



Food and Agriculture Organization
of the United Nations

Annex 3

Economic and Financial Analysis (EFA)

For the GCF-FAO Project “Climate Resilient Agriculture in Somalia (Ugbaad)”



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Abbreviations

BCR	Benefits Cost Ratio
CBA	Cost-Benefit Analysis
CFs	Conversion Factors
EFA	Economic and Financial Analysis
EIRR	Economic Internal Rate of Return
EMIRR	Economic Modified Internal Rate of Return
ENPV	Economic Net Present Value
EOCK	Economic Opportunity Cost of Capital
FFS	Farmers Field School
FNPV	Financial Net Present Value
FIRR	Financial Internal Rate of Return
FMIRR	Financial Modified Internal Rate of Return
GHG	Greenhouse Gas
iCRAP	Integrated Climate Resilient Agriculture Package
NPV	Net Present Value
PV	Present Value
WACC	Weighted Average Cost of Capital
WBG	World Bank Group
WOP	Without Project
WP	With Project

Glossary: Essential Terms

Benefits Cost Ratio (BCR): It is an indicator showing the relationship between the relative costs and benefits of a proposed project, expressed in monetary or qualitative terms. If a project has a BCR greater than 1.0, the project is expected to deliver a positive net present value to a firm and its investors.

Cost-Benefit Analysis (CBA): An analysis that aims to identify the economic, environmental, and social effects of a project, proposal, or program and weigh them against the situation with no project, proposal, or program in place. Consequently, the CBA helps decision makers establish which options would benefit society the most and indicate how limited public resources can be utilized and redistributed to maximize net social welfare.

Conversion Factors (CF): To turn financial price (used in the financial part of EFA/CBA) into economic price (used in the economic part of EFA/CBA), a conversion factor needs to be calculated. The CF is calculated to reflect the actual cost and benefit of the input used by the project, or the output produced by the project. A conversion factor is simply the ratio of the economic value of said input or output to its financial value.

Economic and Financial Analysis (EFA): This type of appraisal differs in content and depth. In the context of this annex, it is understood as a cost-benefit analysis (CBA). See also CBA for details.

Economic Internal Rate of Return (EIRR): The discount rate that makes the economic net present value (ENPV) of a project zero. The EIRR is derived by using economic resource flows and the economic discount rate.

Economic Modified Internal Rate of Return (EMIRR): The EMIRR assumes that positive resource flows are reinvested at the cost of capital and that the initial outlays are financed at the economic cost. The EMIRR is derived by using economic resource flows and economic discount rates.

Economic Net Present Value (ENPV): An economic metric that seeks to capture the total economic value of an investment opportunity. The idea behind ENPV is to project all the future resource inflows and outflows associated with an investment, discount all those future resource flows using economic discount rate to the present day, and then add them together.

Economic Opportunity Cost of Capital (EOCK): EOCK is understood here as the economic opportunity cost of funds obtained from the capital market. It is, then, a weighted average of the marginal productivity of capital in the private sector and the rate of time preference for consumption (Harberger, 1987).

Financial Net Present Value (FNPV): A financial metric that seeks to capture the total value of an investment opportunity. The idea behind FNPV is to project all the future cash inflows and outflows associated with an investment, discount all those future cash flows to the present day, and then add them together.

Financial Internal Rate of Return (FIRR): The discount rate that makes the financial net present value (FNPV) of a project zero. In other words, the expected compound annual rate of return will be earned on a project or investment. The FIRR is derived by using financial cash flows and financial discount rates.

Financial Modified Internal Rate of Return (FMIRR): The financial modified internal rate of return (FMIRR) assumes that positive cash flows are reinvested at the cost of capital and that the initial outlays are financed at the financing cost. The FMIRR is derived by using financial cash flows and financial discount rates.

Net Present Value (NPV): It the value of all future cash flows (positive and negative) over the entire life of an investment discounted to the present.

Present Value (PV): It is the current value of a future sum of money or stream of cash flow given a specified rate of return. Future cash flows are discounted at the discount rate, and the higher the discount rate, the lower the present value of the future cash flows.

Weighted Average Cost of Capital (WACC): The average rate a business pays to finance its assets. It is calculated by averaging the rate of all the company's capital sources (debt and equity), weighted by the proportion of each component.

Without Project Scenario (WOP): This scenario shows the situation before the proposed regulation or intervention was introduced and what the case would be like if the status quo continued.

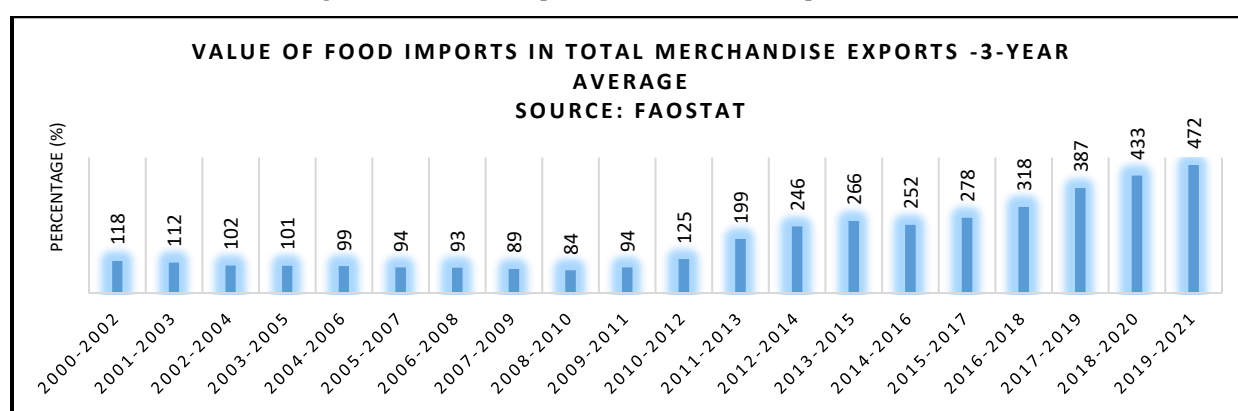
With Project Scenario (WP): This scenario outlines the predicted situation after the investment or intervention is introduced.

1. Introduction

1.1. Economic Context

Somalia's natural and economic situation. Somalia is a country full of abundant natural and human resources that could potentially yield a tremendous opportunity for driving rapid economic growth and improving the lives of its citizens. With over 441 thousand km² of agricultural land¹ and over 8.9 million hectares (ha) of arable land², a quarter of which is irrigated, more than 30 million livestock³ and an annual fish export of approximately 1.8 million tons, Somalia could be well-positioned to leverage these resources for economic development. Furthermore, the country boasts two major rivers, the Juba and Shabelle, with a total length of 2,300 km, and the longest coastline in mainland Africa, stretching for 3,333 km.⁴ Currently, Somalia is trying to rebuild its economic and governance institutions. However, the country's GDP growth has been volatile and low, averaging 2% per year in 2019-2023.⁵ While it is predicted that the GDP will increase in 2024 as Somalia is recovering from the severe drought of 2022-2023, the recent and repeated climate, pandemic, and conflict shocks devastated the households' assets and purchasing power leaving communities vulnerable and more prone of falling below the poverty line. Additionally, Somalia strongly depends on imports (Figure 1), especially food imports, and continues to show negative trade balance.

Figure 1. Value of food imports in total merchandise exports (2000-2021).



Development challenges. Despite the ongoing crisis, Somalia's natural features hold immense potential for economic growth. Particularly, if harnessed effectively, the agricultural sector could be a catalyst for transforming the economy and paving the way for a vibrant and prosperous future for the country. However, the nation is grappling with various challenges, including climate change, locust infestation, land degradation, the COVID-19 pandemic, volatile global commodities prices, and security issues. It has been estimated that in 2022 around 55% of Somalia's population lived below the national poverty line with poverty rates larger among nomadic population (pastoralists). In global rankings, Somalia is classified as the least developed country (LDC) by the United Nations (UN).⁶ It is the 178th country in the Notre Dame Global Adaptation Initiative (ND-GAIN), indicating its high vulnerability and low readiness score. The ND-GAIN Country Index underscores Somalia's urgent need for investment, innovation, and climate-related actions.⁷

¹ Source: <https://data.worldbank.org/indicator/AG.LND.AGRLK2?locations=SO>

² Source: <https://www.trade.gov/country-commercial-guides/somalia-agribusiness-and-food#:~:text=Overview,rivers%20stretching%20over%202%2C500KM.>

³ Source: FAOSTAT: <https://www.fao.org/faostat/en/#data/QCL>

⁴ Source: <https://www.afdb.org/en/documents/somalia-country-food-and-agriculture-delivery-compact>

⁵ Source: <https://www.worldbank.org/en/country/somalia/overview>

⁶ Source: <https://www.un.org/ohrlls/content/list-ldcs>

⁷ Source: <https://gain.nd.edu/our-work/country-index/rankings/>

Somalia's current access to finance in agriculture. The data on access to finance in Somalia is rather sparse. However, access to finance can be defined as limited due to various internal issues:

- (i) Continuous low development of the proper infrastructure, e.g., poor accessibility to banking in rural areas,
- (ii) Semi-sedimentary lifestyle of Somalia's farmers: agro-pastoralists and pastoralists which negatively affects access to banking as they are "on the move,"
- (iii) Low need to possess banking account as transactions at small-farmers level tend to be cash-based.

The latest data collected in 2014 by the World Bank for the Global Financial Development Database⁸ shows the following results:

- Among surveyed 7.86% of all respondents had an account (self or together with someone else) at a bank, credit union, another financial institution (e.g., cooperative, microfinance institution), or the post office (if applicable) including respondents who reported having a debit card in Somalia.
- The percentage of respondents who report saving or setting aside any money by using an account at a formal financial institution such as a bank, credit union, microfinance institution, or cooperative in the past 12 months was 2.82%.
- The percentage of respondents who report borrowing any money from a bank, credit union, microfinance institution, or another financial institution such as a cooperative in the past 12 months was 2.05%.
- The percentage of respondents who report using their accounts at a formal financial institution for farming/business purposes only or for both farming/business purposes and personal transactions was 13.92%.
- The percentage of respondents who borrowed any money in the past 12 months from any of the following sources: a formal financial institution, a store by using installment credit, family or friends, employer, or another private lender was 1.77%.

1.2. Climate Vulnerability Context

Somalia's climate. Somalia's climate is harsh, classified as arid and semi-arid, with two seasons of rainfall: Gu (March-May) and Deyr (September-November). The country experiences scorching temperatures, with annual mean temperatures around 30 °C and the hottest months varying between June-September in the north and December-March in the south. The average annual rainfall is a mere 200mm, with the southwest receiving the highest at 600 mm per annum. These challenging climatic conditions are exacerbated by the effects of climate change, including erratic rain patterns, rising temperatures, and an increase in days with temperatures of 35 °C and higher. Somalia is also grappling with more frequent and more severe droughts, with the worst one in recent times occurring between 2022 -2023.

Natural factors that limit Somalia's development. Water availability and land degradation are two of the most frequently mentioned limiting development factors in Somalia associated with Somalia's natural resource endowments. These two limiting elements are particularly influential in the case of agriculture production, which constitutes the basis of the livelihoods of Somalia's population. Around 75% of all landholders in Somalia are estimated to be small-scale farmers. Agriculture contributes around 70% to the national GDP, 80% to employment and 50% to exports.⁹

Changing climate versus water security. Water security in Somalia is a pressing issue, marked by inadequate supply and poor-quality water. This is not just a result of Somalia's natural conditions but also an effect of insufficient water management, leading to suboptimal water conserving or irrigation infrastructure.¹⁰ The situation is set to worsen with Somalia's increasing climate variability, which will inevitably lead to even more unreliable access to water, exacerbating the already insufficient annual and daily water supply.¹¹

⁸ Source: <https://www.worldbank.org/en/publication/gfdr/data/global-financial-development-database> Please note, only a couple of the most relevant for this analysis variables from that database are presented.

⁹ Source: <https://www.afdb.org/en/documents/somalia-country-food-and-agriculture-delivery-compact>

¹⁰ This water status quo was influenced by multiple factors, among which conflict, associated looting of water infrastructure, and lack of maintenance might be the most relevant.

¹¹ While climate-related issues will be area-dependent and somewhat differ across Somalia, rain and water-related issues will persist across the country.

Worsening water security and its influence on Somalia's agriculture. The combination of heat stress and inadequate water volumes available at crucial growing times in the year, either inadequate rainfall or insufficient irrigation, contribute to frequent crop failures in Somalia. The continuously decreasing water availability is expected to magnify this negative influence on agriculture production for food crops and animal fodder, inevitably leading to poor livestock productivity and insufficient food for human consumption. Pastoralism and agropastoralism, the dominant sectors in the Somali rural economy, are already in continual distress, with falling livestock and crop productivity. Due to continuous climate variability, this status quo is expected to worsen with time. Because of the changing climate and associated water and land degradation issues, agricultural production is increasingly unreliable in meeting human needs and income generation. Furthermore, Somalia's small-scale agriculture producers lack access to improved seeds (e.g., drought-resistant seeds), the necessary agriculture tools, and climate-smart and resilient training on modern land management techniques to decrease land degradation and conserve soil fertility. All of that negatively influences Somalia's food-insecure population, which is around 6.6. million. Unfortunately, with the decreasing water supply and lack of proper land management procedures as climate worsens, this number of food insecure people is expected to keep increasing.

1.3. Historical Climate Finance for Somalia

Past climate-related financing to Somalia. According to the OECD DAC data¹², the following climate financing was delivered to Somalia between 2006-2021 (adaptation and mitigation, as specified in Table 1):

Table 1. Past climate financing in Somalia.

Somalia	Adaptation (in USD 2021 constant \$)			Mitigation (in USD 2021 constant \$)		
	Concessional and developmental : Grants only	Private concessional : Grants only	Debt instruments	Concessional and developmental : Grants only	Private concessional : Grants only	Debt instruments
	1,764,848.57 thousand Note: data for 2010-2021	8,775.69 thousand Note: data for 2010-2021	No data	414,861.53 thousand Note: mitigation funding between 2006-2021	193.04 thousand Note: mitigation funding between 2006-2021	No data

1.4. Climate Resilient Agriculture in Somalia Grant Proposal

Expected impacts of the funding proposal (FP). The ex-ante EFA presented in this annex and accompanying EFA Excel with indicative models that have been prepared in support of the Green Climate Fund (GCF) Funding Proposal (FP) aims to show how the requested grant funding could be used to:

1. Minimize the weather and climate-related risks of Somalia's small-scale farmers (especially agro-pastoralists and pastoralists switching to agro-pastoralism).
2. Address land some degradation issues including invasive species infestation that lead to lower soil fertility and crop production suitability.
3. Facilitate Somalia's smallholders' adaptation to climate change through:
 - a. increased incomes,
 - b. improved food and water security, hence potentially better health,
 - c. enhanced ecosystem and ecosystem services.

¹² Source: <https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm>

2. Methodology

2.1. EFA Basis

The EFA methodology, a GCF prescribed analytical framework for projects' appraisals, was constructed using the well-established cost-benefit analysis (CBA) principles. The modelling and analytical approach, primarily influenced by the "*Manual on Cost Benefit Analysis for Investment Decisions*" by Glenn P. Jenkins, Chun-Yan Kuo, and Arnold Harberger, 2011, was tailored to align with the GCF EFA guidelines. This was achieved through careful methodological alignment based on the GCF *Annex VI: Economic and Financial Analysis (EFA) guidance*.¹³ The modelling approach used in this EFA is visualized in Figure 2 below.

Furthermore, the EFA modelling was pursued from two separate yet complementary perspectives. First, the farm-level modelling from the perspective of intended/direct beneficiaries was employed. Hence, the individual and aggregate *integrated climate-resilient agriculture packages (iCRAPs)* modelling for six regions was prepared. Then, the modelling from the entire project perspective was also developed to show the overall and expected project impacts on Somalia's economy. The complete EFA analysis is comprehensively discussed in the following sections.

2.2. Developing EFA from the Perspective of Intended Beneficiaries

Direct beneficiaries' modelling perspective. It is widely acknowledged that CBA or EFA can be modelled from various perspectives, depending on the analytical interest. In the case of the project, the EFA modelled from the perspective of intended/direct beneficiaries aimed at showing how these agro-pastoralists and pastoralists (individually and in the aggregate, per assumed number of similar beneficiaries in each of the six zones of interest) might benefit through the implementation of the project. This modelling and its estimates differ from the modelling done from the perspective of the entire project as costs, as presented in the budget, do not matter for individual beneficiaries. These targeted direct beneficiaries do not observe project costs. They will be subsidized through activities delivered through and they will not need to pay for these activities.¹⁴

2.2.1. Construction of WOP and Indicative WP Scenarios

WOP and WP scenarios. The first step of the ex-ante EFA involved the modelling pursued from the perspective of intended direct beneficiaries. The process started with constructing six Without Project (WOP) scenarios and six indicative With Project (WP) scenarios. Both scenarios were appraised through financial and economic analysis.

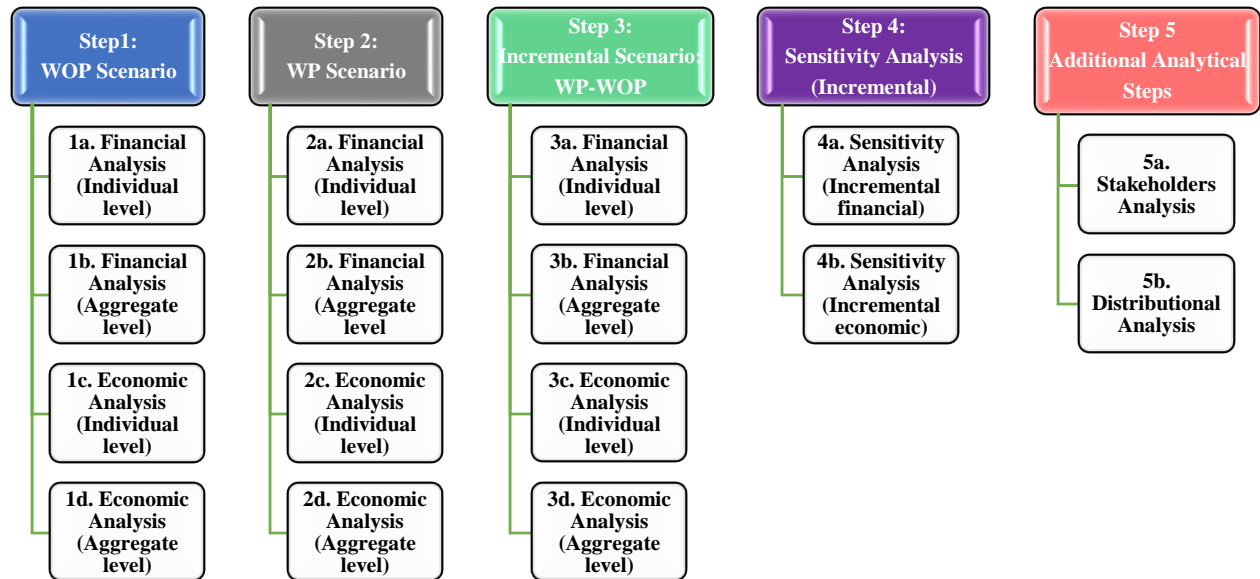
The WOP scenarios were not created in isolation but resulted from a collaborative effort. They were based on the available data obtained through various resources, including FAO Somalia consultations and interviews, knowledge and data from past projects implemented in Somalia, relevant literature, and open-source data portals (e.g., UN Comtrade, FAOSTAT, etc.). Consequently, each WOP scenario represents a counterfactual scenario to the indicative WP.

The role of each WP scenario was to model what the situation would look like once the proposed set of interventions were introduced. However, due to the complicated access to zone-specific data and the anticipated necessity for customization of packages of interventions to different districts (hence many potential models to be created), the WP models were constructed as indicative, meaning representative for each area preselected for interventions. While the WP models are indicative at this stage, they were not created haphazardly. They were consulted in depth with FAO field officers who gathered the relevant data and information from the field. Therefore, they represent the situation on the ground well in each of these preselected intervention areas.

¹³ Source: <https://www.greenclimate.fund/document/annex-vi-economic-and-financial-analysis-efa-guidance>

¹⁴ See section 2.3 for more details on modelling from the entire project perspective.

Figure 2. EFA methodology.

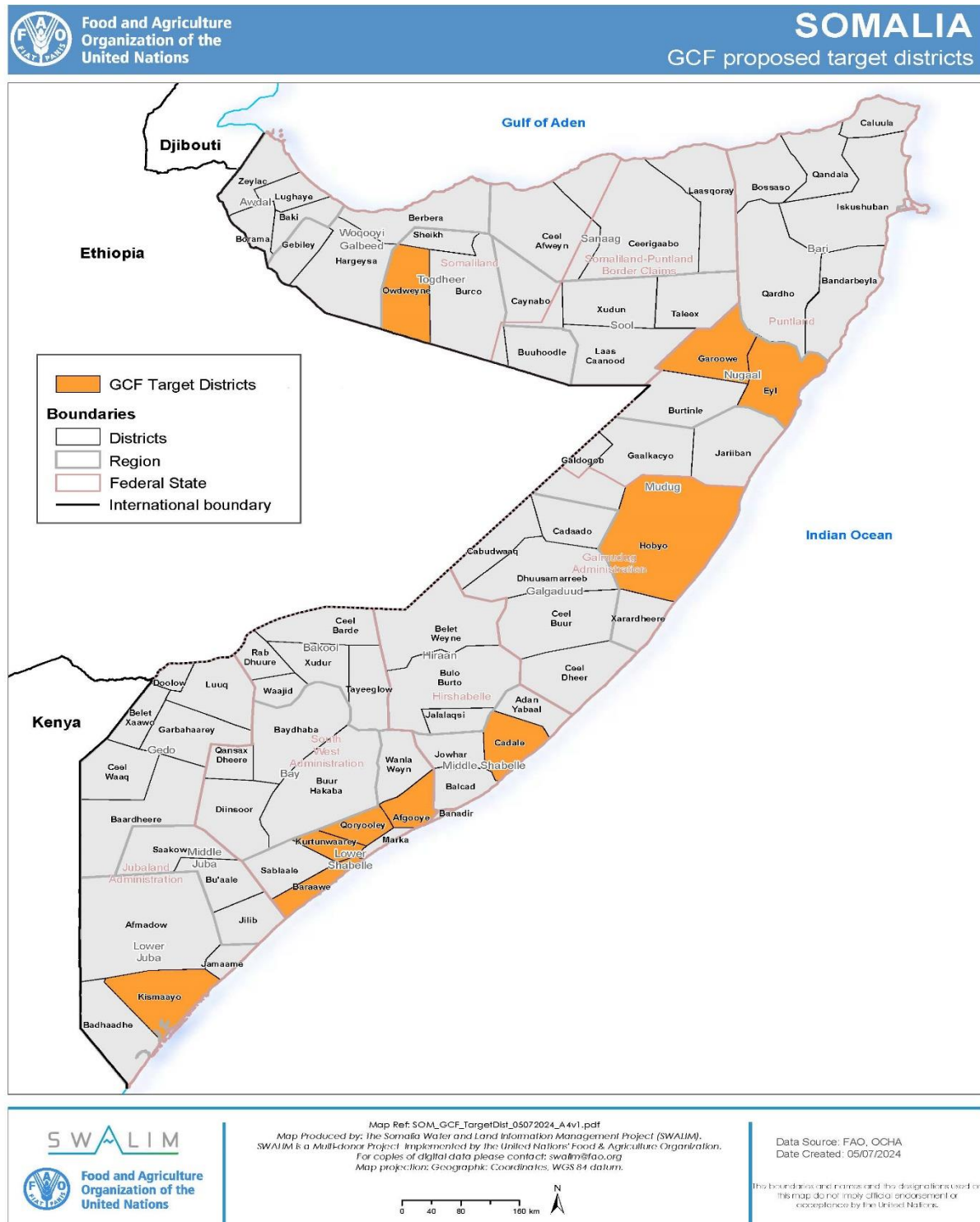


Specifics of indicative WP models. The set of six indicative models appraised in this EFA is not just a collection of data but a significant step towards improving people's livelihoods in these areas. Each of the six appraised indicative models constitutes a set of interventions selected based on the available information and a thorough pre-selection process. These six indicative models are called *integrated climate-resilient agriculture packages (iCRAPs)* as each *iCRAP* consists of several elements that are bundled to provide the best expected outcomes for targeted beneficiaries in each agroecological zone. The focus in proposed *iCRAPs* is on agro-pastoralists and pastoralists transitioning into agropastoral activities as a mode for dealing with changing natural conditions where reliance on livestock rearing alone with the use of common pastures becomes less possible. In agro-pastoral areas, nutrient cycling through the integration of a crop-livestock system and the use of crop residues and byproducts as animal feeds and animal manure as crop fertilizer are common.

The iCRAPs are numbered from 1-6 according to the implementation zone. Among the information regarding *iCRAPs* in six preselected agroecological zones, Table 2 below also shows details about WOP scenarios and gives some information related to typical livelihood types observed in each of the six preselected intervention areas.

Agroecological areas preselected for interventions. The project preparation team has preselected six agroecological zones for proposed interventions. These zones are presented in Figure 3 below and include Lower Juba, Lower Shabelle, Middle Shabelle, Mudug, Nugal, and Togheer.

Figure 3. Map of Targeted Zones.





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Table 2. Appraised indicative models.

Region	Indicative Model	Livelihood Types (as per FAO)	“Without Project” (WOP) Scenario	“With Project” (WP) Scenario Assumed Indicative iCRAP
Lower Juba (relatively higher land productivity and rainfall among preselected zones, similar to Lower Shabelle and Middle Shabelle)	iCRAP (1)	1. Juba pastoral-cattle and goats 2. Southern rainfed - maize, cattle, and goats. 3. Riverine gravity irrigation.	1. Intercropping of sesame and maize in 2 production seasons with unimproved and non-drought-resistant seeds. Rainfed crop production is assumed due to the poor quality of irrigation systems (or their lack). 2. Observed high crop losses due to the use of unimproved quality seeds, insufficient water supply, and poor access to farming tools. 3. Lack of knowledge of climate resilient land management, soil management and post-harvest management techniques 4. Animal rearing is present but with serious deficiencies in animal feed due to poor crops yield and water stress.	Main commodities of intervention: sesame and maize (intercropping) in 2 production seasons. <u>Proposed intervention bundles:</u> <ol style="list-style-type: none"> 1. Provision of improved, e.g., drought-resistant seeds of sesame and maize. 2. Delivery of zone-elevant training to agro-pastoralists on climate resilient agricultural practices including soil management, natural ways of soil fertilization, effective crop management and post-harvest /storage activities to minimize losses. 3. Provision of irrigation rehabilitation in the area that will allow improved water availability for animals and crops, decreasing water deficiency and lowering crop and animal-related losses. Assumed farming with gravity irrigation or simple irrigation solar pumps. 4. Additionally, livestock fattening activities are assumed and an increased volume of camel milk sales to the market due to improved crops management and water availability.
Lower Shabelle (relatively higher land productivity and rainfall among preselected zones, similar to Lower Juba and Middle Shabelle)	iCRAP (2)	1. Southern rainfed maize. 2. Southern inland pastoral: camel, goats. 3. Sorghum high potential agro-pastoral. 4. Riverine gravity irrigation.	1. Intercropping of white sorghum and maize in 2 production seasons with unimproved and non-drought resistant seeds. Rainfed crop production is assumed due to the poor quality of irrigation systems (or their lack). 2. Observed high crop losses due to the use of unimproved quality seeds, insufficient water supply, and poor access to farming tools. 3. Lack of knowledge of climate resilient land management, soil management and post-harvest management techniques 4. Animal rearing is present but with serious deficiencies in animal feed due to poor crops yield and water stress.	Main Commodities of intervention: white sorghum and maize (intercropping) in 2 production seasons. <u>Proposed intervention bundles:</u> <ol style="list-style-type: none"> 1. Provision of improved, e.g., drought-resistant seeds of white sorghum and maize. 2. Delivery of zone-elevant training to agro-pastoralists on climate resilient agricultural practices including soil management, natural ways of soil fertilization, effective crop management and post-harvest /storage activities to minimize losses. 3. Provision of irrigation rehabilitation in the area that will allow improved water availability for animals and crops, decreasing water deficiency and lowering crop and animal-related losses. Assumed farming with gravity irrigation or simple irrigation solar pumps. 4. Additionally, livestock fattening activities are assumed and an increased volume of camel milk sales to the market due to improved crops management and water availability.

Region	Indicative Model	Livelihood Types (as per FAO)	“Without Project” (WOP) Scenario	“With Project” (WP) Scenario Assumed Indicative iCRAP
Middle Shabelle (relatively higher land productivity and rainfall among preselected zones, similar to Lower Juba and Lower Shabelle)	iCRAP (3)	1. Sorghum high potential agro-pastoral. 2. Cowpea belt. 3. Fishing-coastal areas. 4. Riverine gravity irrigation.	1. Intercropping of cowpe and maize in 2 production seasons with unimproved and non-drought resistant seeds. Rainfed crop production is assumed due to the poor quality of irrigation systems (or their lack). 2. Observed high crop losses due to the use of unimproved quality seeds, insufficient water supply, and poor access to farming tools. 3. Lack of knowledge of climate resilient land management, soil management and post-harvest management techniques 4. Animal rearing is present but with serious deficiencies in animal feed due to poor crops yield and water stress.	Main commodities of intervention: white sorghum and cowpea (intercropping) in 2 production seasons. <u>Proposed intervention bundles:</u> <ol style="list-style-type: none"> Provision of improved, e.g., drought-resistant seeds of maize and cowpea. Delivery of zone-elevant training to agro-pastoralists on climate resilient agricultural practices including soil management, natural ways of soil fertilization, effective crop management and post-harvest /storage activities to minimize losses. Provision of irrigation rehabilitation in the area that will allow improved water availability for animals and crops, decreasing water deficiency and lowering crop and animal-related losses. Assumed farming with gravity irrigation or simple irrigation solar pumps. Additionally, livestock fattening activities are assumed and an increased volume of camel milk sales to the market due to improved crops management and water availability.
Mudug	iCRAP (4)	1. Pastoral and cowpea belt. 2. Fishing-coastal areas	1. Intercropping of white sorghum and cowpea in 2 production seasons with unimproved and non-drought resistant seeds. Rainfed crop production is assumed due to the poor quality of irrigation systems (or their lack). 2. Observed high crop losses due to the use of unimproved quality seeds, insufficient water supply, and poor access to farming tools. 3. Lack of knowledge of climate resilient land management, soil management and post-harvest management techniques 4. Animal rearing is present but with serious deficiencies in animal feed due to poor crops yield and water stress.	Main commodities of intervention: White sorghum and cowpea (intercropping) in 1 production season and maize and cowpea (intercropping) in the second production season. <u>Proposed intervention bundles:</u> <ol style="list-style-type: none"> Provision of improved, e.g., drought-resistant seeds of maize, cowpea and white sorghum. Delivery of zone-elevant training to agro-pastoralists on climate resilient agricultural practices including soil management, natural ways of soil fertilization, effective crop management and post-harvest /storage activities to minimize losses. Improved water capturing in the area will allow improved water availability for animals and crops, decreasing water deficiency and lowering crop and animal-related losses. Assumed farming with improved water access due to rainwater saving. Additionally, livestock fattening activities are assumed and an increased volume of camel milk sales to the market due to improved crops management and water availability.

Region	Indicative Model	Livelihood Types (as per FAO)	“Without Project” (WOP) Scenario	“With Project” (WP) Scenario Assumed Indicative iCRAP
Nugal	iCRAP (5)	1.Pastoral	<ol style="list-style-type: none"> 1. Animal rearing activities happen but with serious issues with animal feed availability due to poor condition of common pastures. 2. Assumed grass/pastured -fed livestock. Some additional animal feeding is pursued but it is not done according to animal fattening standards due to the lack of training and issues with livestock feed availability. 	<p>Main commodities of intervention: Intercropping of white sorghum and maize in 2 production seasons.</p> <p><u>Proposed intervention bundles:</u></p> <ol style="list-style-type: none"> 1. Provision of improved, e.g., drought-resistant seeds of white sorghum and maize. 2. Delivery of zone-elevant training to agro-pastoralists on climate resilient agricultural practices including soil management, natural ways of soil fertilization, effective crop management and post-harvest /storage activities to minimize losses. 3. Improved water capturing in the area will allow improved water availability for animals and crops, decreasing water deficiency and lowering crop and animal-related losses. Assumed farming with improved water access due to rainwater saving. 4. Additionally, livestock fattening activities are assumed and an increased volume of camel milk sales to the market due to improved crops management and water availability.
Togdheer	iCRAP (6)	1.Agro-pastoral and pastoral	<ol style="list-style-type: none"> 1. Intercropping of white sorghum and maize in 2 production seasons with unimproved and non-drought resistant seeds. Rainfed crop production is assumed due to the poor quality of irrigation systems (or their lack). 2. Observed high crop losses due to the use of unimproved quality seeds, insufficient water supply, and poor access to farming tools. 3. Lack of knowledge of climate resilient land management, soil management and post-harvest management techniques. 4. Animal rearing is present but with serious deficiencies in animal feed due to poor crops yield and water stress. 	<p>Main commodities of intervention: white sorghum and maize in 2 production seasons.</p> <p><u>Proposed intervention bundles:</u></p> <ol style="list-style-type: none"> 1. Provision of improved, e.g., drought-resistant seeds of maize and white sorghum. 2. Delivery of zone-elevant training to agro-pastoralists on climate resilient agricultural practices including soil management, natural ways of soil fertilization, effective crop management and post-harvest /storage activities to minimize losses. 3. Improved water capturing in the area will allow improved water availability for animals and crops, decreasing water deficiency and lowering crop and animal-related losses. Assumed farming with improved water access due to rainwater saving. 4. Additionally, livestock fattening activities are assumed and an increased volume of camel milk sales to the market due to improved crops management and water availability.



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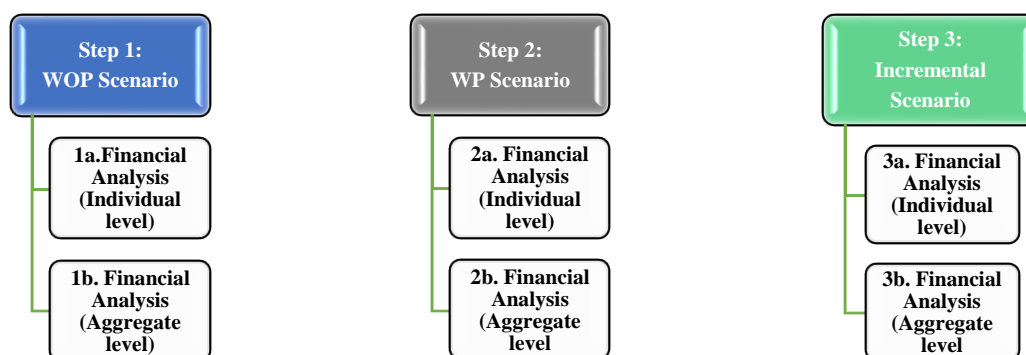
2.2.2. Financial Analysis

Building financial cash flows. The second step of the EFA consisted of constructing three different sets of financial cash flows prepared for each iCRAP. Firstly, the WOP financial cash flows (one for each iCRAP, hence, six) were created. Each WOP cash flow included tracing down all likely inflows and outflows that would accrue in the future to targeted direct beneficiaries (i.e., agro-pastoralists and pastoralists in each of six preselected zones, respectively) if no interventions were introduced. Then, the WP financial cash flows were prepared separately for each of the proposed iCRAPs (six in total). These cash flows were also developed in individual and aggregate forms (Figures 4 and 5 below). The WP cash flows traced down all potential inflows and outflows expected to accrue to beneficiaries once interventions are implemented (as per interventions described in Table 2 above).

Figure 4. WOP-Financial Part of EFA.

Figure 5. WP -Financial part of EFA.

Figure 6. Incremental -Financial Part of EFA.



Lastly, the Incremental scenario with incremental financial cash flows that show the difference between the WOP and each of the WP scenarios were developed separately for each iCRAP (six in total, in individual and aggregate terms, respectively, Figure 6 above).

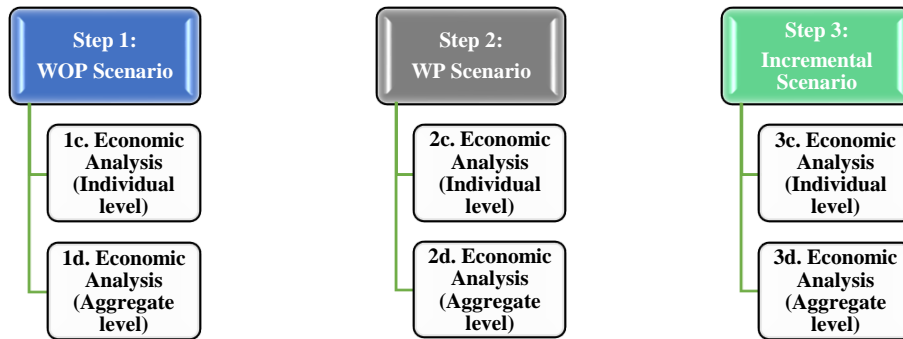
In all iCRAPs 1-6, WOP, WP and Incremental scenarios, standard measures of the project's financial profitability and viability were estimated: Financial Net Present Values (FNPV), Financial Internal Rates of Return (FIRR), and Modified Internal Rates of Return (MIRR). In all cases, the analysis was pursued in individual terms (per 1 ha of farmland) and aggregate terms, for assumed number of hectares in each zone (as per Table 3 below).

2.2.3. Economic Analysis

Deriving economic resource flows. To develop economic analysis, all line entries in financial cash flows were first adjusted to their economic values using a set of calculated Conversion Factors (CFs). The individual and aggregate iCRAP economic resource flows were then created (Figures 7-9 below). The standard project's economic sustainability measures Economic Net Present Values (ENPV), Economic Rates of Return (ERR), Economic Modified Internal Rates of Return (EMIRR), and Benefits Cost Ratios (BCRs) were estimated to show the economic profitability of proposed interventions. Incremental economic analysis was also pursued to show the incremental economic benefits of proposed interventions.

Similarly to the financial part of EFA, the economic analysis was also pursued in individual terms (per 1 ha of farmland) and aggregate terms for assumed number of hectares in each zone (as per Table 3 below).

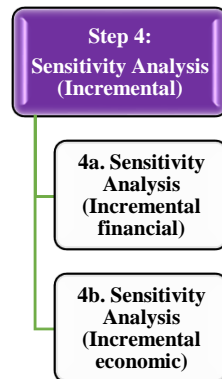
Figure 7. WOP- Economic Part of EFA. Figure 8. WP -Economic Part of EFA. Figure 9. Incremental -Economic Part of EFA.



2.2.4. Sensitivity Analysis: “What if” Analysis

Sensitizing EFA variables. Additionally, a sensitivity analysis was pursued (Figure 10). The role of sensitivity analysis is not trivial, as it determines how target variables are affected based on changes in other variables known as input variables. This can predict the outcome of a decision given a specific range of variables. Sensitivity analysis is fundamental and necessary because data entries used in the EFA’s financial and economic line entries are static by definition; hence, their likely variability over the timeframe of the project or program is not embedded in the obtained FNPVs, FIRR, ENPVs or EIRR. For details, please see section 5 below.

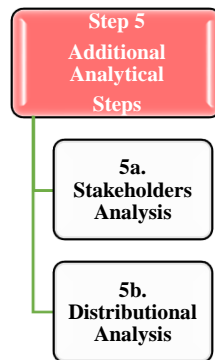
Figure 10. Sensitivity Analysis Part of EFA.



2.2.5. Stakeholders and Distributional Analysis

Knowing that the economic part of the pursued EFA encompasses a comprehensive view of the economy and society, the actors that will benefit directly or indirectly from the interventions coming through the GCF funding need to be identified. Consequently, the stakeholder analysis was employed to identify the actors that will be affected through the outcomes of the proposed interventions (as defined in Table 2). In the EFA (and CBA) framework, the project's impacts on various actors are known as externalities.¹⁵ The project's externalities are derived by taking a difference between the aggregate incremental economic resource flow and the aggregate incremental financial cash flow statements. The aggregate incremental economic resource flow statement represents the benefits to the entire economy while the aggregate incremental financial cash flow statement estimates the financial gains to the project's intended beneficiaries.

Figure 11. Stakeholders and Distributional Part of EFA.



2.3. Developing EFA from the Project Perspective

Project perspective EFA. While the EFA modeled from the perspective of intended direct beneficiaries is very important to show how these beneficiaries might individually (and in aggregate, per area) gain from proposed interventions, the EFA modeled from the perspective of the entire project shows if the money budgeted and spent is worthwhile as it will benefit the entire economy. Consequently, this modeling approach was also employed to show additional angle to the EFA analysis. In this case the following modeling was pursued:

1. For the financial part of the analysis, the net aggregated incremental inflows as modeled in iCRAPs 1-6, respectively were juxtaposed against planned budgetary expenditures during the 7 years of the project implementation period. Consequently, standard overall project financial profitability measures were estimated (FNPV, FIRR, MIRR). Sensitivity analysis on the project perspective financial results was also pursued.
2. For the economic part of the analysis, the net aggregated incremental benefits as modeled in iCRAPs 1-6, respectively were juxtaposed planned budgetary expenditures during the 7 years of the project implementation period. Consequently, standard overall project economic viability measures were estimated (ENPV, EIRR, EMIRR, BCR). Sensitivity analysis on the project perspective economic results was also pursued.

For more details, please refer to Excel sheet *“Overall Project Results.”*

¹⁵ Note: These are not the same as environmental externalities.

3. Specific Modeling Approach and Assumptions

3.1. Overview of Modeling Approach.

The ex-ante nature of the estimated farm level EFA models (iCRAPs 1-6) which are indicative by nature required a set of assumptions that helped develop and appraise the financial inflows and outflows as well as economic benefits and costs of proposed indicative interventions. These assumptions are divided into two sets: (i). general macroeconomic assumptions common to all EFA models (e.g., inflation rate, exchange rate, etc., as outlined in Table 2 below) and (ii). model-specific assumptions relevant to each of the estimated EFA models (as presented in detail with basis and sources of assumptions in the accompanying EFA Excel File, specifically in the Excel sheets “*Data Sources*” and “*Calculations*.”

Both types of assumptions are briefly discussed in the next two subsections below. For details, please refer to the accompanying Excel file.

3.2. General and Macroeconomic Assumptions

The exhaustive set of general and macroeconomic assumptions used in this EFA modeling is presented in Table 3 below.

Table 3. General and Macroeconomic EFA Models’ Assumptions.¹⁶

Item	Value
Project Implementation Period	7 years
Ex-ante EFA analytical period for cash flows	20 years
Total expected number of the project’s beneficiaries	1,152,142 people
Average Household (HH) Size	6 people (FAO est.)
Number of HHs with 6 members on average	192,024 (rounded)
Assumed Average land holding per HH (for indicative modelling)	1 ha
Expected number of hectares per agroecological zone of interest	Lower Juba (27,446), Lower Shabelle (64,888), Middle Shabelle (39,477), Mudug (14,371), Nugal (38,353), Togdheer (7,491)
Expected number of HHs per agroecological zone of interest	Lower Juba (27,446), Lower Shabelle (64,888), Middle Shabelle (39,477), Mudug (14,371), Nugal (38,353), Togdheer (7,491)
Assumed agroecological zones of interest (6)	Lower Shabelle, Lower Juba, Togdheer, Middle Shabelle, Nugaal, Mudug
Somalia Inflation Rate	4.1% ¹⁷
US Inflation Rate	3.10% ¹⁸
SOS to USD exchange rate	570 SOS=1 USD ¹⁹
General VAT level	0%
VAT on agric. inputs like seeds, for example	0%
Estimated Foreign Exchange Premium (FEP)	3.23%
Financial Discount Rate -assumed	15% ²⁰
Economic Discount Rate (Economic Opportunity Cost of Capital (EOCK)-assumed)	15%
Inputs subsidies ²¹	0%

¹⁶ Assumptions are based on the information from the following sources: FAO GCF funding proposal documents, FAO Somalia field interviews, reports, and open access databases, as listed in references and footnotes.

¹⁷ Source: <https://www.imf.org/external/datamapper/PCPIPCH@WEO/OEMDC> accessed on March 12, 2024.

¹⁸ Source: <https://www.imf.org/external/datamapper/PCPIPCH@WEO/OEMDC> accessed on March 12, 2024.

¹⁹ As of March 13, 2024-accessed from: <https://www.forbes.com/advisor/money-transfer/currency-converter/usd-sos/#:~:text=1%20USD%20%3D%20571.661668%20SOS%20Mar%2001%2C%202024%2000%3A41%20UTC&text=The%20currency%20converter%20below%20is,is%20as%20easy%20as%20ever>. Rounded down to SOS 570.

²⁰ Please note: In the case of Somalia there is no agreement as to proper discount rates to be used in the EFA. In this analysis it was decided to use the same discount rate in financial and economic analysis due to the lack of indicators that it should be differentiated and lack of access to the necessary macroeconomic and current data. This is a relatively high discount rate when comparing other countries in the area (for example, Rwanda has calculated economic cost of capital (EOCK) of 13%). This level for financial and economic discount rates was chosen to remain conservative and to curb optimism of this modelling and its results. For example, the WB used economic discount rate of 6% and financial discount rate of 10% in its November, 2023 project in Somalia: <https://documents1.worldbank.org/curated/en/099113023180038846/pdf/BOSIB02ca62b030d109c720b59a2fa65b89.pdf> Therefore, using 15% can be considered as an additional risk mitigating element embedded in this analysis. Please also note that the rule of thumb is that if the project is beneficial under higher discount rates, it will be even more beneficial under lower discount rates.

²¹ Input subsidies while potentially existing could not be traced with any level of precision. Generally, due to various emergencies and frequent need for humanitarian aid agricultural market is probably distorted but the levels of distortions remain extremely hard to trace and document.

3.3. Model-Specific Assumptions

General assumptions. The specifics regarding the individual iCRAP modelling assumptions can be seen in the accompanying Annex 3 Excel file and are not presented here in detail to minimize the size of this report. For specific data assumptions and sources, please refer to the Excel sheet "*Data Sources*"²² and "*Calculations*." However, in the case of each of six proposed iCRAPs and their WOP and WP scenarios, specific care was taken to estimate these models using realistic assumptions on the following: (i). commodities farmgate prices, (ii). yield levels and yield variations under RCP 2.6 and RCP 8.5, (iii). inputs costs and volumes (e.g., labour, etc.), (iv). outputs costs and volumes, (v). animal mortality rates, etc.

Also, special care was taken to establish types of scenarios that are realistic in their nature and are not overoptimistic knowing Somalia's geopolitical and climatic situation. This task was achieved in the first place via using Somalia-specific knowledge obtained during the implementation of past projects and interviews with various stakeholders in selected areas during the preparation of various deliverables required for the FP. When necessary, this field knowledge was supplemented with a desktop review of available data and publications relevant to specific interventions and their commodities (as per **Bibliography** section of this report). Combining all these information sources was used in the EFA modeling process to input necessary values in developing financial and economic flows.

Individual versus aggregate modeling. In the case of all six iCRAPs, all financial and economic flows were built on an assumption of 1 ha of farmland devoted to a specific production under a specific set of interventions. It was assumed that one Household (HH) composed on average of 6 family members cultivates 1 ha of land and that such a HH receives one of the six proposed iCRAPs. The aggregate financial cash flows and economic resource flows were constructed in the following way:

1. To encompass the predicted number of direct beneficiaries, the total number of direct beneficiaries was divided in the following way: Lower Juba (27,446 HHs), Lower Shabelle (64,888 HHs), Middle Shabelle (39,477 HHs), Mudug (14,371 HHs), Nugal (38,353 HHs), Togdheer (7,491 HHs)
2. The results obtained in the modeling of each individual iCRAP were multiplied by this assumed number of hectares (or HHs) to arrive with aggregate results per iCRAP.
3. Both results (financial and economic) are presented in the proper sections below.

Streamlining iCRAPs into EFA modeling. It was assumed that targeted beneficiaries would receive one of the six proposed iCRAPs to arrive at aggregate benefits. In the case of all scenarios, the potential impact of weather and climate-related changes and calamities on beneficiaries of proposed iCRAPs were internalized and modelled in financial cash flows and economic resource flows via yield loss assumptions. The modelling was pursued using RCP 2.6 and 8.5 climate assumptions, respectively. Lastly, the iCRAPs that were appraised in this ex-ante EFA assumed that the main activities under specific iCRAPs would include:

- ✓ Provision of improved, higher yielding and climate resilient seeds.
- ✓ Training farmers in the selected agroecological zones on suggested climate-resilient farming adaptation techniques, including improved landscape management and soil fertility improvements.
- ✓ Training on-farm water management and water capturing (customized to the ground reality in each area of project interest).
- ✓ Assistance in obtaining necessary production inputs (e.g., seeds, natural fertilizer, tools, etc.) to pursue planting.

Farm training will be provided to targeted direct beneficiaries through area-customized Farmers Field Schools (FFS). The FFS curriculum will be customized per area to ensure that the necessary knowledge is passed to targeted beneficiaries in a comprehensible form and that the training includes the necessary information pertinent to the specifics of each zone of intervention (to avoid a "one type fits all" approach).

²² For specific assumptions regarding yields under RCP 2.6 vs 8.5, please refer to the "Data Sources" Excel sheet or links provided below:
https://www.researchgate.net/publication/360896626_Predicting_Maize_Zea_mays_productivity_under_projected_climate_change_with_management_options_in_Amhara_region_Ethiopia ,
https://www.researchgate.net/publication/289495561_Modeling_the_Impact_of_Climate_Change_on_Production_of_Sesame_in_Western_Zone_of_Tigray_Northern_Ethiopia , <https://www.smallholderfeed.co.uk/goat-feeding-guide/> ,
<https://cabigbio.biomedcentral.com/articles/10.1186/s43170-022-00092-9> ,
<https://www.fao.org/3/x6528e/X6528E08.htm#:~:text=They%20eat%208%E2%80%9312%20kg.of%20dry%20matter%20a%20day> ,
<https://www.fao.org/documents/card/fr/c/I8842EN/> , https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4524696

4. EFA Results

4.1. Financial Results

4.1.1. Intended Beneficiaries Perspective

Financial analysis results for direct beneficiaries. The ex-ante financial part of the EFA modelled at the farm level was pursued over 20 years, in individual (per 1 ha) and in aggregate terms (per assumed number of hectares to be included under each indicative iCRAP in each area of intervention-see section 3.3). The obtained results indicate that all six indicative iCRAPs will have positive incremental FNPV, FIRR higher than chosen financial discount rate of 15% and MIRR at decent reinvesting levels. Therefore, obtained analytical results suggest that proposed packages of interventions will bring positive financial impact on intended direct beneficiaries. Tables 4 and 5 below present detailed results per individual iCRAP. Please note, the results are presented separately for RCP 2.6 and RCP 8.5.

For modeling details, please refer to Excel sheets with proper *iCRAP (1)-(7)-WOP/WP/Incremental* modelling.

4.1.2. Overall Project Perspective

Financial analysis results for the entire project. The ex-ante financial part of the entire project perspective EFA was also pursued over 20 years using financial discount rate of 15%. In the case of this analysis, the project budget was considered as well as the project's implementation budgetary disbursement per year (phasing in). The obtained results indicate that the overall project results are positive with positive FNPV, FIRR higher than chosen discount rate of 15% and decent potential reinvestment levels of MIRR. Table 6 below present detailed results from the entire project perspective. Please note, the results are presented separately for RCP 2.6 and RCP 8.5.

For modeling details, please refer to Excel sheet "*Overall Project Results.*"



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Table 4. Incremental Results: Financial Part of the EFA (Direct Beneficiaries Perspective) -RCP 2.6 Assumed

RCP 2.6 Assumed															
ICRAP 1 Individual results				ICRAP 1 Aggregate results ('000 SOS or USD)				ICRAP 2 Individual results				ICRAP 2 Aggregate results ('000 SOS or USD)			
	WOP	WP	Incem.		WOP	WP	Incem.		WOP	WP	Incem.		WOP	WP	Incem.
FNVP(SOS)	66,173	393,894	327,721	FNVP(SOS)	1,816,162	10,810,739	8,994,577	FNVP(SOS)	12,078	102,309	90,230	FNVP(SOS)	783,714	6,638,544	5,854,831
FNVP(USD)	116	691	575	FNVP(USD)	3,186	18,966	15,780	FNVP(USD)	21	179	158	FNVP(USD)	1,375	11,647	10,272
FIRR(%)	17%	22%	65%	FIRR(%)	17%	22%	65%	FIRR(%)	15%	17%	42%	FIRR(%)	15%	17%	42%
MIRR(%)	16%	17%	26%	MIRR(%)	16%	17%	26%	MIRR(%)	15%	16%	20%	MIRR(%)	15%	16%	20%
ICRAP 3 Individual results				ICRAP 3 Aggregate results ('000 SOS or USD)				ICRAP 4 Individual results				ICRAP 4 Aggregate results ('000 SOS or USD)			
	WOP	WP	Incem.		WOP	WP	Incem.		WOP	WP	Incem.		WOP	WP	Incem.
FNVP(SOS)	297,377	741,867	444,490	FNVP(SOS)	8,161,768	20,361,154	12,199,386	FNVP(SOS)	89,074	388,513	299,439	FNVP(SOS)	2,444,719	10,663,069	8,218,350
FNVP(USD)	522	1,302	780	FNVP(USD)	14,319	35,721	21,402	FNVP(USD)	156	682	525	FNVP(USD)	4,289	18,707	14,418
FIRR(%)	22%	28%	55%	FIRR(%)	22%	28%	55%	FIRR(%)	17%	22%	53%	FIRR(%)	17%	22%	53%
MIRR(%)	17%	19%	24%	MIRR(%)	17%	19%	24%	MIRR(%)	16%	17%	22%	MIRR(%)	16%	17%	22%
ICRAP 5 Individual results				ICRAP 5 Aggregate results ('000 SOS or USD)				ICRAP 6 Individual results				ICRAP 6 Aggregate results ('000 SOS or USD)			
	WOP	WP	Incem.		WOP	WP	Incem.		WOP	WP	Incem.		WOP	WP	Incem.
FNVP(SOS)	18,269	365,346	347,078	FNVP(SOS)	501,394	10,027,238	9,525,844	FNVP(SOS)	167,288	297,120	129,832	FNVP(SOS)	4,591,368	8,154,703	3,563,335
FNVP(USD)	32	641	609	FNVP(USD)	880	17,592	16,712	FNVP(USD)	293	521	228	FNVP(USD)	8,055	14,306	6,251
FIRR(%)	15%	21%	36%	FIRR(%)	15%	21%	36%	FIRR(%)	19%	21%	54%	FIRR(%)	19%	21%	54%
MIRR(%)	15%	17%	20%	MIRR(%)	15%	17%	20%	MIRR(%)	16%	17%	22%	MIRR(%)	16%	17%	22%

Table 5. Incremental Results: Financial Part of the EFA (Direct Beneficiaries Perspective) -RCP 8.5 Assumed

RCP 8.5 Assumed															
ICRAP 1 Individual results				ICRAP 1 Aggregate results ('000 SOS or USD)				ICRAP 2 Individual results				ICRAP 2 Aggregate results ('000 SOS or USD)			
	WOP	WP	Incem.		WOP	WP	Incem.		WOP	WP	Incem.		WOP	WP	Incem.
FNVP(SOS)	8,276	290,422	282,146	FNVP(SOS)	227,144	7,970,881	7,743,737	FNVP(SOS)	12,647	93,282	80,634	FNVP(SOS)	820,648	6,052,810	5,232,161
FNVP(USD)	15	510	495	FNVP(USD)	398	13,984	13,586	FNVP(USD)	22	164	141	FNVP(USD)	1,440	10,619	9,179
FIRR(%)	15%	21%	63%	FIRR(%)	15%	21%	63%	FIRR(%)	15%	17%	39%	FIRR(%)	15%	17%	39%
MIRR(%)	15%	17%	25%	MIRR(%)	15%	17%	25%	MIRR(%)	15%	16%	20%	MIRR(%)	15%	16%	20%
ICRAP 3 Individual results				ICRAP 3 Aggregate results ('000 SOS or USD)				ICRAP 4 Individual results				ICRAP 4 Aggregate results ('000 SOS or USD)			
	WOP	WP	Incem.		WOP	WP	Incem.		WOP	WP	Incem.		WOP	WP	Incem.
FNVP(SOS)	372,705	655,384	282,679	FNVP(SOS)	10,229,200	17,987,551	7,758,351	FNVP(SOS)	289,968	448,923	158,955	FNVP(SOS)	7,958,415	12,321,073	4,362,658
FNVP(USD)	654	1,150	496	FNVP(USD)	17,946	31,557	13,611	FNVP(USD)	509	788	279	FNVP(USD)	13,962	21,616	7,654
FIRR(%)	24%	27%	44%	FIRR(%)	24%	27%	44%	FIRR(%)	21%	23%	33%	FIRR(%)	21%	23%	33%
MIRR(%)	17%	18%	23%	MIRR(%)	17%	18%	23%	MIRR(%)	17%	18%	20%	MIRR(%)	17%	18%	20%
ICRAP 5 Individual results				ICRAP 5 Aggregate results ('000 SOS or USD)				ICRAP 6 Individual results				ICRAP 6 Aggregate results ('000 SOS or USD)			
	WOP	WP	Incem.		WOP	WP	Incem.		WOP	WP	Incem.		WOP	WP	Incem.
FNVP(SOS)	59,974	366,419	306,445	FNVP(SOS)	1,646,025	10,056,662	8,410,637	FNVP(SOS)	176,663	298,192	121,529	FNVP(SOS)	4,848,664	8,184,128	3,335,464
FNVP(USD)	105	643	538	FNVP(USD)	2,888	17,643	14,756	FNVP(USD)	310	523	213	FNVP(USD)	8,506	14,358	5,852
FIRR(%)	16%	21%	34%	FIRR(%)	16%	21%	34%	FIRR(%)	19%	21%	46%	FIRR(%)	19%	21%	46%
MIRR(%)	16%	17%	19%	MIRR(%)	16%	17%	19%	MIRR(%)	16%	17%	21%	MIRR(%)	16%	17%	21%

Table 6. Incremental Results: Aggregate Incremental Financial Part of the EFA (Entire Project Perspective) -RCP 2.6 vs. RCP 8.5.

Aggregate Incremental Financial Part Results		Aggregate Incremental Financial Part Results	
RCP 2.6 assumed. Analytical timeframe: 20 years, discount rate: 15%		RCP 8.5 assumed. Analytical timeframe: 20 years, discount rate: 15%	
FNVP (USD)	33,660,424	FNVP (USD)	13,210,389
FIRR (%)	24%	FIRR (%)	18%
MIRR (%)	19%	MIRR (%)	17%



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4.2. Economic Results

4.2.1. Intended Beneficiaries Perspective

Economic analysis results for direct beneficiaries. Similarly to the financial part of EFA, the ex-ante economic part of EFA was pursued over 20 years, in individual (per 1 ha) and in aggregate terms (per assumed number of hectares to be included under each indicative iCRAP in each area of intervention). The obtained results indicate that all six indicative iCRAPs will have positive incremental ENPV, EIRR higher than chosen economic discount rate of 15% and EMIRR at decent reinvesting levels. Therefore, obtained analytical results suggest that proposed packages of interventions will bring positive economic impact to the economy of Somalia. Tables 7 and 8 below present detailed results per individual iCRAP. Please note, the results are presented separately for RCP 2.6 and RCP 8.5.

For modeling details, please refer to Excel sheets with proper *iCRAPs-WOP/WP/Incremental*.

4.2.2. Overall Project Perspective

Economic analysis results for the entire project. The ex-ante economic part of the entire project perspective EFA was pursued also over 20 years using economic discount rate of 15%. In the case of this analysis, the project budget was considered as well as the project's implementation schedule (phasing in). The obtained results indicate that the overall incremental economic project results are positive with positive ENPV, EIRR higher than chosen economic discount rate of 15% and decent potential reinvestment level of EMIRR. Table 9 below present detailed overall results of this project. Please note, the results are presented separately for RCP 2.6 and RCP 8.5.

For modeling details, please refer to Excel sheet "*Overall Project Results*."



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Table 7. Incremental Results: Economic Part of the EFA (Direct Beneficiaries Perspective) -RCP 2.6 Assumed

RCP 2.6 Assumed															
ICRAP 1 Individual results				ICRAP 1 Aggregate results ('000 SOS or USD)				ICRAP 2 Individual results				ICRAP 2 Aggregate results ('000 SOS or USD)			
	WOP	WP	Increm.		WOP	WP	Increm.		WOP	WP	Increm.		WOP	WP	Increm.
BCR	1.17	1.21	1.29	BCR	1.17	1.21	1.29	BCR	1.14	1.16	1.37	BCR	1.14	1.16	1.37
ENPV(SOS)	291,288	784,516	493,229	ENPV(SOS)	7,994,635	21,531,703	13,537,069	ENPV(SOS)	198,038	363,932	165,894	ENPV(SOS)	12,850,203	23,614,669	10,764,466
ENPV(USD)	511	1,376	865	ENPV(USD)	14,026	37,775	23,749	ENPV(USD)	347	638	291	ENPV(USD)	22,544	41,429	18,885
EIRR(%)	22%	29%	89%	EIRR(%)	22%	29%	89%	EIRR(%)	20%	23%	62%	EIRR(%)	20%	23%	62%
EMIRR(%)	17%	19%	28%	EMIRR(%)	17%	19%	28%	EMIRR(%)	16%	17%	23%	EMIRR(%)	16%	17%	23%
ICRAP 3 Individual results				ICRAP 3 Aggregate results ('000 SOS or USD)				ICRAP 4 Individual results				ICRAP 4 Aggregate results ('000 SOS or USD)			
	WOP	WP	Increm.		WOP	WP	Increm.		WOP	WP	Increm.		WOP	WP	Increm.
BCR	1.18	1.22	1.31	BCR	1.18	1.22	1.31	BCR	1.14	1.17	1.33	BCR	1.14	1.17	1.33
ENPV(SOS)	414,963	966,985	552,022	ENPV(SOS)	11,389,016	26,539,710	15,150,694	ENPV(SOS)	296,854	646,273	349,419	ENPV(SOS)	8,147,400	17,737,491	9,590,091
ENPV(USD)	728	1,696	968	ENPV(USD)	19,981	46,561	26,580	ENPV(USD)	521	1,134	613	ENPV(USD)	14,294	31,118	16,825
EIRR(%)	24%	31%	65%	EIRR(%)	24%	31%	65%	EIRR(%)	21%	27%	58%	EIRR(%)	21%	27%	58%
EMIRR(%)	18%	19%	25%	EMIRR(%)	18%	19%	25%	EMIRR(%)	17%	18%	23%	EMIRR(%)	17%	18%	23%
ICRAP 5 Individual results				ICRAP 5 Aggregate results ('000 SOS or USD)				ICRAP 6 Individual results				ICRAP 6 Aggregate results ('000 SOS or USD)			
	WOP	WP	Increm.		WOP	WP	Increm.		WOP	WP	Increm.		WOP	WP	Increm.
BCR	1.24	1.26	1.31	BCR	1.24	1.26	1.31	BCR	1.16	1.18	1.38	BCR	1.16	1.18	1.38
ENPV(SOS)	737,545	1,368,831	631,287	ENPV(SOS)	20,242,532	37,568,717	17,326,185	ENPV(SOS)	403,011	626,295	223,284	ENPV(SOS)	11,060,974	17,189,184	6,128,210
ENPV(USD)	1,294	2,401	1,108	ENPV(USD)	35,513	65,910	30,397	ENPV(USD)	707	1,099	392	ENPV(USD)	19,405	30,156	10,751
EIRR(%)	30%	36%	50%	EIRR(%)	30%	36%	50%	EIRR(%)	23%	27%	77%	EIRR(%)	23%	27%	77%
EMIRR(%)	20%	20%	22%	EMIRR(%)	20%	20%	22%	EMIRR(%)	18%	18%	25%	EMIRR(%)	18%	18%	25%

Table 8. Incremental Results: Economic Part of the EFA (Direct Beneficiaries Perspective) -RCP 8.5 Assumed

RCP 8.5 Assumed															
iCRAP 1 Individual results				iCRAP 1 Aggregate results ('000 SOS or USD)				iCRAP 2 Individual results				iCRAP 2 Aggregate results ('000 SOS or USD)			
	WOP	WP	Increm.		WOP	WP	Increm.		WOP	WP	Increm.		WOP	WP	Increm.
BCR	1.15	1.19	1.26	BCR	1.15	1.19	1.26	BCR	1.14	1.16	1.36	BCR	1.16	1.16	1.36
ENPV(SOS)	237,447	688,279	450,832	ENPV(SOS)	6,516,942	18,890,394	12,373,452	ENPV(SOS)	198,516	356,926	158,411	ENPV(SOS)	12,881,182	23,160,048	10,278,866
ENPV(USD)	417	1,208	791	ENPV(USD)	11,433	33,141	21,708	ENPV(USD)	348	626	278	ENPV(USD)	22,599	40,632	18,033
EIRR(%)	21%	28%	87%	EIRR(%)	21%	28%	87%	EIRR(%)	20%	23%	60%	EIRR(%)	20%	23%	60%
EMIRR(%)	17%	19%	28%	EMIRR(%)	17%	19%	28%	EMIRR(%)	16%	17%	22%	EMIRR(%)	16%	17%	22%
iCRAP 3 Individual results				iCRAP 3 Aggregate results ('000 SOS or USD)				iCRAP 4 Individual results				iCRAP 4 Aggregate results ('000 SOS or USD)			
	WOP	WP	Increm.		WOP	WP	Increm.		WOP	WP	Increm.		WOP	WP	Increm.
BCR	1.19	1.20	1.21	BCR	1.19	1.20	1.21	BCR	1.17	1.18	1.26	BCR	1.17	1.18	1.26
ENPV(SOS)	478,144	856,559	378,415	ENPV(SOS)	13,123,055	23,497,080	10,380,662	ENPV(SOS)	465,352	696,941	231,589	ENPV(SOS)	12,771,960	19,128,126	6,356,166
ENPV(USD)	839	1,503	664	ENPV(USD)	23,023	41,244	18,221	ENPV(USD)	816	1,223	406	ENPV(USD)	22,407	33,558	11,151
EIRR(%)	26%	30%	53%	EIRR(%)	26%	30%	53%	EIRR(%)	25%	27%	41%	EIRR(%)	25%	27%	41%
EMIRR(%)	18%	19%	25%	EMIRR(%)	18%	19%	25%	EMIRR(%)	18%	19%	21%	EMIRR(%)	18%	19%	21%
iCRAP 5 Individual results				iCRAP 5 Aggregate results ('000 SOS or USD)				iCRAP 6 Individual results				iCRAP 6 Aggregate results ('000 SOS or USD)			
	WOP	WP	Increm.		WOP	WP	Increm.		WOP	WP	Increm.		WOP	WP	Increm.
BCR	1.25	1.26	1.29	BCR	1.25	1.26	1.29	BCR	1.16	1.18	1.38	BCR	1.16	1.18	1.38
ENPV(SOS)	412,253	627,194	214,941	ENPV(SOS)	21,387,163	37,593,396	16,206,234	ENPV(SOS)	412,253	627,194	214,941	ENPV(SOS)	11,314,620	17,213,864	5,899,243
ENPV(USD)	723	1,100	377	ENPV(USD)	37,521	65,953	28,432	ENPV(USD)	723	1,100	377	ENPV(USD)	19,850	30,200	10,350
EIRR(%)	23%	27%	67%	EIRR(%)	31%	36%	49%	EIRR(%)	23%	27%	67%	EIRR(%)	23%	27%	67%
EMIRR(%)	18%	18%	24%	EMIRR(%)	20%	20%	22%	EMIRR(%)	18%	18%	24%	EMIRR(%)	18%	18%	24%

Table 9. Aggregate Incremental Economic Part of the EFA (Entire Project Perspective) -RCP 2.6 vs. RCP 8.5.

Aggregate Incremental Economic Results			Aggregate Incremental Economic Results	
RCP 2.6 assumed. Analytical timeframe: 20 years, discount rate: 15%			RCP 8.5 assumed. Analytical timeframe: 20 years, discount rate: 15%	
ENPV (USD)	75,158,126		ENPV (USD)	55,718,521
EIRR (%)	34%		EIRR (%)	29%
EMIRR (%)	23%		EMIRR (%)	21%



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4.3. Sensitivity Analysis Results

4.3.1. Intended Beneficiaries Sensitivity Analysis

iCRAPs-level sensitivity. The pursued sensitivity analysis shows that obtained ex-ante EFA results are largely insensitive to changes in the most important variables. Several "what if scenarios" were created to assess if the obtained incremental FNPV, FIRR, MIRR, ENPV, EMIRR, and ERR can be influenced by decrease in benefits of individual iCRAPs between 10% - 30%. Please note, the results are presented separately for RCP 2.6 and RCP 8.5. The detailed results are presented in Table 10 below.

For modeling details, please refer to Excel sheet "*Sensitivity Analysis iCRAPs.*"

4.3.2. Overall Project Sensitivity Analysis

Entire project sensitivity. The pursued sensitivity analysis on the entire project incremental financial and economic results was also pursued. Like it was the case with individual iCRAPs sensitivity, the result show robustness when benefits are decreased by up to 30%. Please note, the results are presented separately for RCP 2.6 and RCP 8.5. The results are presented in Table 11 below.²³

For modeling details, please refer to Excel sheet "*Overall Project Results.*"

²³ As Table 11 below shows, the only case when aggregate incremental financial results from the entire project perspective turn negative is when the net benefits decrease by 20-30%. However, this situation is rather unlikely as the project will be closely monitored by the field staff of FAO and all potential risks that could influence decrease in net financial inflows will be spotted timely and acted upon. Economic incremental benefits remain positive with decrease in benefits of up to 30% suggesting economic sustainability.



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Table 10. Sensitivity Analysis Results-Direct Beneficiaries EFA.

RCP 2.6 assumed. Analytical timeframe: 20 years, discount rate: 15%		RCP 8.5 assumed. Analytical timeframe: 20 years, discount rate: 15%	
Aggregate Incremental Financial Part Results (sensitized)		Aggregate Incremental Financial Part Results (sensitized)	
Net incremental inflows [-10%]		Net incremental inflows [-10%]	
FNPV (USD)	76,352,090	FNPV (USD)	58,173,171
FIRR (%)	47%	FIRR (%)	40%
MIRR (%)	22%	MIRR (%)	21%
Net incremental inflows [-20%]		Net incremental inflows [-20%]	
FNPV (USD)	67,868,524	FNPV (USD)	51,709,486
FIRR (%)	47%	FIRR (%)	40%
MIRR (%)	22%	MIRR (%)	21%
Net incremental inflows [-30%]		Net incremental inflows [-30%]	
FNPV (USD)	59,384,959	FNPV (USD)	45,245,800
FIRR (%)	47%	FIRR (%)	40%
MIRR (%)	22%	MIRR (%)	21%
RCP 2.6 assumed. Analytical timeframe: 20 years, discount rate: 15%		RCP 8.5 assumed. Analytical timeframe: 20 years, discount rate: 15%	
Aggregate Incremental Economic Results (sensitized)		Aggregate Incremental Economic Results (sensitized)	
Net incremental benefits [-10%]		Net incremental benefits [-10%]	
ENPV (USD)	114,468,497	ENPV (USD)	95,989,951
EIRR (%)	61%	EIRR (%)	55%
EMIRR (%)	24%	EMIRR (%)	23%
Net incremental benefits [-20%]		Net incremental benefits [-20%]	
ENPV (USD)	101,749,775	ENPV (USD)	86,315,616
EIRR (%)	61%	EIRR (%)	55%
EMIRR (%)	24%	EMIRR (%)	23%
Net incremental benefits [-30%]		Net incremental benefits [-30%]	
ENPV (USD)	89,031,054	ENPV (USD)	75,526,164
EIRR (%)	61%	EIRR (%)	55%
EMIRR (%)	24%	EMIRR (%)	23%

Table 11. Sensitivity Analysis Results-Entire Project Perspective EFA.

RCP 2.6 assumed. Analytical timeframe: 20 years, discount rate: 15%	
Aggregate Incremental Financial Part Results (sensitized)	
Net incremental inflows [-10%]	
FNPV (USD)	23,356,715
FIRR (%)	21%
MIRR (%)	18%
Net incremental inflows [-20%]	
FNPV (USD)	13,053,006
FIRR (%)	18%
MIRR (%)	17%
Net incremental inflows [-30%]	
FNPV (USD)	2,749,297
FIRR (%)	16%
MIRR (%)	15%
RCP 2.6 assumed. Analytical timeframe: 20 years, discount rate: 15%	
Aggregate Incremental Economic Results (sensitized)	
Net incremental benefits [-10%]	
ENPV (USD)	60,704,646
EIRR (%)	31%
EMIRR (%)	22%
Net incremental benefits [-20%]	
ENPV (USD)	46,251,167
EIRR (%)	27%
EMIRR (%)	21%
Net incremental benefits [-30%]	
ENPV (USD)	31,797,688
EIRR (%)	24%
EMIRR (%)	19%

RCP 8.5 assumed. Analytical timeframe: 20 years, discount rate: 15%	
Aggregate Incremental Financial Part Results (sensitized)	
Net incremental inflows [-10%]	
FNPV (USD)	4,951,683
FIRR (%)	16%
MIRR (%)	16%
Net incremental inflows [-20%]	
FNPV (USD)	-3,307,023
FIRR (%)	14%
MIRR (%)	15%
Net incremental inflows [-30%]	
FNPV (USD)	-11,565,728
FIRR (%)	12%
MIRR (%)	13%
RCP 8.5 assumed. Analytical timeframe: 20 years, discount rate: 15%	
Aggregate Incremental Economic Results (sensitized)	
Net incremental benefits [-10%]	
ENPV (USD)	43,209,002
EIRR (%)	26%
EMIRR (%)	20%
Net incremental benefits [-20%]	
ENPV (USD)	30,699,483
EIRR (%)	23%
EMIRR (%)	19%
Net incremental benefits [-30%]	
ENPV (USD)	18,189,964
EIRR (%)	20%
EMIRR (%)	17%



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4.4. Stakeholders and Distributional Analysis Results

Stakeholders and distribution of benefits. In the case of the grant proposal and assessed indicative iCRAPs, it has been established that the project externalities will accrue only to the Governments of Somalia, and these externalities will arise due to tariffs on trade, taxes imposed on various project inputs and outputs, and variations in the foreign exchange. All these elements will translate into fiscal impacts that can be assessed from the estimated incremental tax flows to respective countries. The intended project beneficiaries, namely agro-pastoralists and pastoralists in the project-targeted areas, will gain through increased income due to improved land productivity; hence, higher yields in modelled crops and livestock are expected (as per financial analysis results). Table 12 below shows estimated externalities that will accrue to the Government of Somalia through taxation on trade and foreign exchange premiums.²⁴

Table 12. Distributional Analysis.

Stakeholders Analysis Results		Stakeholders Analysis Results	
RCP 2.6 assumed. Analytical timeframe: 20 years, discount rate: 15%, adoption rate 100%		RCP 8.5 assumed. Analytical timeframe: 20 years, discount rate: 15%, adoption rate 100%	
iCRAP (1)		iCRAP (1)	
ENPV (SOS)	4,542,491,248	ENPV (SOS)	4,629,714,989
ENPV (USD)	7,969,283	ENPV (USD)	8,122,307
iCRAP (2)		iCRAP (2)	
ENPV (SOS)	4,909,634,984	ENPV (SOS)	5,046,705,023
ENPV (USD)	8,613,395	ENPV (USD)	8,853,868
iCRAP (3)		iCRAP (3)	
ENPV (SOS)	2,951,307,911	ENPV (SOS)	2,627,563,928
ENPV (USD)	5,177,733	ENPV (USD)	4,609,761
iCRAP (4)		iCRAP (4)	
ENPV (SOS)	1,371,741,152	ENPV (SOS)	1,993,507,501
ENPV (USD)	2,406,563	ENPV (USD)	3,497,382
iCRAP (5)		iCRAP (5)	
ENPV (SOS)	7,800,341,369	ENPV (SOS)	7,795,596,452
ENPV (USD)	13,684,809	ENPV (USD)	13,676,485
iCRAP (6)		iCRAP (6)	
ENPV (SOS)	2,564,874,644	ENPV (SOS)	2,563,779,663
ENPV (USD)	4,499,780	ENPV (USD)	4,497,859

²⁴ Note: These estimates were calculated based on the EFA modelled from the perspective of direct beneficiaries, not on the modelling from the perspective of the entire project as the funding for this project is largely from outside of Somalia.

4.5. Other and Non-monetized Benefits.

Monetized versus non-monetized benefits. It is worth noting that the modeling in the EFA was thorough, but there were still some potential benefits that could not be priced into the analysis. While these benefits could not be quantified, they could still have a significant impact on the project's overall economic benefits. In fact, it's possible that these unquantified benefits could push the economic benefits of the project even higher than what was assessed in section 4.2 of the report. To ensure that all of the potential benefits are considered, this report also includes a discussion of several non-quantified benefits. By taking these into account, we can get a more complete picture of the potential benefits of the project.

Adaptation project. The project is considered as climate adaptation project. However, it is expected that some on farm activities proposed in the indicative iCRAPs will have additional mitigation co-benefits resulting in carbon volume reductions. However, these co-benefits were not monetized/priced in this analysis because presented models are of indicative nature.

Lowering malnutrition and potentially improving health. Lowering malnutrition and improving health are essential goals that can positively impact the lives of individuals and communities. There are various strategies that could be implemented to achieve these goals, such as improving yields, hence incomes of project beneficiaries, training on healthy eating habits, increasing access to nutritious foods, and providing education on nutrition and health. In the case of the project, it has been assessed that agro-pastoralists and pastoralists included in this project are likely to observe higher incomes. While higher incomes are not necessarily equivalent to better nutrition,²⁵ we can conclude that the project can potentially improve access to food for its direct beneficiaries through its positive impact on incomes. However, some nutrition-related information would also need to be passed to project beneficiaries through FFS to provide them with the necessary knowledge.

Improving access to water, hence potentially better sanitation. Improving access to clean water can positively impact sanitation and overall health. By providing access to clean and safe water sources, communities can reduce the spread of waterborne diseases and improve hygiene practices. This can lead to a significant improvement in the overall health of individuals and communities. Additionally, implementing strategies to improve sanitation, such as building latrines and promoting proper waste management, can contribute to better health outcomes. Overall, improving access to water and sanitation is an important goal that can have far-reaching positive impacts. The project will aid in rehabilitating water infrastructure that will positively impact agriculture. This element was modelled in the EFA. However, the potential level of sanitation and health benefits that will stem from the project's funding related to water structures was not priced due to the lack of specific data.

Providing increase in employment opportunities. Providing an increase in employment opportunities can have a positive impact on individuals and communities. Offering job opportunities can help reduce unemployment rates and increase financial stability. This can lead to a boost in the local economy as people have more disposable income to spend on goods and services. Additionally, having a job can provide a sense of purpose, pride, and fulfillment for individuals, which can contribute to better mental health outcomes. It is expected that the project during its 7 years of implementation might induce some job creation for local communities. However, these potential benefits were not priced and included in the EFA as they couldn't be modelled at the ex-ante.

Improving biodiversity status quo. Improving biodiversity is crucial for maintaining a healthy ecosystem and improving livelihoods. Biodiversity provides various essential benefits, such as pollination, nutrient cycling, and pest control. However, human activities such as deforestation, unsustainable resource use, and anthropogenic influence on climate change have led to a decline in biodiversity, which can negatively impact the environment and human well-being. While it is expected that the activities undertaken under the project, like helping manage invasive species, diminishing soil damage, better landscape management, etc., will positively impact the agriculture production of intended beneficiaries, the additional fauna nor flora-related benefits were neither priced nor included in the quantitative analysis. The methodologies for valuation of such benefits are still highly inaccurate and developing

²⁵ With a caveat that can be concluded from issues observed in developed countries where higher incomes did not necessarily improve the population's health (e.g., obesity issues in the US, etc.).

credible modeling for pricing the positive effects of the project on Somalia's fauna and flora couldn't be pursued at this time. However, it is expected that this effect will be positive.

5. Analytical Limitations

Factors that could interfere with the EFA results. It's crucial to understand that while several elements might interfere with the presented EFA results, they are beyond the scope of this analysis.

The first potential problem is the choice of WP scenarios for the analysis. It's important to note that the appraised iCRAP scenarios are INDICATIVE, meaning they may not capture all potential village-specific modalities and differences possible in preselected agroecological zones. However, a meticulous level of analytical thoroughness was undertaken to ensure that these indicative scenarios were as realistic and representative as possible. The nature of this type of analysis (ex-ante EFA) inherently includes some levels of uncertainty, which will be verified and adjusted as the process progresses to the observed status quo.

It is also important to acknowledge that Somalia is exposed to non-climate or weather-related risks, such as the potential risk of escalatory internal unrest or conflict. However, it's reassuring to note that agricultural production has persisted despite the relatively frequent occurrence of such hazards in the past. Somali farmers' resilience and ability to adapt and incorporate risk factors into their on-farm management decisions is a testament to their intelligence and resourcefulness, which can be a source of confidence for investors and stakeholders.

Lastly, the re-occurrence of a pandemic like COVID-19 and its effects on the global economy, mainly Somalia's, are all equally hard to predict. These elements were not modelled into this EFA.

6. Conclusions

EFA results and recommendations. Based on the ex-ante EFA results for the FP project, all proposed indicative interventions are poised to ignite a positive transformation in Somalia's economy. This is particularly encouraging for small-scale farmers, including agro-pastoralists and pastoralists transitioning to agro-pastoral activities, as they stand to benefit significantly.

The comprehensive analysis conducted at both the individual and project levels leaves no room for doubt about the financial profitability and economic sustainability of the project. The individual-level modelling vividly illustrates how the project interventions will translate into increased yields and incomes for the targeted households, providing a tangible reassurance of the project's positive impact. Similarly, the project-level modelling demonstrates that the project will generate positive incremental financial and economic NPVs and IRRs.

Furthermore, the project is expected to impact Somalia's economy positively. For instance, agro-pastoralists and pastoralists' increased productivity and incomes will increase animal forage availability, leading to increased economic activity and improved livelihoods.

The distributive analysis also shows that the Government of Somalia will likely benefit from proposed interventions in the form of tax revenue from tariffs and foreign exchange premiums. This is good news as additional income can help the GoS use this money for public expenditures, and if this money is spent optimally, it can benefit the entire national economy.

Therefore, based on the detailed analysis and findings, it is strongly recommended that the project be pursued as a worthwhile investment. It has the potential to deliver significant benefits to agro-pastoralists and pastoralists and the entire Somali economy.

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