Why Investing in Climate-Smart Crop Management Is a Pragmatic Recovery Plan for Rural Communities in Ghana

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The Rationale for the What-If Sustainable Asset Valuation (SAVi) Simulations

Planning a sustainable recovery requires that we look ahead and forecast how spending today will play out in the national and global economy in the years to come. It is also important that the ongoing, unprecedented wave of public spending triggers a sustainable recovery, one that has the environment, climate, and social cohesion at its core. The Sustainable Asset Valuation (SAVi) What-If simulations are designed to inform this debate by helping us understand the economic and societal benefits that can be realized when public spending is targeted at sustainable infrastructure. Simulations are inspired by ongoing recovery plans and are based on authoritative data and real science.

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Section 1. About This What-If Simulation

This simulation estimates the impact of sustainable recovery financing on climate-smart crop management interventions in a rural community in Ghana. To do so, we draw from preliminary work and simulations undertaken with the Green Climate Fund (GCF). We explored what could happen if the GCF provided financial support to bring down interest rates on loans for climate-smart crop management in rural communities.

In this simulation, we look at the benefits of investing in climate-smart crop management interventions. As explained in Table 1, these interventions are to take place on 2,023 hectares (ha) of the proposed project area that is used for agricultural purposes. Implementing these improved crop management strategies will reduce climate impacts, increase yields, and generate additional revenues from the farmed crops over the 30-year project timeline.

Table 1. Climate-Smart Crop Management

Intervention	Key assumptions	Rationale for investment	GCF sustainable recovery financing
Climate-smart crop management strategies	• 674 ha of land is used for maize production, 674 ha for rice production, and 674 ha for oil palm production. Cumulatively, 2,023 ha of the land in the project area is used for agricultural purposes. • Crop rotation, mixed cropping, improved nutrient management, improved genetic resources, and minimum tillage will be implemented on all 2,023 ha of agricultural land. • A project timeline of 30 years is assumed.	• Due to climate change, agricultural yields are assumed to decline 20% by 2035 if business-as-usual crop management strategies persist. • Climate-smart crop management interventions will help farmers avoid these adverse impacts and increase yields. This will improve food security and improve the livelihoods of the farmers in the project area.	• Financial support to reduce interest rates from 15% to 8% on loans in the first five years of project implementation.

However, the persistently high cost of commercial lending remains a challenge for implementing such interventions in Ghana—interest rates for the agriculture sector currently sit at 15%. Given such high interest rates and the additional economic turbulences caused by the COVID-19 pandemic, the profitability—and, in some cases, the financial feasibility—of climate-smart crop management interventions will suffer.

To enable the sustainable economic recovery of communities through investing into the proposed climate-smart crop management interventions, public donors and lenders such as the GCF could provide concessional finance or other support measures to improve the financial feasibility and performance of the interventions. This simulation explores "what if" the GCF offers recovery support that reduces interest rates on loan repayments from 15% to 8% in the first five years of project implementation. The simulation assumes that the GCF seeks to target lending to sectors that bring additionality in terms of financing, climate resilience, greenhouse gas emissions reductions, as well as societal benefits.

Section 2. The SAVi Simulation Results

Overview

This SAVi assessment consists of:

(1) A comparison of the costs and benefits of several climate-smart crop management interventions with and without GCF sustainable recovery financing available. Comparing the various interventions helps determine which would require GCF support the most.

(2) A valuation of externalities (co-benefits), comparing a baseline scenario with the scenario of investing in climate-smart crop management interventions.

The simulation estimates the impact of five climate-smart crop management interventions implemented over the 2023 ha of agricultural land. The five proposed interventions, which are described in a USAID report by Ng'ang'a et al. (2017), are:

- Crop management, including rotation: This involves practices to ensure that a piece of land is being used for production throughout the whole year. This could include rotating the crops that are being produced on a piece of land based on the season.

- Mixed cropping: This involves producing more than one crop on a plot of land at the same time.

- Improved nutrient management: This involves use of fertilizers and practices to ensure the health of the crops and soil.

- Improved genetic resources: This involves using inputs that have been improved genetically to increase yield.

- Minimum tillage: This involves lowering the intensity of tilling, as intense tilling can disrupt soil productivity.

Capital costs for each climate-smart crop management intervention recur annually. It is assumed that in order to implement these interventions, loans covering the first five years of capital costs are required. GCF recovery support can be provided for the first five years to lower the interest rate from commercial rates of 15% to 8%. We assume that GCF support covers 30% of required loans; the rest of the required loans are assumed to be covered by private sector investors who, because of GCF involvement, realize the value of the project and have been crowded in. Table 2 provides details on assumptions for the two financing scenarios considered in this What-If simulation.

Table 2. Assumptions of the two financing scenarios

Sustainable recovery, high concessional finance from GCF	
Interest rate	8%
Lending period	five years
Repayment period	10 years
Grace period	three years (repayment of loans begins after three years)
Commercial lending, no GCF support	
Interest rate	15% (commercial rate)
Lending period	five years
Repayment period	10 years[1]
Grace period	Three years (repayment of loans begins after 3 years)

For this simulation, in addition to traditional project cost and revenues, we calculated the value of generated externalities. These externalities represent co-benefits caused by climate-smart crop management interventions that are not included in traditional cost-benefit analysis, but will eventually be realized by society (Table 3). The valuation of these externalities is based on publicly available information (Ng'ang'a et al., 2017).

Table 3. Externalities considered in the SAVi assessment

Externalities	1. Reduced soil erosion 2. On-farm biodiversity increase 3. Air quality improvements from carbon sequestration 4. Increases in soil fertility 5. Increased water availability 6. Increased political and social capital

The simulation assumes, on average, each intervention will be applied to 1/5 of the project area, i.e., 405 ha per intervention. An overview of the simulation results is presented in Table 4 and Table 5.

Two scenarios were simulated: GCF offers sustainable recovery financing for all five climate-smart crop management interventions compared to no financial support offered by GCF. The short-term results of the simulation during this five-year period are presented in Table 4. Since costs and benefits

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[1] GCF lending period can be longer that 10 years.

will continue to accumulate after GCF involvement ends, Table 5 presents the long-term outcomes. It is evident from these cumulative results that the GCF sustainable recovery support, in both the short and long terms, makes the climate-smart crop management project more profitable compared to a financing scenario purely based on commercial lending terms. Still, the latter scenario would yield positive net results in the short and long term.

Table 4. Overview of SAVi simulation short-term results (USD)

Cumulative result for all climate-smart crop management interventions over five-year timeline (USD)		
Cost and benefit positions	**No GCF support (15% interest rate)**	**GCF support for first five years (8% interest rate)**
Capital investment	14,445,000	14,445,000
Operation and maintenance (O&M) costs	7,971,000	7,971,000
Total interest payment amount	5,417,000	2,889,000
(1) Total costs	27,832,000	25,304,000
(2) Total revenues	29,603,000	29,603,000
(A) Net operational result [(2)-(1)]	**1,772,000**	**4,299,000**
(B) Cumulative externalities	**3,305,000**	**3,305,000**
Net result including externalities[(A)+(B)]	**5,077,000**	**7,605,000**

Table 5. Overview of SAVi simulation long-term results (USD)

Cumulative result for all climate-smart crop management interventions over 30-year timeline (USD)		
Cost and benefit positions	**No GCF support (15% interest rate)**	**GCF support for first five years (8% interest rate)**
Capital investment	86,667,000	86,667,000
O&M costs	47,824,000	47,824,000
Total interest payment amount	10,833,000	5,778,000
(1) Total costs	145,325,000	140,269,000
(2) Total revenues	177,620,000	177,620,000
(A) Net operational result [(2)-(1)]	**32,296,000**	**37,351,000**
(B) Cumulative externalities	**19,832,000**	**19,832,000**
Net result including externalities[(A)+(B)]	**52,128,000**	**57,184,000**

The following sections (Tables 6 to 15) discuss the total costs and benefits of each climate-smart crop management intervention individually to examine their performance more precisely and identify which would benefit the most from the GCF sustainable recovery financing support.

A Closer Look at the Simulation Results for Crop Rotation

Tables 6 and 7 offer the results of implementing crop rotation over the entire 2,023 ha project area. Table 6 presents short-term results during the first five years of the intervention, and Table 7 presents results by the end of the 30-year project timeline.

First, cumulative costs to implement crop rotation on 2,023 ha of agricultural land amount to USD 30.087 million in the first five years without GCF support. These costs become USD 170.5 million over the 30-year project timeline. With GCF sustainable recovery support to reduce interest rates on loan repayments to 8%, total project costs are reduced to USD 28.9 million in the first five years and USD 168.2 million by the end of the project timeline.

Second, cumulative revenues generated by crop rotation total almost USD 26 million in the short term and USD 155.8 million over 30 years. Regardless of the positive benefits generated by externalities, the net operational result is negative both with and without GCF support in the short term. However,

if the monetary value of positive externalities is integrated in the cost-benefit analysis (CBA), the benefits outweigh costs by USD 363,000 without GCF support and by USD 2.7 million with GCF sustainable recovery support in the long term (Table 7).

The negative net operational results (A) in the short and long terms suggest that investing in crop rotation is not an appealing area for commercial lenders. Sustainable recovery financing from GCF is needed to cover the loss and crowd in private investors for this intervention. However, one can recognize that providing support to lower interest rate payments for loans provided over the first five years alone does not suffice to achieve positive net operational results. It might be necessary to expand the financial support either over a longer time period or to provide loans for even lower interest rates. The attainable positive externalities and the emissions reduction potential of 37,000 tons of carbon dioxide equivalent (CO_2eq) may justify the GCF extending their sustainable recovery financing.

Table 6. SAVi simulation short-term results for crop rotation (USD)

Cumulative result for crop rotation over five-year timeline (USD)		
Cost and benefit positions	**No GCF support (15% interest rate)**	**GCF support for first five years (8% interest rate)**
Capital investment	6,676,000	6,676,000
O&M costs	20,908,000	20,908,000
Total interest payment amount	2,503,000	1,335,000
(1) Total costs	30,087,000	28,919,000
(2) Total revenues	25,970,000	25,970,000
(A) Net operational result [(2)-(1)]	**(4,117,000)**	**(2,948,000)**
(B) Cumulative externalities	**2,508,000**	**2,508,000**
Net result including externalities[(A)+(B)]	**(1,608,000)**	**(440,000)**

Table 7. SAVi simulation long-term results for crop rotation (USD)

Cumulative result for crop rotation over 30-year timeline (USD)		
Cost and benefit positions	**No GCF support (15% interest rate)**	**GCF support for first five years (8% interest rate)**
Capital investment	40,055,000	40,055,000
O&M costs	125,446,000	125,446,000
Total interest payment amount	5,007,000	2,670,000
(1) Total costs	170,509,000	168,172,000
(2) Total revenues	155,822,000	155,822,000
(A) Net operational result [(2)–(1)]	**(14,687,000)**	**(12,350,000)**
(B) Cumulative externalities	**15,050,404**	**15,050,404**
Net result including externalities[(A)+(B)]	**363,000**	**2,700,000**

A Closer Look at the Simulation Results for Mixed Cropping

Tables 8 and 9 offer the results of implementing mixed cropping over the entire 2,023 ha project area. Table 8 presents the short-term results. Table 9 presents results by the end of the 30-year project timeline.

First, cumulative costs for mixed cropping total USD 35 million in the short term and USD 177.6 million over the 30-year project timeline without GCF sustainable recovery support available. With GCF sustainable recovery financing, these costs are reduced to USD 31 in the first five years and USD 170 million after 30 years.

Second, additional revenues generated by mixed cropping total USD 13.2 over five years and USD 79.4 million after 30 years. This suggests that the net operational result is negative both with and without GCF involvement as long as positive externalities are not considered in the assessment.

The consideration of valued externalities generated by mixed cropping adds a benefit of USD 4.45 million to the net results after five years and USD 26.7 million to the net results over 30 years. Despite integrating this benefit into the CBA, mixed cropping results in a net loss both with and without GCF sustainable recovery financing. With GCF support, this loss is reduced to approximately USD 64 million as opposed to USD 71.5 million over the 30-year lifetime.

These negative net results (A) in the short term (and particularly in the long term) suggest that mixed cropping is an unattractive investment area for commercial lenders. The scenario which involves financing support from GCF also does not attain positive net results in the short and long terms, even when the value of positive externalities is integrated into the CBA. While a significant amount (147,000 tons) of reduced CO_2eq. emissions over the 30-year project timeline can be achieved through the mixed cropping intervention, the poor economic performance suggests that mixed cropping is not an effective intervention for achieving the sustainable recovery of rural communities. Alternatively, it could be possible to implement mixed cropping jointly with another climate-smart crop management technique that fulfills the required agricultural and adaptation purposes while performing better economically.

Table 8. SAVi simulation short-term results for mixed cropping (USD)

Cumulative result for mixed cropping over five-year timeline (USD)		
Cost and benefit positions	No GCF support (15% interest rate)	GCF support for first five years (8% interest rate)
Capital investment	21,758,000	21,758,000
O&M costs	5,128,000	5,128,000
Total interest payment amount	8,159,000	4,352,000
(1) Total costs	35,045,000	31,238,000
(2) Total revenues	13,229,000	13,229,000
(A) Net operational result [(2)-(1)]	**(21,816,000)**	**(18,009,000)**
(B) Cumulative externalities	**4,454,000**	**4,454,000**
Net result including externalities[(A)+(B)]	**(17,362,000)**	**(13,555,000)**

Table 9. SAVi simulation long-term results for mixed cropping (USD)

Cumulative result for mixed cropping over five-year timeline (USD)		
Cost and benefit positions	**No GCF support (15% interest rate)**	**GCF support for first five years (8% interest rate)**
Capital investment	130,548,000	130,548,000
O&M costs	30,770,000	30,770,000
Total interest payment amount	16,318,000	8,704,000
(1) Total costs	177,636,000	170,022,000
(2) Total revenues	79,377,000	79,377,000
(A) Net operational result [(2)–(1)]	(98,259,000)	(90,645,000)
(B) Cumulative externalities	26,723,000	26,723,000
Net result including externalities[(A)+(B)]	(71,536,000)	(63,922,000)

A Closer Look at the Simulation for Improved Nutrient Management

Tables 10 and 11 offer the results of implementing improved nutrient management over the entire 2,023 ha project area. Table 10 presents short-term results, and Table 11 presents the results by the end of the 30-year project timeline.

First, cumulative costs for improved nutrient management over the first five years amount to USD 3.57 million without GCF support. Over the 30-year project timeline, these costs total USD 18.5 million.

Second, additional revenues generated by improved nutrient management total USD 33 million in the short term and USD 198 million in the long term, yielding positive net operational results of more than USD 29.4 million and almost USD 179.5 million respectively. This demonstrates that the net operational result is clearly positive in both the short and long terms, irrespective of whether GCF provides financial support as a sustainable recovery instrument or not.

The consideration of valued externalities generated by improved nutrient management adds another USD 28.3 million to the net results after 30 years. This makes the investment even more appealing from a societal point of view. Without GCF involvement, the net economic gain of improved nutrient management amounts to USD 207.8 million over the 30-year project timeline while sustainable recovery financing provided by GCF would increase the long-term net result to almost USD 208.5 million.

The positive net operational results achieved through investments into improved nutrient management promise attractive returns and make it an appealing investment area for commercial lenders. Sustainable recovery financing by GCF is likely not needed to crowd in private investors for this intervention. If, however, commercial lenders do not appear to recognize the promising business case, improved nutrient management is certainly a convincing sustainable recovery intervention due to the relatively low lending volumes for the first five years, the high added revenues and the high climate additionality, represented by the potential to avoid 404,000 tons of greenhouse gas emissions over the project lifetime.

Table 10. SAVi simulation short-term results for improved nutrient management (USD)

Cumulative result for improved nutrient management over five-year timeline (USD)		
Cost and benefit positions	**No GCF support (15% interest rate)**	**GCF support for first five years (8% interest rate)**
Capital investment	1,911,000	1,911,000
O&M costs	941,000	941,000
Total interest payment amount	717,000	382,000
(1) Total costs	3,569,000	3,234,000
(2) Total revenues	33,006,000	33,006,000
(A) Net operational result [(2)–(1)]	**29,437,000**	**29,772,000**
(B) Cumulative externalities	**4,716,000**	**4,716,000**
Net result including externalities[(A)+(B)]	**34,153,000**	**34,488,000**

Table 11. SAVi simulation long-term results for improved nutrient management (USD)

Cumulative result for improved nutrient management over 30-year timeline (USD)		
Cost and benefit positions	**No GCF support (15% interest rate)**	**GCF support for first five years (8% interest rate)**
Capital investment	11,468,000	11,468,000
O&M costs	5,644,000	5,644,000
Total interest payment amount	1,434,000	764,000
(1) Total costs	18,546,000	17,875,000
(2) Total revenues	198,037,000	198,037,000
(A) Net operational result [(2)–(1)]	**179,492,000**	**180,162,000**
(B) Cumulative externalities	**28,295,000**	**28,295,000**
Net result including externalities[(A)+(B)]	**207,787,000**	**208,457,000**

A Closer Look at the Simulation for Improved Genetic Resources

Tables 12 and 13 present the results of implementing improved genetic resources (e.g., drought-resilient seeds and crop varieties) over the entire 2,023 ha project area. Table 12 presents the short-term results, while Table 13 presents results by the end of the 30-year project timeline.

First, in the short term, net operational results of the improved genetic resources intervention are negative, irrespective of whether or not the GCF provides sustainable recovery financing support. Considering valued externalities generated by improved genetic resources adds a positive value of USD 793,000 to net results in the short term. Despite this additional positive benefit, short-term results remain negative both with and without GCF support.

Second, cumulative costs for improved genetic resources over the 30-year project timeline amount to approximately USD 150.5 million without GCF support, or USD 143 million if GCF sustainable recovery financing is provided. Additional revenues generated by improved genetic resources over the 30-year project timeline amount to USD 147.9 million. This implies that the long-term net operational result is positive if the GCF sustainable recovery financing share is provided, while it would turn negative without this recovery contribution.

By the end of the 30 years, the benefits of externalities from improved genetic resources adds another USD 4.76 million to the net results. Accounting for the benefits of externalities, improved genetic resources results in a net gain of USD 2.2 million. With GCF sustainable recovery financing support, this gain amounts to USD 9.5 million.

The negative net operational results (without accounting for externalities) for implementing improved genetic resources without financial support by GCF make it an unattractive investment area for commercial lenders. Sustainable recovery financing support provided by GCF is required to achieve positive net results. The GCF involvement might crowd in private investors for this intervention. In addition, GCF can consider the attainable emissions reduction of 37,000 tons of CO_2eq. emissions and the attainable positive externalities as additional reasons to provide sustainable recovery financing and hence realize the implementation of this climate-smart crop management intervention.

Table 12. SAVi simulation short-term results for improved genetic resources (USD)

Cumulative result for improved genetic resources over five-year timeline (USD)		
Cost and benefit positions	**No GCF support (15% interest rate)**	**GCF support for first five years (8% interest rate)**
Capital investment	20,908,000	20,908,000
O&M costs	1,560,000	1,560,000
Total interest payment amount	7,840,000	4,182,000
(1) Total costs	30,308,000	26,650,000
(2) Total revenues	24,650,000	24,650,000
(A) Net operational result [(2)-(1)]	**(5,658,000)**	**(1,999,000)**
(B) Cumulative externalities	**793,000**	**793,000**
Net result including externalities[(A)+(B)]	**(4,865,000)**	**(1,207,000)**

Table 13. SAVi simulation long-term results for improved genetic resources (USD)

Cumulative result for improved genetic resources over 30-year timeline (USD)		
Cost and benefit positions	No GCF support (15% interest rate)	GCF support for first five years (8% interest rate)
Capital investment	125,446,000	125,446,000
O&M costs	9,361,000	9,361,000
Total interest payment amount	15,681,000	8,364,000
(1) Total costs	150,488,000	143,171,000
(2) Total revenues	147,901,000	147,901,000
(A) Net operational result [(2)-(1)]	**(2,587,000)**	**4,730,000**
(B) Cumulative externalities	**4,758,000**	**4,758,000**
Net result including externalities[(A)+(B)]	**2,172,000**	**9,488,000**

A Closer Look at the Simulation for Minimum Tillage

Tables 14 and 15 offer the results of implementing minimum tillage, a soil conservation practice, over the entire 2,023 ha project area. Table 14 presents the short-term results, and Table 15 presents results by the end of the 30-year project timeline.

First, cumulative costs for minimum tillage over the 30-year project timeline amount to USD 209.4 million without GCF support. Second, additional revenues generated by minimum tillage total almost USD 307 million. This suggests that the net operational result is positive, even without GCF support. Valued externalities generated by minimum tillage add another USD 24.334 million to the net results. This makes the investment even more appealing from a societal point of view. Without GCF support, the net economic gain of minimum tillage amounts to USD 121.853 million.

The positive net results of the minimum tillage intervention would further increase if GCF provides sustainable recovery financing support. However, as the net results are already appealing and promise high level of returns to commercial lenders, it does not appear to be investment area that requires GCF support. A contribution toward a sustainable recovery of rural communities through minimum tillage investments can be achieved without financial support by the GCF.

Table 14. SAVi simulation short-term results for minimum tillage (USD)

Cumulative result for minimum tillage over five-year timeline (USD)		
Cost and benefit positions	**No GCF support (15% interest rate)**	**GCF support for first five years (8% interest rate)**
Capital investment	20,970,000	20,970,000
O&M costs	11,317,000	11,317,000
Total interest payment amount	7,863,000	4,193,000
(1) Total costs	40,150,000	36,480,000
(2) Total revenues	51,161,000	51,161,000
(A) Net operational result [(2)-(1)]	**11,011,000**	**14,681,000**
(B) Cumulative externalities	**4,056,000**	**4,056,000**
Net result including externalities[(A)+(B)]	**15,067,000**	**18,737,000**

Table 15. SAVi simulation long-term results for minimum tillage (USD)

Cumulative result for minimum tillage over 30-year timeline (USD)		
Cost and benefit positions	**No GCF support (15% interest rate)**	**GCF support for first five years (8% interest rate)**
Capital investment	125,818,000	125,818,000
O&M costs	67,901,000	67,901,000
Total interest payment amount	15,726,000	8,386,000
(1) Total costs	209,446,000	202,106,000
(2) Total revenues	306,966,000	306,966,000
(A) Net operational result [(2)-(1)]	**97,520,000**	**104,860,000**
(B) Cumulative externalities	**24,334,000**	**24,334,000**
Net result including externalities[(A)+(B)]	**121,853,000**	**129,193,000**

Section 3. Using the Results of This Simulation

The SAVi What-If simulation demonstrates that the five assessed climate-smart crop management interventions perform very differently in terms of costs, additional revenue generation, and magnitude of co-benefits (externalities). Table 16 provides an overview of the long-term results if sustainable recovery financing is provided by GCF compared to climate-smart crop management interventions being financing through commercial loans only.

Table 16. Results of GCF sustainable recovery financing for various climate-smart crop management interventions over a 30-year timeline.

Cumulative result for over 30-year timeline (USD), financial support terms: 8% interest rate on loans for the first five years					
	Crop rotation	**Mixed cropping**	**Improved nutrient management**	**Improved genetic resources**	**Minimum tillage**
Cost and benefit positions					
Capital investment	40,055,000	130,548,000	11,468,000	125,446,000	125,818,000
O&M costs	125,446,000	30,770,000	5,644,000	9,361,000	67,901,000
Total interest payment amount	2,670,000	8,704,000	764,000	8,364,000	8,386,000
(1) Total costs	168,172,000	170,022,000	17,875,000	143,171,000	202,106,000
(2) Total revenues	155,822,000	79,377,000	198,037,000	147,901,000	306,966,000
(A) Sustainable recovery financing: Net operational result [(2)-(1)]	**(12,350,000)**	**(90,645,000)**	**180,162,000**	**4,730,000**	**104,860,000**
Commercial lending: Net operational results without GCF support	**(14,687,000)**	**(98,259,000)**	**179,492,000**	**(2,587,000)**	**97,520,000**
(B) Cumulative externalities	**15,050,000**	**26,723,000**	**28,295,000**	**4,758,000**	**24,334,000**
Sustainable recovery net result including externalities[(A)+(B)]	**2,700,000**	**(63,922,000)**	**208,457,000**	**9,488,000**	**129,193,000**

The GCF sustainable recovery financing can serve to crowd-in private sector financing and achieve societal benefits. The according key insights of this what-if simulation are as follows.

Interventions that would benefit the most from sustainable recovery financing through GCF´s support are improved genetic resources and crop rotation. The former intervention would indeed yield positive net results only in the long term (30-year timeline) once GCF sustainable recovery financing is provided. The support terms assessed in this What-If simulation could hence serve to crowd in commercial lenders that would otherwise not be interested in lending to this intervention.

The economic feasibility of crop rotation also depends on financial support; however, compared to the improved genetic resources intervention it does not achieve positive net results even under the support conditions assessed in this simulation. It might be necessary for the GCF to expand the concessional financing either over a longer time period than the initial five years or provide loans for interest rates even lower than 8%. Given that the crop rotation intervention can yield co-benefits (positive externalities) amounting to more than USD 15 million (and can hence achieve positive integrated net results under conditions assumed in this simulation) this intervention contributes effectively to GCF's additionality and sustainable recovery ambitions.

Improved nutrient management and minimum tillage are both yielding significant positive net results without GCF´s sustainable recovery financing. Commercial lenders will likely be drawn to these interventions and the involvement of GCF is not needed.

Mixed cropping is by comparison a highly deficient intervention when considering the negative net results. These occur whether or not sustainable recovery financing is provided, and still pertain even if the value of positive externalities is integrated into the net results.

Rural communities, policy-makers, GCF, commercial lenders, and project developers will find this What-If simulation useful for discussing and determining the implementation of effective climate-smart crop management and narrowing down respective financing solutions.

Section 4: The Design of the Simulation

Table 17. Simulation elements

Indicator	Explanation
Capital costs	Capital costs were estimated using per-hectare estimates for each intervention found in CIAT's 2017 report (Ng'ang'a et al. 2017). The estimates assume the practices are implemented over the entire 2,023 ha of land used for agricultural purposes.
O&M costs	O&M costs are based on per-hectare estimates for each CSA intervention in CIAT's 2017 report (Ng'ang'a et al., 2017). The totals were estimated assuming project implementation on 2,023 ha of land.

Total interest amount	Total interest amount assumes loans are required to cover the first five years of project implementation. If the GCF provides sustainable recovery financing through support, the interest rate for loan repayments amounts to 8% of capital costs. Without GCF participation, this rises to 15%.
Additional revenues	Additional crop yields from each intervention were estimated using CIAT's 2017 report (Ng'ang'a et al., 2017). Total additional revenues were then calculated using local market prices.
Cumulative externalities	The financially valued societal benefits realized from externalities are based on per-hectare estimates for each CSA intervention per CIAT's 2017 report (Ng'ang'a et al. 2017). The totals were estimated assuming project implementation on 2,023 ha of land.

References

Ng'ang'a, S.K., Miller, V., Essegbey, G., Karbo, N., Ansah, V., Nautsukpo, D., Kingsley, S., & Girvetz, E. (2017). *Cost and benefit analysis for climate-smart agricultural (CSA) practices in the coastal savannah agro-ecological zone (AEZ) of Ghana*. International Center for Tropical Agriculture CIAT, USAID. https://ccafs.cgiar.org/publications/cost-and-benefit-analysis-climate-smart-agricultural-csa-practices-coastal-savannah#.Xz_YoOgzZPY

About SAVi

The SAVi is a simulation service that helps governments and investors value the many risks and externalities that affect the performance of infrastructure projects. It integrates best-in-class climate data from the EU Copernicus Climate Data Store.

The distinctive features of SAVi are:

- Valuation: SAVi values, in financial terms, the material environmental, social, and economic risks and externalities of infrastructure projects. These variables are ignored in traditional financial analyses.

- Simulation: SAVi combines the results of systems thinking and system dynamics simulation with project finance modelling. We engage with asset owners to identify the risks material to their infrastructure projects and then design appropriate simulation scenarios.

- Customization: SAVi is customized to individual infrastructure projects.

   Check out the SAVi track record, on-line demo, and academy at www.iisd.org/savi.