Economic and financial analysis of the investments proposed

Table of contents

Economic and financial analysis of the investments proposed 1

1. Overview of the Economic and Financial assessment 4

2. Economic and Financial analysis of Component 1 Output 1.1 6

2.1. Assumptions 7

2.1.1. Costs, benefits, and avoided costs 7

2.1.2. Income Tax 12

2.1.3. Avoided costs, carbon sequestration 13

2.2. Scenario GCF Contribution - Results: aggregate value chains performance 15

2.2.1. VC1-Sustainable Tree crop (Cashew) 16

2.2.2. VC2-Sustainable Cassava 18

2.2.3. VC3-Sustainable cereal production (Groundnut) 20

2.2.4. VC4-Sustainable livestock Cattle 22

2.2.5. VC5-Sustainable tree crop (Mango) 24

2.2.6. VC6-Sustainable cereal production (Millet) 26

2.2.7. VC7-Sustainable poultry production (broiler) 28

2.2.8. VC8-Sustainable cereal production (Rice) 30

2.2.9. VC9-Sustainable Tree Crop production (Shea) 32

2.2.10. VC10-Sustainable Horticulture (Tomato) 34

2.3. Scenario GCF Contribution - Results: country performance 36

2.3.1. Burkina Faso 37

2.3.2. Ghana 39

2.3.3. Ivory Coast 41

2.3.4. Mali 43

2.3.5. Senegal 45

2.4. Results: portfolio analysis 47

2.4.1. Burkina Faso 47

2.4.2. Ghana 49

2.4.3. Ivory Coast 50

2.4.4. Mali 51

2.4.5. Senegal 52

2.5. Estimating GCF contribution 53

2.5.1. Burkina Faso 54

2.5.2. Ghana 55

2.5.3. Ivory Coast 56

2.5.4. Mali 57

2.5.5. Senegal 58

2.6. Sensitivity analysis 59

2.6.1. VC1-Sustainable Tree crop (Cashew) 59

2.6.2. VC2-Sustainable Cassava 59

2.6.3. VC3-Sustainable cereal production (Groundnut) 60
2.6.4. VC4-Sustainable livestock Cattle 60
2.6.5. VC5-Sustainable tree crop (Mango) 61
2.6.6. VC6-Sustainable cereal production (Millet) 61
2.6.7. VC7-Poultry Adapted Breeds 62
2.6.8. VC8-Sustainable cereal production (Rice) 62
2.6.9. VC9-Sustainable Tree Crop production (Shea) 63
2.6.10. VC10-Sustainable Horticulture (Tomato) 63

Annex 1: documentation of models and assumptions 64

Sustainable Tree crop (Cashew) 64

Sustainable Cassava 64

Sustainable Groundnut Production 65

Sustainable livestock Cattle 65

Sustainable Tree crop (Mango) 66

Sustainable cereal production (Millet) 66

Poultry Adapted Breed 66

Sustainable cereal production (Rice) 67

Sustainable Tree crop (Shea) 67

Sustainable Horticulture (tomato) 67

Annex 2: Portfolio Composition 69

Burkina Faso 69

Ghana 70

Ivory Coast 71

Mali 72

Senegal 74

Annex 3: Analysis with 5$ Carbon price 79

2.7. Scenario GCF Contribution - Results: aggregate value chains performance 80
2.7.1. VC1-Sustainable Tree crop (Cashew) 80
2.7.2. VC2-Sustainable Cassava 81
2.7.3. VC3-Sustainable cereal production (Groundnut) 82
2.7.4. VC4-Sustainable livestock Cattle 83
2.7.5. VC5-Sustainable tree crop (Mango) 84
2.7.6. VC6-Sustainable cereal production (Millet) 85
2.7.7. VC7-Sustainable poultry production (broiler) 86
2.7.8. VC8-Sustainable cereal production (Rice) 87
2.7.9. VC9-Sustainable Tree Crop production (Shea) 88
2.7.10. VC10-Sustainable Horticulture (Tomato) 89

2.8. Scenario GCF Contribution - Results: country performance 90
2.8.1. Burkina Faso 90
2.8.2. Ghana 92
2.8.3. Ivory Coast 94

2.8.4. Mali 96
2.8.5. Senegal 98

2.9. Results: portfolio analysis 100
2.9.1. Burkina Faso 100
2.9.2. Ghana 101
2.9.3. Ivory Coast 102
2.9.4. Mali 103
2.9.5. Senegal 104

2.10. Estimating GCF contribution 105
2.10.1. Burkina Faso 106
2.10.2. Ghana 107
2.10.3. Ivory Coast 108
2.10.4. Mali 109
2.10.5. Senegal 110

Bibliography* *111

1. Overview of the Economic and Financial assessment

We have carried out two assessments for the investments proposed: one economic and one financial.

- The economic assessment, presented in the form of a Cost Benefit Analysis (CBA), is broad in nature, as it includes indicators that are relevant to the projects (e.g. investment, O&M costs, revenue creation) as well as to society, even if these are not directly connected to the investment and its performance (e.g., reduction of air emissions and water pollution). For this assessment, we considered just one item (hectare or animal), and the lifetime of the investment, which varies from 1 to 20 years.
- The financial assessment (PFA), which typically focuses on project outputs and activities that have direct quantifiable financial revenue generation or cost saving potential to project beneficiaries. Implied or avoided costs and benefits for other economic actors are typically not considered in the financial analysis. For this assessment, we considered all the items (hectares or animals) that are impacted by the investments.

The main difference between the economic and financial analysis is the addition of the cost of financing to the latter. The assessment includes the calculation of the financial Internal Rate of Return (IRR), Net-Present Value (NPV), and Benefit-to-Cost Ratio (BCR) of selected investment options within component 1.1 of the project.

Ten Value Chains (VCs) have been analyzed, considering the implementation of one or more Climate Resilient and Low Emission Agriculture (CRLEA) practices and technologies. This analysis should be interpreted as indicative of the likely impact of the project as designed but may in fact differ from the actual impacts of implementation over the next 6 years, if different CRLEA are chosen and implemented.

Also, we have assessed the performance of the investment at three levels of aggregation. We have considered (a) specific VCs (presented in Annex 1), (b) we have aggregated the assessment considering the investment in each area and in each country, and (c) we have assessed the net contribution of the project for three different beneficiaries: farmers organizations, SMEs, and cooperatives

a) This assessment is needed both to support items (b) and (c) as well as to support an ex-post evaluation of the project. This is needed because it is not possible to know with certainty what investment will be supported by the project during its implementation. As a result, a technology-specific or production practice-specific assessment allows to, at a later stage, create a portfolio that accurately reflects the type of loans approved and hence investment implemented.

b) This assessment is needed to estimate the likely performance of the project, as described in the project proposal. It is useful to determine if GCF contribution is needed and where, and the extent to which the creation of net benefits can be expected in each of the areas of investment and country. This assessment provided a country level estimate of the IRR, NPV, Benefit to Cost Ratio and more.

c) This assessment is needed because it allows determining the value addition of the project in relation to each beneficiary, where each VCs contributes by a certain degree. With this assessment, we can determine the extent to which the investments implemented lead to benefits, including avoided costs, and provide value on top of it, contributing to local sustainable development.

Of all the investments envisaged by the project, the analysis presented in this annex covers only component 1.1. As shown in Table 1, this project assesses activities and outputs under one main component: "*Innovative*

Financing Mechanism to foster the best adaptation practices and use of renewable energy along agricultural value chains".

Components and Outputs		Direct quantifiable financial savings / revenues?
Component 1. Innovative Financing Mechanism to foster the best adaptation practices and use of renewable energy along agricultural value chains.		**Yes**
Output 1.1	Established Financing Facility within agricultural banks with a line of credit to support concessional loans by FO, MSMEs cooperatives, commercial banks to adopt the best adaptation practices along agricultural value chains to increased yields for agricultural produce in the face of increasing droughts.	Yes
Output 1.2	Established revolving fund within the selected banks which provides concessional loans to FO, MSMEs cooperatives, commercial banks and solar operators with RETs to power the selected agricultural value chains	No
Output 1.3	Two revolving funds set up (Activity 1.1.1 and Activity 1.2.1)	No
Component 2: Capacity-building and technical assistance for FOs, cooperatives, MSMEs and Agriculture Banks		**No**
Output 2.1	Strengthened capacity and business planning for FOs and or cooperatives, MSMEs including solar operators (disaggregated by gender and Youth), to design business plans and access green lines products from agricultural banks and other MFIs and commercial banks and implement diversified, climate-resilient livelihood options	No
Output 2.2	Capacity building on green bankable Business Plan development	No
Output 2.3	Improved policy dialogue, government technical and institutional capacity, advocacy, training, knowledge management, information dissemination and stakeholder management	No
Output 2.4	Established SAHEL AWARD	No
Component 3. GCF/GGW Umbrella Programme Coordination		**No**
Output 3.1	Enhanced knowledge management and exchanges	No
Output 3.2	Innovation and digital transformation technologies	No
	Regional Support Program Governance	No
Program management and coordination.		**No**

Table 1: components and outputs of the project.

2. Economic and Financial analysis of Component 1 Output 1.1

An integrated Cost-Benefit Analysis (CBA) and a Project Finance Assessment (PFA) of ten Value Chains (VCs), for which we have analyzed the implementation of one or more CRLEA, were carried out to assess the extent to which CRLEA investments to be implemented in five countries, Burkina Faso, Ghana, Ivory Coast, Mali and Senegal are economically viable. Starting from the assumption of 1 ha of land being subject to the implementation of the investment, we have then customized the models to analyze the outcomes of the total investments by country, for each VC, and for three potential beneficiaries (farmers organizations – FOs -, MSME and cooperatives).

CBA is a "pre-investment tool" that can facilitate investment decisions (IFAD, 2015a). Since costs and benefits of investments often do not occur at the same time, with costs usually preceding benefits, the comparison is not straightforward, especially in the agricultural sector. The CBA can provide solid indicators to support decision-making as well as suggesting the best alternatives for different stakeholders, allowing to compare projects with one another using the same underlying framework of analysis.

In order to capture the full range of outcomes generated by a CRLEA investment, we have expanded the boundaries of traditional CBAs, going beyond direct costs and benefits. In fact, the CBAs presented in this study can be considered "integrated" or "extended" in that they also include an economic valuation of indirect and induced project outcomes, often labeled as "externalities". The CBA, therefore, includes project investments and operation and maintenance cost, resulting in avoided costs from the implementation of the project (e.g. increased carbon sequestration) as well as added benefits (e.g. additional indirect revenue generation). The CBAs provided in this assessment, therefore, estimate the societal value of the project, in alignment with the many benefits that climate-resilient and low emission projects generate.

The PFA focuses instead on the performance of the investment, considering initial investments and operation and management costs (in the form of cash flow outlays), and revenues (in the form of cash flow inflows). It further considers the cost of financing and the desired return on equity investment. Practically, it calculates the net present value (NPV), the internal rate of return (IRR) of the project, and the benefit to cost ratio, to mention three of the main indicators.

The NPV can be defined as the sum of expected costs of the investment are deducted from the discounted value of the expected revenues (or benefits). When NPV is > 0 the project is considered viable. The IRR is defined as the discount rate (r) that produces a zero NPV. It represents the maximum interest rate that a project could face and still be profitable. The project is considered viable when IRR is > r. The benefit-to-cost ratio represents the ratio of the present value of benefits to the present value of costs over the period considered. If it is ≥ to 1 then the project is viable.

For each CRLEA one discount rate and different interest rates are considered. The discount rate is calculated as the weighted average cost of capital (WACC), considering the cost of capital and the return on equity. The specific values of discount rate of the investment for each country are shown in Table 2, as chosen by IFAD. Two values are considered in our analysis, one using the interest rate with GCF contribution ("Commercial Banks Funds or MFIs") and without it ("Agricultural Banks Fund").

Country	Interest Rate Local Currency Interest Rate US$			
	GCF-IGREENFIN	Agricultural Banks Fund	Commercial Banks Fund or MFIs	Average final interest rate to end users
Burkina Faso	0%	12.0%	5%	5%
Côte d'Ivoire	0%	12.5%	4%	4%
Ghana	0%	20.5%	9.5%	9.5%
Mali	0%	8.63%	4%	4%
Senegal	0%	12.5%	4%	4%

Table 2: interest rates applied in each country, considering GCF contribution ("Commercial Banks Funds or MFIs") and without it ("Agricultural Banks Fund").

There is no simple rule for choosing a discount rate to compare present and future costs and benefits. Discount rates reflect our responsibility to future generations and are a matter of ethical choice, our best estimates about technological change and the well-being of people in the future. A strong case can be made for using lower discount rates for public goods and natural/ecological assets (Goldstein, 2012). A variety of discount rates, including zero and negative rates, may be used depending on the nature of the assets being valued, the period involved, the degree of uncertainty, and the scope of the project or policy being evaluated. Presenting a sensitivity analysis of benefit-cost ratios using a range of different discount rates is always recommended, in order to highlight different ethical perspectives and their implications for future generations (TEEB, 2010).

The total investment considered in the analysis presented in this annex (in alignment with component 1.1) amounts to USD 79,250,000, including co-financing from the GCF, IFAD, the Islamic Development Bank, and the governments from the five countries.

2.1. Assumptions

2.1.1. Costs, benefits, and avoided costs

Data for calculating the costs, benefits, and avoided costs of CRLEAs were retrieved from peer-reviewed studies and grey literature; different capital costs were applied for each country. The full description of the methodology can be found in Annex 1. Table 3, Table 4, Table 5, Table 6, Table 7, Table 8, Table 9, Table 10, Table 11, and Table 12 show the monetary costs, benefits, and avoided costs of each CRLEA in each country, as well as the lifetime of the investment.

Sustainable Tree crop (Cashew) Lifetime: 20 years	Units	Burkina Faso	Ghana	Ivory Coast	Mali	Senegal
Costs						
Capital cost	USD/ha	40.00	52.00	50.00	38.00	45.00
Hired Labour	USD/ha	32.89	42.76	41.11	31.24	37.00
Fertilisers	USD/ha	8.00	10.40	10.00	7.60	9.00
Irrigation	USD/ha	0.00	0.00	0.00	0.00	0.00
Other inputs (seeds, pesticides, machinery, fuel, electricity, taxes, transport)	USD/ha	25.78	33.51	32.22	24.49	29.00
Avoided costs						
Reduced nutrient concentration (higher N uptake)	USD/ha	11.71	11.71	11.71	11.71	11.71
Added benefits						
Increased Revenues	USD/ha	96.27	105.00	110.99	64.86	87.95

Table 3: Inclusion of cashew in agroforestry systems

Sustainable Cassava Lifetime: 5 years	Units	Burkina Faso	Ghana	Ivory Coast	Mali	Senegal
Costs						
Capital cost	USD/ha	83.0	95.9	92.2	70.1	83.0
Operation and maintenance	USD/ha	88.9	115.6	111.1	84.4	100.0
Added benefits						
Increased Revenues	USD/ha	146.98	230.53	195.70	137.52	186.02

Table 4:Sustainable land management techniques

Sustainable cereal production (Groundnut) Lifetime: 15 years	Units	Burkina Faso	Ghana	Ivory Coast	Mali	Senegal
Costs						
Capital cost	USD/ha	177.32	298.56	324.71	217.75	286.96
Operation and maintenance	USD/ha	14.88	30.44	32.40	16.89	30.96
Added benefits						
Increased Revenues	USD/ha	111.03	227.17	241.77	126.01	196.89

Table 5: Efficient water management techniques

Sustainable livestock Cattle Lifetime: 1 year	Units	Burkina Faso	Ghana	Ivory Coast	Mali	Senegal
Costs						
Capital cost	USD/head	697.9	982.2	1000.0	650.2	800.0
Cost of fodder	USD/head	308.2	400.6	385.2	292.8	346.7
Operation and maintenance (RAP)	USD/head	5.4	7.1	6.8	5.2	6.1
Added benefits						
Manure production	USD/head	33.5	43.5	41.8	31.8	37.7
Revenues from fattening	USD/head	1028.4	1336.9	1285.5	976.9	1156.9
Mean average income from RAP	USD/head	21.9	28.4	27.3	20.8	24.6

Table 6: Livestock disease control

Sustainable Tree crop (Mango) Lifetime: 15 years	Units	Burkina Faso	Ghana	Ivory Coast	Mali	Senegal
Costs						
Capital cost	USD/ha	1333.3	1733.3	1666.6	1266.6	1500.0
Operation and maintenance	USD/ha	285.47	371.11	356.84	271.20	321.16
Added benefits						
Increased Revenues	USD/ha	554.7	593.4	583.1	570.2	578.5

Table 7: Drip irrigation for mango

Sustainable cereal production (Millet) Lifetime: 15 years	Units	Burkina Faso	Ghana	Ivory Coast	Mali	Senegal
Costs						
Capital cost	USD/ha	215.00	230.00	226.00	221.00	224.19
Operation and maintenance	USD/ha	28.89	30.91	30.37	29.70	30.13
Added benefits						
Increased Revenues	USD/ha	158.13	182.17	290.27	179.52	175.18

Table 8: Millet cultivation – Demi-Lunes

Poultry Adapted Breeds Lifetime: 1 year	Units	Burkina Faso	Ghana	Ivory Coast	Mali	Senegal
Costs						
Capital cost	USD/chicken	4.89	5.40	5.19	5.07	5.08
Operation and maintenance	USD/chicken	2.19	2.51	2.42	2.14	2.23
Added benefits						
Increased Revenues	USD/chicken	8.00	8.93	8.59	8.15	8.26

Table 9: Poultry adapted breeds

Sustainable cereal production (Rice) Lifetime: 15 years	Units	Burkina Faso	Ghana	Ivory Coast	Mali	Senegal
Costs						
Capital cost	USD/ha	572	503	558	394	222
Operation and maintenance	USD/ha	395.00	341.00	365.00	589.00	151.00
Avoided costs						
Avoided costs of seeds	USD/ha	3.70	3.25	3.61	2.55	2.91
Added benefits						
Increased Revenues	USD/ha	639.00	700.00	876.00	621.00	548.00

Table 10: System of Rice Intensification

Sustainable Tree Crop production (Shea) Lifetime: 20 years	Units	Burkina Faso	Ghana	Ivory Coast	Mali	Senegal
Costs						
Capital cost	USD/ha	36.46	41.78	40.26	35.70	37.22
Operation and maintenance	USD/ha	175.13	200.67	193.37	171.48	178.78
Avoided costs						
Reduced nutrient concentration (higher N uptake)	USD/ha	9.60	10.99	10.59	9.40	9.80
Added benefits						
Increased Revenues	USD/ha	222.22	288.89	277.78	211.11	250.00

Table 11: Shea cultivation in parklands

Sustainable Horticulture (Tomato) Lifetime: 10 years	Units	Burkina Faso	Ghana	Ivory Coast	Mali	Senegal
Costs						
Capital cost	USD/ha	1,619.0	1,855.2	1,787.7	1,585.3	1,652.8
Operation and maintenance	USD/ha	81.0	92.8	89.4	79.3	82.6
Added benefits						
Increased Revenues	USD/ha	928.9	1,328.1	948.2	1,025.5	572.4

Table 12: Solar pump irrigation

2.1.2. Income Tax

The following values of income tax have been used in the assessment. These values were provided by IFAD.

- Burkina Faso personal income tax rate 12-15% (we used 13.5%)
- Ghana personal income tax rate 30%
- Ivory Coast personal income tax rate 60%
- Mali personal income tax rate 3%
- Senegal personal income tax rate between 20-30% (we used 25%)

2.1.3. Avoided costs, carbon sequestration

Through an ex-act analysis, IFAD provided values of carbon sequestration for each VC in every country. These values cover a 20-year period, and are shown in Table 13, Table 14, Table 15, Table 16, and Table 17.

To calculate the annual monetary revenues of carbon sequestration we divided those values by 20 then we multiplied them by 5 USD including an annual increase of 2.5%. Annual monetary revenues were considered as avoided costs in the economic and financial analysis.

The value of carbon sequestration was assumed to amount to 40$/Ton. Another analysis that considers a value of 5$/Ton is shown in Annex 3.

	Burkina Faso		
vc n*	VC	unit	Tco2eq
vc-1	sustainable tree crop- Cashew	1 ha	-160
vc-2	Sustainable Cassava	1 ha	-23
vc-3	Sustainable cereal prod. (Groundnut)	1 ha	-26
vc-4	Sustainable livestock (cattle)	1 dairy cattle	0
vc-5	Sustainable tree crop (Mango)	1 ha	-145
vc-6	Sustainable cereal prod. (Millet)	1 ha	-26
vc-7	Sustainable poultry production (broiler)	10 chickens	0
vc-8	Sustainable cereal prod. (Rice)	1 ha	-26
vc-9	Sustainable tree crop production (Shea)	1 ha	-150
vc-10	Sustainable horticulture (tomato)	1 ha	-26

Table 13: Carbon sequestration values over 20 years per VC – Burkina Faso

	Ghana		
vc n*	VC	unit	Tco2eq
vc-1	sustainable tree crop- Cashew	1 ha	-187
vc-2	Sustainable Cassava	1 ha	-42
vc-3	Sustainable cereal prod. (Groundnut)	1 ha	-47
vc-4	Sustainable livestock (cattle)	1 dairy cattle	0
vc-5	Sustainable tree crop (Mango)	1 ha	-172
vc-6	Sustainable cereal prod. (Millet)	1 ha	-47
vc-7	Sustainable poultry production (broiler)	10 chickens	0
vc-8	Sustainable cereal prod. (Rice)	1 ha	-47
vc-9	Sustainable tree crop production (Shea)	1 ha	-178
vc-10	Sustainable horticulture (tomato)	1 ha	-47

Table 14: Carbon sequestration values over 20 years per VC – Ghana

	Ivory Coast		
vc n*	VC	unit	Tco2eq
vc-1	sustainable tree crop- Cashew	1 ha	-187
vc-2	Sustainable Cassava	1 ha	-42
vc-3	Sustainable cereal prod. (Groundnut)	1 ha	-47
vc-4	Sustainable livestock (cattle)	1 dairy cattle	0
vc-5	Sustainable tree crop (Mango)	1 ha	-172
vc-6	Sustainable cereal prod. (Millet)	1 ha	-47
vc-7	Sustainable poultry production (broiler)	10 chickens	0
vc-8	Sustainable cereal prod. (Rice)	1 ha	-47
vc-9	Sustainable tree crop production (Shea)	1 ha	-178
vc-10	Sustainable horticulture (tomato)	1 ha	-47

Table 15: Carbon sequestration values over 20 years per VC – Ivory Coast

	Mali		
vc n*	VC	unit	Tco2eq
vc-1	sustainable tree crop- Cashew	1 ha	-160
vc-2	Sustainable Cassava	1 ha	-23
vc-3	Sustainable cereal prod. (Groundnut)	1 ha	-26
vc-4	Sustainable livestock (cattle)	1 dairy cattle	0
vc-5	Sustainable tree crop (Mango)	1 ha	-145
vc-6	Sustainable cereal prod. (Millet)	1 ha	-26
vc-7	Sustainable poultry production (broiler)	10 chickens	0
vc-8	Sustainable cereal prod. (Rice)	1 ha	-26
vc-9	Sustainable tree crop production (Shea)	1 ha	-150
vc-10	Sustainable horticulture (tomato)	1 ha	-26

Table 16: Carbon sequestration values over 20 years per VC – Mali

	Senegal		
vc n*	VC	unit	Tco2eq
vc-1	sustainable tree crop- Cashew	1 ha	-160
vc-2	Sustainable Cassava	1 ha	-23
vc-3	Sustainable cereal prod. (Groundnut)	1 ha	-26
vc-4	Sustainable livestock (cattle)	1 dairy cattle	0
vc-5	Sustainable tree crop (Mango)	1 ha	-145
vc-6	Sustainable cereal prod. (Millet)	1 ha	-26
vc-7	Sustainable poultry production (broiler)	10 chickens	0
vc-8	Sustainable cereal prod. (Rice)	1 ha	-26
vc-9	Sustainable tree crop production (Shea)	1 ha	-150
vc-10	Sustainable horticulture (tomato)	1 ha	-26

Table 17: Carbon sequestration values over 20 years per VC – Senegal

2.2. Scenario GCF Contribution - Results: aggregate value chains performance

The results of the analysis performed for each value chain are shown in Table 19 - Table 37, including the analysis of both 1 ha of land (or one animal) being supported and the aggregated results for the entire program. The analysis of each investment considers the lifetime of the intervention (ranging between 1 and 20 years depending on the type of investment analyzed). The analysis also considered the discount rates with GCF contribution, as shown in Table 2.

Overall, the results are positive, indicating that the investments will generate value for farmers. Further, it is possible to note the size of the positive externalities generated, which is comparable (generally slightly lower) that the revenues generated by the project. This highlights the importance to consider the societal impacts of investment in climate adaptation, in addition to the direct economic benefits these generate.

Further, the results presented below consider the full lifetime of investments, which often goes well beyond the duration of the project (6 years). As a result, both revenues and externalities extend beyond the formal duration of the involvement of GCF and other partners in the project. Regarding the IRR, NPV, and BCR, we also show their values when including externalities, or avoided costs (S-IRR, S-NPV, and S-IRR).

Concerning specific types of investments, the following value chains show both positive IRR and BCR (for both assessments, 1ha/1head and programme), which means that they are profitable investments in all the assessed countries: VC2, VC3, VC6, VC7, VC9, and VC10. The remaining VCs are at times not economically viable with the assumptions used about impacts on productivity and related revenue creation, and costs of implementation. The following sections present a variety of results, for all the VCs and for all the countries analyzed.

2.2.1. VC1-Sustainable Tree crop (Cashew)

1 ha											
VC 1-Sustainable Tree crop (Cashew)	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
Burkina Faso	$1,373	$1,925	$8,408.39	$329	5,368.34	1.38	7.17	74%	905%	2.00	1.00
Ghana	$1,785	$2,100	$9,787.80	$109	4,128.29	1.13	6.06	35%	779%	2.00	1.00
Ivory Coast	$1,717	$2,220	$9,787.80	$326	6,770.43	1.28	6.73	55%	829%	2.00	1.00
Mali	$1,305	$1,297	$8,408.39	$(17)	5,519.97	0.98	7.14	-2%	879%	N/A	1.00
Senegal	$1,545	$1,759	$8,408.39	$131	5,668.09	1.12	6.33	29%	768%	1.00	1.00

Table 18: portfolio analysis (1ha) – VC1

Program																
VC 1-Sustainable Tree crop (Cashew)	Total investment	Revenues generated	Value of externalities	Undiscounted net benefits with externalities	Undiscounted net benefits without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) discounted	Benefit to cost ratio (lifetime) discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio-Farmers organizations	Debt Service Coverage Ratio-MSMEs	Debt Service Coverage Ratio-COOPERATIVES
Burkina Faso	$3,139,361	$4,051,136	$17,933,656	$20,082,103	$1,267,878	$12,991,174	$611,964	27%	342%	8.15	1.19	1.00	2.00	1.97	1.97	1.97
Ghana	$4,478,221	$4,848,358	$22,901,121	$24,794,752	$768,305	$11,456,532	$15,730	10%	294%	7.84	0.89	1.00	2.00	1.02	1.02	1.02
Ivory Coast	$4,478,221	$5,329,703	$23,817,166	$26,293,957	$1,306,452	$18,390,483	$609,297	19%	313%	7.36	1.12	1.00	2.00	1.38	1.38	1.38
Mali	$3,201,745	$2,930,323	$19,252,660	$20,147,987	$(50,007)	$14,096,445	$(277,637)	-15%	332%	7.91	0.86	1.00	2.00	0.79	0.79	0.79
Senegal	$4,478,221	$4,692,693	$22,739,479	$24,450,292	$594,271	$17,070,452	$93,103	7%	290%	6.94	0.98	1.00	2.00	1.26	1.26	1.26

Table 19: portfolio analysis (Program) – VC1

Table 18 and Table 19 show the performance of Value Chain 1 (sustainable tree crops, cashew). Both the 1ha (Table 18) and programme (Table 19) investments show similar results for all countries, except Mali, where the NPV, BCR, and IRR are negative. These indicators are always positive if they also consider externalities. On the other hand, Burkina Faso is the country where investing in VC1 is more profitable, considering the values of NPV, IRR and BCR. For example, the NPV (programme - Table 19) in Burkina Faso is 6 times larger than the one in Senegal, the country with the smallest positive NPV. These differences can be explained by lower investment and O&M costs in Burkina Faso as well as higher revenues than in Senegal (see Table 3).

2.2.2. VC2-Sustainable Cassava

1 ha											
VC 2 - Sustainable Cassava	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
Burkina Faso	$527	$735	$248	$168	$383	1.36	1.82	64%	126%	2.00	1.00
Ghana	$674	$1,153	$453	$346	$691	1.64	2.28	117%	210%	1.00	1.00
Ivory Coast	$648	$979	$453	$284	$686	1.48	2.17	88%	185%	2.00	1.00
Mali	$492	$688	$248	$166	$386	1.37	1.87	70%	142%	2.00	1.00
Senegal	$583	$930	$248	$300	$520	1.57	1.98	100%	160%	1.00	1.00

Table 20: portfolio analysis (1ha) – VC2

Program																
VC2-SustainableCassava	Total investment	Revenues generated	Value of externalities	Undiscounted net benefits with externalities	Undiscounted net benefits without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) discounted	Benefit to cost ratio (lifetime) discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio-Farmers organizations	Debt Service Coverage Ratio-MSMEs	Debt Service Coverage Ratio-COOPERATIVES
Burkina Faso	$3,118,613	$4,499,021	$1,873,374	$3,850,687	$1,838,614	$2,269,395	$963,987	33%	63%	2.04	1.31	1.00	2.00	2.40	1.69	1.97
Ghana	$4,460,502	$7,821,423	$3,786,930	$8,221,551	$4,181,756	$3,542,632	$1,653,508	54%	96%	2.56	1.42	1.00	1.00	2.19	2.42	3.06
Ivory Coast	$4,460,502	$6,905,199	$3,938,407	$7,343,766	$3,142,379	$4,874,747	$1,909,337	41%	86%	2.48	1.45	1.00	2.00	1.94	1.94	2.35
Mali	$3,189,077	$4,564,669	$2,028,929	$3,988,775	$1,824,368	$2,588,928	$1,061,252	34%	66%	2.08	1.34	2.00	2.00	2.84	1.67	1.95
Senegal	$4,460,502	$7,292,794	$2,396,386	$6,138,472	$3,582,072	$4,030,044	$2,225,693	47%	74%	2.16	1.53	1.00	1.00	3.03	2.15	2.65

Table 21: portfolio analysis (Program) – VC2

Table 20 and Table 21 show the performance of Value Chain 2 (sustainable cassava). This investment shows positive results of NPV, IRR, and BCR in all the five countries considered in this study (in both the 1ha and programme assessments), It is worth noting that Ghana shows the highest IRR in both Table 20 and Table 21 since it is expected that this investment in this country will generate the highest revenues, as shown in Table 4.

2.2.3. VC3-Sustainable cereal production (Groundnut)

1 ha											
VC3 - Sustainable cereal production (Groundnut)	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
Burkina Faso	$400	$1,665	$956	$821	$1,467	3.47	5.42	54%	85%	2.00	2.00
Ghana	$755	$3,408	$1,728	$1,241	$2,106	3.31	4.92	66%	99%	2.00	2.00
Ivory Coast	$811	$3,627	$1,728	$2,003	$3,260	3.92	5.76	64%	95%	2.00	2.00
Mali	$471	$1,890	$956	$995	$1,691	3.45	5.17	50%	75%	2.00	2.00
Senegal	$751	$2,953	$956	$1,558	$2,253	3.47	4.57	58%	77%	1.00	1.00

Table 22: portfolio analysis (1ha) – VC3

Program																
VC3-Sustainable cereal production (Groundnut)	Total investment	Revenues generated	Value of externalities	Undiscounted net benefits with externalities	Undiscounted net benefits without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) discounted	Benefit to cost ratio (lifetime) discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio-Farmers organizations	Debt Service Coverage Ratio-MSMEs	Debt Service Coverage Ratio-COOPERATIVES
Burkina Faso	$1,852,156	$7,038,146	$4,489,784	$12,428,051	$6,962,791	$7,219,642	$3,909,657	50%	79%	5.22	2.71	2.00	3.00	5.04	5.04	5.04
Ghana	$2,816,137	$11,610,902	$6,538,331	$19,597,836	$11,673,623	$7,605,056	$4,343,706	60%	91%	4.53	2.19	2.00	2.00	3.84	3.84	3.84
Ivory Coast	$2,796,113	$11,429,323	$6,048,155	$18,807,177	$11,473,204	$12,153,895	$7,264,815	59%	87%	5.52	3.22	2.00	2.00	3.41	3.41	3.41
Mali	$1,841,571	$6,753,249	$3,797,075	$11,256,775	$6,627,496	$7,179,793	$4,100,874	46%	71%	4.94	2.81	3.00	3.00	5.72	5.72	5.72
Senegal	$2,868,916	$10,304,950	$3,702,856	$14,412,903	$9,931,487	$9,215,958	$6,226,022	52%	70%	4.24	2.86	3.00	3.00	4.96	4.96	4.96

Table 23: portfolio analysis (Program) – VC3

Table 22 and Table 23 show the performance of Value Chain 3 (Sustainable cereal production (Groundnut)). The results show similar outputs like the ones of VC2: the BCR, IRR, and NPV are positive in all the five countries considered in this study and for both the 1ha and programme assessments. In this case, Ivory Coast is the country that shows the largest IRR, since it is expected that this investment in this country will generate the highest revenues, as shown in Table 5.

2.2.4. VC4-Sustainable livestock Cattle

1head											
VC4-Sustainable livestock Cattle	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
Burkina Faso	$1,006	$1,084	$-	$36	$36	1.04	1.04	10%	10%	1.00	1.00
Ghana	$1,383	$1,409	$-	$(68)	$(68)	0.95	0.95	2%	2%	1.00	1.00
Ivory Coast	$1,385	$1,355	$-	$(74)	$(74)	0.95	0.95	-4%	-4%	N/A	N/A
Mali	$943	$1,030	$-	$53	$53	1.06	1.06	13%	13%	1.00	1.00
Senegal	$1,147	$1,219	$-	$33	$33	1.03	1.03	8%	8%	1.00	1.00

Table 24: portfolio analysis (1head) – VC4

Program															
VC4-Sustainable livestock Cattle	Total investment	Revenues generated	Value of externalities	Undiscounted net benefits with externalities	Undiscounted net benefits without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) discounted	Benefit to cost ratio (lifetime) discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio-Farmers organizations	Debt Service Coverage Ratio-MSMEs	Debt Service Coverage Ratio-COOPERATIVES
Burkina Faso	$2,919,008	$8,080,303	$-	$6,496,647	$6,496,647	$3,880,105	$3,880,105	76%	76%	2.40	2.40	1.00	1.00	5.45	5.45	5.45
Ghana	$4,114,017	$11,260,386	$-	$9,051,515	$9,051,515	$3,627,902	$3,627,902	72%	72%	1.96	1.96	1.00	1.00	3.42	3.42	3.42
Ivory Coast	$4,075,423	$11,059,478	$-	$8,885,952	$8,885,952	$5,765,413	$5,765,413	69%	69%	2.43	2.43	2.00	1.00	3.20	3.20	3.20
Mali	$2,985,255	$8,285,664	$-	$6,661,648	$6,661,648	$4,366,441	$4,366,441	77%	77%	2.51	2.51	1.00	1.00	6.74	6.74	6.74
Senegal	$4,152,487	$11,464,828	$-	$9,217,756	$9,217,756	$6,027,355	$6,027,355	75%	75%	2.49	2.49	1.00	1.00	5.36	5.36	5.36

Table 25: portfolio analysis (Program) – VC4

Table 24 and Table 25 show the performance of Value Chain 4 (Sustainable livestock Cattle). This investment generates the largest IRRs in Burkina Faso, Mali, and Senegal. This is because in Ghana and in Ivory Coast either the capital or O&M costs are high, as shown in Table 6, and because in Ghana the interest rate is the highest, at 9.5% (as shown in Table 2).

2.2.5. VC5-Sustainable tree crop (Mango)

1ha											
VC5-sustainable tree crop (Mango)	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
Burkina Faso	$5,615	$8,321	$5,330	$1,461	$5,067	1.34	2.18	19%	44%	5.00	3.00
Ghana	$7,300	$8,902	$6,323	$7	$3,173	1.00	1.68	10%	34%	8.00	3.00
Ivory Coast	$7,019	$8,747	$6,323	$849	$5,451	1.15	1.97	11%	36%	8.00	3.00
Mali	$5,335	$8,553	$5,330	$2,058	$5,937	1.48	2.39	22%	48%	5.00	3.00
Senegal	$6,317	$8,677	$5,330	$1,360	$5,240	1.27	2.03	15%	38%	2.00	1.00

Table 26: portfolio analysis (1ha) – VC5

Program																
VC5-sustainable tree crop (Mango)	Total investment	Revenues generated	Value of externalities	Undiscounted net benefits with externalities	Undiscounted net benefits without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) discounted	Benefit to cost ratio (lifetime) discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio-Farmers organizations	Debt Service Coverage Ratio-MSMEs	Debt Service Coverage Ratio-COOPERATIVES
Burkina Faso	$2,490,525	$3,377,799	$2,391,635	$4,260,025	$1,432,349	$2,281,198	$541,760	14%	37%	2.21	1.10	3.00	5.00	1.96	1.96	1.96
Ghana	$3,552,672	$3,965,008	$3,112,979	$4,661,774	$981,239	$1,380,900	$(171,233)	6%	29%	1.73	0.71	4.00	6.00	1.19	1.19	1.19
Ivory Coast	$3,552,672	$4,051,893	$3,237,498	$4,917,123	$1,089,367	$2,843,021	$263,318	7%	30%	2.01	0.97	1.00	5.00	1.31	1.31	1.31
Mali	$2,540,016	$3,727,430	$2,567,538	$4,848,041	$1,812,392	$2,945,223	$899,358	18%	40%	2.40	1.25	3.00	4.00	2.52	2.52	2.52
Senegal	$3,552,672	$4,465,994	$3,032,541	$5,190,141	$1,604,711	$3,034,274	$617,886	11%	32%	2.04	1.07	3.00	5.00	1.79	1.79	1.79

Table 27: portfolio analysis (Program) – VC5

Table 26 and Table 27 show the performance of Value Chain 5 (sustainable tree crop (Mango)). In this case, the IRRs are positive in all the five countries considered in this study. On the other hand, the programme outputs (Table 27) show a negative BCR (<1) in both Ghana and Ivory Coast. As in the case of VC4, this is because that in Ghana and in Ivory Coast either the capital or O&M costs are high, as shown in Table 7, and because in Ghana the interest rate is the highest, at 9.5% (as shown in Table 2).

2.2.6. VC6-Sustainable cereal production (Millet)

1ha/1head											
VC6-Sustainable cereal production (Millet)	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
Burkina Faso	$648	$2,372	$956	$1,126	$1,773	3.19	4.44	60%	86%	2.00	2.00
Ghana	$694	$2,733	$1,728	$954	$1,819	3.02	4.85	66%	109%	2.00	1.00
Ivory Coast	$682	$4,354	$1,728	$2,663	$3,921	5.73	7.96	115%	158%	1.00	1.00
Mali	$666	$2,693	$956	$1,445	$2,140	3.62	4.88	68%	93%	2.00	2.00
Senegal	$676	$2,628	$-	$1,388	$1,388	3.48	3.48	65%	65%	1.00	1.00

Table 28: portfolio analysis (1ha) – VC6

Program																
VC6-Sustainable cereal production (Millet)	Total investment	Revenues generated	Value of externalities	Undiscounted net benefits with externalities	Undiscounted net benefits without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) discounted	Benefit to cost ratio (lifetime) discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio-Farmers organizations	Debt Service Coverage Ratio-MSMEs	Debt Service Coverage Ratio-COOPERATIVES
Burkina Faso	$2,161,202	$7,225,528	$3,228,945	$10,620,245	$6,736,409	$6,187,508	$3,820,307	53%	76%	4.19	2.55	2.00	3.00	5.01	5.01	5.01
Ghana	$3,082,901	$11,099,949	$7,783,233	$19,973,625	$10,611,806	$7,830,667	$3,948,912	58%	97%	4.75	2.05	1.00	2.00	3.61	3.61	3.61
Ivory Coast	$3,082,901	$17,999,362	$7,920,989	$28,862,294	$19,334,779	$19,055,097	$12,681,624	101%	140%	7.57	4.76	1.00	1.00	5.09	5.09	5.09
Mali	$2,204,149	$8,139,113	$3,203,704	$11,697,266	$7,843,791	$7,560,451	$4,982,652	60%	82%	4.60	3.01	2.00	2.00	6.72	6.72	6.72
Senegal	$3,082,901	$10,950,496	$4,417,253	$15,736,006	$10,422,851	$10,149,039	$6,594,781	57%	79%	4.46	2.90	2.00	2.00	5.21	5.21	5.21

Table 29: portfolio analysis (Program) – VC6

Table 28 and Table 29 show the performance of Value Chain 6 (Sustainable cereal production (Millet)). The results of both the 1ha and programme assessments indicate that this investment is positive in all the five countries considered in this study. The investment is particularly profitable in Ivory Coast where the IRR is always larger than 100%. This is due to the large revenues that the investments in VC6 can generate in this country, as shown in Table 8.

2.2.7. VC7-Sustainable poultry production (broiler)

1head											
VC7-Poultry	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
Burkina Faso	$7.08	$8.00	$-	$0.64	$0.64	1.09	1.09	19%	19%	1.00	1.00
Ghana	$7.91	$8.93	$-	$0.47	$0.47	1.06	1.06	19%	19%	1.00	1.00
Ivory Coast	$7.60	$8.59	$-	$0.75	$0.75	1.10	1.10	19%	19%	1.00	1.00
Mali	$7.21	$8.15	$-	$0.71	$0.71	1.10	1.10	18%	18%	1.00	1.00
Senegal	$7.31	$8.26	$-	$0.72	$0.72	1.10	1.10	19%	19%	1.00	1.00

Table 30: portfolio analysis (1head) – VC7

Program																
VC7-Poultry	Total investment	Revenues generated	Value of externalities	Undiscounted net benefits with externalities	Undiscounted net benefits without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) discounted	Benefit to cost ratio (lifetime) discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio-Farmers organizations	Debt Service Coverage Ratio-MSMEs	Debt Service Coverage Ratio-COOPERATIVES
Burkina Faso	$2,917,076	$8,538,043	$-	$7,050,211	$7,050,211	$4,235,979	$4,235,979	82%	82%	2.54	2.54	1.00	1.00	5.83	5.83	5.83
Ghana	$4,182,939	$11,996,677	$-	$9,789,383	$9,789,383	$4,011,263	$4,011,263	81%	81%	2.09	2.09	1.00	1.00	3.66	3.66	3.66
Ivory Coast	$4,184,814	$11,980,654	$-	$9,765,986	$9,765,986	$6,425,767	$6,425,767	81%	81%	2.59	2.59	1.00	1.00	3.49	3.49	3.49
Mali	$2,949,366	$8,913,218	$-	$7,493,745	$7,493,745	$4,932,524	$4,932,524	83%	83%	2.72	2.72	1.00	1.00	7.36	7.36	7.36
Senegal	$4,150,469	$12,266,331	$-	$10,185,022	$10,185,022	$6,703,141	$6,703,141	82%	82%	2.66	2.66	1.00	1.00	5.81	5.81	5.81

Table 31: portfolio analysis (Program) – VC7

Table 30 and Table 31 show the performance of Value Chain 7 (Poultry). This value chain shows positive and similar BCR, IRR, and NPV in all the five countries considered in this study and for both the 1ha and programme assessments. The reason for this is due to the fact that costs and revenues are similar in all the assessed countries (as shown in Table 9). Besides, even if different interest rates are applied (as shown in Table 2), the lifetime of this investment is one year, thus, it contributes to generates similar financial and economic outputs.

2.2.8. VC8-Sustainable cereal production (Rice)

1ha											
VC8 - Sustainable cereal production (Rice)	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
Burkina Faso	$6,497	$9,585	$1,011	$1,960	$2,645	1.42	1.57	42%	53%	3.00	2.00
Ghana	$5,618	$10,500	$1,776	$2,306	$3,197	1.73	2.01	71%	92%	2.00	2.00
Ivory Coast	$6,033	$13,140	$1,782	$5,123	$6,420	2.11	2.39	92%	110%	2.00	1.00
Mali	$9,229	$9,315	$994	$(38)	$686	0.99	1.10	3%	23%	12.00	5.00
Senegal	$2,487	$8,220	$999	$4,191	$4,919	3.21	3.59	179%	204%	2.00	1.00

Table 32: portfolio analysis (1ha) – VC8

Program																
VC8 - Sustainable cereal production (Rice)	Total investment	Revenues generated	Value of externalities	Undiscounted net benefits with externalities	Undiscounted net benefits without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) discounted	Benefit to cost ratio (lifetime) discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio-Farmers organizations	Debt Service Coverage Ratio-MSMEs	Debt Service Coverage Ratio-COOPERATIVES
Burkina Faso	$3,055,372	$4,162,440	$478,916	$2,106,407	$1,577,979	$1,090,282	$752,362	24%	31%	1.41	1.21	2.00	2.00	2.12	2.12	2.12
Ghana	$4,352,517	$7,510,712	$1,386,627	$5,636,256	$4,103,694	$2,180,323	$1,488,534	42%	55%	1.75	1.32	2.00	2.00	2.08	2.08	2.08
Ivory Coast	$4,340,518	$8,725,642	$1,291,640	$6,985,058	$5,554,177	$4,532,931	$3,539,976	55%	67%	2.19	1.84	1.00	2.00	2.51	2.51	2.51
Mali	$3,198,826	$2,998,827	$346,193	$397,000	$31,981	$37,888	$(221,301)	-8%	5%	1.01	0.88	2.00	2.00	0.90	0.90	0.90
Senegal	$4,353,589	$13,285,852	$1,762,147	$12,811,158	$10,864,522	$7,949,872	$6,706,070	106%	122%	3.21	2.72	1.00	1.00	6.61	6.61	6.61

Table 33: portfolio analysis (Program) – VC8

Table 32 and Table 33 show the performance of Value Chain 8 (Sustainable cereal production (Rice)). The results of the IRR and BCR indicate that the investment is profitable and similar in Burkina Faso, Ghana, and Ivory Coast, in both the 1ha and programme assessments. In Senegal, the IRR is always larger than 100%, suggesting that investing in VC8 in this country generates the largest outputs, mainly thanks to low capital and O&M costs (as shown in Table 10).

2.2.9. VC9-Sustainable Tree Crop production (Shea)

1ha/1head											
VC9 - Sustainable Tree Crop production (Shea)	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
Burkina Faso	$3,539	$4,444	$8,047	$550	$5,372	1.25	3.42	129%	1001%	1.00	1.00
Ghana	$4,055	$5,778	$9,541	$735	$4,653	1.41	3.57	211%	1113%	1.00	1.00
Ivory Coast	$3,908	$5,556	$8,996	$1,107	$7,138	1.41	3.68	210%	1144%	1.00	1.00
Mali	$3,465	$4,222	$8,043	$503	$5,798	1.21	3.45	111%	1001%	1.00	1.00
Senegal	$3,613	$5,000	$8,051	$931	$6,232	1.38	3.53	191%	1046%	1.00	1.00

Table 34: portfolio analysis (1ha) – VC9

Program																
VC10 - Sustainable Horticulture (tomato)	Total investment	Revenues generated	Value of externalities	Undiscounted net benefits with externalities	Undiscounted net benefits without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) discounted	Benefit to cost ratio (lifetime) discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio-Farmers organizations	Debt Service Coverage Ratio-MSMEs	Debt Service Coverage Ratio-COOPERATIVES
Burkina Faso	$3,145,137	$3,669,462	$1,955,474	$2,789,152	$802,113	$1,658,757	$328,553	21%	63%	1.84	1.09	1.00	1.00	1.58	1.58	1.58
Ghana	$4,486,460	$5,938,661	$9,411,866	$11,478,956	$1,910,146	$5,387,173	$655,834	36%	189%	4.01	1.13	1.00	1.00	1.47	1.47	1.47
Ivory Coast	$4,486,460	$5,925,732	$11,291,876	$13,377,032	$1,896,085	$9,386,891	$1,081,329	36%	218%	4.20	1.26	1.00	1.00	1.63	1.63	1.63
Mali	$3,207,636	$3,630,905	$7,717,615	$8,543,530	$696,813	$5,965,763	$288,733	17%	194%	3.89	1.08	1.00	1.00	1.68	1.68	1.68
Senegal	$4,486,460	$5,768,519	$10,406,503	$12,305,545	$1,725,101	$8,611,102	$955,618	32%	201%	3.93	1.22	1.00	1.00	2.06	2.06	2.06

Table 35: portfolio analysis (Program) – VC9

Table 34 and Table 35 show the performance of Value Chain 9 (Sustainable Tree Crop production (Shea)). The results of both the 1ha and programme assessments indicate that this investment is always positive. However, the BCR in both Burkina Faso and Mali is the lowest. This is because in these countries investing in VC10 generates the lowest revenues (as shown in Table 11).

2.2.10. VC10-Sustainable Horticulture (Tomato)

1ha											
VC10 - Sustainable Horticulture (tomato)	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
Burkina Faso	$2,429	$9,289	$597	$4,928	$5,384	3.20	3.40	52%	55%	2.00	2.00
Ghana	$2,783	$13,281	$1,079	$5,900	$6,565	3.42	3.69	66%	72%	2.00	2.00
Ivory Coast	$2,682	$9,482	$1,079	$5,178	$6,046	3.06	3.41	47%	53%	3.00	2.00
Mali	$2,378	$10,255	$597	$6,089	$6,569	3.73	3.95	59%	63%	2.00	2.00
Senegal	$2,479	$5,724	$597	$2,319	$2,800	2.00	2.21	27%	31%	4.00	4.00

Table 36: portfolio analysis (1ha) – VC10

Program															
VC10 - Sustainable Horticulture (tomato)	Total investment	Revenues generated	Value of externalities	Undiscounted net benefits with externalities	Undiscounted net benefits without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) discounted	Benefit to cost ratio (lifetime) discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio-Farmers organizations	Debt Service Coverage Ratio-MSMEs	Debt Service Coverage Ratio-COOPERATIVES
Burkina Faso	$1,580,532	$7,108,695	$542,933	$8,119,561	$7,453,036	$4,575,654	$4,173,787	50%	53%	3.32	2.98	3.00	3.00	5.23	5.23	5.23
Ghana	$2,254,589	$12,653,127	$1,221,838	$15,369,042	$13,869,068	$5,770,084	$5,160,455	63%	69%	2.99	2.52	2.00	2.00	4.31	4.31	4.31
Ivory Coast	$2,254,589	$9,375,065	$1,267,945	$11,202,099	$9,645,522	$6,983,725	$5,951,496	46%	51%	3.58	3.03	3.00	3.00	2.99	2.99	2.99
Mali	$1,611,939	$8,174,436	$565,503	$9,486,499	$8,792,266	$5,999,334	$5,538,960	57%	60%	4.04	3.69	3.00	3.00	7.06	7.06	7.06
Senegal	$2,254,589	$6,121,055	$758,675	$6,384,343	$5,452,965	$3,730,293	$3,112,659	27%	31%	2.31	1.98	5.00	5.00	3.21	3.21	3.21

Table 37: portfolio analysis (Program) – VC10

Table 36 and Table 37 show the performance of Value Chain 10 (Sustainable Horticulture (Tomato)). This VC generates the worst outputs in Senegal since in this country the expected outputs are the lowest (as shown in Table 12). Nevertheless, investing in this VC always generates positive outcomes in all the considered countries.

2.3. Scenario GCF Contribution - Results: country performance

Table 38 - Table 46 show the aggregate results of the analysis for Burkina Faso, Ghana, Ivory Coast, and Senegal respectively. The results shown in these tables are the same as the ones described in section 2.2, but here they are aggregated by country.

Overall, both the BCR and IRR of every value chain are always positive in Burkina Faso, meaning that the investments are always profitable in this country, although with different degrees of revenues. In Ghana and Ivory Coast, the BCR of VC4 for 1ha/1head is negative. In the same countries, the BCR is of VC5 for the entire programme is also <1. Mali shows a negative BCR and IRR of VC1 and VC8 for the investments of one ha/head and of the entire programme. In the programme assessment of Senegal, the only negative BCR is the one of VC1.

2.3.1. Burkina Faso

	One hectare / one head										
	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
VC1	$1,373	$1,925	$8,408	$329	$5,368	1.38	7.17	74%	905%	2.00	1.00
VC2	$527	$735	$248	$168	$383	1.36	1.82	64%	126%	2.00	1.00
VC3	$400	$1,665	$956	$821	$1,467	3.47	5.42	54%	85%	2.00	2.00
VC4	$1,006	$1,084	$-	$36	$36	1.04	1.04	10%	10%	1.00	1.00
VC5	$5,615	$8,321	$5,330	$1,461	$5,067	1.34	2.18	19%	44%	5.00	3.00
VC6	$648	$2,372	$956	$1,126	$1,773	3.19	4.44	60%	86%	2.00	2.00
VC7	$7	$8	$-	$1	$1	1.09	1.09	19%	19%	1.00	1.00
VC8	$6,497	$9,585	$1,011	$1,960	$2,645	1.42	1.57	42%	53%	3.00	2.00
VC9	$3,539	$4,444	$8,047	$550	$5,372	1.25	3.42	129%	1001%	1.00	1.00
VC10	$2,429	$9,289	$597	$4,928	$5,384	3.20	3.40	52%	55%	2.00	2.00

Table 38: 1ha/1head portfolio – Burkina Faso

Table 37 shows the results of the 1ha/1head assessment in Burkina Faso. The results indicate that all VCs produce positive outcomes, and suggested by the NPV, BCR, and IRR, which are always positive. From the point of view of the BCR, only three VCs are larger than 3: VC3, VC6, and VC10. If externalities are included, the IRR (which becomes the S-IRR) always grow, sometimes even to more than 1000%, like in the case of VC1 and VC9

	Program															
	Total investment	Revenues generated	Value of externalities	Undiscounted net benefit with externalities	Undiscounted net benefit without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio - Farmers organizations	Debt Service Coverage Ratio - MSMEs	Debt Service Coverage Ratio - COOPERATIVES
VC1	$3,139,361	$4,051,136	$17,933,656	$20,082,103	$1,267,878	$12,991,174	$611,964	27%	342%	8.15	1.19	1.00	2.00	1.97	1.97	1.97
VC2	$3,118,613	$4,499,021	$1,873,374	$3,850,687	$1,838,614	$2,269,395	$963,987	33%	63%	2.04	1.31	1.00	2.00	2.40	1.69	1.97
VC3	$1,852,156	$7,038,146	$4,489,784	$12,428,051	$6,962,791	$7,219,642	$3,909,657	50%	79%	5.22	2.71	2.00	3.00	5.04	5.04	5.04
VC4	$2,919,008	$8,080,303	$-	$6,496,647	$6,496,647	$3,880,105	$3,880,105	76%	76%	2.40	2.40	1.00	1.00	5.45	5.45	5.45
VC5	$2,490,525	$3,377,799	$2,391,635	$4,260,025	$1,432,349	$2,281,198	$541,760	14%	37%	2.21	1.10	3.00	5.00	1.96	1.96	1.96
VC6	$2,161,202	$7,225,528	$3,228,945	$10,620,245	$6,736,409	$6,187,508	$3,820,307	53%	76%	4.19	2.55	2.00	3.00	5.01	5.01	5.01
VC7	$2,917,076	$8,538,043	$-	$7,050,211	$7,050,211	$4,235,979	$4,235,979	82%	82%	2.54	2.54	1.00	1.00	5.83	5.83	5.83
VC8	$3,055,372	$4,162,440	$478,916	$2,106,407	$1,577,979	$1,090,282	$752,362	24%	31%	1.41	1.21	2.00	2.00	2.12	2.12	2.12
VC9	$3,145,137	$3,669,462	$1,955,474	$2,789,152	$802,113	$1,658,757	$328,553	21%	63%	1.84	1.09	1.00	1.00	1.58	1.58	1.58
VC10	$1,580,532	$7,108,695	$542,933	$8,119,561	$7,453,036	$4,575,654	$4,173,787	50%	53%	3.32	2.98	3.00	3.00	5.23	5.23	5.23

Table 39: programme portfolio – Burkina Faso

Table 39 shows the results of the programme assessment in Burkina Faso. Like in the 1ha/1head assessment, all the VCs produce positive results, even though no one shows a BCR larger than 3. The IRRs are always smaller than 100%, although their values vary considerably between the different VCs, from 21% in VC9 to 76% in VC4.

2.3.2. Ghana

	One hectare / one head										
	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
VC1	$1,785	$2,100	$9,788	$109	$4,128	1.13	6.06	35%	779%	2.00	1.00
VC2	$674	$1,153	$453	$346	$691	1.64	2.28	117%	210%	1.00	1.00
VC3	$755	$3,408	$1,728	$1,241	$2,106	3.31	4.92	66%	99%	2.00	2.00
VC4	$1,383	$1,409	$-	$(68)	$(68)	0.95	0.95	2%	2%	1.00	1.00
VC5	$7,300	$8,902	$6,323	$7	$3,173	1.00	1.68	10%	34%	8.00	3.00
VC6	$694	$2,733	$1,728	$954	$1,819	3.02	4.85	66%	109%	2.00	1.00
VC7	$8	$9	$-	$0	$0	1.06	1.06	19%	19%	1.00	1.00
VC8	$5,618	$10,500	$1,776	$2,306	$3,197	1.73	2.01	71%	92%	2.00	2.00
VC9	$4,055	$5,778	$9,541	$735	$4,653	1.41	3.57	211%	1113%	1.00	1.00
VC10	$2,783	$13,281	$1,079	$5,900	$6,565	3.42	3.69	66%	72%	2.00	2.00

Table 40: 1ha/1head portfolio – Ghana

Table 40 shows the results of the 1ha/1head assessment in Ghana. The results indicate that all VCs produce positive outcomes, except VC4, where the BCR is smaller than 1. On the contrary, VC10 shows the largest BCR (3.99) which increases to 4.76 if externalities are also included. The IRRs are always positive, but with large variations between VCs, from 2% in VC4 to more than 200% in VC9.

	Program															
	Total investment	Revenues generated	Value of externalities	Undiscounted net benefit with externalities	Undiscounted net benefit without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio - Farmers organizations	Debt Service Coverage Ratio - MSMEs	Debt Service Coverage Ratio - COOPERATIVES
VC1	$4,478,221	$4,848,358	$22,901,121	$24,794,752	$768,305	$11,456,532	$15,730	10%	294%	7.84	0.89	1.00	2.00	1.02	1.02	1.02
VC2	$4,460,502	$7,821,423	$3,786,930	$8,221,551	$4,181,756	$3,542,632	$1,653,508	54%	96%	2.56	1.42	1.00	1.00	2.19	2.42	3.06
VC3	$2,816,137	$11,610,902	$6,538,331	$19,597,836	$11,673,623	$7,605,056	$4,343,706	60%	91%	4.53	2.19	2.00	2.00	3.84	3.84	3.84
VC4	$4,114,017	$11,260,386	$-	$9,051,515	$9,051,515	$3,627,902	$3,627,902	72%	72%	1.96	1.96	1.00	1.00	3.42	3.42	3.42
VC5	$3,552,672	$3,965,008	$3,112,979	$4,661,774	$981,239	$1,380,900	$(171,233)	6%	29%	1.73	0.71	4.00	6.00	1.19	1.19	1.19
VC6	$3,082,901	$11,099,949	$7,783,233	$19,973,625	$10,611,806	$7,830,667	$3,948,912	58%	97%	4.75	2.05	1.00	2.00	3.61	3.61	3.61
VC7	$4,182,939	$11,996,677	$-	$9,789,383	$9,789,383	$4,011,263	$4,011,263	81%	81%	2.09	2.09	1.00	1.00	3.66	3.66	3.66
VC8	$4,352,517	$7,510,712	$1,386,627	$5,636,256	$4,103,694	$2,180,323	$1,488,534	42%	55%	1.75	1.32	2.00	2.00	2.08	2.08	2.08
VC9	$4,486,460	$5,938,661	$9,411,866	$11,478,956	$1,910,146	$5,387,173	$655,834	36%	189%	4.01	1.13	1.00	1.00	1.47	1.47	1.47
VC10	$2,254,589	$12,653,127	$1,221,838	$15,369,042	$13,869,068	$5,770,084	$5,160,455	63%	69%	2.99	2.52	2.00	2.00	4.31	4.31	4.31

Table 41: programme portfolio – Ghana

Table 42 shows the results of the programme assessment in Ghana. Contrary to the 1ha/1head assessment, VC4 shows a positive BCR, while VC5 a negative one. Like in Table 39 (programme portfolio – Burkina Faso), no IRR is larger than 100%.

2.3.3. Ivory Coast

	One hectare / one head										
	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
VC1	$1,717	$2,220	$9,788	$326	$6,770	1.28	6.73	55%	829%	2.00	1.00
VC2	$648	$979	$453	$284	$686	1.48	2.17	88%	185%	2.00	1.00
VC3	$811	$3,627	$1,728	$2,003	$3,260	3.92	5.76	64%	95%	2.00	2.00
VC4	$1,385	$1,355	$-	$(74)	$(74)	0.95	0.95	-4%	-4%	N/A	N/A
VC5	$7,019	$8,747	$6,323	$849	$5,451	1.15	1.97	11%	36%	8.00	3.00
VC6	$682	$4,354	$1,728	$2,663	$3,921	5.73	7.96	115%	158%	1.00	1.00
VC7	$8	$9	$-	$1	$1	1.10	1.10	19%	19%	1.00	1.00
VC8	$6,033	$13,140	$1,782	$5,123	$6,420	2.11	2.39	92%	110%	2.00	1.00
VC9	$3,908	$5,556	$8,996	$1,107	$7,138	1.41	3.68	210%	1144%	1.00	1.00
VC10	$2,682	$9,482	$1,079	$5,178	$6,046	3.06	3.41	47%	53%	3.00	2.00

Table 42: 1ha/1head portfolio – Ivory Coast

Table 42 shows the results of the 1ha/1head assessment in Ivory Coast. The results are similar to the ones shown in Table 40 (1ha/1head assessment in Ghana), since the BCR of VC4 is the only being negative, while VC9 presents the largest IRR (+200%). In this case, VC6 show the largest BCR (5.73),

	Program															
	Total investment	Revenues generated	Value of externalities	Undiscounted net benefit with externalities	Undiscounted net benefit without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio - Farmers organizations	Debt Service Coverage Ratio - MSMEs	Debt Service Coverage Ratio - COOPERATIVES
VC1	$4,478,221	$5,329,703	$23,817,166	$26,293,957	$1,306,452	$18,390,483	$609,297	19%	313%	7.36	1.12	1.00	2.00	1.38	1.38	1.38
VC2	$4,460,502	$6,905,199	$3,938,407	$7,343,766	$3,142,379	$4,874,747	$1,909,337	41%	86%	2.48	1.45	1.00	2.00	1.94	1.94	2.35
VC3	$2,796,113	$11,429,323	$6,048,155	$18,807,177	$11,473,204	$12,153,895	$7,264,815	59%	87%	5.52	3.22	2.00	2.00	3.41	3.41	3.41
VC4	$4,075,423	$11,059,478	$-	$8,885,952	$8,885,952	$5,765,413	$5,765,413	69%	69%	2.43	2.43	2.00	1.00	3.20	3.20	3.20
VC5	$3,552,672	$4,051,893	$3,237,498	$4,917,123	$1,089,367	$2,843,021	$263,318	7%	30%	2.01	0.97	1.00	5.00	1.31	1.31	1.31
VC6	$3,082,901	$17,999,362	$7,920,989	$28,862,294	$19,334,779	$19,055,097	$12,681,624	101%	140%	7.57	4.76	1.00	1.00	5.09	5.09	5.09
VC7	$4,184,814	$11,980,654	$-	$9,765,986	$9,765,986	$6,425,767	$6,425,767	81%	81%	2.59	2.59	1.00	1.00	3.49	3.49	3.49
VC8	$4,340,518	$8,725,642	$1,291,640	$6,985,058	$5,554,177	$4,532,931	$3,539,976	55%	67%	2.19	1.84	1.00	2.00	2.51	2.51	2.51
VC9	$4,486,460	$5,925,732	$11,291,876	$13,377,032	$1,896,085	$9,386,891	$1,081,329	36%	218%	4.20	1.26	1.00	1.00	1.63	1.63	1.63
VC10	$2,254,589	$9,375,065	$1,267,945	$11,202,099	$9,645,522	$6,983,725	$5,951,496	46%	51%	3.58	3.03	3.00	3.00	2.99	2.99	2.99

Table 43: programme portfolio – Ivory Coast

Table 43 shows the results of the programme assessment in Ivory Coast. The results are again similar to the ones of Ghana (Table 41), since contrary to the 1ha/1head assessment, VC4 shows a positive BCR, while VC5 a negative one. In this case however, VC6 presents an IRR larger than 100%.

2.3.4. Mali

	One hectare / one head										
	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
VC1	$1,305	$1,297	$8,408	$(17)	$5,520	0.98	7.14	-2%	879%	N/A	1.00
VC2	$492	$688	$248	$166	$386	1.37	1.87	70%	142%	2.00	1.00
VC3	$471	$1,890	$956	$995	$1,691	3.45	5.17	50%	75%	2.00	2.00
VC4	$943	$1,030	$-	$53	$53	1.06	1.06	13%	13%	1.00	1.00
VC5	$5,335	$8,553	$5,330	$2,058	$5,937	1.48	2.39	22%	48%	5.00	3.00
VC6	$666	$2,693	$956	$1,445	$2,140	3.62	4.88	68%	93%	2.00	2.00
VC7	$7	$8	$-	$1	$1	1.10	1.10	18%	18%	1.00	1.00
VC8	$9,229	$9,315	$994	$(38)	$686	0.99	1.10	3%	23%	12.00	5.00
VC9	$3,465	$4,222	$8,043	$503	$5,798	1.21	3.45	111%	1001%	1.00	1.00
VC10	$2,378	$10,255	$597	$6,089	$6,569	3.73	3.95	59%	63%	2.00	2.00

Table 44: 1ha/1head portfolio – Mali

Table 44 shows the results of the 1ha/1head assessment in Mali. The results indicate that all VCs produce positive outcomes, and suggested by the NPV, BCR, and IRR, which are always positive. The only exceptions are VC1 and VC8, where the BCR is slightly smaller than 1 (0.98 and 0.99 respectively), with VC1 also showing a negative IRR (-2%) that grows up to 149% if externalities are included.

	Program															
	Total investment	Revenues generated	Value of externalities	Undiscounted net benefit with externalities	Undiscounted net benefit without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio - Farmers organizations	Debt Service Coverage Ratio - MSMEs	Debt Service Coverage Ratio - COOPERATIVES
VC1	$3,201,745	$2,930,323	$19,252,660	$20,147,987	$(50,007)	$14,096,445	$(277,637)	-15%	332%	7.91	0.86	1.00	2.00	0.79	0.79	0.79
VC2	$3,189,077	$4,564,669	$2,028,929	$3,988,775	$1,824,368	$2,588,928	$1,061,252	34%	66%	2.08	1.34	2.00	2.00	2.84	1.67	1.95
VC3	$1,841,571	$6,753,249	$3,797,075	$11,256,775	$6,627,496	$7,179,793	$4,100,874	46%	71%	4.94	2.81	3.00	3.00	5.72	5.72	5.72
VC4	$2,985,255	$8,285,664	$-	$6,661,648	$6,661,648	$4,366,441	$4,366,441	77%	77%	2.51	2.51	1.00	1.00	6.74	6.74	6.74
VC5	$2,540,016	$3,727,430	$2,567,538	$4,848,041	$1,812,392	$2,945,223	$899,358	18%	40%	2.40	1.25	3.00	4.00	2.52	2.52	2.52
VC6	$2,204,149	$8,139,113	$3,203,704	$11,697,266	$7,843,791	$7,560,451	$4,982,652	60%	82%	4.60	3.01	2.00	2.00	6.72	6.72	6.72
VC7	$2,949,366	$8,913,218	$-	$7,493,745	$7,493,745	$4,932,524	$4,932,524	83%	83%	2.72	2.72	1.00	1.00	7.36	7.36	7.36
VC8	$3,198,826	$2,998,827	$346,193	$397,000	$31,981	$37,888	$(221,301)	-8%	5%	1.01	0.88	2.00	2.00	0.90	0.90	0.90
VC9	$3,207,636	$3,630,905	$7,717,615	$8,543,530	$696,813	$5,965,763	$288,733	17%	194%	3.89	1.08	1.00	1.00	1.68	1.68	1.68
VC10	$1,611,939	$8,174,436	$565,503	$9,486,499	$8,792,266	$5,999,334	$5,538,960	57%	60%	4.04	3.69	3.00	3.00	7.06	7.06	7.06

Table 45: programme portfolio – Mali

Table 45 shows the results of the programme assessment in Mali. Like in the 1ha/1head assessment, all the VCs produce positive results except VC1 and VC8.

2.3.5. Senegal

	One hectare / one head										
	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
VC1	$1,545	$1,759	$8,408	$131	$5,668	1.12	6.33	29%	768%	1.00	1.00
VC2	$583	$930	$248	$300	$520	1.57	1.98	100%	160%	1.00	1.00
VC3	$751	$2,953	$956	$1,558	$2,253	3.47	4.57	58%	77%	1.00	1.00
VC4	$1,147	$1,219	$-	$33	$33	1.03	1.03	8%	8%	1.00	1.00
VC5	$6,317	$8,677	$5,330	$1,360	$5,240	1.27	2.03	15%	38%	2.00	1.00
VC6	$676	$2,628	$-	$1,388	$1,388	3.48	3.48	65%	65%	1.00	1.00
VC7	$7	$8	$-	$1	$1	1.10	1.10	19%	19%	1.00	1.00
VC8	$2,487	$8,220	$999	$4,191	$4,919	3.21	3.59	179%	204%	2.00	1.00
VC9	$3,613	$5,000	$8,051	$931	$6,232	1.38	3.53	191%	1046%	1.00	1.00
VC10	$2,479	$5,724	$597	$2,319	$2,800	2.00	2.21	27%	31%	4.00	4.00

Table 46: 1ha/1head portfolio – Senegal

Table 46 shows the results of the 1ha/1head assessment in Senegal. In this case, the results show positive BCR and IRR values for all the value chains.

	Program															
	Total investment	Revenues generated	Value of externalities	Undiscounted net benefit with externalities	Undiscounted net benefit without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio - Farmers organizations	Debt Service Coverage Ratio - MSMEs	Debt Service Coverage Ratio - COOPERATIVES
VC1	$4,478,221	$4,692,693	$22,739,479	$24,450,292	$594,271	$17,070,452	$93,103	7%	290%	6.94	0.98	1.00	2.00	1.26	1.26	1.26
VC2	$4,460,502	$7,292,794	$2,396,386	$6,138,472	$3,582,072	$4,030,044	$2,225,693	47%	74%	2.16	1.53	1.00	1.00	3.03	2.15	2.65
VC3	$2,868,916	$10,304,950	$3,702,856	$14,412,903	$9,931,487	$9,215,958	$6,226,022	52%	70%	4.24	2.86	3.00	3.00	4.96	4.96	4.96
VC4	$4,152,487	$11,464,828	$-	$9,217,756	$9,217,756	$6,027,355	$6,027,355	75%	75%	2.49	2.49	1.00	1.00	5.36	5.36	5.36
VC5	$3,552,672	$4,465,994	$3,032,541	$5,190,141	$1,604,711	$3,034,274	$617,886	11%	32%	2.04	1.07	3.00	5.00	1.79	1.79	1.79
VC6	$3,082,901	$10,950,496	$4,417,253	$15,736,006	$10,422,851	$10,149,039	$6,594,781	57%	79%	4.46	2.90	2.00	2.00	5.21	5.21	5.21
VC7	$4,150,469	$12,266,331	$-	$10,185,022	$10,185,022	$6,703,141	$6,703,141	82%	82%	2.66	2.66	1.00	1.00	5.81	5.81	5.81
VC8	$4,353,589	$13,285,852	$1,762,147	$12,811,158	$10,864,522	$7,949,872	$6,706,070	106%	122%	3.21	2.72	1.00	1.00	6.61	6.61	6.61
VC9	$4,486,460	$5,768,519	$10,406,503	$12,305,545	$1,725,101	$8,611,102	$955,618	32%	201%	3.93	1.22	1.00	1.00	2.06	2.06	2.06
VC10	$2,254,589	$6,121,055	$758,675	$6,384,343	$5,452,965	$3,730,293	$3,112,659	27%	31%	2.31	1.98	5.00	5.00	3.21	3.21	3.21

Table 47: programme portfolio – Senegal

Table 47 shows the results of the programme assessment in Senegal. Contrary to the 1ha/1head assessment (Table 46) the BCR of VC1 is negative (VC1). All the IRRs are positive, although with high variability, from 7% in VC1 to 106% in VC8.

2.4. Results: portfolio analysis

GCF involvement is critical for the effective implementation of this program, to make investments more economically viable and also create awareness about CC impacts and available investments to improve climate resilience. Support can be targeted, with a differentiated approach for different types of beneficiaries. The following sections present results aggregated by beneficiary and by country, to determine the extent to which the investments implemented will be more or less beneficiary for specific beneficiaries in each country. These results may then inform the approach used to offer targeted support to farmers (e.g. with the provision of more advantageous financing conditions for farmers organisations, which normally face the highest financing risk).

The portfolio compositions were prepared together with the agricultural banks from each country (see Annex 2).

2.4.1. Burkina Faso

	Portfolio composition		
	FOs	MSME	Cooperatives
VC1			
VC2			
VC3			29.63%
VC4			
VC5			25.93%
VC6	0.40%		
VC7		100.00%	44.44%
VC8	98.94%		
VC9	0.66%		
VC10			

Table 48: Portfolio composition in Burkina Faso

	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR
FOs	$1,947.57	$2,660	1.43	1.59	43%	59%
MSME	$0.64	$0.64	1.09	1.09	19%	19%
Cooperatives	$622.21	$1,749	1.86	2.66	29%	45%

Table 49: 1ha/1head – beneficiaries in Burkina Faso

	S-NPV	NPV	S- IRR (lifetime)	IRR (lifetime)	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio
FOs	$1,114,206	$761,709	32%	24%	1.42	1.22	1.99	2.00	2.13
MSME	$4,235,979	$4,235,979	82%	82%	2.54	2.54	1.00	1.00	5.83
Cooperatives	$4,613,232	$3,181,530	69%	55%	3.25	2.22	1.81	2.63	4.59

Table 50: programme – beneficiaries in Burkina Faso

Table 48 shows the portfolio composition in Burkina Faso. FOs and MSME will receive funding for mainly one VC each, VC8 and VC7 respectively. This is why the results shown in Table 49 and Table 50 for these

beneficiaries are similar, if not identical, to those VCs. On the other hand, the portfolio of cooperatives is a mix between VC3, VC5, and VC7.

2.4.2. Ghana

	Portfolio composition		
	FOs	MSME	Cooperatives
VC1	8.73%		
VC2	15.87%		
VC3			
VC4			
VC5	23.81%		
VC6	19.84%		
VC7		100.00%	
VC8	17.86%		
VC9	13.89%		
VC10			

Table 51: Portfolio composition in Ghana

	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR
FOs	$769	$2,804	1.70	3.11	79%	302%
MSME	$0	$0.47	1.06	1.06	19%	19%
Cooperatives	$-	$-	0.00	-	0%	0%

Table 52: 1ha/1head – beneficiaries in Ghana

	S-NPV	NPV	S- IRR (lifetime)	IRR (lifetime)	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio
FOs	$4,582,547	$1,363,477	103%	35%	3.32	1.27	1.89	2.65	2.01
MSME	$4,011,263	$4,011,263	81%	81%	2.09	2.09	1.00	1.00	3.66
Cooperatives	$-	$-	0%	0%	0.00	0.00	0.00	0.00	0.00

Table 53: programme – beneficiaries in Ghana

Table 51 shows the portfolio composition in Ghana. In this case, cooperatives are not considered. Like in Burkina Faso, also in this country MSME will receive investments only for VC7. The portfolio of FOs is a mix of six different VCs, showing positive results in both the 1ha/1head assessment (Table 52) as well as in the programme assessment (Table 53).

2.4.3. Ivory Coast

	Portfolio composition		
	FOs	MSME	Cooperatives
VC1	29.76%	55.56%	
VC2	8.47%		33.33%
VC3			
VC4			
VC5	29.76%		
VC6			
VC7			
VC8	0.28%		33.33%
VC9			
VC10	31.74%	44.44%	33.33%

Table 54: Portfolio composition in Ivory Coast

	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR
FOs	$2,031	$5,632	1.83	3.86	42%	290%
MSME	$2,482	$6,449	2.07	5.25	52%	484%
Cooperatives	$3,528	$4,384	2.22	2.66	75%	116%

Table 55: 1ha/1head – beneficiaries in Ivory Coast

	S-NPV	NPV	S- IRR (lifetime)	IRR (lifetime)	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio
FOs	$8,960,526	$2,320,223	126%	26%	4.14	1.71	1.63	3.21	1.92
MSME	$13,320,813	$2,983,608	197%	31%	5.68	1.97	1.89	2.44	2.09
Cooperatives	$5,463,801	$3,800,270	68%	47%	2.75	2.11	1.67	2.33	2.62

Table 56: programme – beneficiaries in Ivory Coast

Table 54 shows the portfolio composition in Ivory Coast. Each beneficiary shows a portfolio with a different mix of VCs, from cooperatives, where investments in three value chains are split equally, to FOs, where VC8 represents only 0.28% of the total investment, while VC10 accounts for almost one-third of it.
Nevertheless, the financial and economic indicators shown in both Table 55 and Table 56 are similar among these countries.

2.4.4. Mali

	Portfolio composition		
	FOs	MSME	Cooperatives
VC1			
VC2			
VC3	33.33%	29.39%	11.11%
VC4		23.51%	55.56%
VC5		19.84%	
VC6	33.33%	3.67%	22.22%
VC7		13.96%	
VC8	33.33%	5.95%	
VC9		3.67%	
VC10			11.11%

Table 57: Portfolio composition in Mali

	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR
FOs	$801	$1,506	2.69	3.72	40%	63%
MSME	$783	$2,020	1.95	2.77	31%	79%
Cooperatives	$1,138	$1,423	2.19	2.69	34%	43%

Table 58: 1ha/1head – beneficiaries in Mali

	S-NPV	NPV	S- IRR (lifetime)	IRR (lifetime)	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio
FOs	$4,926,044	$2,954,075	53%	33%	3.51	2.23	2.33	2.33	4.45
MSME	$4,908,852	$3,279,398	69%	49%	3.27	2.24	2.08	2.28	5.15
Cooperatives	$5,570,248	$4,604,149	76%	68%	3.41	2.78	1.67	1.67	6.66

Table 59: programme – beneficiaries in Mali

Table 57 shows the portfolio composition in Mali. The portfolio of each beneficiary is a mix of different VCs. The NPV, IRR, and BCR shown in both Table 58 and Table 59 indicate that these portfolios in Mali will generate positive outcomes for all the interested beneficiaries.

2.4.5. Senegal

	Portfolio composition		
	FOs	MSME	Cooperatives
VC1		43.76%	
VC2			
VC3		22.45%	36.14%
VC4			
VC5		2.75%	
VC6		11.68%	53.49%
VC7			
VC8			
VC9			
VC10		19.35%	10.37%

Table 60: Portfolio composition in Senegal

	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR
FOs	$-	$-	0.00	-	0%	0%
MSME	$1,055	$3,835	2.10	4.68	39%	368%
Cooperatives	$1,546	$1,847	3.32	3.74	58%	66%

Table 61: 1ha/1head – beneficiaries in Senegal

	S-NPV	NPV	S- IRR (lifetime)	IRR (lifetime)	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio
FOs	$-	$-	0%	0%	0.00	0.00	0.00	0.00	0.00
MSME	$11,530,778	$2,828,317	159%	27%	5.01	1.82	2.39	2.89	2.95
Cooperatives	$9,146,381	$6,100,512	71%	52%	4.16	2.79	2.67	2.67	4.91

Table 62: programme – beneficiaries in Senegal

Table 60 shows the portfolio composition in Senegal. In this case, FOs are not considered, while the portfolio compositions of both MSME and cooperatives generate positive IRR, BCR and NPV, as indicated in both Table 61 and Table 62.

2.5. Estimating GCF contribution

As indicated earlier, the implementation of the project would allow to reduce the interest rate when compared to the standard agricultural bank funds, as indicated in Table 63.

Country	Interest Rate Local Currency Interest Rate US$			
	GCF-IGREENFIN	Agricultural Banks Fund	Commercial Banks Fund or MFIs	Average final interest rate to end users
Burkina Faso	0%	12.0%	5%	5%
Côte d'Ivoire	0%	12.5%	4%	4%
Ghana	0%	20.5%	9.5%	9.5%
Mali	0%	8.63%	4%	4%
Senegal	0%	12.5%	4%	4%

Table 63: interest rates applied in each country, considering GCF contribution ("Commercial Banks Funds or MFIs") and without it ("Agricultural Banks Fund").

The next tables show the NPV, S-NPV, BCR, and S-BCR, for each country and beneficiary considering the portfolio compositions shown in section 2.4.

2.5.1. Burkina Faso

		NPV	S-NPV	BCR	S-BCR
With GCF	**FOs**	$1,948	$ 2,660	1.43	1.59
	MSME	$0.64	$ 0.64	1.09	1.09
	Cooperatives	$622	$ 1,749	1.86	2.66
Without GCF	**FOs**	$1,082	$ 3,639	1.34	2.13
	MSME	$0.30	$ 0.30	1.04	1.04
	Cooperatives	$271.20	$ 990	1.57	2.19

Table 64: 1ha/1head – beneficiaries in Burkina Faso – GCF Contribution

		S-NPV	NPV	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	Debt Service Coverage Ratio
With GCF	**FOs**	$ 1,114,206	$761,709	1.42	1.22	2.13
	MSME	$ 4,235,979	$4,235,979	2.54	2.54	5.83
	Cooperatives	$ 4,613,232	$3,181,530	3.25	2.22	4.59
Without GCF	**FOs**	$ 543,027	$317,367	1.20	0.96	1.51
	MSME	$ 2,373,126	$2,373,126	1.92	1.92	3.95
	Cooperatives	$ 2,510,514	$1,660,628	2.52	1.53	3.21

Table 65: programme – beneficiaries in Burkina Faso – GCF Contribution

Table 64 and Table 65 show the S-NPV, NPV, BCR, and S-BCR of both the 1ha/1head and programme assessments for three beneficiaries in Burkina Faso, considering their portfolio composition, as well as different interest rates, which are lower with the GCF contribution. The results indicate that the GCF contribution is relevant for all beneficiaries, in particular for FOs, since for example in the programme assessment their BCR would decrease from 1.43 to 0.96.

2.5.2. Ghana

		NPV	S-NPV	BCR	S-BCR
With GCF	**FOs**	$769	$2,804	1.70	3.11
	MSME	$0.47	$0.47	1.06	1.06
	Cooperatives	$-	$-	0.00	-
Without GCF	**FOs**	$219	$1,334	1.44	2.64
	MSME	$(0)	$(0)	0.99	0.99
	Cooperatives	$-	$-	0.00	-

Table 66: 1ha/1head – beneficiaries in Ghana – GCF Contribution

		S-NPV	NPV	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	Debt Service Coverage Ratio
With GCF	**FOs**	$4,582,547	$1,363,477	3.32	1.27	2.01
	MSME	$4,011,263	$4,011,263	2.09	2.09	3.66
	Cooperatives	$-	$-	0.00	0.00	0.00
Without GCF	**FOs**	$2,174,034	$434,324	2.82	0.82	1.50
	MSME	$1,816,990	$1,816,990	1.36	1.36	2.68
	Cooperatives	$-	$-	0.00	0.00	0.00

Table 67: programme – beneficiaries in Ghana – GCF Contribution

Table 66 and Table 67 show the S-NPV, NPV, BCR, and S-BCR of both the 1ha/1head and programme assessments for two beneficiaries in Ghana, considering their portfolio composition, as well as different interest rates, which are lower with the GCF contribution. As both tables indicate, the BCR of MSME (1ha/1head) and of FOs (programme) would be negative without the contribution of the GCF, suggesting that those investments would not be viable without such support.

2.5.3. Ivory Coast

		NPV	S-NPV	BCR	S-BCR
With GCF	**FOs**	$2,031	$5,632	1.83	3.86
	MSME	$2,482	$6,449	2.07	5.25
	Cooperatives	$3,528	$4,384	2.22	2.66
Without GCF	**FOs**	$962	$2,871	1.51	3.32
	MSME	$1,402	$3,390	1.71	4.59
	Cooperatives	$2,002	$2,466	1.89	2.24

Table 68: 1ha/1head – beneficiaries in Ivory Coast – GCF Contribution

		S-NPV	NPV	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	Debt Service Coverage Ratio
With GCF	**FOs**	$8,960,526	$2,320,223	4.14	1.71	1.92
	MSME	$13,320,813	$2,983,608	5.68	1.97	2.09
	Cooperatives	$5,463,801	$3,800,270	2.75	2.11	2.62
Without GCF	**FOs**	$4,529,027	$851,321	3.84	1.03	1.42
	MSME	$7,023,742	$1,206,577	5.59	1.16	1.53
	Cooperatives	$2,569,165	$1,689,054	2.03	1.34	1.75

Table 69: programme – beneficiaries in Ivory Coast – GCF Contribution

Table 68 and Table 69 show the S-NPV, NPV, BCR, and S-BCR of both the 1ha/1head and programme assessments for three beneficiaries in Ivory Coast, considering their portfolio composition, as well as different interest rates, which are lower with the GCF contribution. The BCRs would be always positive even without the GCF contribution, even though they would be significantly lower. However, NPVs with the GCF would be almost twice larger with the GCF, suggesting the importance of such support.

2.5.4. Mali

		NPV	S-NPV	BCR	S-BCR
With GCF	**FOs**	$801	$1,506	2.69	3.72
	MSME	$783	$2,020	1.95	2.77
	Cooperatives	$1,138	$1,423	2.19	2.69
Without GCF	**FOs**	$521	$1,034	2.35	3.22
	MSME	$485	$1,372	1.73	2.43
	Cooperatives	$823	$1,034	1.95	2.37

Table 70: 1ha/1head – beneficiaries in Mali – GCF Contribution

		S-NPV	NPV	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	Debt Service Coverage Ratio
With GCF	**FOs**	$4,926,044	$2,954,075	3.51	2.23	4.45
	MSME	$4,908,852	$3,279,398	3.27	2.24	5.15
	Cooperatives	$5,570,248	$4,604,149	3.41	2.78	6.66
Without GCF	**FOs**	$3,134,598	$1,823,744	2.89	1.65	3.30
	MSME	$3,177,678	$2,083,071	2.74	1.74	3.71
	Cooperatives	$3,633,258	$2,992,526	2.75	2.14	4.76

Table 71: programme – beneficiaries in Mali – GCF Contribution

Table 70 and Table 71 show the S-NPV, NPV, BCR, and S-BCR of both the 1ha/1head and programme assessments for three beneficiaries in Mali, considering their portfolio composition, as well as different interest rates, which are lower with the GCF contribution. The BCRs would be always positive even without the GCF contribution, even though they would be significantly lower. However, NPVs with the lower interest rates of the GCF would be significantly larger with the GCF, suggesting the importance of such support.

2.5.5. Senegal

		NPV	S-NPV	BCR	S-BCR
With GCF	**FOs**	$-	$-	0.00	-
	MSME	$1,055	$3,835	2.10	4.68
	Cooperatives	$1,546	$1,847	3.32	3.74
Without GCF	**FOs**	$-	$-	0.00	-
	MSME	$500	$2,010	1.71	4.17
	Cooperatives	$798	$1,191	2.58	3.40

Table 72: 1ha/1head – beneficiaries in Senegal – GCF Contribution

		S-NPV	NPV	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	Debt Service Coverage Ratio
With GCF	**FOs**	$-	$-	0.00	0.00	0.00
	MSME	$11,530,778	$2,828,317	5.01	1.82	2.95
	Cooperatives	$9,146,381	$6,100,512	4.16	2.79	4.91
Without GCF	**FOs**	$-	$-	0.00	0.00	0.00
	MSME	$5,959,040	$1,114,297	4.82	1.11	1.97
	Cooperatives	$4,176,415	$2,678,002	2.83	1.57	3.22

Table 73: programme – beneficiaries in Senegal – GCF Contribution

Table 72 and Table 73 show the S-NPV, NPV, BCR, and S-BCR of both the 1ha/1head and programme assessments for two beneficiaries in Senegal, considering their portfolio composition, as well as different interest rates, which are lower with the GCF contribution. The BCRs would be always positive even without the GCF contribution, even though they would be significantly lower. However, NPVs with the GCF would be almost two times larger with the GCF, suggesting the importance of such support.

2.6. Sensitivity analysis

The sensitivity analysis shown in this section considers three different alternative scenarios, always assuming the GCF intervention. The first one assumes that costs are 20% higher than the base case, the second one also expects that costs are 20% higher but also that benefits are 20% lower than the base case. Finally, the third scenario assumes that benefits are 20% lower than the base case. In the tables below, we compare the results of the IRR and of the NPV. IRR outputs are also compared to references from the literature. Only the 1ha/1head assessment has been considered.

2.6.1. VC1-Sustainable Tree crop (Cashew)

	Base case		Costs +20%		Costs +20% Benefits -20%		Benefits -20%	
	IRR	NPV	IRR	NPV	IRR	NPV	IRR	NPV
Burkina Faso	74%	$328.84	34%	$154.71	Negative	$(85.18)	26%	$88.95
Ghana	35%	$109.50	-9%	$(53.59)	Negative	$(238.58)	Negative	$(75.49)
Ivory Coast	55%	$325.72	18%	$89.26	Negative	$(212.34)	9%	$24.12
Mali	-2%	$(17.19)	Negative	$(196.90)	Negative	$(373.17)	Negative	$(193.46)
Senegal	29%	$130.93	Negative	$(81.88)	Negative	$(320.88)	Negative	$(108.07)

Table 74: VC1 – Sensitivity Analysis – 1ha

As Table 74 shows, under the base case scenario the investment in VC1 is negative only in Mali. However, if costs are 20% higher, it becomes profitable in Burkina Faso and Ivory Coast. This is true also under the third scenario, where costs do not change from the base case, but where benefits are 20% lower. If costs are higher and at the same time the benefits are lower than 20%, then investing in VC1 is not profitable in any of the five countries considered in this study. We conclude that the GCF support is always essential in Ghana and Senegal, while it is needed under certain scenarios in Burkina Faso and Ivory Coast, while in Mali the investment is never profitable.

According to the literature, the inclusion of cashew in agroforestry systems generates a positive IRR (+40%) (Loganathan, Mani, Mariappan, & Indrakumar, 2016). This result is aligned with most of the IRRs shown in the base case scenario.

2.6.2. VC2-Sustainable Cassava

	Base case		Costs +20%		Costs +20% Benefits -20%		Benefits -20%	
	IRR	NPV	IRR	NPV	IRR	NPV	IRR	NPV
Burkina Faso	64%	$168.47	29%	$74.91	-17%	$(52.35)	22%	$41.21
Ghana	117%	$345.53	75%	$237.62	28%	$60.60	66%	$168.51
Ivory Coast	88%	$284.34	49%	$166.97	2%	$(7.27)	40%	$110.10
Mali	70%	$166.17	32%	$76.97	-19%	$(45.47)	24%	$43.74
Senegal	100%	$299.91	60%	$194.28	14%	$28.67	51%	$134.30

Table 75: VC2 – Sensitivity Analysis – 1ha

As Table 75 indicates, under the base case scenario, investing in VC2 is always profitable in all the five countries considered in this assessment. This is true also if costs increase by 20% or if the values of benefits decrease by 20% from the base case. However, under the scenario where costs increase and the benefits decrease, then both the IRR and NPV in Burkina Faso and Mali become negative, while in Ivory Coast the NPV is also negative, and the IRR is very close to 0%.

The values of the IRRs shown under the base case are aligned with the literature, since Alene et al (2018) indicated that investing in sustainable cassava can generate IRRs whose values range between 23% to more than 400%.

2.6.3. VC3-Sustainable cereal production (Groundnut)

	Base case		Costs +20%		Costs +20% Benefits -20%		Benefits -20%	
	IRR	NPV	IRR	NPV	IRR	NPV	IRR	NPV
Burkina Faso	54%	$820.50	44%	$754.16	33%	$523.71	41%	$590.06
Ghana	66%	$1,241.02	53%	$1,133.67	40%	$778.10	51%	$885.46
Ivory Coast	64%	$2,002.80	52%	$1,865.83	39%	$1,328.30	49%	$1,465.27
Mali	50%	$995.33	40%	$914.24	30%	$634.08	38%	$715.17
Senegal	58%	$1,557.68	46%	$1,431.46	35%	$993.70	44%	$1,119.92

Table 76: VC3 – Sensitivity Analysis – 1ha

Table 76 shows the values of IRR and NPV under different sensitivity scenarios for VC3. As the table indicates, every scenario shows positive results. We conclude that in this case the intervention of the GCF is needed only to increase the benefits from the investments in this CRLEA.

Accordingly, to the literature (Rathod & Trivedi, 2011), investing in sustainable groundnut generates IRRs whose values range from 20% to 70%, similar to the values shown under the base case scenario.

2.6.4. VC4-Sustainable livestock Cattle

	Base case		Costs +20%		Costs +20% Benefits -20%		Benefits -20%	
	IRR	NPV	IRR	NPV	IRR	NPV	IRR	NPV
Burkina Faso	10%	$35.57	-16%	$(163.74)	-41%	$(370.17)	-21%	$(170.86)
Ghana	2%	$(67.94)	-22%	$(338.85)	-46%	$(596.17)	-27%	$(325.26)
Ivory Coast	-4%	$(74.39)	-26%	$(349.78)	-49%	$(610.29)	-31%	$(334.90)
Mali	13%	$53.24	-14%	$(134.10)	-40%	$(332.08)	-19%	$(144.75)
Senegal	8%	$33.05	-17%	$(194.80)	-43%	$(429.26)	-22%	$(201.41)

Table 77: VC4 – Sensitivity Analysis – 1head

Table 77 indicates that investing in sustainable livestock is not profitable under the base case scenario only in Ivory Coast, where both the IRR and NPV are negative, and Ghana, where the NPV is negative, and the IRR is very close to 0%. Under all the other scenarios, where costs increase, benefits decrease, or both, the investment is never profitable. In other words, the GCF intervention is critical to generate profitable outputs in most countries.

According to the World Bank (2018), investing in sustainable livestock generates an IRR close to 45% in Zambia. No other references have been found.

2.6.5. VC5-Sustainable tree crop (Mango)

	Base case		Costs +20%		Costs +20% Benefits -20%		Benefits -20%	
	IRR	NPV	IRR	NPV	IRR	NPV	IRR	NPV
Burkina Faso	19%	$1,461.12	10%	$601.94	-1%	$(549.46)	8%	$309.72
Ghana	10%	$6.63	1%	$(920.90)	-15%	$(1,849.74)	-1%	$(922.22)
Ivory Coast	11%	$848.91	2%	$(277.80)	-13%	$(1,574.29)	0%	$(447.58)
Mali	22%	$2,057.54	14%	$1,201.24	3%	$(66.57)	12%	$789.73
Senegal	15%	$1,360.27	7%	$346.23	-5%	$(939.86)	5%	$74.18

Table 78: VC5 – Sensitivity Analysis – 1ha

As Table 78 shows, under the base case scenario the investment in VC5 is never negative. However, if costs are 20% higher, it becomes unprofitable in Ghana and Ivory Coast, where the NPVs are negative, and the IRRs are very close to zero. This is true also under the third scenario, where costs do not change from the base case, but where benefits are 20% lower. If costs are higher and at the same time the benefits are lower than 20%, then investing in VC5 is not profitable in any of the five countries considered in this study (only the IRR of Mali is positive, but still close to 0%). We conclude that the GCF support is always essential in Ghana and Ivory Coast while it is needed under certain scenarios in all the other countries.

Accordingly, to the literature (Sowjanya, Vijaya, Rajeswara, & Kulkarni, 2013), investing in sustainable Mango generates an IRR close to 20% similar to the values shown under the base case scenario.

2.6.6. VC6-Sustainable cereal production (Millet)

	Base case		Costs +20%		Costs +20% Benefits -20%		Benefits -20%	
	IRR	NPV	IRR	NPV	IRR	NPV	IRR	NPV
Burkina Faso	60%	$1,126.15	48%	$1,023.18	35%	$694.98	45%	$797.95
Ghana	66%	$953.76	52%	$859.38	39%	$574.25	50%	$668.63
Ivory Coast	115%	$2,663.18	94%	$2,550.45	72%	$1,905.09	89%	$2,017.82
Mali	68%	$1,444.54	54%	$1,334.31	40%	$935.17	51%	$1,045.40
Senegal	65%	$1,388.28	52%	$1,276.46	38%	$886.98	49%	$998.80

Table 79: VC6 – Sensitivity Analysis – 1ha

Table 79 shows the values of IRR and NPV under different sensitivity scenarios for VC6. As the table indicates, every scenario shows positive results. We conclude that in this case the intervention of the GCF is needed only to increase the benefits from the investments in this CRLEA.

Accordingly, to the literature (FAO, 2016), investing in sustainable millet generates IRRs whose values range from 90% to 145%, similar to the values shown under the base case scenario.

2.6.7. VC7-Poultry Adapted Breeds

	Base case		Costs +20%		Costs +20% Benefits -20%		Benefits -20%	
	IRR	NPV	IRR	NPV	IRR	NPV	IRR	NPV
Burkina Faso	19%	$0.64	-8%	$(0.75)	-36%	$(2.27)	-14%	$(0.88)
Ghana	19%	$0.47	-9%	$(1.07)	-36%	$(2.70)	-14%	$(1.16)
Ivory Coast	19%	$0.75	-9%	$(0.75)	-36%	$(2.40)	-14%	$(0.90)
Mali	18%	$0.71	-8%	$(0.72)	-35%	$(2.29)	-14%	$(0.86)
Senegal	19%	$0.72	-8%	$(0.73)	-36%	$(2.32)	-14%	$(0.87)

Table 80: VC7 – Sensitivity Analysis – 1head

Table 80 indicates that under the base case scenario, investing in adapted breed of poultry generates positive outcomes in all the countries considered in this study. However, under all the other scenarios, where costs increase, benefits decrease, or both, the investment is never profitable. In other words, the GCF intervention is always critical to generate profitable outputs.

Accordingly, to the literature (Miklyaev, Afra, & Hashemi, 2017), investing in adapted breeds of poultry generates IRRs around 50%.

2.6.8. VC8-Sustainable cereal production (Rice)

	Base case		Costs +20%		Costs +20% Benefits -20%		Benefits -20%	
	IRR	NPV	IRR	NPV	IRR	NPV	IRR	NPV
Burkina Faso	42%	$1,960.17	23%	$1,025.93	-2%	$(300.35)	19%	633.89
Ghana	71%	$2,306.48	48%	$1,672.16	24%	$576.54	43%	1,210.86
Ivory Coast	92%	$5,122.63	65%	$4,199.51	39%	$2,251.87	60%	3,174.98
Mali	3%	$(38.27)	Negative	$(1,426.61)	Negative	$(2,807.30)	Negative	-1,418.96
Senegal	179%	$4,191.33	138%	$3,811.20	97%	$2,592.81	129%	2,972.94

Table 81: VC8 – Sensitivity Analysis – 1ha

As Table 81 shows, investing in VC8 always generates positive outcomes under the base case scenario, with the exception of Mali where the NPV is negative. This is true also if costs increase by 20% from the base case or if the value of the benefits decreases by 20%. If both costs increase and benefits decrease, the investment becomes negative also in Burkina Faso, but it remains positive in all the other three remaining countries.

Investing in sustainable rice production generates different values of IRR, which range from 30% (GIZ, 2020) to 150% (RICOWAS Full Proposal, 2021). Therefore, the values of IRR shown in the base case scenario are aligned with the literature.

2.6.9. VC9-Sustainable Tree Crop production (Shea)

	Base case		Costs +20%		Costs +20% Benefits -20%		Benefits -20%	
	IRR	NPV	IRR	NPV	IRR	NPV	IRR	NPV
Burkina Faso	129%	$550.29	27%	$106.61	Negative	$(447.13)	4%	$(3.45)
Ghana	211%	$735.37	96%	$373.47	Negative	$(135.49)	73%	$226.40
Ivory Coast	210%	$1,106.63	95%	$573.09	Negative	$(181.77)	72%	$351.76
Mali	111%	$502.79	11%	$29.66	Negative	$(544.04)	Negative	$(70.90)
Senegal	191%	$930.53	79%	$437.26	Negative	$(242.12)	57%	$251.15

Table 82: VC9 – Sensitivity Analysis – 1ha

Table 82 indicates that under the base case scenario, investing in sustainable shea production generates positive outcomes in all the countries considered in this study. This is true also if costs increase by 20%. If the values of benefits decrease by 20% compared to the base case, the investment is negative in Mali and also Burkina Faso. Finally, if both costs increase, and benefits decrease by 20% respectively, then the investment is never positive. We conclude that the support of the GCF is needed under certain scenarios, depending on the assumption of the sensitivity analysis.

Investing in sustainable shea production generates different values of IRR, which range from 56% to 100% (FAO; GSA;, 2020). Therefore, the values of IRR shown in the base case scenario may be overestimated, in some cases, but for Ghana, Ivory Coast, and Mali, they would be more aligned with the increased costs scenario as well as with the decreased benefits scenario.

2.6.10. VC10-Sustainable Horticulture (Tomato)

	Base case		Costs +20%		Costs +20% Benefits -20%		Benefits -20%	
	IRR	NPV	IRR	NPV	IRR	NPV	IRR	NPV
Burkina Faso	52%	$4,927.76	41%	$4,478.95	31%	$3,044.58	39%	$3,493.40
Ghana	66%	$5,899.77	54%	$5,412.28	41%	$3,744.84	51%	$4,232.33
Ivory Coast	47%	$5,177.76	38%	$4,675.24	28%	$3,137.16	36%	$3,639.69
Mali	59%	$6,088.93	48%	$5,643.30	36%	$3,979.88	46%	$4,425.51
Senegal	27%	$2,319.17	20%	$1,854.58	13%	$926.14	19%	$1,390.74

Table 83: VC10 – Sensitivity Analysis – 1ha

Table 83 shows the values of IRR and NPV under different sensitivity scenarios for VC10. As the table indicates, every scenario shows positive results. We conclude that in this case the intervention of the GCF is needed only to increase the benefits from the investments in this CRLEA.

Accordingly, to the literature, investing in sustainable horticulture (tomato) (Gebrezgabher, Leh, Merrey, Kodua, & Schmitter, 2021) generates IRRs of 58%, similar to the values shown under the base case scenario.

Annex 1: documentation of models and assumptions

Sustainable Tree crop (Cashew)

INVESTMENTS	
Capital costs	The document *"Recuperatio de 55 ha de terres degradees: confection de demis lunes sous forme de cash for work"* indicated the capital cost of trees. These costs were confirmed and adjusted by IFAD
Hired Labour	Van Der Wijngaart et al. (2019) indicated that in the Sahel region, the cost of hired labour for cultivating fruits and nuts amounts to 37 USD/ha. These costs were confirmed and adjusted by IFAD
Fertilisers	Van Der Wijngaart et al. (2019) indicated that in the Sahel region, the cost of fertilizers for cultivating fruits and nuts amounts to 9 USD/ha. These costs were confirmed and adjusted by IFAD
Irrigation	Van Der Wijngaart et al. (2019) indicated that in the Sahel region, the cost of fertilizers for cultivating fruits and nuts amounts to 0 USD/ha, since we are considering only rainfed agriculture. These costs were confirmed and adjusted by IFAD
Other inputs	Van Der Wijngaart et al. (2019) indicated that in the Sahel region the cost of other inputs for cultivating fruits and nuts (seeds, pesticides, machinery, fuel, electricity, taxes, transport) amounts to 29 USD/ha. These costs were confirmed and adjusted by IFAD
AVOIDED COSTS	
Water Pollution	Curtis (2004) provides estimates of avoided water quality costs from reduced nutrient concentratio in water. In the case of Nitrogen (N), the average value is 11.71 Int$ per hectare per year. This value was then multiplied by the area covered by trees (1 ha).
Carbon sequestration	Provided by IFAD
ADDED BENEFITS	
Revenues	We calculated the revenues (in USD/ha) per country by dividing the national wholesale prices of cashew by the average national yield of the same crop. Wholesale proces have been retrived from Selina Wamucii (2021) and by the European Commission (2020). National yields have been retrived from FAOSTAT (FAO, 2021). Next, we multiplied the revenues by 21%, which is the reported increase of cashew productivity from sustainable practices (Olam Nuts, 2020)

Sustainable Cassava

INVESTMENTS	
Capital costs	Capital costs were indicated by IFAD
O&M costs	O&M costs were assumed and confirmed by IFAD
AVOIDED COSTS	
Carbon sequestration	Provided by IFAD

ADDED BENEFITS	
Revenues	We downloaded national wholesale prices of cassava from Selina Wamucii, expressed in USD/tons (2021). Next, multiplied those values by the increase of productivity (t/ha) due to intercropping systems (Joint, F.A.O, 2018)

Sustainable Groundnut Production

INVESTMENTS	
Capital costs	From the World Bank (2017) we retrieved the capital costs of efficient water management techniques to increase groundnut productivity
O&M costs	From the World Bank (2017) we retrieved the O&M costs of efficient water management techniques to increase groundnut productivity
AVOIDED COSTS	
Carbon sequestration	Provided by IFAD
ADDED BENEFITS	
Revenues	From the World Bank (2017) we retrieved the total revenues of efficient water management techniques to increase groundnut productivity (in FCFA/kg and then transformed in USD/tons). We multiplied those values by the national yields of groundnut (FAO, 2021) to obtain the economic values per ha in each country. Next we multiplied those values by 30%, which is the observed yield gain from groundnut irrigation (Kadiyala, et al., 2021). In this way, we obtained the added revenues from groundnut irrigation.

Sustainable livestock Cattle

INVESTMENTS	
Capital costs	Costs of cows were provided by Nkwake, P. et al. (2014) . Costs were adjusted by IFAD
O&M (cost of fodder)	Considering a cost of fodder of 0.036 USD/kg (Kumar, Begeladze, Calmon, & Saint-Laurent, 2015), and the fodder requirements for cows (Expert systems for sheep and goat, s.d.; TNAU Agritech portal, s.d.). The total costs of fodder were adjusted by IFAD
O&M (RAP)	The restricted application protocol (RAP) is a refinement of ITC that involves spraying of insecticide at dip concentration only to the tsetse predilection feeding sites on cattle. From Okello et al (2021) we retrieved the costs of RAP and we adjusted them for each country
ADDED BENEFITS	
Manure Production	Considering the cost of manure of 0.08 USD/kg (FAO, 2015), and the manure production from cows (Osuhor, Alawa, & Akpa, 2002; Font-Palma, 2019), the total added benefits of manure production were calculated for these cattle. We assumed that only 20% of manure will be collected.
Revenues	Net benefits of cows were provided by Nkwake, P. et al. (2014).

Mean average income from RAP	From Okello et al (2021) we retrieved the monetary benefits of RAP and we adjusted them for each country

Sustainable Tree crop (Mango)

INVESTMENTS	
Capital costs	The capital costs of drip irrigation were retrieved from Andersson (2015) and adjusted for each country
O&M	O&M costs of drip irrigation were retrieved from Ram et al (2018) and adjusted for each country
AVOIDED COSTS	
Carbon sequestration	Provided by IFAD
ADDED BENEFITS	
Revenues	Increased productivity revenues from drip irrigation were retrieved from Ram et al (2018) and adjusted for each country

Sustainable cereal production (Millet)

INVESTMENTS	
Capital cost – Demi Lunes (DL)	The document "*Recuperatio de 55 ha de terres degradees: confection de demis lunes sous forme de cash for work*" provided the total costs of single DL.Capital Costs were adjusted by IFAD
Capital Cost (O&M)	O&M costs of demi-lunes were retrieved from SEI (2012) and adjusted for each country
AVOIDED COSTS	
Carbon sequestration	Provided by IFAD
ADDED BENEFITS	
Revenues	To calculate the added revenues we multiplied the national gross production values of millet by the total agricultural land of the same crops (FAO, 2021). Next, we multiplied those values (in USD/ha) by 80%, which is the crop yield increase indicated by IFAD

Poultry Adapted Breed

INVESTMENTS	
Capital costs	Capital costs were retrieved from Molina-Flores et al. (2020) and then adjusted for each country
Capital Cost (O&M)	O&M costs of demi-lunes were retrieved from Hermelin (2004) and adjusted for each country
ADDED BENEFITS	

Revenues	Since a publication (Padhi, 2016) stated that "indigenous chicken meat was 13% higher in market and supermarket compared to prices of meat from commercial chickens", we considered 13% of total costs as the added value.

Sustainable cereal production (Rice)

INVESTMENTS	
Capital costs	We considered capital costs of System of Rice Intensification (SRI) in selected countries (RICOWAS Full Proposal, 2021)
O&M costs	We considered O&M costs of System of Rice Intensification in selected countries (RICOWAS Full Proposal, 2021)
AVOIDED COSTS	
Carbon sequestration	Provided by IFAD
Avoided costs of seeds	Avoided costs of seeds from SRI were retrieved from two different sources and adjusted for each country (Cornell University, 2020; Miklyaev, Hashemi, & Schultz, Cost Benefit Analysis of Senegal's Rice Value Chains., 2017)
ADDED BENEFITS	
Revenues	Added revenues from the use of System of Rice Intensification were retrieved from the RICOWAS project (RICOWAS Full Proposal, 2021)

Sustainable Tree crop (Shea)

INVESTMENTS	
Capital costs	Capital costs were retrieved from Grais et al (2017) and adjusted for each country
O&M costs	O&M costs were indicated by IFAD
AVOIDED COSTS	
Water Pollution	Curtis (2004) provides estimates of avoided water quality costs from reduced nutrient concentratio in water. In the case of Nitrogen (N), the average value is 11.71 Int$ per hectare per year. This value was then multiplied by the area covered by trees (1 ha).
Carbon sequestration	Provided by IFAD
ADDED BENEFITS	
Revenues	Revenues were retrieved from Heeb (2013) and adjusted for each country

Sustainable Horticulture (tomato)

INVESTMENTS	
Capital costs	We retrieved capital costs of solar irrigation from a publication and we adjusted them for each country (Agrawal & Jain, 2019)
O&M costs	O&M costs were assumed and confirmed by IFAD

AVOIDED COSTS	
Carbon sequestration	Provided by IFAD
ADDED BENEFITS	
Revenues	We calculated the yield difference of horticultural products in the sahel under rainfed and irrigated agriculture (van der Wijngaart, et al., 2019). Next, we multiplied those values by the national annual producer prices (FAO, 2021) to calculate the additional gross margin (used to estimate additional revenues from switching from rainfed agriculture to irrigated agriculture)

Annex 2: Portfolio Composition

Burkina Faso

Type of beneficiaries	Targeted value chains (VCs)	VCs	Amount
FOs	Sustainable Millet Value Chain	6	300,000
FOs	Sustainable Shea value chain	9	500,000
FOs	Sustainable Rice Value chain	8	75,000,000
Cooperative	Forest production of mangoes	5	75,000,000
Cooperative	Mangoes forestry production	5	100,000,000
MSME	Renewable Energy	7	125,000,000
Cooperative	Sustainable Water management	3	200,000,000
Cooperative	Recycling of agricultural waste	7	300,000,000

Table 84: Portfolio composition in Burkina Faso

Ghana

Type of beneficiaries	Targeted value chains (VCs)	VCs	Amount
FOs	Sustainable shea value chain	9	3,500,000
FOs	Sustainable Rice value chain	8	4,500,000
FOs	Sustainable Millet value chain	6	5,000,000
FOs	Sustainable cashew value chain	1	2,200,000
MSME	Sustainable climate resilient Poultry quality feed	7	4,000,000
FOs	Sustainable cassava value chain	2	4,000,000
Farmers Organizations	Sustainable Mango value chain	5	6,000,000
MSME	Sustainable chicken value chain	7	4,500,000

Table 85: Portfolio composition in Ghana

Ivory Coast

Type of beneficiaries	Targeted value chains (VCs)	VCs	Amount
FOs	Sustainable tomato and pepper value chain	2/10	20,000,000
FOs	Sustainable tomato and pepper value chain	10	30,000,000
MSME	Sustainable cashew production	1	250,000,000
FOs	Establishment of forest tree nurseries	1/5	75,000,000
MSME	Solar energy equipment manufacturing	10	200,000,000
Cooperative	Food processing	2/ 8/ 10	250,000,000
FOs	Sustainable rice value chain	8	350,000
FOs	Sustainable cassava value chain	2	250,000
FOs	Sustainable cassava value chain	2	250,000
FOs	Sustainable cassava value chain	2	170,000

Table 86: Portfolio composition in Ivory Coast

Mali

Type of beneficiaries	Targeted value chains (VCs)	VCs	Amount
Cooperative	Sustainable Tomato value chain	10	10,000,000
Cooperative	Sustainable Millet Production	6	10,000,000
MSME	Sustainable cattle including fodder Production, processing and marketing of meat, establishment refrigeration systems	4	50,000,000
MSME	Sustainable cattle production	4	200,000,000
MSME	Sustainable cattle production	4	100,000,000
MSME	Sustainable cattle production	4	100,000,000
MSME	Sustainable cattle production	4	100,000,000
MSME	Sustainable Chicken value chain	7	100,000,000
MSME	Sustainable cattle production	4	90,000,000
MSME	Sustainable chicken value chain	7	150,000,000
MSME	Sustainable chicken value chain	7	130,000,000
MSME	Sustainable mango value chain	5	110,000,000
MSME	Sustainable mango value chain	5	30,000,000
MSME	Sustainable mango value chain	5	300,000,000
MSME	Sustainable mango value chain	5	100,000,000
MSME	Processing and export of harvested products (Shea butter.)	9	100,000,000
MSME	Purchasing unit from small producers and processing of Groundnuts	3	800,000,000
Cooperative	Sustainable groundnuts and millet production	3/6	20,000,000
FOs	Eco friendly equipment's and technologies for land agricultural	3/6/8	10,000,000
MSME	Eco friendly equipment's and technologies for land agricultural	8	100,000,000
MSME	Amenities of farmland / rice cultivation	8	30,000,000
MSME	Amenities of farmland / rice cultivation	8	32,000,000

MSME	Processing of millet into flour and other derived products	6	100,000,000

Table 87: Portfolio composition in Mali

Senegal

Type of beneficiaries	Targeted value chains (VCs)	VCs	Amount
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	13,000,000
Cooperative	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	30,000,000
Cooperative	Sustainable Millet	6	5,200,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	16,000,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	3,500,000
MSME	Sustainable Millet	6	33,000,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	60,900,000
MSME	Sustainable Millet	6	150,000,000
Cooperative	Sustainable Millet	6	100,000,000
MSME	Marketing of improved Seeds and organic fertilizers	3/6	100,000,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	100,000,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	100,000,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	100,000,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	11,200,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	3,000,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	6,500,000

MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	2,500,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	6,500,000
MSME	Sustainable marketing of improved ground nuts and millet seeds that are climate resilient and to resistant to pest and diseases	3	5,000,000
MSME	Sustainable marketing of improved ground nuts and millet seeds that are climate resilient and to resistant to pest and diseases	3/6	35,000,000
Cooperative	Sustainable marketing of improved ground nuts and millet seeds that are climate resilient and to resistant to pest and diseases	3/6	30,000,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	2,000,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	3,000,000
MSME	Sustainable marketing of improved ground nuts and millet seeds that are climate resilient and to resistant to pest and diseases	3/6	100,000,000
MSME	Sustainable marketing of improved ground nuts and millet seeds that are climate resilient and to resistant to pest and diseases	3/6	150,000,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	16,000,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	9,000,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	9,000,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	4,000,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	5,000,000
MSME	Sustainable Millet Production with Zai techniques and half-moon	6	20,000,000

MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	5,000,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	4,000,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	4,500,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	4,500,000
MSME	Acquisition of eco-friendly equipment's for sustainable production of groundnuts and millet	3/6	8,147,000
MSME	Acquisition of eco-friendly equipment's for sustainable production of groundnuts and millet	3/6	17,733,690
MSME	Acquisition of eco-friendly equipment's for sustainable production of groundnuts and millet	3/6	9,736,416
MSME	Acquisition of eco-friendly equipment's for sustainable production of groundnuts and millet	3/6	13,892,934
MSME	Acquisition of eco-friendly equipment's for sustainable production of groundnuts and millet	3/6	8,147,000
Cooperative	Acquisition of eco-friendly equipment's for sustainable production of groundnuts and millet	3/6	21,269,620
Cooperative	Acquisition of eco-friendly equipment's for sustainable production of groundnuts and millet	3/6	16,961,910
Cooperative	Production, processing and marketing of groundnut production , establishment Groundnut oil with RET, refining oil and use of the waste for feeding and manure	3	30,000,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	20,000,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	7,500,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	2,542,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	2,600,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	30,000,000

MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	35,000,000
MSME	Sustainable Groundnuts production with improved varieties, organic fertilizer, and practices conservation	3	2,745,000
MSME	Production, processing and marketing of Tomato with a processing unit that meet all environmental and climate resilient norms	10	30,000,000
MSME	Production, processing and marketing of Tomato with a processing unit that meet all environmental and climate resilient norms	10	3,000,000
MSME	Production, processing and marketing of Tomato with a processing unit that meet all environmental and climate resilient norms	10	5,000,000
MSME	Sustainable Mango production with native species, processing and marketing	5	99,989,800
MSME	Production, processing and marketing of Tomato with a processing unit that meet all environmental and climate resilient norms	10	30,000,000
MSME	Production, processing and marketing of Tomato with a processing unit that meet all environmental and climate resilient norms	10	16,000,000
MSME	Production, processing and marketing of Tomato with a processing unit that meet all environmental and climate resilient norms	10	10,000,000
MSME	Production, processing and marketing of Tomato with a processing unit that meet all environmental and climate resilient norms	10	20,000,000
MSME	Production, processing and marketing of Tomato with a processing unit that meet all environmental and climate resilient norms	10	40,000,000
MSME	Production, processing and marketing of Tomato with a processing unit that meet all environmental and climate resilient norms	10	3,500,000.00

MSME	Production, processing and marketing of Tomato with a processing unit that meet all environmental and climate resilient norms	10	2,000,000
MSME	Production, processing and marketing of Tomato with a processing unit that meet all environmental and climate resilient norms	10	15,000,000
MSME	Production, processing and marketing of Tomato with a processing unit that meet all environmental and climate resilient norms	10	3,500,000
MSME	Production, processing and marketing of Tomato with a processing unit that meet all environmental and climate resilient norms	10	25,000,000
Cooperative	Production, processing and marketing of Tomato with a processing unit that meet all environmental and climate resilient norms	10	27,000,000
MSME	Processing and marketing of Tomato integrated with onion with a processing unit that meet all environmental and climate resilient norms	10	500,000,000
MSME	Sustainable cashew nurseries production using shorter gestation period of improved varieties of Cashew	1	900,000,000
MSME	Sustainable cashew nurseries production using shorter gestation period of improved varieties of Cashew	1	200,000,000
MSME	Sustainable cashew nurseries production using shorter gestation period of improved varieties of Cashew	1	150,000,000
MSME	Sustainable cashew nurseries production using shorter gestation period of improved varieties of Cashew	1	150,000,000
MSME	Sustainable cashew nurseries production using shorter gestation period of improved varieties of Cashew	1	100,000,000
MSME	Sustainable cashew nurseries production using shorter gestation period of improved varieties of Cashew	1	90,000,000

Table 88: Portfolio composition in Senegal

Annex 3: Analysis with 5$ Carbon price

This Annex shows the economic and financial analysis considering a carbon price of 5$.

2.7. Scenario GCF Contribution - Results: aggregate value chains performance

2.7.1. VC1-Sustainable Tree crop (Cashew)

1 ha											
VC 1-Sustainable Tree crop (Cashew)	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
Burkina Faso	$1,373	$1,925	$1,256	$329	$1,086	1.38	2.25	74%	204%	2.00	1.00
Ghana	$1,785	$2,100	$1,428	$109	$702	1.13	1.86	35%	149%	2.00	1.00
Ivory Coast	$1,717	$2,220	$1,428	$326	$1,270	1.28	2.07	55%	174%	2.00	1.00
Mali	$1,305	$1,297	$1,256	$(17)	$814	0.98	1.91	-2%	142%	N/A	1.00
Senegal	$1,545	$1,759	$1,256	$131	$962	1.12	1.90	29%	145%	1.00	1.00

Table 89: portfolio analysis (1ha) – VC1

Program																
VC 1-Sustainable Tree crop (Cashew)	Total investment	Revenues generated	Value of externalities	Undiscounted net benefits with externalities	Undiscounted net benefits without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) discounted	Benefit to cost ratio (lifetime) discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio-Farmers organizations	Debt Service Coverage Ratio-MSMEs	Debt Service Coverage Ratio-COOPERATIVES
Burkina Faso	$3,139,361	$4,051,136	$2,704,817	$4,101,503	$1,267,878	$2,483,694	$611,964	27%	78%	2.24	1.19	1.00	2.00	1.97	1.97	1.97
Ghana	$4,478,221	$4,848,358	$3,370,805	$4,300,336	$768,305	$1,708,328	$15,730	10%	57%	1.92	0.89	1.00	2.00	1.02	1.02	1.02
Ivory Coast	$4,478,221	$5,329,703	$3,505,638	$4,979,764	$1,306,452	$3,230,498	$609,297	19%	66%	2.04	1.12	1.00	2.00	1.38	1.38	1.38
Mali	$3,201,745	$2,930,323	$2,903,754	$2,992,028	$(50,007)	$1,894,056	$(277,637)	-15%	55%	1.93	0.86	1.00	2.00	0.79	0.79	0.79
Senegal	$4,478,221	$4,692,693	$3,429,648	$4,187,244	$594,271	$2,658,108	$93,103	7%	56%	1.88	0.98	1.00	2.00	1.26	1.26	1.26

Table 90: portfolio analysis (Program) – VC1

2.7.2. VC2-Sustainable Cassava

1 ha											
VC 2 - Sustainable Cassava	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
Burkina Faso	$527	$735	$31	$168	$195	1.36	1.42	64%	72%	2.00	2.00
Ghana	$674	$1,153	$57	$346	$389	1.64	1.72	117%	129%	1.00	1.00
Ivory Coast	$648	$979	$57	$284	$335	1.48	1.57	88%	100%	2.00	1.00
Mali	$492	$688	$31	$166	$194	1.37	1.43	70%	80%	2.00	2.00
Senegal	$583	$930	$31	$300	$327	1.57	1.62	100%	108%	1.00	1.00

Table 91: portfolio analysis (1ha) – VC2

Program																
VC2-SustainableCassava	Total investment	Revenues generated	Value of externalities	Undiscounted net benefits with externalities	Undiscounted net benefits without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) discounted	Benefit to cost ratio (lifetime) discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio-Farmers organizations	Debt Service Coverage Ratio-MSMEs	Debt Service Coverage Ratio-COOPERATIVES
Burkina Faso	$3,118,613	$4,499,021	$234,172	$2,090,123	$1,838,614	$1,127,163	$963,987	33%	37%	1.40	1.31	2.00	2.00	2.40	1.69	1.97
Ghana	$4,460,502	$7,821,423	$473,366	$4,686,730	$4,181,756	$1,889,649	$1,653,508	54%	60%	1.56	1.42	1.00	1.00	2.19	2.42	3.06
Ivory Coast	$4,460,502	$6,905,199	$492,301	$3,667,552	$3,142,379	$2,280,013	$1,909,337	41%	47%	1.58	1.45	1.00	2.00	1.94	1.94	2.35
Mali	$3,189,077	$4,564,669	$253,616	$2,094,919	$1,824,368	$1,252,212	$1,061,252	34%	38%	1.43	1.34	2.00	2.00	2.84	1.67	1.95
Senegal	$4,460,502	$7,292,794	$299,548	$3,901,622	$3,582,072	$2,451,237	$2,225,693	47%	50%	1.61	1.53	1.00	1.00	3.03	2.15	2.65

Table 92: portfolio analysis (Program) – VC2

2.7.3. VC3-Sustainable cereal production (Groundnut)

1 ha											
VC3 - Sustainable cereal production (Groundnut)	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
Burkina Faso	$400	$1,665	$119	$821	$901	3.47	3.72	54%	58%	2.00	2.00
Ghana	$755	$3,408	$216	$1,241	$1,349	3.31	3.51	66%	70%	2.00	2.00
Ivory Coast	$811	$3,627	$216	$2,003	$2,160	3.92	4.15	64%	68%	2.00	2.00
Mali	$471	$1,890	$119	$995	$1,082	3.45	3.67	50%	53%	2.00	2.00
Senegal	$751	$2,953	$119	$1,558	$1,645	3.47	3.61	58%	60%	1.00	1.00

Table 93: portfolio analysis (1ha) – VC3

Program																
VC3-Sustainable cereal production (Groundnut)	Total investment	Revenues generated	Value of externalities	Undiscounted net benefits with externalities	Undiscounted net benefits without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) discounted	Benefit to cost ratio (lifetime) discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio-Farmers organizations	Debt Service Coverage Ratio-MSMEs	Debt Service Coverage Ratio-COOPERATIVES
Burkina Faso	$1,852,156	$7,038,146	$561,223	$7,645,948	$6,962,791	$4,323,405	$3,909,657	50%	54%	3.03	2.71	3.00	3.00	5.04	5.04	5.04
Ghana	$2,816,137	$11,610,902	$817,291	$12,664,149	$11,673,623	$4,751,375	$4,343,706	60%	64%	2.48	2.19	2.00	2.00	3.84	3.84	3.84
Ivory Coast	$2,796,113	$11,429,323	$756,019	$12,389,950	$11,473,204	$7,875,950	$7,264,815	59%	62%	3.51	3.22	2.00	2.00	3.41	3.41	3.41
Mali	$1,841,571	$6,753,249	$474,634	$7,206,156	$6,627,496	$4,485,739	$4,100,874	46%	49%	3.07	2.81	4.00	4.00	5.72	5.72	5.72
Senegal	$2,868,916	$10,304,950	$462,857	$10,491,664	$9,931,487	$6,599,764	$6,226,022	52%	54%	3.03	2.86	4.00	4.00	4.96	4.96	4.96

Table 94: portfolio analysis (Program) – VC3

2.7.4. VC4-Sustainable livestock Cattle

1head											
VC4-Sustainable livestock Cattle	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
Burkina Faso	$1,006	$1,084	$-	$36	$36	1.04	1.04	10%	10%	1.00	1.00
Ghana	$1,383	$1,409	$-	$(68)	$(68)	0.95	0.95	2%	2%	1.00	1.00
Ivory Coast	$1,385	$1,355	$-	$(74)	$(74)	0.95	0.95	-4%	-4%	N/A	N/A
Mali	$943	$1,030	$-	$53	$53	1.06	1.06	13%	13%	1.00	1.00
Senegal	$1,147	$1,219	$-	$33	$33	1.03	1.03	8%	8%	1.00	1.00

Table 95: portfolio analysis (1head) – VC4

Program															
VC4-Sustainable livestock Cattle	Total investment	Revenues generated	Value of externalities	Undiscounted net benefits with externalities	Undiscounted net benefits without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) discounted	Benefit to cost ratio (lifetime) discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio-Farmers organizations	Debt Service Coverage Ratio-MSMEs	Debt Service Coverage Ratio-COOPERATIVES
Burkina Faso	$2,919,008	$8,080,303	$-	$6,496,647	$6,496,647	$3,880,105	$3,880,105	76%	76%	2.40	2.40	1.00	1.00	5.45	5.45	5.45
Ghana	$4,114,017	$11,260,386	$-	$9,051,515	$9,051,515	$3,627,902	$3,627,902	72%	72%	1.96	1.96	1.00	1.00	3.42	3.42	3.42
Ivory Coast	$4,075,423	$11,059,478	$-	$8,885,952	$8,885,952	$5,765,413	$5,765,413	69%	69%	2.43	2.43	2.00	1.00	3.20	3.20	3.20
Mali	$2,985,255	$8,285,664	$-	$6,661,648	$6,661,648	$4,366,441	$4,366,441	77%	77%	2.51	2.51	1.00	1.00	6.74	6.74	6.74
Senegal	$4,152,487	$11,464,828	$-	$9,217,756	$9,217,756	$6,027,355	$6,027,355	75%	75%	2.49	2.49	1.00	1.00	5.36	5.36	5.36

Table 96: portfolio analysis (Program) – VC4

2.7.5. VC5-Sustainable tree crop (Mango)

1ha											
VC5-sustainable tree crop (Mango)	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
Burkina Faso	$5,615	$8,321	$666	$1,461	$1,912	1.34	1.45	19%	22%	5.00	5.00
Ghana	$7,300	$8,902	$790	$7	$402	1.00	1.09	10%	13%	8.00	7.00
Ivory Coast	$7,019	$8,747	$790	$849	$1,424	1.15	1.25	11%	14%	8.00	7.00
Mali	$5,335	$8,553	$666	$2,058	$2,543	1.48	1.59	22%	26%	5.00	4.00
Senegal	$6,317	$8,677	$666	$1,360	$1,845	1.27	1.36	15%	18%	2.00	1.00

Table 97: portfolio analysis (1ha) – VC5

Program																
VC5-sustainable tree crop (Mango)	Total investment	Revenues generated	Value of externalities	Undiscounted net benefits with externalities	Undiscounted net benefits without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) discounted	Benefit to cost ratio (lifetime) discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio-Farmers organizations	Debt Service Coverage Ratio-MSMEs	Debt Service Coverage Ratio-COOPERATIVES
Burkina Faso	$2,490,525	$3,377,799	$298,954	$1,785,809	$1,432,349	$759,189	$541,760	14%	18%	1.24	1.10	4.00	5.00	1.96	1.96	1.96
Ghana	$3,552,672	$3,965,008	$389,122	$1,441,306	$981,239	$22,783	$(171,233)	6%	10%	0.83	0.71	5.00	6.00	1.19	1.19	1.19
Ivory Coast	$3,552,672	$4,051,893	$404,687	$1,567,836	$1,089,367	$585,781	$263,318	7%	11%	1.10	0.97	4.00	5.00	1.31	1.31	1.31
Mali	$2,540,016	$3,727,430	$320,942	$2,191,848	$1,812,392	$1,155,091	$899,358	18%	21%	1.40	1.25	4.00	4.00	2.52	2.52	2.52
Senegal	$3,552,672	$4,465,994	$379,068	$2,052,890	$1,604,711	$919,934	$617,886	11%	14%	1.20	1.07	5.00	5.00	1.79	1.79	1.79

Table 98: portfolio analysis (Program) – VC5

2.7.6. VC6-Sustainable cereal production (Millet)

1ha/1head											
VC6-Sustainable cereal production (Millet)	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
Burkina Faso	$648	$2,372	$119	$1,126	$1,207	3.19	3.34	60%	63%	2.00	2.00
Ghana	$694	$2,733	$216	$954	$1,062	3.02	3.25	66%	71%	2.00	2.00
Ivory Coast	$682	$4,354	$216	$2,663	$2,820	5.73	6.00	115%	120%	1.00	1.00
Mali	$666	$2,693	$119	$1,445	$1,532	3.62	3.78	68%	71%	2.00	2.00
Senegal	$676	$2,628	$-	$1,388	$1,388	3.48	3.48	65%	65%	1.00	1.00

Table 99: portfolio analysis (1ha) – VC6

Program																
VC6-Sustainable cereal production (Millet)	Total investment	Revenues generated	Value of externalities	Undiscounted net benefits with externalities	Undiscounted net benefits without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) discounted	Benefit to cost ratio (lifetime) discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio-Farmers organizations	Debt Service Coverage Ratio-MSMEs	Debt Service Coverage Ratio-COOPERATIVES
Burkina Faso	$2,161,202	$7,225,528	$403,618	$7,221,888	$6,736,409	$4,116,207	$3,820,307	53%	56%	2.76	2.55	2.00	3.00	5.01	5.01	5.01
Ghana	$3,082,901	$11,099,949	$972,904	$11,782,034	$10,611,806	$4,434,131	$3,948,912	58%	63%	2.38	2.05	2.00	2.00	3.61	3.61	3.61
Ivory Coast	$3,082,901	$17,999,362	$990,124	$20,525,719	$19,334,779	$13,478,308	$12,681,624	101%	106%	5.11	4.76	1.00	1.00	5.09	5.09	5.09
Mali	$2,204,149	$8,139,113	$400,463	$8,325,476	$7,843,791	$5,304,877	$4,982,652	60%	63%	3.21	3.01	2.00	2.00	6.72	6.72	6.72
Senegal	$3,082,901	$10,950,496	$552,157	$11,086,995	$10,422,851	$7,039,063	$6,594,781	57%	60%	3.09	2.90	2.00	2.00	5.21	5.21	5.21

Table 100: portfolio analysis (Program) – VC6

2.7.7. VC7-Sustainable poultry production (broiler)

1head											
VC7-Poultry	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
Burkina Faso	$7.08	$8.00	$-	$0.64	$0.64	1.09	1.09	19%	19%	1.00	1.00
Ghana	$7.91	$8.93	$-	$0.47	$0.47	1.06	1.06	19%	19%	1.00	1.00
Ivory Coast	$7.60	$8.59	$-	$0.75	$0.75	1.10	1.10	19%	19%	1.00	1.00
Mali	$7.21	$8.15	$-	$0.71	$0.71	1.10	1.10	18%	18%	1.00	1.00
Senegal	$7.31	$8.26	$-	$0.72	$0.72	1.10	1.10	19%	19%	1.00	1.00

Table 101: portfolio analysis (1head) – VC7

Program															
VC7-Poultry	Total investment	Revenues generated	Value of externalities	Undiscounted net benefits with externalities	Undiscounted net benefits without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) discounted	Benefit to cost ratio (lifetime) discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio-Farmers organizations	Debt Service Coverage Ratio-MSMEs	Debt Service Coverage Ratio-COOPERATIVES
Burkina Faso	$2,917,076	$8,538,043	$-	$7,050,211	$7,050,211	$4,235,979	$4,235,979	82%	82%	2.54	2.54	1.00	1.00	5.83	5.83	5.83
Ghana	$4,182,939	$11,996,677	$-	$9,789,383	$9,789,383	$4,011,263	$4,011,263	81%	81%	2.09	2.09	1.00	1.00	3.66	3.66	3.66
Ivory Coast	$4,184,814	$11,980,654	$-	$9,765,986	$9,765,986	$6,425,767	$6,425,767	81%	81%	2.59	2.59	1.00	1.00	3.49	3.49	3.49
Mali	$2,949,366	$8,913,218	$-	$7,493,745	$7,493,745	$4,932,524	$4,932,524	83%	83%	2.72	2.72	1.00	1.00	7.36	7.36	7.36
Senegal	$4,150,469	$12,266,331	$-	$10,185,022	$10,185,022	$6,703,141	$6,703,141	82%	82%	2.66	2.66	1.00	1.00	5.81	5.81	5.81

Table 102: portfolio analysis (Program) – VC7

2.7.8. VC8-Sustainable cereal production (Rice)

1ha											
VC8 - Sustainable cereal production (Rice)	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
Burkina Faso	$6,497	$9,585	$175	$1,960	$2,079	1.42	1.45	42%	44%	3.00	3.00
Ghana	$5,618	$10,500	$265	$2,306	$2,440	1.73	1.77	71%	74%	2.00	2.00
Ivory Coast	$6,033	$13,140	$270	$5,123	$5,320	2.11	2.15	92%	94%	2.00	2.00
Mali	$9,229	$9,315	$158	$(38)	$77	0.99	1.01	3%	7%	12.00	8.00
Senegal	$2,487	$8,220	$163	$4,191	$4,311	3.21	3.27	179%	183%	2.00	1.00

Table 103: portfolio analysis (1ha) – VC8

Program																
VC8 - Sustainable cereal production (Rice)	Total investment	Revenues generated	Value of externalities	Undiscounted net benefits with externalities	Undiscounted net benefits without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) discounted	Benefit to cost ratio (lifetime) discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio-Farmers organizations	Debt Service Coverage Ratio-MSMEs	Debt Service Coverage Ratio-COOPERATIVES
Burkina Faso	$3,055,372	$4,162,440	$82,571	$1,668,677	$1,577,979	$810,733	$752,362	24%	25%	1.25	1.21	2.00	2.00	2.12	2.12	2.12
Ghana	$4,352,517	$7,510,712	$206,220	$4,331,000	$4,103,694	$1,591,861	$1,488,534	42%	44%	1.39	1.32	2.00	2.00	2.08	2.08	2.08
Ivory Coast	$4,340,518	$8,725,642	$195,334	$5,769,918	$5,554,177	$3,690,187	$3,539,976	55%	57%	1.90	1.84	2.00	2.00	2.51	2.51	2.51
Mali	$3,198,826	$2,998,827	$54,835	$89,688	$31,981	$(180,167)	$(221,301)	-8%	-5%	0.90	0.88	2.00	2.00	0.90	0.90	0.90
Senegal	$4,353,589	$13,285,852	$286,728	$11,180,044	$10,864,522	$6,908,773	$6,706,070	106%	109%	2.80	2.72	1.00	1.00	6.61	6.61	6.61

Table 104: portfolio analysis (Program) – VC8

2.7.9. VC9-Sustainable Tree Crop production (Shea)

1ha/1head											
VC9 - Sustainable Tree Crop production (Shea)	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
Burkina Faso	$3,539	$4,444	$1,174	$550	$1,258	1.25	1.57	129%	262%	1.00	1.00
Ghana	$4,055	$5,778	$1,385	$735	$1,310	1.41	1.72	211%	347%	1.00	1.00
Ivory Coast	$3,908	$5,556	$1,350	$1,107	$2,005	1.41	1.75	210%	350%	1.00	1.00
Mali	$3,465	$4,222	$1,170	$503	$1,276	1.21	1.54	111%	246%	1.00	1.00
Senegal	$3,613	$5,000	$1,178	$931	$1,710	1.38	1.69	191%	322%	1.00	1.00

Table 105: portfolio analysis (1ha) – VC9

Program																
VC10 - Sustainable Horticulture (tomato)	Total investment	Revenues generated	Value of externalities	Undiscounted net benefits with externalities	Undiscounted net benefits without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) discounted	Benefit to cost ratio (lifetime) discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio-Farmers organizations	Debt Service Coverage Ratio-MSMEs	Debt Service Coverage Ratio-COOPERATIVES
Burkina Faso	$3,145,137	$3,669,462	$1,035,106	$1,852,286	$802,113	$1,044,102	$328,553	21%	49%	1.50	1.09	1.00	1.00	1.58	1.58	1.58
Ghana	$4,486,460	$5,938,661	$2,304,357	$4,249,984	$1,910,146	$1,833,377	$655,834	36%	77%	1.85	1.13	1.00	1.00	1.47	1.47	1.47
Ivory Coast	$4,486,460	$5,925,732	$2,539,358	$4,474,940	$1,896,085	$2,960,428	$1,081,329	36%	80%	1.92	1.26	1.00	1.00	1.63	1.63	1.63
Mali	$3,207,636	$3,630,905	$1,771,086	$2,495,378	$696,813	$1,599,574	$288,733	17%	63%	1.73	1.08	1.00	1.00	1.68	1.68	1.68
Senegal	$4,486,460	$5,768,519	$2,428,686	$4,191,393	$1,725,101	$2,753,457	$955,618	32%	75%	1.86	1.22	1.00	1.00	2.06	2.06	2.06

Table 106: portfolio analysis (Program) – VC9

2.7.10. VC10-Sustainable Horticulture (Tomato)

1ha											
VC10 - Sustainable Horticulture (tomato)	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
Burkina Faso	$2,429	$9,289	$75	$4,928	$4,985	3.20	3.22	52%	52%	2.00	2.00
Ghana	$2,783	$13,281	$135	$5,900	$5,983	3.42	3.45	66%	67%	2.00	2.00
Ivory Coast	$2,682	$9,482	$135	$5,178	$5,286	3.06	3.10	47%	48%	3.00	2.00
Mali	$2,378	$10,255	$75	$6,089	$6,149	3.73	3.76	59%	60%	2.00	2.00
Senegal	$2,479	$5,724	$75	$2,319	$2,379	2.00	2.02	27%	27%	4.00	4.00

Table 107: portfolio analysis (1ha) – VC10

Program																
VC10 - Sustainable Horticulture (tomato)	Total investment	Revenues generated	Value of externalities	Undiscounted net benefits with externalities	Undiscounted net benefits without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) discounted	Benefit to cost ratio (lifetime) discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio-Farmers organizations	Debt Service Coverage Ratio-MSMEs	Debt Service Coverage Ratio-COOPERATIVES
Burkina Faso	$1,580,532	$7,108,695	$67,867	$7,536,352	$7,453,036	$4,224,021	$4,173,787	50%	50%	3.03	2.98	3.00	3.00	5.23	5.23	5.23
Ghana	$2,254,589	$12,653,127	$152,730	$14,056,565	$13,869,068	$5,236,658	$5,160,455	63%	64%	2.58	2.52	2.00	2.00	4.31	4.31	4.31
Ivory Coast	$2,254,589	$9,375,065	$158,493	$9,840,094	$9,645,522	$6,080,525	$5,951,496	46%	46%	3.10	3.03	3.00	3.00	2.99	2.99	2.99
Mali	$1,611,939	$8,174,436	$70,688	$8,879,045	$8,792,266	$5,596,507	$5,538,960	57%	57%	3.74	3.69	3.00	3.00	7.06	7.06	7.06
Senegal	$2,254,589	$6,121,055	$94,834	$5,569,388	$5,452,965	$3,189,863	$3,112,659	27%	28%	2.02	1.98	5.00	5.00	3.21	3.21	3.21

Table 108: portfolio analysis (Program) – VC10

2.8. Scenario GCF Contribution - Results: country performance

2.8.1. Burkina Faso

	One hectare / one head										
	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
VC1	$1,373	$1,925	$1,256	$329	$1,086	1.38	2.25	74%	204%	2.00	1.00
VC2	$527	$735	$31	$168	$195	1.36	1.42	64%	72%	2.00	2.00
VC3	$400	$1,665	$119	$821	$901	3.47	3.72	54%	58%	2.00	2.00
VC4	$1,006	$1,084	$-	$36	$36	1.04	1.04	10%	10%	1.00	1.00
VC5	$5,615	$8,321	$666	$1,461	$1,912	1.34	1.45	19%	22%	5.00	5.00
VC6	$648	$2,372	$119	$1,126	$1,207	3.19	3.34	60%	63%	2.00	2.00
VC7	$7	$8	$-	$1	$1	1.09	1.09	19%	19%	1.00	1.00
VC8	$6,497	$9,585	$175	$1,960	$2,079	1.42	1.45	42%	44%	3.00	3.00
VC9	$3,539	$4,444	$1,174	$550	$1,258	1.25	1.57	129%	262%	1.00	1.00
VC10	$2,429	$9,289	$75	$4,928	$4,985	3.20	3.22	52%	52%	2.00	2.00

Table 109: 1ha/1head portfolio – Burkina Faso

	Program															
	Total investment	Revenues generated	Value of externalities	Undiscounted net benefit with externalities	Undiscounted net benefit without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio - Farmers organizations	Debt Service Coverage Ratio - MSMEs	Debt Service Coverage Ratio - COOPERATIVES
VC1	$3,139,361	$4,051,136	$2,704,817	$4,101,503	$1,267,878	$2,483,694	$611,964	27%	78%	2.24	1.19	1.00	2.00	1.97	1.97	1.97
VC2	$3,118,613	$4,499,021	$234,172	$2,090,123	$1,838,614	$1,127,163	$963,987	33%	37%	1.40	1.31	2.00	2.00	2.40	1.69	1.97
VC3	$1,852,156	$7,038,146	$561,223	$7,645,948	$6,962,791	$4,323,405	$3,909,657	50%	54%	3.03	2.71	3.00	3.00	5.04	5.04	5.04
VC4	$2,919,008	$8,080,303	$-	$6,496,647	$6,496,647	$3,880,105	$3,880,105	76%	76%	2.40	2.40	1.00	1.00	5.45	5.45	5.45
VC5	$2,490,525	$3,377,799	$298,954	$1,785,809	$1,432,349	$759,189	$541,760	14%	18%	1.24	1.10	4.00	5.00	1.96	1.96	1.96
VC6	$2,161,202	$7,225,528	$403,618	$7,221,888	$6,736,409	$4,116,207	$3,820,307	53%	56%	2.76	2.55	2.00	3.00	5.01	5.01	5.01
VC7	$2,917,076	$8,538,043	$-	$7,050,211	$7,050,211	$4,235,979	$4,235,979	82%	82%	2.54	2.54	1.00	1.00	5.83	5.83	5.83
VC8	$3,055,372	$4,162,440	$82,571	$1,668,677	$1,577,979	$810,733	$752,362	24%	25%	1.25	1.21	2.00	2.00	2.12	2.12	2.12
VC9	$3,145,137	$3,669,462	$1,035,106	$1,852,286	$802,113	$1,044,102	$328,553	21%	49%	1.50	1.09	1.00	1.00	1.58	1.58	1.58
VC10	$1,580,532	$7,108,695	$67,867	$7,536,352	$7,453,036	$4,224,021	$4,173,787	50%	50%	3.03	2.98	3.00	3.00	5.23	5.23	5.23

Table 110: programme portfolio – Burkina Faso

2.8.2. Ghana

	One hectare / one head										
	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
VC1	$1,785	$2,100	$1,428	$109	$702	1.13	1.86	35%	149%	2.00	1.00
VC2	$674	$1,153	$57	$346	$389	1.64	1.72	117%	129%	1.00	1.00
VC3	$755	$3,408	$216	$1,241	$1,349	3.31	3.51	66%	70%	2.00	2.00
VC4	$1,383	$1,409	$-	$(68)	$(68)	0.95	0.95	2%	2%	1.00	1.00
VC5	$7,300	$8,902	$790	$7	$402	1.00	1.09	10%	13%	8.00	7.00
VC6	$694	$2,733	$216	$954	$1,062	3.02	3.25	66%	71%	2.00	2.00
VC7	$8	$9	$-	$0	$0	1.06	1.06	19%	19%	1.00	1.00
VC8	$5,618	$10,500	$265	$2,306	$2,440	1.73	1.77	71%	74%	2.00	2.00
VC9	$4,055	$5,778	$1,385	$735	$1,310	1.41	1.72	211%	347%	1.00	1.00
VC10	$2,783	$13,281	$135	$5,900	$5,983	3.42	3.45	66%	67%	2.00	2.00

Table 111: 1ha/1head portfolio – Ghana

	Program															
	Total investment	Revenues generated	Value of externalities	Undiscounted net benefit with externalities	Undiscounted net benefit without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio - Farmers organizations	Debt Service Coverage Ratio - MSMEs	Debt Service Coverage Ratio - COOPERATIVES
VC1	$4,478,221	$4,848,358	$3,370,805	$4,300,336	$768,305	$1,708,328	$15,730	10%	57%	1.92	0.89	1.00	2.00	1.02	1.02	1.02
VC2	$4,460,502	$7,821,423	$473,366	$4,686,730	$4,181,756	$1,889,649	$1,653,508	54%	60%	1.56	1.42	1.00	1.00	2.19	2.42	3.06
VC3	$2,816,137	$11,610,902	$817,291	$12,664,149	$11,673,623	$4,751,375	$4,343,706	60%	64%	2.48	2.19	2.00	2.00	3.84	3.84	3.84
VC4	$4,114,017	$11,260,386	$-	$9,051,515	$9,051,515	$3,627,902	$3,627,902	72%	72%	1.96	1.96	1.00	1.00	3.42	3.42	3.42
VC5	$3,552,672	$3,965,008	$389,122	$1,441,306	$981,239	$22,783	$(171,233)	6%	10%	0.83	0.71	5.00	6.00	1.19	1.19	1.19
VC6	$3,082,901	$11,099,949	$972,904	$11,782,034	$10,611,806	$4,434,131	$3,948,912	58%	63%	2.38	2.05	2.00	2.00	3.61	3.61	3.61
VC7	$4,182,939	$11,996,677	$-	$9,789,383	$9,789,383	$4,011,263	$4,011,263	81%	81%	2.09	2.09	1.00	1.00	3.66	3.66	3.66
VC8	$4,352,517	$7,510,712	$206,220	$4,331,000	$4,103,694	$1,591,861	$1,488,534	42%	44%	1.39	1.32	2.00	2.00	2.08	2.08	2.08
VC9	$4,486,460	$5,938,661	$2,304,357	$4,249,984	$1,910,146	$1,833,377	$655,834	36%	77%	1.85	1.13	1.00	1.00	1.47	1.47	1.47
VC10	$2,254,589	$12,653,127	$152,730	$14,056,565	$13,869,068	$5,236,658	$5,160,455	63%	64%	2.58	2.52	2.00	2.00	4.31	4.31	4.31

Table 112: programme portfolio – Ghana

2.8.3. Ivory Coast

	One hectare / one head										
	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
VC1	$1,717	$2,220	$1,428	$326	$1,270	1.28	2.07	55%	174%	2.00	1.00
VC2	$648	$979	$57	$284	$335	1.48	1.57	88%	100%	2.00	1.00
VC3	$811	$3,627	$216	$2,003	$2,160	3.92	4.15	64%	68%	2.00	2.00
VC4	$1,385	$1,355	$-	$(74)	$(74)	0.95	0.95	-4%	-4%	N/A	N/A
VC5	$7,019	$8,747	$790	$849	$1,424	1.15	1.25	11%	14%	8.00	7.00
VC6	$682	$4,354	$216	$2,663	$2,820	5.73	6.00	115%	120%	1.00	1.00
VC7	$8	$9	$-	$1	$1	1.10	1.10	19%	19%	1.00	1.00
VC8	$6,033	$13,140	$270	$5,123	$5,320	2.11	2.15	92%	94%	2.00	2.00
VC9	$3,908	$5,556	$1,350	$1,107	$2,005	1.41	1.75	210%	350%	1.00	1.00
VC10	$2,682	$9,482	$135	$5,178	$5,286	3.06	3.10	47%	48%	3.00	2.00

Table 113: 1ha/1head portfolio – Ivory Coast

	Program															
	Total investment	Revenues generated	Value of externalities	Undiscounted net benefit with externalities	Undiscounted net benefit without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio - Farmers organizations	Debt Service Coverage Ratio - MSMEs	Debt Service Coverage Ratio - COOPERATIVES
VC1	$4,478,221	$5,329,703	$3,505,638	$4,979,764	$1,306,452	$3,230,498	$609,297	19%	66%	2.04	1.12	1.00	2.00	1.38	1.38	1.38
VC2	$4,460,502	$6,905,199	$492,301	$3,667,552	$3,142,379	$2,280,013	$1,909,337	41%	47%	1.58	1.45	1.00	2.00	1.94	1.94	2.35
VC3	$2,796,113	$11,429,323	$756,019	$12,389,950	$11,473,204	$7,875,950	$7,264,815	59%	62%	3.51	3.22	2.00	2.00	3.41	3.41	3.41
VC4	$4,075,423	$11,059,478	$-	$8,885,952	$8,885,952	$5,765,413	$5,765,413	69%	69%	2.43	2.43	2.00	1.00	3.20	3.20	3.20
VC5	$3,552,672	$4,051,893	$404,687	$1,567,836	$1,089,367	$585,781	$263,318	7%	11%	1.10	0.97	4.00	5.00	1.31	1.31	1.31
VC6	$3,082,901	$17,999,362	$990,124	$20,525,719	$19,334,779	$13,478,308	$12,681,624	101%	106%	5.11	4.76	1.00	1.00	5.09	5.09	5.09
VC7	$4,184,814	$11,980,654	$-	$9,765,986	$9,765,986	$6,425,767	$6,425,767	81%	81%	2.59	2.59	1.00	1.00	3.49	3.49	3.49
VC8	$4,340,518	$8,725,642	$195,334	$5,769,918	$5,554,177	$3,690,187	$3,539,976	55%	57%	1.90	1.84	1.00	2.00	2.51	2.51	2.51
VC9	$4,486,460	$5,925,732	$2,539,358	$4,474,940	$1,896,085	$2,960,428	$1,081,329	36%	80%	1.92	1.26	1.00	1.00	1.63	1.63	1.63
VC10	$2,254,589	$9,375,065	$158,493	$9,840,094	$9,645,522	$6,080,525	$5,951,496	46%	46%	3.10	3.03	3.00	3.00	2.99	2.99	2.99

Table 114: programme portfolio – Ivory Coast

2.8.4. Mali

	One hectare / one head										
	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
VC1	$1,305	$1,297	$1,256	$(17)	$814	0.98	1.91	-2%	142%	N/A	1.00
VC2	$492	$688	$31	$166	$194	1.37	1.43	70%	80%	2.00	2.00
VC3	$471	$1,890	$119	$995	$1,082	3.45	3.67	50%	53%	2.00	2.00
VC4	$943	$1,030	$-	$53	$53	1.06	1.06	13%	13%	1.00	1.00
VC5	$5,335	$8,553	$666	$2,058	$2,543	1.48	1.59	22%	26%	5.00	4.00
VC6	$666	$2,693	$119	$1,445	$1,532	3.62	3.78	68%	71%	2.00	2.00
VC7	$7	$8	$-	$1	$1	1.10	1.10	18%	18%	1.00	1.00
VC8	$9,229	$9,315	$158	$(38)	$77	0.99	1.01	3%	7%	12.00	8.00
VC9	$3,465	$4,222	$1,170	$503	$1,276	1.21	1.54	111%	246%	1.00	1.00
VC10	$2,378	$10,255	$75	$6,089	$6,149	3.73	3.76	59%	60%	2.00	2.00

Table 115: 1ha/1head portfolio – Mali

	Program															
	Total investment	Revenues generated	Value of externalities	Undiscounted net benefit with externalities	Undiscounted net benefit without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio - Farmers organizations	Debt Service Coverage Ratio - MSMEs	Debt Service Coverage Ratio - COOPERATIVES
VC1	$3,201,745	$2,930,323	$2,903,754	$2,992,028	$(50,007)	$1,894,056	$(277,637)	-15%	55%	1.93	0.86	1.00	2.00	0.79	0.79	0.79
VC2	$3,189,077	$4,564,669	$253,616	$2,094,919	$1,824,368	$1,252,212	$1,061,252	34%	38%	1.43	1.34	2.00	2.00	2.84	1.67	1.95
VC3	$1,841,571	$6,753,249	$474,634	$7,206,156	$6,627,496	$4,485,739	$4,100,874	46%	49%	3.07	2.81	3.00	4.00	5.72	5.72	5.72
VC4	$2,985,255	$8,285,664	$-	$6,661,648	$6,661,648	$4,366,441	$4,366,441	77%	77%	2.51	2.51	1.00	1.00	6.74	6.74	6.74
VC5	$2,540,016	$3,727,430	$320,942	$2,191,848	$1,812,392	$1,155,091	$899,358	18%	21%	1.40	1.25	4.00	4.00	2.52	2.52	2.52
VC6	$2,204,149	$8,139,113	$400,463	$8,325,476	$7,843,791	$5,304,877	$4,982,652	60%	63%	3.21	3.01	2.00	2.00	6.72	6.72	6.72
VC7	$2,949,366	$8,913,218	$-	$7,493,745	$7,493,745	$4,932,524	$4,932,524	83%	83%	2.72	2.72	1.00	1.00	7.36	7.36	7.36
VC8	$3,198,826	$2,998,827	$54,835	$89,688	$31,981	$(180,167)	$(221,301)	-8%	-5%	0.90	0.88	2.00	2.00	0.90	0.90	0.90
VC9	$3,207,636	$3,630,905	$1,771,086	$2,495,378	$696,813	$1,599,574	$288,733	17%	63%	1.73	1.08	1.00	1.00	1.68	1.68	1.68
VC10	$1,611,939	$8,174,436	$70,688	$8,879,045	$8,792,266	$5,596,507	$5,538,960	57%	57%	3.74	3.69	3.00	3.00	7.06	7.06	7.06

Table 116: programme portfolio – Mali

2.8.5. Senegal

	One hectare / one head										
	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
VC1	$1,545	$1,759	$1,256	$131	$962	1.12	1.90	29%	145%	1.00	1.00
VC2	$583	$930	$31	$300	$327	1.57	1.62	100%	108%	1.00	1.00
VC3	$751	$2,953	$119	$1,558	$1,645	3.47	3.61	58%	60%	1.00	1.00
VC4	$1,147	$1,219	$-	$33	$33	1.03	1.03	8%	8%	1.00	1.00
VC5	$6,317	$8,677	$666	$1,360	$1,845	1.27	1.36	15%	18%	2.00	1.00
VC6	$676	$2,628	$-	$1,388	$1,388	3.48	3.48	65%	65%	1.00	1.00
VC7	$7	$8	$-	$1	$1	1.10	1.10	19%	19%	1.00	1.00
VC8	$2,487	$8,220	$163	$4,191	$4,311	3.21	3.27	179%	183%	2.00	1.00
VC9	$3,613	$5,000	$1,178	$931	$1,710	1.38	1.69	191%	322%	1.00	1.00
VC10	$2,479	$5,724	$75	$2,319	$2,379	2.00	2.02	27%	27%	4.00	4.00

Table 117: 1ha/1head portfolio – Senegal

	Program															
	Total investment	Revenues generated	Value of externalities	Undiscounted net benefit with externalities	Undiscounted net benefit without externalities	S-NPV	NPV	IRR (lifetime)	S-IRR (lifetime)	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio - Farmers organizations	Debt Service Coverage Ratio - MSMEs	Debt Service Coverage Ratio - COOPERATIVES
VC1	$4,478,221	$4,692,693	$3,429,648	$4,187,244	$594,271	$2,658,108	$93,103	7%	56%	1.88	0.98	1.00	2.00	1.26	1.26	1.26
VC2	$4,460,502	$7,292,794	$299,548	$3,901,622	$3,582,072	$2,451,237	$2,225,693	47%	50%	1.61	1.53	1.00	1.00	3.03	2.15	2.65
VC3	$2,868,916	$10,304,950	$462,857	$10,491,664	$9,931,487	$6,599,764	$6,226,022	52%	54%	3.03	2.86	3.00	4.00	4.96	4.96	4.96
VC4	$4,152,487	$11,464,828	$-	$9,217,756	$9,217,756	$6,027,355	$6,027,355	75%	75%	2.49	2.49	1.00	1.00	5.36	5.36	5.36
VC5	$3,552,672	$4,465,994	$379,068	$2,052,890	$1,604,711	$919,934	$617,886	11%	14%	1.20	1.07	5.00	5.00	1.79	1.79	1.79
VC6	$3,082,901	$10,950,496	$552,157	$11,086,995	$10,422,851	$7,039,063	$6,594,781	57%	60%	3.09	2.90	2.00	2.00	5.21	5.21	5.21
VC7	$4,150,469	$12,266,331	$-	$10,185,022	$10,185,022	$6,703,141	$6,703,141	82%	82%	2.66	2.66	1.00	1.00	5.81	5.81	5.81
VC8	$4,353,589	$13,285,852	$286,728	$11,180,044	$10,864,522	$6,908,773	$6,706,070	106%	109%	2.80	2.72	1.00	1.00	6.61	6.61	6.61
VC9	$4,486,460	$5,768,519	$2,428,686	$4,191,393	$1,725,101	$2,753,457	$955,618	32%	75%	1.86	1.22	1.00	1.00	2.06	2.06	2.06
VC10	$2,254,589	$6,121,055	$94,834	$5,569,388	$5,452,965	$3,189,863	$3,112,659	27%	28%	2.02	1.98	5.00	5.00	3.21	3.21	3.21

Table 118: programme portfolio – Senegal

2.9. Results: portfolio analysis

2.9.1. Burkina Faso

	Portfolio composition		
	FOs	MSME	Cooperatives
VC1			
VC2			
VC3			29.63%
VC4			
VC5			25.93%
VC6	0.40%		
VC7		100.00%	44.44%
VC8	98.94%		
VC9	0.66%		
VC10			

Table 119: Portfolio composition in Burkina Faso

	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR
FOs	$1,947.57	$2,070.47	1.43	1.45	43%	46%
MSME	$0.64	$0.64	1.09	1.09	19%	19%
Cooperatives	$622.21	$763.02	1.86	1.96	29%	31%

Table 120: 1ha/1head – beneficiaries in Burkina Faso

	S-NPV	NPV	S- IRR (lifetime)	IRR (lifetime)	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio
FOs	$825,355	$761,709	26%	24%	1.26	1.22	1.99	2.00	2.13
MSME	$4,235,979	$4,235,979	82%	82%	2.54	2.54	1.00	1.00	5.83
Cooperatives	$3,360,493	$3,181,530	57%	55%	2.35	2.22	2.37	2.63	4.59

Table 121: programme – beneficiaries in Burkina Faso

2.9.2. Ghana

	Portfolio composition		
	FOs	MSME	Cooperatives
VC1	8.73%		
VC2	15.87%		
VC3			
VC4			
VC5	23.81%		
VC6	19.84%		
VC7		100.00%	
VC8	17.86%		
VC9	13.89%		
VC10			

Table 122: Portfolio composition in Ghana

	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR
FOs	$769	$1,047	1.70	1.89	79%	112%
MSME	$0	$0	1.06	1.06	19%	19%
Cooperatives	$-	$-	0.00	-	0%	0%

Table 123: 1ha/1head – beneficiaries in Ghana

	S-NPV	NPV	S- IRR (lifetime)	IRR (lifetime)	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio
FOs	$1,873,193	$1,363,477	48%	35%	1.59	1.27	2.33	2.65	2.01
MSME	$4,011,263	$4,011,263	81%	81%	2.09	2.09	1.00	1.00	3.66
Cooperatives	$-	$-	0%	0%	0.00	0.00	0.00	0.00	0.00

Table 124: programme – beneficiaries in Ghana

2.9.3. Ivory Coast

	Portfolio composition		
	FOs	MSME	Cooperatives
VC1	29.76%	55.56%	
VC2	8.47%		33.33%
VC3			
VC4			
VC5	29.76%		
VC6			
VC7			
VC8	0.28%		33.33%
VC9			
VC10	31.74%	44.44%	33.33%

Table 125: Portfolio composition in Ivory Coast

	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR
FOs	$2,031	$2,523	1.83	2.11	42%	80%
MSME	$2,482	$3,055	2.07	2.53	52%	118%
Cooperatives	$3,528	$3,647	2.22	2.28	75%	81%

Table 126: 1ha/1head – beneficiaries in Ivory Coast

	S-NPV	NPV	S- IRR (lifetime)	IRR (lifetime)	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio
FOs	$3,268,932	$2,320,223	42%	26%	2.06	1.71	2.53	3.21	1.92
MSME	$4,497,177	$2,983,608	57%	31%	2.51	1.97	1.89	2.44	2.09
Cooperatives	$4,016,909	$3,800,270	50%	47%	2.19	2.11	1.67	2.33	2.62

Table 127: programme – beneficiaries in Ivory Coast

2.9.4. Mali

	Portfolio composition		
	FOs	MSME	Cooperatives
VC1			
VC2			
VC3	33.33%	29.39%	11.11%
VC4		23.51%	55.56%
VC5		19.84%	
VC6	33.33%	3.67%	22.22%
VC7		13.96%	
VC8	33.33%	5.95%	
VC9		3.67%	
VC10			11.11%

Table 128: Portfolio composition in Mali

	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR
FOs	$801	$897	2.69	2.82	40%	44%
MSME	$783	$943	1.95	2.05	31%	38%
Cooperatives	$1,138	$1,173	2.19	2.25	34%	35%

Table 129: 1ha/1head – beneficiaries in Mali

	S-NPV	NPV	S- IRR (lifetime)	IRR (lifetime)	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio
FOs	$3,203,483	$2,954,075	36%	33%	2.40	2.23	2.33	2.33	4.45
MSME	$3,505,687	$3,279,398	53%	49%	2.38	2.24	2.28	2.28	5.15
Cooperatives	$4,724,912	$4,604,149	69%	68%	2.86	2.78	1.67	1.67	6.66

Table 130: programme – beneficiaries in Mali

2.9.5. Senegal

	Portfolio composition		
	FOs	MSME	Cooperatives
VC1		43.76%	
VC2			
VC3		22.45%	36.14%
VC4			
VC5		2.75%	
VC6		11.68%	53.49%
VC7			
VC8			
VC9			
VC10		19.35%	10.37%

Table 131: Portfolio composition in Senegal

	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR
FOs	$-	$-	0.00	-	0%	0%
MSME	$1,055	$1,464	2.10	2.48	39%	90%
Cooperatives	$1,546	$1,584	3.32	3.38	58%	59%

Table 132: 1ha/1head – beneficiaries in Senegal

	S-NPV	NPV	S- IRR (lifetime)	IRR (lifetime)	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	S-Payback Period (Years)	Payback Period (Years)	Debt Service Coverage Ratio
FOs	$-	$-	0%	0%	0.00	0.00	0.00	0.00	0.00
MSME	$4,109,927	$2,828,317	49%	27%	2.29	1.82	2.45	2.89	2.95
Cooperatives	$6,481,245	$6,100,512	54%	52%	2.96	2.79	2.67	2.67	4.91

Table 133: programme – beneficiaries in Senegal

2.10. Estimating GCF contribution

As indicated earlier, the implementation of the project would allow to reduce the interest rate when compared to the standard agricultural bank funds, as indicated in Table 134

Country	Interest Rate Local Currency Interest Rate US$			
	GCF-IGREENFIN	Agricultural Banks Fund	Commercial Banks Fund or MFIs	Average final interest rate to end users
Burkina Faso	0%	12.0%	5%	5%
Côte d'Ivoire	0%	12.5%	4%	4%
Ghana	0%	20.5%	9.5%	9.5%
Mali	0%	8.63%	4%	4%
Senegal	0%	12.5%	4%	4%

Table 134: interest rates applied in each country, considering GCF contribution ("Commercial Banks Funds or MFIs") and without it ("Agricultural Banks Fund").

The next tables show the NPV, S-NPV, BCR, and S-BCR, for each country and beneficiary considering the portfolio compositions shown in section 2.4.

2.10.1. Burkina Faso

		NPV	S-NPV	BCR	S-BCR
With GCF	**FOs**	$1,948	$2,070	1.43	1.45
	MSME	$0.64	$0.64	1.09	1.09
	Cooperatives	$622	$763	1.86	1.96
Without GCF	**FOs**	$1,082	$1,424	1.34	1.44
	MSME	$0.30	$0.30	1.04	1.04
	Cooperatives	$271.20	$361	1.57	1.64

Table 135: 1ha/1head – beneficiaries in Burkina Faso – GCF Contribution

		S-NPV	NPV	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	Debt Service Coverage Ratio
With GCF	**FOs**	$825,355	$761,709	1.26	1.22	2.13
	MSME	$4,235,979	$4,235,979	2.54	2.54	5.83
	Cooperatives	$3,360,493	$3,181,530	2.35	2.22	4.59
Without GCF	**FOs**	$357,715	$317,367	1.00	0.96	1.51
	MSME	$2,373,126	$2,373,126	1.92	1.92	3.95
	Cooperatives	$1,766,864	$1,660,628	1.65	1.53	3.21

Table 136: programme – beneficiaries in Burkina Faso – GCF Contribution

2.10.2. Ghana

		NPV	S-NPV	BCR	S-BCR
With GCF	**FOs**	$769	$1,047	1.70	1.89
	MSME	$0.47	$0.47	1.06	1.06
	Cooperatives	$-	$-	0.00	-
Without GCF	**FOs**	$219	$372	1.44	1.61
	MSME	$(0)	$(0)	0.99	0.99
	Cooperatives	$-	$-	0.00	-

Table 137: 1ha/1head – beneficiaries in Ghana – GCF Contribution

		S-NPV	NPV	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	Debt Service Coverage Ratio
With GCF	**FOs**	$1,873,193	$1,363,477	1.59	1.27	2.01
	MSME	$4,011,263	$4,011,263	2.09	2.09	3.66
	Cooperatives	$-	$-	0.00	0.00	0.00
Without GCF	**FOs**	$713,031	$434,324	1.14	0.82	1.50
	MSME	$1,816,990	$1,816,990	1.36	1.36	2.68
	Cooperatives	$-	$-	0.00	0.00	0.00

Table 138: programme – beneficiaries in Ghana – GCF Contribution

2.10.3. Ivory Coast

		NPV	S-NPV	BCR	S-BCR
With GCF	**FOs**	$2,031	$2,523	1.83	2.11
	MSME	$2,482	$3,055	2.07	2.53
	Cooperatives	$3,528	$3,647	2.22	2.28
Without GCF	**FOs**	$962	$1,223	1.51	1.77
	MSME	$1,402	$1,691	1.71	2.13
	Cooperatives	$2,002	$2,067	1.89	1.94

Table 139: 1ha/1head – beneficiaries in Ivory Coast – GCF Contribution

		S-NPV	NPV	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	Debt Service Coverage Ratio
With GCF	**FOs**	$3,268,932	$2,320,223	2.06	1.71	1.92
	MSME	$4,497,177	$2,983,608	2.51	1.97	2.09
	Cooperatives	$4,016,909	$3,800,270	2.19	2.11	2.62
Without GCF	**FOs**	$1,378,975	$851,321	1.43	1.03	1.42
	MSME	$2,060,493	$1,206,577	1.81	1.16	1.53
	Cooperatives	$1,803,834	$1,689,054	1.43	1.34	1.75

Table 140: programme – beneficiaries in Ivory Coast – GCF Contribution

2.10.4. Mali

		NPV	S-NPV	BCR	S-BCR
With GCF	**FOs**	$801	$897	2.69	2.82
	MSME	$783	$943	1.95	2.05
	Cooperatives	$1,138	$1,173	2.19	2.25
Without GCF	**FOs**	$521	$591	2.35	2.46
	MSME	$485	$600	1.73	1.82
	Cooperatives	$823	$850	1.95	2.00

Table 141: 1ha/1head – beneficiaries in Mali – GCF Contribution

		S-NPV	NPV	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	Debt Service Coverage Ratio
With GCF	**FOs**	$3,203,483	$2,954,075	2.40	2.23	4.45
	MSME	$3,505,687	$3,279,398	2.38	2.24	5.15
	Cooperatives	$4,724,912	$4,604,149	2.86	2.78	6.66
Without GCF	**FOs**	$1,989,703	$1,823,744	1.81	1.65	3.30
	MSME	$2,236,501	$2,083,071	1.88	1.74	3.71
	Cooperatives	$3,072,617	$2,992,526	2.22	2.14	4.76

Table 142: programme – beneficiaries in Mali – GCF Contribution

2.10.5. Senegal

		NPV	S-NPV	BCR	S-BCR
With GCF	**FOs**	$-	$-	0.00	-
	MSME	$1,055	$1,464	2.10	2.48
	Cooperatives	$1,546	$1,584	3.32	3.38
Without GCF	**FOs**	$-	$-	0.00	-
	MSME	$500	$722	1.71	2.07
	Cooperatives	$798	$847	2.58	2.68

Table 143: 1ha/1head – beneficiaries in Senegal – GCF Contribution

		S-NPV	NPV	S-Benefit to cost ratio (lifetime) / discounted	Benefit to cost ratio (lifetime) / discounted	Debt Service Coverage Ratio
With GCF	**FOs**	$-	$-	0.00	0.00	0.00
	MSME	$4,109,927	$2,828,317	2.29	1.82	2.95
	Cooperatives	$6,481,245	$6,100,512	2.96	2.79	4.91
Without GCF	**FOs**	$-	$-	0.00	0.00	0.00
	MSME	$1,830,849	$1,114,297	1.66	1.11	1.97
	Cooperatives	$2,865,304	$2,678,002	1.73	1.57	3.22

Table 144: programme – beneficiaries in Senegal – GCF Contribution

Bibliography

Agrawal, S., & Jain, A. (2019). Sustainable deployment of solar irrigation pumps: Key determinants and strategies. *Wiley Interdisciplinary Reviews: Energy and Environment, 8(2)*, e325.

Alene, A. D., Abdoulaye, T., Rusike, J., Labarta, R., Creamer, B., Del Río, M., & Becerra, L. A. (2018). Identifying crop research priorities based on potential economic and poverty reduction impacts: The case of cassava in Africa, Asia, and Latin America. *PLoS One, 13(8)*, e0201803.

Andersson, L. (2015). *Low-Cost Drip Irrigation - On farm implementation in South Africa.* Retrieved from Luleå University of Technology: http://ltu.diva-portal.org/smash/get/diva2:1025520/FULLTEXT01.pdf

Assumption. (n.d.).

Cornell University. (2020). *SRI International Network and Resources Center*. Retrieved from http://sri.ciifad.cornell.edu/

Curtis, I. (2004). Valuing ecosystem goods and services: a new approach using a surrogate market and the combination of a multiple criteria analysis and a Delphi panel to assign weights to the attributes. *Ecological Economics, 50(3-4)*, 163-194.

European Commission. (2020). *Cashew value chain analysis in Mali.*

Expert systems for sheep and goat. (n.d.). *Feeding Management and Methods*. Retrieved from http://www.agritech.tnau.ac.in/expert_system/sheepgoat/Feeding%20Management%20of%20Sheep%20and%20Goats.html#:~:text=In%20addition%20to%20grazing%2C%20animals,kg%20per%20head%20per%20day.

FAO. (2012). *CARBON SEQUESTRATION IN AGRICULTURAL SOILS.*

FAO. (2015). *FARMER´S COMPOST HANDBOOK Experiences in Latin America.*

FAO. (2016). *Strengthening Agricultural Water Efficiency and Productivity on the African and Global Level.* FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS.

FAO. (2021). *FAOSTAT*. Retrieved from Food and Agriculture Organization of the United Nations: http://www.fao.org/faostat/en/#data/PP

FAO; GSA;. (2020). *Global Shea Alliance.* Retrieved from https://globalshea.com/gsamain/storage/img/marqueeupdater/2020.05.27.09.41GSA%20FAO%20REPORT.pdf

Font-Palma, C. (2019). Methods for the treatment of cattle manure—A review. *C—Journal of Carbon Research, 5(2),*.

Gebrezgabher, S., Leh, M., Merrey, D. J., Kodua, T. T., & Schmitter, P. (2021). *Solar photovoltaic technology for small-scale irrigation in Ghana: suitability mapping and business models. Agricultural Water Management–Making a Business Case for Smallholders (Vol. 178).* International Water Management Institute (IWMI).

GIZ. (2020). *BUSINESS MODEL for Rice cultivation using SYSTEM OF RICE INTENSIFICATION (SRI).* Deutsche Gesellschaft für Internationale Zusammenarbeit.

Grais, A., Sidman, G., Netzer, M., Tepe, T., & Pearson, T. (2017). *Feed the Future Ghana Agriculture and Natural Resource Management Project.*

Heeb, L. (2013). *Field Report Shea Pilot Project – North Kintampo District.* Bern University.

Hermelin, B. (2004). Agricultural dumping: the case of chicken in Western and Central Africa. *SOS Faim, Farming Dynamics, 4*.

IFAD. (2015a). *IFAD'S INTERNAL GUIDELINES Economic and Financial Analysis of rural investment projects.*

Joint, F.A.O. (2018). *Cassava Production Guidelines for Food Security and Adaptation to Climate Change in Asia and Africa (No. IAEA-TECDOC--1840).* Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture.

Kadiyala, M., Nedumaran, S., Padmanabhan, J., Gumma, M., Gummadi, S., Srigiri, S., . . . Whitbread, A. (2021). Modeling the potential impacts of climate change and adaptation strategies on groundnut production in India. *Science of The Total Environment, 776*, 145996.

Kumar, C., Begeladze, S., Calmon, M., & Saint-Laurent, C. (2015). Enhancing food security through forest landscape restoration: Lessons from Burkina Faso, Brazil, Guatemala, Viet Nam, Ghana, Ethiopia and Philippines. *IUCN, Gland*.

Loganathan, R., Mani, K., Mariappan, G., & Indrakumar, K. (2016). Cost, returns and economic viability of cashew plantations in Tamil Nadu. *International Research Journal of Agricultural Economics and Statistics, 7(1)*, 76-85.

Miklyaev, M., Afra, S., & Hashemi, M. (2017). Cost-benefit Analysis of Rwanda's Poultry Value Chains. *Development Discussion Paper 2017, 5.*

Miklyaev, M., Hashemi, M., & Schultz, M. (2017). Cost Benefit Analysis of Senegal's Rice Value Chains. *Development Discussion Paper, Cambridge Resources International.*

Molina-Flores, B., Manzano-Baena, P., & Coulibaly, M. (2020). *The role of livestock in food security, poverty reduction and wealth creation in West Africa.* FAO.

Nkwake, P., Magistro, J., & Horjus, P. (2014). *ADAPTING TO THE SAHEL'S CHANGING CLIMATE: LOCAL APPROACHES AN ECONOMIC AND TECHNICAL FEASIBILITY ANALYSIS OF ADAPTATION TECHNIQUES IN NIGER, BURKINA FASO AND MALI.*

Okello, W., MacLeod, E., Muhanguzi, D., Waiswa, C., & Welburn, S. (2021). Controlling tsetse flies and ticks using insecticide treatment of cattle in Tororo district Uganda: cost benefit analysis. *Frontiers in Veterinary Science, 8*, 174.

Olam Nuts. (2020, 11 30). *Addressing Sustainability Challenges in Cashews*. Retrieved from https://olamnuts.com/types-of-nuts-blog/post/addressing-sustainability-challenges-in-cashews

Osuhor, C., Alawa, J., & Akpa, G. (2002). Research note: Manure production by goats grazing native pasture in Nigeria. *Tropical Grasslands, 36(2)*.

Padhi, M. (2016). Importance of indigenous breeds of chicken for rural economy and their improvements for higher production performance. *Scientifica*.

Ram, V., Makwana, A., & Bhatu, H. (2018). Cost-benefit analysis and water productivity of MIS for a crop production in Kodinar region of Gujarat. *Green Farming, 9(1)*, 169-172.

Rathod, A. B., & Trivedi, S. A. (2011). Summer groundnut crop performance and economics under drip irrigation at various water application levels. *National Conference on Recent Trends in Engineering and Technology.*

RICOWAS Full Proposal. (2021). Scaling-up climate-resilient rice production in West Africa.

SEI. (2012). *Evolution of Agricultural Water Management in Rainfed Crop-Livestock Systems of the Volta Basin*. Retrieved from Stockholm Environment Institute: https://www.sei.org/publications/evolution-of-agricultural-water-management-in-rainfed-crop-livestock-systems-of-the-volta-basin/

Selina Wamucii. (2021). *Prices*. Retrieved from https://www.selinawamucii.com/insights/prices/

Sowjanya, B., Vijaya, K., Rajeswara, R., & Kulkarni, B. (2013). *ECONOMIC FEASIBILITY OF DRIP IRRIGATION IN MANGO CULTIVATION: A STUDY IN ANDHRA PRADESH, INDIA*. Retrieved from Academic & Law Serials: http://www.academic-and-law-serials.com/component/content/article.html?id=305

TNAU Agritech portal. (n.d.). *Animal Husbandry*. Retrieved from https://agritech.tnau.ac.in/animal_husbandry/animhus_cattle_%20feed%20management.html#:~:text=The%20total%20dry%20matter%20requirement,processing%20of%20feeds%2C%20palatability%20etc.&text=with%20a%20minimum%20of%206,a%20cow%20of%20average%20size.

van der Wijngaart, R., Helming, J., Jacobs, C., Delvaux, P., Hoek, S., & Gomez y Paloma, S. (2019). *Irrigation and irrigated agriculture potential in the Sahel: The case of the Niger River basin.* RC Technical Report.

World Bank. (2017). *Senegal Groundnut Value Chain Competitiveness and Prospects for Development.*

World Bank. (2018). Retrieved from IMPLEMENTATION COMPLETION AND RESULTS REPORT Credit Number 5053-ZM ON A CREDIT IN THE AMOUNT OF SDR32.60 MILLION (US$ 50.0 MILLION EQUIVALENT) TO THE The Republic of Zambia FOR THE Zambia: Livestock Development and Animal Health Project December 7, 2018: https://documents1.worldbank.org/curated/en/583181545926617156/pdf/133059zm-12192018-636810265287041661.pdf