Economic Analysis

A. Introduction

1. The objective of this program is to build and scale up the resilience and adaptive capacity of smallholder farmers and rural communities of seven Sahelian Least Developed Countries (LDCs) to climate change using an **Integrated Climate Risk Management Approach**. The program seeks to upgrade, strengthen, scale-up, and replicate current fragmented climate risk management practices by introducing a combination of climate risk preparedness, climate risk reduction (adaptation and mitigation), and climate risk transfer through micro-insurance and macro insurance. The main targeted crops are key staple crops (millet, maize, sorghum, groundnuts) and livestock (cash-asset).
2. The regional program is organized into three mutually reinforcing components:
    - Component 1. Climate risk preparedness: This component will aim to foster a better understanding of the risks of climate change by building national capacity and systems to generate, interpret, and deliver tailored, robust climate evidence – information on climate risks and vulnerabilities for local communities and decision-makers. It will also support the development of functional and sustained early warning systems, agro-climate services for more efficient and cost-effective anticipatory responses.
    - Component 2. Climate risk reduction measures and options (adaptation and mitigation): This component aims to strengthen climate change adaptation measures, increase climate-resilient and low emission investments in smallholder agriculture value chains and food systems, through a better adoption and implementation of climate adaptation and mitigation best practices and solutions.
    - Component 3. Climate risk transfer (micro and sovereign risk transfer mechanism): This component will support countries and smallholder farmers to address the residual risks of climate change on smallholder farmers through the use of risk transfer instruments to national and international insurance markets with timely compensation to weather-related shocks (dry spells or drought), to prevent the use of negative coping strategies (selling of animals and assets, migration, competition over resources and conflicts) in the event of climate disasters.
3. The interventions are designed to strengthen the resilience of vulnerable households and governments in Burkina Faso, Chad, Mali, Mauritania, Niger, Senegal, The Gambia.

4. The economic feasibility of the project was determined using funds flow from small-scale farmers who will benefit from the project. The economic cost-benefit analysis was carried out to assess the impact of the project on society's welfare.
5. Discounted fund flows period is assumed to be 16 years,[1] and benefits such as institutional capacity improvement and knowledge on insurance and tackling climate change impacts are not captured.

B. Identifying the Costs and benefits of project intervention

6. The agricultural sector across Sahelian countries continues to be marked by low productivity due to structural issues such as low soil fertility, lack of technology and capacity, and failure to adopt land reform (reference), but also because of high vulnerability to climate and climate-related risks. These risks include: (i) high dependence on rainwater, which is the sole water source for a vast majority of smallholder farms and is limited to a short wet season in many countries; (ii) high inter-annual climate variability that drives a significant year to year changes in rainfall and temperature; (iii) recurrence of natural disasters and extreme weather events, including floods and droughts, locust outbreaks, livestock, and crop diseases and pests, which all reduce productivity levels; (iv) fluctuations in the agricultural market for both inputs and outputs; and (v) limited disaster management policies in support of agriculture. The combination of these risks results in lower yields, loss of productive assets, loss of income, loss of productivity, increased costs, and changes in taxes and market access (IFAD, 2018). These can affect a farmer's ability to repay financial obligations and lead to a loan default. These financial shocks, combined with an inability to access external financing easily, limit farmers' abilities to expand, diversify, and modernize their agriculture activities and therefore increase their climate resilience. When natural disasters occur, governments tend to alleviate the effects of crop failures or other hazards by providing post-disaster direct compensation as a relief measure, which does not address the underlying problem, and may even exacerbate it (e.g., increase dependency; FAO,2018). The weakness or absence of the agricultural insurance industry constrains farmer's resilience to climate risks.

7. Three additive benefits with the project are estimated in this analysis. Increased productivity due to better climate risk preparedness, additional

[1] The lifespan of the project can be extended beyod 16 years given the soft nature of the investments. However, to be conservative, we choose the lifespan of typical early warning system for the purpse of the economic anlysis.

productivity and income due to risk transfer through micro and macro insurance schemes and mitigation co-benefit of reduced emissions due to minigrids for irrigation.

Table: Productivity of major crops under BAU and bundle package

Crops yields	BAU- in a regular rainy season	Bundle- Package
Millet	827 kg/ ha	3700kg /ha
Maize	1369 kg/ha	4500 kg/ ha
Sorghum	880 kg/ha	4000kg/ha
Groundnuts	946 kg/ha	4300kg/ha
Livestock	Meat: 48-50 kg Milk : 2,230 l/day	Meat: 75 kg Milk: 5-8 l/day

Source: (IFAD PADAER- PAFA -E,2017- FAO , 2018)

8. The interventions from this project are expected to lead to improved farmer productivity and compensation for crop losses during drought. In the absence of data on crop losses, this analysis uses agricultural productivity increase and the benefit of the investment. The major components of the project on climate risk preparedness and climate risk reduction measures are expected to increase productivity. Also, the potential for climate risk transfer increases private sector involvement and ultimately value-added from the agriculture sector. Examples with CNASS Senegal is a good case provide in the project proposal and feasibility.

9. Using data from the World Bank's World Development Indicator, we calculate the average per capita value added of agriculture (Agriculture, forestry, and fishing, value-added per worker (constant 2010 US$)) across the seven countries and multiplied by the lower bound of direct beneficiaries in the countries (817,922 households from current IFAD projects). The average value-added estimate between 2008 and 2018 is used for all the countries estimated at $10,690 per farmer.

Countries	Average Agriculture per capita value added (2008-2018)
Burkina Faso	$ 1,472
Chad	$ 1,467
The Gambia, The	$ 2,333
Mali	$ 1,062

Mauritania	$ 1,740
Niger	$ 481
Senegal	$ 2,136
Total Aggregate Average	$ 10,690

Source: Author's calculation using the World Development Indicator

10. We also assume a conservative 0.5 percent increase in agricultural value added. The conservative benefit of the project is similar to estimates used to appraise investments in early warning systems in Africa by the World Bank and United Nations Development Programme.[2]

11. The project is expected to install 492 minigrids generating a total of 49,200 kWp installed capacity at 100 kWp capacity/minirid for irrigation and agricultural services. The baseline emissions are calculated based on the fuel consumption of the technology in use or that would have been used to generate the equivalent quantity of energy in the absence of the project activity, using the following option.

[2] A study by Hallegatte (2012), was used to develop estimates of the benefits and costs of improving met/hydro information and early warning systems in developing countries. The study determined that in Europe, weather forecasts have led to value-added gains of between 0.1 percent and 1.0 percent in weather-sensitive sectors. However, Hallegatte's estimation does not include avoided losses, only productivity gains.

Calculation of Emission Reductions				
Year	Estimation of baseline emissions	Estimation of project activity emissions	Estimation of leakage	Estimation of overall emission reductions
	(tCO_2e)	(tCO_2e)	(tCO_2e)	(tCO_2e)
Year 1	57,466	0	0	57,466
Year 2	56,891	0	0	56,891
Year 3	56,316	0	0	56,316
Year 4	55,742	0	0	55,742
Year 5	55,167	0	0	55,167
Year 6	54,592	0	0	54,592
Year 7	54,018	0	0	54,018
Year 8	53,443	0	0	53,443
Year 9	52,868	0	0	52,868
Year 10	52,294	0	0	52,294
Year 11	51,719	0	0	51,719
Year 12	51,144	0	0	51,144
Year 13	50,570	0	0	50,570
Year 14	49,995	0	0	49,995
Year 15	49,420	0	0	49,420
Year 16	48,846	0	0	48,846
Year 17	48,271	0	0	48,271
Year 18	47,696	0	0	47,696
Year 19	47,122	0	0	47,122
Year 20	46,547	0	0	46,547
Year 21	45,972	0	0	45,972
Year 22	45,398	0	0	45,398
Year 23	44,823	0	0	44,823
Year 24	44,249	0	0	44,249
Year 25	43,674	0	0	43,674
Total (tCO_2e)	1,264,243	0	0	1,264,243

Source: Emission Reductions Calculation Spread Sheet

12. We assume a carbon price of 5 US$/tCO$_2$e. The nominal prices as of April 1, 2020 published by World Bank (2020) shows the price varying from less than 1 US$/tCO$_2$e to about 119 US$/tCO$_2$e with almost half of the covered emissions priced at less than US$10/tCO2e. South Africa's estimate of 7 US$/tCO$_2$e is the closest to the Sahel countries covered in this project and to be conservative a price of 5 US$/tCO$_2$e is assumed at a growth rate of 2.5% p.a.
13. Given that this project will primarily provide support to farmers, there is no specific O&M plan. We, however, assumed 3% of the cost of the investment for the O&M plan.

Other significant benefits not quantified:

14. Other benefits not quantified include benefits on carbon emissions reduction from agriculture. These measures are based on changes in behavior of the farmers and the value may range significantly. Example include:
    - Land use changes through land restoration:

  - Promotion of agroforestry techniques on degraded land: building parkland via assisted natural regeneration, planting hedgerows around horticulture plots
  - Restoring pasture on degraded land
  - Restoring degraded land to convert it into cropland (cereals, sorghum and millet) through the promotion of planting pits and half-moons with organic manure and micro-dosing of urea
- Sustainable management and enrichment of dry Sahelian forests and shrubland having an extremely degraded initial stage (80 % of biomass lost).
- Progressive sequestration of carbon through perennial species introduced by agroforestry techniques

15. Other benefits include strengthened capacity, and the multiplier effect of the interventions could be access to credit from MFIs. Some MFIs are more confident to provide loans when farmers are de-risked with a package of measures. During the design, some MFIs states that they could lower doing their loans if such measures are in place by 1 to 3 %.
16. Farmers and decision-makers engaging in climate risk preparedness (component 1), will be able to understand climate risks better and tailored agro-climatic information services including advisories on how to transfer disaster risk further (component 3), increase productivity and capacity to cope with climate change and variability (component 2). By increasing their understanding and ability to prepare and manage risk, farmers will also be able to access weather index insurance and receive compensation in case of drought/dry spells from public and private insurance companies (Component 3). To ensure that increased productivity translates into increased food security and incomes, farmers will also benefit from expanded access to markets (component 2) by decreasing post-harvest losses, enhancing the quality of product to marketable level, climate-resilient storage and roads, and further investing in climate-resilient practices, technologies, and inputs along the selected agricultural value chains.

C. Methodology and Parameter Assumptions

17. The economic analysis is based on the following additional assumptions about the project and economic conditions:
    - Significant benefits generally won't accrue the first three years of the project. Given the soft nature of the interventions, benefits can accrue starting from the fourth year.

- The Take-up rate of the grant is assumed to be 100% with the assumption that there will be enough beneficiaries recruited to meet the target.

D. Costs and Benefits

18. The total economic cost of the project amounts to USD 143.4 million, including co-financing from IFAD, AFDB, African Risk Capacity (ARC), and the governments from the seven countries. The cost excludes the operating and maintenance costs for the interventions over the lifetime of the project.
19. The cost-benefit analysis shows that with a 10 percent discount rate, the discounted net present value of the project is valued at about 122.3 million USD. The Economic Internal Rate of Return (EIRR) is 29%, which exceeds the discount rate of 10%.
20. Though the internal rate of return is 29% for the base case, there are other benefits not captured in this analysis highlighted previously. Benefits estimated in this analysis provide a lower bound on the value of the project.
21. Three sensitivity test cases are examined: (i) total cost increased by 20%; and (ii) total benefits decreased by 20%, and (iii) total cost increased by 20%, and total benefits simultaneously reduced by 20%. In all cases, the project remains economically feasible, and EIRR remains above the minimum threshold. The results are presented below.

Table 1: Net present value (million USD) and Economic Internal Rate of Return (EIRR)

	NPV	EIRR
Base case	$123.02M	29%
Cost +20%	$100.83M	24%
Benefits – 20%	$76.22M	22%
Cost +20% and benefit -20%	$54.03M	18%

Financial Analysis

E. Approach and Methodology

22. Unlike economic analysis, financial analysis is ONLY conducted on proposed project outputs and activities that have direct quantifiable financial revenue generation or cost saving potential to project beneficiaires. Implied or avoided cost-benefits are typically not considered for financial analysis
23. As indicated in the main proposal document, this project plans activities and outputs under 3 main components as shown in the Table below.

Table – Proposed Project Components and Outputs

Components and Outputs		Direct quantifiable financial savings / revenues?
Component 1: Climate Risk Preparedness		**No**
Output 1.1	Increased access to agro-climatic information services and early warning infrastructure to support integrated climate risks management	No
Output 1.2	Awareness raising, capacity building and institutional development on integrated climate risks management.	No
Component 2: Development of population resilience		**Yes**
Output 2.1	Best available technologies, adaptation/mitigation practices adopted and implemented with agricultural insurance schemes	Yes
Output 2.2	Diversified livelihood through the promotion of income generating activities	Yes
Component 3. Risk transfer		**No**
Output 3.1	Access to micro insurance	No
Output 3.2	Sovereign risk transfer mechanism (macro-insurance)	No
Output 4: Programme management and coordination.		**No**

24. This financial analysis has been carried out in accordance with the Guidelines for the Financial Analysis of Projects followed by IFAD/UNDP/other international development agencies. These guidelines

clearly mandate that a financial analysis of project cash flows be computed and Financial Internal Rate of Return (FIRR) calculated only for those proposed project activities or outputs that can clearly result in direct and quantifiable financial revenue generation (incremental earnings from baseline) or a direct and quantifiable financial savings potential to the project owners or to the project beneficiaries. These guidelines stand to ensure that GCF's minimum concession policy is always protected in the proposal.

25. In all, there are 4 components and 8 outputs that constitute this proposed project. However, as can be seen from Table 1 above, only outputs 2.1 and 2.2 under Component 2 have the potential to result in direct and quantifiable earnings or direct and quantifiable savings to the project beneficiaries.

26. All other outputs (including insurance/risk transfer activities under Component 3) of this proposed project result only in avoided-cost benefits or non-attributable savings that are of public good in nature to the larger community of at-risk population in this project's target countries, and these benefits have been assessed and evaluated under 'economic analysis' section of this annex. Hence, a financial modeling-based analysis has not been conducted and an FIRR has not been calculated for proposed outputs under Components 1, 3 and 4.

27. However, considering the GCF's minimum concession policy, this project's proposed outputs under Components 1, 3, 4 have been analyzed from a macro-economic and government perspective to assess the need for a GCF grant as the only feasible financial instrument to fund the project's proposed activities.

F. Financial Analysis of Component 2 Outputs

28. The interventions are designed to strengthen the resilience of vulnerable households and governments in Burkina Faso, Chad, Mali, Mauritania, Niger, Senegal, The Gambia.
29. Financial analysis of proposed outputs under Component 2 (i) best available technologies, adaptation/mitigation practices adopted and implemented with agricultural insurance schemes and (ii) diversified livelihood through the promotion of income generating activities was determined using a broad estimation of incremental revenue via

agriculturs l value-add to beneficiary smallholder farmers who will benefit from the project.

30. Discounted cashflows period is assumed to be 16 years.[3] (same as economic analysis)

31. Using data from the World Bank's World Development Indicators (WDI), we calculate the average per capita value added of agriculture (Agriculture, forestry, and fishing, value-added per worker (constant 2010 US$)) across the seven countries and multiplied by the lower bound of beneficiaries in the countries (817,922 households from current IFAD projects). The average value-added estimate between 2008 and 2018 is used for all the countries estimated at $10,690 per beneficiary farmer.

Countries	**Average Agriculture per capita value added (2008-2018)**
Burkina Faso	$ 1,472
Chad	$ 1,467
The Gambia, The	$ 2,333
Mali	$ 1,062
Mauritania	$ 1,740
Niger	$ 481
Senegal	$ 2,136
Total Aggregate Average	$ 10,690

Source: Author's calculation using the World Development Indicator

32. We also assume a conservative 0.2% increase in agricultural value added due to Component 2 interventions alone (without estimating other benefits considered under economic analysis where 0.5% increment was estimated). The conservative benefit of the project is similar to estimates used to appraise investments in climate change mitigation/adaptation interventions for smallholder farmers in Africa by the World Bank and United Nations Development Programme.

33. Agricultural value-add (incremental revenues) are also incremented conservatively by 2% per annum for all countries (conservative estimates)

[3] The lifespan of the project can be extended beyod 16 years given the soft nature of the investments. However, to be conservative, we choose the lifespan of typical early warning system for the purpse of the economic anlysis.

unlike under economic analysis that considers value added at constant prices.

34. Given that this project will primarily provide support to farmers, there is no specific O&M plan. We, however, assumed 3% of the cost of the investment for the O&M plan.

G. Cost of Capital/Hurdle Rate and Other Assumptions

35. Financial analysis is based on the following additional assumptions about the project and economic conditions:
    - Significant benefits generally won't accrue the first three years of the project. Given the soft nature of the interventions, benefits can accrue starting from the fourth year.
    - The Take-up rate of the grant is assumed to be 100% with the assumption that there will be enough beneficiaries recruited to meet the target.
    - Cost of capital (also considered hurdle rate for FIRR) is considered to be 15%. This is typically the interest rate at which smallholder farmers are able to borrow from commercial banks/lenders in countries such as Niger (as per IFAD approved GCF project titled 'SAP012: Inclusive Green Financing for Climate Resilient and Low Emission Smallholder Agriculture')

H. Financial Analysis Results of Component 2 Outputs

36. The total financial cost of component 2 of the proposed project amounts to USD 53.5 million, including co-financing from IFAD, AFDB, African Risk Capacity (ARC), and the governments from the seven countries. The cost excludes the operating and maintenance costs for the interventions over the lifetime of the project.
37. Financial analysis shows that with a 15% hurdle rate, the discounted Financial Net Present Value (FNPV) in the base case is valued at about $34.5 Million. Financial Internal Rate of Return (FIRR) is 34%, which exceeds the hurdle rate of 15%.
38. Three sensitivity test cases are examined: (i) total cost increased by 20%; and (ii) total financial revenues decreased by 20%, and (iii) total cost increased by 20%, and total financial revenues simultaneously reduced by 20%. In all cases, the project remains financially feasible, and FIRR remains above the minimum threshold. The results are presented below.

Table: Sensitivity Analysis of Financial Net Present Value (million USD) and Financial Internal Rate of Return (EIRR)

	FNPV	**FIRR**	**Hurdle Rate**
Base case	$34.49M	34%	15%
Cost +20%	$27.41M	28%	15%
Benefits – 20%	$20.52M	27%	15%
Cost +20% and benefit -20%	$13.44M	22%	15%

I. Financial Analysis of Other Component Outputs

39. **Nature of Benefits warrant grant instruments** – The proposed activities under this project aim to install hard infrastructure, technology infrastructure raise awareness, build capacities, cover risks, diversify livelihoods and assessment methodologies that generate benefits which are of public-good in nature, such as model / information led decision making, protection of larger agricultural areas and other properties, and better planning and prioritization of agricultural livelihoods. Public-good nature of benefits will also be generated from Component 1 which focuses on improving capacities of decision makers and institutions and improving policies and regulations. Therefore, none of these outputs will generate any "directly identifiable, attributable and quantifiable" incremental financial revenues or produce any "directly identifiable, attributable and quantifiable" tangible financial cost recovery/savings of resources to either the project owner (Governments of Sahel region coutries) or to the project beneficiaries during and after implementation of the proposed project. Due to this larger public-good nature of the benefits derived from this proposal, repayment of any kind of loan from the project benefits is not feasible. For this reason, even a concessional loan with 0% interest rate cannot be repaid and hence grants are the ideal instruments to finance the proposed activities of this project.

40. **GCF involvement is critical for this proposal** since there is an overwhelming evidence of climate change being the only factor behind the increasing frequency and severity of extreme climate-related impact on smallholder farmer livelihoods in target Sahel region countries. While some private commercial lenders, investors, and DFIs such as IFAD, ARC, AfDB and WFP are participating in this project which recover some of their

financial costs, these returns will come at a cost of additional burden on the already vulnerable target communities in the absence of GCF grants. But the provision of these support and services to smallholder farmers is considered to be basic and essential responsibility of governments in the region, to ensure climate resilience and food security in an otherwise highly vulnerable region. All governments in the proposed project have expressed their financial commitments to the project; however, the existing public finance/fiscal situation does not enable these governments to fully fund costs of this proposed project.

41. In addition, governments in the Sahel region have limited track record of financing climate resilient and food-secure smallholder farmer interventions. Most of the existing programs are focused on post-event recovery only which are neither based on integrated approaches as discussed in the activities above, nor do they model systemic, transformational changes to combat climate change. Hence, given its mandate for enhancing resilience of vulnerable communities to climate change, GCF is best positioned to reduce/close the existing financing and knowledge gaps and barriers to improved resilience of smalllholder farmers of Sahel region to climate change induced hazards.

42. **Vulnerable target population that cannot pay for climate services –** Target countries in this project in the Sahel region consist of poor and vulnerable smallholder farmer populations with high levels of poverty and low-levels of Human Development Index (HDI) and income levels.

Countries	**HDI (2018)**	**HDI Rank (2018) Out of 189 Countries**	**National Poverty Rate (World Bank Data)**
Burkina Faso	0.423	183	41.4% (2018)
Chad	0.404	186	42.3% (2018)
The Gambia	0.460	174	48.6% (2015)
Mali	0.427	182	42.1% (2019)

Mauritania	0.520	159	31.0% (2014)
Niger	0.354	189	40.8% (2018)
Senegal	0.505	164	46.7% (2011)

43. **Impact of Covid-19 Necessitates Need for GCF Grants** – According to a paper by the International Institute of Strategic Studies (IISS) published in June 2020,[4] COVID-19 could compound an already-dire humanitarian situation in the Sahel by exposing up to 50 million more people to food insecurity. Because the informal economy provides most of the employment in the region, it should be better protected against shocks such as the disruption caused by COVID-19. Despite the financial contributions European and other non-African nations have made to the efforts to combat COVID-19 in the Sahel, these are deemed insufficient for now, and hence, governments in the region require additional financial and technical support to combat climate change and increase food security in the age of Covid19.

44. **Fiscal and Debt Constraints of Governments in Sahel region:** Fiscal deficits and debt-to-GDP ratios of governments in Sahel region are high, which limit their ability to finance transformative investments to combat the impact of climate change on smallholder farmers.

Countries	**Fiscal Deficit as % of GDP**	**Debt-to-GDP Ratio (%) – IMF Data**
Burkina Faso	-5.3% (2017)	38.3% (2017)
Chad	-3.5% (2017)	52.5% (2017)
The Gambia	-17.6% (2017)	123.2% (2017)
Mali	-3.4% (2017)	35.5% (2017)
Mauritania	-1.1% (2017)	91.1% (2017)
Niger	-4.4% (2017)	46.5% (2017)
Senegal	-3.8% (2017)	61.2% (2017)

[4] IISS paper "Covid19: Implications for the Sahel", June 2020

J. Recommendations and Conclusion –

45. In all there are 4 components and 8 outputs that constitute this proposed project. However, except for proposed outputs under Component 2, none of the other Component outputs clearly result in direct and quantifiable earnings or direct and quantifiable savings to the project owners or the project beneficiaries. It is only pertinent to mention here that all the activities and outputs of this proposed project result only in non-attributable savings that are of public good in nature to the larger community of the at-risk population in target countries of Sahel region. Hence, a financial modeling-based analysis has been conducted and an FIRR/FNPV has been calculated only for proposed outputs under Component 2.
46. Financial analysis shows that with a 15% hurdle rate, the discounted Financial Net Present Value (FNPV) in the base case is valued at about $34.5 Million. Financial Internal Rate of Return (FIRR) is 34%, which exceeds the hurdle rate of 15%.
47. Three sensitivity test cases are examined: (i) total cost increased by 20%; and (ii) total financial revenues decreased by 20%, and (iii) total cost increased by 20%, and total financial revenues simultaneously reduced by 20%. In all cases, the project remains financially feasible, and FIRR remains above the minimum threshold.
48. Considering the GCF's minimum concession policy, this project's proposed outputs under other components have been analysed from a macro-economic and government perspective to assess the need for GCF grant as the only feasible financial instrument to fund the project activities. Hence, taking into consideration the factors such as the public good nature of benefits arising out of the project, climate change being the key driver, economic, geographic and demographic distribution of the target population, impact of COVID-19, current economic situation and persistent fiscal risks in Sahel region countries, and the catalytic nature of GCF grants, we recommend the following –

- There is significant co-financing from Governments of target countries in Sahel region, apart from IFAD, AfDB, ARC and WFP and there is no incremental ability to stretch their contributions owing to budgetary and fiscal consolidation reasons.
- The nature of the benefits does not accommodate repayment of capital in whatever form or serviceability of a loan instrument.

- Increase in government spending to address COVID-19 pandemic has strained/will continue to strain public finances and magnify developmental and climate change challenges in Sahel region
- Hence, it is recommended that in order to reduce / close the existing financing and knowledge gaps and barriers to improve resilience of smallholder population in Sahel regionto climate change-induced impact, catalytic capital in the form of GCF grants are essential.

Reference:

1. Hallegatte, S. (2012). *A cost effective solution to reduce disaster losses in developing countries: hydro-meteorological services, early warning, and evacuation*. The World Bank.

2. IFAD GCF Proposal "SAP012: Inclusive Green Financing for Climate Resilient and Low Emission Smallholder Agriculture"; Niger, December 2019