed farming (crops and animals)
	016 - Support activities to agriculture and post-harvest crop activities	0161 - Support activities for crop production
		0162 - Support activities for animal production
		0162 - Support activities for animal production
		0163 - Post-harvest crop activities
		0164 - Seed processing for propagation
	017 - Hunting, trapping and related service activities	0170 - Hunting, trapping and related service activities
02 - Forestry and logging	Each of these divisions is disaggregated into multiple groups and classes.	
03 - Fishing and aquaculture		

Source: United Nations Department of Economic and Social Affairs- Statistics Division (2024). International Standard Industrial Classification of All Economic Activities (ISIC) Revision 5.

Compile historical annual O&M cost data, disaggregated by investment entity and source.

Historical O&M data are needed to provide a historical basis from which to identify future O&M costs for new physical assets and to provide data for the first year of the scenarios. It is worth noting that in the context of agriculture, physical assets include cropland and land for pasture. Annual O&M costs for the physical assets that are in operation during the historical period should be collected for the same years for which historical investment and financial flows data are collected. Information about the expected lifetimes of assets such as buildings, machinery, equipment that are in operation during the historical period and annual fluctuations in O&M costs (if any) also need to be collected. O&M data should be collected at a level of disaggregation consistent with the investment and financial flows data and the O&M data for assets purchased during the historical period should be tracked separately from the O&M data for assets purchased before the historical period (see Chapter II, Table 2.4: 'Template for three years of historical O&M cost data for an investment flow in 2023').

O&M data are a particularly important part of agricultural baseline and adaptation costs since many field-level agricultural costs are O&M costs. Significant O&M costs are likely to include: agricultural inputs, such as seeds, plants, fertilizers and other inputs for soil management and amendment, animal stock and animal feed; energy usage (electricity and fuels); building and equipment maintenance and/or leasing; real estate expenses; and insurance. (Note that if the national financial assessment also includes energy sector mitigation, agricultural adaption measures that include energy consumption should not duplicate, or be inconsistent with, energy sector measures.)

The O&M data that need to be collected may reside in one or more of the same locations as the investment and financial flows data (e.g., national accounts, agriculture ministry records and plans, industry records, statistical agencies, extension agencies, research institutions, etc.), and in FAO sources. If such data are not available, countries should utilize one of the estimation approaches described in Chapter II. In-country experts may be particularly useful for supplying cost estimates.

Compile historical annual subsidy cost data, if subsidies are included explicitly in the assessment.

There are numerous types of agricultural subsidies, including direct financial transfers (e.g., grants and low-interest loans to producers), preferential tax treatments and reductions or exemption from trade tariffs and charges (e.g., for water access and discharge). If a country chooses to include subsidies explicitly in the financial assessment, annual costs of subsidies for each type of investment and financial flow during the historical period should be collected for the same years for which historical investment and financial flows data are collected. Subsidies should be compiled separately for IF, FF and O&M (see Chapter II, Table 2.5: 'Template for three years of historical subsidy cost data').

Information on subsidies may be available from relevant government ministries and agencies, statistical agencies, research organizations, academic institutions and private sector entities.

Compile other input data for scenarios.

In addition to historical investment and financial flows and O&M cost data, the characterization of the scenarios and identification of annual costs for the scenarios will require the collection of other historical and non-historical data relevant to the sector. Which data are needed will depend on the sectoral scope. Information that will be needed may include the items listed below.

- Characterization of agricultural production subsectors included in the scope, including crop species and varieties cultivated, quantities produced, areas planted and harvested, yields per hectare, animal species and breeds raised, animal populations, animal product production statistics, domestic consumption and exports, agricultural inputs and other management practices, employment and national land-use statistics: Information about the current situation and projections over the assessment period should be collected. Information about current environmental stressors (e.g., water shortages, land degradation) and vulnerability to climate change should also be collected for background information.

- Characterization of agricultural processing and associated transport aspects included in the scope or that might be significantly affected by adaptation, such as geographic shifting of production locations on the production side of agriculture: This would include the nature and scale of operations, energy and water usage and employment. Information about the current situation and projections over the assessment period should be collected. Information about current environmental stressors and projected vulnerability to climate change should also be collected.

- Characterization of adaptation options, including technical feasibility, cultural acceptability, scalability, costs (capital and O&M) and economic feasibility: Possible externalities and linkages with other sectors should be noted and a convention on how to avoid double counting should be adopted from the outset as mentioned in section 8.2, Step 1.

- Information about sectoral and macroeconomic policies (both recent and expected) that could significantly affect the agriculture sector should be collected.

These data and information may be available from the domestic sources mentioned above for investment and financial flows and O&M cost data. In addition, FAO maintains statistical databases that contain potentially useful national agricultural statistics and related information, such as:

- FAOSTAT which contains data on: crop and animal production, trade and consumption; agricultural prices; agricultural resources (land, labour, machinery, fertilizers, agrochemicals); and food security; and

- AQUASTAT which is an information system for the collection, analysis and dissemination of data and information on water resources and agricultural water management by country and by region. It includes data on dams, irrigation system investment costs and irrigated areas.

Step 3.

Define baseline scenario.

This step entails describing what is likely to occur in each agricultural subsector under business-as-usual activities without additional measures to adapt to climate change over the assessment period. It should reflect current sectoral and national plans, expected socio-economic trends and expected investments in the sector. It should include a quantitative description of the socio-economic factors that affect the sector (e.g., demographic change, economic growth), as well as other relevant characteristics (e.g., domestic food consumption, domestic crop, meat and dairy production or other domestic consumption statistics, imports and exports, water supply availability, land availability). The baseline scenario description should include specific information about equipment, facility and infrastructure investments that are expected (and as is relevant) in each measure and research, education, assistance and institutional investments.

Step 4.

Identify annual IF, FF and O&M costs (and subsidy costs if included explicitly) for the baseline scenario.

Identify annual IF and FF for each investment type, disaggregated by investment entity and funding source.

In this step, annual IF for the baseline scenario facility and infrastructure investments and annual FF for the baseline scenario research, education, assistance and institutional investments are identified for each subsector. As discussed in Chapter II, costs should be in real terms (i.e., inflation adjusted), in constant 2025 US$ or national currency, should be reported in the year in which they are expected to be incurred and should be discounted using appropriate public and private discount rates. The annual IF and FF values for each investment type should be disaggregated by investment entity and funding source and be divided into investment flows and financial flows. Data sources could include model output, and/or government and private sector planning documents or values might be derived from historical data. This may call for expert judgement regarding the future evolution of domestic and international financial flows directed at R&D and extension programmes and their impact.

The output of this step will be a stream of annual investment flows and financial flows for each investment type in each subsector for the entire assessment period, by investment entity and funding source. These data should be organized as in Chapter II, Table 2.6: 'Baseline scenario: *cumulative* investment and financial flows and O&M' and Table 2.7: 'Baseline scenario: *annual* investment and financial flows and O&M.'

Identify annual O&M costs for each IF, disaggregated by investment entity and funding source.

Annual O&M costs for assets purchased during the assessment period and for assets purchased before the assessment period and that are expected to still be in operation need to be collected (or derived) for each subsector. Costs should be in real terms, in constant 2025 US$ or national currency, should be reported in the year in which they are expected to be incurred and should be discounted.

The annual O&M costs for each investment type should be disaggregated by investment entity and funding source and be divided into O&M for assets purchased during the assessment period and for assets purchased prior to the assessment period. For those assets purchased during the assessment period that are expected to still be in operation after the last year of the assessment period, annual O&M costs for each additional year the assets will be in operation should be identified, up to an additional five years after the last year of the assessment period. Possible data sources include those described above for IF and FF.

Identify annual subsidy costs for each investment type and for IF, FF and O&M costs, if subsidies are included explicitly in the assessment.

If a country chooses to include subsidies explicitly in the financial assessment, annual subsidy costs should be identified for each relevant investment type and for all categories of cost (IF, FF and O&M), in the baseline scenario (see Chapter II, Section 2.2.1).

Step 5.

Define target scenario.

This step entails describing what is likely to occur in the agriculture sector over the assessment period under the implementation of additional and scaled up adaptation measures. The measures and activities to be considered come from the national target that is being assessed (NDC, LT-LEDS, other) and have been broken down into concrete steps of action that can be operationalized and used in the financial assessment.

Useful previous work to consider when establishing the target scenario includes the agriculture scenario elaborated for the National Communication, projections from national or sector plans and projections approved by government bodies. This would include comprehensive descriptions of the specific adaptation measures that could be implemented according to existing information and the implications of those measures for the evolution of the selected subsectors and measures (e.g., introduction of less water intensive crop varieties may lead to an increase in cereal production to meet anticipated demand despite an anticipated decline in annual rainfall). The vulnerabilities that the adaptation measures are designed to reduce and the climate changes from which vulnerabilities were assessed should be described as well.

The adaptation measures need to be defined clearly and completely so that IF, FF and O&M costs can be identified in the next step. This should include specific information about facility and infrastructure investments that would occur in each measure (e.g., the timing and magnitude of facility upgrades for an intensive livestock operations) and non-asset investments (e.g., the timing, nature and magnitude of an extension programme on livestock health management). In-country expertise and prior work on climate change adaptation (e.g., National Communications, NAPs) should be utilized in this step.

Step 6.

Identify annual IF, FF, O&M costs (and subsidy costs if included) for the target scenario.

Identify annual IF and FF for each investment type, disaggregated by investment entity and funding source.

In this step annual IF for the target scenario facility and infrastructure investments and annual FF for the target scenario research, education, assistance and institutional investments are identified for each measure and option defined in the previous step. As discussed in Chapter II, costs should be in real terms (i.e., inflation adjusted), in constant 2025 US$ or national currency, should be reported in the year in which they are expected to be incurred and, when aggregated over time, they should be discounted using the relevant public or private discount rate. The annual IF and FF for each investment type should be disaggregated by investment entity and funding source and be divided into investment flows and financial flows.

The output of this step will be a stream of annual investment flows and financial flows for each investment and financial flow type in each subsector for the entire assessment period, by investment entity and funding source. These data should be organized as in Chapter II, Table 2.8: 'Target scenario: *cumulative* investment and financial flows and O&M' and Table 2.9: 'Target scenario: *annual* investment and financial flows and O&M.'

Identify annual O&M costs for each IF, disaggregated by investment entity and funding source.

Annual O&M costs for assets purchased during the assessment period and for assets purchased before the assessment period and that are expected to still be in operation need to be collected for each of the measures and options defined in the previous step. Costs should be in real terms, in constant 2025 US$ or national currency, should be reported in the year in which they are expected to be incurred and should be discounted.

The annual O&M costs for each investment type should be disaggregated by investment entity and funding source and be divided into O&M for assets purchased during the assessment period and for assets purchased prior to the assessment period. For those assets purchased during the assessment period that are expected to still be in operation after the last year of the assessment period, annual O&M costs for each additional year the assets will be in operation should be identified, up to an additional five years after the last year of the assessment period.

Identify annual subsidy costs for each relevant investment type and for IF, FF and O&M costs, if subsidies are included explicitly in the assessment.

If a country chooses to include subsidies explicitly in the financial assessment, annual subsidy costs should be identified for each relevant investment type and for all categories of cost (IF, FF and O&M) (see Chapter II, Section 2.2.1).

Step 7.

Calculate the changes in IF, FF and O&M costs (and in subsidy costs if included explicitly) needed to implement target scenario.

The changes in IF, FF and O&M costs that are needed to implement the adaptation measures in each activity are calculated in this step by subtracting baseline scenario investment and financial flows and O&M values from those of the target scenario. The two primary objectives of this step are to determine: 1) how *cumulative* IF, FF and O&M costs would change; and 2) how *annual* IF, FF and O&M costs would change. These calculations, which should be completed for each subsector, are described in detail in Chapter II.

Step 8.

Identify policy implications.

The purpose of this step is to identify the policy implications of the results of the previous step for the sector. The analyses in the previous step calculated the magnitude and timing of required shifts and increases in IF, FF and O&M by each investment entity that would be needed to implement the adaptation measures in each subsector. The respective institutions responsible for investment and financial flows and their funding sources (domestic and foreign, public and private) are also identified for the different investment and cost types.

Looking at the results of Step 7, it needs to be determined which investment entities are responsible for the most significant (largest and/or highest priority) changes in investment and financial flows. In doing so, it is important to distinguish between public and private financial sources.

Based on this, policies will be identified that might be used to induce those entities to implement the proposed measures and change their investment patterns (e.g., through laws, regulations, incentives, planning, guidance, information campaigns, etc.). Policy measures include a variety of instruments, including economic instruments (e.g., taxes and subsidies), regulatory instruments (e.g., zoning regulations, technology standards, mandatory practices), voluntary agreements, information dissemination, strategic planning and research, development and demonstration programmes funded both by the public and the private sectors.

This will help to identify:

- the most relevant policy instruments to induce the implementation of key adaptation measures by private sector entities (e.g., to adopt priority adaptation practices, such as changes in crop varieties and practices); and
- the priority public programmes for adaptation (e.g., new extension programmes for new crop varieties) and their associated institutional needs.

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