Continental Investment Plan for accelerating Rice Self-Sufficiency in Africa (CIPRiSSA)

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Citation:
Africa Rice Center (AfricaRice). 2018. Continental Investment Plan for accelerating Rice Self-Sufficiency in Africa (CIPRiSSA). Abidjan, Côte d'Ivoire: 204 pp.

ISBN:
Print 978-92-9113-392-5
PDF 978-92-9113-393-2

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Abbreviations and Acronyms

AfDB	: African Development Bank
AfricaRice	: Africa Rice Center (Centre du Riz pour l'Afrique)
ARICA	: Advanced Rice Varieties for Africa
CARD	: Coalition for African Rice Development
CIPRiSSA	: Continental Investment Plan for accelerating Rice Self-Sufficiency in Africa
CSA	: Climate-Smart Agriculture
FAO	: Food and Agriculture Organization (of the United Nations)
GDP	: Gross Domestic Product
GIZ	: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH (German Corporation for International Cooperation GmbH)
HDI	: Human Development Index
IRM	: Integrated rice management
ITC	: International Trade Centre
MT	: Million Metric Tons
OECD	: Organization for Economic Cooperation and Development
PLAR	: Participatory learning and action research
PPP	: Public-Private Partnerships
SSA	: Sub-Saharan Africa
T	: Metric Ton
TAAT	: Technologies for African Agricultural Transformation
UN	: United Nations
WARDA	: West Africa Rice Development Association

Preface

A shortage in the global supply of rice, which resulted in high prices of the commodity, led to riots in several major African capital cities during the period of 2007-2008. In the aftermath of this crisis, rice-importing countries in Africa vowed to accelerate efforts to achieve self-sufficiency in rice. Consequently, national rice development strategies geared towards achieving rice self-sufficiency were developed, and most of them included set production targets and investment requirements.

Significant progress has been made in increasing rice production, which however, has not stopped rice imports into the continent. Africa still imports about 12.6 million tons (MT) of milled rice annually, estimated at a cost of about US$ 6.4billion. This huge rice import bill adds further pressure to the meager financial resources of the continent, thereby limiting the possibility to invest in other sectors of inclusive development and sustained growth. This, in fact, raises the specter of food insecurity in most of these countries.

Ending rice import would create significant impact on job security, ensure gender inclusion, improve the balance of payments, provide protection to internal financial resources and encourage economic diversification. This would in turn enhance the pathway out of poverty. To provide further support to African countries as they strive to attain rice self-sufficiency, the Africa Rice Center (AfricaRice) initiated the Continental Investment Plan for accelerating Rice Self-sufficiency in Africa (CIPRiSSA).

CIPRiSSA is intended to provide information on and ways to improve the performance of the rice value chain to accelerate the move towards the attainment of rice self-sufficiency. Planned for 8 years (2018-2025), CIPRiSSA targets the following 10 initial countries: Cameroon, Côte d'Ivoire, Ghana, Madagascar, Mali, Nigeria, Senegal, Sierra Leone, Tanzania and Uganda. For each country, the Plan contains background information on the rice value chain, the investments required to achieve self-sufficiency, as well as the benefits and profitability of the proposed investments. It also underscores the significant importance of private investments and public-private partnerships while emphasizing the need to continue amplifying current efforts aimed at creating and/or consolidating an enabling environment for private investments in the rice sector in African countries.

Through its "FeedAfrica" initiative, which considers the agricultural sector as a job driver and growth accelerator for economic transformation in Africa, the African Development Bank (AfDB) is a strategic partner with AfricaRice in CIPRiSSA. AfricaRice hopes to enrich CIPRiSSA so that it will serve as a key evidence-based policy and investment decision making instrument for accelerating and maintaining rice self-sufficiency in the Continent. It will do this through systematic biannual studies, which will be extended to other countries in collaboration with other stakeholders.

Dr Harold Roy-Macauley
Director General, Africa Rice Center

Acknowledgements

This publication is the product of a study that aims at providing credible information for policy and investment decision-making for the development of the rice sector in Africa. The study was funded by the African Development Bank (AfDB) and the Africa Rice Center (AfricaRice). The World Bank-facilitated West African Agricultural Productivity Program (WAAPP), managed at the regional level by the West and Central African Council for Agricultural Research and Development (CORAF), contributed to the funding of the study for Ghana.

We are deeply grateful to the following focal persons who led in-country data collection, collation and analysis: Tobie Manga Ondoa (Cameroon), Yves Joël Dirabou (Côte d'Ivoire), Alhassan Imoro (Ghana), Rodolphe Bruno Rakoto (Madagascar), Adama Yaya Diarra (Mali), Fatima Aliyu (Nigeria), Alioune Fall (Senegal), Joseph Kargbo (Sierra Leone), Kissa Kajigili (Tanzania), and Cleopas Mucunguzi (Uganda).

The production of this publication benefited greatly from the technical and intellectual guidance of the following AfricaRice team of researchers: Aminou Arouna, Gaudiose Mujawamariya, Mandiaye Diagne, and Rose Fiamohe. The following researchers at AfricaRice contributed towards the conceptualization of the methodology used in the study: Sidi Sanyang, Kazuki Saito and Amadou Beye.

Our ideas about deploying credible information in developing a plan for accelerating rice self-sufficiency in Africa has been greatly enriched by Harold Roy-Macauley, Director General of AfricaRice.

The study was led by Marcel Nwalozie, Coordinator of the Support System for Accelerating Rice Self-Sufficiency in Africa (SSARSSA) initiative at AfricaRice.

The Africa Rice Sector

Salient Issues

Rice has continued to grow in importance as Africa's leading staple. Demand for the crop has consistently increased in the past three decades (1998-2018) as evidenced by its importance in the strategic food security planning policies of many African countries.[1] In these countries, rice demand exceeds production and the difference is imported at huge foreign exchange costs. For example, in 2015, Africa consumed 27.4 million tons (MT) of rice of which 9.8 MT (36%) was imported. Previous attempts at achieving rice self-sufficiency lacked adequate strategic identification and analyses of priority investments for reaching the goal.

Rice Production

Although rice can be produced in all African regions, West Africa accounted for more than 40% of Africa's rice production between 2006 and 2010.[2a] During this period, the leading producers were Egypt (6.1 MT), Madagascar (4.1 MT), and Nigeria (3.9 MT).[3] Other major rice-growing countries include Côte d'Ivoire, Ghana, Guinea, Liberia, Mali, Senegal, Tanzania and Sierra Leone. However, rice yields are very low mainly because of inadequate investments in improved technologies and new irrigation schemes, as well as the myriad of challenges encountered in fully developing the rice value chain in Africa.[4] Following the 2007/2008 food crisis that caused social unrest in several African countries, many African governments, in partnership with development agencies, launched ambitious rice production programs. According to a 2013 study by the Africa Rice Center (AfricaRice),[5] the growth rate in rice production in sub-Saharan Africa (SSA) increased from 3.2% per year prior to the food crisis (2000-2007) to 8.4% per year thereafter (2007-2012). Also, paddy rice production increased by 2.8 MT annually from 2000 to 2007 and by 4.7 MT annually between 2007 and 2012. Average rice yields also increased by about 30% between 2007 and 2012. The study also attributed 71% of the increase between 2007 and 2012 to yield increases and 29% to area expansion – these compared favorably with 24% attributed to yield increase and 76% to increase in harvested area between 2000 and 2007. This demonstrates the merit of technological innovation, including improved genetic materials and crop management, in enhancing the productivity and production of rice in Africa.

[2a]GRiSP (Global Rice Science Partnership). 2013; Otenga and Sant'Anna, 1999-this study is a little old, but WA remains the most important rice producing region in the continent.
[3]GRiSP (Global Rice Science Partnership), *Op. cit.* p.33.
[4]van Oort *et al.*, 2015.
[5]Seck *et al.*, 2013.

Rice Consumption

In 2015, Africa consumed 27.4 MT of rice of which 9.8 MT (36%) was imported at a cost of US$ 4.1 billion.[6] The projected need by 2020 is 31.2 MT of milled rice against local production of 19.9 MT, if nothing is done urgently, and the cost of importing the difference will be US$ 4.8 billion. By 2025, Africa will need 34.9 MT of milled rice against local production of 22.3 MT. Africa would thus be importing 12.6 MT of milled rice at a price of US$ 5.5 billion annually. The attainment of self-sufficiency in rice in Africa will drastically reduce this huge import bill while the concomitant foreign exchange savings could be re-invested in other sectors of the economy, thereby increasing employment opportunities for the youth, women and other vulnerable groups. Rice consumption in Africa is expected to continue growing in the foreseeable future because of three main factors: African population growth, increasing per capita consumption, and a shifting consumer preference toward 'premium' rice as urbanization increases. Twenty-two of the 43 rice-producing countries in Africa import between 10% and 93% of their domestic rice requirements. Some of these countries show growing gaps in the local rice balance sheet (Figure 1.1). These gaps create strong market opportunities for both existing and new investors in the rice industry.

[6]FAOSTAT, 2017.

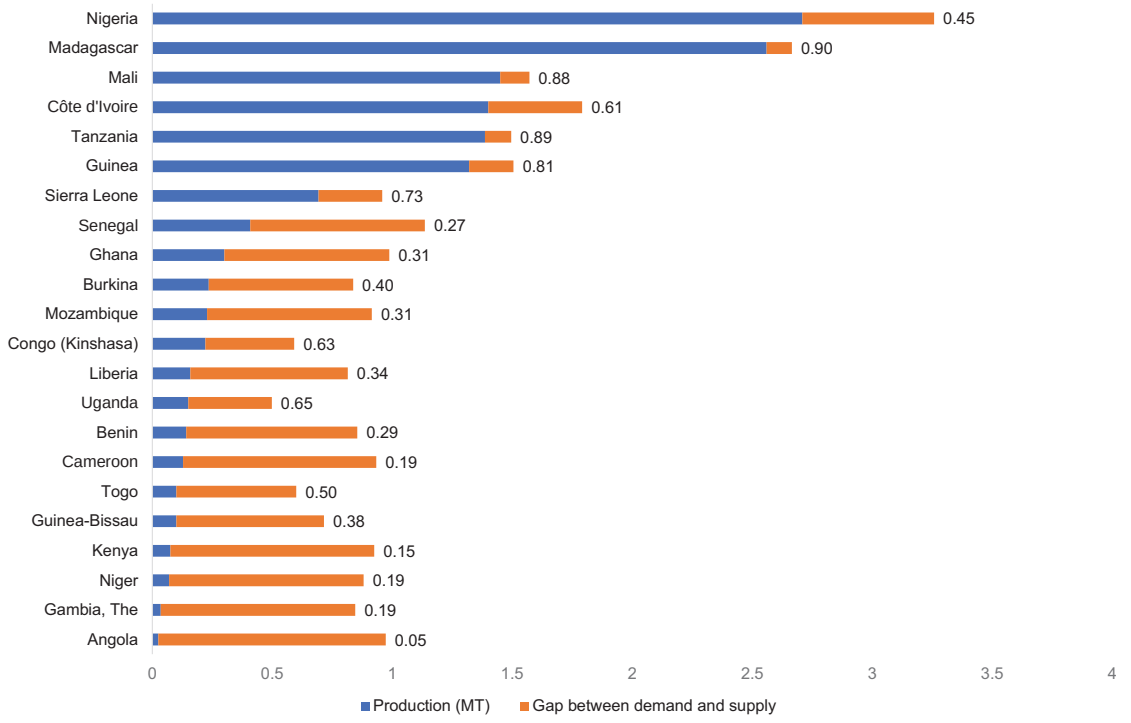


Figure 1.1. Rice self-sufficiency ratio for selected sub-Saharan African countries[7]

Opportunities for rice production development

Production

Opportunities for increasing rice production depend, to a large extent, on the biophysical and socio-economic environments. The challenges to area expansion, higher cropping intensification and yield vary widely by ecology. In partnership with various African countries, AfricaRice has developed several high-yielding rice varieties suited for various ecologies, and with tolerance of the main biotic and abiotic stresses.[8] AfricaRice's breakthrough in developing NERICA (New Rice for Africa) varieties provides an exciting opportunity for farmers to stabilize and intensify low-input upland systems. The NERICAs are resistant to most stresses, including weeds and drought; they have high-yielding potential and mature much earlier (90 to 110 days) than local varieties. It is estimated that about 1 million farm households cultivated NERICA varieties on 1.4 million ha in 2013 – with yields as high as 7 tons/hectare (t/ha) largely attributed to their low input needs, tolerance of drought, iron toxicity and blast, and resistance to the witch weed, *Striga*.

[7]USDA, 2018. The graph is based on production and consumption statistics of 2015.
[8]A catalogue of improved rice varieties for different ecologies is available at Africa Rice Center.

AfricaRice has also recently made available 18 new ARICA (Advanced Rice for Africa) varieties with high-yielding capacity under low-input conditions (5 ARICAs in 2013, 7 in 2014, and 6 in 2016). The yields of ARICA 1, ARICA 2 and ARICA 3 are 20–44%, 50–111%, and 2–69%, respectively, higher than that of NERICA-L 19 which is in wide use in West Africa.

The recently developed sub1 rice varieties, currently available in parts of West Africa and Madagascar, are climate-smart and can withstand submergence/flooding conditions for up to 14 days. When flooding occurs, non-usage of sub1 varieties can lead to total crop failure whereas sub1 rice varieties yield up to 4 t/ha under such conditions. AfricaRice has also developed hybrid rice varieties that are ready for release – these varieties can yield up to 10 t/ha or more.

Improved rice varieties provide excellent opportunities for profitable investments and possibilities for rice cropping intensification in all the ecologies. The continuous availability and use of good quality seeds of these new varieties offer great hope for attaining rice self-sufficiency in Africa. In addition, AfricaRice has developed many packages of agricultural practices that can help farmers to attain the full potentials of improved rice varieties. Sustainable intensification and diversification of rice production in the different ecologies require considerable investments. Therefore, attention will be given under CIPRiSSA to the identification and management of bottlenecks preventing access to capital and other necessary resources. Market forces drive both diversification and intensification; hence a focus on the efficiency of market linkages is warranted. The capacity of locally produced rice to compete with imported rice should be explored, with respect to the efficiency (cost-effectiveness and rice quality) of small-scale processing units.

Post-harvest handling and processing

Enhancing the competitiveness of locally produced rice in Africa will necessitate considerable investments in post-harvest processing (including promoting awareness of quality among producers and the deployment of improved rice milling and packaging technologies), and produce pricing. Although the determination of rice quality begins during production in the field, the down-stream end of the value chain plays a significant role in the final quality. The focus of CIPRiSSA will be to reduce impurities in local rice, ensure higher grain quality, and enhance milling efficiency.

Market-pull opportunities

Investment projections that would transform the rice value chain in Africa will seek to reduce/eliminate shortage of supplies, ensure strong consumer preferences, as well as appropriate and competitive rice prices. The timely supply of market information will be a determinant of success in produce distribution. Markets will also require the availability of appropriate facilities for rice produce collection and shipment, storage in production zones, road infrastructure for linking production zones with urban areas, and the provision of access to institutional credit.

Rice Sector Development Policies

To enhance the performance of the rice value chain in Africa, public decision-takers should implement policies that guarantee success in the local rice production-processing-marketing-consumption continuum. Such public policies would involve increased investments in rural infrastructure (including irrigation infrastructure, roads, electricity, tele-communication, storage facilities, producer organizations, commodity chain infrastructure or organized markets, food safety certification, traceability, etc.). These policies are needed to drive private investments in the rice value chain. Other policies would include reform of the rice sector governance and the strengthening of inputs supply, financing, taxation, and commercialization. More specifically, policy measures are needed to: (i) increase the availability of quality seed of improved rice varieties; (ii) improve the linkage between farmers and suppliers of agro-chemicals, by creating viable marketing and distribution systems to ensure the timely availability of agro-chemicals at affordable prices, and promote proper handling and application through capacity building; (iii) promote modern agricultural mechanization to minimize drudgery, increase labor productivity and reduce production costs; (iv) increase irrigated rice land; (v) improve rice quality to international market standards through improving post-harvest processing capacity; (vi) improve access to credit for actors in the rice value chain in a timely and adequate manner; (vii) provide adequate extension services; and (viii) promote the use of science and technology in rice value chain development through enhancing the linkage between research, extension and other rice value chain actors. Policies on land use and tenure systems also need to be addressed in ways that motivate private investments. Such policy measures will positively affect the market share of investments in rice production in Africa.

Context and Background for Developing a Continental Investment Plan for Rice Self-Sufficiency in Africa

The rice sector in Africa can become an engine for economic growth across the continent – with a potential for contributing to creating wealth and jobs, ensuring food security, reducing economic migration from Africa, and ensuring social stability in the polity. However, these potentials remain unrealized.

In 2015, Africa, with an estimated population of 1.2 billion, consumed 27.4 MT of rice of which 9.8 MT (36%) was imported at a cost of US$ 4.1 billion.[9] The projected need by 2020 is 31.2 MT of milled rice against local production of 19.9 MT, if nothing is done urgently, and the cost of importing the difference will be US$ 4.8 billion. By 2025, Africa will need 34.9 MT of milled rice against local production of 22.3 MT. Africa will thus be importing 12.6 MT of milled rice at a cost of US$ 5.5 billion annually. Shifting consumer preferences towards rice, coupled with increasing urbanization, continues to mount pressure on the demand for rice in Africa.

More than 20 million farmers in Africa produce rice and the rice value chain sustains the livelihoods of more than 100 million people involved in rice production, processing and trading (Keya, 2008). Many countries in SSA have made significant efforts to increase domestic rice productivity and production by encouraging the adoption of new and improved varieties and crop management. Consequently, 71% of the increase in paddy rice production during 2007-2012 was attributed to yield increase and 29% to area expansion. This compared favorably with only 24% attributed to yield increase and 76% to increase in harvested area in 2000-2007 (Seck *et al*., 2013). More robust, coherent and sustained investments in the rice value chain would guarantee rice self-sufficiency in Africa.

Considering these strategic challenges, the African Development Bank (AfDB) mandated AfricaRice to lead the development of a Continental Investment Plan for accelerating Rice Self-Sufficiency in Africa (CIPRiSSA). CIPRiSSA, an eight-year (2018-2025) rice sector investment plan, will be the convener tool for integrating the rice component in the AfDB-led Technologies for African Agricultural Transformation (TAAT) initiative.

Expected Benefits from CIPRiSSA

CIPRiSSA will convey the seriousness of governments and establish the credibility of the business concept. It will also help investors and citizens who are not familiar with the investment

[9]FAOSTAT, *Op. cit.*

requirements in each segment of the rice value chain as well as the benefits derivable from such investments. In addition, it will help to attract established businesses and start-up of new lines of activity. CIPRiSSA will reduce the chances of failure in rice investment decision-taking. The specific benefits will include the following:

- Clarification of policy objectives – CIPRiSSA provides a tool for thinking through the financial requirements of an investment policy, and this will help investors to clarify the ramifications of investments needed to achieve the goal.

- Staying focused on the goal – CIPRiSSA summarizes expected funding requirements for and earnings from the different segments of the rice value chain.

- Objective definition of success – CIPRiSSA will tap into the concept of public-private partnership (PPP) policy and measure the level of investment interests it would attract to the rice sector.

- CIPRiSSA will enhance evidence-based policy-making – The basis of CIPRiSSA is the outcome of assessments of market potentials, including location, size, and characteristics of the market for rice, drivers of demand, production and selling costs, policy support, etc. CIPRiSSA will, therefore, ensure that policy is based on objective and verifiable evidence, usually through commissioned studies, thereby eliminating uninformed 'guesses' and the consequent poor investment planning that resulted in flaws and failures in attaining rice self-sufficiency in the past.

- Focus on growth priorities and imperatives – CIPRiSSA draws attention to factors that promote growth. These include financial resources, policy administration, policy continuity, ease of doing business, returns on investment, profitability, job creation, etc.

- Better appreciation of interdependencies and the requisites – The success of the rice self-sufficiency policy will also depend on some fundamentals, several of which are outside the rice industry and the agriculture sector. These will include essential infrastructure, such as roads, power supply, water, fiscal and monetary regulations, etc. CIPRiSSA recognizes the ramifications of these interdependencies and will weave them together in detailed country-specific projects - a compact and holistic package.

- CIPRiSSA aims to reduce the chances of policy failure – All the foregoing will reduce the chances of rice sector investment policy paralysis or outright failure. CIPRiSSA will engage in the proactive identification of threats, active coordination and monitoring.

Analysis of Options and Opportunities

Africa has no other realistic option than to pursue the goals of self-sufficiency in rice because continued dependency on rice imports is socially, politically and economically risky, besides not being viable or sustainable.

Continued importation of rice – A socio-politically risky prospect: Rice has become both a strategic and political crop in Africa.[10] The demand for rice has been growing at an annual rate of 6%, i.e. faster than any other food staple[11] and supplanting other local food types (e.g. cassava in Nigeria).[12] From several indications, rice consumption is self-promoted by rising urbanization. Rice has also become the leading provider of food calories in West Africa and Madagascar, and the second largest source of food energy in SSA. This growing role of rice explains its transformation into a political crop, with "its price and accessibility influencing social stability",[13] as was the case in the 2008 food riots in several African cities. However, rice production in Africa has not kept pace with demand and imports have continued to fill the gap. Rice imports into Africa accounted for 32% of global rice trade in 2008.[14] SSA rice imports averaged 7.5 MT per annum between 2000 and 2007, 8.3 MT from 2008 to 2011, 10.2 MT from 2010 to 2012, and above 12 MT after 2012. [15,16] Several factors contributed to the post-2008 development, including the substitution of other grains for rice due to the severe droughts that affected grain production in many west African states in 2011; early announcement by Nigeria of the hiking of import duties on milled rice from 5% to 30% and semi-milled rice from 30% to 50% (which prompted importers to complete their procurement before the take-off of the scheme); and a combination of recourse to lower import tariffs and/or retail price controls in several west and east African countries (including Côte d'Ivoire, Mali, Senegal, Burundi, Kenya, and Rwanda). In all cases, import-dependency is not sustainable because it drains African countries' foreign exchange and poses significant risks, including to food and job security, economic diversification, and poverty reduction. It is important to mention that the demand for rice in Asia, the source of Africa's imports, is steadily increasing. Therefore, Africa must quickly find sustainable alternatives to satisfy its rice needs.

Prospects for Achieving Rice Self-Sufficiency: The success of Africa's efforts in attaining self-sufficiency in rice production has been minimal because of policy inadequacies and weaknesses in strategy, caused by the presence of major constraints in the rice industry.[17] CIPRiSSA will strengthen

[10]Roy-Macauley, 2016.
[11]Ibid.
[12]Gyimah-Brempong et al., 2016.
[13]Seck et al., Op. cit., p.24.
[14]Ibid.
[15]USDA, 2018
[16]Seck et al. 2013.
[17]Norman and Otoo, 2003 ; van Ittersum et al., 2016.

technical capacity to formulate and implement rice investment policies/strategies, assess economic viability, and ensure sufficient political commitment to attaining the goal of rice self-sufficiency.

Technical Prospects of Rice Self-Sufficiency in SSA: Technical feasibility of rice self-sufficiency refers to the presence of and/or ability to procure the physical necessities for achieving rice self-sufficiency, i.e. land, labor, material, infrastructure, technology, processes, etc. It thus enquires into whether individual countries currently have or can produce realistic logistical or tactical plans on how to produce, process, and market rice products to consumers in quantities and quality that meet local needs. In other words, technical feasibility assessment asks whether there is or can be a flowchart of how rice products can move through all the stages, i.e. seed → paddy → processing (milling and marketing / packaging / branding → sale in SSA countries. These plans also respond to issues on land availability and management, improving rice farm yields through the adoption of climate-smart agricultural technologies, policy and infrastructural considerations, and access to markets.

Market and Other Infrastructural Considerations: Three types of infrastructure are useful when considering the technical evaluation of rice self-sufficiency in Africa: (i) *Market infrastructure (*including roads, modern drying and storage facilities, improved dehullers and mini-mills, and modern mills for better post-harvest handling of paddy to increase milling out-turn and product quality) have an important impact on economic viability; (ii) *Production infrastructure (*such as irrigation) is also vital for achieving rice self-sufficiency - irrigation facilities are the most important aspects of production infrastructure; and (iii) *Physical infrastructure (*such as electricity, communication, health, schools, etc.) are motivating factors for producers to invest in rural rice producing areas.

Design of The Country Rice Investment Plans

CIPRiSSA is a high-level investment plan for attaining rice self-sufficiency in the participating countries by 2025 based on data collected from the individual countries. The plan comprises a global summary and presentations for each of the 10 participating countries. The projections show that all the participating countries can achieve rice self-sufficiency by 2025, with most of them becoming rice exporters by then. The projections cover the annual paddy and milled rice production potentials of each country and the attendant self-sufficiency rates. They also show the level of new irrigation and non-irrigation investments required to achieve the potentials and the gains that would accrue from the investments, including in foreign exchange savings, new farming households trained in rice production, new land areas in different ecologies brought into rice farming, expected rates of profitability and contribution to countries' Gross Domestic Product (GDP).

CIPRiSSA's projections show that SSA countries have innate potentials for attaining rice self-sufficiency by 2025, given the right policy environment and adequate resources. The key challenge for participating countries is to develop and manage the right policies for creating the necessary atmosphere for mobilizing the needed resources to unleash the potentials. Clearly, the countries' public sectors alone cannot provide all of the required level of funding without the private sector - that would be repeating the failed policies of the past. Strategies for attracting the requisite private sector, development partners, and international capital into the sector are vital. One approach would be for each country to build on the CIPRiSSA investment plan and package a country-specific business case for attaining rice self-sufficiency.

The business plan should proceed on the premise that achieving rice self-sufficiency by 2025 is a public-sector initiative to promote opportunities for private sector business investment. The investment plan would make the business case and demonstrate the credibility of the rice self-sufficiency policy by providing convincing country-specific information on its potentials, inevitability, and benefits. The benefits must include sustainable financial and non-financial advantages to satisfy its diverse audiences. The non-financial benefits should be concrete contributions to the attainment of the social goals of food security, eradication of hunger, progressive poverty reduction, etc., and how to measure progress.[18] The plan will analyze the business idea, explore its feasibility and viability, assess its potentials to achieve stated goals, quantify its financial implications (amounts, expected timing of flows, and their sources), evaluate associated risks, and devise necessary risk mitigation measures. The detailed country business case (or investment project) must simultaneously address

[18]This chapter used some ideas expressed in the article: The Staff of Entrepreneur Media Inc., 2014.

two types of audiences – internal and external - discuss issues relating to policy management, and propose policy management arrangements for instilling confidence in the audiences.

Internal Audience: The internal audience comprises both state and non-state stakeholders, whose decisional influence, goodwill, and support will be neeed for the proposal to succeed. The state actors include political decision makers, government administrators and technical personnel. The plan needs the necessary commitment of political leaders in both the executive and legislative branches to enact needed policies, follow through with them, and both vote and release the right budget for required public investment in infrastructure, etc. The plan must also persuade government administrators and technical personnel who will implement the policies, or otherwise facilitate or oversee their successful implementation. Non-state stakeholders include organized interest groups (such as farmers' organizations), consumers, ordinary citizens, and development partners. Development partners come under the category of internal audience because they will not engage in business investment. The best they can offer will be direct budget or project support to the government or technical assistance to government institutions implementing the policy. The investment project will address the concerns of this category of audience. This will require laying out the clear long-term and intermediate goals of the idea and drawing up strategic plans for achieving them. The plan must also explain the necessity for the paradigm shift from rice as a development program of government to rice as a business opportunity, the implications of the paradigm shift, the steps and requirements of the new paradigm, the respective roles of stakeholders (state and non-state), the financing approach, and include a list of key success factors/indicators or balanced scorecard for measuring success in non-financial terms.

External Audience: A key purpose of CIPRiSSA is to attract enough private investors and capital into the rice industry to propel the push for rice self-sufficiency by 2025 and sustain it thereafter. In addition to self-sufficiency in rice, CIPRiSSA demonstrates benefits to households, returns on investment, profitability, impact on GDP, potential in employment creation, and many other aligning benefits. The detailed project plan will incorporate a comprehensive outlay on the investment requirements over a period, including a detailed and itemized breakdown of every major area of investment requirement – including procurement of quality seeds, fertilizers, and quality paddy, processing and milling, provision of aggregation centers, pipeline support services (research, extension, and capacity building, including gender), infrastructure (feeder roads, electric power, etc.), etc. Although estimates of investment outlay need not be precise, they should be realistic and indicative of requirements. Wild, arbitrary, and misleading guesses can put off prospective investors and/or lead to lopsided investment.

The CIPRiSSA Business Case

The business case for CIPRiSSA comprises policy definition, organization, and finance. *Policy Definition* provides basic contextual information on many of the '*what, why, how'* questions[19]. It thus provides the 'Justification' as implied in the sections "Background information" (basic information, potentials, policy concept), "Opportunity" (describing motivation for the policy, definition of the problem, and statement of scope), "Objective" (explains the necessity for the policy and what it seeks to accomplish), "Benefits and limitations" (social and economic benefits of the policy and constraints to executing and achieving them), and "Impact and interdependencies" (results, milestones, progress indicators, key success indicators, and major players/contributors). Policy definition also includes "Outline of the plan" (activities, timelines, and responsibility for action), "Market analysis" (describes the current business environment - technology, customer demographics, etc. - and possible changes that could affect the success of the policy/project), and "Project description" (provides sufficient information to enable decisions on the feasibility and viability of the project to be taken).

CIPRiSSA's Project organization includes "Project governance" (arrangements for regulation and implementation, including coordination), and "Progress reporting" (periodic reporting and monitoring).

Finance involves 'Financial appraisal/analysis' (which compares benefits to costs, analyzes the value of a project as an investment, and the expected return on investment - net present value, internal rate of return, payback period, etc. - and rates of return), and "Sensitivity Analysis" (evaluates the likelihood of successful implementation of the policy/project using risk analysis).

[19]Webster, 2016.

Methodology used in Developing CIPRiSSA

CIPRiSSA targets 10 pilot countries – **Cameroon, Côte d'Ivoire, Ghana, Madagascar, Mali, Nigeria, Senegal, Sierra Leone, Tanzania** – which are the most important in terms of rice production and consumption in Africa - and **Uganda (**taking regional trade opportunities into account). CIPRiSSA is country-specific, thereby providing opportunities for individualized negotiations with development partners for supplementary or complementary investments in identified priority segments of each country's rice value chain. Notwithstanding its country focus, CIPRiSSA will facilitate regional integration through increased inter-African trade, as countries producing in excess of their local needs can sell to other countries producing less than their needs.

The process of developing CIPRiSSA involved consultations between AfricaRice and Ministers of Agriculture of the 10 countries, during which each country nominated a focal person who was mandated to collect and collate credible data for preparing the investment plans. Data collection was facilitated using a tool jointly validated by all stakeholders – including the country focal persons, the AfDB, the private sector, Coalition for African Rice Development (CARD), and AfricaRice. Thereafter, each focal person worked in-country to collect the data, with a team of local stakeholders in the rice sector, including relevant ministries, agencies, and the private sector. Data collection focused on country needs, especially those related to inputs (seed, fertilizer and post-harvest machines), production and distribution, transfer of appropriate technologies, capacity building of rice value chain actors, and market opportunities.

The data collection tool was designed to gather relevant country-based information on (i) the current trends of the main factors of rice production, processing, marketing and trade; (ii) major rice growing, business and enabling environments; (iii) major players in the domestic and foreign rice value chains; and (iv) country-specific projections and investments needed to achieve self-sufficiency by 2025. These bits of information provided insights into the current status of the rice sector, priority segments of the domestic rice value chain where investments are really needed, the level of investment needed, and the ongoing policy commitments in each country. The data collected were used to develop the strategic investment plans for optimizing the performance of the rice value chain in CIPRiSSA's target countries.

Using two computer models - ERIS[20] and COMFAR[21] - AfricaRice conducted computations and projections based on the data collected from the target countries. This process examined: (i)

[20]Emergency Rice Initiative Spreadsheets (ERIS) developed by AfricaRice.
[21]Computer Model for Feasibility Analysis and Reporting (COMFAR), a UNIDO software.

aspects of the rice value chain needing priority investment; (ii) estimates of desired resources; (iii) timelines for achieving self-sufficiency if the necessary investments are made; and (iv) milestones on the investment-production-consumption continuum. The process also analyzed the following elements for each country: (i) benefits/costs ratio (BCR); (ii) ratio of the benefits of an investment proposal expressed in monetary terms and relative to its costs; and (iii) the net present value (NPV), which is a measure of the profit calculated by subtracting the present value (PV) of cash outflows (including initial cost) from the present values of cash inflows over a period; (iv) modified internal rate of return (MIRR), which is the internal rate of return of an investment that is modified to account for the difference between re-investment rate and investment returns. These computations provided information on monetary returns on investments under CIPRiSSA. A review of the rich existing literature on the subject preceded the development of the CIPRiSSA approach. The review pulled together existing thoughts on several issues pertinent to the rice sector and articulated the benefits of the CIPRiSSA approach. The literature review discussed the following five areas:

(1) The Africa rice sector, including salient issues and constraints, opportunities, and challenges of rice production, consumption, processing, marketing, trade, etc.

(2) Context and background of rice self-sufficiency in Africa.

(3) Analysis of options and opportunities in the Africa rice industry, addressing the risks posed by rice import dependency to food security, foreign exchange and the fiscal account balance, employment and gender gap, economic diversification and growth, and poverty reduction. Technical issues in rice self-sufficiency in SSA - land availability and management, the role of Climate-Smart Agriculture (CSA) techniques[22] in the sustainable improvement of rice yield, market and other infrastructural considerations, and government policies – were also reviewed.

(4) Design of the country rice investment plans, which examine the audiences that such a plan should address and make a case for an independent rice self-sufficiency regulatory commission to implement the rice policy - this is to guarantee expert management of the policy, reduce red tape, promote transparency, and ensure better policy continuity and sustainability.[23]

(5) Expected benefits of preparing a country investment plan for rice self-sufficiency.

[22]FAO, 2013; World Bank, 2015a.
[23]OECD, 2003; OECD Observer, 2007.

The ERIS data analytical process

The Emergency Rice Initiative Spreadsheet (ERIS) was developed to assist AfricaRice's member countries in developing strategies to boost domestic rice production through improved access to inputs (seed, mineral fertilizer), machines/equipment, and upgrading the rice value chain. ERIS allows the user to enter country-specific data on the area planted with rice, numbers of rice farmers, as well as agro-economic parameters in the different regions or districts of the country. Three main ecologies are considered: upland, rainfed lowland and irrigated lowland. ERIS also allows the calculation of quantities and costs related to enhanced mineral fertilizer and rice seed (foundation and certified) use, machinery, labeling and packaging. ERIS contains a minimum of 24 sheets divided into 3 sub-sets: data sheets, parameter sheets and output sheets.

Data sheets: The data sheets are used to enter specific statistics on rice (e.g. area harvested, producer price, production, consumption and import volumes); names of districts, regions; and specific information on rice (average rice area per farmer, share of rice area per ecology), cotton or other important cash crops (tobacco, sugarcane, tea, etc.) in a country.

Parameter sheets: The parameter sheet contains dummy numbers that can be changed to suit the needs and specificities of a country. It comprises, among others, parameters on fertilizer and seed costs/prices, rice share of the different ecologies in the country, actual yield in the different ecologies, fertilizer formula, milling rate of paddy, unit cost of technology transfer, machine/equipment, training, labeling, packaging, etc. The necessary changes could be made to reflect the reality in a country and to conduct different scenarios to boost rice production.

Output sheets: The output part contains information on the outcome of different scenarios based on the data provided (in the data sheet). The output sheets provide the quantity of additional production gains by ecology that result from various scenarios. The rate of reduction of imports due to this additional total gain is therefore calculated and makes it possible to assess the impact of the implementation of the different policy measures. Furthermore, the foreign exchange gain arising from these different scenarios is captured. The output sheets also provide information on the quantities of seed and fertilizer as well as the number and types of machines/equipment for pre-harvest, harvest and post-harvest operations required to implement the program. The output sheets indicate the costs of producing certified seed, acquiring fertilizers, distributing these inputs to farmers, and transferring technology. Finally, these sheets also provide the number of targeted farming households, areas by ecology, the number of improved machines/equipment for rice production and harvest/post-harvest (tractors, power tillers, ASI thresher-cleaners, mills, parboilers, etc.) based on each country's requirements.

ERIS provided the Republic of Benin the needed decision-making tool in the development of its rice sector

Cyriaque Akakpo is head of the rice research program and deputy director of the Institut National de Recherches Agricoles du Bénin (INRAB). As such, he is closely involved in Benin's rice development work. Like AfricaRice, INRAB sensed a looming crisis back in 2006. In that year, the Ministry of Agriculture signed an accord with GIZ to assist the country in boosting national production to 600,000 tons (t) of milled rice by 2015 — equivalent to 900,000 t of paddy. INRAB also arranged rice production activities as part of the African Rice Initiative (ARI). A fundamental problem at that time, however, was determining what steps needed to be taken to reach the goal. In 2008, Akakpo took part in the workshop that launched ERIS and was trained on the ERIS decision-support tool. Now he had something in hand which would detail the progression required to achieve the country's rice development goal. The supply of 900,000 t of paddy rice by 2015 was entered into ERIS, but the prediction of resources required to reach the goal — funds, seeds and fertilizers — was unrealistic. Consequently, INRAB settled for the lower target of 300,000 t of milled rice (450,000 t of paddy). ERIS determined the requirements to increase paddy production by 100,000 t per year: 60 t of Foundation Seed to provide 2,200 metric tons of Certified Seed for the farmers. These figures form the basis of Benin's national rice development strategy[24].

Description of COMFAR (Computer Model for Feasibility Analysis and Reporting) process

Methodology of analysis of CIPRiSSA investments using COMFAR: Financial and economic analyses were performed to assess the profitability of the CIPRiSSA investments. The two forms of analysis do not provide the same information but complement each other. Financial analysis involves examining the activities and resource flows of the main entities (stakeholders) or groups of entities separately. Economic analysis takes the perspective of the nation, but can also take the perspective of a region or a sector, if the program focuses on one of these. Economic analysis involves examining the impact on society (the economy) as a whole.

Financial analysis: Financial analysis calculates the incentives for the main stakeholders, checks the profitability of the investments, the solvency and longer-term sustainability of the project, and helps to design possible cost recovery mechanisms. It prepares the ground for an economic analysis. In financial analysis, measures and indices of the project's performance

[24]AfricaRice, 2009.

are analyzed based on the market prices (observed prices). Only cash inflows and outflows are considered. In the financial analysis, three main indicators are considered: the net present value (NPV), the modified internal rate of return (MIRR) and the benefits-costs ratio (BCR). NPV is defined as the sum of the present (discounted) values of the amounts in a series of periods. It is a method of aggregating the amount occurring in different periods of time in a common measuring unit, i.e. present value. Whenever NPV > 0, the investment is considered worthwhile or profitable. Among mutually exclusive investments, the one with the highest NPV should be chosen. NPV is computed as follows:

$$\mathrm{NPV} = \sum_{j=1}^{n} \mathrm{DCFj} + \mathrm{DSV}$$

$$\mathrm{DCF_j} = \frac{A_j}{f(c/d)_j} \mathrm{DSV} = \frac{SV}{f(c/d)_n}$$

Where DCF_j is the discounted cash flow in period j; DSV is the discounted salvage value, the salvage value (SV) being the residual value of an investment; A_j is the net of all positive and negative flows in period j; f(c/d) is the discounting factor (for calculating the equivalent of a present value to its future value using the interest rate); and n is the number of periods in the planning horizon.

The internal rate of return (IRR) is defined as the discounted rate at which the NPV is equal to zero. It can also be defined as the rate at which the investment generates net benefits. The IRR may not be unique. The number of IRRs will be equal to the number of the roots of the polynomial by which it is expressed, which results from changes in the periodic amounts from positive to negative (or the reverse). Another deficiency of the IRR is that there is an inherent assumption that all cash surpluses are invested at the IRR. To correct these two weaknesses of the IRR, the modified internal rate of return (MIRR) is calculated. For the calculation of MIRR, an estimate of the average realistic reinvestment rate of surplus funds and a borrowing rate for deficit in effect over the planning period are assumed. The solution is unique. This represents the maximum interest rate that a project could face and still not waste resources. For the project to be profitable, the MIRR must be greater than the interest rate (r) that could be earned in alternative investments - therefore, when MIRR is greater than r the project is considered viable. MIRR is determined as follows:

1. The value P of all periodic surpluses is determined by summing the value of such surpluses compounded by the reinvestment rate to the year following the termination of production (year of recovery of residual value of assets):

$$P = \sum_{j=1}^{n} A_j^+$$

Where A_j is the net surplus value in any period compounded at the reinvestment rate.

2. The present value N of all periodic deficits is determined by summing the values of such deficits discounted at the borrowing rate to the temporal reference point for the project:

$$N = \sum_{j=1}^{n} A_j^-$$

Where A_j is the net deficit in any period discounted at the borrowing rate.

3. MIRR is determined by:

$$MIRR = \left(\frac{P}{N}\right)^{\frac{1}{n}} - 1$$

Where n is the number of years in the planning horizon.

The benefits-costs ratio (BCR) indicator is the ratio of the present value of benefits to the present value of costs over the time horizon. BCR provides some advantages when a ranking of alternative investment projects is needed under budgetary constraints. BCR also defines the profitability of the unit currency of investments.

Economic analysis: The purpose of the economic analysis of a project is to determine its contribution to the national objectives. The most fundamental objectives are the increase in national income and employment, as well as efforts on income distribution and the foreign exchange flow.

For the analysis of economic costs and benefits, market prices of project outputs and inputs are adjusted to economic prices or shadow prices. In economic appraisal (economic benefits/

costs analysis), prices are adjusted to eliminate distortions. Price adjustments include correction for taxes, subsidies and exchange rate. Inputs and outputs for which the market price is to be adjusted to the economic value can be placed into one of three categories: traded, tradable and non-traded. Traded items are imports and exports. Tradable items are those not directly traded but which induce trade or which would be traded in the absence of a restrictive trade policy. Items are non-traded either for policy or fiscal reasons or because the cost of production is higher than the export price (including transportation costs). Traded and tradable items are appraised in terms of foreign exchange, and non-traded items are further disaggregated into traded, tradable and non-traded by considering the inputs used in the production of such goods.

Two methods can be used to determine the effects of the project on a national criterion. Value added, when aggregated for all producers of goods and services in the economy, amounts to the national income. The economic appraisal (benefits/costs) methods attempt to achieve a similar valuation of the project by assigning shadow prices or accounting prices to the inputs and outputs of the project if market prices do not reflect economic prices. The results of each analysis should be similar, if not identical, when benefits/costs analysis is performed at efficiency prices (prices that would prevail if markets were in equilibrium). In the corresponding value-added analysis - with and without the project - the incremental value-added impact resulting from the implementation of the project is determined from one or more rounds of decomposition of the inputs and outputs. In this program, both methods were used as they complement each other in the estimation of economic indicators. Economic analysis includes estimations of three economic results: value-added, employment effect and benefits/costs analysis.

Using the value-added analysis, the gross domestic value-added measures the real monetary contribution of the investment to the economy of the country in terms of direct and indirect value-added generated. The gross domestic value-added is expressed as the difference between the gross revenue (value of outputs and other incomes, including sales taxes but not including subsidies on sales), and material inputs (adjusted for taxes/duties included and value added included but subsidies not included). For national welfare, however, it is not the domestic but net national-value added that is relevant.

The net domestic value-added is the difference between the gross domestic value-added and the investments (fixed investment plus pre-production expenditure net of interest) adjusted for taxes/duties and value-added included but subsidies are not included. The net national value-added is expressed as the net domestic value-added minus the repatriated payments (wages, profits/dividends, interest, etc.).

The employment effect provides indicators of employment creation by the investment. It is of particular interest in countries experiencing high rates of unemployment or under-employment. The employment effects take into account direct and indirect employment. Direct employment is calculated based on the quantity of labor employed directly by the project. Indirect employments are related to the total number of workers and the total wage bill for skilled and unskilled labor employed in the input-supplying or output-using project. Under economic costs-benefits analysis, the economic present value and rate of return are determined in a manner similar to financial analysis.

Sensitivity analysis: Financial and economic analyses are based on estimates for the future. However, the future cannot be predicted with certainty. Sensitivity analysis is performed to deal with the main risks and uncertainties that could affect the proposed investment. It is performed for an investment to show how the net cash return or the profitability of an investment changes when different values are assigned to the input or output variables. Sensitivity analysis must be made on each of the key risk factors to assess their possible effects on the expected benefits. A sensitivity analysis consists of changing the value of key factors such as price, costs, and discount rate, to assess their impact on benefits. The variables (quantities or prices or both) having the greatest impact on the financial and economic results are then varied. Sensitivity analysis is performed by assigning values to the critical variables corresponding to reasonably pessimistic, normal, and optimistic scenarios and by computing the discounted cash flows (MIRR or NPV) and any ratio chosen as a yardstick for investment appraisal.

Data: To assess the profitability of the CIPRiSSA investments, data used for financial and economic analyses are mainly based on the data collected by AfricaRice and country focal persons nominated by the ministries in charge of agriculture. Data required for financial analysis concern prices and quantities of inputs and outputs. These data are obtained from the primary data and the results of the ERIS models on the required investment for achieving a given level of rice production. Data used concern: expected additional rice production and the selling price, total target rice area, total cost of seed, total quantity and price of Urea and NPK, costs of transportation and distribution of fertilizers, total cost of capacity building and technology transfer, number and prices of equipment/machineries (tractors, ASI threshers, GEM parboilers, milling machines, etc.), cost of rice branding and packaging, labor cost and cost of new irrigation schemes. For economic analysis, prices are adjusted to eliminate distortions. Price adjustments include correction for taxes and subsidies. Inputs and outputs for which the market price is adjusted to the economic value concern traded and tradable goods. For

instance, equipment/machineries that are imported (such as tractors and milling machines), ASI threshers and GEM parboilers (which are fabricated locally but using imported material) are tradable goods. The financial prices of these goods are adjusted by subtracting taxes and subsidies.

For milled rice, international market price without taxes and subsidies is used. Due to the variability of the price of milled rice, sensitivity analysis is performed for three scenarios: normal scenario (using the market price), pessimistic scenario (-10% of the price), and optimistic scenario (+10% of the price).

Summarized Results for Ten Initial Countries

The 10 CIPRiSSA countries are jointly set to be self-sufficient in rice by 2025 (Figures A1.1, A1.2). The results indicate that Côte d'Ivoire, Mali, Madagascar, Nigeria, Sierra Leone, and Tanzania should have surplus for export before 2025. However, Uganda will not be in a position to export rice by 2025. These projections align with the countries' aspirations as indicated in their national rice development strategies, which specify their desire to be self-sufficient and commence rice exportation by 2018 (±2 years). However, the realization of the aspirations and projections depend on the fulfilment of several conditions, including adequate public and private sector investments as specified in the investment plan, strict implementation of TAAT-rice activities, and the provision by AfricaRice of evidence on which each country can base its decisions.

Estimated total annual investments for the 10 countries combined under CIPRiSSA range from US$ 318 million in 2018 to US$ 372 million in 2025. These include new investments in irrigation (US$108 million in 2018 to US$ 128 million in 2025), and non-irrigation (US$ 210 million in 2018 to $ 244 million in 2025) (Figure A1.3; Table A1). The estimated cumulative total cost of all new investments required in the 10 countries combined is US$ 2.7 billion, comprising US$ 943 million (34%) for new irrigation investment and US$ 1.8 billion (66%) for non-irrigation investment (Figure A1.4). The largest investment is on fertilizer acquisition, packaging and distribution (US$ 770 million), followed by production and distribution of certified and foundation seeds (US$ 493 million), fabrication and importation of machines and equipment (US$ 441 million), marketing and upgrading (US$ 67 million), technology transfer and capacity building (US$ 41 million) (Figure A1.5).

Projected benefits of the program outweigh the cost of investments. The estimated additional production of milled rice is 7.33 MT (equivalent to 11.7 MT of paddy) (Figure A1.6), ranging from 830,151 T in 2018 to 1,044,179 T in 2025 (Table A1). The largest beneficiaries are upland rice farmers (6.6 million households), followed by lowland rice farmers (5.4 million households) and irrigated rice farmers (4.8 million households) (Figure A1.7). The successful implementation of the program is expected to save US$ 2.67 billion in foreign exchange for the 10 countries combined (ranging from US$ 295 million in 2018 to US$ 377 million in 2025) (Figures A1.4 and A1.8; Table A1).

Profitability analysis indicates that the new investments in the continent's rice value chain would generate significant high benefits-costs ratios – BCR (NPV ratio to investment) (Figure A1.9). For example, the BCR would be 1.29 for Côte d'Ivoire, 1.64 for Senegal, and 1.35 for Uganda with corresponding modified internal rates of return (MIRR) of 70.44% for Côte d'Ivoire, 54.76% for

Senegal, and 61.82% for Uganda. These signify that every US$1.00 invested will yield a benefit of US$1.29 in Côte d'Ivoire, US$1.64 in Senegal, and US$1.35 in Uganda. Similar ratios and MIRRs were obtained for each of the other countries. Except for a few countries, the investment will generally remain profitable even under pessimistic scenarios.

Similarly, the NPV of the investment made under the program is positive for all 10 countries even under pessimistic scenarios. At current prices, the NPV ranges between US$ 39.5 million in Ghana to US$ 227.9 million in Madagascar (Figure A1.10). The real monetary contribution of the project to the economy in terms of direct and indirect generated value added, also known as GDP, is estimated at US$ 2.78 billion for the 10 countries; the corresponding net national value added which represents the contribution to national welfare is estimated at US$ 2.14 billion (Figure A1.11).

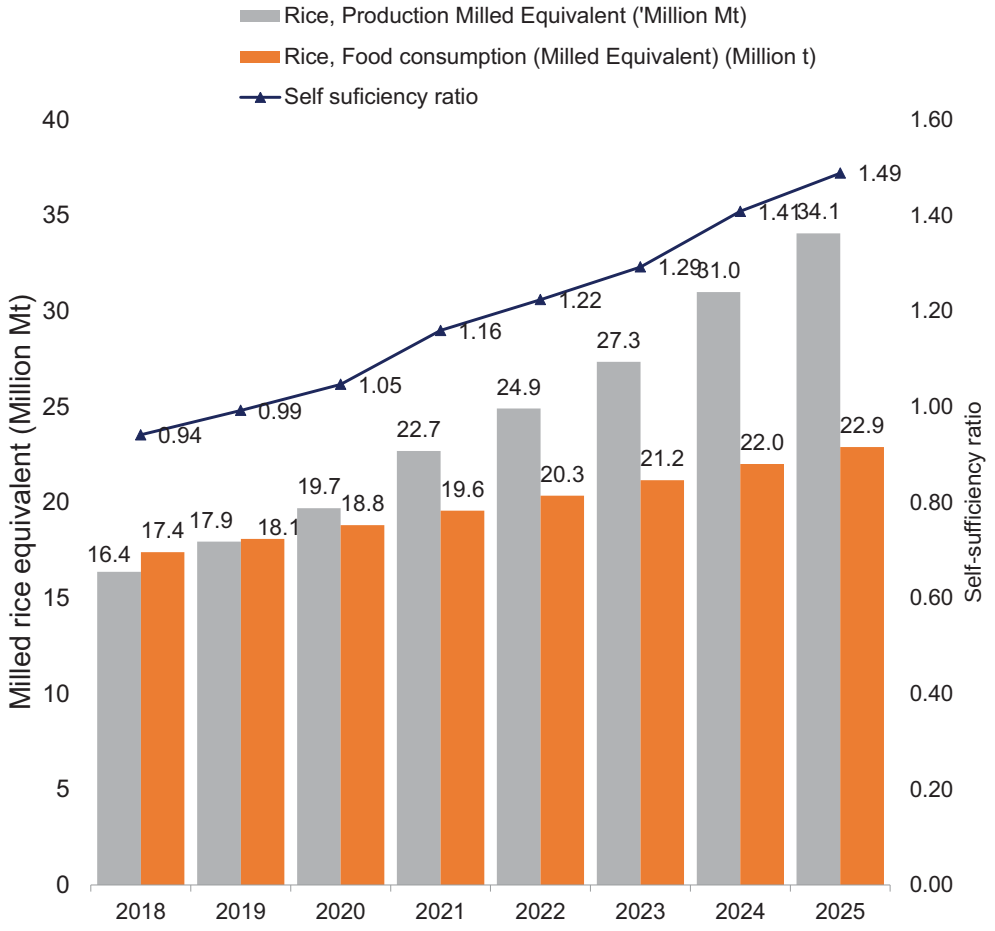


Figure A1.1: Trends in production, consumption and self-sufficiency ratio in 10 CIPRiSSA countries

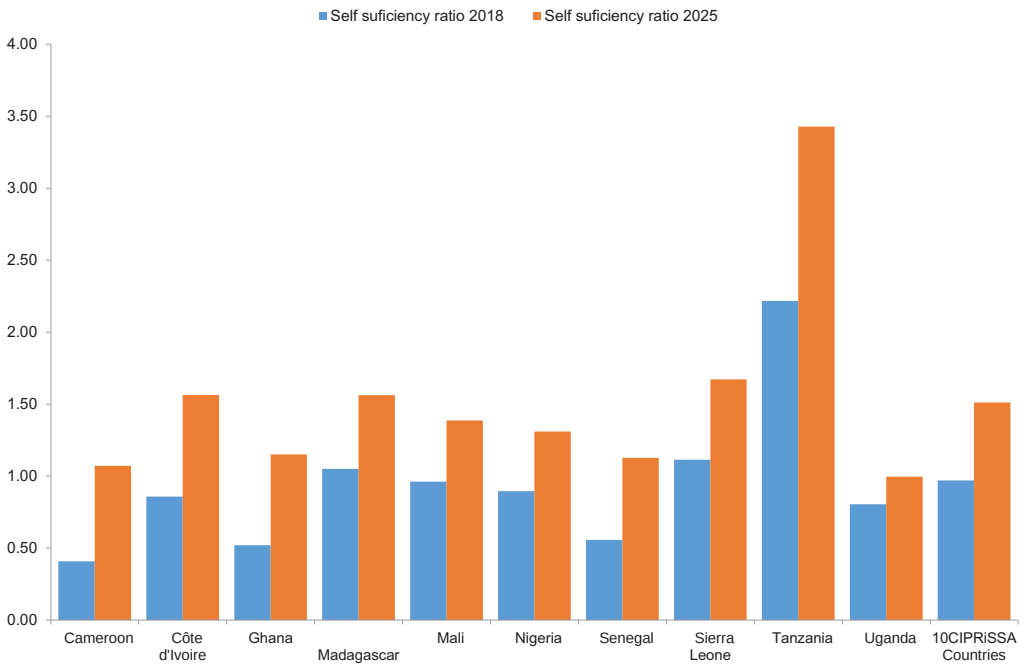


Figure A1.2: Rice self-sufficiency ratio in 2018 and 2025 for 10 CIPRiSSA countries

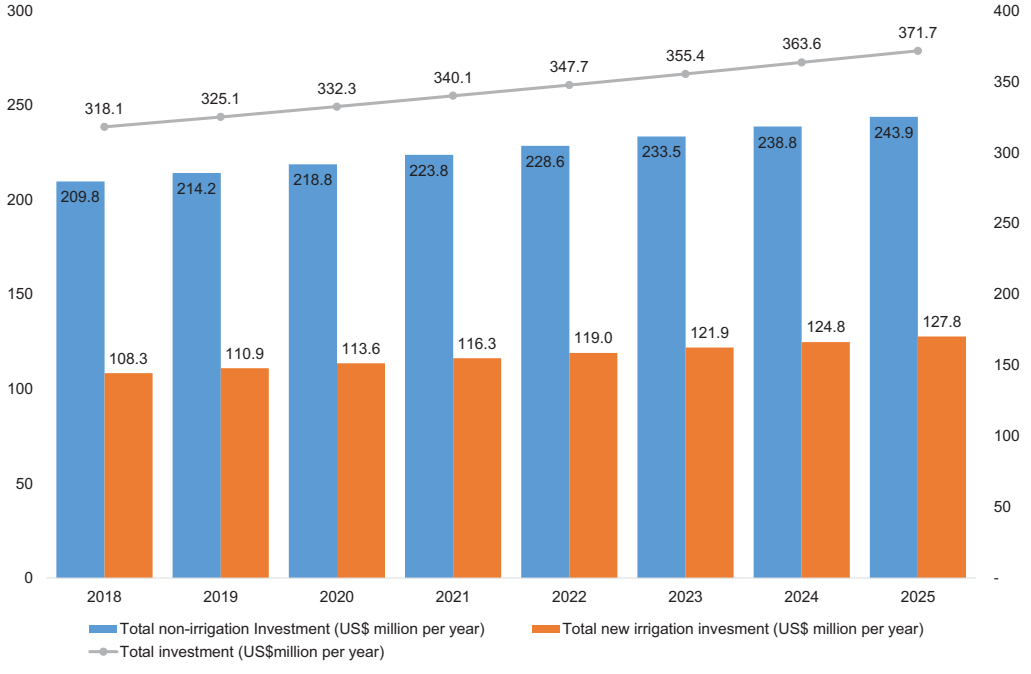


Figure A1.3: Irrigation, non-irrigation and total investments in 10 CIPRiSSA countries

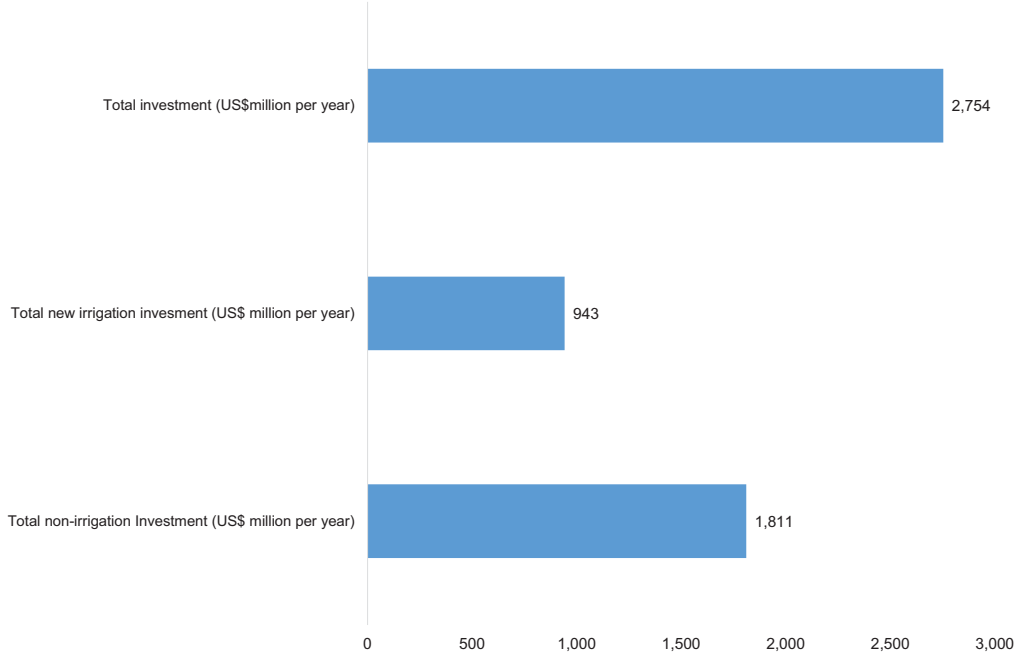


Figure A1.4: Overall irrigation, non-irrigation and total investments over 2018-2025 in 10 CIPRiSSA countries

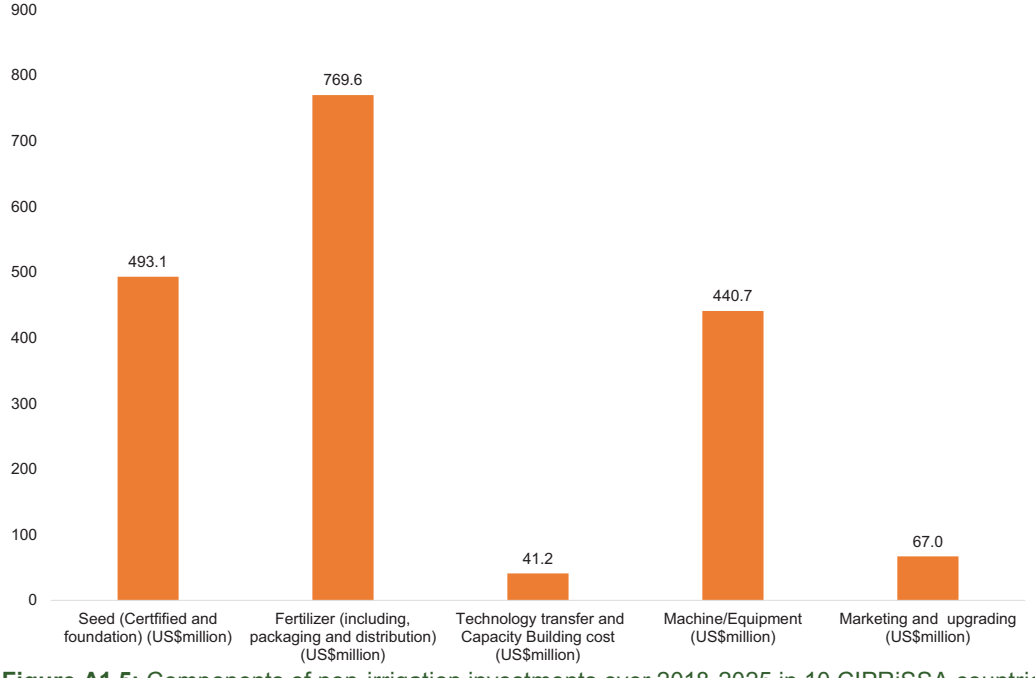


Figure A1.5: Components of non-irrigation investments over 2018-2025 in 10 CIPRiSSA countries

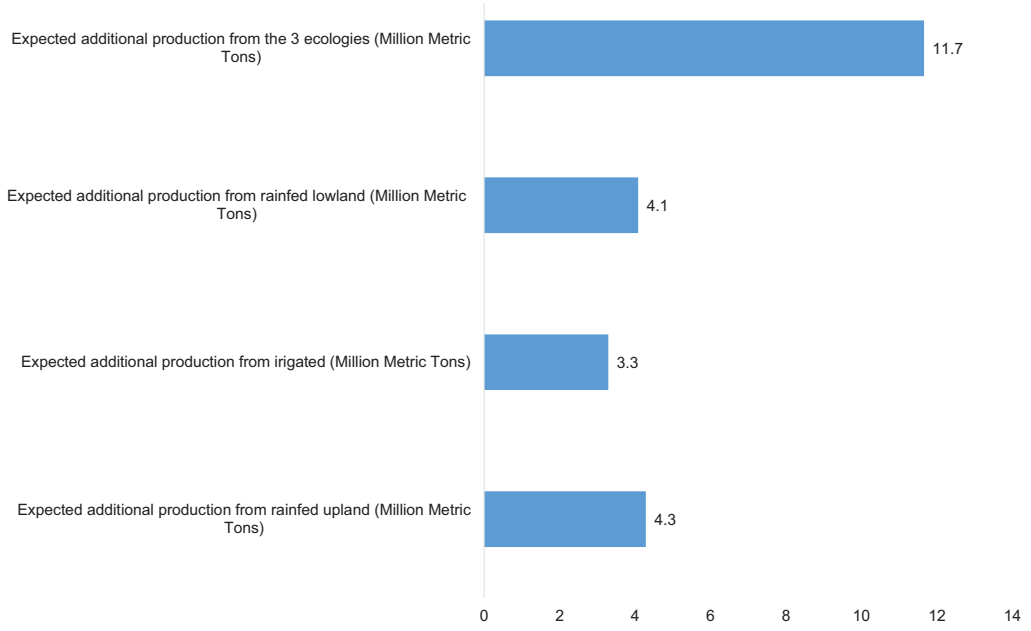


Figure A1.6. Additional production by rice growing environment in 10 CIPRiSSA countries

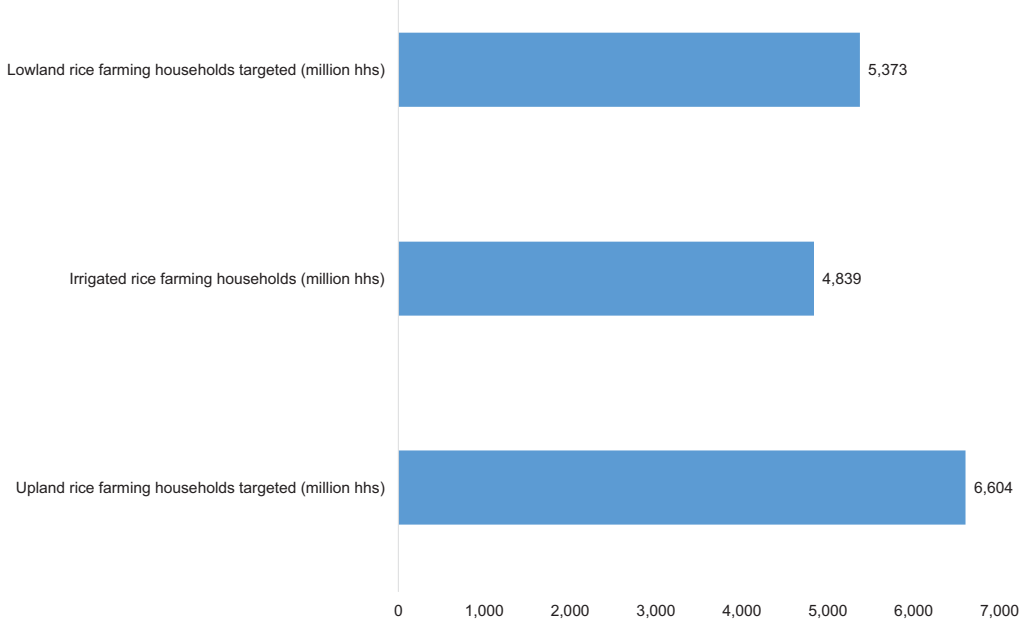


Figure A1.7. Number of household beneficiaries by rice growing environment in 10 CIPRiSSA countries

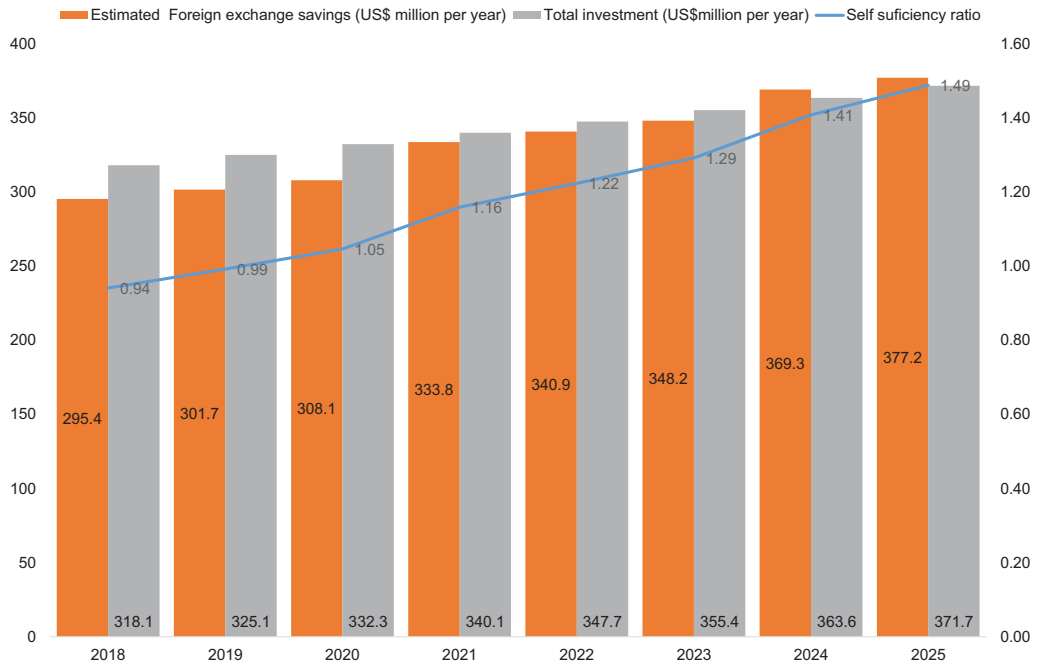


Figure A1.8. Trends in foreign exchange savings, total investments (US$ million per year) and self-sufficiency ratio for the 10 CIPRiSSA countries

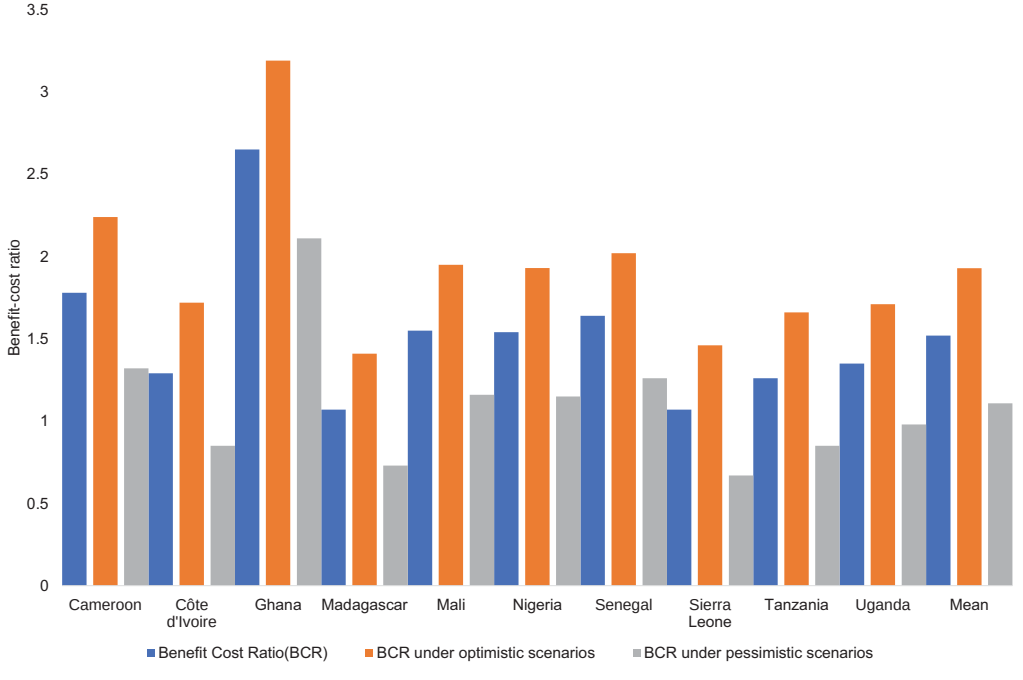


Figure A1.9: Benefits-Costs ratio (BCR) of investments in 10 CIPRiSSA countries

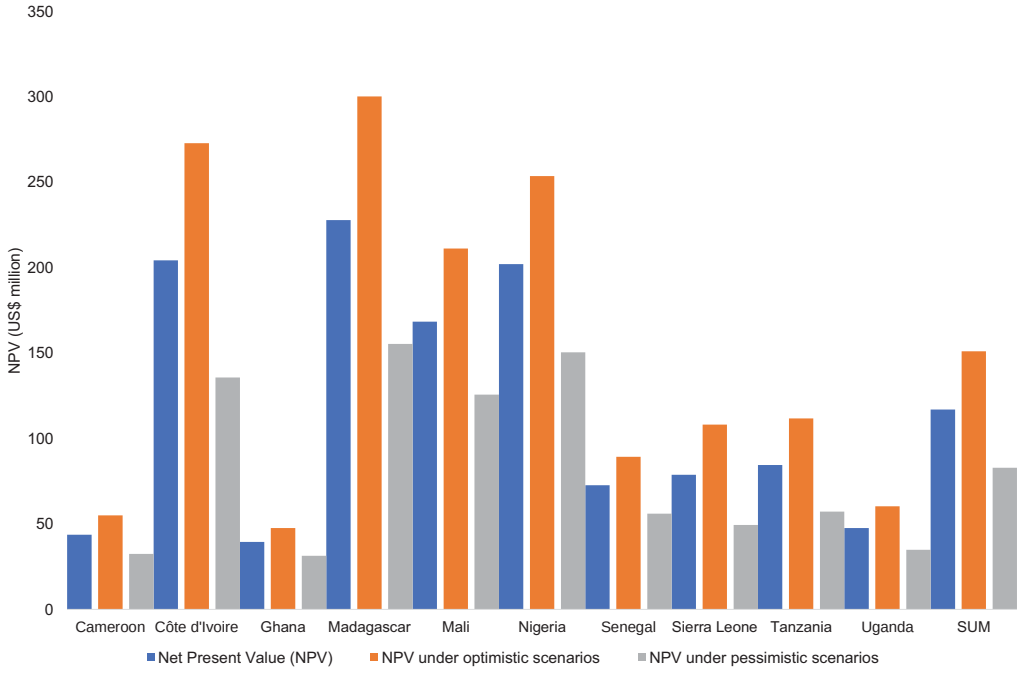


Figure A1.10: Net Present Value (NPV) of investments in 10 CIPRiSSA countries

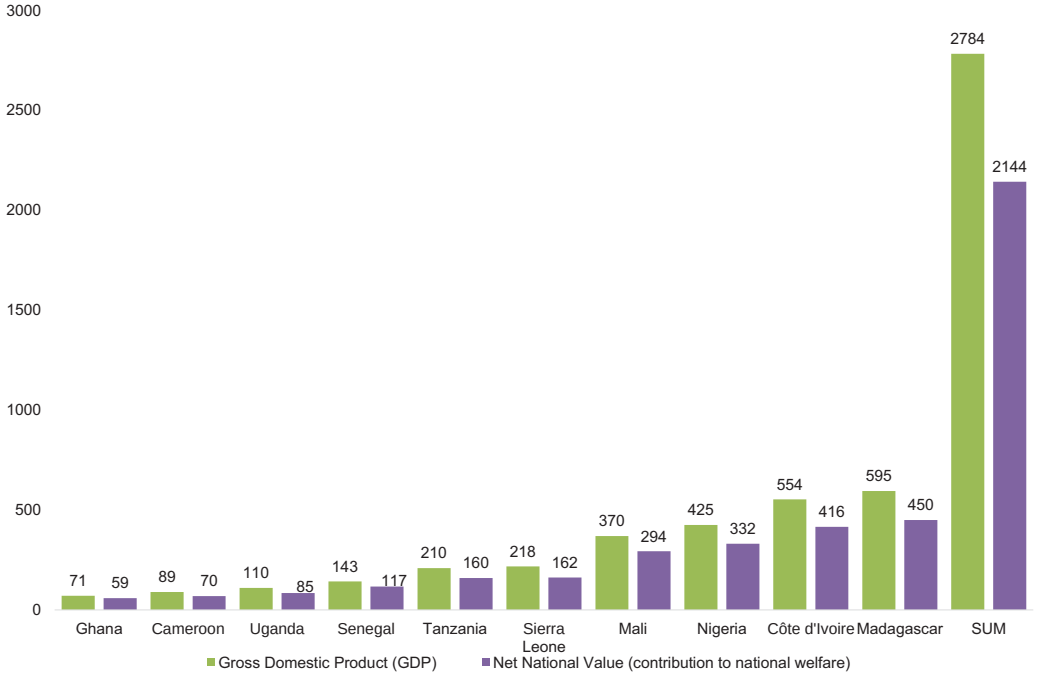


Figure A1.11: The contribution of investments to economic growth in 10 CIPRiSSA countries

Table A1: Projected estimates in required investments, production gains, land area, and farming households for ten CIPRiSSA countries[25] (2018-2025)

	2018	2019	2020	2021	2022	2023	2024	2025
Rice, production milled equivalent (T)	16,367,489	17,947,168	19,686,319	22,682,075	24,898,771	27,342,938	30,992,994	34,063,849
Rice, food consumption (milled equivalent) (T)	17,391,574	18,087,237	18,810,727	19,563,156	20,345,682	21,159,509	22,005,890	22,886,125
Self-sufficiency ratio	0.94	0.99	1.05	1.16	1.22	1.29	1.41	1.49
ADDITIONAL GAIN FROM THE PROGRAM								
Expected additional production from rainfed upland (T)	501,610	510,876	520,364	530,079	540,028	550,216	560,648	571,331
Expected additional production from irrigated lowland (T)	378,123	387,165	396,424	405,905	415,614	425,555	435,736	446,161
Expected additional production from rainfed lowland (T)	469,033	480,264	491,764	503,540	515,599	527,948	540,593	553,541
Expected additional production from the 3 ecologies (T)	1,348,765	1,378,304	1,408,551	1,439,525	1,471,241	1,503,719	1,536,976	1,571,032
Expected additional production from technology adoption (T)	34,819	34,896	34,975	35,055	35,138	35,222	35,309	35,397
Expected additional paddy production from the program (T)	1,383,584	1,413,200	1,443,526	1,474,580	1,506,379	1,538,941	1,572,285	1,606,429
Expected additional rice, food (milled equivalent) from the program (T)	830,151	847,920	866,116	928,985	949,019	969,533	1,021,985	1,044,179
Estimated foreign exchange savings (US$ per year)	295,401,805	301,670,753	308,090,156	333,752,059	340,894,931	348,209,232	369,267,898	377,232,163
PRODUCERS and AREA TARGETED								
Number of upland rice farming households targeted	621,001	635,857	651,070	666,647	682,598	698,932	715,659	732,786
Number of substitute farming households targeted (upland rice)	149,886	149,886	149,886	149,886	149,886	149,886	149,886	149,886

[25]Cameroon, Côte d'Ivoire, Ghana, Madagascar, Mali, Nigeria, Senegal, Sierra Leone, Tanzania and Uganda

	2018	2019	2020	2021	2022	2023	2024	2025
Total number of upland rice farmers	770,888	785,744	800,956	816,533	832,485	848,819	865,545	882,672
Number of Irrigated rice farming households targeted	556,008	569,311	582,933	596,882	611,166	625,793	640,770	656,108
Number of lowland rice farming households targeted	617,293	632,075	647,210	662,710	678,581	694,833	711,475	728,516
	0	0	0	0	0	0	0	0
Total number of farmers/trainees targeted	1,944,189	1,987,129	2,031,099	2,076,125	2,122,231	2,169,444	2,217,790	2,267,296
Number of farmers targeted for PLAR training	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
Number of farmers targeted for Video training	197,749	198,996	200,272	201,580	202,919	204,290	205,693	207,131
Number of farmers targeted for Radio-TV training	1,944,189	1,987,129	2,031,099	2,076,125	2,122,231	2,169,444	2,217,790	2,267,296
Number of trainees targeted for IRM training	400	400	400	400	400	400	400	400
Number of trainees targeted for post-harvest training	10,500	10,500	10,500	10,500	10,500	10,500	10,500	10,500
Number of villages targeted for PLAR training	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Number of villages targeted for Video training	2,481	2,493	2,506	2,519	2,532	2,546	2,560	2,574
Number of villages targeted for Radio-TV training	19,442	19,871	20,311	20,761	21,222	21,694	22,178	22,673
	0	0	0	0	0	0	0	0
Total rice area targeted (ha)	486,047	496,782	507,775	519,031	530,558	542,361	554,447	566,824
Total additional upland rice area (ha)	153,909	156,695	159,547	162,468	165,459	168,521	171,658	174,869
Total additional irrigated rice area (ha)	34,750	35,582	36,433	37,305	38,198	39,112	40,048	41,007
Total additional lowland rice area (ha)	77,162	79,009	80,901	82,839	84,823	86,854	88,934	91,065
Total additional rice area (ha)	265,822	271,286	276,882	282,612	288,479	294,488	300,640	306,940

	2018	2019	2020	2021	2022	2023	2024	2025
Total rice areas already under rice (ha)	220,226	225,496	230,893	236,419	242,079	247,873	253,807	259,884
INPUTS (quantity and cost)								
Seed								
Total foundation seed equivalent (T)	499	510	520	532	543	555	567	579
Total certified seed requirement (T)	24,840	25,380	25,934	26,501	27,081	27,676	28,284	28,908
Production cost of foundation seed (US$)	981,660	1,002,506	1,023,852	1,045,710	1,068,093	1,091,013	1,114,483	1,138,517
Production cost of certified seed (US$)	52,728,978	53,858,496	55,015,123	56,199,508	57,412,319	58,654,237	59,925,962	61,228,207
Cost of storage, weighing, packaging of certified seed	3,380,818	3,454,401	3,529,750	3,606,908	3,685,917	3,766,822	3,849,670	3,934,505
Cost of distribution of certified seed (US$)	41,089	41,997	42,926	43,878	44,852	45,850	46,872	47,918
Total cost of certified seed package (including, packaging and distribution)	56,150,885	57,354,894	58,587,799	59,850,294	61,143,088	62,466,910	63,822,503	65,210,631
Total cost of seed (certified and foundation)	57,132,545	58,357,400	59,611,651	60,896,004	62,211,181	63,557,923	64,936,986	66,349,147
Fertilizer								
Total Urea (T)	63,271	64,696	66,154	67,648	69,178	70,744	72,348	73,990
Total NPK (T)	48,605	49,678	50,777	51,903	53,056	54,236	55,445	56,682
Total Fertilizer (T)	111,876	114,374	116,932	119,551	122,233	124,980	127,793	130,673
Total cost of Urea (US$)	26,257,460	26,848,647	27,454,022	28,073,926	28,708,708	29,358,725	30,024,342	30,705,934
Total cost of NPK (US$)	36,550,753	37,358,021	38,184,665	39,031,147	39,897,946	40,785,547	41,694,451	42,625,169
Total cost of fertilizer (US$)	62,808,213	64,206,668	65,638,687	67,105,074	68,606,654	70,144,272	71,718,793	73,331,102
Cost of fertilizer transportation and distribution	26,111,791	26,694,834	27,291,870	27,903,235	28,529,273	29,170,336	29,826,784	30,498,986

	2018	2019	2020	2021	2022	2023	2024	2025
Total cost of fertilizer (including, packaging, transportation and distribution)	88,920,004	90,901,503	92,930,557	95,008,309	97,135,927	99,314,608	101,545,577	103,830,089
Technology transfer and capacity building								
Cost of PLAR training	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000
Cost of Video training	744,179	747,920	751,750	755,673	759,689	763,802	768,014	772,326
Cost of Radio-TV training	38,884	39,743	40,622	41,522	42,445	43,389	44,356	45,346
Cost of IRM training	1,600,000	1,600,000	1,600,000	1,600,000	1,600,000	1,600,000	1,600,000	1,600,000
Cost of post-harvest (GEM, ASI) training	745,000	745,000	745,000	745,000	745,000	745,000	745,000	745,000
Total technology transfer and capacity building cost	5,128,063	5,132,662	5,137,372	5,142,195	5,147,134	5,152,191	5,157,369	5,162,672
Machine/Equipment (quantity and cost)								
Number of tractors (for a fraction of the additional areas)	116	119	122	125	128	131	134	137
Number of power tillers (for a fraction of the additional areas)	1,926	1,964	2,004	2,044	2,086	2,128	2,172	2,216
Number of ASI/ATA thresher-cleaners (for a fraction of the additional production)	2,306	2,355	2,406	2,458	2,511	2,565	2,620	2,677
Number of mini-milling machines	461	471	481	492	502	513	524	535
Number of GEM parboilers (for a fraction of the additional production)	381	389	398	406	415	424	433	442
Total cost tractors (US$)	7,722,228	7,905,421	8,093,011	8,285,102	8,481,804	8,683,227	8,889,484	9,100,691
Total cost of power tiller (US$)	12,046,142	12,287,674	12,535,002	12,788,266	13,047,609	13,313,176	13,585,117	13,863,584
Total cost of ASI/ATA thresher-cleaners (US$)	10,721,834	10,951,333	11,186,339	11,426,985	11,673,407	11,925,744	12,184,136	12,448,730

	2018	2019	2020	2021	2022	2023	2024	2025
Total cost of mini milling machine (US$)	11,696,546	11,946,908	12,203,279	12,465,802	12,734,626	13,009,902	13,291,785	13,580,432
Total cost of GEM (US$)	8,881,102	9,070,242	9,263,921	9,462,248	9,665,336	9,873,297	10,086,250	10,304,313
Total cost of Machine/ Equipment (US$)	51,067,853	52,161,577	53,281,551	54,428,405	55,602,783	56,805,346	58,036,770	59,297,749
Marketing and upgrading (cost)								
Cost of training/ meeting on branding and packaging (US$)	41,156	41,156	41,156	41,156	41,156	41,156	41,156	41,156
Cost of participation and exhibition in trade fair (US$)	74,732	74,732	74,732	74,732	74,732	74,732	74,732	74,732
Cost of marketing campaigns (US$)	506,554	506,554	506,554	506,554	506,554	506,554	506,554	506,554
Cost of high quality bags for the packaging of the additional milled rice (US$)	6,902,105	7,049,843	7,201,127	7,723,843	7,890,407	8,060,969	8,497,072	8,681,597
Total cost of marketing and upgrading (US$)	7,524,546	7,672,284	7,823,568	8,346,284	8,512,848	8,683,410	9,119,513	9,304,038
Total Investment (US$ per year)	209,773,011	214,225,426	218,784,699	223,821,197	228,609,873	233,513,477	238,796,216	243,943,696
Total additional irrigation scheme by 2025 (ha) planned by each country (a)	371,457	371,457	371,457	371,457	371,457	371,457	371,457	371,457
Annual additional irrigation scheme by 2025 (ha) planned by each country (b) = (a)/8	46,432	46,432	46,432	46,432	46,432	46,432	46,432	46,432
Total annual additional irrigated rice area (ha) from CIPRiSSA (c)	34,750	35,582	36,433	37,305	38,198	39,112	40,048	41,007
(b)-(c)	11,682	10,850	9,999	9,127	8,234	7,320	6,384	5,425
Cost of new irrigation schemes from CIPRiSSA (US$)	108,334,224	110,918,076	113,563,940	116,273,304	119,047,694	121,888,668	124,797,826	127,776,804

Policy Needs for Effective Attainment of CIPRiSSA'S Goal

Achieving CIPRiSSA's goal requires a paradigm shift to one in which the private sector plays the leading role in rice production, processing, marketing, and distribution while the public sector creates an enabling environment, including the provision of incentives and other public goods (such as infrastructure, institutional capacity and innovations). The public sector cannot continue to drive agricultural development as in the past because this will perpetuate low agricultural development, food insecurity, dependence on large food imports and food aid, etc. CIPRiSSA envisages that nimble, private-sector business units will actively engage in the future of agriculture in Africa. To achieve this, the public sector needs to make business-friendly regulations and policies to attract and retain the needed private sector capital. Key areas needing government policy and regulatory intervention include the following:

a) **Agriculture within wider development policies:** Governments need to situate agriculture within the overall national development agenda and define the envisaged role of the rice sector in agriculture. Mere platitudes on the importance of agriculture will not suffice to attract the private capital needed to actualize CIPRiSSA. The required policy should specify in concrete terms how the government intends to use/is using agriculture to address the major socio-economic development challenges of the day, including poverty, income generation, food and nutrition security, job creation, youth and gender issues, etc. Governments should also show budgetary commitment to the policy and a results-framework for tracking progress.

b) **Rice Sector Financing Policy:** There are two aspects to this - adopting measures aimed at fast-tracking the implementation of the Comprehensive Africa Agriculture Development Program (CAADP) policy of allocating at least 10% of public expenditures to agriculture, and agreeing on a framework within the policy on how to distribute the funds, clearly defining the place of the rice sector within it. The Kampala Principles for Agricultural Finance agreed at a MFW4A[26] conference in June 2011[27] form a good starting point for formulating a policy on agricultural finance. The principles «recognised that while agricultural finance is a part of the overall financial system of a country, the financial services needs of agriculture sectors in Africa are pressing and demand special attention.»[28] Along these principles, it is important that the policy includes measures to de-risk agricultural financing.

[26] Making Finance Work for Africa (MFW4A).
[27] Ocaya, 2012.
[28] MF4A, 2012.

c) **Opportunities for a Public-Private-Producer Partnership:** The Agricultural (and Rice Sector) Finance Policy should clearly define areas of needed private sector involvement and the incentives aimed at attracting and retaining private-sector participation. These incentive measures should include both tangible gains and intangible measures to address costly bureaucratic red tape and facilitate policy administration.

d) **Infrastructure and Institutions:** Governments need to outline the range of services and infrastructure available to support agricultural value chain development - from inputs to transportation and packaging, extension, and available financial products for addressing the needs of value chains. The outline should specify what applies to the rice sector and the administrative arrangements, e.g. one-stop shops.

e) **Cross-cutting gender laws and policies:** Governments should provide concise notes on existing laws and policies on gender, environment, and other cross-cutting issues affecting agriculture and their implications for investors. For example, the note should explain investors' obligations towards helping to resolve such gender issues as (i) women's lack of control over productive resources and social or economic power; (ii) women's lack of education and training; (iii) women's relatively poorer health status resulting from multi-tasking on domestic and other responsibilities that affect their agricultural productivity; and (iv) the inadequate time at their disposal, also due to involvement in numerous activities.[29] The note should also clarify similar obligations of investors on the environment and other cross-cutting issues.

f) **Control over Land and Natural Resources:** Governments need to enact policies to address the 'untitled' nature of land, arising from communal ownership of up to 80% of land in Africa. Researchers have described such land holdings as "'dead capital', where the poor, lacking property rights, cannot make the capital invested in their property work for them as collateral in debt markets".[30] Prospective investors will not make the necessary investment in the absence of secure land rights.

g) **Conditions for Investor Access to Land and Natural Resources:** Governments also need to spell out the policy on access to land, including for large-scale (integrated) farming, and any preferential treatment attached to the rice sector. The policy should explain, for example, the key issues, how government has addressed them, what incentives apply, how intending investors should approach the issues, where they can obtain assistance, etc. Under CIPRiSSA, the establishment of a one-stop shop that addresses all relevant issues, including land, will be very helpful for showing commitment and facilitating business.

[29] Odebode, 2012.
[30] De Soto, 2000.

h) **Contract Farming and Supply Chain Relationships:** African governments need to provide a policy and legal framework for contract farming to facilitate its use and protect all the parties involved. Contract farming refers to « agricultural production and marketing carried out under a previous agreement between producers and their buyers ».[31] Contract farming will help to guarantee sustained "operations of very vulnerable suppliers (farmers)"[32] and constant supply of quality rice paddy to large-scale millers and other players in the industry. Production and marketing contracts can be distinguished. In production contracts, the buyer owns the product while still under production and compensates the farmer for the services provided. Conversely, the farmer retains ownership over the crops in marketing contracts while the processor guarantees to buy a certain quantity of the farmer's crop in a season at a single guaranteed price or a menu of prices varying with preset quantity and quality levels; such marketing contracts would probably suit Africa better.

Contract farming guarantees a market for the farmer and protects both the farmer and buyer against the legendary volatility of crop prices, since the buyer will procure specified quantities at specified prices. The society benefits from a steady supply of the crop as food and industrial raw material, reduction of food wastages (especially those arising from poor storage and conservation by the farmer in bumper harvest periods), increased employment and household incomes generated by stable farming and industrial activities, etc. However, certain requirements are necessary for successful contract farming arrangements. Top on the list are a reliable supply of water, quality inputs, and modern farming techniques. Rain-fed farming and traditional techniques are not enough.

Some big organizations can organize participating farmers to ensure adequate supply, provide them with quality seeds, and train and monitor them on the use of modern techniques, etc. They are, however, unlikely to simultaneously undertake research and development, produce quality seeds, construct irrigation facilities to ensure reliable water supply, and provide all necessary pre- and post-harvest infrastructure; governments must thus play key roles in these processes. Government assistance is also necessary in mobilizing farmers, given government's local presence and superior knowledge of communities, and in securing fair prices for the farmers through ensuring unhindered flow of information to all parties.

i) **Support for Producer Organizations:** The policy framework must recognize the critical role of producer organizations (POs) in Africa's quest to improve agriculture and achieve food self-sufficiency, and outline government's approach to organizing them and developing their

[31]UNIDROIT, FAO and IFAD, 2015.
[32]Federgruen *et al.,* 2015.

capacities.[33] POs have a wide diversity of rural advisory services (RAS) roles, depending on their aims, resources, vision, or institutional environment; these services include access to timely and adequate advice, information, finance, capacity building, markets, inputs, and advocacy. Their "involvement in the provision of RAS has been identified as an efficient and sustainable solution to the limitations of both the hierarchical public sector extension system and market-driven private sector extension systems".[34] POs are important because fragmented «small and marginal farmers» dominate Africa's farming landscape. This fragmentation and lack of organization makes it economically non-viable for the farmers to adopt the latest technology, use high yielding varieties or inputs like quality seeds and fertilizers. They are thus unable to realize good value from their marketable surplus by individually selling their produce or compete with their products in the market due to poor quality ; proper organization will enable farmers to «utilize scale to procure inputs at a lower price, and gain more selling power for their produce/product.»[35]. However, not all POs have the required capacities to carry out all these functions; many often require assistance in organization, training, and resource mobilization.

j) **Diversity of Market Outlets:** Diversity of agricultural inputs and outputs markets is vital for effective private sector participation in the rice industry. Such diversity will offer alternatives and engender a competitive environment in which the private sector thrives. The freedom of farming and processing units to source inputs and channel their products to markets of their choice will enhance adherence to quality specifications, promote competitive pricing of both inputs and outputs, and obviate the need for price controls. Governments' role in the process will be to ensure the right regulatory atmosphere that promotes market diversity. Excessive control of the sourcing of inputs, such as fertilizers, and setting of selling prices for either inputs or outputs will stifle initiative and hinder new entrants with a competitive spirit. Therefore, governments should strike the proper balance in protecting the local industry against established large international exporters. Subsidy regimes targeted at assisting poorer farming households must be imaginative and transparent. Government policy should also emphasize government's role in setting and enforcing proper standards for inputs and outputs. In addition, governments should ensure effective (timely and reliable) dissemination of information on market outlets and commodity prices to promote transparency and guide both buyers and sellers.

k) **Market Co-ordination:** Effective market coordination is important for linking smallholder farmers to the market. Small farm holdings predominate in SSA as «more than two-thirds

[33] A producer organization (PO) is a formal (registered under national legislation) or informal (unregistered) institution for collective action. Its members are rural dwellers that get part, or all, of their livelihood from agriculture (crops, livestock, fisheries, and/or other rural activities). (Source: Toillier *et al.,* 2015).

[34] Toillier *et al.,* Op. cit., p.1.

[35] FAO Regional Office for Africa, 2010.

of the holdings have an average size of less than one hectare and account for over 90% of agricultural output».[36] Most of these smallholders practice either subsistence farming or operate largely in local markets because they have no access to the more lucrative provincial, national, regional or global markets. Consequently, incentives are weak, investments, technology adoption and productivity are low, leading to a low level equilibrium poverty trap.[37] The typically small production surpluses of smallholders expose them to higher risks and transaction costs and prevent them from effectively participating in markets. Innovative approaches that link 'farms to markets' will facilitate their participation by reducing transaction costs, minimizing associated risks, and thereby help them to emerge more quickly from the poverty trap. Two market coordination instruments have proved effective in this regard: (i) the development of physical infrastructure, connecting smallholders to markets through information technology, roads, ports, etc.; and (ii) establishing "accompanying institutions that can reduce the marketing risk and transaction costs in the process of exchange between producers and consumers".[38] However, "the exact nature of infrastructure and institutions that can enable the small holders transcend from subsistence farming of a village economy to actively participate in provincial, national and international markets, would vary from country to country and even from region to region within a country."[39] Each country participating in CIPRiSSA is required to develop a clear policy and agenda on market coordination suited to its environment and situation.

l) **Competition Policy:** Trade liberalization, deregulation, and privatization are key aspects of market competition and economic efficiency but they may not, on their own, successfully achieve the objective in the agriculture sector. There should be aspects of carefully prepared generic competition policy and competition law. Even if certain aspects of the agricultural sector are not open to international competition, powerful local players can individually or collectively restrict competition among themselves. They abuse their market power and create strategic barriers to entry or to expansion in order to limit potential competition, swallow their competitors, and diminish competitive pressure on the market.[40] Countries must guard against this by developing competition policies and possibly competition laws. A good competition policy will promote competition, putting "businesses under constant pressure to offer the best possible range of goods at the best possible prices, because if they don't, consumers have the choice to buy elsewhere".[41] A regulatory agency will enforce the policy or law to guard against harmful practices, while promoting beneficial ones. These include:

[36]Torero, 2011.
[37]Ibid.
[38]Ibid.
[39]Ibid.
[40]Jenny, 2017.
[41]European Commission, 2012.

- Preventing collusion among business units that restrict competition, e.g. cartels or other unfair arrangements in which companies agree to avoid competing and try to set their own rules
- Checking abuse of a dominant position – where a major player tries to squeeze competitors out of the market
- Disallowing mergers (and other formal agreements whereby companies join forces permanently or temporarily) in a way that restricts, instead of expanding, markets and disenfranchising, rather than benefitting consumers
- Ensuring the conduct of market liberalization in a way that does not give an unfair advantage to these old monopolies
- Offering subsidies and state financial support in a manner that does not distort fair and effective competition or harm the agriculture sector or the economy
- Protecting local industry against unfair dumping from abroad, while being careful not to encourage inefficiency that would harm the sector and the economy in the long run.

m) Quotas and Market Preferences: Individual African countries should also articulate clear long-term policies on how to tap into international trade agreements, especially agreements anchored on the Uruguay Round of Trade Talks. The most important of these agreements affecting the CIPRiSSA program is that on trade quotas and trade preferences[42]; each country needs a clear and proactive policy on what to do with the emerging rice surpluses as countries attain self-sufficiency and begin exports. Exporting to European markets will require producing certain types of rice and attaining specific export quality standards. A variety of tariff concessions and preferences for EU rice imports exist[43] and CIPRiSSA countries should apprise themselves of these and the attaching quotas, and sensitize their farmers on how to tap into them. For instance, "Egypt has an import concession for 39,000 t of rice at a 25% tariff reduction while preferences are given through a 110,000 metric ton quota to the African, Caribbean, and Pacific countries at a 35% tariff reduction"[44] Further, the EU discriminates in favor of the least developed countries (LDCs)[45], it implements the 'Everything but Arms' initiative of 2001[46] that provides for the gradual reduction of tariffs to zero on fresh bananas

[42]Trade preferences refer to an international scheme agreed under the Generalized System of Preferences (GSP) that allows developing countries to export products to developed countries' markets at lower import duties than apply to exports from other countries (See the Internet «Global System of Trade Preferences - Brief note on the Agreement on Global System of Trade Preferences among developing countries (GSTP) » available at http://www.eicindia.gov.in/Knowledge-Repository/Certification/Global_System_of_Trade_Preferences.pdf).

[43]Wailes, 2005.

[44]Ibid.

[45]Five of the 10 initial CIPRiSSA countries are among the least of 47 least developed countries (LDCs) published by the UN in June 2017. The countries are Madagascar, Mali, Senegal, Sierra Leone, and Uganda; see https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/ldc_list.pdf.

[46]Achterbosch *et al.*, 2003; Wailes, 2005.

by 2006 and on rice and sugar by 2009. "The challenge for developing countries is to create a climate that allows investment to take place in activities in which a comparative advantage can be sustained in the long run"[47].

n) **Public Policies for Private Standards:** The World Trade Organization (WTO) regime has successfully reduced the use of tariffs and quotas to restrict international trade, although countries still use non-tariff measures, such as public and private standards, to achieve the same goal. By definition, standards (or "technical regulations") "take the form of mandatory minimum quality standards (MQS)"[48] aimed at "increasing the provision of some desirable attribute(s)" of the … product".[49] Usually, some form of legislation backs these quality standards which are often enforced through the considerably expensive process of official inspection of production facilities and/or end products.

Public regulatory standards in the food sector (including rice) seek to reduce risks to human health related to food consumption and protect consumers from sellers' fraudulent or deceptive practices in relation to measurement and voluntary quality claims.[50] To achieve this, public regulation must meet certain international "basics in public standard setting",[51] including the following:

- *Sanitary and Phytosanitary (SPS) Agreement*, which stipulates the basic rules for food safety and animal and plant health standards. The agreement allows countries to develop their own standards based on science and apply them only to the extent necessary to protect human, animal or plant life or health. Countries may not, therefore, arbitrarily or unjustifiably discriminate between countries where identical or similar conditions prevail. Member countries should also use international standards, guidelines, and recommendations where they exist. This requirement gives *de facto* mandatory status to the Codex Alimentarius and other international standards setting bodies.

- *Technical Barriers to Trade (TBT) Agreement*, which allows members to pursue legitimate policy objectives, such as the protection of human health and safety, or the environment, but not to use them to obstruct trade, through unnecessary regulations, standards, labeling, customs forms, testing, certification procedures and other technical aspects.

[47]Brenton and Ikezuki, 2005.
[48]Smith, 2009.
[49]International Trade Centre (ITC), 2011.
[50]Smith, Op. cit., p.10-11; ITC, *Op. cit.*, p.7-8.
[51]ITC, *Op. cit.*, p.7-8.

- *Trade Related Intellectual Property Rights (TRIPS) Agreement* has created global minimum standards for protecting and enforcing intellectual property rights in international trade and requires similar intellectual property regimes from all signatory nations. WTO members must adapt their laws to the minimum standards of protection and comply with detailed obligations for the enforcement of intellectual property rights.

In addition to public regulations, private standards and certification schemes set by trade associations also exist. These are voluntary, although they may become mandatory in practice, especially where compliance is a condition for market entry. Private certification schemes are becoming increasingly common, driven largely by (in the foods business) the need "to facilitate compliance with public regulation". Other factors behind their rise include a perception that public standards or regulatory frameworks are failing to achieve the desired outcomes, "a desire to differentiate certain products or operators in the market", greater attention by consumers on food safety and quality, and a globalization of agricultural food chains. Besides, there is also an observable "shift from public to more private market governance, partly due to a lack of technical expertise and financial resources to deal with the ever more complex standards issues at public level". Changes in public (policy) standards often result in changes in private standards, given that private standards often aim to facilitate compliance with public regulation.

o) Trade policy: Governments in CIPRiSSA participating countries should situate the foregoing discussions on a generic trade policy to govern their economic transactions across international borders. The basic purposes of all trade foreign policies are "to discourage imports from, and encourage exports to, the foreign sector" and increase the balance of trade surpluses or reduce trade deficits.[52] The three most important elements of trade policies are tariffs, import quotas, and export subsidies. As the domestic rice production increases, CIPRiSSA countries need to use the three instruments imaginatively and within international trade laws and agreements to create more favorable balance of trade situations, and increase domestic income and employment. Imaginative trade policies will assist domestic firms in fighting off competition from foreign rice exporters, thereby helping to increase their sales, profits, and net worth. They can thus help to attract local and foreign investors into the industry. However, tariffs can also increase the domestic price of goods and harm domestic consumers, many of whom are poor. Governments, therefore, need to strike a proper balance in the process.

[52]Edwards, 1993.

Country-specific CIPRiSSA Projections

Cameroon

Country Background

With a population of 23.3 million people[53], Cameroon is endowed with significant natural resources, including oil and gas, high value timber species, minerals, and agricultural products (such as coffee, cotton, cocoa, maize, and cassava). While the country has enjoyed peace for many decades, in spite of its highly diverse population, it now faces an increasingly challengin g situation in its northern regions where Boko Haram is waging a war. Due to a high population growth rate, the number of poor people increased by 12% between 2007 and 2014 to 8.1 million[54]. Poverty is increasingly concentrated in Cameroon's northern regions, where an estimated 56% of the poor live. This trend was observed even before the Boko Haram insurgency began destabilizing these regions. Economic activity slowed in 2016, with a GDP growth of 5.6%, representing 0.2 points below its 2015 level[55]. This outcome was due to the slower growth in oil production (3% in 2016 against 37% in 2015) caused by the maturity of the main oil fields, and the avian flu epidemic that damaged the local poultry industry, particularly in the west which accounts for 80% of poultry production. However, continued implementation of the government's ambitious infrastructure plan and interventions to boost the agriculture and forestry sectors have significantly contributed to sustaining strong growth in public works, construction, and services. To attract more investments, Cameroon should prioritize improvement in governance - it ranked 130th out of 168 countries in the 2015 Transparency International corruption perceptions index and 172nd out of 189 economies in the 2016 Doing Business Report.[56] With the goal of becoming an emerging economy by 2035, Cameroon adopted a vision in 2009 aimed at strengthening its role as the agricultural locomotive of the Central African sub-region. This vision recognizes the agricultural sector as the driving force of the economy, because it guarantees food security for the population while ensuring green and sustainable development. The vision is operationalized in the Growth and Employment Strategy Paper (GESP) for the 2010-2020 period, whose three pillars are: (i) growth, (ii) employment, and (iii) governance and strategic management of the State. CIPRiSSA is consistent with these three pillars, as well as those of the Rural Sector Development Strategy, namely: (i) institutional development and capacity building for public and private stakeholders; (ii) improvement of crop sector productivity and competitiveness; (iii) modernization of rural infrastructure; and (iv) sustainable natural resource management.

[53]http://www.worldbank.org/en/country/Cameroon/overview.
[54]Ibid.
[55]Ibid.
[56]Ibid.

CIPRiSSA Results for Cameroon

Self-Sufficiency

Baseline data provided by Cameroon show that local production of rice is very low and the country is highly dependent on imports to meet its needs. Cameroon has been working to stem this tide. Consequently, local rice production dramatically increased by 18% during 2006 - 2015. If this trend continues, Cameroon will achieve 41% self-sufficiency in rice by 2018 and 107% by 2025, with a little margin for limited export (Figure A2.1).

Paddy and Milled Rice Production

Paddy production during 2018 - 2025 is projected at 6.37 MT, rising steadily from 415,851 T in 2018 to 1.3 MT in 2025 (average of 796,719 T annually) (Figure A2.1). The milled rice equivalent would be 4.02 MT, ranging from 249,511 T in 2018 to 861,044 T in 2025 (average of 502,480 T per annum). The estimated food equivalent of the milled rice would be 5.63 MT, also rising steadily from 610,996 T in 2018 to 804,029 T in 2025 (Figure A2.1; Table A2).

New Investments

Between 2018 and 2025, Cameroon will require additional cumulative investments of US$ 275.25 million in irrigation (77.5% of total investment or US$ 213.41 million) and non-irrigation (22.5% of total investment or US$ 61.8 million) to realize the projections above. The cost of these new investments will increase annually from US$ 32 million in 2018 to USS$ 37 million in 2025 (Figures A2.2 and A2.3). The priority areas for non-irrigation investments include: (i) purchase and distribution of fertilizers to farmers (US$ 25.92 million or 41.9% of non-irrigation investment); (ii) machines/equipment (US$ 14.82 million or 24.0% of non-irrigation investment); (iii) seed production/ distribution (US$ 14.37 million or 23.2% of non-irrigation investment); (iv) technology transfer and capacity building on rice production (US$ 4.03 million or 6.5% of non-irrigation investment); and (v) marketing and upgrading (including post-harvest capacity building) (US$ 2.72 million or 4.40% of non-irrigation investment). Annual new non-irrigation investments will be US$ 7.22 million in 2018, increasing to US$ 8.27 million in 2025 (Figures A2.4 and A2.5). New irrigation investments will also increase progressively every year - from US$ 24.52 million in 2018 to US$ 28.94 million in 2025 (Figure A2.2). The new irrigation facilities will develop about 17,212 hectares (ha) from 2018 to 2025, progressively increasing from 1,978 ha in 2018 to 2,334 ha in 2025 (Figure A2.6).

Benefits

Cameroon will save US$ 96.82 million in foreign exchange by 2025, increasing progressively from US$ 10.77 million in 2018 to US$ 13.57 million in 2025 (Figure A2.7).

CIPRiSSA will empower 554,419 new farming households in Cameroon by 2025, increasing annually from 64,332 in 2018 to 74,514 in 2025 (Figure A2.11). This will be achieved by empowering the households through training in participatory learning and action research (PLAR), video, radio-TV, Integrated Rice Management (IRM), and (v) post-harvest practices (Figure A2.10). The targeted additional (upland, irrigated and lowland) rice area is 65,314 ha, increasing annually from 7,661 ha in 2018 to 8,692 ha in 2025 (Figure A2.8). Under CIPRiSSA, Cameroon will produce additional 411,119 T of paddy or 266,728 T of milled rice by 2025 (Figure A2.9).

Profitability analysis

Excluding the cost of new irrigation schemes, Cameroon will need to invest US$ 61.8 million, with an annual operational cost of US$ 7.7 million, to achieve 107% self-sufficiency in rice by 2025. These investments will generate a benefits/costs ratio (NPV ratio to investment) of 1.78 and a net present value (NPV) of US$ 43.7 million, with a modified internal rate of return (MIRR) of 116.18%. Thus, each dollar invested in the program will generate a net benefit of US$ 1.78 and the CIPRiSSA investment will remain viable as long as the financial rate of alternative investment projects in the country is less than 116.18%. The NPV is above zero and indicates that the investments are profitable (Table A12).

The estimated payback period of the investments is 1.91 years (by 2019), meaning that all investments will be recovered before the end of the program. All these indicators imply that the investments required to achieve self-sufficient in rice by 2025 are profitable for private sector investment. Similarly, economic analyses show that the estimate gross domestic value-added (which measures the real monetary contribution of the program to the country's economy in terms of direct and indirect generated value added) is US$ 89.4 million. This represents the contribution of the program to the Gross Domestic Product (GDP). The estimated net national value added (which represents the contribution to national welfare) is US$ 69.5 million. The economic internal rate of rate return is 30.10%. In total, the investments will create 16,767 direct employments. Sensibility analysis shows that the projected investments remain profitable under both pessimistic (-10% of the price) and optimistic (+10% of the price) scenarios, since the NPV ratio is greater than zero in both cases. Under optimistic scenarios, the investments will generate a benefits/costs ratio (NPV ratio to investment) of 2.24, a net profit of US$ 55.1 million, with an MIRR of 159.93%. Under pessimistic scenarios, the investments will generate a benefits/costs ratio (NPV ratio to investment) of 1.32, a net profit of US$ 32.4 million, with an MIRR of 75.74%. In addition, the break-even point analysis shows that the investments remain profitable even with a 57.89% reduction in the market price.

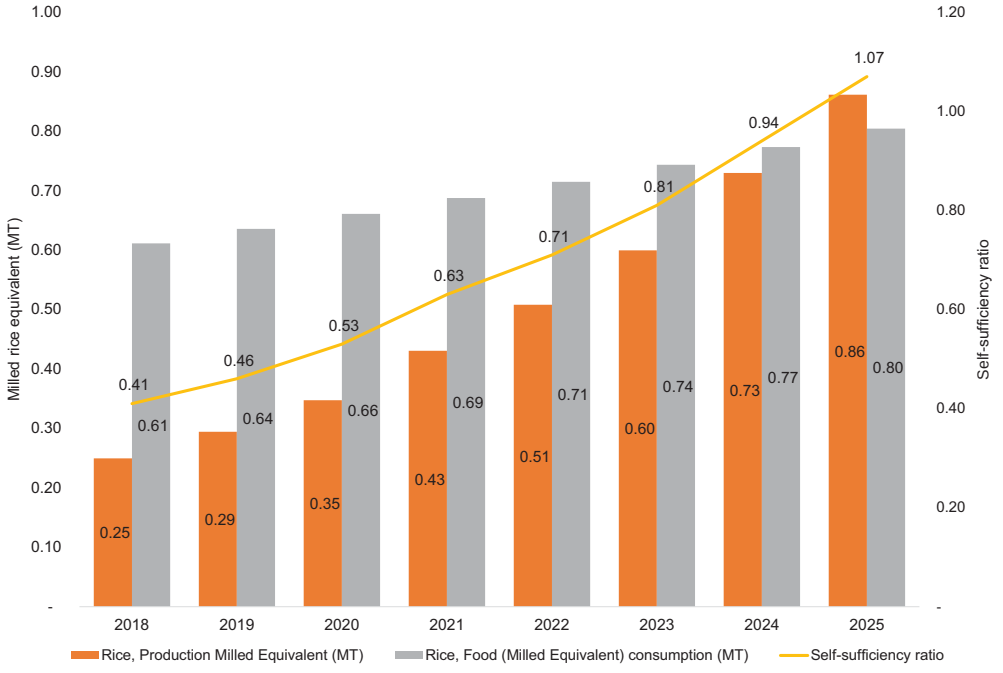


Figure A2.1: Milled rice production and consumption versus self-sufficiency in Cameroon

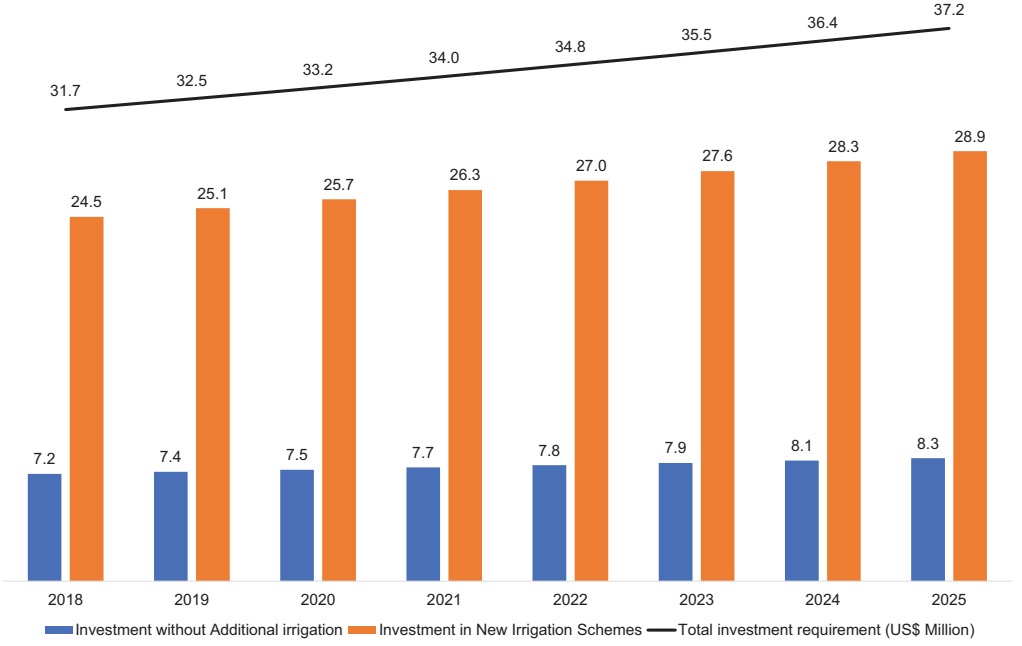


Figure A2.2: Additional irrigation and non-irrigation investments required by Cameroon (US$ million)

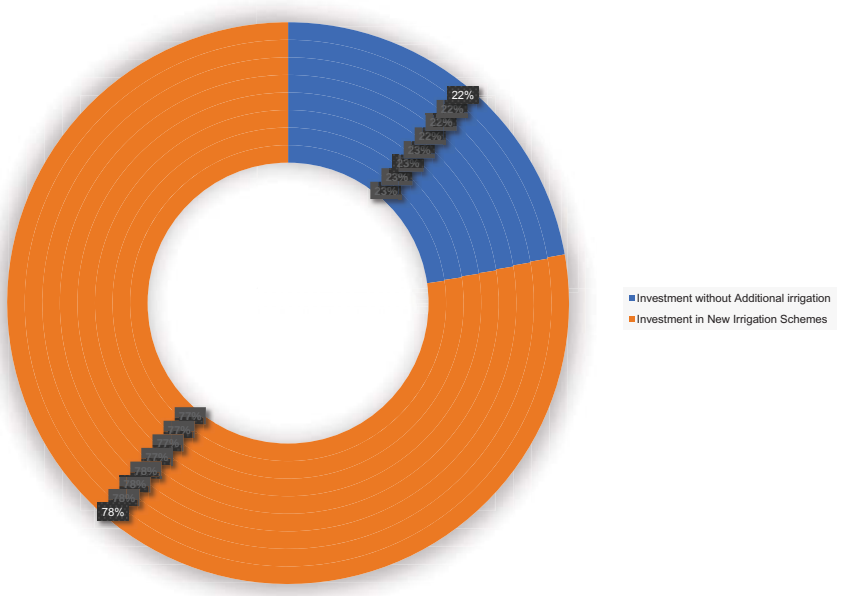


Figure A2.3: Additional irrigation and non-irrigation investments required by Cameroon (%)

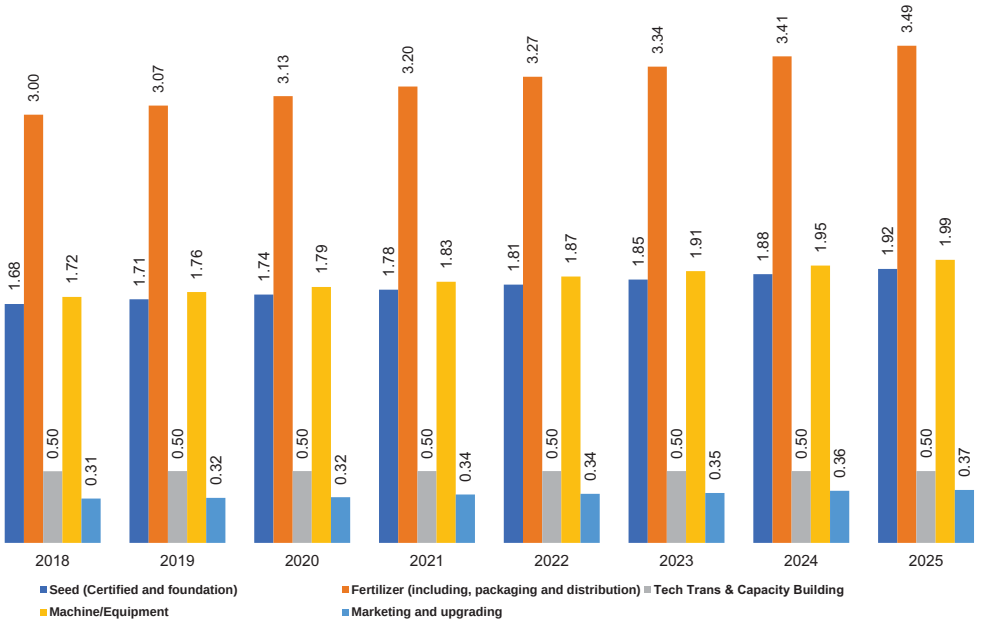


Figure A2.4: Composition of new (non-irrigation) investments required by Cameroon (US$ million)

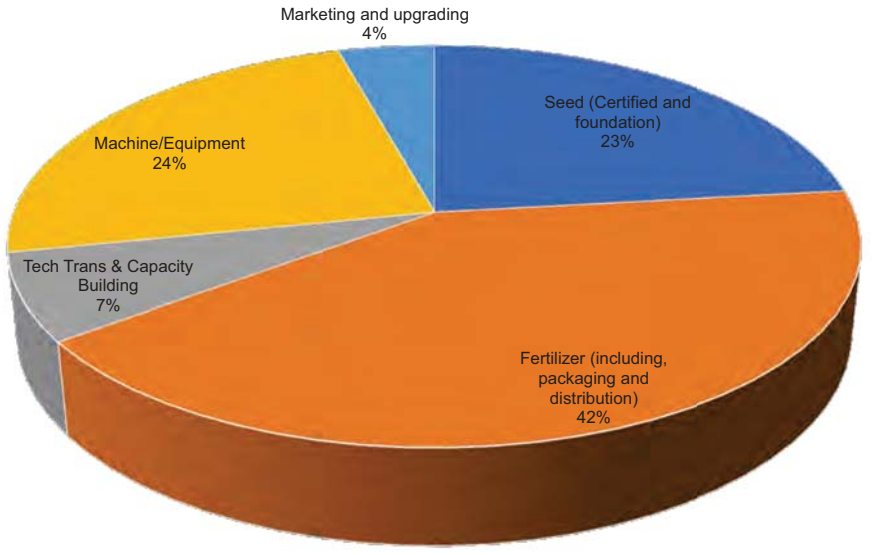


Figure A2.5: Distribution of new non-irrigation investments required in Cameroon (%)

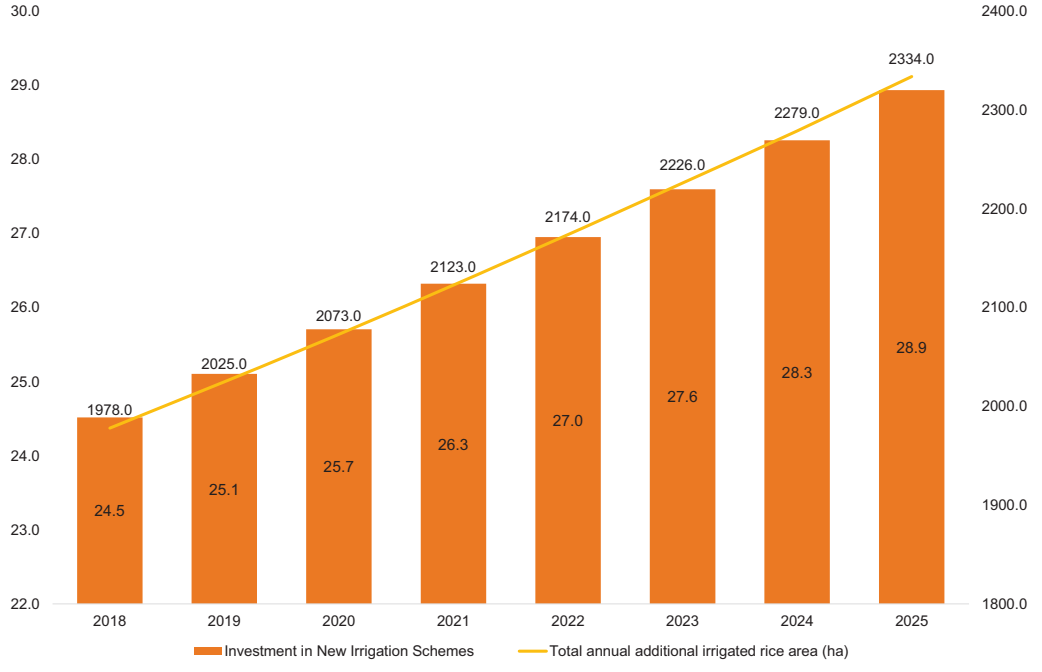


Figure A2.6: Additional irrigated rice area (ha) versus new irrigation investments in Cameroon (US$ million)

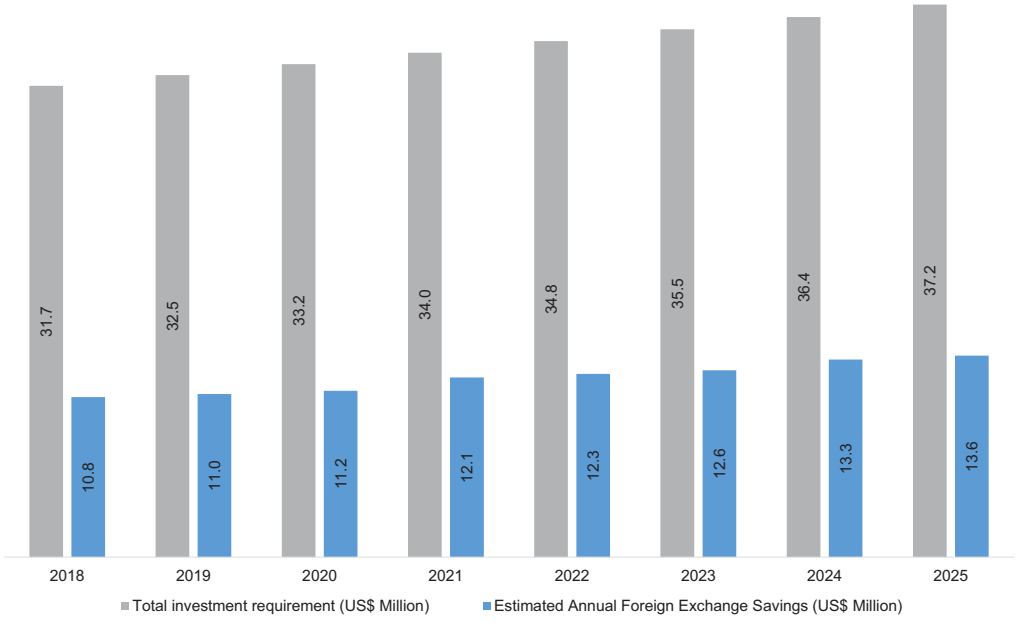


Figure A2.7: Estimated annual new costs versus annual foreign exchange savings for Cameroon (US$ million)

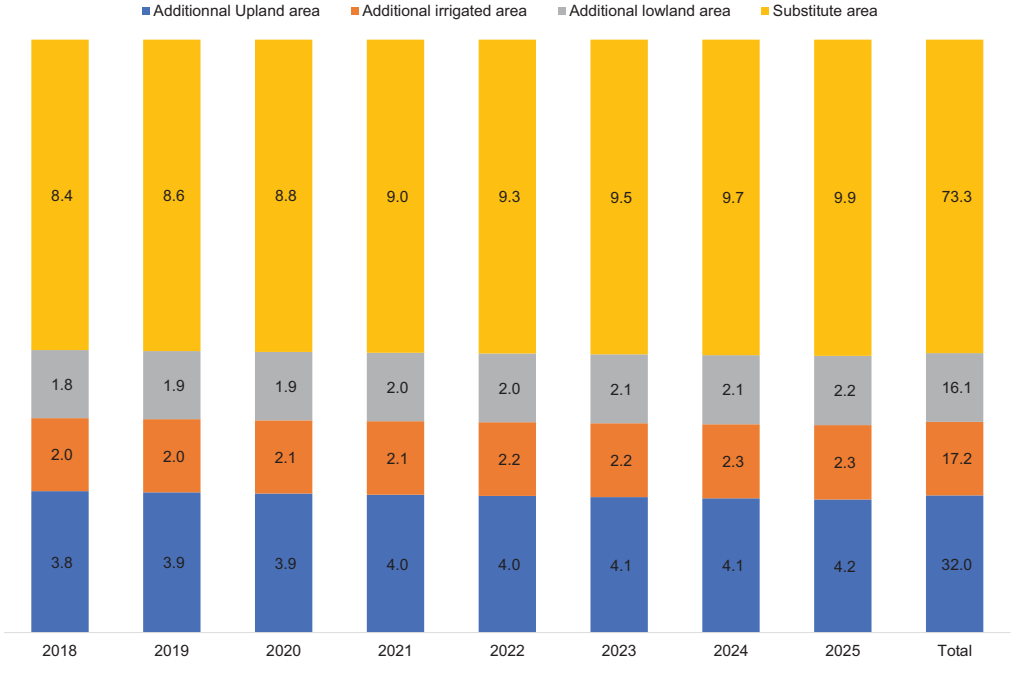


Figure A2.8: Expected gains from CIPRiSSA in Cameroon 1: Rice area expansion per ecology ('000 ha)

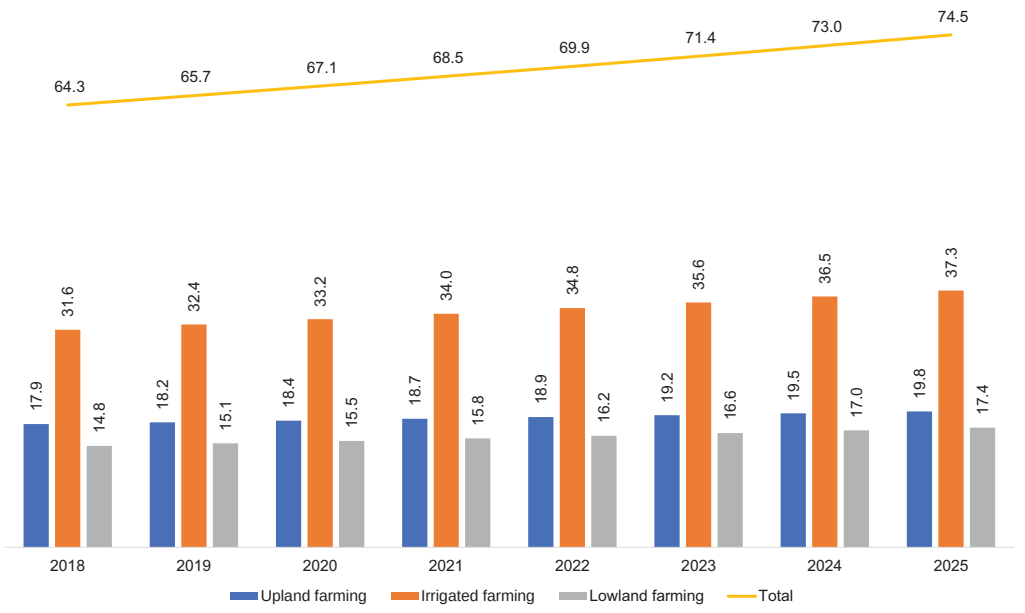
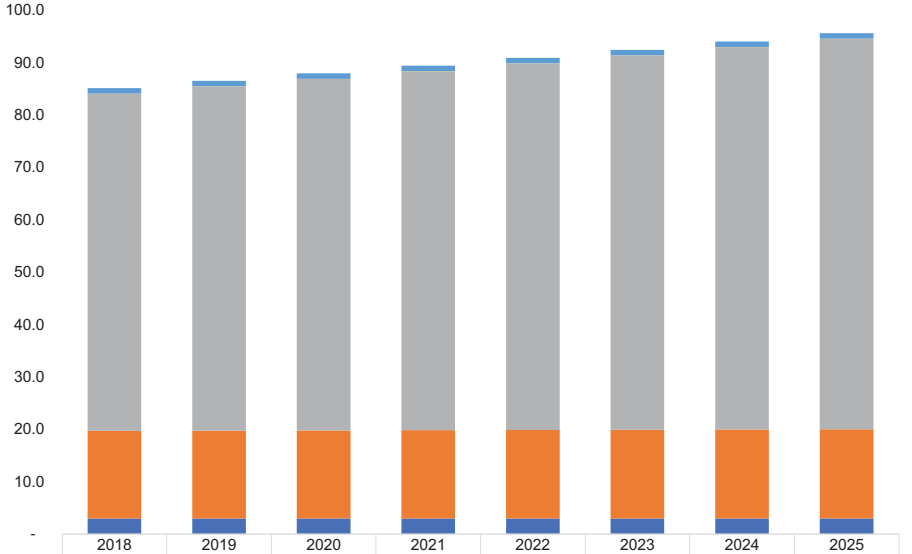


Figure A2.9: Expected gains from CIPRiSSA in Cameroon 2: Expected additional production per ecology ('000 tons)



	2018	2019	2020	2021	2022	2023	2024	2025
Post harvest training	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
IRM training	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Radio-TV training	64.3	65.7	67.1	68.5	69.9	71.4	73.0	74.5
Video training	16.7	16.7	16.8	16.8	16.9	16.9	17.0	17.0
PLAR training	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0

Figure A2.10: Expected gains from CIPRiSSA in Cameroon 3: Number of farmers and other actors targeted for training ('000 persons)

Figure A2.11: Expected gains from CIPRiSSA in Cameroon 4: Number of beneficiary households targeted ('000 households)

Table A2: Projected estimates for required investments, production gains, land area, and farming households for Cameroon (2018-2025)

CAMEROON	2018	2019	2020	2021	2022	2023	2024	2025
PROJECTED STATISTICS ON RICE (Production, consumption import)								
Rice, paddy production (T)	415,851	490,705	579,031	683,257	806,243	951,367	1,122,613	1,324,684
Rice, production (milled equivalent) (T)	249,511	294,423	347,419	430,452	507,933	599,361	729,699	861,044
Rice, food consumption (milled equivalent) (T)	610,996	635,436	660,853	687,287	714,779	743,370	773,105	804,029
Self-sufficiency ratio	0.41	0.46	0.53	0.63	0.71	0.81	0.94	1.07
ADDITIONAL GAIN FROM THE PROGRAM								
Expected additional production from rainfed upland (T)	14,821	15,008	15,200	15,396	15,597	15,803	16,014	16,230
Expected additional production from irrigated (T)	19,561	20,030	20,510	21,001	21,504	22,019	22,547	23,087
Expected additional production from rainfed lowland (T)	13,424	13,744	14,071	14,407	14,750	15,102	15,462	15,831
Expected additional production from the 3 ecologies (T)	47,806	48,782	49,781	50,804	51,851	52,924	54,023	55,148
Expected additional production from technology adoption(T)	1,981	1,984	1,986	1,989	1,991	1,994	1,997	1,999
Expected additional paddy production from the program (T)	49,787	50,765	51,767	52,792	53,843	54,918	56,019	57,147
Expected additional rice, food (milled equivalent) from the program (T)	29,872	30,459	31,060	33,259	33,921	34,598	36,413	37,146
Estimated foreign exchange savings (US$ per year)	10,772,277	10,980,280	11,193,275	12,094,780	12,331,717	12,574,340	13,306,234	13,570,376
PRODUCERS AND AREA TARGETED								
Number of upland rice farming households targeted	10,316	10,560	10,809	11,064	11,326	11,594	11,868	12,149
Number of substitute farming households targeted (upland rice)	7,617	7,617	7,617	7,617	7,617	7,617	7,617	7,617
Total number of upland rice farmers	17,933	18,176	18,426	18,681	18,943	19,210	19,485	19,765
Number of Irrigated rice farming households targeted	31,640	32,398	33,174	33,968	34,782	35,615	36,468	37,342
Number of lowland rice farming households targeted	14,759	15,111	15,471	15,840	16,218	16,605	17,001	17,407
Total number of farmers/ trainees targeted	64,332	65,685	67,071	68,490	69,943	71,430	72,954	74,514
Number of farmers targeted by PLAR training	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000

CAMEROON	2018	2019	2020	2021	2022	2023	2024	2025
Number of farmers targeted by Video training	16,708	16,749	16,791	16,834	16,879	16,924	16,970	17,017
Number of farmers targeted by Radio-TV training	64,332	65,685	67,071	68,490	69,943	71,430	72,954	74,514
Number of trainees targeted by IRM training	40	40	40	40	40	40	40	40
Number of trainees targeted by post-harvest training	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050
Number of villages targeted by PLAR training	100	100	100	100	100	100	100	100
PROJECTED STATISTICS ON RICE (Production, consumption import)								
Number of villages targeted by Video training	224	224	225	225	225	226	226	227
Number of villages targeted by Radio-TV training	643	657	671	685	699	714	730	745
Total rice area targeted (ha)	16,083	16,421	16,768	17,122	17,486	17,858	18,238	18,628
Total additional upland rice area (ha)	3,838	3,884	3,931	3,979	4,028	4,078	4,129	4,182
Total additional irrigated rice area (ha)	1,978	2,025	2,073	2,123	2,174	2,226	2,279	2,334
Total additional lowland rice area (ha)	1,845	1,889	1,934	1,980	2,027	2,076	2,125	2,176
Total additional rice area (ha)	7,661	7,798	7,938	8,082	8,229	8,380	8,534	8,692
Total rice areas already on rice (ha)	8,422	8,623	8,830	9,041	9,257	9,478	9,705	9,937
INPUTS (quantity and cost)								
Seed								
Total foundation seed equivalent (T)	14	14	14	14	15	15	15	15
Total certified seed requirement (T)	770	786	802	818	835	852	869	887
Production cost of the foundation seed (US$)	26,712	27,214	27,728	28,254	28,793	29,344	29,909	30,488
Production cost of the certified seed (US$)	1,543,087	1,573,144	1,603,923	1,635,441	1,667,715	1,700,763	1,734,605	1,769,259
Cost of storage, weighing, packaging of certified seed	104,786	106,913	109,091	111,322	113,606	115,945	118,340	120,792
Cost of distribution of certified seed (US$)	1,360	1,388	1,418	1,447	1,478	1,510	1,542	1,575
Total cost of certified seed package (including, packaging and distribution)	1,649,232	1,681,446	1,714,432	1,748,210	1,782,799	1,818,217	1,854,486	1,891,626
Total cost of seed (certified and foundation)	1,675,945	1,708,660	1,742,160	1,776,464	1,811,591	1,847,562	1,884,396	1,922,114
Fertilizer								
Total Urea (T)	2,188	2,236	2,285	2,335	2,386	2,439	2,492	2,547
Total NPK (T)	1,608	1,642	1,677	1,712	1,749	1,786	1,824	1,863
Total fertilizer (T)	3,797	3,878	3,962	4,047	4,135	4,224	4,316	4,410
Total cost of Urea (US$)	908,143	927,938	948,207	968,964	990,218	1,011,982	1,034,269	1,057,091

CAMEROON	2018	2019	2020	2021	2022	2023	2024	2025
Total cost of NPK (US$)	1,209,444	1,234,883	1,260,932	1,287,607	1,314,922	1,342,892	1,371,534	1,400,863
Total cost of fertilizer (US$)	2,117,587	2,162,821	2,209,140	2,256,571	2,305,140	2,354,874	2,405,803	2,457,953
Cost of fertilizer transport and distribution	886,126	905,155	924,640	944,592	965,023	985,945	1,007,369	1,029,307
Total cost of fertilizer (including, packaging and distribution)	3,003,714	3,067,975	3,133,779	3,201,163	3,270,163	3,340,820	3,413,172	3,487,261
Technology transfer and capacity building								
Cost of PLAR training	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
Cost of Video (training	67,125	67,248	67,374	67,503	67,636	67,771	67,909	68,051
Cost of Radio-TV (training	1,287	1,314	1,341	1,370	1,399	1,429	1,459	1,490
Cost of IRM training	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Cost of post-harvest (GEM, ASI/ATA thresher-cleaner) training	74,500	74,500	74,500	74,500	74,500	74,500	74,500	74,500
Total technology transfer and Capacity Building cost	502,912	503,062	503,216	503,373	503,534	503,699	503,868	504,041
PROJECTED STATISTICS ON RICE (Production, consumption import)								
Machine/Equipment (quantity and cost)								
Number of tractors (for a fraction of the additional areas)	7	7	7	7	7	7	8	8
Number of power tiller (for a fraction of the additional areas)	47	48	49	50	50	51	52	53
Number of ASI/ATA thresher-cleaner (for a fraction of the additional production)	83	85	86	88	90	92	93	95
Number of mini-milling machine	17	17	17	18	18	18	19	19
Number of GEM parboilers (for a fraction of the additional production)	9	9	10	10	10	10	10	11
Total cost tractor (US$)	437,383	447,858	458,585	469,569	480,816	492,333	504,127	516,204
Total cost of power tiller (US$)	296,283	300,956	305,741	310,642	315,660	320,798	326,060	331,448
Total cost of ASI/ATA thresher-cleaner (US$)	385,816	393,395	401,157	409,105	417,244	425,578	434,112	442,851
Total cost of mini milling machine (US$)	420,890	429,159	437,626	446,296	455,175	464,267	473,577	483,110
Total cost of GEM (US$)	184,396	188,019	191,729	195,527	199,417	203,400	207,479	211,656
Total cost of machine/ equipment (US$)	1,724,768	1,759,387	1,794,838	1,831,139	1,868,312	1,906,377	1,945,355	1,985,269
Marketing and upgrading (cost)								
Cost of training/meeting on branding and packaging (US$)	4,116	4,116	4,116	4,116	4,116	4,116	4,116	4,116

CAMEROON	2018	2019	2020	2021	2022	2023	2024	2025
Cost of participation and exhibition in trade fair (US$)	7,473	7,473	7,473	7,473	7,473	7,473	7,473	7,473
Cost of marketing campaigns (US$)	50,655	50,655	50,655	50,655	50,655	50,655	50,655	50,655
Cost of high quality bags for the packaging of the additional milled rice (US$)	248,366	253,245	258,242	276,526	282,028	287,661	302,745	308,839
Total cost of marketing and upgrading (US$)	310,610	315,490	320,486	338,771	344,272	349,905	364,989	371,083
TOTAL COST WITHOUT NEW IRRIGATION SCHEMES	7,217,948	7,354,574	7,494,479	7,650,910	7,797,873	7,948,363	8,111,779	8,269,767
Total additional irrigation scheme by 2025 (ha) planned by each country (a)	57,900	57,900	57,900	57,900	57,900	57,900	57,900	57,900
Annual additional irrigation scheme by 2025 (ha) planned by each country (b) = (a)/8	7,238	7,238	7,238	7,238	7,238	7,238	7,238	7,238
Total annual additional irrigated rice area (ha) from CIPRiSSA (c)	1,978	2,025	2,073	2,123	2,174	2,226	2,279	2,334
(b)-(c)	5,260	5,213	5,164	5,114	5,064	5,012	4,958	4,904
Cost of new irrigation schemes from CIPRiSSA (US$)	24,518,885	25,106,092	25,707,392	26,323,123	26,953,632	27,599,273	28,260,410	28,937,414

Côte d'Ivoire

Country Background

With the smooth presidential election held in October 2015, followed by a referendum in October 2016 which established the country's Third Republic and a peaceful parliamentarian election in December 2016, it can be concluded that political stability has been restored in Côte d'Ivoire. However, recent social demands and mutinies reflect the fragile nature of this stability. Nevertheless, the economy of Côte d'Ivoire continues to prosper. Most of the country's economic and financial indicators are positive. A minor decline in the growth rate in 2016 (to slightly bellow 8%) was due to a contraction of the agricultural sector because of unfavorable weather conditions[57]. The other sectors, including telecommunications, finance, transport, energy, and trade, performed well. Prospects for the next three years are bright, with a growth rate expected to converge towards 7.5% in 2019[58].

To successfully diversify its economy, Côte d'Ivoire must build its human capital to meet its labor market needs more effectively. Indeed, modern product processing methods and services require skills that are still scarce among local workers. The key social challenge will be to reduce inequalities significantly by keeping the country's economy on a strong growth path. In 2014, Côte d'Ivoire ranked 172nd among 188 countries on the United Nations Human Development Index (HDI). Between 1985 and 2011, the depth and severity of poverty increased considerably, as the poverty rate rose from approximately 10% to 51%. However, the latest World Bank Living Standards Monitoring Survey showed that poverty decreased to 46% in 2015 due to the recent economic recovery[59].

From 1960, Côte d'Ivoire embarked on an outward-looking policy and strong State regulation in favor of Agriculture. This policy was characterized by two development thrusts (i) cash/export crops production (cocoa, coffee, oil palm, rubber, pineapple, sugar cane, cotton, banana, etc.); and (ii) food crops production (plantain, yam, cassava, rice, maize and various vegetables) as well as smallholder livestock production. From 1990, following the implementation of structural adjustment programs, the country initiated reforms, particularly in the agricultural sector, with the policy of State withdrawal from production and marketing functions and the liberalization of all sectors. To adapt to the prevailing social and economic context, the Ivorian Government adopted three laws: Law N° 97-721 of 23 December 1997 on cooperatives; Law N° 98-750 of 23 December 1998 on rural land tenure; and Law N° 2001-635 of 9 October 2001 to establish the Agricultural Development Fund. During 2010 – 2015, it implemented the National Agricultural Investment Programme (PNIA) within the framework of the Comprehensive Africa Agriculture Development Programme (CAADP) process.

[57]http://www.worldbank.org/en/country/cotedivoire/overview.
[58]Ibid.
[59]Ibid.

CIPRiSSA Results for Côte d'Ivoire

Self-Sufficiency

Available national production data indicate that Côte d'Ivoire made significant progress in rice production during 2009 – 2016, with an average annual growth rate of 12%. Based on this, CIPRiSSA estimates that the country will attain 86% rice self-sufficiency in 2018 and 156% by 2025 and could begin to fully meet its domestic need by 2021, with a self-sufficiency rate of 113% (Figure A3.1).

Paddy and Milled Rice Production

Under CIPRiSSA, Côte d'Ivoire is expected to produce a total of 31.74 MT of paddy, with annual production ranging from 2.58 MT in 2018 to 5.71 MT in 2025. These will be equivalent to 19.95 MT of total milled rice, comprising annual targets increasing steadily from 1.55 MT in 2018 to 3.71 MT in 2025. The total milled rice food equivalent of 16.62 MT will be achieved as annual consumption levels ranging from 1.80 MT in 2018 to 2.37 MT in 2025 (Figure A3.1; Table A3).

New Investments

Achieving these targets would require new investments in both irrigation and non-irrigation areas. Total new investment requirements would cost US$ 344.82 million between 2018 and 2025, ranging from US$ 39.78 million in 2018 to US$ 46.59 million in 2025. These costs comprise 81.8% of total investment requirements or US$ 282.23 million as non-irrigation investments and 18.2% of total investment requirements or US$ 62.59 million as additional irrigation investments. Investments in new irrigation range from US$ 32.57 million in 2018 to US$ 38.13 million in 2025 while annual new non-irrigation investments range between US$7.21 million in 2018 and US$ 8.46 million in 2025 (Figures A3.2 and A3.3). The five priority areas identified for non-irrigation investments are: (i) fertilizer (42.1% of of non-irrigation investment requirements or US$ 118.74 million); (ii) certified quality seeds (32.2% or US$ 90.89 million); (iii) machines/equipment (20.8% or US$ 58.75 million); (iv) marketing/upgrading of the rice value chain (3.4% or US$ 9.61million); and (v) technology transfer and capacity building (1.5% or US$ 4.23 million) (Figures A3.4 and A3.5).

Annual investments (in US$ millions) in new irrigation will increase from 7.21 in 2018 to 8.46 in 2025 (Figure A3.2). The program will develop 7,659 ha of additional irrigation area by 2025, ranging from 883 ha in 2018 to 1,036 ha in 2025 (Figure A3.6).

Benefits

If Côte d'Ivoire judiciously invests according to CIPRISSA projections, she will produce an additional 1.73 MT of paddy or 1.09 MT of milled rice equivalent by 2025 (Figure A3.9).

Expected benefits from CIPRiSSA would also accrue from foreign exchange savings, addition of new farming households, and bringing additional land of varying ecosystems into rice cultivation. Côte d'Ivoire would therefore be saving US$ 388.75 million in foreign exchange between 2018 and 2025, with annual targets ranging from US$ 42.74 million in 2018 to US$ 55.05 million in 2025 (Figure A3.7). CIPRiSSA will benefit 2.68 million farmers by 2025, increasing annually from 309,538 households in 2018 to 362,586 households in 2025 (Figures A3.10 and A3.11). About 58% of the farmers will be cultivating rice in upland areas (Figure A3.11). The total additional rice areas targeted is 432,194 ha, with annual targets ranging from 49,953 ha in 2018 to 58,293 ha in 2025 (Figure A3.8).

Profitability

Excluding the cost of new irrigation schemes, Côte d'Ivoire is expected to invest US$ 282.23 million, with an average annual operational cost of US$ 35.28 million, to achieve 156% self-sufficiency rice by 2025. These investments will generate a benefits/costs ratio (NPV ratio to investment) of 1.29, an NPV of US$ 204.37 million, with an MIRR of 70.44%. This means that each dollar invested in the CIPRiSSA program will generate a net benefit of US$ 1.29. With an NPV greater than zero, the program is profitable and will remain financially viable if the financial rate of alternative investment projects in the country is less than 70.44% (Table A12).

The estimated payback period of the investments is 3 years (by 2020), meaning that all investments will be recovered before the end of the program. These indicators imply that the program is profitable enough for private sector investment.

The estimated gross domestic value-added (which measures the real monetary contribution of the program to the country's economy in terms of direct and indirect generated value added) is US$ 553.58 million and this represents the program's contribution to the GDP. The estimated net national value added (which represents the contribution to national welfare) is US$ 415.97 million. The economic internal rate of return is 28.43%. In total, the program will create 80,951 direct employments.

Sensibility analysis shows that the proposed investments remain profitable under both pessimistic (-10% of the price) and optimistic (+10% of the price) scenarios, since the NPV ratio is greater than zero in both cases. Under optimistic scenarios, the investments will generate a benefits/costs ratio (NPV ratio to investment) of 1.72, a net profit of US$ 272.97 million, and an MIRR of 106.25%. Under pessimistic scenarios, the investments will generate a benefits/costs ratio (NPV ratio to investment) of 0.85, a net profit of US$ 135.77 million, with an MIRR of 41.36%. In addition, the break-even point analysis shows that the investments remain profitable even with a 67% reduction in the market price.

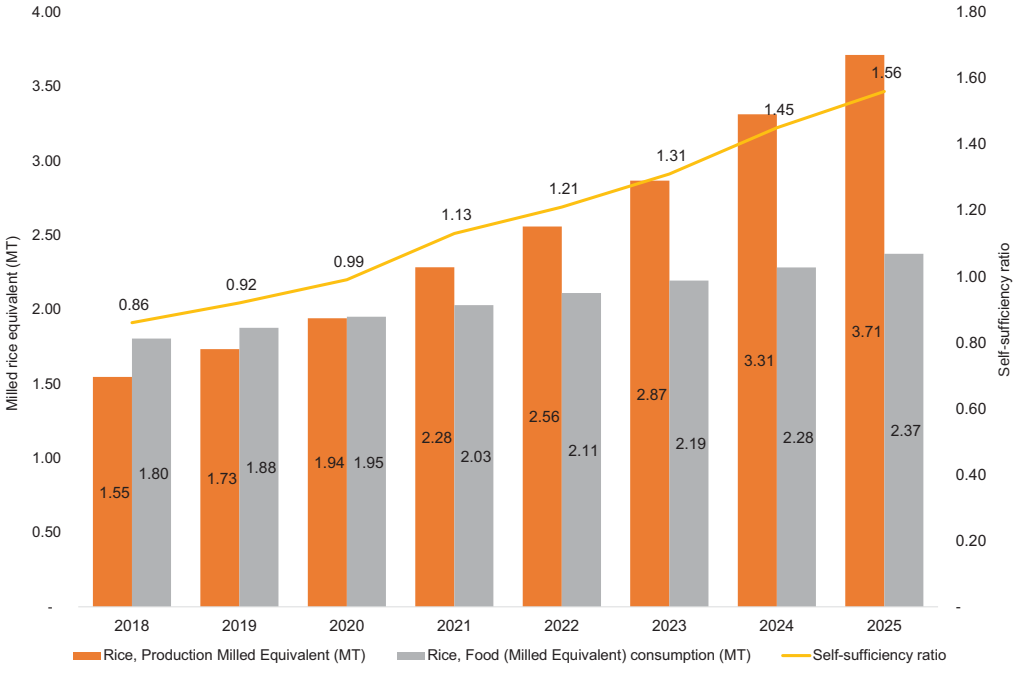


Figure A3.1: Milled rice production and consumption versus self-sufficiency in Côte d'Ivoire

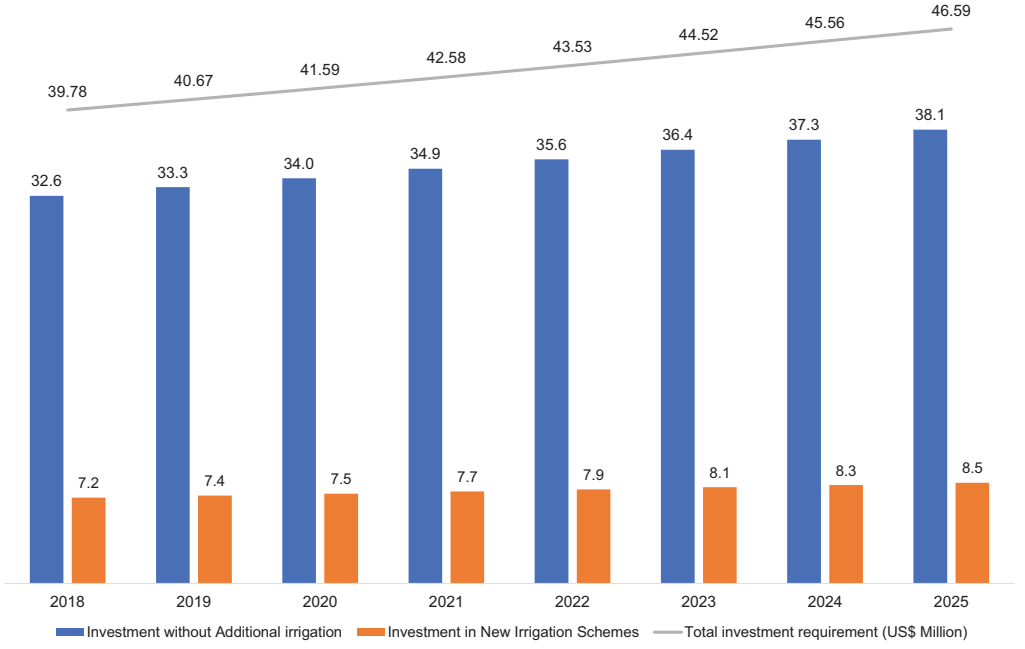


Figure A3.2: Additional irrigation and non-irrigation investments required by Côte d'Ivoire (US$ million)

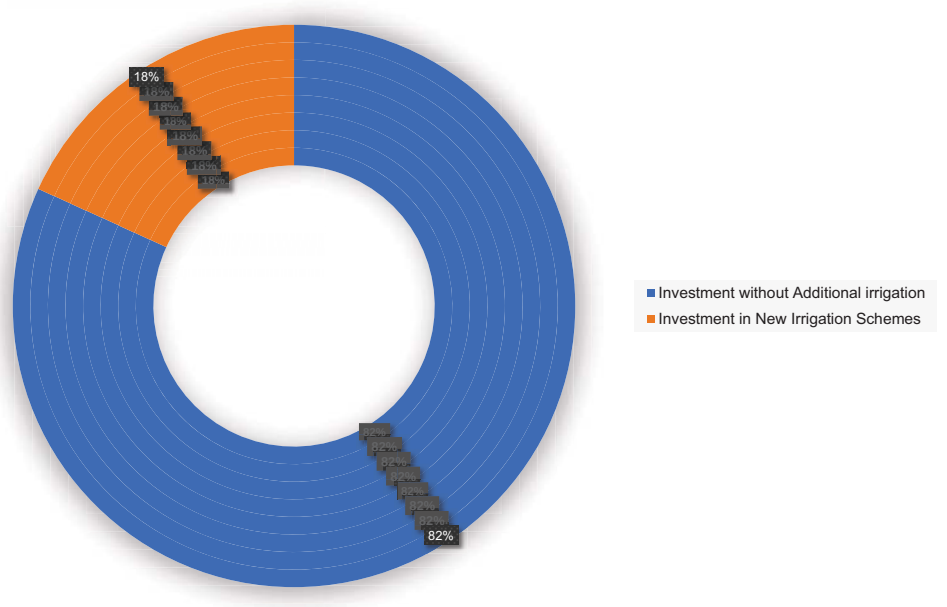


Figure A3.3: Additional irrigation and non-irrigation investments required by Côte d'Ivoire (%)

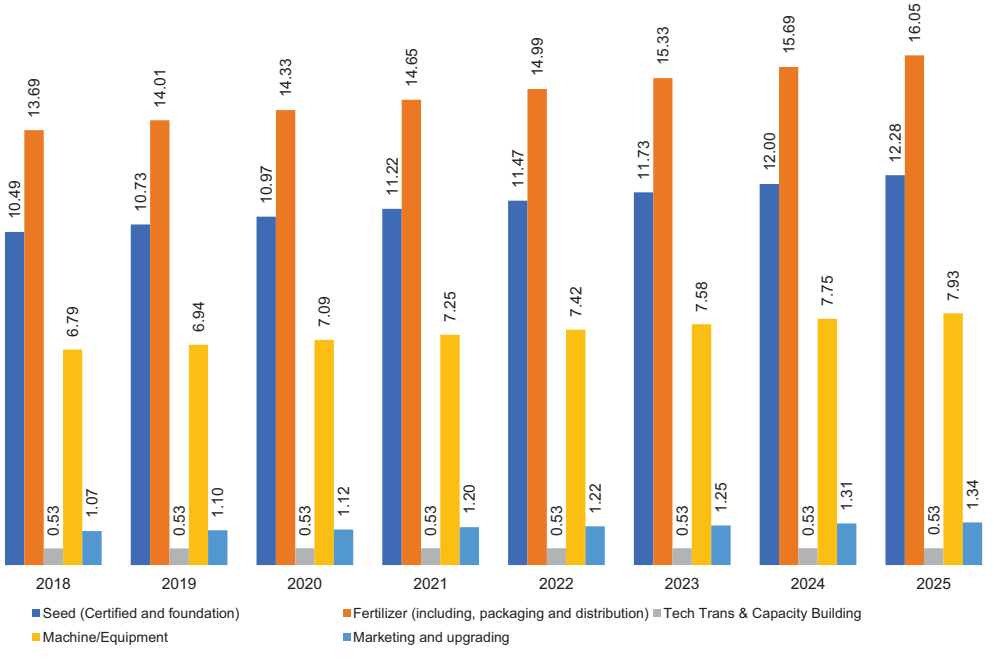


Figure A3.4: Composition of new non-irrigation investments required by Côte d'Ivoire (US$ million)

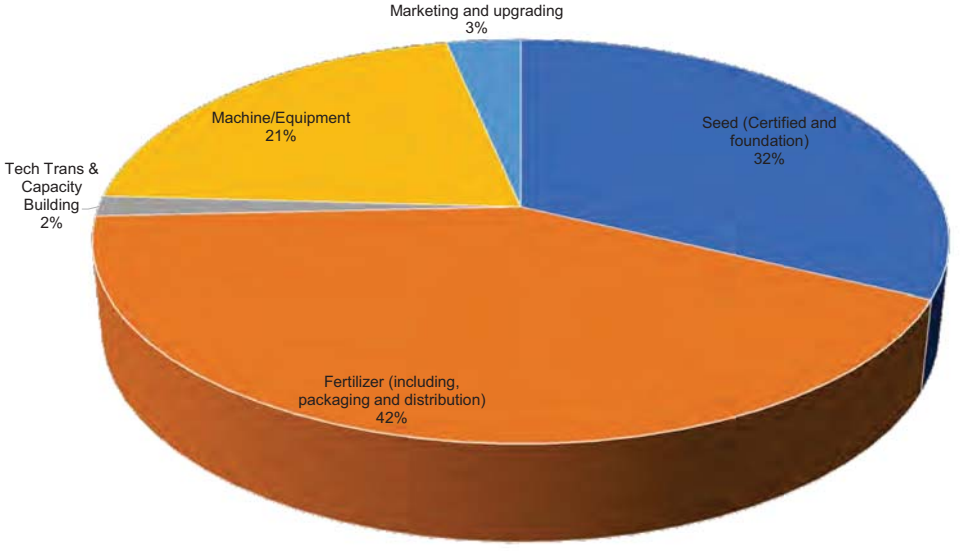


Figure A3.5: Distribution of required new non-irrigation investments in Côte d'Ivoire (%)

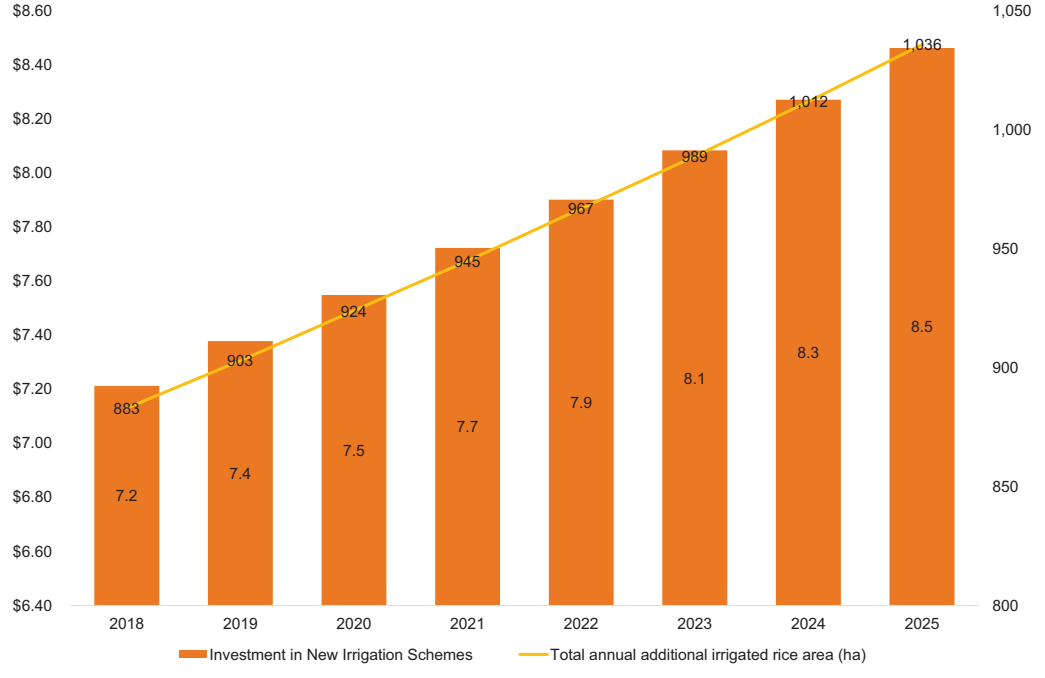


Figure A3.6: Additional investments in irrigated rice area (ha) versus new irrigation (US$ million) in Côte d'Ivoire

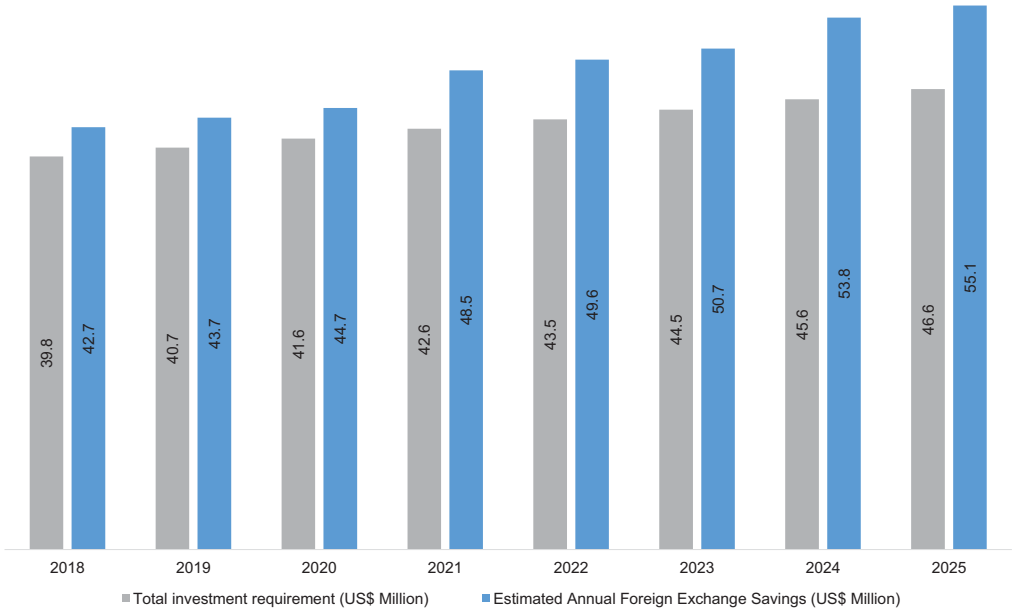


Figure A3.7: Estimated annual new investments costs versus annual foreign exchange savings for Côte d'Ivoire (US$ million)

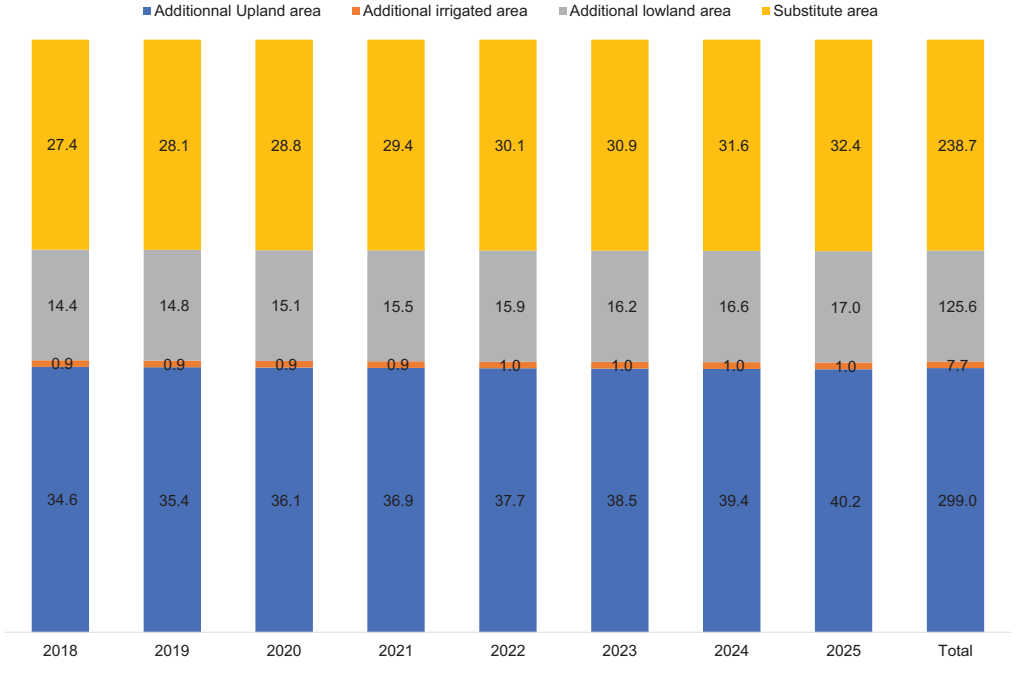


Figure A3.8: Expected gains from CIPRiSSA in Côte d'Ivoire 1: Rice area expansion per ecology ('000 ha)

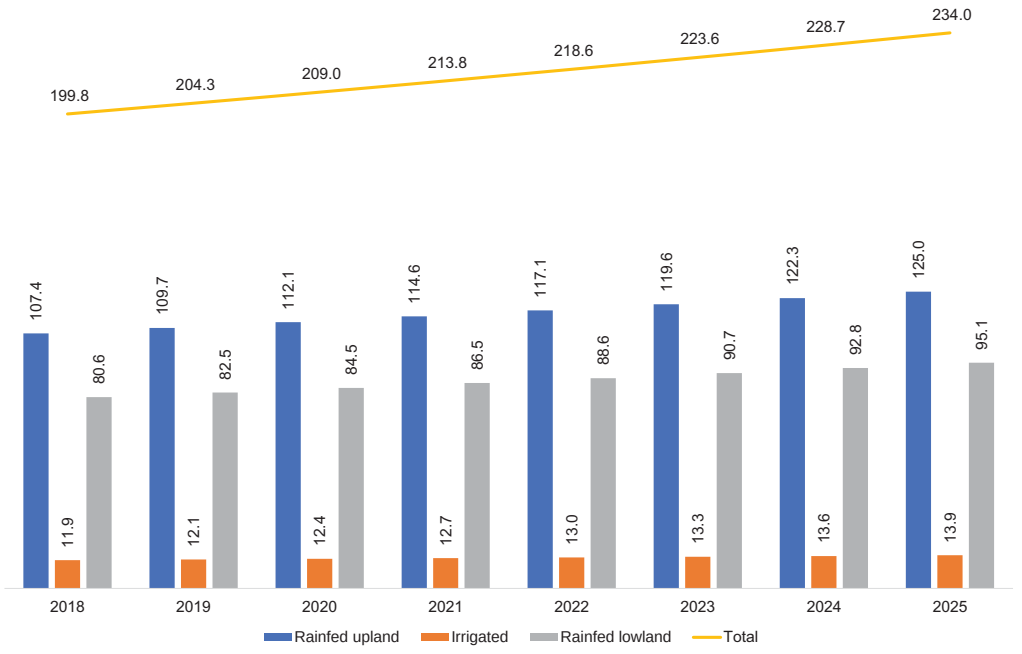


Figure A3.9: Expected gains from CIPRiSSA in Côte d'Ivoire 2: Expected additional production per ecology ('000 tons)

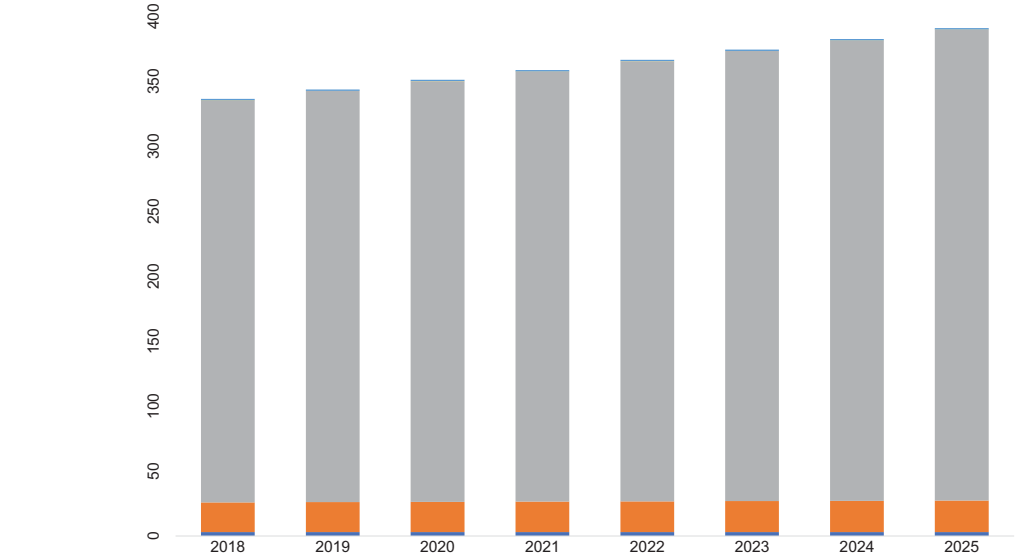


Figure A3.10: Expected gains from CIPRiSSA in Côte d'Ivoire 3: Number of farmers and other actors targeted for training ('000 persons)

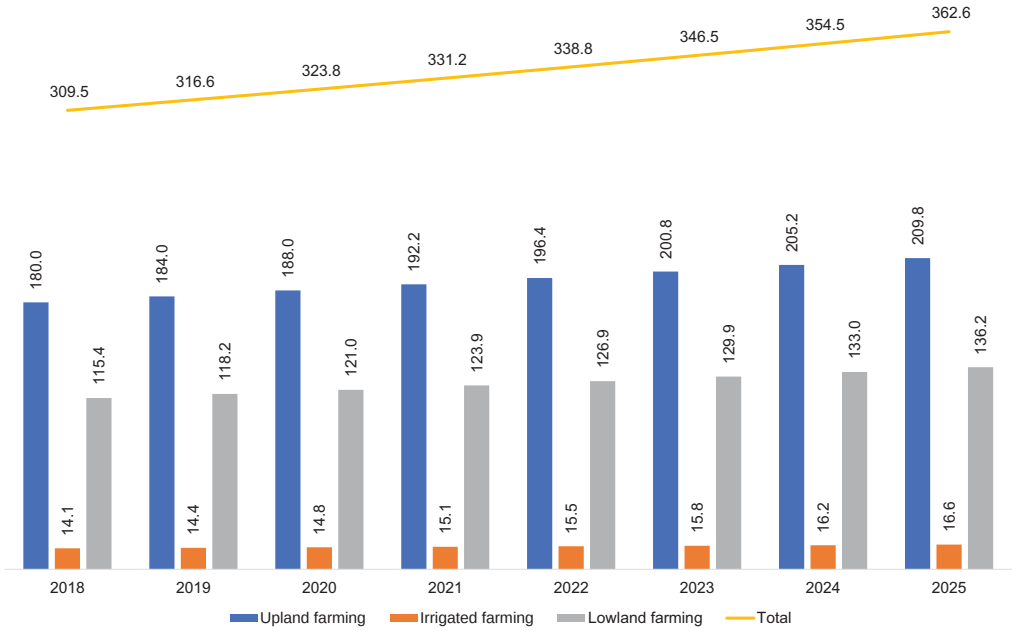


Figure A3.11: Expected gains from CIPRiSSA in Côte d'Ivoire 4: Number of beneficiary households targeted ('000 households)

Table A3: Projected estimates in required investments, production gains, land area, and farming households for Côte d'Ivoire (2018-2025)

CÔTE D'IVOIRE	2018	2019	2020	2021	2022	2023	2024	2025
PROJECTED STATISTICS ON RICE (production, consumption import)								
Rice, paddy production (T)	2,577,968	2,888,125	3,235,598	3,624,875	4,060,986	4,549,567	5,096,929	5,710,144
Rice, production milled equivalent (T)	,546,781	1,732,875	1,941,359	2,283,671	2,558,421	2,866,227	3,313,004	3,711,594
Rice, food (milled equivalent) consumption (T)	1,804,109	1,876,273	1,951,324	2,029,377	2,110,552	2,194,974	2,282,773	2,374,084
Self-sufficiency ratio	0.86	0.92	0.99	1.13	1.21	1.31	1.45	1.56
ADDITIONAL GAIN FROM THE PROGRAM								
Expected additional production from rainfed upland (T)	107,377	109,715	112,110	114,562	117,073	119,645	122,278	124,974
Expected additional production from irrigated (T)	11,873	12,147	12,427	12,714	13,008	13,309	13,618	13,933
Expected additional production from rainfed lowland (T)	80,553	82,482	84,457	86,479	88,550	90,670	92,842	95,066
Expected additional production from the 3 ecologies (T)	199,802	204,343	208,994	213,755	218,631	223,624	228,737	233,973
Expected additional production from technology adoption (T)	2,755	2,768	2,780	2,793	2,807	2,821	2,835	2,849
Expected additional paddy production from the program (T)	202,557	207,111	211,774	216,549	221,438	226,445	231,572	236,822
Expected additional rice, food (milled equivalent) from the program (T)	121,534	124,267	127,064	136,426	139,506	142,660	150,522	153,934
Estimated Foreign exchange savings (US$ per year)	42,739,316	43,696,546	44,676,750	48,483,702	49,574,814	50,692,113	53,834,692	55,051,572

CÔTE D'IVOIRE	2018	2019	2020	2021	2022	2023	2024	2025
PRODUCERS AND AREA TARGETED								
Number of upland rice farming households targeted	165,693	169,653	173,709	177,862	182,115	186,469	190,928	195,495
Number of substitute farming households targeted (upland rice)	14,300	14,300	14,300	14,300	14,300	14,300	14,300	14,300
Total number of Upland rice farmers	179,993	183,953	188,009	192,162	196,415	200,769	205,228	209,795
Number of irrigated rice farming households targeted	14,122	14,447	14,781	15,122	15,472	15,830	16,197	16,572
Number of lowland rice farming households targeted	115,424	118,187	121,017	123,915	126,883	129,921	133,033	136,219
Total number of farmers/trainees targeted	309,538	316,588	323,807	331,199	338,769	346,521	354,458	362,586
PROJECTED STATISTICS ON RICE (production, consumption import)								
Number of farmers targeted by PLAR training	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Number of farmers targeted by Video training	22,846	23,035	23,228	23,426	23,628	23,836	24,048	24,266
Number of farmers targeted by Radio-TV training	309,538	316,588	323,807	331,199	338,769	346,521	354,458	362,586
Number of trainees targeted by IRM training	40	40	40	40	40	40	40	40
Number of trainees targeted by post-harvest training	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050
Number of villages targeted by PLAR training	100	100	100	100	100	100	100	100

CÔTE D'IVOIRE	2018	2019	2020	2021	2022	2023	2024	2025
Number of villages targeted by Video training	287	289	291	293	295	297	299	301
Number of villages targeted by Radio-TV training	3,095	3,166	3,238	3,312	3,388	3,465	3,545	3,626
Total rice area targeted (ha)	77,385	79,147	80,952	82,800	84,692	86,630	88,614	90,646
Total additional upland rice area (ha)	34,642	35,385	36,145	36,924	37,721	38,538	39,374	40,230
Total additional irrigated rice area (ha)	883	903	924	945	967	989	1,012	1,036
Total additional lowland rice area (ha)	14,428	14,773	15,127	15,489	15,860	16,240	16,629	17,027
Total additional rice area (ha)	49,953	51,061	52,196	53,359	54,549	55,768	57,015	58,293
Total rice areas already on rice (ha)	27,432	28,086	28,755	29,441	30,143	30,863	31,599	32,353
INPUTS (quantity and cost)								
Seed								
Total foundation seed equivalent (T)	98	100	102	105	107	109	112	114
Total certified seed requirement (T)	4,284	4,381	4,481	4,583	4,687	4,794	4,903	5,015
Production cost of the foundation seed ((US$)	192,327	196,672	201,121	205,677	210,342	215,120	220,012	225,021
Production cost of the certified seed (US$)	9,708,940	9,928,324	10,152,973	10,383,013	10,618,575	10,859,790	11,106,794	11,359,726
Cost of storage, weighing, packaging of certified seed	583,066	596,297	609,846	623,719	637,926	652,473	667,370	682,624
Cost of distribution of certified seed (US$)	6,542	6,691	6,844	7,000	7,160	7,324	7,491	7,663
Total cost of certified seed package (including, packaging and distribution)	10,298,548	10,531,312	10,769,662	11,013,732	11,263,660	11,519,586	11,781,655	12,050,013
Total cost of seed (certified and foundation)	10,490,875	10,727,984	10,970,783	11,219,409	11,474,002	11,734,706	12,001,666	12,275,034

CÔTE D'IVOIRE	2018	2019	2020	2021	2022	2023	2024	2025
PROJECTED STATISTICS ON RICE (production, consumption import)								
Fertilizer								
Total Urea (T)	9,358	9,573	9,793	10,018	10,249	10,485	10,727	10,975
Total NPK (T)	7,738	7,915	8,095	8,280	8,469	8,663	8,861	9,065
Total Fertilizer (T)	17,096	17,487	17,888	18,298	18,718	19,148	19,588	20,039
Total cost of Urea (US$)	3,883,476	3,972,644	4,063,952	4,157,451	4,253,194	4,351,235	4,451,629	4,554,433
Total cost of NPK (US$)	5,819,320	5,951,857	6,087,574	6,226,549	6,368,860	6,514,586	6,663,809	6,816,614
Total cost of fertilizer ((US$)	9,702,796	9,924,501	10,151,526	10,384,001	10,622,054	10,865,821	11,115,439	11,371,047
Cost of fertilizer transport and distribution	3,990,260	4,081,545	4,175,021	4,270,739	4,368,755	4,469,124	4,571,901	4,677,145
Total cost of fertilizer (including, packaging and distribution)	13,693,056	14,006,046	14,326,547	14,654,740	14,990,810	15,334,945	15,687,340	16,048,192
Technology transfer and Capacity building								
Cost of PLAR training	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
Cost of Video (training	86,078	86,644	87,224	87,817	88,425	89,047	89,685	90,337
Cost of Radio-TV (training	6,191	6,332	6,476	6,624	6,775	6,930	7,089	7,252
Cost of IRM training	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Cost of post-harvest (GEM, ASI/ATA thresher-cleaner) training	74,500	74,500	74,500	74,500	74,500	74,500	74,500	74,500
Total technology transfer and Capacity Building cost	526,769	527,476	528,200	528,941	529,700	530,478	531,274	532,089
Machine/Equipment (quantity and cost)								
Number of tractors (for a fraction of the additional areas)	3	3	3	3	3	3	3	3
Number of power tiller (for a fraction of the additional areas)	409	418	427	437	447	456	467	477

CÔTE D'IVOIRE	2018	2019	2020	2021	2022	2023	2024	2025
Number of ASI/ ATA thresher-cleaner (for a fraction of the additional production)	338	345	353	361	369	377	386	395
Number of mini-milling machine	68	69	71	72	74	75	77	79
Number of GEM parboilers (for a fraction of the additional production)	38	38	39	40	41	42	43	44
Total cost tractor (US$)	195,212	199,715	204,326	209,047	213,882	218,832	223,902	229,093
Total cost of power tiller (US$)	2,558,126	2,614,848	2,672,932	2,732,409	2,793,314	2,855,680	2,919,543	2,984,939
Total cost of ASI/ ATA thresher-cleaner (US$)	1,569,681	1,604,969	1,641,103	1,678,105	1,715,995	1,754,794	1,794,524	1,835,208
Total cost of mini milling machine (US$)	1,712,380	1,750,875	1,790,295	1,830,660	1,871,994	1,914,321	1,957,663	2,002,045
PROJECTED STATISTICS ON RICE (production, consumption import)								
Total cost of GEM (US$)	750,213	767,078	784,348	802,033	820,141	838,685	857,674	877,118
Total cost of machine/ equipment (US$)	6,785,612	6,937,485	7,093,003	7,252,253	7,415,326	7,582,312	7,753,305	7,928,403
Marketing and upgrading (cost)								
Cost of training/ meeting on branding and packaging (US$)	4,116	4,116	4,116	4,116	4,116	4,116	4,116	4,116
Cost of participation and exhibition in trade fair (US$)	7,473	7,473	7,473	7,473	7,473	7,473	7,473	7,473
Cost of marketing campaigns (US$)	50,655	50,655	50,655	50,655	50,655	50,655	50,655	50,655
Cost of high quality bags for the packaging of the additional milled rice (US$)	1,010,471	1,033,187	1,056,449	1,134,282	1,159,892	1,186,118	1,251,480	1,279,852

CÔTE D'IVOIRE	2018	2019	2020	2021	2022	2023	2024	2025
Total cost of marketing and upgrading (US$)	1,072,715	1,095,432	1,118,693	1,196,526	1,222,137	1,248,362	1,313,724	1,342,096
TOTAL COST WITHOUT IRRIGATION SCHEMES	32,569,029	33,294,422	34,037,226	34,851,870	35,631,975	36,430,803	37,287,309	38,125,814
Total additional irrigation scheme by 2025 (ha) planned by each country (a)	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000
Annual additional irrigation scheme by 2025 (ha) planned by each country (b) = (a)/8	8,750	8,750	8,750	8,750	8,750	8,750	8,750	8,750
Total annual additional irrigated rice area (ha) from CIPRiSSA (c)	883	903	924	945	967	989	1,012	1,036
(b)-(c)	7,867	7,847	7,826	7,805	7,783	7,761	7,738	7,714
Cost of new irrigation schemes from CIPRiSSA ((US$)	7,212,581	7,378,941	7,549,294	7,723,735	7,902,363	8,085,278	8,272,582	8,464,383

Ghana

Country Background

Ghana has a population of about 28 million people[60]. In July 2011, Ghana achieved the World Bank Group per capita income threshold for classification as a Lower Middle Income Country (LMIC). The country's economic growth was spurred by favorable commodity prices for gold and cocoa (Ghana's main exports), the start of the commercialization of a major oil discovery, and robust growth in the services sector[61]. Increasing growth in Ghana has been accompanied by significant poverty reduction, especially due to the large gains in agricultural productivity and related increased incomes for small-scale farmers (cash crop growers notably cocoa farmers and livestock farmers) and increased employment in the services sector[62]. However, this economic growth has been accompanied by growing inequality - the number of people living in poverty decreased by 2.5 million in the South but increased by 0.9 million in the North. Compared to the North, the South of Ghana indeed benefited from higher farm productivity, output growth, greater crop diversification and greater off-farm employment opportunities in its rapidly-growing urban areas[63].

Following the substantial fiscal slippage in 2016, Ghana's economic performance improved in the first half of 2017 as the government cut both its recurrent and capital expenditures to keep its fiscal consolidation program on track. These measures subsequently led to an expansion of the economy as observed in the third quarter of 2017- the industrial sector recorded the highest growth of 11.5%, compared to 1.8% in 2016, with significant contributions from mining and petroleum. The agriculture sector grew by 7.6%, up from 5% the previous year, driven by good performances in the crops, fisheries, and cocoa sub-sectors. However, growth in the services sector slowed to 3.7% from 6.6%, due to slower growth in information, communication, and finance. Also, non-oil growth slowed to 3.9% from 6.3% in the same period of 2016. The external sector improved as the cedi continued to stabilize and the reserve buffer expanded. The June 2017 trade balance turned out a surplus of $1.43 billion, equivalent to 3.1% of GDP from a deficit of 3.3% the previous year. This was attributed to export earnings, especially from gold, cocoa, and oil[64] The petroleum sector can indeed reinforce Ghana's growth prospects over the next decade both directly and, prospectively, through its impact on the level of public expenditure. In this regard, the key challenge for Ghana will be to foster increased levels of productivity and investments in the non-oil sector, where higher and sustained growth will serve to generate jobs beyond the relatively few ones that the petroleum sector can create, and have a broader impact on reducing poverty and enhancing shared prosperity[65].

[60]http://www.worldbank.org/en/country/ghana/overview.
[61]World Bank, 2013.
[62]Ibid.
[63]Ibid.
[64]http://www.worldbank.org/en/country/ghana/overview (Op. cit.).
[65]World Bank, 2013.

The country expects a doubling of the demand for food within the next 25 years. While the fishery sector is relatively well developed, the rural agricultural areas in the North, unlike the South, have remained at the margin of the country's economic growth and need to be integrated. Farmers in the North, and especially women, are engaged in subsistence food crop farming, producing over 70% of the food crops. They are hampered, however, by poor links to value chains and little access to information, improved technologies, land and credit[66]. In its Country Partnership Strategy, the World Bank estimates that, to address the target food demand, rural agricultural development will require the adoption of new production and processing technologies by 250,000 processors and producers and an enhanced focus on sustainable land management, with an increase from 0 to 2,000 ha in selected micro-watersheds that are under sustainable land and watershed management technologies.

CIPRiSSA Results for Ghana

Self-Sufficiency

Between 2006 and 2015, Ghana's average annual growth rate in rice production was only 13% (36% during 2007-2010 and 9% during 2012-2015). Ghana needs a 15% average annual growth rate in production to achieve rice self-sufficiency by 2025; CIPRiSSA estimates that the country will attain 52% rice self-sufficiency in 2018 and 115% by 2025 and could begin to fully meet its domestic need by 2024, with a self-sufficiency rate of 104% (Figure A4.1).

Paddy and Milled Rice Production

Annual paddy production will rise steadily from 974,881 T in 2018 to 2.6 MT by 2025, amounting to a total of 13.83 MT during the period. The total milled rice equivalent will be 8.43 MT, ranging from 584,928 T in 2018 to 1.69 MT in 2025. The total food equivalent of milled rice will be 10.29 MT, rising steadily from 1.12 MT in 2018 to 1.47 MT in 2025 (Figure A4.1; Table A4).

New Investments

To achieve self-sufficiency by 2025, Ghana will need to expand its irrigation area and invest in non-irrigation infrastructural developments at a total cost of US$ 36.01 million between 2018 and 2025. The new investment costs would increase annually from US$ 4.2 million in 2018 to USS$ 4.8 million in 2025 (Figure A4.2). Non-irrigation investments would account for 73.1% of total investment or US$ 26.31 million compared to 26.9% or about US$ 9.70 million for new irrigation schemes (Figure A4.3).

[66]Ibid.

The priority areas for non-irrigation investments include (i) purchase and distribution of fertilizer to farmers (US$ 9.48 million or 36.0% of non-irrigation investments); (ii) seed production/distribution (US$ 5.38 million or 20.5%); (iii) machines/equipment (US$ 5.90 million or 22.4%); (iv) technology transfer and capacity building on rice production (US$ 3.98 million 15.1%); and (v) marketing and upgrading (including post-harvest capacity building) (US$ 1.57 million or 6.0%). Annual new investments in non-irrigation would be US$ 3.09 million in 2018, increasing every year to US$ 3.49 million in 2025 (Figures A4.4 and A4.5). Investments in additional irrigation would also increase progressively every year, from US$ 1.12 million in 2018 to US$ 1.31 million in 2025 (Figure A4.2). These new irrigation facilities would develop about 1,187 ha, increasing progressively from 137 ha in 2018 to 161 ha in 2025 (Figure A4.6).

Benefits

The projected cumulative foreign exchange savings from the foregoing investments would amount to US$ 49.03 million during 2018-2025, increasing annually from US$ 5.53 million in 2018 to US$ 6.79 million in 2025 (Figures A4.7).

CIPRiSSA will empower 197,167 new farming households in Ghana by 2025, increasing annually from 22,778 households in 2018 to 26,605 households in 2025 (Figure A4.11). Households will be empowered though training on PLAR, video, radio-TV, IRM, and post-harvest practices (Figure A4.10). The program targets 49,292 ha of new rice area, increasing from 5,694 ha in 2018 to 6,651 ha in 2025 (Figures A4.8 and A4.9). The program will add 156,510 t of paddy, equivalent to about 129,075 t of milled rice, by 2025 (Figure A4.9).

Profitability analysis

Without adding new irrigation schemes, Ghana needs to invest US$ 26.31 million to achieve 115% self-sufficiency by 2025, at an average annual operational cost of US$ 3.29 million. These investments will generate a benefits/costs ratio (NPV ratio to investment) of 2.65, an NPV of US$ 39.51 million, and an MIRR of 141.27%. Every dollar invested in the program will generate a net benefit of US$ 2.65. Investment in CIPRiSSA will remain viable as long as the financial rate of alternative investment projects in the country is less than 141.27%. The NPV is above zero, indicating that the investments are profitable.

The total investment, including the construction of new irrigation schemes, will be US$ 36.01 million over the eight years, with an annual average investment of US$ 4.50 million. This investment will generate an NPV of US$ 32.97 million, a benefits/costs ratio of 1.22, and an MIRR of 64.78% (Table A12).

The payback period of the investments is 1.73 years (by 2019), indicating that all investments will be recovered before the end of the project. These indicators imply that the investment required to achieve self-sufficient in rice by 2025 is profitable for private investors. Similarly, economic analyses show the program's contribution to the overall welfare of the country and to the national objectives. The estimated gross domestic value-added (which measures the real monetary contribution of the program to the country's economy in terms of direct and indirect generated value added) is US$ 70.81 million. This represents the contribution of the project to the GDP. The estimated net national value added (which represents the contribution to national welfare) is US$ 59.34 million. The economic internal rate of return is 58.34%. The investments will create 5,952 direct employments. Sensibility analysis shows that the investments remain profitable under both pessimistic (-10% of the price) and optimistic (+10% of the price) scenarios. The NPV ratio is greater than zero in the two cases. Under optimistic scenarios, the investments will generate a benefits/costs ratio cost (NPV ratio to investment) of 3.19, a net profit of US$ 47.60 million, with an MIRR of 176.55%. Under pessimistic scenarios, the investments will generate a benefits/costs ratio cost (NPV ratio to investment) of 2.11, a net profit of US$ 31.42 million, and a MIRR of 106.62%. In addition, the break-even point analysis shows that the investments remain profitable even with a 54.05% reduction of the market price.

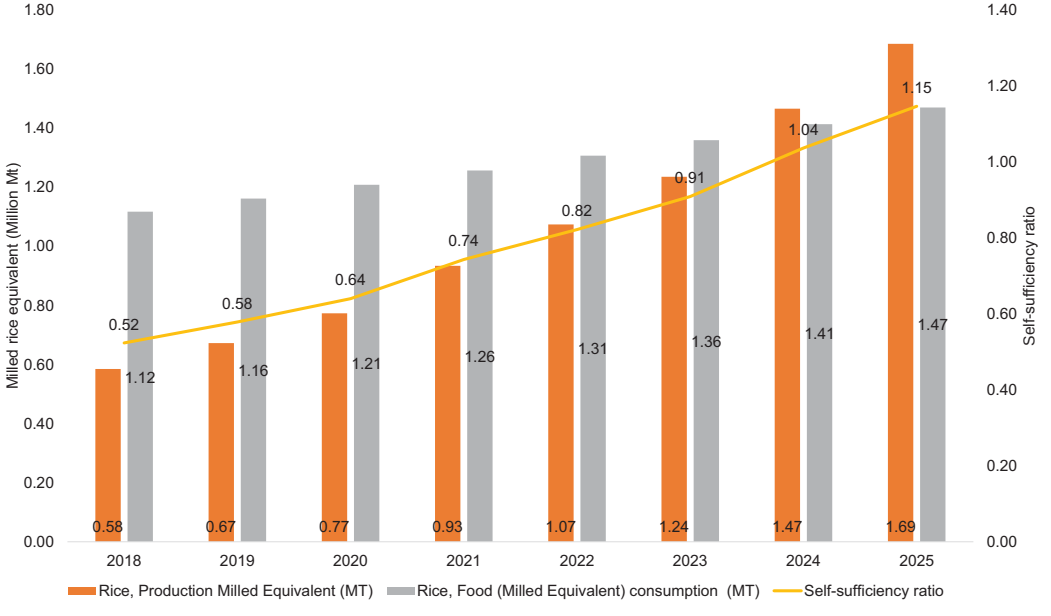


Figure A4.1: Milled rice production and consumption versus self-sufficiency in Ghana

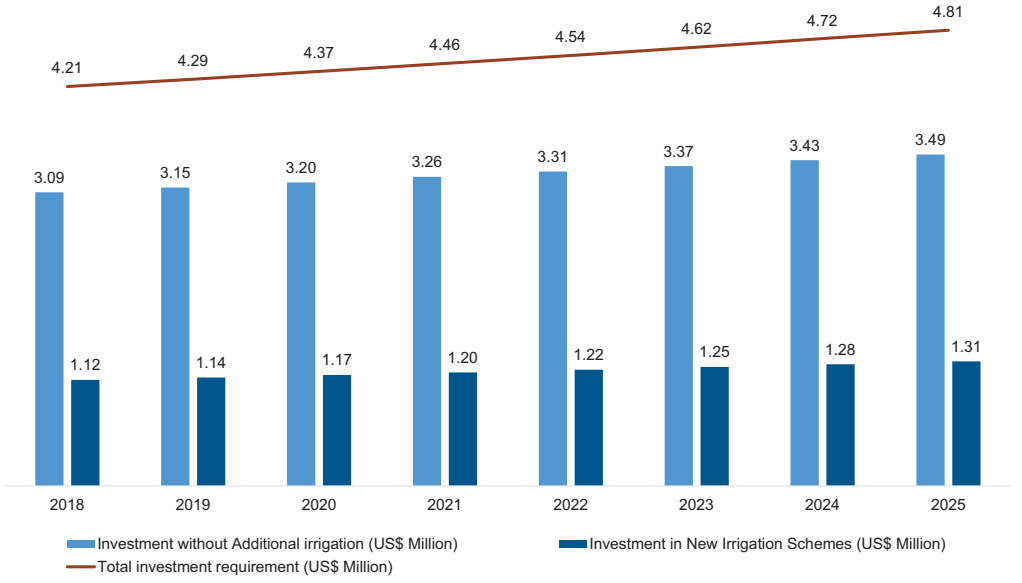


Figure A4.2: Additional irrigation and non-irrigation investments required by Ghana (US$ million)

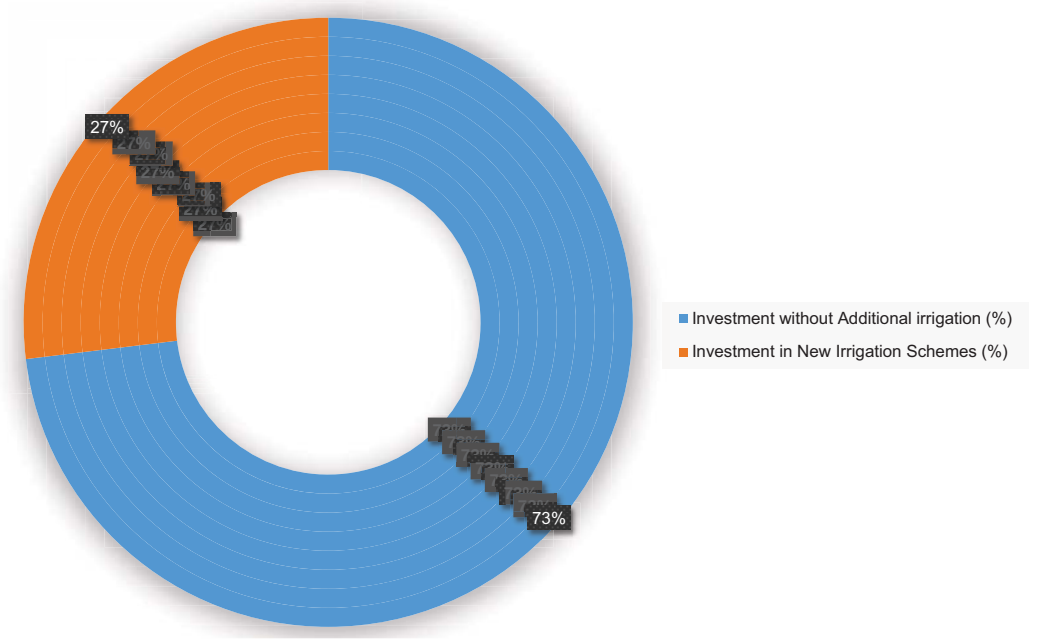


Figure A4.3: Additional irrigation and non-irrigation investments required by Ghana (%)

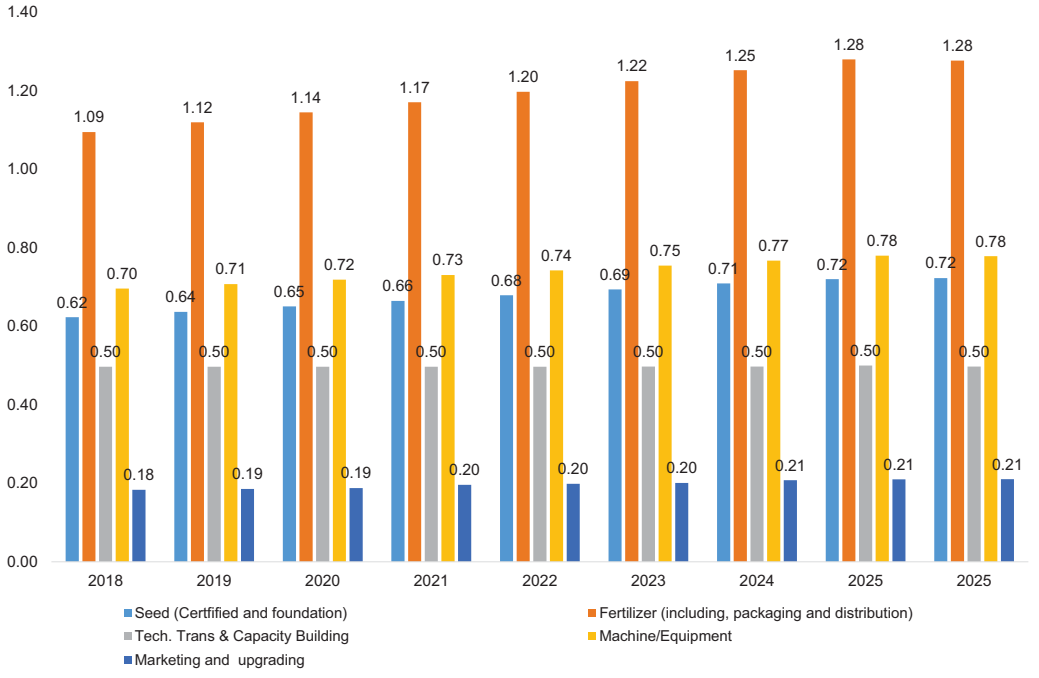


Figure A4.4: Composition of new non-irrigation investments required by Ghana (US$ million)

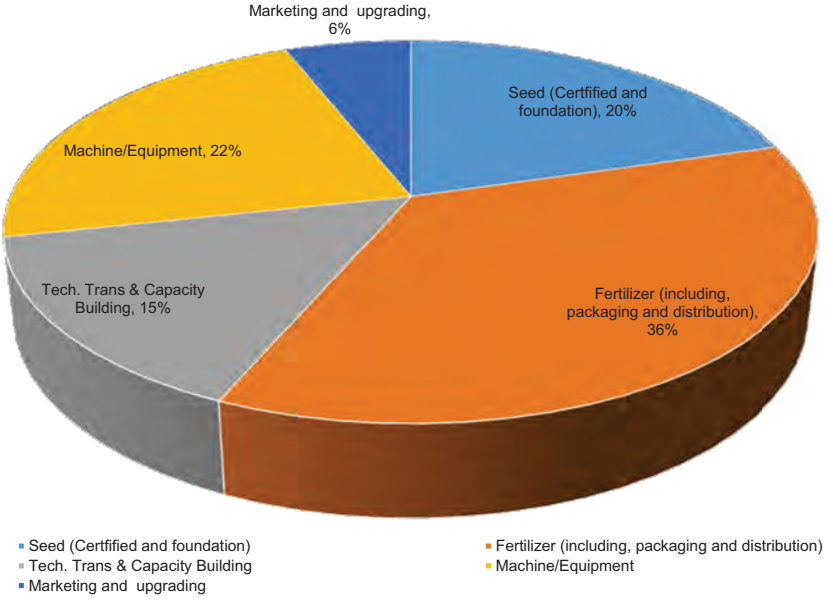


Figure A4.5: Distribution of required new non-irrigation investments in Ghana (%)

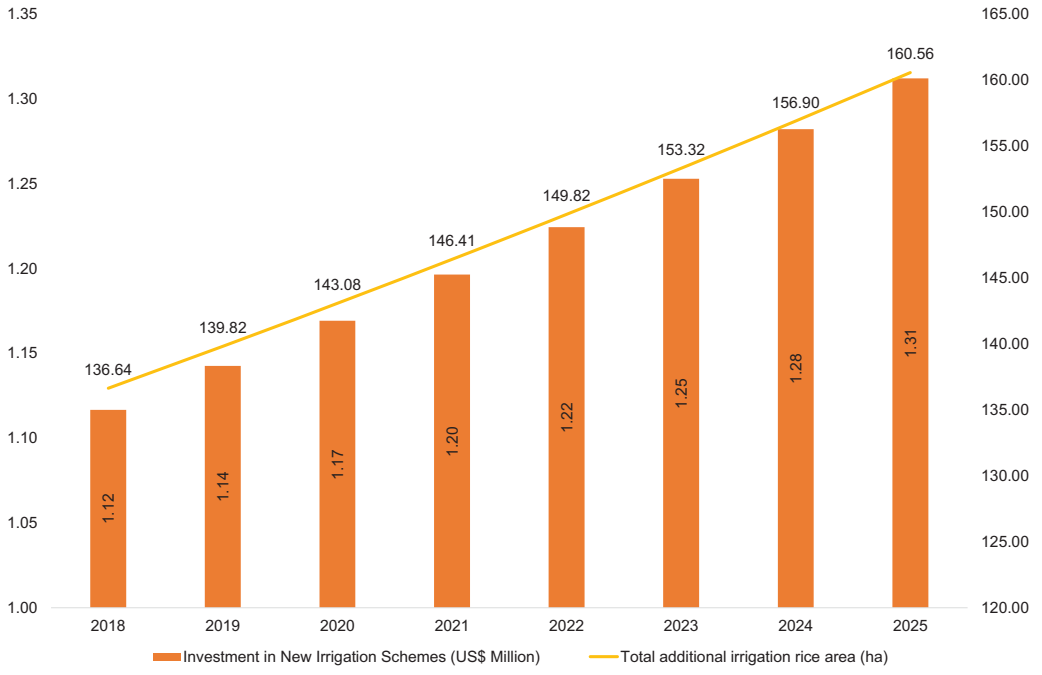


Figure A4.6: Additional irrigated rice area (ha) versus new irrigation investments in Ghana (US$ million)

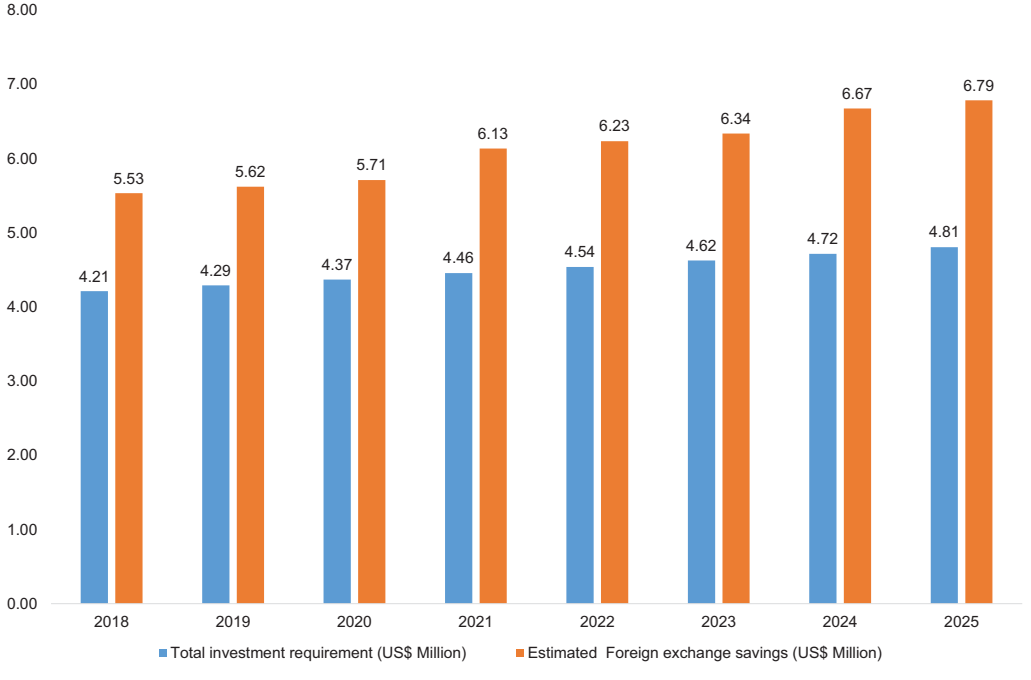


Figure A4.7: Estimated annual new costs versus annual foreign exchange savings for Ghana (US$ million)

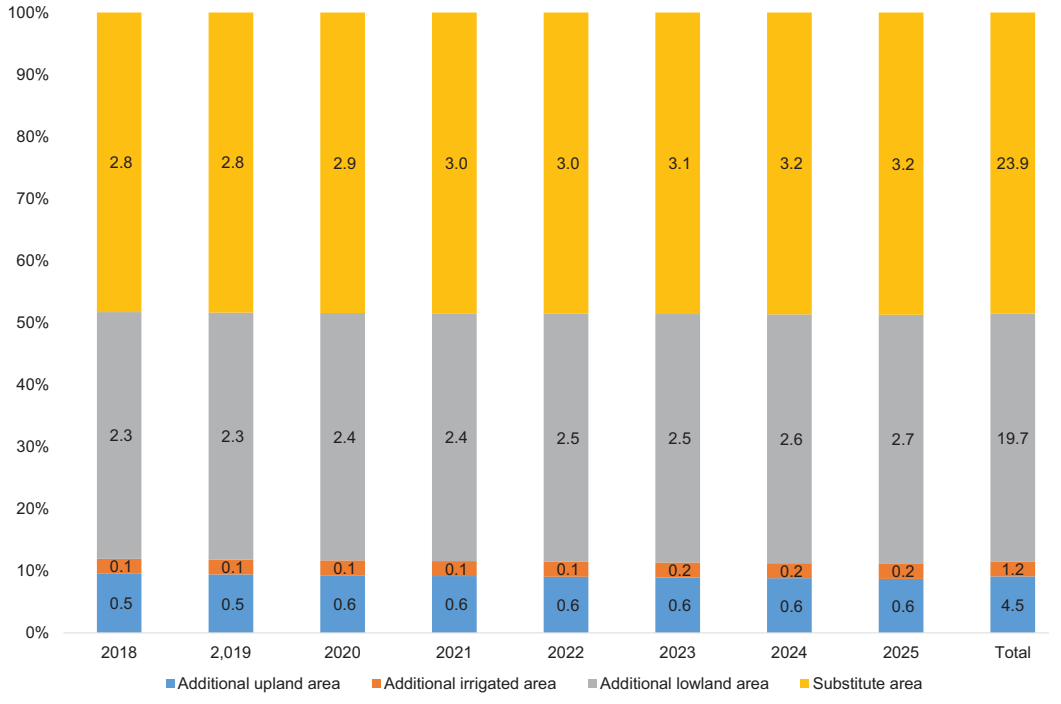


Figure A4.8: Expected gains from CIPRiSSA in Ghana 1: Rice area expansion per ecology ('000 ha)

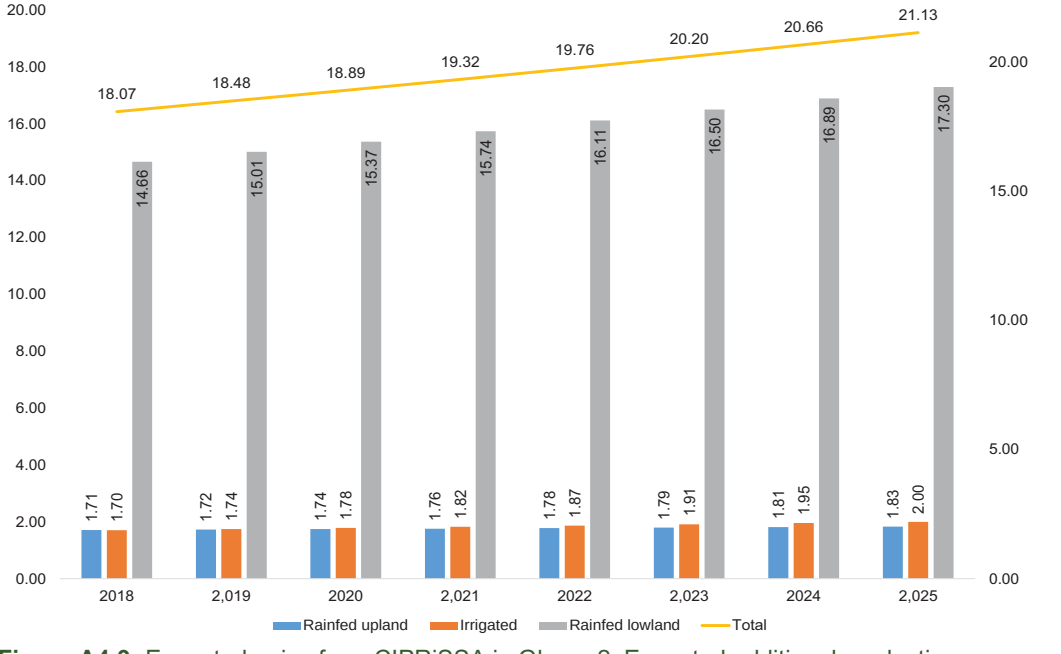


Figure A4.9: Expected gains from CIPRiSSA in Ghana 2: Expected additional production per ecology ('000 tons)

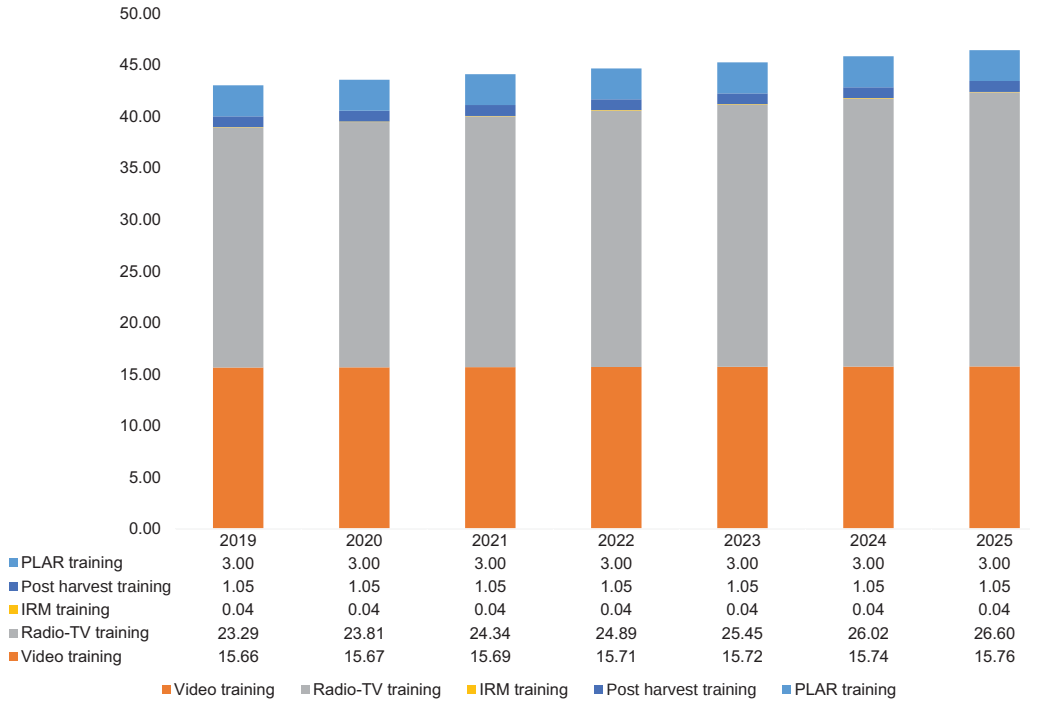


Figure A4.10: Expected gains from CIPRiSSA in Ghana 3: Number of farmers and other actors targeted for training ('000 persons)

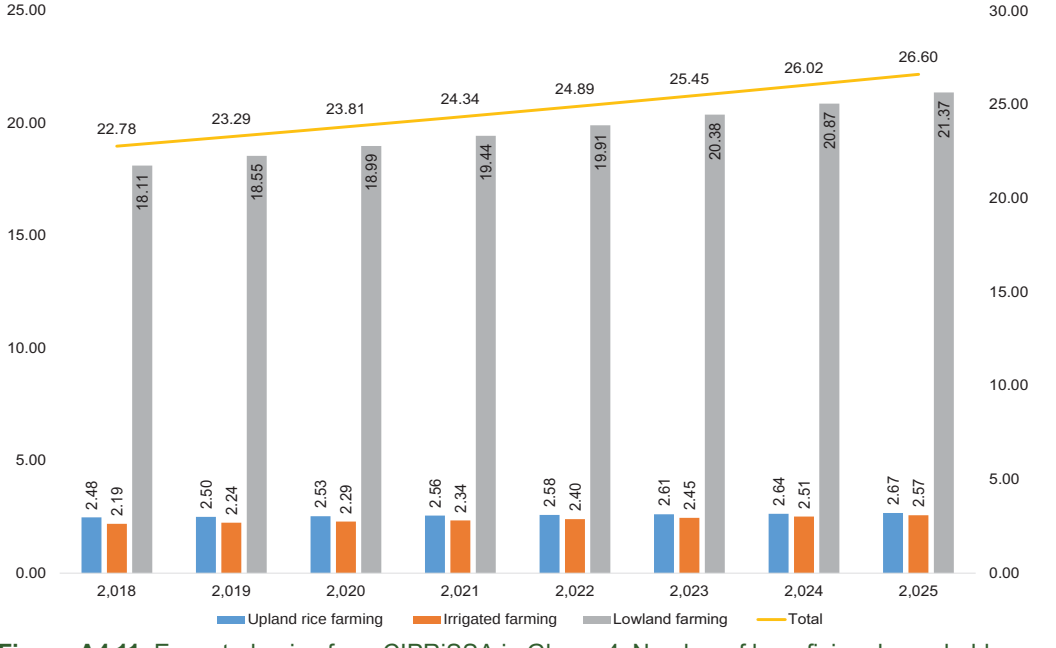


Figure A4.11: Expected gains from CIPRiSSA in Ghana 4: Number of beneficiary households targeted ('000 households)

Table A4: Projected estimates for required investments, production gains, land area, and farming households for Ghana (2018-2025)

	2018	2019	2020	2021	2022	2023	2024	2025
PROJECTED STATISTICS ON RICE (production, consumption import)								
Rice, paddy production (T)	974,881	1,121,113	1,289,280	1,482,672	1,705,073	1,960,834	2,254,959	2,593,203
Rice, production milled equivalent (T)	584,929	672,668	773,568	934,083	1,074,196	1,235,325	1,465,723	1,685,582
Rice, food (milled equivalent) consumption (T)	1,117,293	1,161,985	1,208,464	1,256,802	1,307,075	1,359,358	1,413,732	1,470,281
Self-sufficiency ratio	0.52	0.58	0.64	0.74	0.82	0.91	1.04	1.15
ADDITIONAL GAIN FROM THE PROGRAM								
Expected additional production from rainfed upland (T)	1,708	1,724	1,741	1,758	1,776	1,794	1,812	1,831
Expected additional production from irrigated (T)	1,701	1,741	1,782	1,823	1,866	1,909	1,954	1,999
Expected additional production from rainfed lowland (T)	14,663	15,013	15,372	15,739	16,115	16,499	16,893	17,297
Expected additional production from the 3 ecologies (T)	18,073	18,479	18,894	19,320	19,756	20,202	20,659	21,127
Expected additional production from technology adoption (T)	6,269	6,270	6,271	6,272	6,273	6,274	6,275	6,276
Expected additional paddy production from the program (T)	24,342	24,749	25,166	25,592	26,029	26,476	26,934	27,403
Expected additional rice, food (milled equivalent) from the program (T)	14,605	14,849	15,099	16,123	16,398	16,680	17,507	17,812
Estimated foreign exchange savings (US$ per year)	5,532,356	5,620,331	5,710,418	6,133,956	6,234,073	6,336,593	6,674,015	6,785,562
PRODUCERS AND AREA TARGETED								
Number of upland rice farming households targeted	1,227	1,253	1,279	1,305	1,333	1,361	1,389	1,418
Number of substitute farming households targeted (upland rice)	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250
Total number of upland rice farmers	2,477	2,503	2,529	2,555	2,583	2,611	2,639	2,668

	2018	2019	2020	2021	2022	2023	2024	2025
Number of irrigated rice farming households targeted	2,186	2,237	2,289	2,343	2,397	2,453	2,510	2,569
Number of lowland rice farming households targeted	18,114	18,547	18,989	19,443	19,907	20,382	20,869	21,367
Total number of farmers/trainees targeted	22,778	23,286	23,807	24,340	24,887	25,446	26,018	26,605
Number of farmers targeted by PLAR training	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Number of farmers targeted by Video training	15,642	15,658	15,673	15,690	15,706	15,723	15,740	15,758
Number of farmers targeted by Radio-TV training	22,778	23,286	23,807	24,340	24,887	25,446	26,018	26,605
Number of trainees targeted by IRM training	40	40	40	40	40	40	40	40
Number of trainees targeted by post harvest training	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050
Number of villages targeted by PLAR training	100	100	100	100	100	100	100	100
Number of villages targeted by Video training	207	207	207	207	207	208	208	208
Number of villages targeted by Radio-TV training	228	233	238	243	249	254	260	266
Total rice area targeted (ha)	5,694	5,822	5,952	6,085	6,222	6,361	6,505	6,651
Total additional upland rice area (ha)	543	547	552	557	562	568	573	578
Total additional irrigated rice area (ha)	137	140	143	146	150	153	157	161
Total additional lowland rice area (ha)	2,264	2,318	2,374	2,430	2,488	2,548	2,609	2,671
Total additional rice area (ha)	2,944	3,005	3,069	3,134	3,201	3,269	3,338	3,410
Total rice areas already on rice (ha)	2,751	2,816	2,883	2,951	3,021	3,093	3,166	3,241

	2018	2019	2020	2021	2022	2023	2024	2025
INPUTS (quantity and cost)								
Seed								
Total foundation seed equivalent (T)	6	6	6	6	6	6	6	7
Total certified seed requirement (T)	285	292	298	305	312	318	326	333
Production cost of the foundation seed ((US$)	11,166	11,408	11,655	11,908	12,167	12,432	12,704	12,983
Production cost of the certified seed ((US$)	572,645	585,048	597,749	610,755	624,072	637,709	651,674	665,973
Cost of storage, weighing, packaging of certified seed	38,851	39,708	40,585	41,483	42,403	43,345	44,310	45,297
Cost of distribution of certified seed ((US$)	481	492	503	514	526	538	550	562
Total cost of certified seed package (including, packaging and distribution)	611,978	625,248	638,837	652,752	667,001	681,592	696,533	711,833
Total cost of seed (certified and foundation)	623,144	636,656	650,492	664,660	679,168	694,025	709,238	724,816
Fertilizer								
Total Urea (T)	823	842	861	881	901	922	943	964
Total NPK (T)	569	582	595	609	622	636	650	665
Total Fertilizer (T)	1,393	1,424	1,456	1,489	1,523	1,558	1,593	1,629
Total cost of Urea (US$)	341,626	349,410	357,380	365,542	373,899	382,457	391,221	400,195
Total cost of NPK ((US$)	428,219	437,781	447,573	457,599	467,867	478,380	489,146	500,171
Total cost of fertilizer (US$)	769,845	787,191	804,953	823,141	841,766	860,838	880,367	900,365
Cost of fertilizer transport and distribution	325,041	332,387	339,908	347,610	355,497	363,574	371,844	380,312
Total cost of fertilizer (including, packaging and distribution)	1,094,887	1,119,578	1,144,861	1,170,752	1,197,263	1,224,411	1,252,211	1,280,678
Technology transfer and capacity building								
Cost of PLAR training	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
Cost of Video (training	62,017	62,063	62,110	62,159	62,208	62,259	62,311	62,364

	2018	2019	2020	2021	2022	2023	2024	2025
Cost of Radio-TV (training	456	466	476	487	498	509	520	532
Cost of IRM training	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Cost of post-harvest (GEM, ASI/ATA thresher-cleaner) training	74,500	74,500	74,500	74,500	74,500	74,500	74,500	74,500
Total technology transfer and capacity building cost	496,972	497,029	497,086	497,145	497,206	497,268	497,332	497,397
Machine/Equipment (quantity and cost)								
Number of tractors (for a fraction of the additional areas)	1	1	1	1	1	1	1	1
Number of power tiller (for a fraction of the additional areas)	23	24	24	25	25	26	27	27
Number of ASI/ATA thresher-cleaner (for a fraction of the additional production)	41	41	42	43	43	44	45	46
Number of mini-milling machine	8	8	8	9	9	9	9	9
Number of GEM parboilers (for a fraction of the additional production)	4	5	5	5	5	5	5	5
Total cost tractor (US$)	66,354	66,354	66,354	66,354	66,354	66,354	66,354	66,354
Total cost of power tiller (US$)	146,327	149,393	152,532	155,747	159,039	162,410	165,862	169,396
Total cost of ASI/ATA thresher-cleaner (US$)	188,636	191,788	195,016	198,322	201,707	205,173	208,722	212,356
Total cost of mini milling machine (US$)	205,784	209,223	212,745	216,351	220,044	223,825	227,697	231,662
Total cost of GEM (US$)	89,166	90,656	92,182	93,744	95,344	96,983	98,660	100,378
Total cost of machine/ equipment (US$)	696,266	707,414	718,829	730,517	742,487	754,743	767,294	780,146
Marketing and upgrading (cost)								
Cost of training/meeting on branding and packaging (US$)	4,116	4,116	4,116	4,116	4,116	4,116	4,116	4,116
Cost of participation and exhibition in trade fair (US$)	7,473	7,473	7,473	7,473	7,473	7,473	7,473	7,473

	2018	2019	2020	2021	2022	2023	2024	2025
Cost of marketing campaigns ((US$)	50,655	50,655	50,655	50,655	50,655	50,655	50,655	50,655
Cost of high quality bags for the packaging of the additional milled rice ((US$)	121,433	123,462	125,540	134,052	136,340	138,682	145,560	148,095
Total cost of marketing and upgrading (US$)	183,677	185,706	187,784	196,296	198,584	200,926	207,804	210,339
TOTAL COST WITHOUT IRRIGATION	3,094,946	3,146,382	3,199,052	3,259,370	3,314,708	3,371,374	3,433,879	3,493,375
Total additional irrigation scheme by 2025 (ha) planned by each country (a)								
Annual additional irrigation scheme by 2025 (ha) planned by each country (b) = (a)/8								
Total annual additional irrigated rice area (ha) from CIPRiSSA (c)	137	140	143	146	150	153	157	161
(b)-(c)	(137)	(140)	(143)	(146)	(150)	(153)	(157)	(161)
Cost of new irrigation schemes from CIPRiSSA (US$)	1,116,634	1,142,612	1,169,213	1,196,453	1,224,346	1,252,909	1,282,158	1,312,108

Madagascar

Country Background

Madagascar is the fifth largest island in the world, with a land mass of 587,000 km^2 and 24.24 million[67] inhabitants in 2016. Its economy is based essentially on agriculture, particularly vanilla, and tourism. Given its unique biodiversity, it is very vulnerable to the consequences of climate change. Its current National Development Plan focuses on three areas - improving governance, fostering economic recovery, and expanding access to basic social services. Although Madagascar made some progress in the achievement of the Millennium Development Goals in the 2000s, the political crisis from 2009 to 2014 seriously undermined that progress. Today, Madagascar's education, health, nutrition and access to water are among the poorest in the world.

The country's development challenges are immense, with 90% of the population being poor and an extreme poverty rate of 77.8%[68] in 2012. Madagascar is ranked among the poorest countries in Africa - per capita GDP stands at $420; one child in two under the age of five suffers from chronic malnutrition; and Madagascar was ranked 154th out of 187 countries in the 2015 Human Development Index. Madagascar is also one of the 10 countries most at risk from the effects of global warming[69]. Despite the above, the Malagasy economy has been gradually improving and the medium-term outlook is encouraging. Gross domestic product (GDP) growth reached 4.1% in 2016, exceeding the average of 2.6% recorded over the previous five years[70]. In 2016, the economy was led by the expansion of the tertiary sector, public works programs, and the recovery in the primary sector, which was aided by favorable weather conditions and higher vanilla prices. The country's economic stability was reinforced by its control over inflation and the improvement in the external balance owing to greater inflows of direct investment.

CIPRiSSA Results for Madagascar

Self-Sufficiency

Baseline data collected in Madagascar under CIPRiSSA indicated an upward trend in rice production between 2006 and 2010 with 9% annual growth rate, and a downward trend between 2011 and 2015. On this basis, the country could achieve 105% self-sufficiency by 2018 and 156% in 2025 (Table A5; Figure A5.1).

[67]http://www.worldbank.org/en/country/Madagascar/overview.
[68]Ibid.
[69]Ibid.
[70]Ibid.

Paddy and Milled Rice Production

Between 2018 and 2025, Madagascar will produce 48.13 MT of paddy or 30.20 MT milled rice equivalent. Annual production will increase from 2.64 MT milled rice equivalent in 2018 to 5.16 MT in 2025. The milled rice food equivalent will rise steadily annually from 2.51 MT in 2018 to 3.30 MT in 2025, culminating in a total of 23.13 MT (Figure A5.1; Table A5).

New Investments

New irrigation and non-irrigation investments are necessary to realize these potentials. The total new investments will cost US$ 674.26 million between 2018 and 2025, comprising annual commitments ranging from US$ 77.45 million in 2018 to US$ 91.46 million in 2025 (Figure A5.2).

The share of non-irrigation investments would be 62.3% of total investments or US$ 420.35 million compared with 37.7% or US$ 253.91 million for additional irrigation investments (Figure A5.3). Investment in non-irrigation will progressively increase from US$48.28 million in 2018 to US$57.02 million in 2025 (Figure A5.2; Table A5). The non-irrigation priority areas include (i) fertilizer acquisition and distribution (48.6% of non-irrigation investment or US$ 204.39 million); (ii) machinery and equipment (25.7% or US$ 108.12 million); (iii) certified and foundation seed production and distribution (21.1% or US$ 88.75 million); (iv) marketing and upgrading of rice value chain (3.5% or US$ 14.71 million); and (v) technology transfer and capacity building (1.0% or US$ 4.38 million) (Figures A5.4, A5.5). Investments in new irrigation will increase annually from US$ 29.17 million in 2018 to US$ 34.43 million in 2025 (Figures A5.2 and A5.6). The new irrigation facilities will develop 211,590 ha, progressively increasing from 24,306 ha in 2018 to 28,695 ha in 2025 (Figure A5.6).

Benefits

The cumulative foreign exchange savings of US$ 593.93 million will be contributed by annual savings ranging from US$ 64.92 in 2018 to US$ 84.53 in 2025 (Figure A5.7). The targeted total rice area is 1.06 million ha (including 343,036 ha of newly developed land from the different ecologies), with annual targets ranging from 121,784 ha in 2018 to 143,728 ha in 2025 (Figure A5.8). The additional paddy production from these new areas will range between 311,761 T in 2018 to 367,932 T in 2025 (Figure A5.9). This will contribute 2.73 MT of additional paddy or 1.71 MT of milled rice by 2025 (Figure A5.9)

CIPRiSSA will empower 4.24 million farming households, with the annual target increasing from 487,136 in 2018 to 574,911 in 2025 (Figure A5.11). They will be empowered through training on PLAR, video, radio-TV, IRM, and post-harvest practices (Figure A5.10).

Profitability analysis

Excluding the cost of new irrigation schemes, the estimated total investment for achieving 156% self-sufficiency in Madagascar by 2025 is US$ 420.35 million, with an average annual operational cost of US$ 52.54. These investments will generate a benefits/costs ratio (NPV ratio to investment) of 1.07, an NPV of US$ 227.90 million, and an MIRR of 41.92%. This means that each dollar invested in the program will generate a net benefit of US$ 1.55. CIPRiSSA will remain viable as long as the financial rate of alternative investment projects in the country is less than 41.92%. The NPV is much higher than zero, indicating that the investments are profitable.

The total investment required, including the construction of new irrigation schemes, is US$ 674.26 million, with annual average investments of US$ 84.28. These investments will generate an NPV of US$ 112.17 million, a benefits/costs ratio of 0.26, and an MIRR of 14.16% (Table A12). The estimated payback period of the investments is 4.24 years (by 2022), meaning that all investments will be recovered before the end of the program. Thus, the investments required to achieve self-sufficient in rice by 2025 are profitable for the private sector.

Similarly, economic analyses of the contribution of CIPRiSSA to the overall welfare of the country and to the national objectives show an estimated gross domestic value-added (which measures the real monetary contribution of the project to the economy of the country in terms of direct and indirect generated value-added) of US$ 595.34 million. This represents the contribution of the program to the GDP. The estimated net national value added (which represents CIPRiSSA's contribution to national welfare) is US$ 450.10 million. The economic internal rate of rate return is 10.89%. In total, 127,686 direct employments will be created by the investments.

Sensibility analysis shows that the proposed investments remain profitable under both pessimistic (-10% of the price) and optimistic (+10% of the price) scenarios. The NPV ratio is greater than zero in the two cases. Under optimistic scenarios, the investments will generate a benefits/costs ratio (NPV ratio to investment) of 1.41, a net profit of US$ 300.30 million, and MIRR of 56.73%. Under pessimistic scenarios, the investments will generate a benefits/costs ratio (NPV ratio to investment) of 0.73, a net profit of US$ 155.47 million, with a MIRR of 28.54%. In addition, the break-even point analysis shows that the investments remain profitable even with 80.64% reduction of the market price.

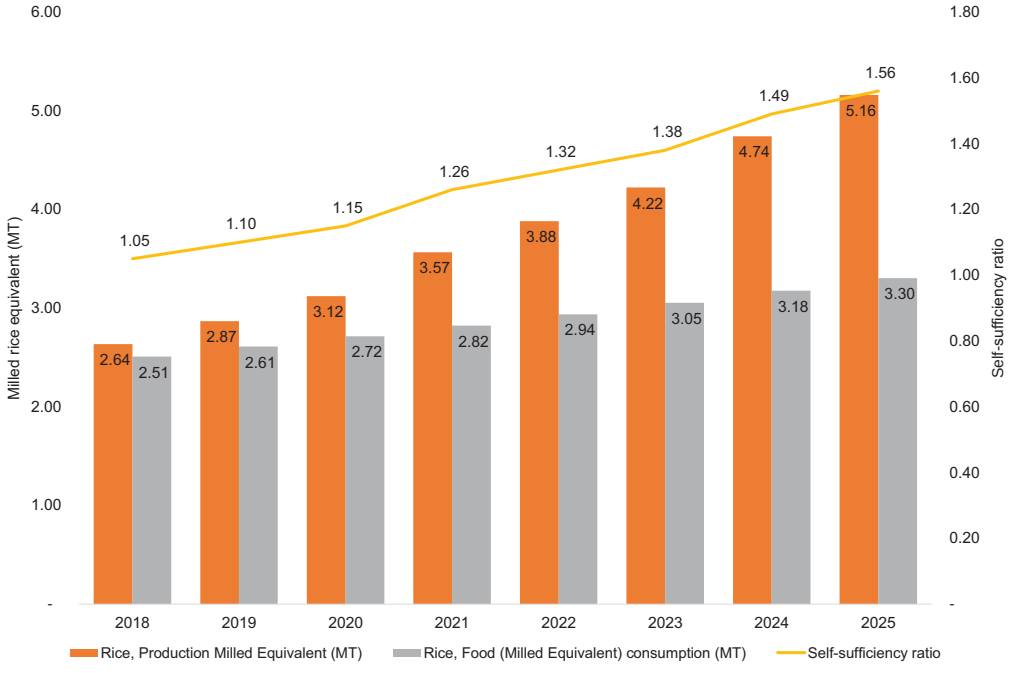


Figure A5.1: Milled rice production and consumption versus self-sufficiency in Madagascar

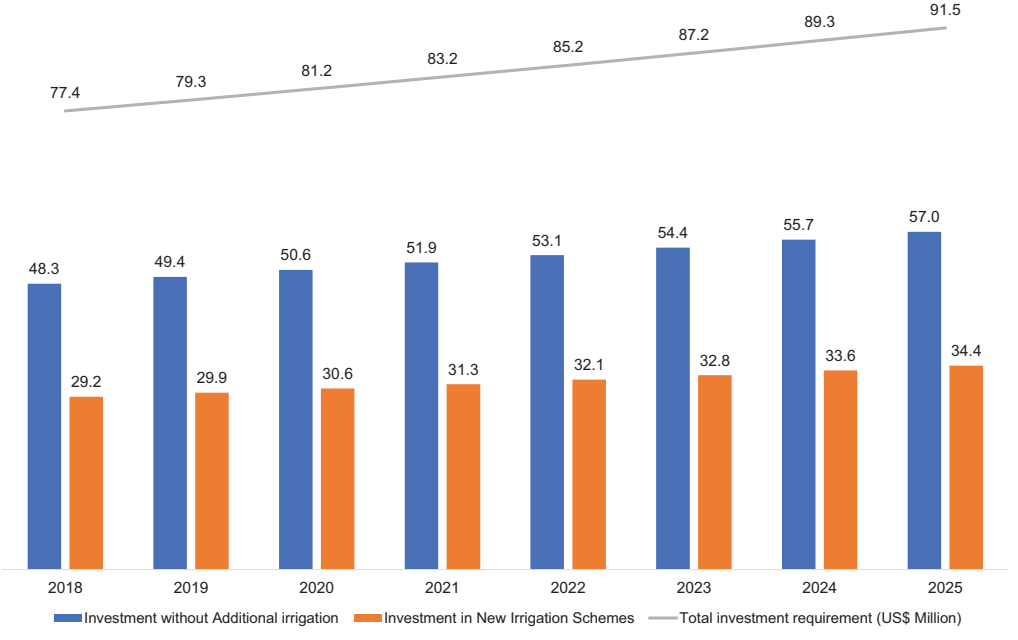


Figure A5.2: Additional irrigation and non-irrigation investments required by Madagascar (US$ million)

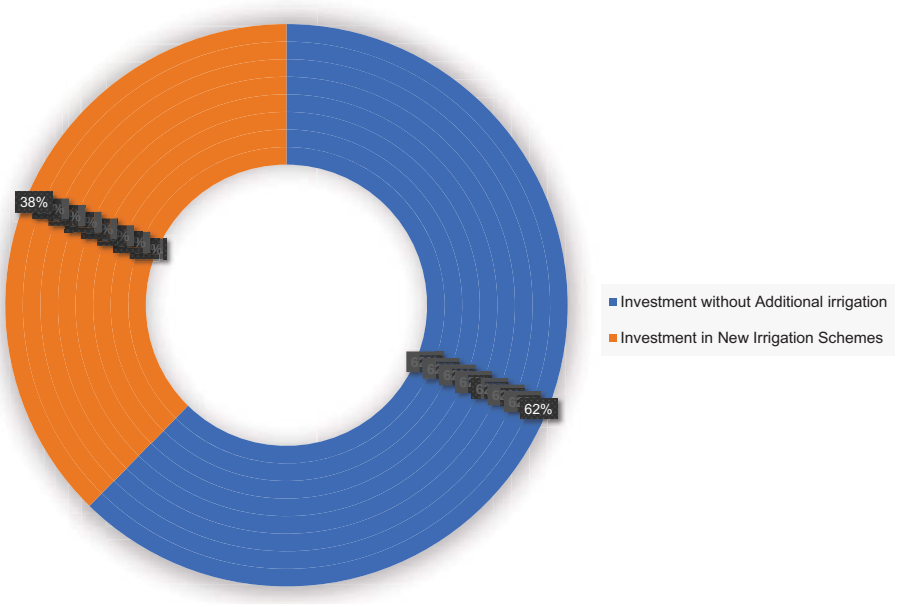


Figure A5.3: Additional irrigation and non-irrigation investments required by Madagascar (%)

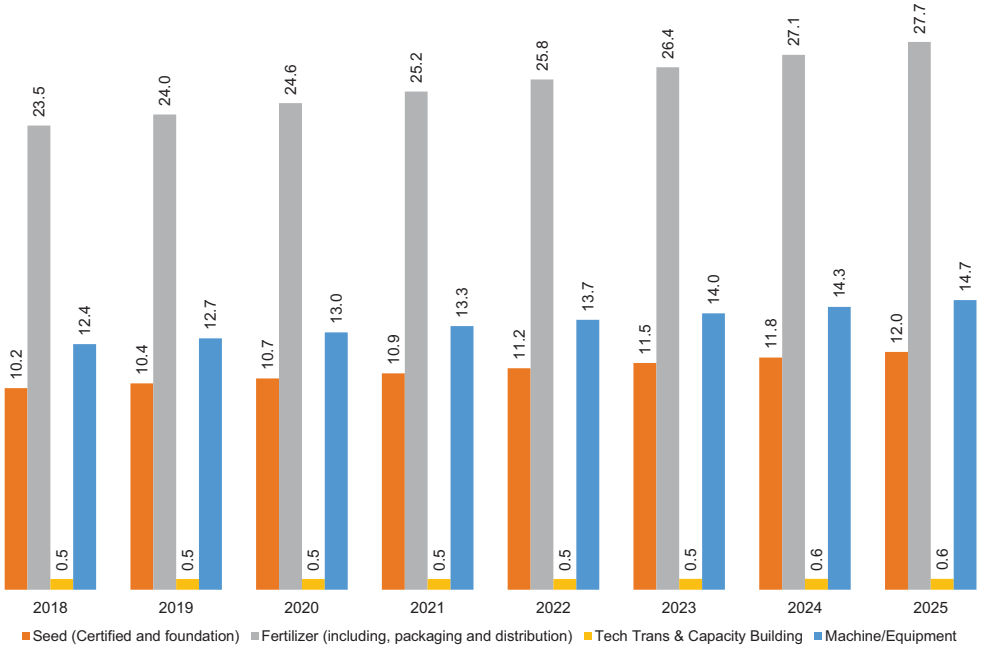


Figure A5.4: Composition of new non-irrigation investments required by Madagascar (US$ million)

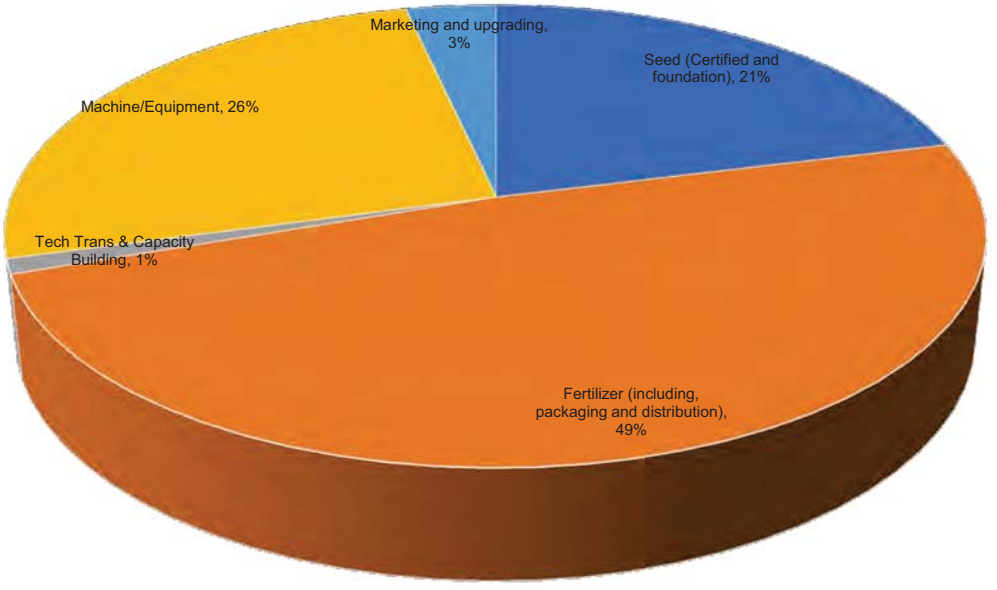


Figure A5.5: Distribution of required new non-irrigation investments in Madagascar (%)

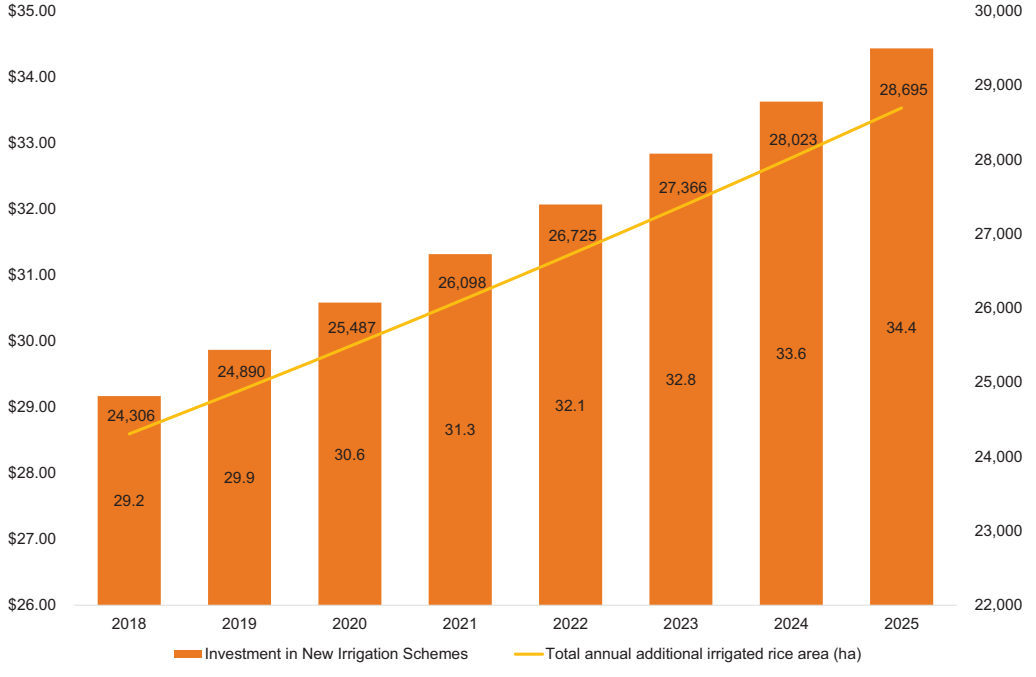


Figure A5.6: Additional irrigated rice area (ha) versus new irrigation investments (US$ million) in Madagascar

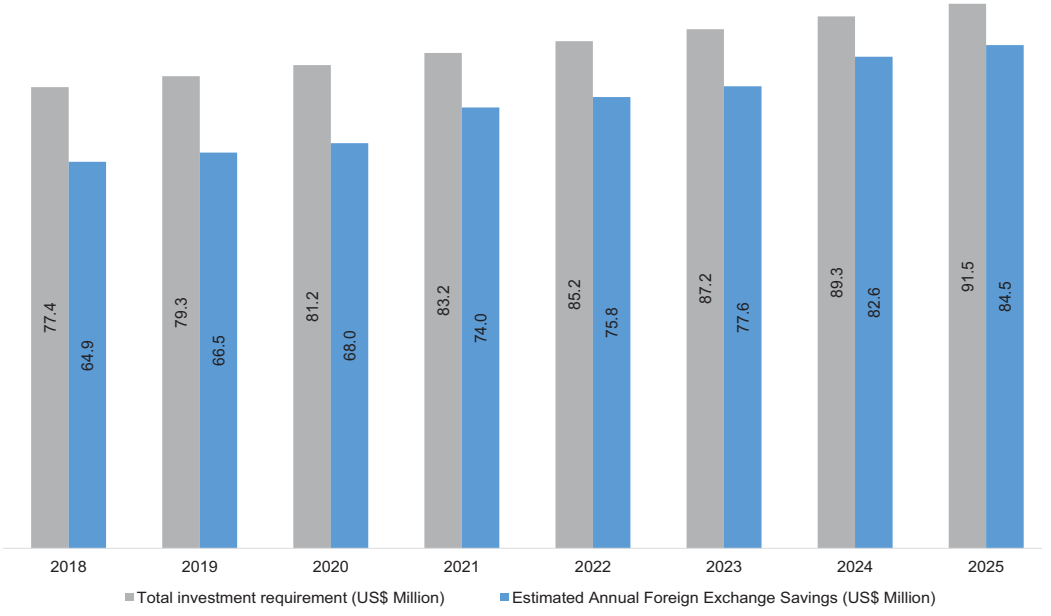


Figure A5.7: Estimated annual new investments costs versus annual savings for Madagascar (US$ million)

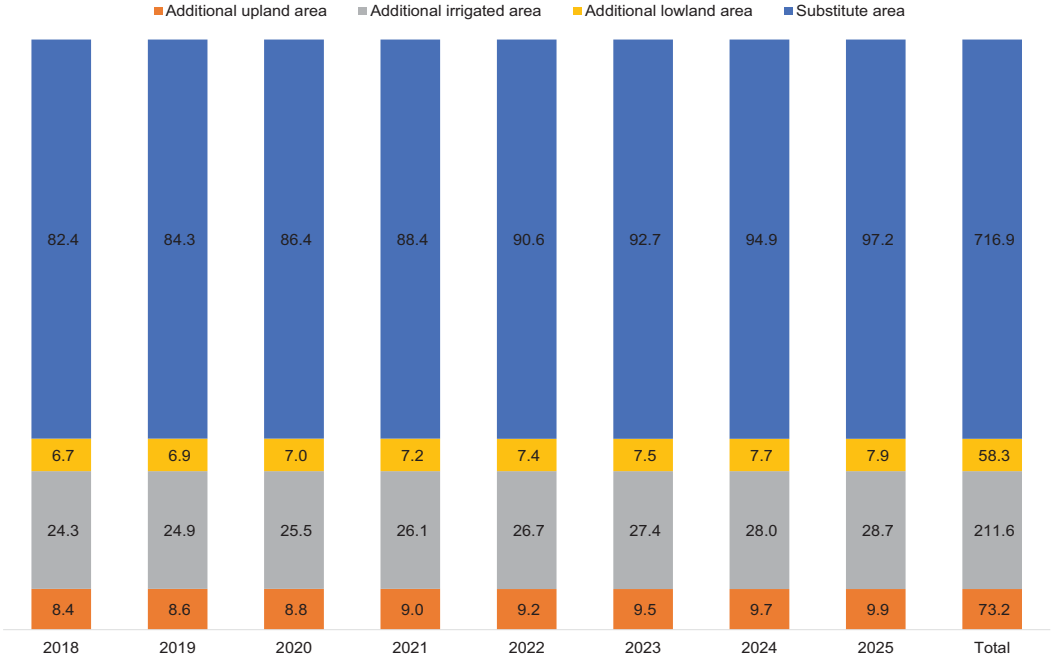


Figure A5.8: Expected gains from CIPRiSSA in Madagascar 1: Rice area expansion per ecology ('000 ha)

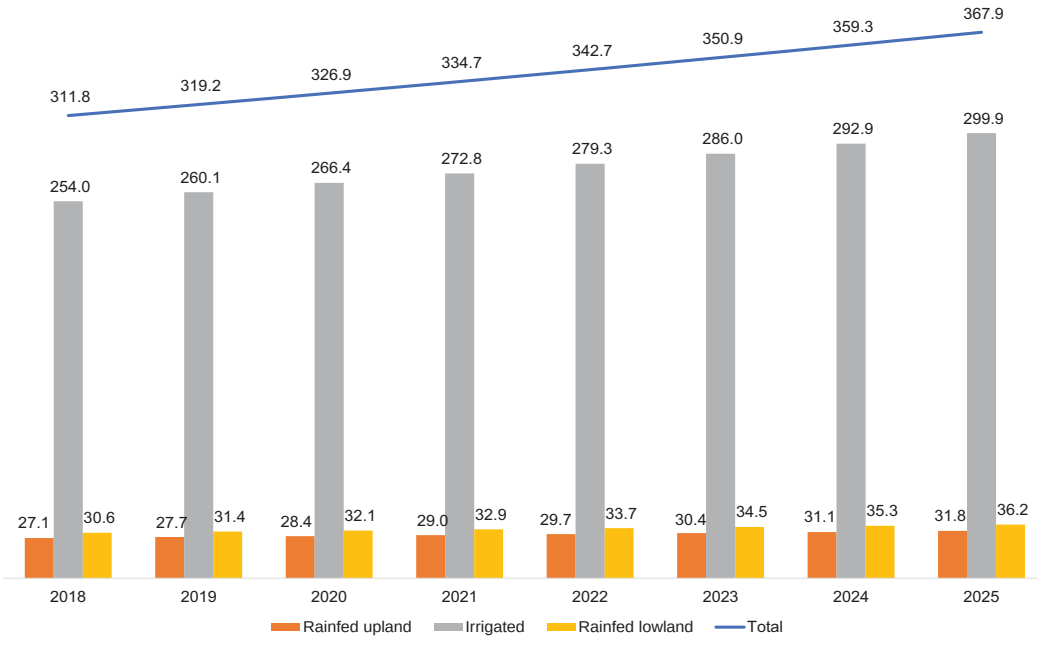
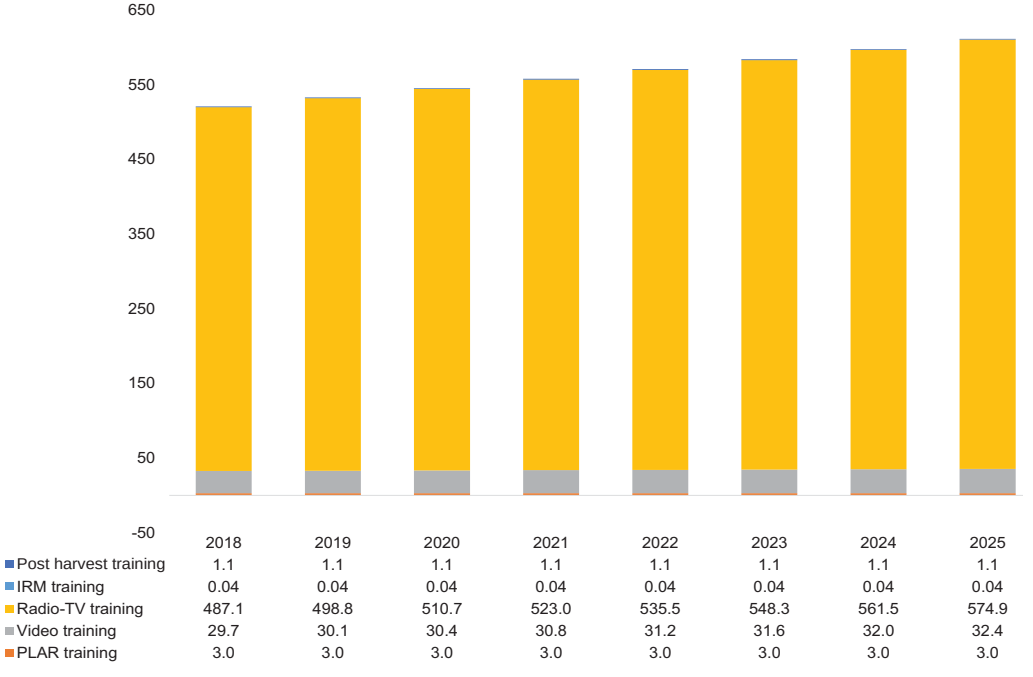


Figure A5.9: Expected gains from CIPRiSSA in Madagascar 2: Expected additional production per ecology ('000 tons)



	2018	2019	2020	2021	2022	2023	2024	2025
Post harvest training	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
IRM training	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Radio-TV training	487.1	498.8	510.7	523.0	535.5	548.3	561.5	574.9
Video training	29.7	30.1	30.4	30.8	31.2	31.6	32.0	32.4
PLAR training	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0

Figure A5.10: Expected gains from CIPRiSSA in Madagascar 3: Number of farmers and other actors targeted for training ('000 persons)

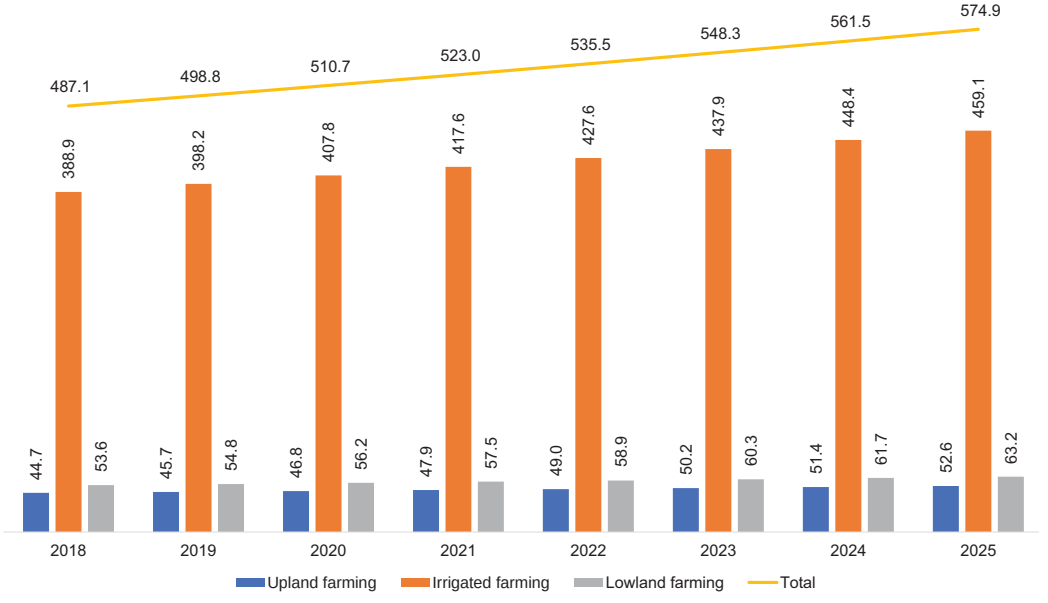


Figure A5.11: Expected gains from CIPRiSSA in Madagascar 4: Number of beneficiary households targeted ('000 households)

Table A5: Projected estimates in required investments, production gains, land area, and farming households for Madagascar (2018-2025)

MADAGASCAR	2018	2019	2020	2021	2022	2023	2024	2025
PROJECTED STATISTICS ON RICE (production, consumption import)								
Rice, paddy production (T)	4,392,195	4,779,791	5,201,592	5,660,615	6,160,145	6,703,757	7,295,341	7,939,130
Rice, production milled equivalent (T)	2,635,317	2,867,875	3,120,955	3,566,187	3,880,891	4,223,367	4,741,972	5,160,435
Rice, food (milled equivalent) consumption (T)	2,510,394	2,610,809	2,715,242	2,823,851	2,936,805	3,054,278	3,176,449	3,303,507
Self-sufficiency ratio	1.05	1.10	1.15	1.26	1.32	1.38	1.49	1.56
ADDITIONAL GAIN FROM THE PROGRAM								
Expected additional production from rainfed upland (T)	27,072	27,707	28,357	29,023	29,704	30,402	31,117	31,849
Expected additional production from irrigated (T)	254,049	260,145	266,388	272,780	279,326	286,029	292,892	299,921
Expected additional production from rainfed lowland (T)	30,639	31,373	32,125	32,894	33,682	34,489	35,316	36,162
Expected additional production from the 3 ecologies (T)	311,761	319,226	326,870	334,697	342,713	350,920	359,325	367,932
Expected additional production from technology adoption (T)	2,753	2,774	2,795	2,817	2,840	2,863	2,886	2,910
Expected additional paddy production from the program (T)	314,513	321,999	329,665	337,514	345,552	353,783	362,211	370,842
Expected additional rice, food (milled equivalent) from the program (T)	188,708	193,200	197,799	212,634	217,698	222,883	235,437	241,047
Estimated foreign exchange savings (US$ per year)	64,920,010	66,462,715	68,042,445	74,029,210	75,789,727	77,592,497	82,564,417	84,529,241
PRODUCERS AND AREA TARGETED								
Number of upland rice farming households targeted	43,911	44,961	46,036	47,137	48,264	49,419	50,601	51,811

MADAGASCAR	2018	2019	2020	2021	2022	2023	2024	2025
Number of substitute farming households targeted (upland rice)	759	759	759	759	759	759	759	759
Total number of upland rice farmers	44,670	45,720	46,795	47,896	49,023	50,178	51,360	52,570
Number of irrigated rice farming households targeted	388,901	398,233	407,788	417,574	427,594	437,855	448,362	459,121
Number of lowland rice farming households targeted	53,565	54,848	56,162	57,508	58,885	60,296	61,741	63,220
Total number of farmers/trainees targeted	487,136	498,801	510,746	522,977	535,503	548,328	561,462	574,911
Number of farmer targeted by PLAR training	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Number of farmers targeted by PLAR training	29,729	30,082	30,444	30,815	31,194	31,583	31,981	32,388
Number of farmers targeted by Video training	487,136	498,801	510,746	522,977	535,503	548,328	561,462	574,911
Number of farmers targeted by Radio-TV training	40	40	40	40	40	40	40	40
Number of trainees targeted by post harvest training	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050
Number of villages targeted by PLAR training	100	100	100	100	100	100	100	100
Number of villages targeted by Video training	328	332	335	339	343	347	351	355
Number of villages targeted by Radio-TV training	4,871	4,988	5,107	5,230	5,355	5,483	5,615	5,749
Total rice area targeted (ha)	121,784	124,700	127,686	130,744	133,876	137,082	140,366	143,728
Total additional upland rice area (ha)	8,423	8,620	8,822	9,028	9,239	9,456	9,677	9,904

MADAGASCAR	2018	2019	2020	2021	2022	2023	2024	2025
Total additional irrigated rice area (ha)	24,306	24,890	25,487	26,098	26,725	27,366	28,023	28,695
Total additional lowland rice area (ha)	6,696	6,856	7,020	7,188	7,361	7,537	7,718	7,903
Total additional rice area (ha)	39,425	40,365	41,329	42,315	43,325	44,359	45,418	46,502
Total rice areas already on rice (ha)	82,359	84,335	86,358	88,430	90,551	92,723	94,948	97,226
INPUTS (quantity and cost)								
Seed								
Total foundation seed equivalent (T)	69	71	72	74	76	78	80	81
Total certified seed requirement (T)	5,229	5,354	5,482	5,613	5,747	5,885	6,026	6,170
Production cost of the foundation seed (US$)	135,803	139,044	142,363	145,762	149,243	152,806	156,456	160,193
Production cost of the certified seed (US$)	9,340,328	9,563,590	9,792,210	10,026,317	10,266,043	10,511,522	10,762,893	11,020,297
Cost of storage, weighing, packaging of certified seed	711,648	728,676	746,112	763,967	782,251	800,973	820,145	839,776
Cost of distribution of certified seed (US$)	10,295	10,542	10,794	11,053	11,318	11,589	11,866	12,150
Total cost of certified seed package (including, packaging and distribution)	10,062,271	10,302,807	10,549,117	10,801,337	11,059,611	11,324,084	11,594,904	11,872,224
Total cost of seed (certified and foundation)	10,198,074	10,441,851	10,691,480	10,947,099	11,208,854	11,476,891	11,751,360	12,032,417
Fertilizer								
Total Urea (T)	17,709	18,134	18,568	19,013	19,469	19,935	20,413	20,902
Total NPK (T)	12,178	12,470	12,769	13,074	13,388	13,708	14,037	14,373
Total Fertilizer (T)	29,888	30,604	31,337	32,087	32,856	33,643	34,449	35,275
Total cost of Urea (US$)	7,349,324	7,525,415	7,705,732	7,890,376	8,079,452	8,273,065	8,471,326	8,674,344
Total cost of NPK (US$)	9,158,153	9,377,455	9,602,020	9,831,975	10,067,449	10,308,574	10,555,487	10,808,325

MADAGASCAR	2018	2019	2020	2021	2022	2023	2024	2025
Total cost of fertilizer (US$)	16,507,477	16,902,870	17,307,752	17,722,351	18,146,901	18,581,640	19,026,812	19,482,669
Cost of fertilizer transport and distribution	6,975,768	7,142,868	7,313,979	7,489,197	7,668,619	7,852,348	8,040,486	8,233,140
Total cost of fertilizer (including, packaging and distribution)	23,483,245	24,045,738	24,621,731	25,211,548	25,815,520	26,433,987	27,067,298	27,715,808
Technology transfer and Capacity building								
Cost of PLAR training	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
Cost of Video training	98,453	99,513	100,599	101,711	102,850	104,016	105,210	106,432
Cost of Radio-TV training	9,743	9,976	10,215	10,460	10,710	10,967	11,229	11,498
Cost of IRM training	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Cost of post-harvest (GEM, ASI/ATA thresher-cleaner) training	74,500	74,500	74,500	74,500	74,500	74,500	74,500	74,500
Total technology transfer and Capacity Building cost	542,695	543,989	545,314	546,670	548,060	549,482	550,939	552,430
Machine/Equipment (quantity and cost)								
Number of tractors (for a fraction of the additional areas)	81	83	85	87	89	91	93	96
Number of power tiller (for a fraction of the additional areas)	126	129	132	135	138	142	145	148
Number of ASI/ATA thresher-cleaner (for a fraction of the additional production)	524	537	549	563	576	590	604	618
Number of mini-milling machine	105	107	110	113	115	118	121	124
Number of GEM parboilers (for a fraction of the additional production)	58	60	61	63	64	66	67	69

MADAGASCAR	2018	2019	2020	2021	2022	2023	2024	2025
Total cost tractor (US$)	5,376,053	5,505,056	5,637,156	5,772,425	5,910,941	6,052,781	6,198,026	6,346,756
Total cost of power tiller (US$)	788,166	806,790	825,860	845,388	865,385	885,862	906,830	928,302
Total cost of ASI/ ATA thresher-cleaner (US$)	2,437,263	2,495,274	2,554,676	2,615,505	2,677,793	2,741,576	2,806,890	2,873,772
Total cost of mini milling machine (US$)	2,658,832	2,722,117	2,786,920	2,853,278	2,921,229	2,990,811	3,062,062	3,135,024
Total cost of GEM (US$)	1,164,864	1,192,590	1,220,980	1,250,053	1,279,823	1,310,307	1,341,524	1,373,489
Total cost of machine/ equipment (US$)	12,425,179	12,721,826	13,025,592	13,336,649	13,655,171	13,981,338	14,315,333	14,657,343
Marketing and upgrading (cost)								
Cost of training/ meeting on branding and packaging (US$)	4,116	4,116	4,116	4,116	4,116	4,116	4,116	4,116
Cost of participation to exhibition in trade fair (US$)	7,473	7,473	7,473	7,473	7,473	7,473	7,473	7,473
Cost of marketing campaigns (US$)	50,655	50,655	50,655	50,655	50,655	50,655	50,655	50,655
Cost of high quality bags for the packaging of the additional milled rice (US$)	1,568,971	1,606,315	1,644,555	1,767,898	1,810,001	1,853,114	1,957,492	2,004,135
Total cost of marketing and upgrading (US$)	1,631,215	1,668,559	1,706,799	1,830,142	1,872,245	1,915,358	2,019,736	2,066,379
TOTAL COST WITHOUT IRRIGATION SCHEMES	48,280,408	49,421,963	50,590,916	51,872,109	53,099,850	54,357,056	55,704,666	57,024,378
Total additional irrigation scheme by 2025 (ha) planned by each country (a)	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000

MADAGASCAR	2018	2019	2020	2021	2022	2023	2024	2025
Annual additional irrigation scheme by 2025 (ha) planned by each country (b) = (a)/8	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250
Total annual additional irrigated rice area (ha) from CIPRiSSA (c)	24,306	24,890	25,487	26,098	26,725	27,366	28,023	28,695
(b)-(c)	(18,056)	(18,640)	(19,237)	(19,848)	(20,475)	(21,116)	(21,773)	(22,445)
Cost of new irrigation schemes from CIPRiSSA (US$)	29,167,538	29,867,439	30,584,137	31,318,035	32,069,548	32,839,096	33,627,114	34,434,044

Mali

Country Background

Mali is a vast landlocked and geographically diverse country of 1,241,238 km². It is a predominantly desert country with a highly undiversified economy. As such, it is vulnerable to commodity price fluctuations and to the effects of climate change. Mali has a population of more than 18 million, 10% of whom live in the northern regions[71]. High population growth rates and drought have fueled food insecurity, poverty, and instability. The delivery of services in this large, sparsely populated territory is challenging and affects geographic equity and social cohesion.

The political and security situation has been particularly volatile in recent years. In early 2012, there was a military coup and an occupation of the northern regions by armed groups. These events were followed by the deployment of French-led military forces in January 2013. The French handed over to the United Nations Multidimensional Integrated Stabilization Mission in Mali (MINUSMA) in July 2013. Presidential election was held peacefully in Mali in 2013 and local government elections were conducted in November 2016.

Peace negotiations between government and two rebel coalitions, known as the "Platform" and "Coordination" groups, resulted in the signing of an agreement by the government with the Platform group on 15 May 2015 and the Coordination group on 20 June 2015. While the new agreements do not envision an autonomous status for the northern regions, it gives a stronger impetus to decentralization, creating a critical role for these regions, and a development zone consisting of a program of accelerated development for the north (PDAN-(*Programme de développement accéléré du Nord*). However, their implementation remains challenging. Security, which is critical for ensuring economic recovery and poverty reduction, remains fragile, with continuing attacks on the UN force and the Malian army by terrorist groups, mainly again in the northern regions of Mali.

While Mali experienced an overall drop in national poverty from 55.6% in 2001 to 43.6% in 2010, regional differences persist and the poverty rate rebounded to 45%[72] in 2013. Mali ranked 176th out of 188 countries on the 2015 United Nations Human Development Index[73]. Poverty is much lower in urban areas, with 90% of all the poor living in rural areas in the south, where population density is highest. Drought and conflict have only increased the incidence of poverty.

Over the past few years, Mali's economic growth has been influenced by several exogenous shocks. The country's steady state growth rate has hovered around 4.5% over the last decade, driven by rapid growth in labor supply, urbanization (along with informal sector and tertiary

[71]http://www.worldbank.org/en/country/mali/overview.
[72]Ibid.
[73]Ibid.

sector development), extensive agriculture, public investment, and gold mining activities[74]. The structure of its Gross Domestic Product (GDP) has remained relatively stable since 1990, with the primary (agriculture, gold) and tertiary (trade, transport, and public administration) sectors each contributing 35-40% to GDP, and the secondary sector making up the balance[75]. Mali's industrial sector is indeed limited and consists largely of privately owned small enterprises and a few large enterprises (cotton milling, electricity, and mining).

With the progressive consolidation of political stability and improved security conditions, growth accelerated to 7.0% in 2014, its highest level since 2003, and remained robust in 2015 and 2016 at 6.0% and 5.4%, respectively. Mali's economy is projected to grow by around 5% over the period 2017-2019, reflecting a return to normalcy and a gradual tapering of the recent surge in international aid.

During the period 2007-2016, the government's main policies for the agricultural sector have focused on increasing domestic rice production, reforming the cotton sector and maintaining input subsidies programs. Regarding consumer policies, the main forms of assistance include food distribution, food sales at subsidized prices, and *ad hoc* measures to stabilize food prices, such as the closure of the border for food exports or the waiver of import duties on imported foods.

CIPRiSSA Results for Mali

Self-Sufficiency

The CIPRiSSA baseline data for Mali indicate an 8% annual growth rate in rice production over the period 2006-2015. Projections based on these data suggest that Mali will achieve 96% rice self-sufficiency in 2018, 100% in 2019, and 139% by 2025 (Figure A6.1), enabling the country to export rice within West Africa and possibly beyond.

Paddy and Milled Rice Production

Mali is expected to produce a total of 31.92 MT of paddy between 2018 and 2025, comprising annual production ranging from 2.97 MT in 2018 to 5.19 MT in 2025. The total milled rice equivalent will be 20.02 MT, with annual production ranging from 1.78 MT in 2018 to 3.78 MT in 2025. The total milled rice food equivalent will be 17.05 MT, rising steadily from 1.85 MT in 2018 to 2.44 MT in 2025 (Figure A6.1).

New Investments

Between 2018 and 2025, new investments of US$ 282.48 million in both irrigation (20.3% of total investment or US$ 57.29 million) and non-irrigation (79.7% of total investment or US$ 225.18 million) are required to achieve these projections. Annual investments will range from US$ 33.20 million

[74]Ibid.
[75]Ibid.

in 2018 to US$ 37.52 million in 2025 (Figures A6.2 and A6.3). Annual non-irrigation investments will vary between US$26.6 million in 2018 and US$29.8 million in 2015 (Figure A6.2). The priority investment areas include (i) fertilizer acquisition/distribution (40% of non-irrigation investments or equivalent of US$ 90.97 million); (ii) quality seed production and distribution (30 % or US$ 68.30 million); (iii) acquisition of machines/equipment (24% or US$ 52.98 million); (iv) marketing of produce and upgrading of value chain (4% or US$8.88 million); and (v) technology transfer and capacity building (2 % of total investments (US$4.05 million) (Figures A6.4 and A6.5).

The annual cost of new irrigation investments will also rise progressively from US$ 6.60 million in 2018 to US$ 7.75 million in 2025 (Figures A6.2 and A6.6). The program will develop a total of 13,556 ha of additional irrigation facilities, progressively increasing annually from 1,561 ha in 2018 to 1,835 ha in 2025 (Figure A6.6).

Benefits

Expected benefits from CIPRiSSA will include foreign exchange savings, additional households in rice farming, and additional land of varying ecosystems brought into rice cultivation. Mali will save US$ 370.64 million in foreign exchange between 2018 and 2025, with annual savings ranging from US$ 41.83 million in 2018 to US$ 51.29 million in 2025 (Figure A6.7).

The program will benefit 2.05 million farmers by 2025, with annual targets ranging from 242,278 in 2018 to 271,800 in 2025 (Figure A6.11). They will be empowered through training on PLAR, video, radio-TV, IRM, and post-harvest practices (Figure A6.10). The total additional rice area targeted is 355,652 ha, increasing annually from 42,987 ha in 2018 to 46,574 ha in 2025 (Figures A6.8). By 2025, the program will produce an additional 1.6 MT of paddy equivalent to 1.1 MT of milled rice (Figure A6.9).

Profitability

To achieve 139% self-sufficiency in 2025, Mali needs to invest US$ 225.18 million, excluding the cost of new irrigation schemes, with an average annual operational cost of US$ 28.15 million. These investments will generate a benefits/costs ratio (NPV ratio to investment) of 1.55, an NPV of US$ 168.52 million, with an MIRR of 74.29%. This means that each dollar invested in the program will generate a net benefit of US$ 1.55 and that CIPRiSSA will be viable as long as the financial rate of alternative investment projects in the country is less than 74.29%. The NPV is much higher than zero, indicating that the investments are profitable.

The construction of new irrigation schemes will raise the total investment to US$ 282.48 million, with an average annual investment of US$ 35.31 million. This investment will generate an NPV of US$ 142.38 million a benefits/costs ratio of 0.91, and an MIRR of 43.79% (Table A12).

The estimated payback period of the investments is 2.46 years (by 2020), meaning that all investments will be recovered before the end of the program. Thus, the investments required to achieve self-sufficiency in rice by 2025 are profitable for the private sector. In terms of the program's contribution to the overall welfare of the country and to the national objectives, the estimated gross domestic value-added (which measures the real monetary contribution of the project to the economy of the country in terms of direct and indirect generated value added) is US$ 369.72 million. This represents the contribution of the project to the GDP. The estimated net national value added (which represents the contribution to national welfare) is US$ 293.98 million. The economic internal rate of rate return is 24.35%. In total, 62,555 direct employments will be created through the investments.

Sensibility analysis shows that the investments remain profitable under both pessimistic (-10% of the price) and optimistic (+10% of the price) scenarios. The NPV ratio is greater than zero in both cases. Under optimistic scenarios, the investments will generate a benefits/costs ratio (NPV ratio to investment) of 1.95, a net profit of US$ 211.31 million, with an MIRR of 97.92%. Under pessimistic scenarios, the investments will generate a benefits/costs ratio (NPV ratio to investment) of 1.16, a net profit of US$ 125.73 million, with an MIRR of 52.34%. In addition, the break-even point analysis shows that the investments remain profitable even with a 67.38% reduction of the market price.

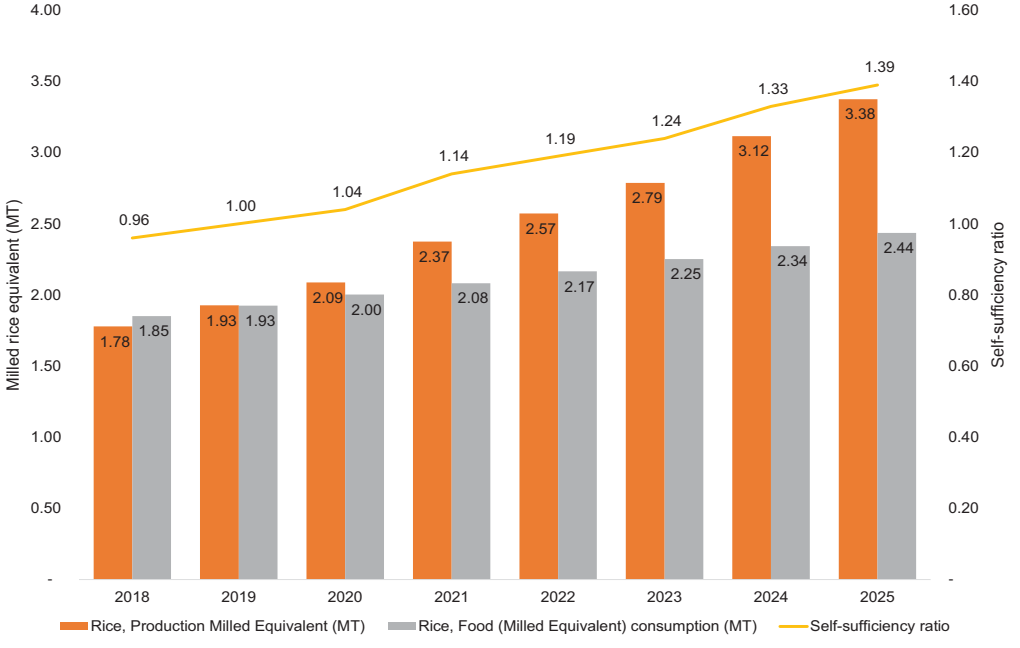


Figure A6.1: Milled rice production and consumption versus self-sufficiency in Mali (US$ million)

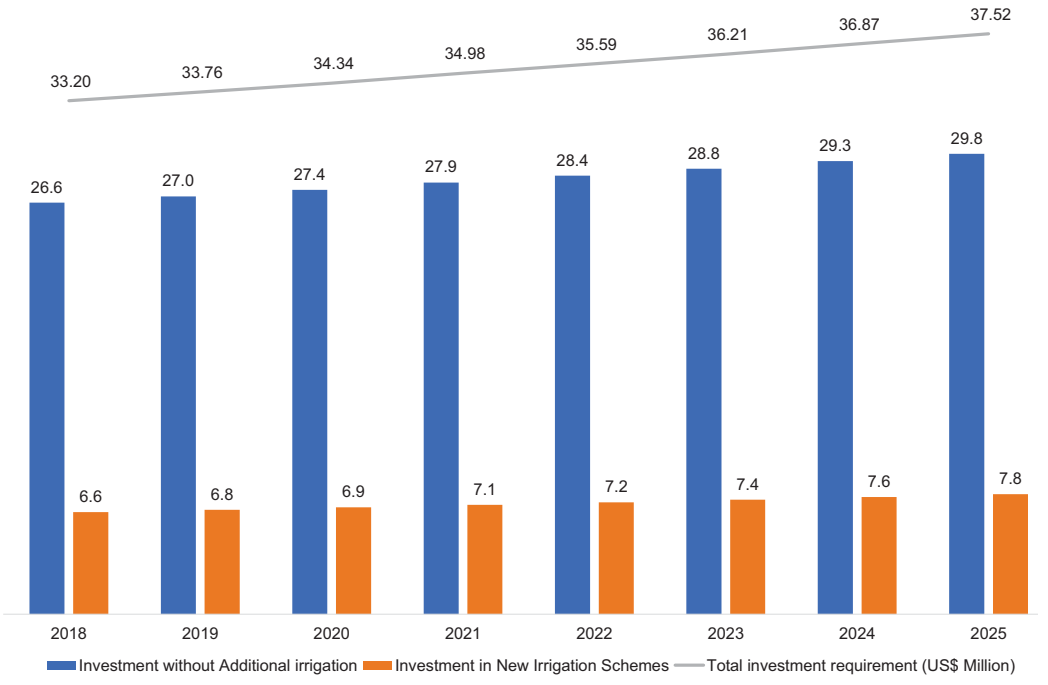


Figure A6.2: Additional irrigation and non-irrigation investments required by Mali (US$ million)

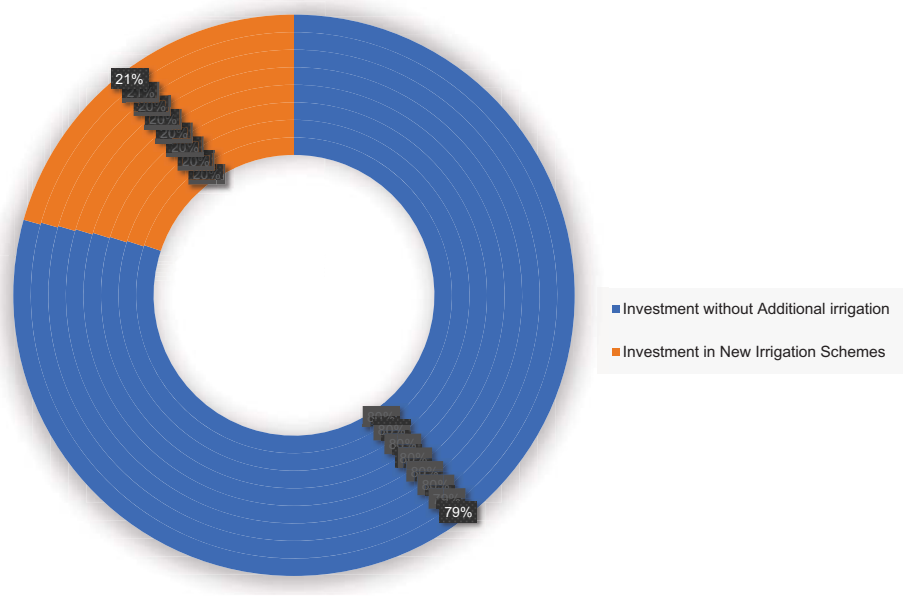


Figure A6.3: Additional irrigation and non-irrigation investments required by Mali (%)

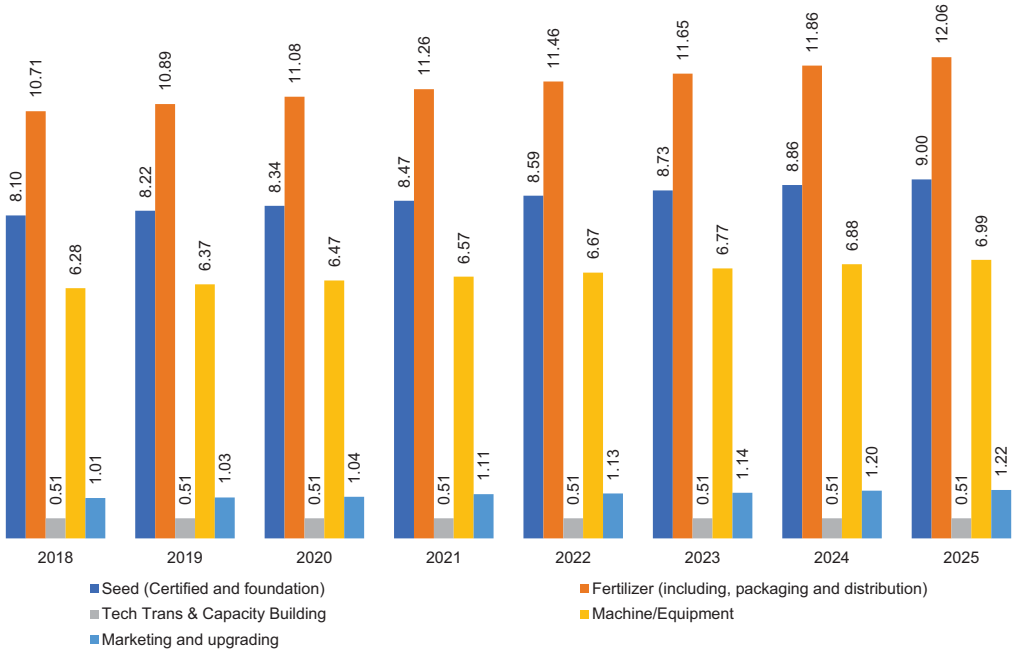


Figure A6.4: Composition of new (non-irrigation) investments required by Mali (US$ million)

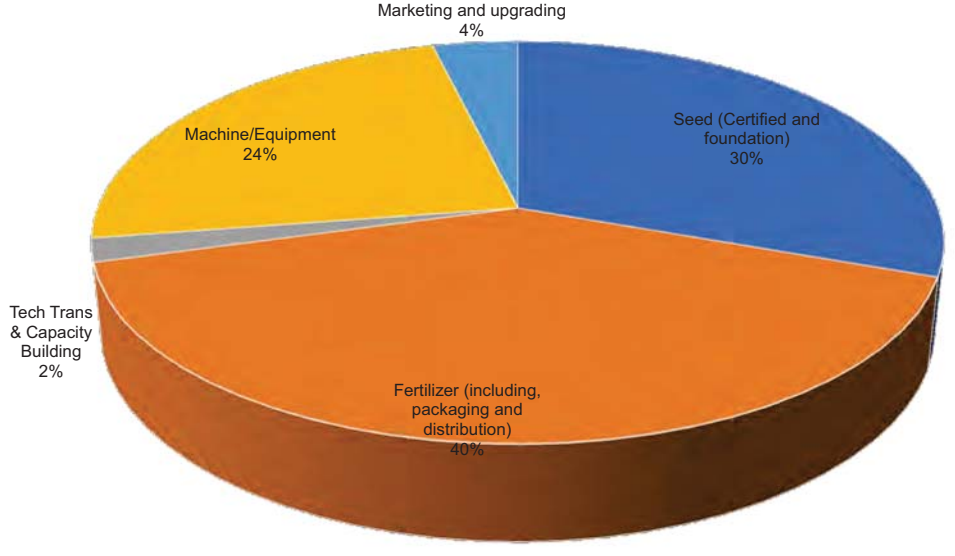


Figure A6.5: Distribution of required new non-irrigation investments in Mali (%)

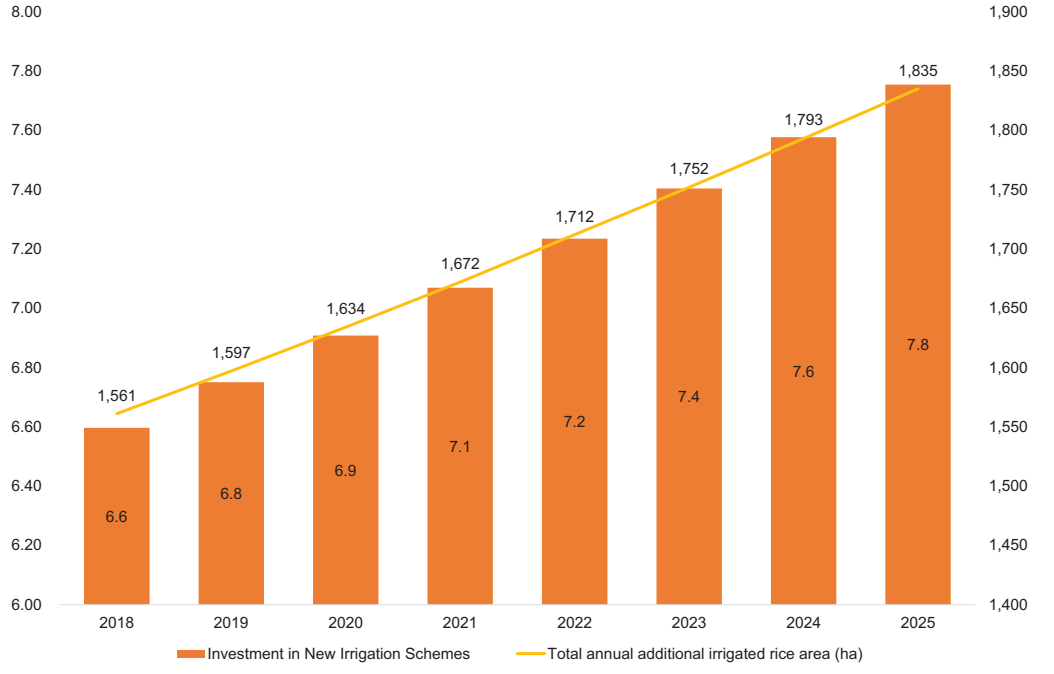


Figure A6.6: Additional irrigated rice area (ha) versus new irrigation investments (US$ Million) in Mali

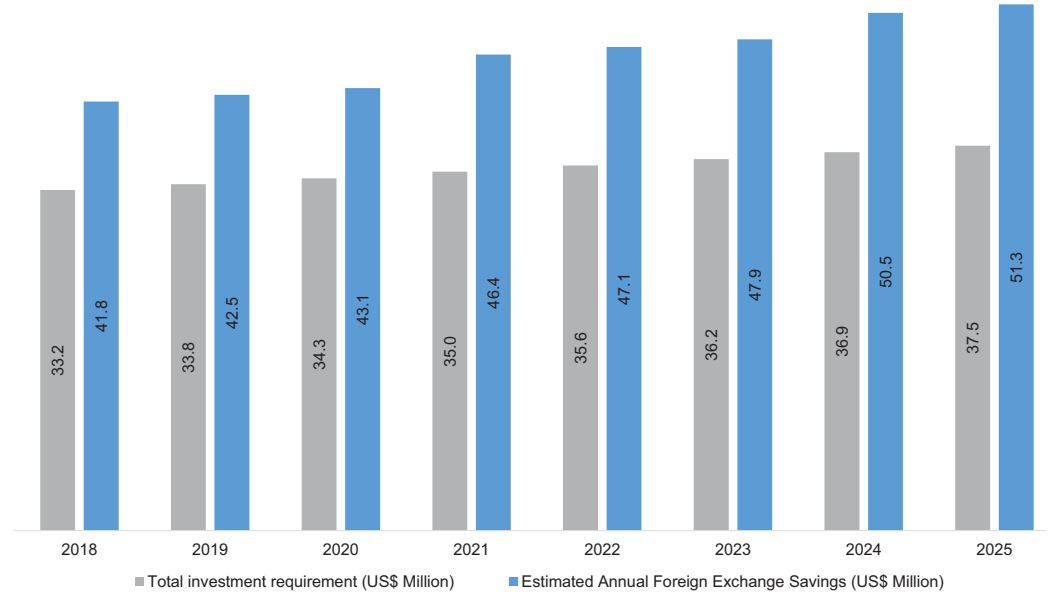


Figure A6.7: Estimated annual new costs versus foreign exchange savings by Mali (US$ Million)

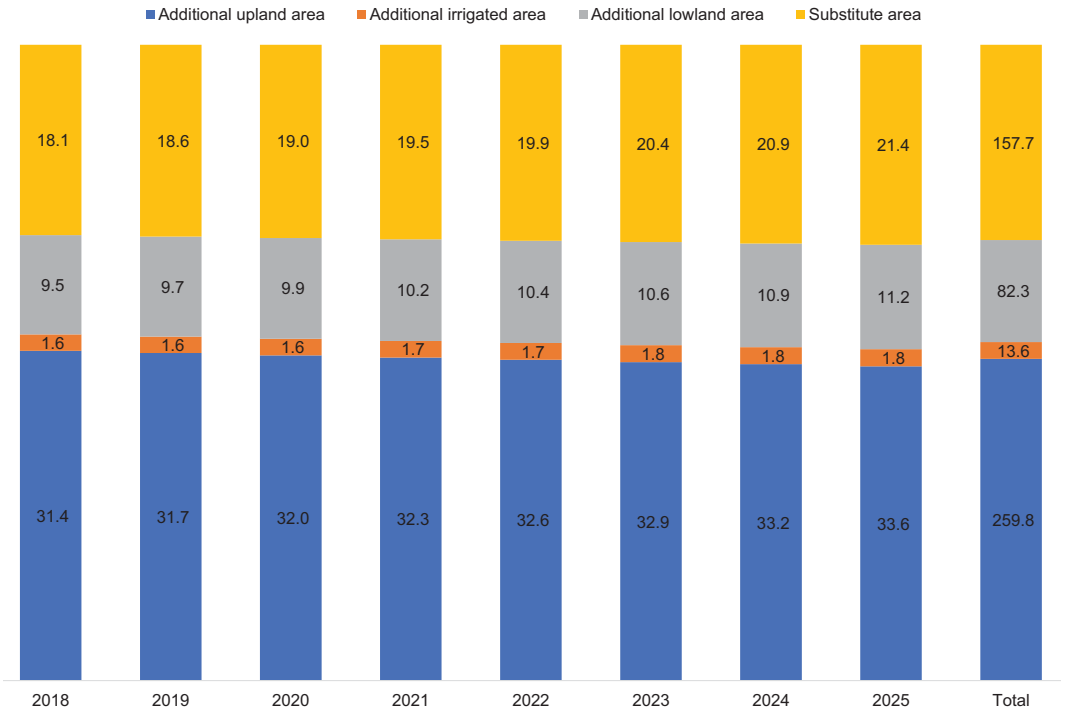


Figure A6.8: Gains from CIPRiSSA in Mali 1: Rice area expansion per ecology ('000 ha)

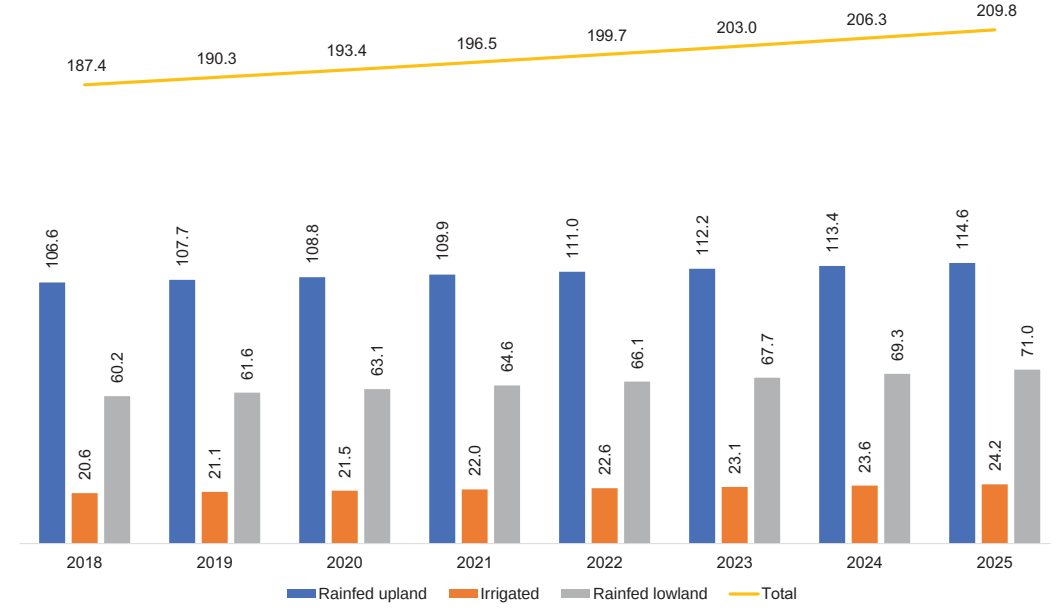


Figure A6.9: Expected gains from CIPRiSSA in Mali 2: Expected additional production per ecology ('000 tons)

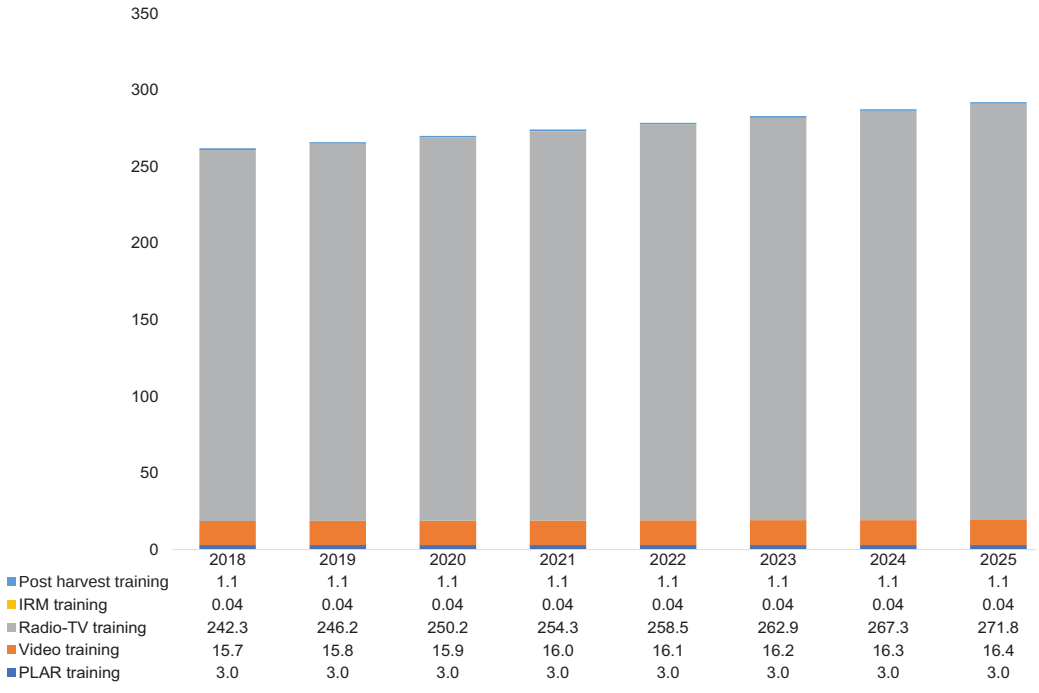


Figure A6.10: Expected gains in Mali from CIPRiSSA 3: Number of farmers and other actors targeted for training ('000 persons)

Figure A6.11: Expected gains from CIPRiSSA in Mali 4: Number of beneficiary households targeted ('000 households)

Table A6: Projected estimates for required investments, production gains, hectarage, and farming households for Mali

MALI	2018	2019	2020	2021	2022	2023	2024	2025
PROJECTED STATISTICS ON RICE (production, consumption import)								
Rice, paddy production (T)	2,964,236	3,211,439	3,479,257	3,769,410	4,083,761	4,424,327	4,793,294	5,193,031
Rice, production milled equivalent (T)	1,778,542	1,926,863	2,087,554	2,374,729	2,572,769	2,787,326	3,115,641	3,375,470
Rice, food (milled equivalent) consumption (T)	1,851,023	1,925,064	2,002,067	2,082,150	2,165,435	2,252,053	2,342,135	2,435,820
Self-sufficiency ratio	0.96	1.00	1.04	1.14	1.19	1.24	1.33	1.39
ADDITIONAL GAIN FROM THE PROGRAM								
Expected additional production from rainfed upland (T)	106,611	107,672	108,758	109,870	111,010	112,176	113,370	114,593
Expected additional production from irrigated (T)	20,573	21,053	21,544	22,048	22,563	23,091	23,631	24,184
Expected additional production from rainfed lowland (T)	60,166	61,603	63,075	64,583	66,126	67,707	69,326	70,983
Expected additional production from the 3 ecologies (T)	187,350	190,328	193,378	196,501	199,699	202,974	206,327	209,761
Expected additional production from technology adoption (T)	3,533	3,540	3,547	3,554	3,561	3,569	3,576	3,584
Expected additional paddy production from the program (T)	190,883	193,868	196,925	200,055	203,260	206,542	209,903	213,345
Expected additional rice, food (milled equivalent) from the program (T)	114,530	116,321	118,155	126,035	128,054	130,122	136,437	138,674
Estimated foreign exchange savings (US$ per year)	41,828,975	42,474,970	43,136,468	46,403,553	47,138,677	47,891,444	50,473,744	51,292,779
PRODUCERS and AREA TARGETED								
Number of upland rice farming households targeted	63,866	65,399	66,968	68,575	70,221	71,906	73,632	75,399
Number of substitute farming households targeted (upland rice)	77,768	77,768	77,768	77,768	77,768	77,768	77,768	77,768
Total number of upland rice farmers	141,634	143,167	144,737	146,344	147,990	149,675	151,401	153,168

MALI	2018	2019	2020	2021	2022	2023	2024	2025
Number of irrigated rice farming households targeted	24,969	25,552	26,148	26,759	27,384	28,025	28,681	29,352
Number of lowland rice farming households targeted	75,674	77,482	79,334	81,230	83,171	85,159	87,195	89,280
Total number of farmers/trainees targeted	242,278	246,201	250,219	254,333	258,545	262,859	267,277	271,800
Number of farmers targeted by PLAR training	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Number of farmers targeted by Video training	15,698	15,788	15,879	15,973	16,069	16,168	16,269	16,372
Number of farmers targeted by Radio-TV training	242,278	246,201	250,219	254,333	258,545	262,859	267,277	271,800
Number of trainees targeted by IRM training	40	40	40	40	40	40	40	40
Number of trainees targeted by post harvest training	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050
Number of villages targeted by PLAR training	100	100	100	100	100	100	100	100
Number of villages targeted by Video training	219	220	221	222	223	224	225	226
Number of villages targeted by Radio-TV training	2,423	2,462	2,502	2,543	2,585	2,629	2,673	2,718
Total rice area targeted (ha)	60,569	61,550	62,555	63,583	64,636	65,715	66,819	67,950
Total additional upland rice area (ha)	31,417	31,704	31,999	32,300	32,609	32,925	33,248	33,579
Total additional irrigated rice area (ha)	1,561	1,597	1,634	1,672	1,712	1,752	1,793	1,835
Total additional lowland rice area (ha)	9,459	9,685	9,917	10,154	10,396	10,645	10,899	11,160
Total additional rice area (ha)	42,437	42,987	43,550	44,126	44,717	45,321	45,940	46,574
Total rice areas already on rice (ha)	18,133	18,564	19,005	19,457	19,920	20,394	20,879	21,376
INPUTS (quantity and cost)								
Seed								
Total foundation seed equivalent (T)	75	76	77	78	79	80	81	83

MALI	2018	2019	2020	2021	2022	2023	2024	2025
Total certified seed requirement (T)	3,320	3,372	3,424	3,478	3,533	3,590	3,648	3,707
Production cost of the foundation seed (US$)	146,614	148,749	150,935	153,173	155,465	157,812	160,215	162,676
Production cost of the certified seed (US$)	7,494,440	7,604,989	7,718,191	7,834,109	7,952,810	8,074,360	8,198,827	8,326,281
Cost of storage, weighing, packaging of certified seed	451,891	458,889	466,055	473,394	480,908	488,603	496,482	504,551
Cost of distribution of certified seed (US$)	5,120	5,203	5,288	5,375	5,464	5,555	5,649	5,744
Total cost of certified seed package (including, packaging and distribution)	7,951,451	8,069,081	8,189,534	8,312,878	8,439,183	8,568,518	8,700,958	8,836,576
Total cost of seed (certified and foundation)	8,098,065	8,217,830	8,340,469	8,466,051	8,594,647	8,726,330	8,861,173	8,999,252
Fertilizer								
Total Urea (T)	7,315	7,443	7,574	7,708	7,846	7,986	8,130	8,278
Total NPK (T)	6,057	6,155	6,255	6,358	6,464	6,571	6,682	6,795
Total Fertilizer (T)	13,372	13,598	13,829	14,066	14,309	14,558	14,812	15,073
Total cost of Urea (US$)	3,035,721	3,088,827	3,143,208	3,198,894	3,255,917	3,314,308	3,374,100	3,435,328
Total cost of NPK (US$)	4,554,823	4,628,582	4,704,112	4,781,455	4,860,654	4,941,753	5,024,799	5,109,838
Total cost of fertilizer (US$)	7,590,544	7,717,410	7,847,320	7,980,349	8,116,570	8,256,061	8,398,900	8,545,166
Cost of fertilizer transport and distribution	3,121,010	3,173,770	3,227,797	3,283,120	3,339,771	3,397,782	3,457,185	3,518,014
Total cost of fertilizer (including, packaging and distribution)	10,711,553	10,891,180	11,075,117	11,263,469	11,456,342	11,653,843	11,856,085	12,063,180
Technology transfer and Capacity building								
Cost of PLAR training	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
Cost of Video (training	65,812	66,081	66,356	66,638	66,926	67,222	67,524	67,834
Cost of Radio-TV (training	4,846	4,924	5,004	5,087	5,171	5,257	5,346	5,436
Cost of IRM training	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Cost of post-harvest (GEM, ASI/ ATA thresher-cleaner) training	74,500	74,500	74,500	74,500	74,500	74,500	74,500	74,500
Total technology transfer and capacity building cost	505,158	505,505	505,860	506,224	506,597	506,979	507,369	507,770

MALI	2018	2019	2020	2021	2022	2023	2024	2025
Machine/Equipment (quantity and cost)								
Number of tractors (for a fraction of the additional areas)	5	5	5	6	6	6	6	6
Number of power tiller (for a fraction of the additional areas)	341	345	349	354	358	363	368	373
Number of ASI/ATA thresher-cleaner (for a fraction of the additional production)	318	323	328	333	339	344	350	356
Number of mini-milling machine	64	65	66	67	68	69	70	71
Number of GEM parboilers (for a fraction of the additional production)	35	36	36	37	38	38	39	40
Total cost tractor (US$)	345,170	353,221	361,466	369,909	378,555	387,408	396,474	405,757
Total cost of power tiller (US$)	2,130,950	2,157,715	2,185,122	2,213,188	2,241,926	2,271,355	2,301,490	2,332,348
Total cost of ASI/ATA thresher-cleaner (US$)	1,479,210	1,502,343	1,526,031	1,550,288	1,575,127	1,600,562	1,626,608	1,653,278
Total cost of mini milling machine (US$)	1,613,684	1,638,920	1,664,762	1,691,223	1,718,320	1,746,068	1,774,481	1,803,576
Total cost of GEM (US$)	706,973	718,029	729,351	740,944	752,815	764,972	777,420	790,167
Total cost of machine/ equipment (US$)	6,275,986	6,370,228	6,466,732	6,565,552	6,666,744	6,770,365	6,876,472	6,985,126
Marketing and upgrading (cost)								
Cost of training/meeting on branding and packaging (US$)	4,116	4,116	4,116	4,116	4,116	4,116	4,116	4,116
Cost of participation and exhibition in trade fair (US$)	7,473	7,473	7,473	7,473	7,473	7,473	7,473	7,473
Cost of marketing campaigns (US$)	50,655	50,655	50,655	50,655	50,655	50,655	50,655	50,655
Cost of high quality bags for the packaging of the additional milled rice (US$)	952,231	967,123	982,372	1,047,886	1,064,676	1,081,868	1,134,377	1,152,977
Total cost of marketing and upgrading (US$)	1,014,475	1,029,367	1,044,616	1,110,130	1,126,920	1,144,112	1,196,621	1,215,221
TOTAL COST WITHOUT IRRIGATION SCHEMES	26,605,237	27,014,110	27,432,795	27,911,428	28,351,250	28,801,629	29,297,720	29,770,549

MALI	2018	2019	2020	2021	2022	2023	2024	2025
Total additional irrigation scheme by 2025 (ha) planned by each country (a)	2,222	22,222	22,222	22,222	22,222	22,222	22,222	22,222
Annual additional irrigation scheme by 2025 (ha) planned by each country (b) = (a)/8	2,778	2,778	2,778	2,778	2,778	2,778	2,778	2,778
Total annual additional irrigated rice area (ha) from CIPRiSSA (c)	1,561	1,597	1,634	1,672	1,712	1,752	1,793	1,835
(b)-(c)	1,217	1,181	1,143	1,105	1,066	1,026	985	943
Cost of new irrigation schemes from CIPRiSSA (US$)	6,596,436	6,750,313	6,907,882	7,069,233	7,234,456	7,403,645	7,576,894	7,754,301

Nigeria

Country Background

Nigeria is by far the most populous country in Africa, nearly equaling the combined populations of the next two ranking countries – Ethiopia and Egypt[76]. Official World Bank estimates put the country's population at approximately 181 million[77] or 47% of West Africa's population, and attribute to it one of the largest youth populations in the world[78].The country is a federation consisting of 36 autonomous states plus a federal capital territory and a multi-ethnic and culturally diverse society. The country has abundant natural resources, is Africa's biggest oil exporter, and has the continent's largest natural gas reserves.[79]

Nigeria's economy is the biggest in Africa and 27th in the world, with a GDP of US$486.7 billion as of 2015.[80] However, the oil-based economy has been performing sluggishly since 2015 due to the crash of oil prices in mid-2014. The economy grew by only 2.7% in 2015, significantly below the 6.3% growth of 2014, but it went into recession throughout 2016 and the first quarter of 2017. Official figures indicate that the economy climbed out of recession in the second quarter of 2017 with a 0.1% growth. Inflation doubled to 18.8% at the end of 2016 from 9.6% in 2015, but has eased somewhat to 16.1% at the end of June 2017.[81] However, the World Bank predicts average inflation to "likely remain at double digits over 2017/2018" and the economy to "grow by about 1% in 2017 and 2.5% in 2018, based on an expected increase in oil output, as well as the accelerated implementation of public and social investment projects by the Federal Government."[82] Nigeria's economy is private sector-driven, and the recent lower growth rate of the economy has led to renewed focus on economic diversification, promotion of growth in the private sector, and employment creation.[83]

Nigeria is, however, a food-deficit country. Agriculture is primarily rainfed, characterized by low productivity, low technology use and high labor intensity.[84] Nevertheless, value addition in the agricultural sector has been growing rapidly since 2005, averaging about 7% annually.[85] All parts of the country are rich in agricultural produce. The northern regions traditionally farm sorghum, millet, and maize, while the central and southern regions farm cassava, yam, plantain, maize, and sorghum. Rice is an essential cash crop, farmed in nearly all sections. However, production is

[76]United Nations, Department of Economic and Social Affairs, Population Division (UN DESA), 2017.
[77]Other estimates, including the FAO Facts Sheets put the country's population at over 190 million; see also other estimates at UN DESA, *Op. cit*.
[78]http://www.worldbank.org/en/country/nigeria/overview .
[79]Ibid.
[80]World Bank, 2015b.
[81]Estimates from the country's National Bureau of Statistics, www.nigerianstat.gov.ng..
[82]http://www.worldbank.org/en/country/nigeria/overview, *Op. cit*.
[83]Ibid.
[84]FAO, 2017.
[85]Ibid which cites *IFPRI. 2016. Delving Deeper into the Agricultural Transformation and Youth Employment Nexus: The Nigerian Case*.

mostly small-scale, which accounts for "80% of total production and only 20% of consumption".[86] Cash crops previously generated significant revenues, but neglect of new investments from the 1970s due to prioritization of the oil sector reduced the influence of agriculture on the economy, and left the country highly vulnerable to fluctuating world oil prices. Today, Nigeria is one of the largest rice producers in Africa, but also one of the largest rice importers in the world.[87]

The country is currently implementing policies to redress the situation and "transform agriculture into a sustainable and profitable sector with a focus on increasing agricultural productivity and production for direct consumption and processing for local market and export".[88] Nigeria's Vision 20: 2020 (2009) is the country's "long-term economic blueprint" expressing this policy. Shorter-term development documents anchoring on Vision 20: 2020 include the:

- New Medium-Term Plan 2010–2013, the National Agricultural Sector Strategy (NASS) and a five-point agricultural agenda, which is largely consistent with CAADP[89]
- Agriculture Transformation Agenda (ATA) 2013–2015
- National Agriculture and Food Security Strategy (NAFSS, 2010–2020)
- Green Alternative: Agriculture Promotion Policy (2016 – 2020) that builds on the successes of the ATA
- National Policy on Food and Nutrition, launched in 2016
- CAADP National Agricultural Investment Plan (NAIP, 2011–2014), and
- National Agriculture and Food Security Programme

In 2017, the Federal Government launched the Synthesis Report of the Nigeria Zero Hunger Strategic Review, which is a strategic plan and road map to achieve SDG2[90] (End hunger, achieve food security and improved nutrition, and promote sustainable agriculture) by 2030. The government also launched the Economic Recovery and Growth Plan (ERGP) 2017–2020 – a new medium-term plan to tackle the economic crisis, restore growth, and ensure sustainable and inclusive growth.

CIPRiSSA Results for Nigeria

Self-Sufficiency

Based on data for the period 2006 to 2012, rice production in Nigeria grew at 9% annually and the country will attain 89% sufficiency in 2018 and 131% by 2025 (Figure A7.1).

[86]Ibid.
[87]Ibid.
[88]Ibid.
[89]The AU/NEPAD Comprehensive African Agricultural Development Plan was originally launched in Maputo, Mozambique in 2003 and reinforced in Malabo, Equatorial Guinea in 2014 with the following four pillars (down from the original five): water management, rural infrastructure, increasing food supply, and technology transfer to the agricultural sector.
[90]Sustainable Development Goals.

Paddy and Milled Rice Production

Paddy production will increase progressively from 8.9 MT in 2018 to 15.80 MT in 2025, amounting to a cumulative total of 96.53 MT. This will yield 60.55 MT milled rice equivalent with annual targets ranging from 5.34 MT in 2018 to 10.27 MT in 2025. The total milled rice food equivalent will be 54.94 MT, progressively increasing from 5.96 MT in 2018 to 7.85 MT in 2025 (Figure A7.1, Table A7).

New Investments

Additional irrigation and non-irrigation investments amounting to US$ 433 million are required to realize these potentials (Figures A7.2 and A7.3; Table A7). The total additional non-irrigation costs of US$ 291 million (or 67% of the total cost of new investments) comprise annual expenditures ranging from US$ 34 million in 2018 to US$ 39 million in 2025. The total additional irrigation costs of US$ 141 million (or 33% of total investments) will include annual expenditures ranging from US$ 16 million in 2018 to US$ 19 million in 2025.

Nigeria's priority non-irrigation investment domains in the rice value chain (Figure A7.4) include: (i) fertilizer procurement/distribution (39% of non-irrigation investment or US$ 114.9 million); (ii) machines/equipment (30% of non-irrigation investment or US$ 86.6 million); (iii) quality seeds production/distribution (26% of non-irrigation investment or US$ 75.0 million); (iv) marketing and upgrading of the rice value chain (4% of non-irrigation investment or US$ 10.6 million); and (v) technology transfer and capacity building of actors in the value chain (1% of non-irrigation investment or US$ 4.3 million) (Figure A7.5). Fertilizer, machinery, and seeds together constitute the most important cost elements, accounting for 95% of total costs. Year-on-year, fertilizer costs will range from US$ 13.28 million in 2018 to US$ 15.50 million in 2025, amounting to a total of US$ 114.90 million. The estimated cost of new machinery and equipment ranges from US$ 10.03 million in 2018 to US$ 11.65 million in 2025. The annual costs of seeds range from US$8.70 million in 2018 to US$ 10.10 million in 2025 (Figure A7.4).

Under CIPRiSSA, Nigeria will bring 23,584 ha additional land under irrigation, increasing annually from 2,710 ha in 2018 to 3,198 ha in 2025 (Figures A7.6 and A7.8)

Benefits

CIPRiSSA will save Nigeria US$ 444.29 million in foreign exchange, ranging from US$ 49.1 million in 2018 to US$ 62.6 million in 2025 (Figure A7.7). Through training in PLAR, video, radio-TV, IRM, and post-harvest practices, the program will benefit 2.49 million farm households, increasing progressively from 288,510 in 2018 to 336,390 in 2025 (Figures A7.10 and A7.11). Of the total target of 623,765 ha, 355,590 ha will be new/additional rice fields including 178,826 ha of rainfed

upland, 23,584 ha of irrigated and 153,180 ha of rainfed lowland (Figure A7.8). This expansion will increase paddy production by between 218,627 T (135,492 T of milled rice) in 2018 and 255,069 T (170,526 T of milled rice) in 2025 (Figure A7.9; Table A7).

Profitability analysis

Excluding investments in new irrigation schemes, Nigeria needs to invest US$ 291.42 million to achieve 131% self-sufficiency by 2025, with an average annual operational cost of US$ 36.43. These investments will generate a benefits/costs ratio (NPV ratio to investment) of 1.54, an NPV of US$ 202.14 million, with an MIRR of 71.88%. Thus, each dollar invested in the program will generate a net benefit of US$ 1.54. The NPV is much higher than zero, indicating that the investments are profitable. CIPRiSSA will remain viable as long as the financial rate of alternative investment projects in the country is less than 71.88%.

The projected investment of US$ 432.60 million includes the construction of new irrigation schemes, at an average annual cost of US$ 54.07 million. This investment will generate a net profit of US$ 137.79 million, a benefits/costs ratio of 0.55, and an MIRR of 26.81% (Table A12).

The estimated payback period of the investments is 3 years (by 2020), meaning that all investments will be recovered before the end of the program. The investments required to achieve self-sufficient in rice by 2025 is therefore profitable for private sector involvement.

Regarding the program's contribution to the overall welfare of the country and to the national objectives, the estimated gross domestic value-added (which measures the real monetary contribution of the project to the economy of the country in term of direct and indirect generated value added) is US$ 424.91million and this represents the program's contribution to the GDP. The projected net national value added (which represents the contribution to national welfare) is US$ 331.58 million. The economic internal rate of rate return is 23.61%. In total, the program will create 75,347 direct employments.

Sensibility analysis shows that the proposed investments remain profitable under both pessimistic (-10% of the price) and optimistic (+10% of the price) scenarios, since the NPV ratio is greater than zero in the two cases. Under optimistic scenarios, the investments will generate a benefits/costs ratio (NPV ratio to investment) of 1.93, a net profit of US$ 253.74 million, and an MIRR of 95.24%. Under pessimistic scenarios, the investments will generate a benefits/costs ratio (NPV ratio to investment) of 1.15, a net profit of US$ 150.54 million, with an MIRR of 50.49%. In addition, the break-even point analysis shows that the investments remain profitable even with a 65.65% reduction in the market price.

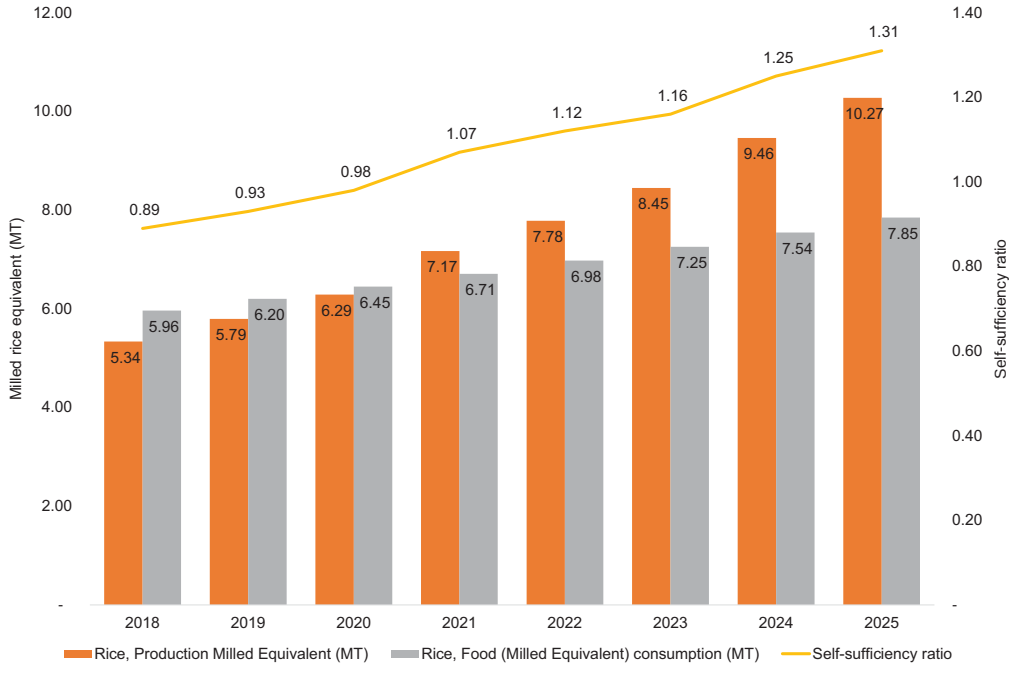


Figure A7.1: Milled rice production and consumption versus self-sufficiency in Nigeria

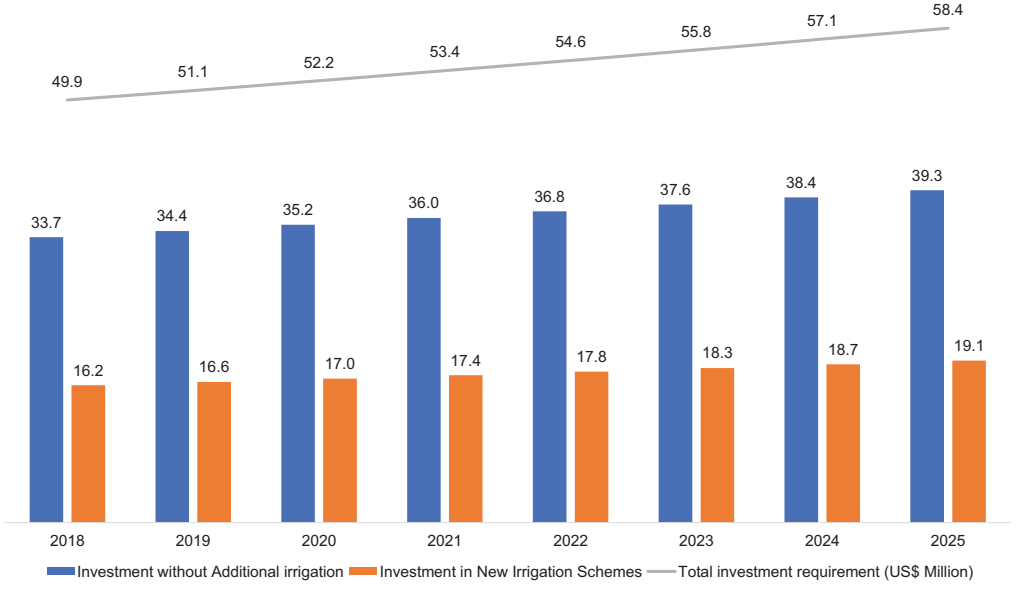


Figure A7.2: Additional irrigation and non-irrigation investments required by Nigeria (US$ million)

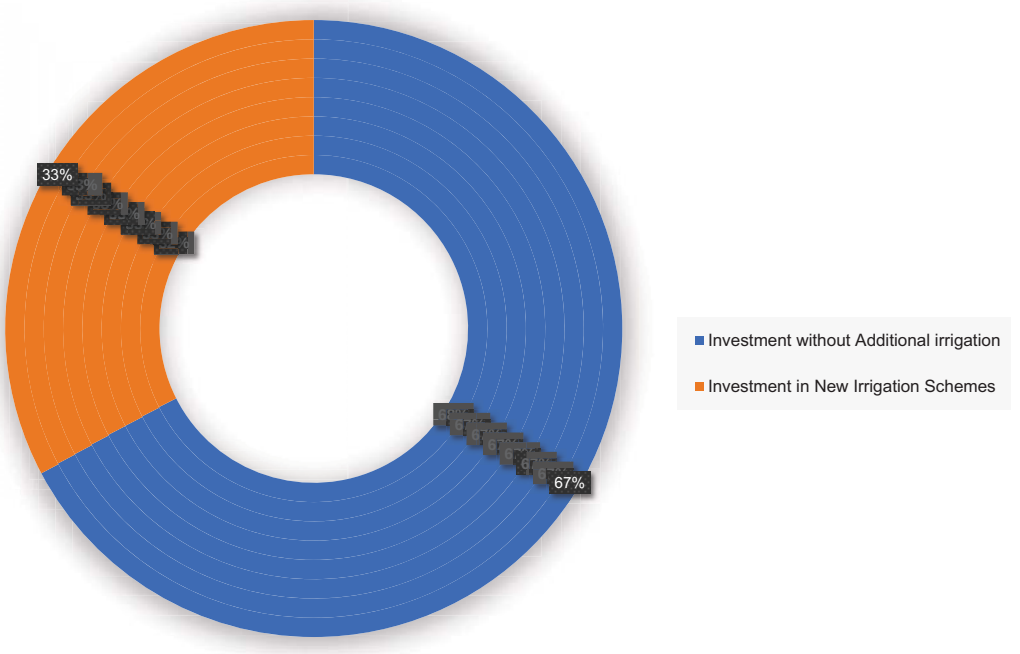


Figure A7.3: Additional irrigation and non-irrigation investments required by Nigeria (%)

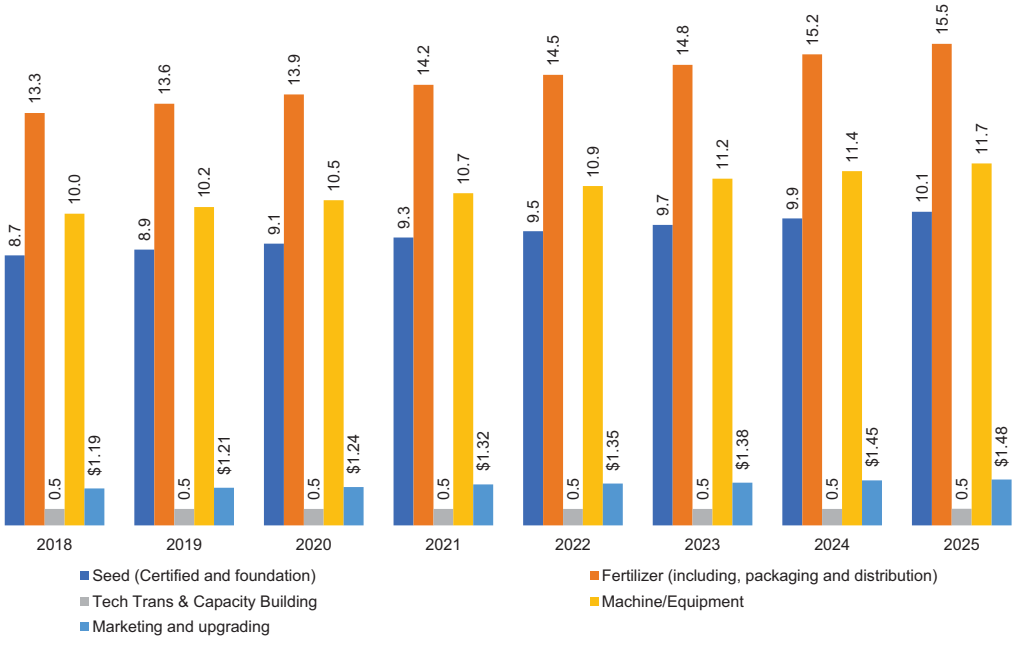


Figure A7.4: Composition of new (non-irrigation) investments required by Nigeria (US$ million)

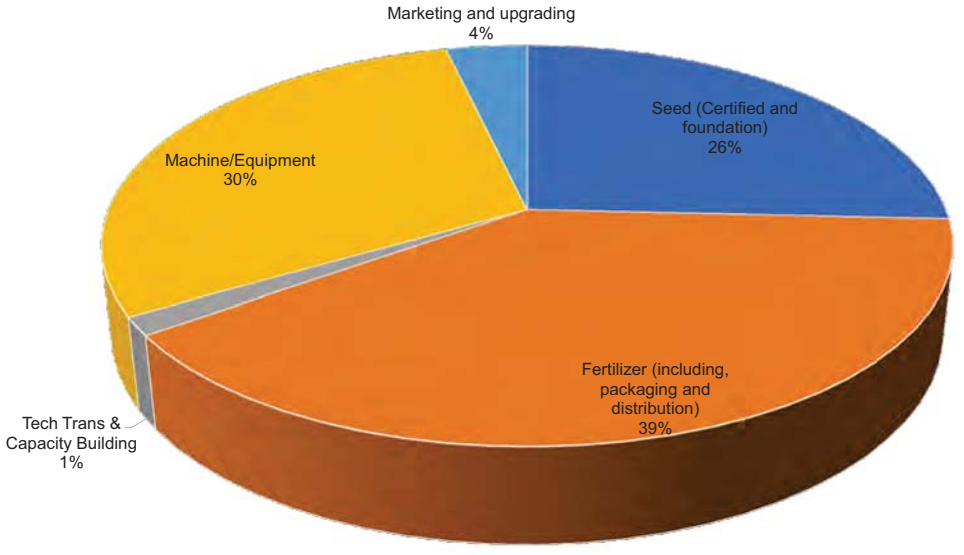


Figure A7.5: Distribution of new non-irrigation investments required in Nigeria (%)

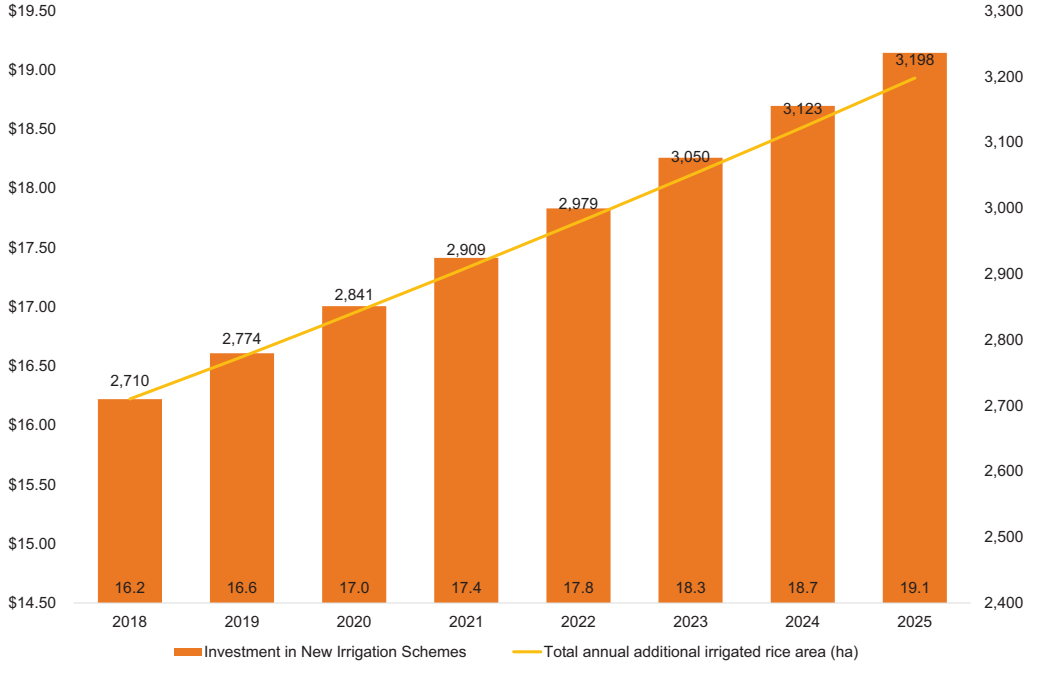


Figure A7.6: Additional irrigated rice area (ha) versus new irrigation Investments in Nigeria (US$ million)

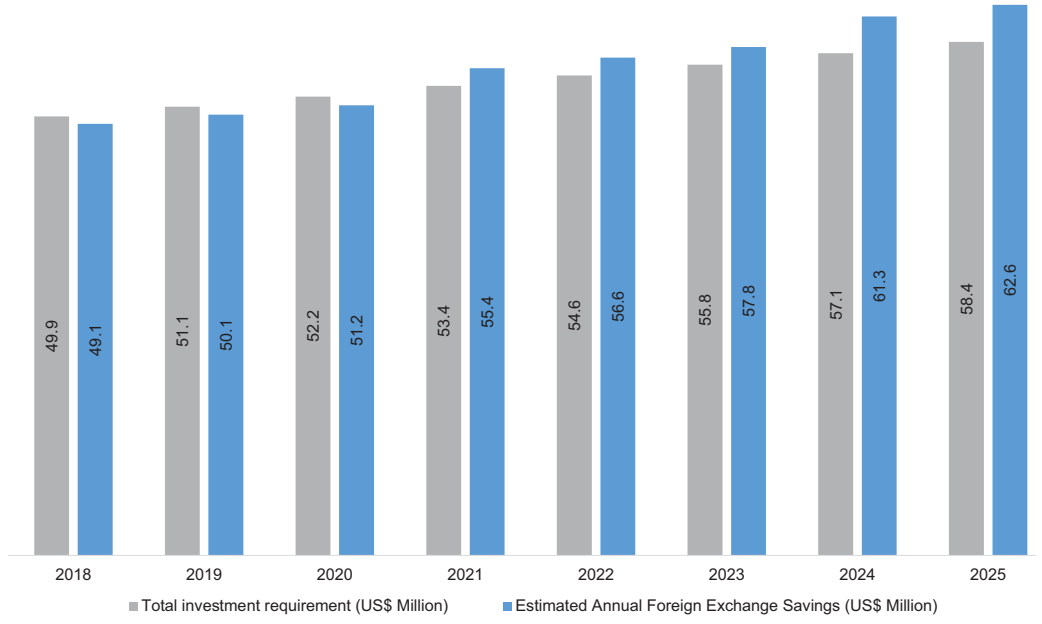


Figure A7.7: Estimated annual new investments costs versus annual savings for Nigeria (US$ million)

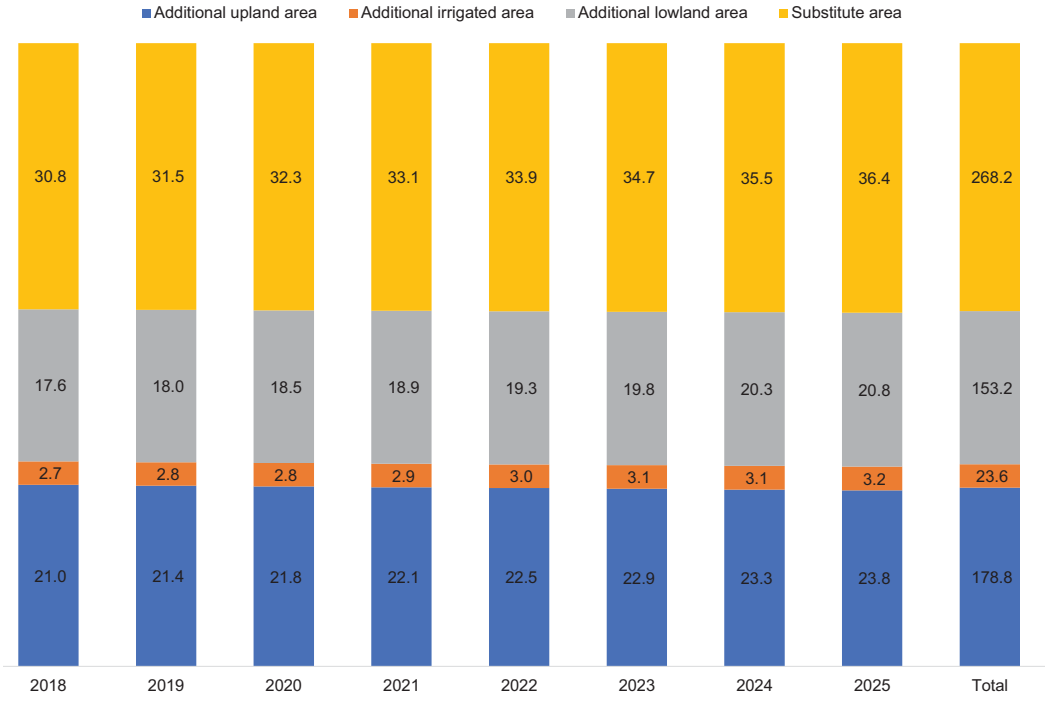


Figure A7.8: Expected gains from CIPRiSSA in Nigeria 1: Rice area expansion per ecology ('000 ha)

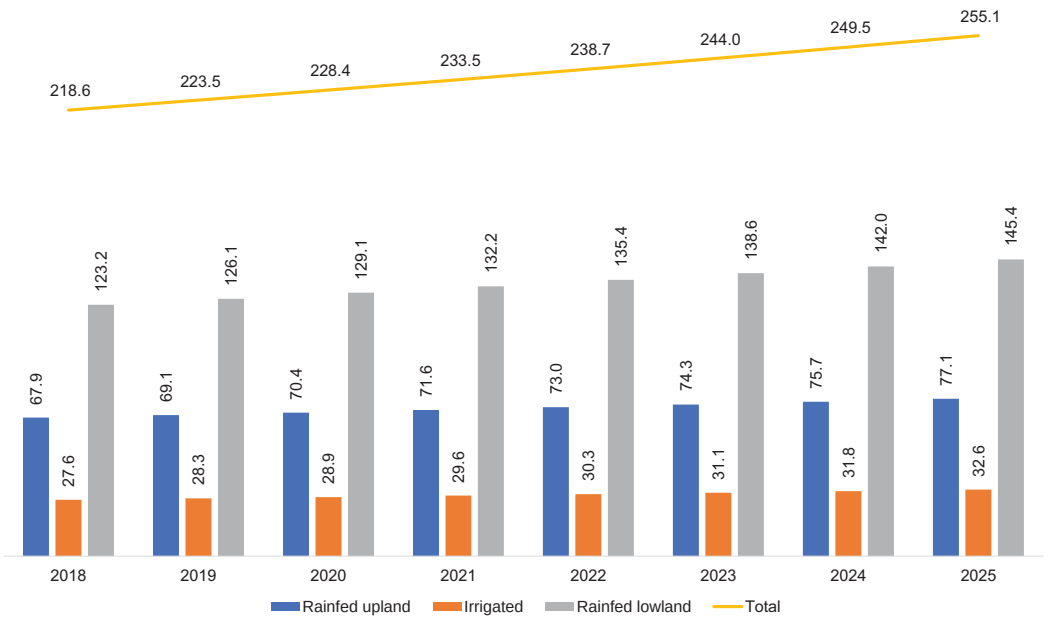


Figure A7.9: Expected gains from CIPRiSSA in Nigeria 2: Expected additional production per ecology ('000 tons)

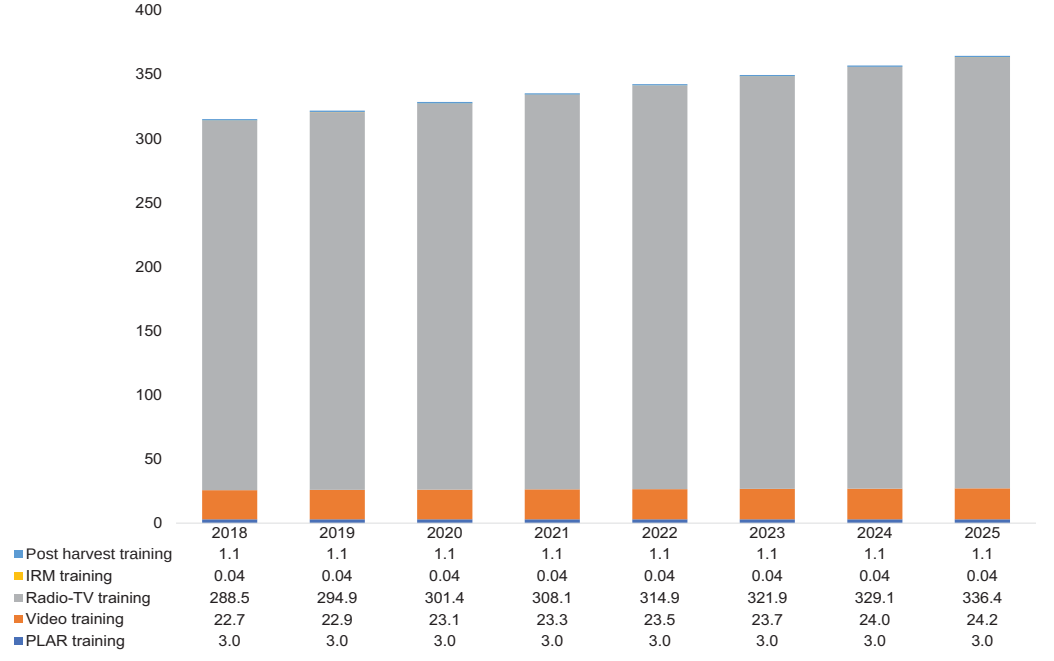


Figure A7.10: Expected gains from CIPRiSSA in Nigeria 3: Number of farmers and other actors targeted for training ('000 persons)

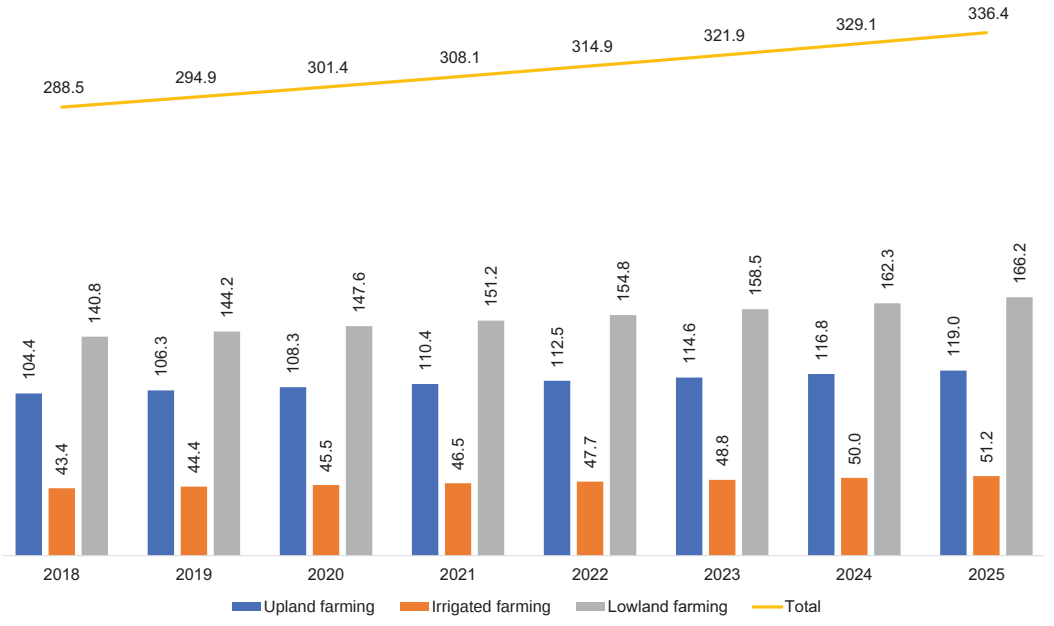


Figure A7.11: Expected gains from CIPRiSSA in Nigeria 4: Number of beneficiary households targeted ('000 households)

Table A7: Projected estimates of required investments, production gains, land area, and farming households for Nigeria (2018-2025)

NIGERIA	2018	2019	2020	2021	2022	2023	2024	2025
PROJECTED STATISTICS ON RICE (Production, consumption import)								
Rice, paddy production (T)	8,893,021	9,654,249	10,480,638	11,377,763	12,351,682	13,408,966	14,556,752	15,802,787
Rice, production milled equivalent (T)	5,335,812	5,792,549	6,288,383	7,167,991	7,781,560	8,447,649	9,461,889	10,271,812
Rice, food (milled equivalent) consumption (T)	5,962,816	6,201,329	6,449,382	6,707,357	6,975,651	7,254,677	7,544,864	7,846,659
Self-sufficiency ratio	0.89	0.93	0.98	1.07	1.12	1.16	1.25	1.31
ADDITIONAL GAIN FROM THE PROGRAM								
Expected additional production from rainfed upland (T)	67,869	69,097	70,354	71,641	72,960	74,310	75,692	77,108
Expected additional production from irrigated (T)	27,604	28,266	28,943	29,637	30,347	31,074	31,819	32,582
Expected additional production from rainfed lowland (T)	123,154	126,108	129,132	132,229	135,401	138,648	141,974	145,379
Expected additional production from the 3 ecologies (T)	218,627	223,470	228,429	233,508	238,708	244,033	249,485	255,069
Expected additional production from technology adoption (T)	7,193	7,204	7,216	7,228	7,240	7,253	7,266	7,279
Expected additional paddy production from the program (T)	225,820	230,674	235,645	240,736	245,948	251,285	256,751	262,348
Expected additional rice, food (milled equivalent) from the program (T)	135,492	138,405	141,387	151,663	154,947	158,310	166,888	170,526
Estimated foreign exchange savings (US$ per year)	49,092,313	50,140,578	51,214,001	55,429,507	56,622,548	57,844,221	61,310,975	62,640,292

NIGERIA	2018	2019	2020	2021	2022	2023	2024	2025
PRODUCERS and AREA TARGETED								
Number of upland rice farming households targeted	81,328	83,276	85,271	87,313	89,405	91,546	93,740	95,985
Number of substitute farming households targeted (upland rice)	23,050	23,050	23,050	23,050	23,050	23,050	23,050	23,050
Total number of upland rice farmers	104,378	106,326	108,321	110,363	112,455	114,596	116,790	119,035
Number of irrigated rice farming households targeted	43,353	44,392	45,455	46,545	47,660	48,802	49,972	51,170
Number of lowland rice farming households targeted	140,779	144,156	147,613	151,153	154,778	158,491	162,292	166,185
Total number of farmers/trainees targeted	288,510	294,873	301,389	308,061	314,893	321,890	329,054	336,390
Number of farmers targeted by PLAR training	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Number of farmers targeted by Video training	22,734	22,927	23,124	23,327	23,534	23,746	23,963	24,185
Number of farmers targeted by Radio-TV training	288,510	294,873	301,389	308,061	314,893	321,890	329,054	336,390
Number of trainees targeted by IRM training	40	40	40	40	40	40	40	40
Number of trainees targeted by post-harvest training	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050
Number of villages targeted by PLAR training	100	100	100	100	100	100	100	100
Number of villages targeted by Video training	299	301	303	305	307	310	312	314
Number of villages targeted by Radio-TV training	2,885	2,949	3,014	3,081	3,149	3,219	3,291	3,364
Total rice area targeted (ha)	72,128	73,718	75,347	77,015	78,723	80,472	82,263	84,097

NIGERIA	2018	2019	2020	2021	2022	2023	2024	2025
Total additional upland rice area (ha)	21,012	21,377	21,751	22,134	22,526	22,927	23,339	23,760
Total additional irrigated rice area (ha)	2,710	2,774	2,841	2,909	2,979	3,050	3,123	3,198
Total additional lowland rice area (ha)	17,597	18,019	18,452	18,894	19,347	19,811	20,287	20,773
Total additional rice area (ha)	41,319	42,171	43,043	43,937	44,852	45,789	46,748	47,731
Total rice areas already on rice (ha)	30,809	31,548	32,304	33,078	33,871	34,683	35,515	36,366
INPUTS (quantity and cost)								
Seed								
Total foundation seed equivalent (T)	79	80	82	84	86	87	89	91
Total certified seed requirement (T)	3,759	3,841	3,925	4,010	4,098	4,188	4,280	4,375
Production cost of the foundation seed (US$)	154,766	158,067	161,448	164,911	168,456	172,086	175,804	179,610
Production cost of the certified seed (US$)	8,022,560	8,194,463	8,370,491	8,550,744	8,735,323	8,924,331	9,117,876	9,316,066
Cost of storage, weighing, packaging of certified seed	511,615	522,750	534,152	545,828	557,784	570,027	582,564	595,401
Cost of distribution of certified seed (US$)	6,098	6,232	6,370	6,511	6,655	6,803	6,954	7,109
Total cost of certified seed package (including, packaging and distribution)	8,540,273	8,723,445	8,911,013	9,103,082	9,299,762	9,501,161	9,707,394	9,918,577
Total cost of seed (certified and foundation)	8,695,039	8,881,512	9,072,461	9,267,993	9,468,218	9,673,247	9,883,198	10,098,187
Fertilizer								
Total Urea (T)	9,514	9,729	9,948	10,173	10,403	10,638	10,880	11,127
Total NPK (T)	7,213	7,372	7,535	7,702	7,872	8,047	8,226	8,410
Total Fertilizer (T)	16,727	17,101	17,483	17,874	18,275	18,686	19,106	19,536
Total cost of Urea (US$)	3,948,479	4,037,399	4,128,453	4,221,692	4,317,169	4,414,937	4,515,052	4,617,570

NIGERIA	2018	2019	2020	2021	2022	2023	2024	2025
Total cost of NPK (US$)	5,423,994	5,543,618	5,666,114	5,791,549	5,919,995	6,051,524	6,186,209	6,324,127
Total cost of fertilizer (US$)	9,372,473	9,581,017	9,794,567	10,013,241	10,237,164	10,466,461	10,701,261	10,941,696
Cost of fertilizer transport and distribution	3,904,120	3,991,258	4,080,487	4,171,857	4,265,420	4,361,229	4,459,337	4,559,800
Total cost of fertilizer (including, packaging and distribution)	13,276,593	13,572,275	13,875,053	14,185,098	14,502,584	14,827,690	15,160,598	15,501,496
Technology transfer and capacity building								
Cost of PLAR training	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
Cost of Video (training	89,832	90,411	91,003	91,610	92,231	92,867	93,518	94,185
Cost of Radio-TV training	5,770	5,897	6,028	6,161	6,298	6,438	6,581	6,728
Cost of IRM training	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Cost of post-harvest (GEM,ASI/ATA thresher-cleaner) training	74,500	74,500	74,500	74,500	74,500	74,500	74,500	74,500
Total technology transfer and capacity building cost	530,102	530,808	531,531	532,271	533,029	533,805	534,599	535,413
Machine/equipment (quantity and cost)								
Number of tractors (for a fraction of the additional areas)	9	9	9	10	10	10	10	11
Number of power tiller (for a fraction of the additional areas)	322	328	335	342	349	356	364	371
Number of ASI/ATA thresher-cleaner (for a fraction of the additional production)	376	384	393	401	410	419	428	437
Number of mini-milling machine	75	77	79	80	82	84	86	87
Number of GEM parboilers (for a fraction of the additional production)	125	128	131	134	137	140	143	146

NIGERIA	2018	2019	2020	2021	2022	2023	2024	2025
Total cost tractor (US$)	599,297	613,658	628,363	643,422	658,841	674,631	690,800	707,357
Total cost of power tiller (US$)	2,012,753	2,053,795	2,095,821	2,138,856	2,182,923	2,228,049	2,274,257	2,321,574
Total cost of ASI/ATA thresher-cleaner (US$)	1,749,950	1,787,569	1,826,090	1,865,536	1,905,928	1,947,290	1,989,645	2,033,016
Total cost of mini milling machine (US$)	1,909,037	1,950,075	1,992,098	2,035,130	2,079,194	2,124,317	2,170,522	2,217,836
Total cost of GEM (US$)	3,763,666	3,844,573	3,927,422	4,012,259	4,099,132	4,188,090	4,279,183	4,372,463
Total cost of machine/ equipment (US$)	10,034,703	10,249,669	10,469,794	10,695,202	10,926,020	11,162,377	11,404,407	11,652,246
Marketing and upgrading (cost)								
Cost of training/ meeting on branding and packaging (US$)	4,116	4,116	4,116	4,116	4,116	4,116	4,116	4,116
Cost of participation and exhibition in trade fair (US$)	7,473	7,473	7,473	7,473	7,473	7,473	7,473	7,473
Cost of marketing campaigns (US$)	50,655	50,655	50,655	50,655	50,655	50,655	50,655	50,655
Cost of high quality bags for the packaging of the additional milled rice (US$)	1,126,518	1,150,735	1,175,533	1,260,972	1,288,274	1,316,232	1,387,555	1,417,801
Total cost of marketing and upgrading (US$)	1,188,762	1,212,979	1,237,777	1,323,216	1,350,518	1,378,476	1,449,799	1,480,045
TOTAL COST WITHOUT IRRIGATION SCHEMES	33,725,200	34,447,243	35,186,616	36,003,780	36,780,368	37,575,595	38,432,601	39,267,387
Total additional irrigation scheme by 2025 (ha) planned by each country (a)	NA	NA	NA	NA	NA	NA	NA	NA

NIGERIA	2018	2019	2020	2021	2022	2023	2024	2025
Annual additional irrigation scheme by 2025 (ha) planned by each country (b) = (a)/8	-	-	-	-	-	-	-	-
Total annual additional irrigated rice area (ha) from ClPRiSSA (c)	2,710	2,774	2,841	2,909	2,979	3,050	3,123	3,198
(b)-(c)	-	-	-	-	-	-	-	-
Cost of new irrigation schemes from ClPRiSSA (US$)	16,220,130	16,608,811	17,006,821	17,414,383	17,831,727	18,259,086	18,696,703	19,144,822

Senegal

Country Background

Senegal is a stable, lower middle-income country, occupying an area of 196,722 km² on the westernmost part of the African Sahel region. Based on the 2013 census,[91] Senegal has an estimated population of 15.3 million (2016/17), 23% of whom live in the Dakar region and 40% in other urban areas. Senegal has never experienced a military coup and has had three peaceful political transitions and four presidents since independence in 1960. The next presidential election is due in 2019, while legislative elections were conducted in 2017. The president serves a 7-year term, renewable only once, while members of the National Assembly serve 5-year terms.[92] Agriculture accounts for about 17.5% of the GDP, lower than the SSA average of about 24%.[93] Notwithstanding this, the sector was the main source of livelihood for 69% of the workforce in 2013.[94] Farming is for both cash and subsistence purposes. The main cash crops are sugarcane, groundnuts, and cotton, while cereals (rice, millet, sorghum and maize) are mainly for subsistence.[95]

Senegal experienced slow economic growth, compared to other SSA countries, in the period from 2006 but the economy has picked up significantly since 2014. The growth of 6.5% in 2015 and 6.6% in 2016 makes Senegal the second fastest growing economy in West Africa (behind Côte d'Ivoire) and the fourth fastest in SSA.[96] The slow growth of the 2006-period resulted from "a decline of traditional economic drivers (construction and services), the persistence of a current account deficit in the balance of payments and insufficient levels of productivity of the agriculture sector."[97] Measures introduced under the Emerging Senegal Plan (PSE) reforms to tackle these issues are yielding positive results.[98] For instance, fiscal and monetary policy controls led to faster increases in exports over imports, reducing the current account deficit from 7.0% of GDP in 2015 to 6.5% in 2016. Imports of food and capital goods increased, but energy imports decreased, partially compensating for the higher imports. In addition, fiscal deficit fell from 4.8% of GDP in 2015 to 4.2% in 2016 due to increased tax revenue collection (above 20% of GDP), the capping of recurrent expenditure, and increased public investment. Public debt increased from 56.7% of GDP in 2015 to 60% in 2016. However, the latest debt sustainability analysis (DSA) shows that the risk of debt distress is low.

[91] http://www.worldbank.org/en/country/senegal/overview.
[92] https://www.sec.gouv.sn/-Le-President-de-la-Republique-.html.
[93] IFAO, 2015.
[94] Ibid.
[95] Ibid. Citing www.new-ag.info/en/country/profile.php?a=530.
[96] http://www.worldbank.org/en/country/senegal/overview, *Op. cit*.
[97] Ibid. Citing République du Sénégal. 2014. Plan Sénégal Emergent (PSE). Available at www.gouv.sn/Plan-Senegal-Emergent-PSE.html
[98] http://www.worldbank.org/en/country/senegal/overview Op.cit.; the discussions in the next two paragraphs borrows extensively from this document and the FAO Fact Sheet on Senegal, cited above.

Agricultural areas targeted by the government posted strong outcomes, aided by good weather. These include groundnuts, rice, and horticulture. Extractive, food, and chemical industries led the 6.8% growth in the industrial sector. Services continued to perform strongly, growing by 5.6% due to advances in transport and financial services, buoyed by affordable oil and the PSE reforms. Services accounts for more than half of Senegal's total GDP. Agriculture has also shown some resurgence from 2014, following the launching of the PSE, which has strengthened domestic demand and improved the business climate. This enabled the primary sector to lead the 2016 growth, boosted by fishing and agriculture. However, the key factors responsible for low productivity in the sector have not fully disappeared, i.e. (i) poor access to water, with only 1.3% of agricultural land equipped for irrigation; (ii) vulnerability to climatic shocks, with high risks of drought and regular, severe flooding affecting urban areas; (iii) inadequate access to land; (iv) low sustainability of fishery resources; and (v) poorly structured value chains.[99]

In the social sector, Senegal faces problems with food insecurity, high and growing food imports, driven by a population growth rate of nearly 3%. Available data show that almost half of the population lives under the national poverty line (2011), while 2.2 million people, representing 15.5% of the population, were food-insecure in 2013.[100] To address this, Senegal has deployed «important efforts … to achieve rice self-sufficiency in the country»[101].

Development Approach

In the long term, Senegal plans to double GDP and GDP per capita in 10 and 15 years, respectively.[102] The country has organized the economy into high potential key economic clusters to achieve this. The clusters include livestock, agriculture and agro-industry (cereals, horticulture, oleaginous and products from wild harvest), fish and aquaculture products. To achieve these goals, the government has enacted and structured several economic and social policy frameworks around three main priorities: (i) growth, productivity and wealth creation; (ii) human capital, social protection and sustainable development; and (iii) governance, institutions, peace and security. The key economic and social policy strategies are the:

- Poverty Reduction Strategy Paper 2003-2005 (DSRP I)
- Poverty Reduction Strategy Paper 2006-2010 (DSRP II)
- Accelerated Growth Strategy (SCA), adopted in 2008 and later incorporated into the National Strategy for Economic and Social Development (SNDES) and the PSE (see below)

[99]FAO, 2015, *Op. cit*.
[100]Ibid. Citing the World Food Programme, www.wfp.org/countries/senegal/overview .
[101]Ibid.
[102]The Accelerated Growth Strategy (SCA), adopted in 2008 firsts expressed these targets, which SNDES and the PSE (see below) later incorporated.

- Economic and Social Policy Document (DPES) 2011- 2015, and
- National Strategy for Economic and Social Development (SNDES 2013-2017), which replaced the DPES in November 2012.

The government also launched the very important PSE in December 2013, which aims to make Senegal an emerging economy by 2035. The document has since been the "reference for economic and social policy in the medium- and long-term". The government's long-term policy on agriculture is to make it the engine of economic growth, as stated in the Agro-Sylvo-Pastoral Orientation Law (LOASP) of 2004 which provides the framework for the development of agriculture for the next 20 years. The law is the basis for the preparation of several sectoral development plans, such as the National Agricultural Development Programme, the National Livestock Plan, and the Grand Agricultural Offensive for Food and Abundance (GOANA). In February 2014, Senegal launched the Accelerated Programme for Agriculture in Senegal (PRACAS) as the agricultural component of the PSE. PRACAS envisions the agricultural sector to become "a competitive, diversified, and sustainable agriculture sector that would be the major source of economic development by 2017". PRACAS is a continuation and reformulated version of existing policies expressed in previous agriculture development programs. PRACAS decided to initially focus "its investments on strategic products with the objectives of achieving rice and onion self-sufficiency by 2017 and 2016, respectively, optimizing the performance of the groundnut sector and developing the off-season fruits and vegetables sector. The programme will then progressively cover all main agricultural commodities."

CIPRiSSA Results for Senegal

Self-Sufficiency

Based on the observed annual rice production growth of 14% between 2006 and 2015, Senegal will attain 56% self-sufficiency in rice production in 2018 and 113% by 2025 (Figure A8.1). This will enable the country to maintain a healthy buffer and export small quantities of rice to neighboring markets.

Paddy and Milled Rice Production

The projections show that Senegal will produce 17.4 MT of paddy under CIPRiSSA, rising from 1.33 MT in 2018 to 3.28 MT by 2025. The total milled rice equivalent will be 10.98 MT, with annual targets ranging from 0.80 MT in 2018 to 2.13 MT in 2025. The total milled rice food equivalent of 13.24 MT will comprise annual targets ranging from 1.44 MT in 2018 to 1.89 MT in 2025 (Figure A8.1; Table A8).

New Investments

Senegal will need to invest US$ 230.80 million (US$ 148.66 million or 65% for non-irrigation and US$ 82.14 million or 35% for additional irrigation) between 2018 and 2025 (Figures A8.2 and A8.3). The priority areas for non-irrigation investments include: (i) fertilizer procurement and distribution (US$ 32.1 million or 39% of the non-irrigation investment); (ii) quality seeds procurement and distribution (US$ 21.6 million or 26%); (iii) machines/equipment (US$ 20.6 million or 25%); (iv) technology transfer/capacity development of actors in the value chain (US$ 4.05 or 4.9%); and (v) marketing/upgrading of the rice value chain (US$ 3.6 or 4.6%) (Figures A8.4 and A8.5). The total cost of new non-irrigation requirements will comprise annual targets ranging from US$ 9.49 million in 2018 to US$ 11.08 million in 2025 (Figure A8.2). The annual cost of investment in new irrigation schemes will be US$ 17.1 million in 2018, rising progressively to US$20.2 million in 2025 (Figure A8.2). The program will develop 11,191 ha of new irrigation facilities, progressively increasing annually from 2,090 ha in 2018 to 2,467 ha in 2025 (A8.5).

Benefits

CIPRiSSA will save Senegal US$ 146.64 million, with annual targets ranging from US$ $16.15 million in 2018 to US$ $20.73 million by 2025 (Figure A8.6). The program will empower 719,453 new farming households in Senegal by 2025, with annual targets increasing from 82,828 in 2018 to 97,381 in 2025 (Table A8; Figure A8.10). Households will be empowered through training in PLAR, video, radio-TV, IRM, and post-harvest practices (Figure A8.9). The total additional rice area targeted is 96,320 ha, increasing from 11,107 ha in 2018 to 13,018 ha in 2025.

Profitability analysis

Senegal will become one of the "*blue oceans"* for investments in the rice value chain given the relatively high potentials for quick returns. Investments in the country's rice value chain will create uncontested market space to its southern and northern neighbors. Excluding the cost of new irrigation schemes, Senegal needs to investment US$ 82.14 million, with average annual operational costs of US$ 10.26 million, to achieve 113% self-sufficiency in rice by 2025. These investments will generate a benefits/costs ratio (NPV ratio to investment) of 1.64, an NPV of US$ 72.72 million, and an MIRR of 54.76%. Thus, each dollar invested in the program will generate a net benefit of US$ 1.64. With an NPV much higher than zero, the CIPRiSSA investment is profitable and will remain viable as long as the financial rate of alternative investment projects in the country is less than 54.76% (Table A12).

The estimated payback period of the investments is 4 years (by 2021), meaning that all investments will be recovered before the end of the program. All the indicators show that the proposed investment is profitable for private involvement. Considering the program's contribution to the overall welfare of the country and to the national objectives, the estimated gross domestic value-added (which

measures the real monetary contribution of the project to the economy of the country in terms of direct and indirect generated value added) is US$ 142.68 million and represents the program's contribution to the GDP. The estimated net national value added (which represents the contribution to national welfare) is US$ 116.81 million. The economic internal rate of return is 23.70%. In total, the program will create 21,686 direct employments.

Sensibility analysis shows that the proposed investments are profitable under both pessimistic (-10% of the price) and optimistic (+10% of the price) scenarios. The NPV ratio is greater than zero in both cases. Under optimistic scenarios, the investments will generate a benefits/costs ratio (NPV ratio to investment) of 2.02, a net profit of US$ 89.35 million, and an MIRR of 68.04%. Under pessimistic scenarios, the investments will generate a benefits/costs ratio (NPV ratio to investment) of 1.26, an NPV of US$ 56.02 million, and an MIRR of 41.92%. In addition, the break-even point analysis shows that the investments remain profitable even with a 76.08% reduction in the market price.

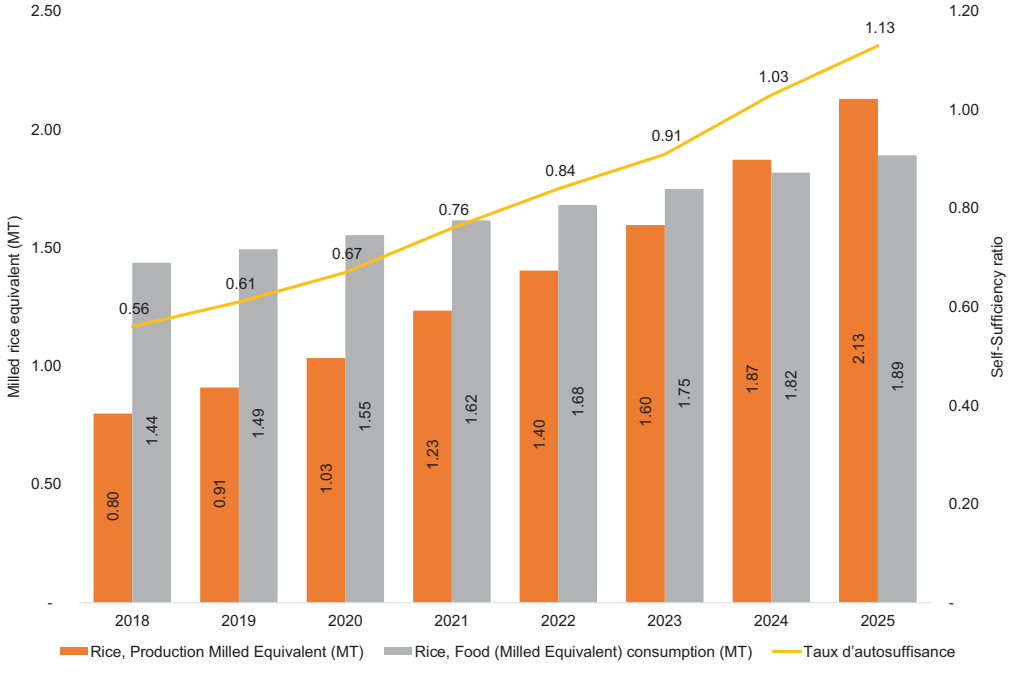


Figure A8.1: Milled rice production and consumption versus self-sufficiency in Senegal

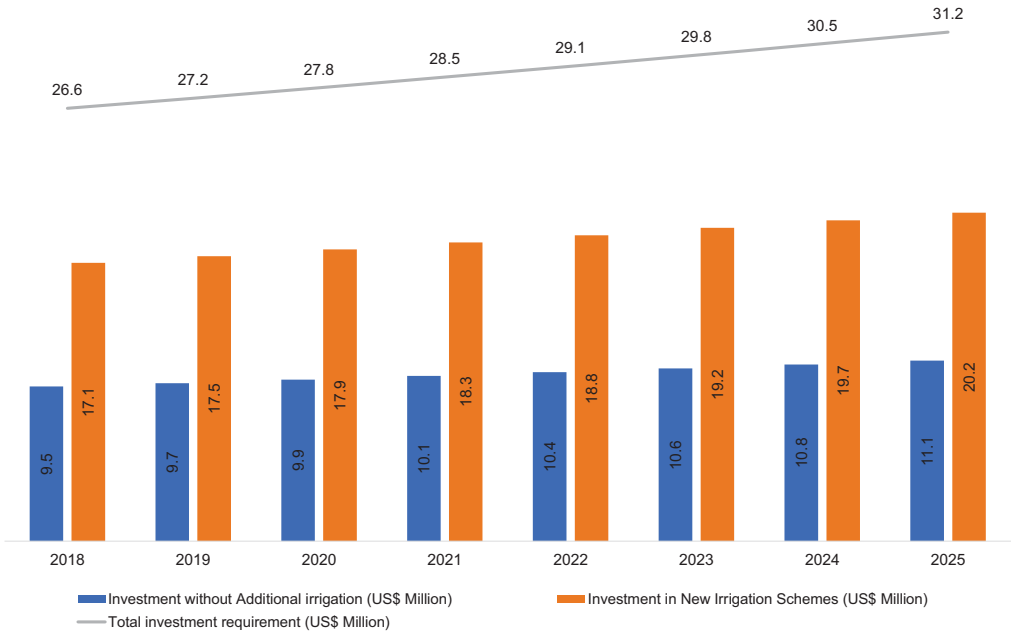


Figure A8.2: Additional investments required: irrigation and non-irrigation investments required by Senegal (US$ million)

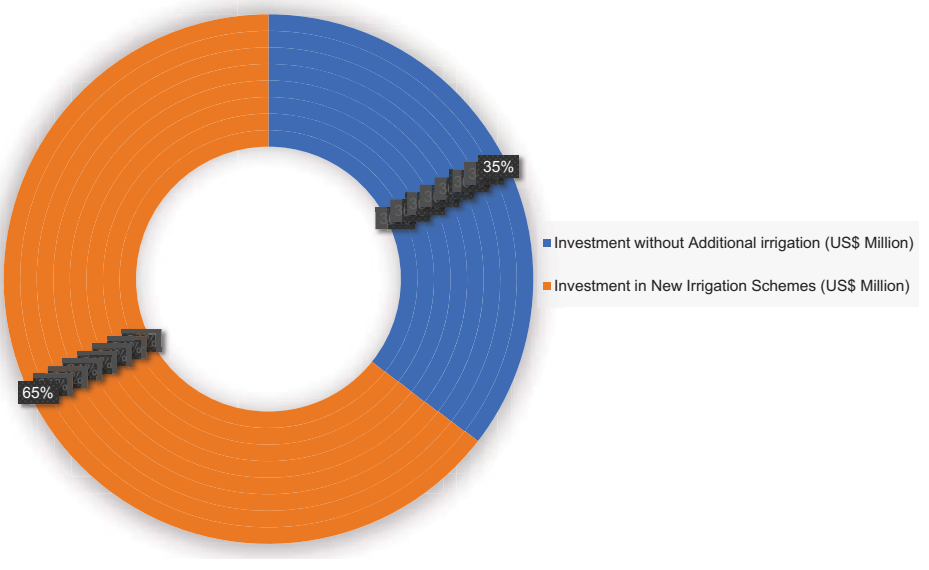


Figure A8.3: Additional irrigation and non-irrigation investments required by Senegal (%)

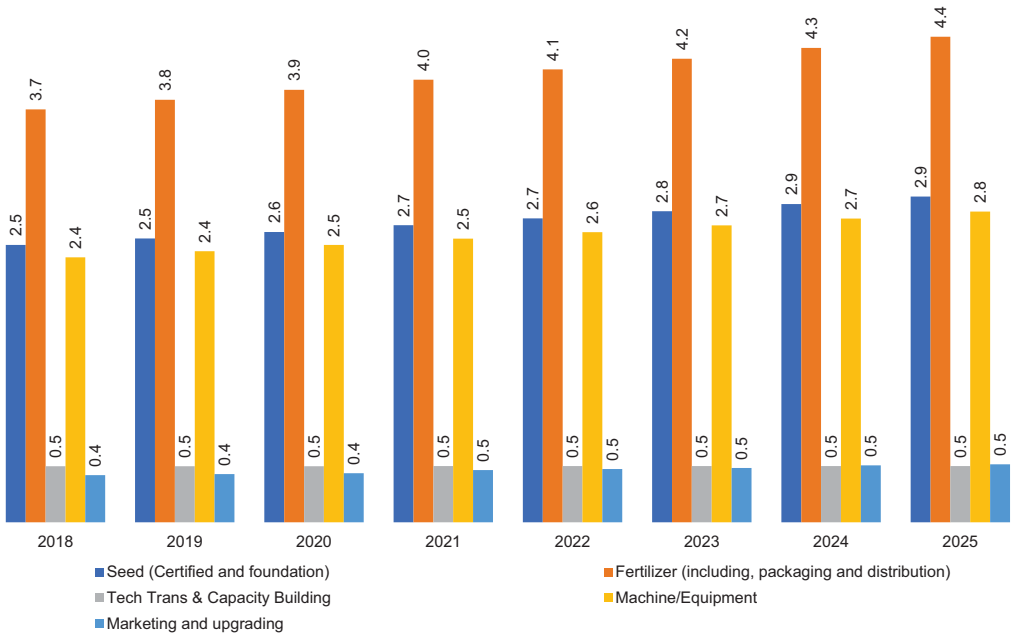


Figure A8.4: Composition of new (non-irrigation) investments required by Senegal (US$ million)

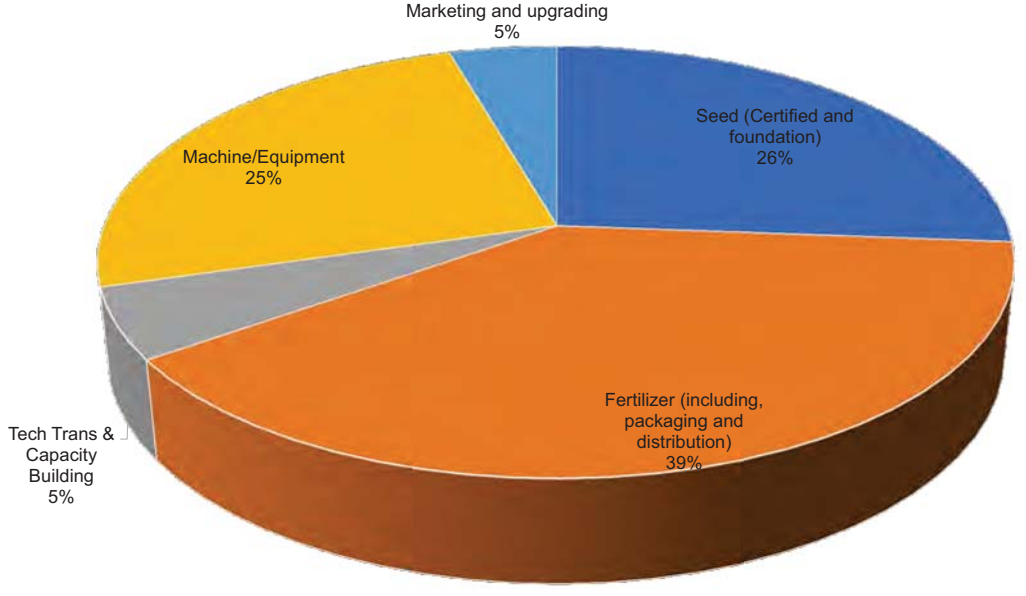


Figure A8.5: Distribution of new non-irrigation investments required in Senegal (%)

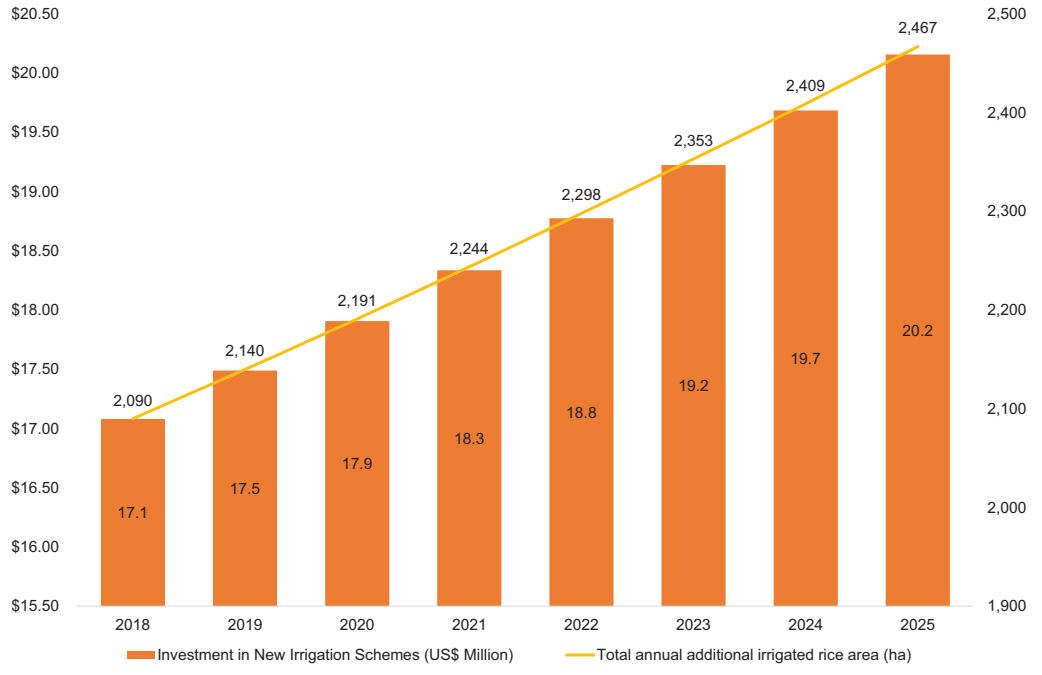


Figure A8.6: Additional irrigated rice area (ha) versus new irrigation investments (US$ Million) in Senegal

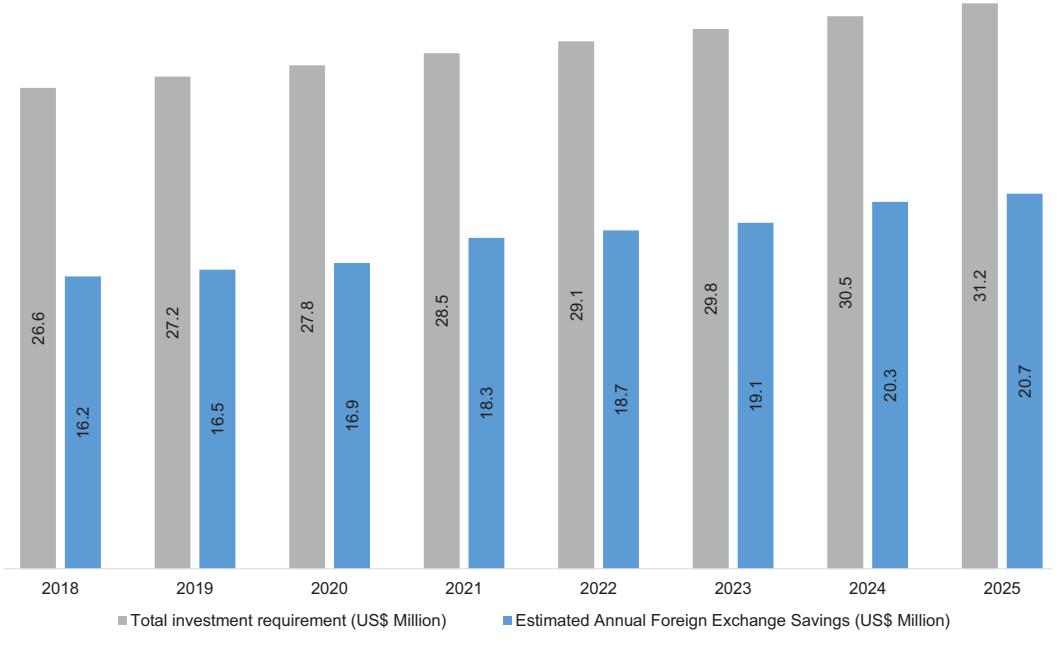


Figure A8.7: Estimated annual new investments costs versus annual foreign exchange savings for Senegal (US$ millions)

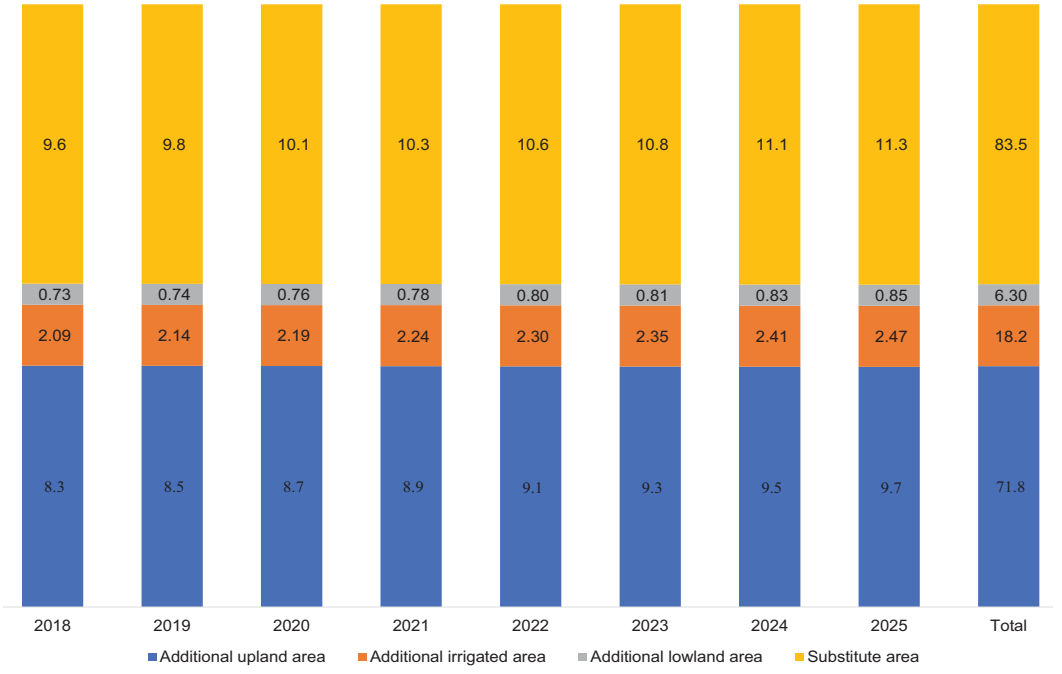


Figure A8.8: Expected gains from CIPRiSSA in Senegal 1: Rice area expansion per ecology ('000 ha)

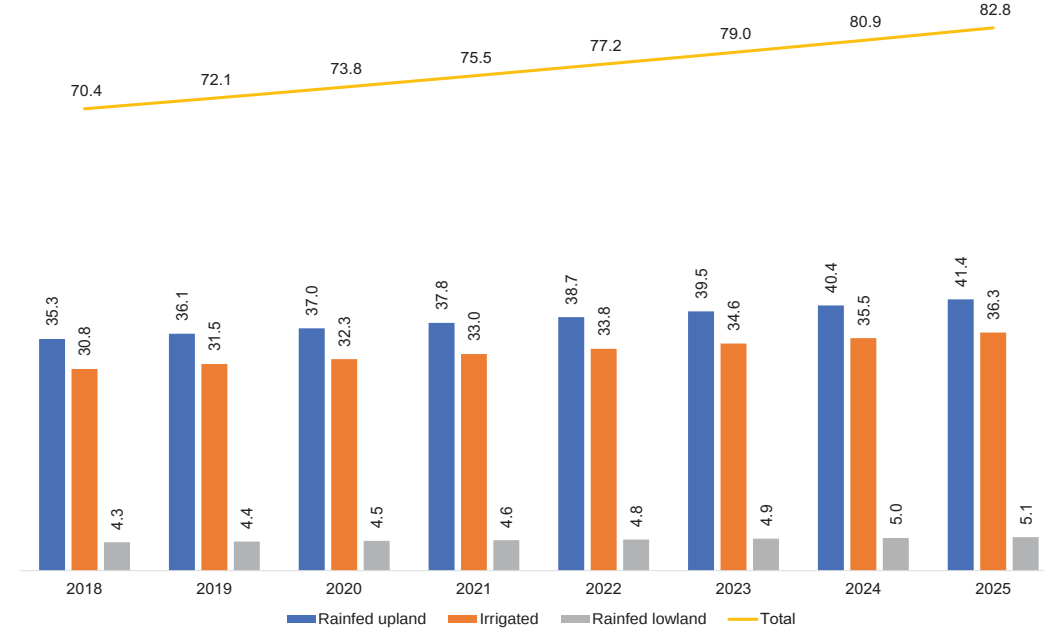


Figure A8.9: Expected gains from CIPRiSSA in Senegal 2: Expected additional production per ecology ('000 tons)

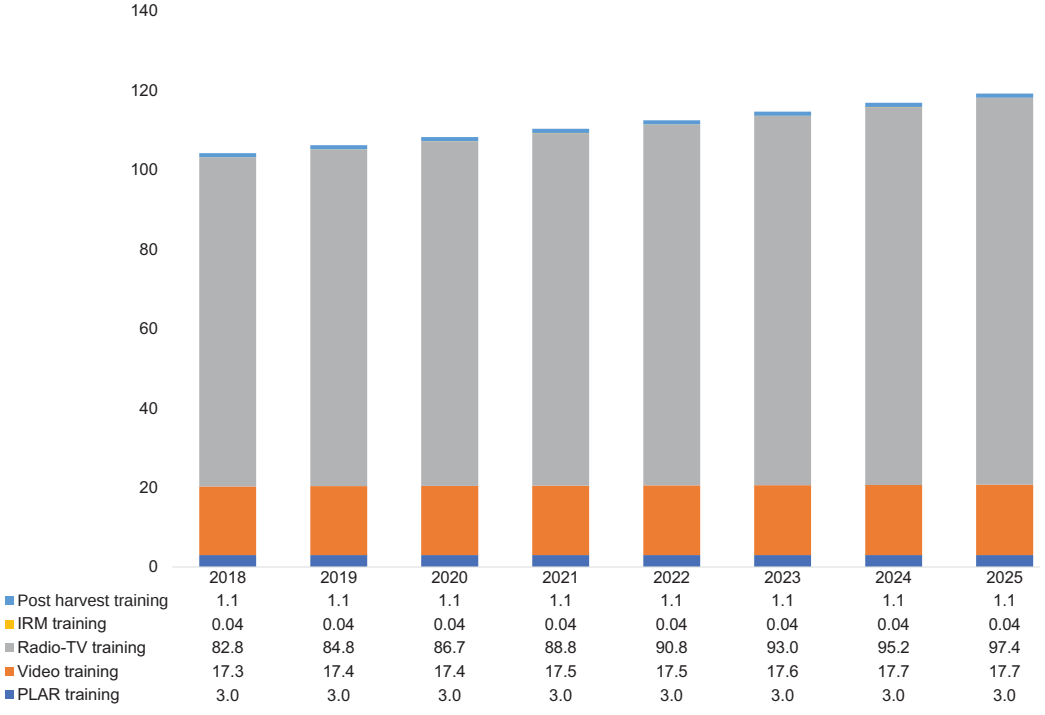


Figure A8.10: Expected gains from CIPRiSSA in Senegal 3: Number of farmers and other actors targeted in training ('000 persons)

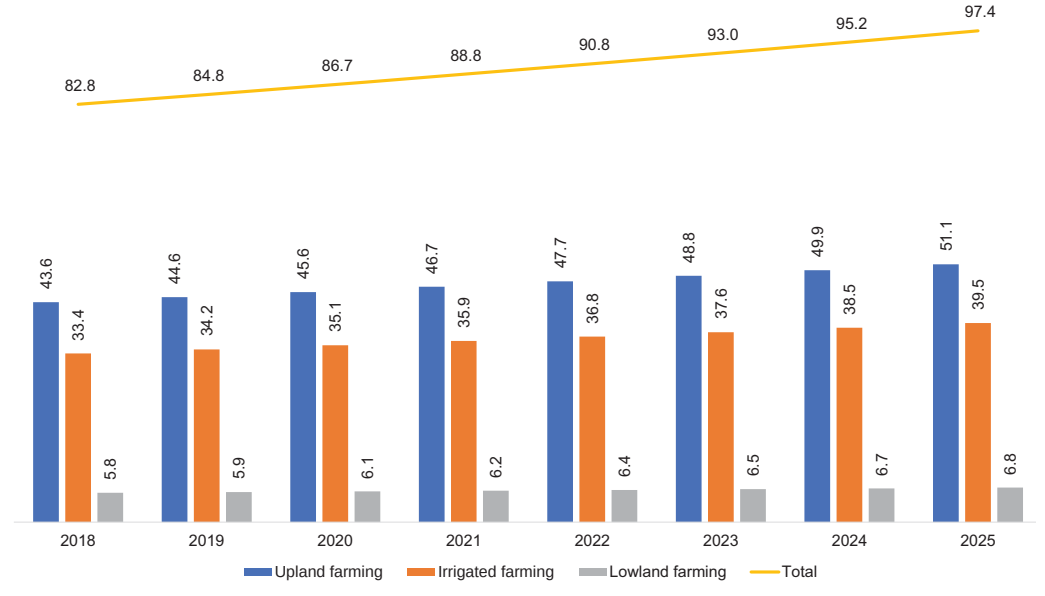


Figure A8.11: Expected gains from CIPRiSSA in Senegal 4: Number of beneficiary households targeted ('000 households)

Table A8: Projected estimates in required investments, production gains, hectarage, and farming households for Senegal (2018-2025)

SENEGAL	2018	2019	2020	2021	2022	2023	2024	2025
PROJECTED STATISTICS ON RICE (Production, consumption import)								
Rice, paddy production (T)	1,332,631	1,515,356	1,723,136	1,959,406	2,228,073	2,533,579	2,880,974	3,276,003
Rice, production milled equivalent (T)	799,578	909,214	1,033,882	1,234,426	1,403,686	1,596,155	1,872,633	2,129,402
Rice, food (milled equivalent) consumption (T)	1,436,927	1,494,404	1,554,180	1,616,348	1,681,002	1,748,242	1,818,171	1,890,898
Self-sufficiency ratio	0.56	0.61	0.67	0.76	0.84	0.91	1.03	1.13
ADDITIONAL GAIN FROM THE PROGRAM								
Expected additional production from rainfed upland (T)	35,335	36,136	36,957	37,797	38,657	39,538	40,440	41,364
Expected additional production from irrigated (T)	30,766	31,502	32,257	33,030	33,821	34,631	35,461	36,310
Expected additional production from rainfed lowland (T)	4,329	4,432	4,536	4,643	4,753	4,865	4,980	5,098
Expected additional production from the 3 ecologies (T)	70,430	72,070	73,750	75,470	77,231	79,034	80,881	82,772
Expected additional production from technology adoption (T)	2,084	2,088	2,091	2,095	2,099	2,102	2,106	2,110
Expected additional paddy production from the program (T)	72,514	74,158	75,841	77,565	79,329	81,137	82,987	84,882
Expected additional rice, food (milled equivalent) from the program (T)	43,509	44,495	45,505	48,866	49,978	51,116	53,942	55,174
Estimated foreign exchange savings (US$ per year)	16,153,899	16,518,158	16,891,159	18,277,187	18,691,153	19,115,055	20,265,311	20,726,159
PRODUCERS AND AREA TARGETED								
Number of upland rice farming households targeted	41,680	42,677	43,697	44,742	45,811	46,907	48,029	49,177
Number of substitute farming households targeted (upland rice)	1,909	1,909	1,909	1,909	1,909	1,909	1,909	1,909

SENEGAL	2018	2019	2020	2021	2022	2023	2024	2025
Total number of upland rice farmers	43,589	44,586	45,606	46,651	47,720	48,816	49,938	51,086
Number of irrigated rice farming households targeted	33,440	34,241	35,061	35,901	36,761	37,642	38,544	39,467
Number of lowland rice farming households targeted	5,798	5,935	6,075	6,219	6,365	6,516	6,670	6,827
Total number of farmers/trainees targeted	82,828	84,762	86,742	88,770	90,847	92,973	95,151	97,381
Number of farmers targeted by PLAR training	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Number of farmers targeted by Video training	17,292	17,351	17,411	17,472	17,535	17,599	17,665	17,733
Number of farmers targeted by Radio-TV training	82,828	84,762	86,742	88,770	90,847	92,973	95,151	97,381
Number of trainees targeted by IRM training	40	40	40	40	40	40	40	40
Number of trainees targeted by post-harvest training	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050
Number of villages targeted by PLAR training	100	100	100	100	100	100	100	100
Number of villages targeted by Video training	224	224	225	226	226	227	228	228
Number of villages targeted by Radio-TV training	828	848	867	888	908	930	952	974
Total rice area targeted (ha)	20,707	21,190	21,686	22,193	22,712	23,243	23,788	24,345
Total additional upland rice area (ha)	8,292	8,479	8,670	8,866	9,067	9,272	9,483	9,698
Total additional irrigated rice area (ha)	2,090	2,140	2,191	2,244	2,298	2,353	2,409	2,467

SENEGAL	2018	2019	2020	2021	2022	2023	2024	2025
Total additional lowland rice area (ha)	725	742	759	777	796	814	834	853
Total additional rice area (ha)	11,107	11,361	11,621	11,887	12,160	12,439	12,725	13,018
Total rice areas already on rice (ha)	9,600	9,829	10,064	10,305	10,552	10,804	11,062	11,327
INPUTS (quantity and cost)								
Seed								
Total foundation seed equivalent (T)	21	22	22	23	23	24	24	25
Total certified seed requirement (T)	1,061	1,085	1,111	1,137	1,163	1,190	1,218	1,246
Production cost of the foundation seed (US$)	41,586	42,546	43,529	44,535	45,566	46,621	47,702	48,809
Production cost of the certified seed (US$)	2,298,601	2,351,843	2,406,363	2,462,192	2,519,361	2,577,902	2,637,848	2,699,232
Cost of storage, weighing, packaging of certified seed	144,371	147,727	151,165	154,685	158,289	161,980	165,760	169,630
Cost of distribution of certified seed (US$)	1,751	1,791	1,833	1,876	1,920	1,965	2,011	2,058
Total cost of certified seed package (including, packaging and distribution)	2,444,722	2,501,362	2,559,362	2,618,753	2,679,570	2,741,847	2,805,618	2,870,920
Total cost of seed (certified and foundation)	2,486,308	2,543,908	2,602,891	2,663,289	2,725,136	2,788,468	2,853,320	2,919,728
Fertilizer								
Total Urea (T)	2,561	2,621	2,683	2,746	2,810	2,876	2,944	3,013
Total NPK (T)	2,071	2,119	2,169	2,219	2,271	2,324	2,379	2,435
Total Fertilizer (T)	4,632	4,740	4,851	4,965	5,081	5,201	5,323	5,448
Total cost of Urea (US$)	1,062,888	1,087,817	1,113,345	1,139,486	1,166,254	1,193,665	1,221,733	1,250,475
Total cost of NPK (US$)	1,557,163	1,593,522	1,630,754	1,668,880	1,707,920	1,747,898	1,788,835	1,830,754
Total cost of fertilizer (US$)	2,620,050	2,681,339	2,744,099	2,808,366	2,874,174	2,941,562	3,010,568	3,081,229
Cost of fertilizer transport and distribution	1,081,078	1,106,384	1,132,297	1,158,832	1,186,004	1,213,828	1,242,319	1,271,495

SENEGAL	2018	2019	2020	2021	2022	2023	2024	2025
Total cost of fertilizer (including, packaging and distribution)	3,701,129	3,787,724	3,876,397	3,967,198	4,060,178	4,155,390	4,252,887	4,352,724
Technology transfer and capacity building								
Cost of PLAR training	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
Cost of Video (training	67,163	67,339	67,519	67,704	67,892	68,086	68,284	68,486
Cost of Radio-TV (training	1,657	1,695	1,735	1,775	1,817	1,859	1,903	1,948
Cost of IRM training	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Cost of post-harvest (GEM, ASI/ ATA thresher-cleaner) training	74,500	74,500	74,500	74,500	74,500	74,500	74,500	74,500
Total technology transfer and Capacity Building cost	503,320	503,535	503,754	503,979	504,209	504,445	504,687	504,934
Machine/equipment (quantity and cost)								
Number of tractors (for a fraction of the additional areas)	7	7	7	7	8	8	8	8
Number of power tiller (for a fraction of the additional areas)	75	77	79	80	82	84	86	88
Number of ASI/ATA thresher-cleaner (for a fraction of the additional production)	121	124	126	129	132	135	138	141
Number of mini-milling machine	24	25	25	26	26	27	28	28
Number of GEM parboilers (for a fraction of the additional production)	13	14	14	14	15	15	15	16
Total Cost tractor (US$)	462,267	473,339	484,677	496,287	508,175	520,349	532,815	545,581
Total Cost of power tiller (US$)	470,078	480,708	491,593	502,739	514,152	525,840	537,808	550,063
Total Cost of ASI/ ATA thresher-cleaner (US$)	561,936	574,674	587,717	601,073	614,749	628,754	643,095	657,781
Total cost of mini milling machine (US$)	613,021	626,917	641,145	655,716	670,636	685,914	701,559	717,579
Total cost of GEM (US$)	268,571	274,659	280,893	287,276	293,813	300,506	307,361	314,379
Total cost of machine/ equipment (US$)	2,375,873	2,430,296	2,486,024	2,543,090	2,601,526	2,661,364	2,722,638	2,785,382

SENEGAL	2018	2019	2020	2021	2022	2023	2024	2025
Marketing and upgrading (cost)								
Cost of training/ meeting on branding and packaging (US$)	4,116	4,116	4,116	4,116	4,116	4,116	4,116	4,116
Cost of participation to exhibition in trade fair (US$)	7,473	7,473	7,473	7,473	7,473	7,473	7,473	7,473
Cost of marketing campaigns (US$)	50,655	50,655	50,655	50,655	50,655	50,655	50,655	50,655
Cost of high quality bags for the packaging of the additional milled rice (US$)	361,742	369,942	378,338	406,283	415,528	424,994	448,487	458,728
Total cost of marketing and upgrading (US$)	423,987	432,186	440,583	468,527	477,772	487,238	510,731	520,972
TOTAL COST WITHOUT IRRIGATION SCHEMES	9,490,617	9,697,648	9,909,648	10,146,083	10,368,821	10,596,905	10,844,263	11,083,741
Total additional irrigation scheme by 2025 (ha) planned by each country (a)	89,417	89,417	89,417	89,417	89,417	89,417	89,417	89,417
Annual additional irrigation scheme by 2025 (ha) planned by each country (b) = (a)/8	11,177	11,177	11,177	11,177	11,177	11,177	11,177	11,177
Total annual additional irrigated rice area (ha) from CIPRiSSA (c)	2,090	2,140	2,191	2,244	2,298	2,353	2,409	2,467
(b)-(c)	9,087	9,037	8,986	8,933	8,880	8,825	8,768	8,710
Cost of new irrigation schemes from CIPRiSSA (US$)	17,079,538	17,488,626	17,907,532	18,336,491	18,775,745	19,225,542	19,686,134	20,157,780

Sierra Leone

Country Background

Sierra Leone is a small country on the west coast of Africa, with a population of 7.1 million inhabitants as at 2015.[103] The country is a constitutional democracy with five regions. Democratic elections were held in March 2018, the fourth since the end of the 11-year civil war in 2002 that claimed the lives of over 50,000 Sierra Leoneans. The country suffered two major disasters in 2014/15 - the Ebola virus epidemic that commenced in May 2014 and the collapse of iron ore prices. Sierra Leone is currently grappling with the aftermath of the August 2017 mudslide that killed more than 300 persons and devastated a vast land area. Prior to the Ebola virus outbreak, the country was seeking to transform to a middle-income economy.

The country's economy has shown resilience in dealing with disasters, recovering well from the earlier shocks. New investments in mining, agriculture, and fisheries helped to restart the economy and the IMF has declared the recovery to be sustainable over the medium-term.[104] The IMF projects real GDP to recover from -20.6% in 2015 to 5.4% in 2017, reaching 6.5% by 2020.[105] However, inflation remains a challenge, exacerbated by unrelenting exchange rate pressures and an "accommodative monetary stance". Inflation rose from 9.5% at the end of 2015 to 17.4% in December 2016, but the IMF projects inflation to decline to 7.5% by 2020. Development challenges facing the country include high youth unemployment, poor infrastructure, and widespread rural and urban impoverishment.

CIPRiSSA Results for Sierra Leone

Self-Sufficiency

During the period 2006-2015, rice production in Sierra Leone increased rapidly with an average annual growth rate of 9%. If this rate holds steady, CIPRiSSA projects that Sierra Leone will achieve 111% self-sufficiency in 2018 and 167% by 2025 (Figure A9.1). This will put the country well on the path of commercializing rice exports to the Mano River Union countries and beyond.

Paddy and Milled Rice Production

Under CIPRiSSA, Sierra Leone will produce a total of 16.96 MT of paddy, comprising annual targets ranging from 1.54 MT (0.92 MT milled rice equivalent) in 2018 to 2.81 MT (1.82 MT milled rice equivalent) in 2025. This will yield 7.64 MT milled rice food equivalent, progressively increasing from 0.83 MT in 2018 to 1.09 MT in 2025 (Figure A9.1; Table A9).

[103]http://www.worldbank.org/en/country/sierraleone/overview.
[104]Ibid.
[105]Ibid.

New Investments

The available data suggest that Sierra Leone does not require new investments in irrigation to attain the foregoing projections. However, US$186.44 million worth of new non-irrigation investments will be required, ranging from US$21 million in 2018 to US$25 million in 2025 (Figure A9.2; Table A9). The priority areas for the new investments are:

(i) Fertilizer procurement and distribution (US$ 73.88 million or 39.6% of the total costs);

(ii) Procurement of quality seeds and their distribution (US$ 64.35 million or 34.5% of the total);

(iii) Machines/equipment (US$ 37.93 million or 20.3% of the total);

(iv) Upgrading and promotion of local rice preferred by a niche market in Sierra Leone (US$ 6.27 million or 3.4% of the additional costs); and

(v) Technology transfer and capacity building of actors of the value chain (US$ 4.01 or 2.2% of total additional costs) (Figures A9.3 and A9.4; Table A9).

Benefits

The CIPRiSSA investment will produce an additional 1.10MT of paddy or 693,986T of milled rice by 2025 (Figure A9.7).

It is projected that under CIPRiSSA, in addition to achieving self-sufficiency in rice and a sustained vibrant rice export business, Sierra Leone will save US$ 246.90 million in foreign exchange by 2025 (Figure A9.5). The program's target is to reach 1.74 million farmers/trainees through training in PLAR, video, radio-TV, IRM, and post-harvest practices, increasing progressively from 199,646 households in 2018 to 235,652 in 2025 (Figures A9.8 and A9.9) and add 303,429 ha of new rice fields by 2025 (Figure A9.6).

Profitability

To achieve 167% self-sufficiency in 2025, Sierra Leone needs to invest US$ 186.44 million for non-irrigation, with an average annual operational cost of US$ 23.30 million. These investments will generate a benefits/costs ratio (NPV ratio to investment) of 1.07, an NPV of US$ 78.81 million, and an MIRR of 47.89%. Each dollar invested in the project will generate a net benefit of US$ 1.07. The CIPRiSSA investment is profitable, since the NPV is much higher than zero, and will remain viable as long as the financial rate of alternative investment projects in the country is less than 47.89% (Table A12).

The estimated payback period of the investments is 4.04 years (by 2021), meaning that all investments will be recovered before the end of the program. The investments required to

achieve self-sufficient in rice by 2025 are profitable for private involvement. The estimated gross domestic value-added (which measures the real monetary contribution of the program to the country's economy in terms of direct and indirect generated value added) is US$ 218.08 million. This represents the program's contribution of the project to the Gross Domestic Product (GDP). The estimated net national value added (which represents the contribution to national welfare) is US$ 161.91 million. The economic internal rate of rate return is 6.71%. In total, the program will create 52,333 direct employments.

Sensitivity analysis shows that the proposed investments are profitable under both pessimistic (-10% of the price) and optimistic (+10% of the price) scenarios as the NPV ratio is greater than zero in both cases. Under optimistic scenarios, the investments will generate a benefits/costs ratio (NPV ratio to investment) of 1.46, a net profit of US$ 108.20 million and an MIRR) of 70.86%. Under pessimistic scenarios, the investments will generate a benefits/costs ratio (NPV ratio to investment) of 0.67, a net profit of US$ 49.41 and an MIRR of 28.84%. In addition, the break-even point analysis shows that the investments remain profitable even with a 75.15% reduction in the market price.

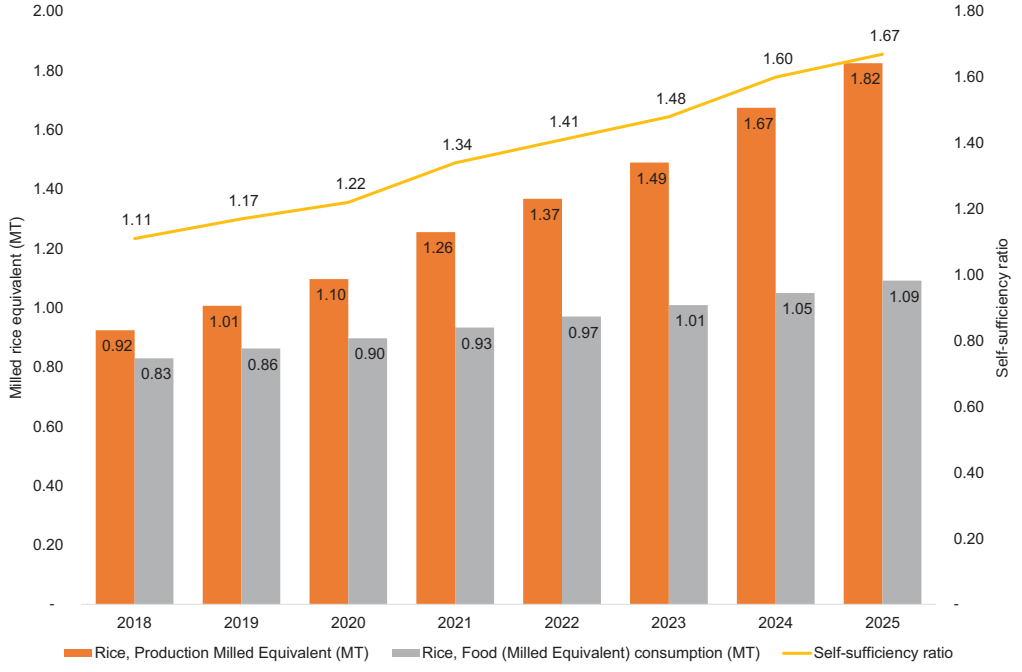


Figure A9.1: Milled rice production and consumption versus self-sufficiency in Sierra Leone

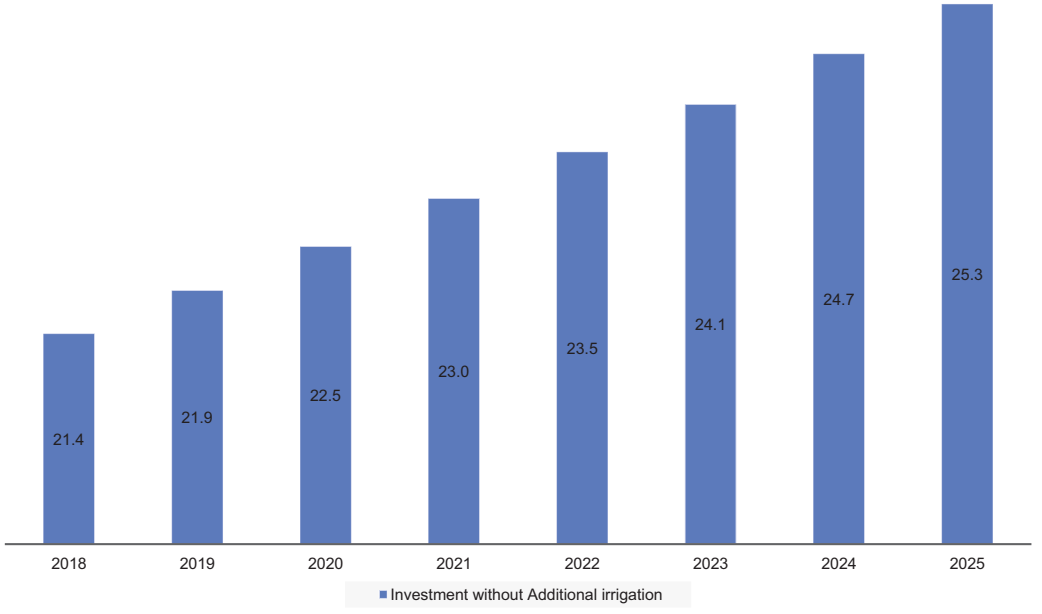


Figure A9.2: Additional only irrigation investments required by Sierra Leone (US$ million)

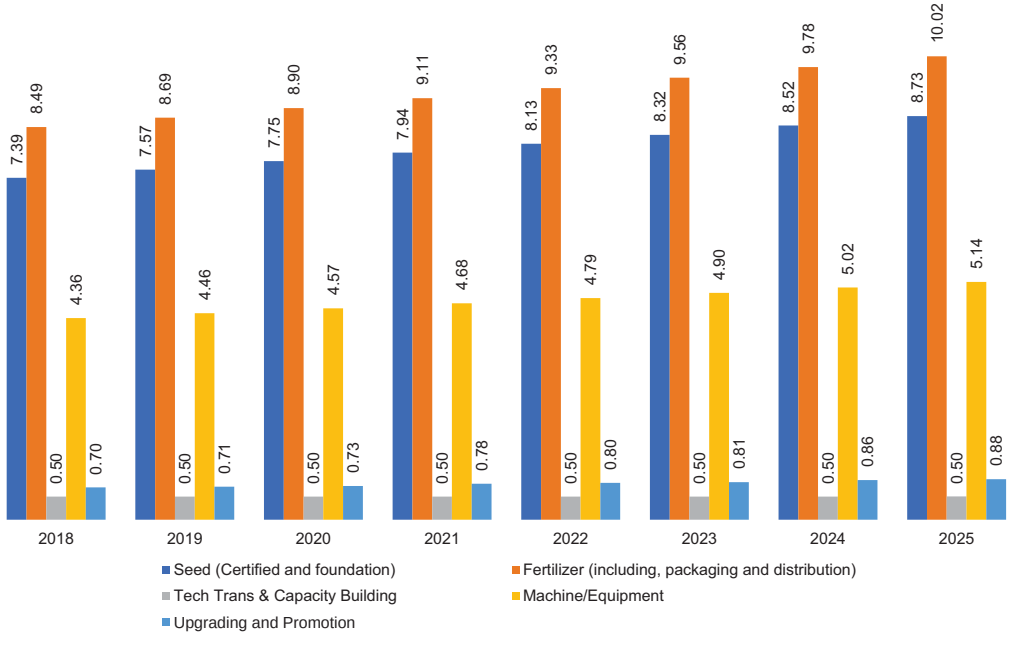


Figure A9.3: Composition of new non-irrigation investments required by Sierra Leone (US$ million)

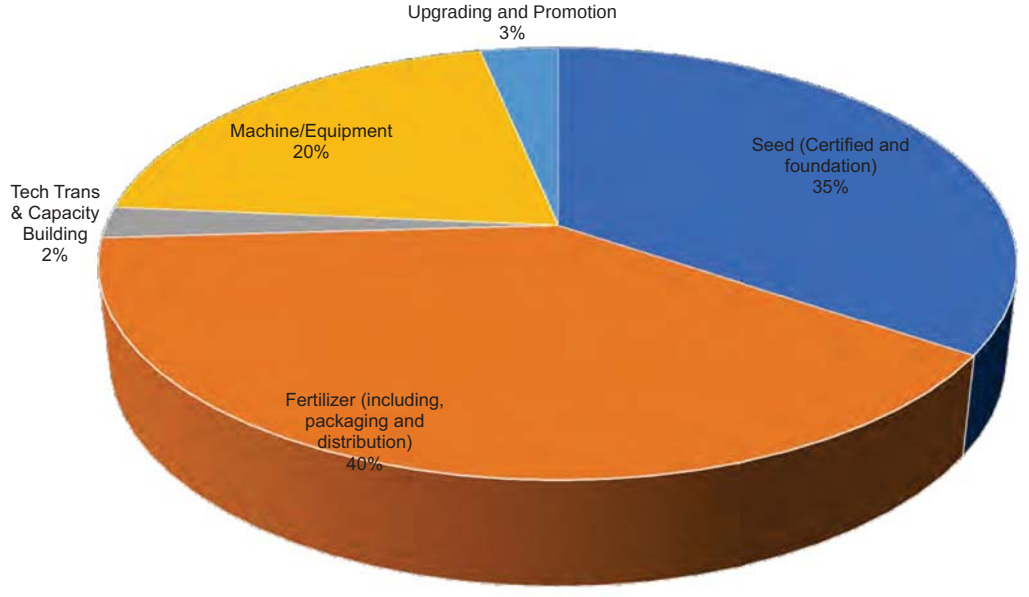


Figure A9.4: Distribution of new non-irrigation investments required in Sierra Leone (%)

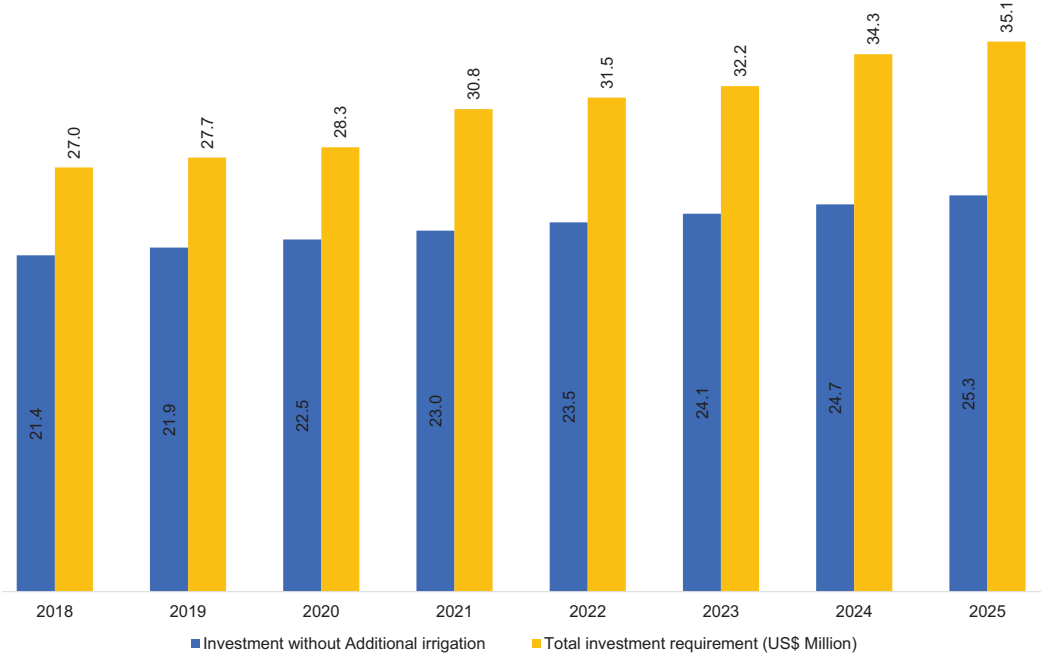


Figure A9.5: Estimated annual new investments costs versus annual foreign exchange savings by Sierra Leone (US$ million)

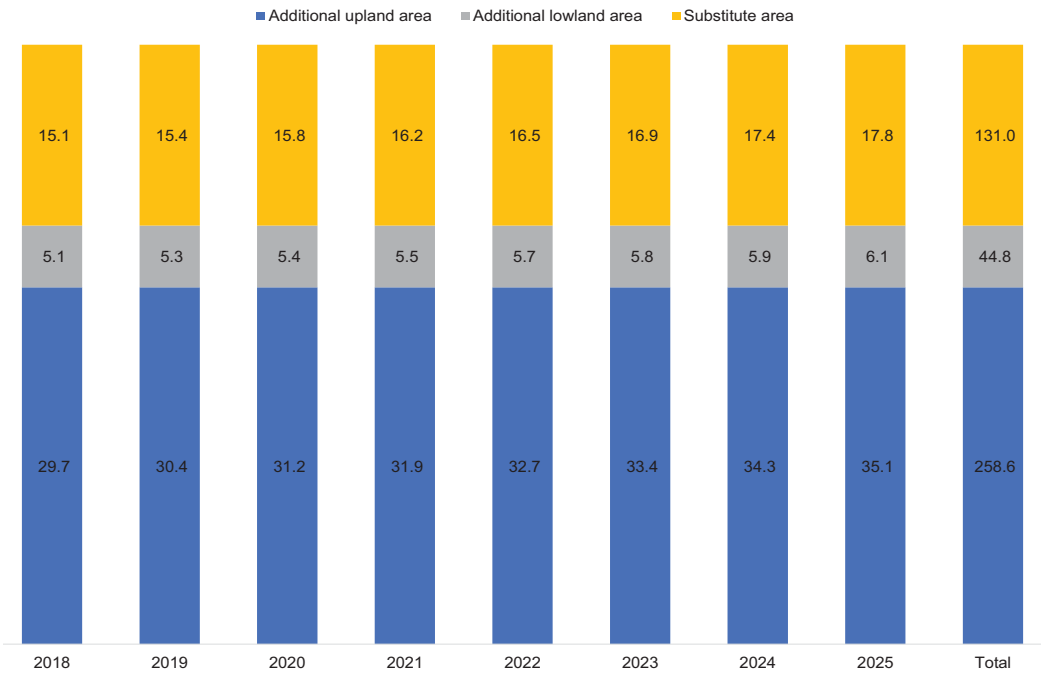


Figure A9.6: Expected gains from CIPRiSSA in Sierra Leone 1: Rice area expansion per ecology ('000 ha)

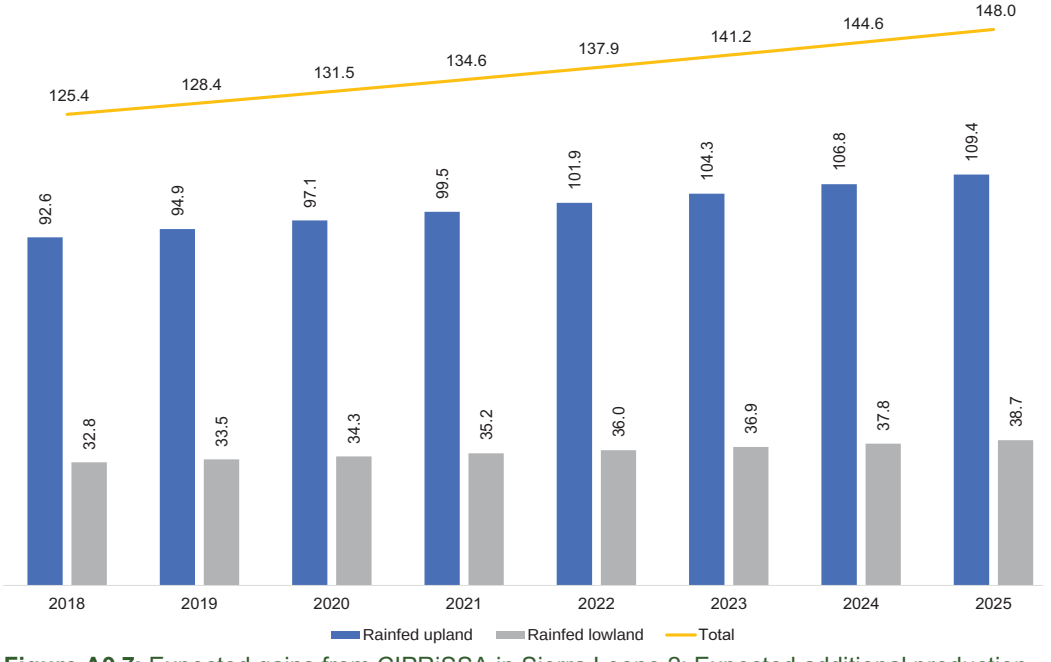


Figure A9.7: Expected gains from CIPRiSSA in Sierra Leone 2: Expected additional production per ecology ('000 tons)

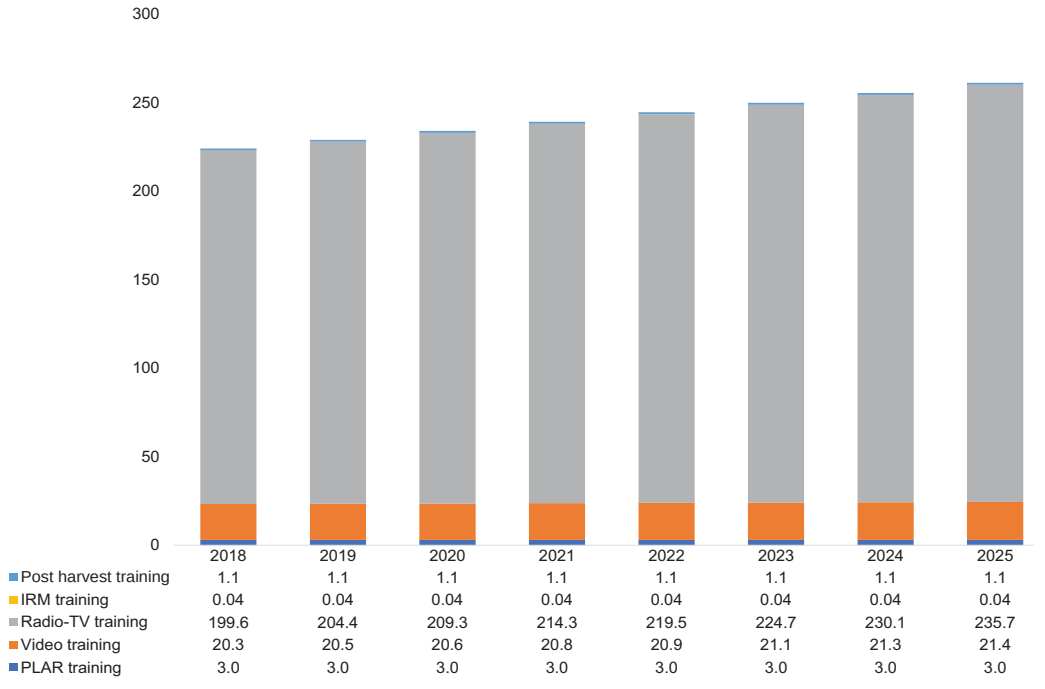


Figure A9.8: Expected gains from CIPRiSSA in Sierra Leone 3: Number of farmers and other actors targeted for training ('000 persons)

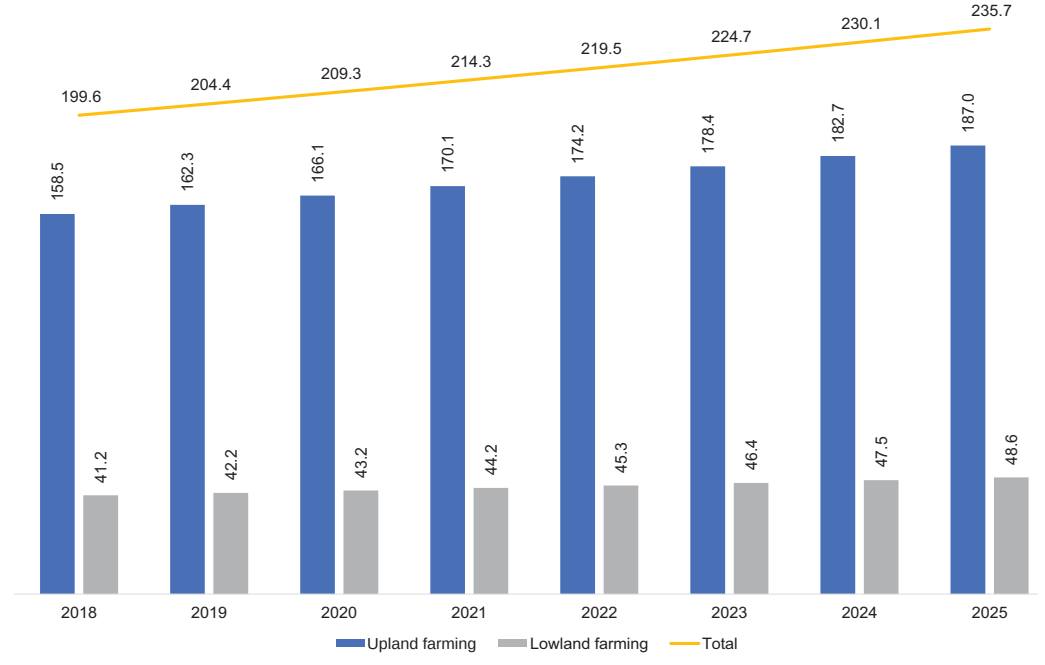


Figure A9.9: Expected gains from CIPRiSSA 4: Number of beneficiary households targeted ('000 households)

Table A9: Projected estimates in investments requirement, production gains, land area, and farming households for Sierra Leone (2018-2025)

SIERRA LEONE	2018	2019	2020	2021	2022	2023	2024	2025
PROJECTED STATISTICS ON RICE (Production, consumption import)								
Rice, paddy production (T)	1,540,586	1,678,493	1,828,745	1,992,448	2,170,804	2,365,127	2,576,844	2,807,513
Rice, production milled equivalent (T)	924,351	1,007,096	1,097,247	1,255,242	1,367,607	1,490,030	1,674,949	1,824,884
Rice, food (milled equivalent) consumption (T)	829,677	862,864	897,379	933,274	970,605	1,009,429	1,049,806	1,091,799
Self-sufficiency ratio	1.11	1.17	1.22	1.34	1.41	1.48	1.60	1.67
ADDITIONAL GAIN FROM THE PROGRAM								
Expected additional production from rainfed upland (T)	92,646	94,867	97,141	99,470	101,855	104,297	106,798	109,359
Expected additional production from irrigated (T)	0	0	0	0	0	0	0	0
Expected additional production from rainfed lowland (T)	32,757	33,542	34,345	35,167	36,009	36,872	37,755	38,659
Expected additional production from the 3 ecologies (T)	125,403	128,408	131,486	134,637	137,864	141,169	144,553	148,018
Expected additional production from technology adoption (T)	2,377	2,386	2,395	2,404	2,413	2,423	2,432	2,442
Expected additional paddy production from the program (T)	127,781	130,795	133,881	137,041	140,278	143,592	146,985	150,460
Expected additional rice, food (milled equivalent) from the program (T)	76,668	78,477	80,329	86,336	88,375	90,463	95,540	97,799
Estimated foreign exchange savings (US$ per year)	27,044,049	27,679,658	28,330,521	30,771,004	31,495,378	32,237,136	34,265,176	35,072,955
PRODUCERS AND AREA TARGETED								
Number of upland rice farming households targeted	158,459	162,258	166,148	170,131	174,211	178,388	182,665	187,045

SIERRA LEONE	2018	2019	2020	2021	2022	2023	2024	2025
Number of substitute farming households targeted (upland rice)	0	0	0	0	0	0	0	0
Total number of upland rice farmers	158,459	162,258	166,148	170,131	174,211	178,388	182,665	187,045
Number of irrigated rice farming households targeted	0	0	0	0	0	0	0	0
Number of lowland rice farming households targeted	41,187	42,173	43,183	44,217	45,276	46,360	47,470	48,607
Total number of farmers/trainees targeted	199,646	204,431	209,331	214,348	219,486	224,748	230,135	235,652
Number of farmers targeted by PLAR training	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Number of farmers targeted by Video training	20,335	20,480	20,628	20,780	20,936	21,095	21,258	21,426
Number of farmers targeted by Radio-TV training	199,646	204,431	209,331	214,348	219,486	224,748	230,135	235,652
Number of trainees targeted by IRM training	40	40	40	40	40	40	40	40
Number of trainees targeted by post-harvest training	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050
Number of villages targeted by PLAR training	100	100	100	100	100	100	100	100
Number of villages targeted by Video training	203	205	206	208	209	211	213	214
Number of villages targeted by Radio-TV training	1,996	2,044	2,093	2,143	2,195	2,247	2,301	2,357
Total rice area targeted (ha)	49,911	51,108	52,333	53,587	54,872	56,187	57,534	58,913
Total additional upland rice area (ha)	29,711	30,423	31,153	31,900	32,664	33,448	34,250	35,071

SIERRA LEONE	2018	2019	2020	2021	2022	2023	2024	2025
Total additional irrigated rice area (ha)	0	0	0	0	0	0	0	0
Total additional lowland rice area (ha)	5,148	5,272	5,398	5,527	5,659	5,795	5,934	6,076
Total additional rice area (ha)	34,859	35,695	36,551	37,427	38,324	39,243	40,183	41,147
Total rice areas already on rice (ha)	15,052	15,413	15,782	16,160	16,548	16,944	17,350	17,766
INPUTS (quantity and cost)								
Seed								
Total foundation seed equivalent (T)	70	71	73	75	77	78	80	82
Total certified seed requirement (T)	2,892	2,961	3,032	3,105	3,179	3,255	3,333	3,413
Production cost of the foundation seed (US$)	137,153	140,440	143,807	147,254	150,784	154,398	158,100	161,890
Production cost of the certified seed (US$)	6,857,637	7,022,012	7,190,333	7,362,694	7,539,191	7,719,924	7,904,994	8,094,506
Cost of storage, weighing, packaging of certified seed	393,581	403,015	412,675	422,567	432,696	443,068	453,690	464,566
Cost of distribution of certified seed ((US$)	4,219	4,321	4,424	4,530	4,639	4,750	4,864	4,980
Total cost of certified seed package (including, packaging and distribution)	7,255,437	7,429,348	7,607,432	7,789,790	7,976,525	8,167,742	8,363,548	8,564,053
Total cost of seed (certified and foundation)	7,392,590	7,569,788	7,751,239	7,937,044	8,127,309	8,322,140	8,521,648	8,725,943
Fertilizer								
Total Urea (T)	5,506	5,638	5,773	5,911	6,053	6,198	6,347	6,499
Total NPK (T)	4,991	5,111	5,233	5,359	5,487	5,619	5,753	5,891
Total Fertilizer (T)	10,497	10,749	11,006	11,270	11,540	11,817	12,100	12,390
Total cost of Urea (US$)	2,284,984	2,339,745	2,395,819	2,453,240	2,512,038	2,572,248	2,633,903	2,697,037
Total cost of NPK (US$)	3,753,343	3,843,302	3,935,421	4,029,750	4,126,343	4,225,254	4,326,539	4,430,256

SIERRA LEONE	2018	2019	2020	2021	2022	2023	2024	2025
Total cost of fertilizer ((US$)	6,038,328	6,183,047	6,331,240	6,482,990	6,638,381	6,797,502	6,960,442	7,127,293
Cost of fertilizer transport and distribution	2,450,031	2,508,750	2,568,878	2,630,449	2,693,497	2,758,059	2,824,170	2,891,868
Total cost of fertilizer (including, packaging and distribution)	8,488,359	8,691,797	8,900,118	9,113,438	9,331,879	9,555,562	9,784,613	10,019,161
Technology transfer and Capacity building								
Cost of PLAR training	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
Cost of Video training	61,004	61,439	61,884	62,340	62,807	63,286	63,775	64,277
Cost of Radio-TV training	3,993	4,089	4,187	4,287	4,390	4,495	4,603	4,713
Cost of IRM training	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Cost of post-harvest (GEM, ASI/ATA thresher-cleaner) training	74,500	74,500	74,500	74,500	74,500	74,500	74,500	74,500
Total technology transfer and Capacity Building cost	499,496	500,027	500,571	501,127	501,697	502,280	502,878	503,490
Machine/Equipment (quantity and cost)								
Number of tractors (for a fraction of the additional areas)	0	0	0	0	0	0	0	0
Number of power tiller (for a fraction of the additional areas)	290	297	305	312	319	327	335	343
Number of ASI/ATA thresher-cleaner (for a fraction of the additional production)	213	218	223	228	234	239	245	251
Number of mini-milling machine	43	44	45	46	47	48	49	50
Number of GEM parboilers (for a fraction of the additional production)	24	24	25	25	26	27	27	28
Total cost tractor (US$)	0	0	0	0	0	0	0	0
Total cost of power tiller (US$)	1,817,283	1,860,843	1,905,448	1,951,124	1,997,895	2,045,790	2,094,834	2,145,055
Total cost of ASI/ ATA thresher-cleaner (US$)	990,212	1,013,568	1,037,485	1,061,976	1,087,055	1,112,736	1,139,033	1,165,962

SIERRA LEONE	2018	2019	2020	2021	2022	2023	2024	2025
Total cost of mini milling machine (US$)	1,080,231	1,105,711	1,131,802	1,158,520	1,185,879	1,213,894	1,242,582	1,271,958
Total cost of GEM (US$)	473,261	484,424	495,855	507,560	519,547	531,820	544,389	557,259
Total cost of Machine/ Equipment (US$)	4,360,987	4,464,546	4,570,591	4,679,180	4,790,376	4,904,241	5,020,838	5,140,234
Marketing and upgrading (cost)								
Cost of training/ meeting on branding and packaging (US$)	4,116	4,116	4,116	4,116	4,116	4,116	4,116	4,116
Cost of participation and exhibition in trade fair (US$)	7,473	7,473	7,473	7,473	7,473	7,473	7,473	7,473
Cost of marketing campaigns (US$)	50,655	50,655	50,655	50,655	50,655	50,655	50,655	50,655
Cost of high quality bags for the packaging of the additional milled rice (US$)	637,442	652,477	667,874	717,822	734,773	752,132	794,348	813,128
Total cost of marketing and upgrading (US$)	699,686	714,722	730,118	780,066	797,018	814,376	856,592	875,372
TOTAL COST	21,441,118	21,940,880	22,452,636	23,010,856	23,548,278	24,098,599	24,686,569	25,264,199

Tanzania

Country Background

The United Republic of Tanzania is an East African country of about 50 million people,[106] rich in natural and mineral resources, and endowed with diverse agro-climatic regions.[107] Tanzania is one of the most politically stable countries in Africa, an attribute that enabled it to maintain a high economic growth rate, averaging 6 – 7% per annum in the last decade.[108] Agriculture is the foundation of the Tanzanian economy. It accounts for about half of the national income, three quarters of merchandise exports, provides employment for about 75% of Tanzanians, produces approximately 97% of food requirements, and provides links with the non-farm sector through agro processing, consumption, export, provision of raw materials to industries, and a market for manufactured goods. Tanzania has been a net exporter of rice to regional markets since 2010.[109]

Despite these achievements, agriculture's contribution to GDP has been slowing, due to the slower growth in the agriculture sector than in the rest of the economy. For example, in 2012, agriculture contributed 28% of the GDP, compared to 33% in 2000. In addition, agriculture grew by only 4.2% between 2001 and 2011, compared to 6.9% for the entire economy.[110] However, the World Bank Facts Sheet on Tanzania reports that "agricultural production increased over the previous year" (2016).[111] The government's official website also confirms that the production "of food crops is not stable, varying from year to year depending on the amount of rainfall received.[112]

Several factors explain the relatively low share of agriculture in the economy; these include (i) the dominance of small farm holdings; (ii) dependence on rain-fed crop production, especially in the rural areas; (iii) limited use quality seed of improved varieties and fertilizers; (iv) the low share of cultivated area over arable land, etc. These factors combined to make Tanzanian agricultural productivity one of the lowest in SSA[113] and the country a net importer of staple foods during 2007 – 2013.

Economic growth has been non-inflationary, with inflation rate remaining around the projected medium-term target of 5%. The value of the currency (the Tanzanian shilling) also remained stable in 2016 after the volatility it experienced in 2015. Exports have also been growing modestly and imports falling significantly, narrowing the current account deficit in 2016, and leaving gross

[106]http://www.worldbank.org/en/country/tanzania/overview.
[107]FAO, 2014.
[108]http://www.worldbank.org/en/country/tanzania/overview, *Op. cit*.
[109]FAO, 2014, *Op.cit*. Citing, Barreiro-Hurle J. 2012. Analysis of incentives and disincentives for rice in the United Republic of Tanzania. Technical notes series, MAFAP, FAO, Rome..
[110]http://www.worldbank.org/en/country/tanzania/overview, *Op. cit*.
[111]Ibid.
[112]Official Tanzania Government website, https://tanzania.go.tz/home/pages/13.
[113]Ihttp://www.worldbank.org/en/country/tanzania/overview,*Op. cit*.

international reserves at $4.3 billion at the end of January 2017. This level of reserves can finance the equivalent of approximately four months of projected imports of goods and services. The government sector has spearheaded and funded agricultural development for a long time. However, recent macro-economic reforms have opened and continue to open up "the sector to private investment in production and processing, input importation and distribution, and agricultural marketing".[114] Following these reforms, the government retains regulatory and public support functions or facilitation.

The sustained economic performance has impacted positively on the social sector, helping to reduce the poverty rate from 60% in 2007 to about 47% in 2016. However, the absolute number of poor people has not declined because of the high population growth rate of more than 3% per annum. Thus, "about 12 million Tanzanians still live in extreme poverty, earning less than US$ 0.60 per day".[115] Primary school enrolment has increased tremendously through a policy of universal education and scrapping of fees and other mandatory contributions tied to enrolment and attendance in primary and secondary schools. The country's Human Development Index (HDI) has risen in the last two decades from 0.3 in 1991 to almost 0.5 in 2012. This notwithstanding, acute and widespread poverty, under-nutrition, and malnutrition remain in the rural sector, which hosts more than 80% of the poor.

CIPRiSSA Results for Tanzania

Self-Sufficiency

Tanzania has already achieved self-sufficiency in rice and exports rice to regional markets. Tanzania achieved an average annual growth rate of 9% in rice production between 2006 and 2015. This estimate indicates that local rice production has already outpaced the country's domestic needs, and the self-sufficiency ratio will reach 222% in 2018 and 343% by 2025 (Figure A10.1). This analysis illustrates Tanzania's great potentials to be a vibrant rice exporter to the regional East African community and beyond.

Paddy and Milled Rice Production

The projections show that paddy production would rise steadily from 3.9 MT in 2018 to 7.3 MT in 2025, amounting to a cumulative total of 43.7 MT by 2025. The milled rice equivalent would range between 2.3 MT in 2018 and 4.8 MT in 2025, for a cumulative total of 27.4 MT. The food equivalent of the milled rice would also rise steadily from 1.06 MT in 2018 to 1.39 MT in 2025 with a cumulative total of 9.74MT (Figure A10.1; Table A10).

[114]Ibid.
[115]Ibid.

New Investments

Between 2018 and 2025, Tanzania will require additional irrigation and non-irrigation investments of US$ 197 million to realize the foregoing projections (Figure A10.2), comprising US$ 161 or 82% of total investment for non-irrigation and US$ 36 or about 18% of total investment for irrigation (Figure A10.3).

The priority areas for non-irrigation investments include (i) fertilizer procurement and distribution (US$ 72.26 million or 44.9 % of non-irrigation investment); (ii) quality seeds procurement and distribution (US$ 45.52 million or 28.3 %); (iii) machines/equipment (US$ 33.09 million or 20.6 %); (iv) marketing/upgrading of the value chain (US$ 5.85 million or 3.6%); and (v) technology transfer/capacity development of actors in the value chain (US$ 4.15 million or 2.6 %) (Figures A10.4 and A10.5). The total projected investment in non-irrigation of US$ 161 million will comprise annual targets ranging from US$ 19 million in 2018 to US$ 22 million in 2025 (Figure A10.2).

New investments in irrigation will also increase progressively every year from US$ 4.11 million in 2018 to US$ 4.85 million in 2025 (Figure A10.2).

Benefits

The new irrigation facilities will develop 7,155 ha, with annual targets ranging from 822 ha in 2018 to 970 ha in 2025 (Figure A10.6). Tanzania is expected to save US$ 226.82 million in foreign exchange, with annual targets ranging from US$ 25.01 million in 2018 to US$ 32.04 million in 2025 (Figure A10.7). CIPRiSSA's target is to empower 1.54 million new farming households in Tanzania by 2025, with annual targets ranging from 178,413 in 2018 to 207,962 in 2025 (Figures A10.10 and A10.11). These households will be empowered through training in PLAR, video, radio-TV, IRM, and post-harvest practices. The total rice area targeted will increase annually from 25,341 ha in 2018 to 29,257 ha in 2025 (Figure A10.8). This expansion will increase paddy production by between 114,840 T (71,601 T of milled rice) in 2018 and 134,178 T (90,171 T of milled rice) in 2025 (Figure A10.9).

Profitability

Excluding the cost of new irrigation schemes, Tanzania needs to invest US$ 160.86 million, with an average annual operational cost of US$ 20.11 million, to achieve 343% self-sufficiency in rice by 2025. These investments will generate a benefits/costs ratio (NPV ratio to investment) of 1.26, an NPV of US$ 84.57 million, and an MIRR of 54.62%. Each dollar invested in the program will generate a net benefit of US$ 1.26. With an NPV much higher than zero, investments in CIPRiSSA are profitable and will remain financially viable as long as the financial rate of alternative investment projects in the country is less than 54.62%.

The projected total investment including the cost of construction of new irrigation schemes is US$ 196.64 million, with an average annual target of US$ 24.58 million. This investment will generate an NPV of US$ 68.26 million, a benefits/costs ratio of 0.70, and an MIRR of 31.79% (Table A12).

The estimated payback period of the investments is 3.21 years (by 2021), meaning that all investments will be recovered before the end of the project. These indicators imply that investments required to achieve 343% self-sufficient in rice by 2025 are profitable for private sector involvement. Regarding the program's contribution to the overall welfare of the country and to the national objectives, the estimated gross domestic value-added (which measures the real monetary contribution of the project to the economy of the country in terms of direct and indirect generated value added) is US$ 209.51 million. This represents the program's contribution of the GDP. The estimated net national value added (which represents the program's contribution to national welfare) is US$ 159.92 million. The economic internal rate of rate return is 11.95%. In total, the program will create 46,590 new direct employments.

Sensibility analysis shows that the proposed investments remain profitable under both pessimistic (-10% of the price) and optimistic (+10% of the price) scenarios, with NPVs greater than zero. Under optimistic scenarios, the investments will generate a benefits/costs ratio (NPV ratio to investment) of 1.66, a net profit of US$ 111.84 million, and an MIRR of 76.76%. Under pessimistic scenarios, the investments will generate a benefits/costs ratio (NPV ratio to investment) of 0.85, a net profit of US$ 57.29 million, with an MIRR of 35.32%. In addition, the break-even point analysis shows that the investments remain profitable even with a 73.85% reduction of the market price.

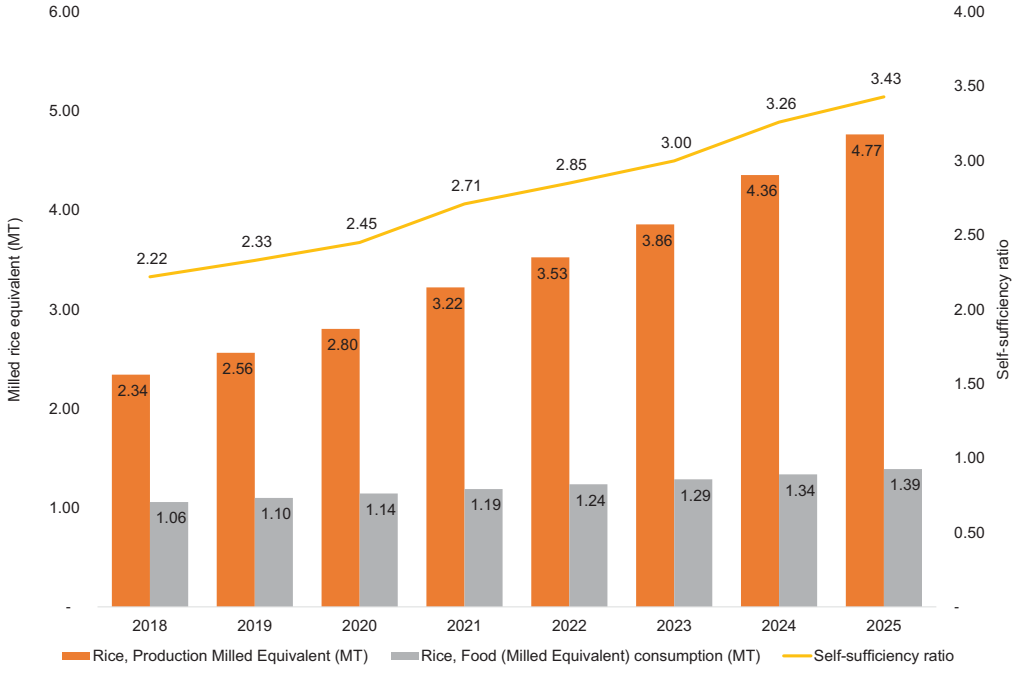


Figure A10.1: Milled rice production and consumption versus self-sufficiency in Tanzania

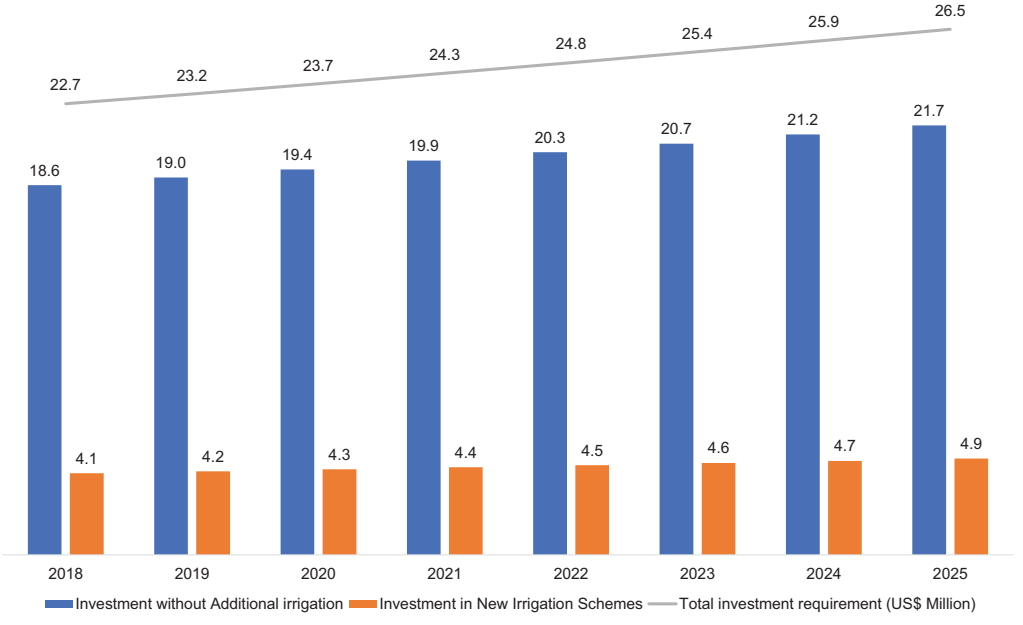


Figure A10.2: Additional irrigation and non-irrigation investments required by Tanzania (US$ million)

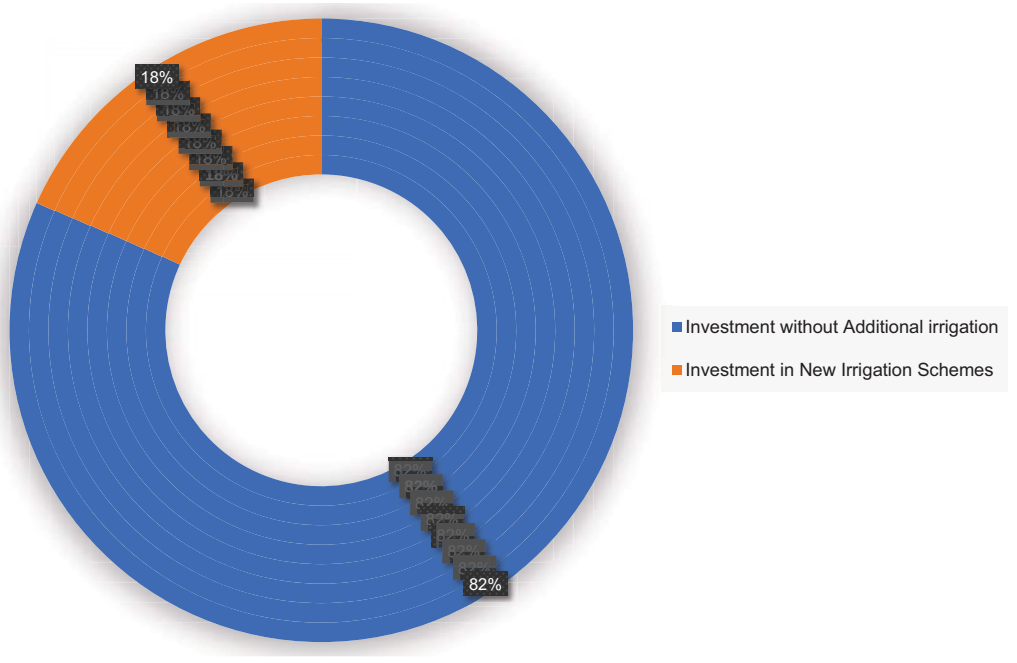


Figure A10.3: Additional irrigation and non-irrigation investments required by Tanzania (%)

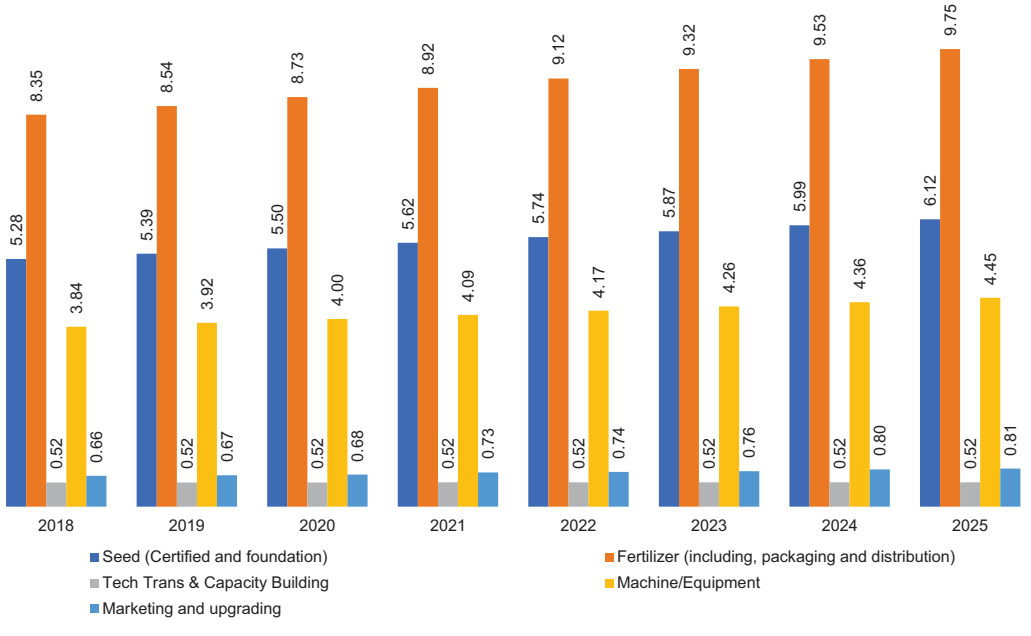


Figure A10.4: Composition of new non-irrigation investments required by Tanzania (US$ million)

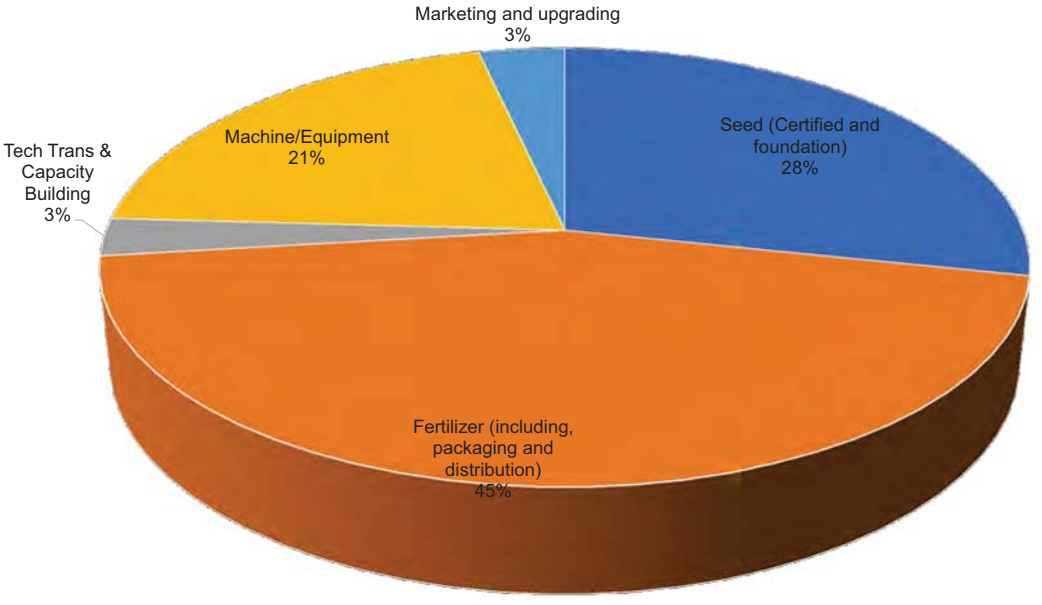


Figure A10.5: Distribution of new non-irrigation investments required in Tanzania (%)

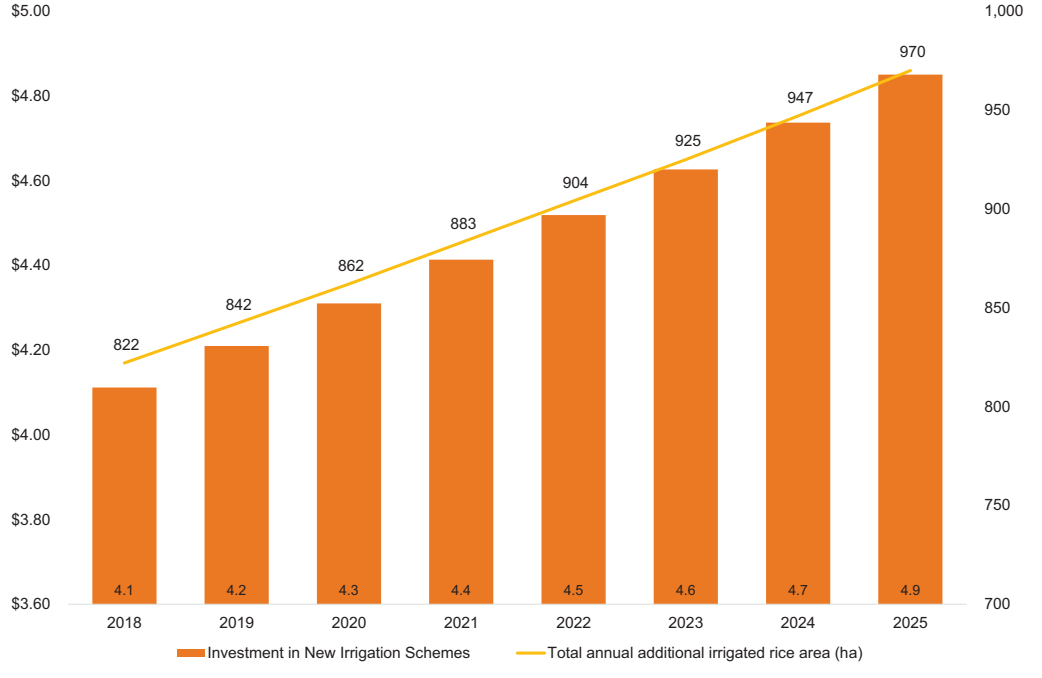


Figure A10.6: Additional irrigated rice area (ha) versus new irrigation investments (US$ million) in Tanzania

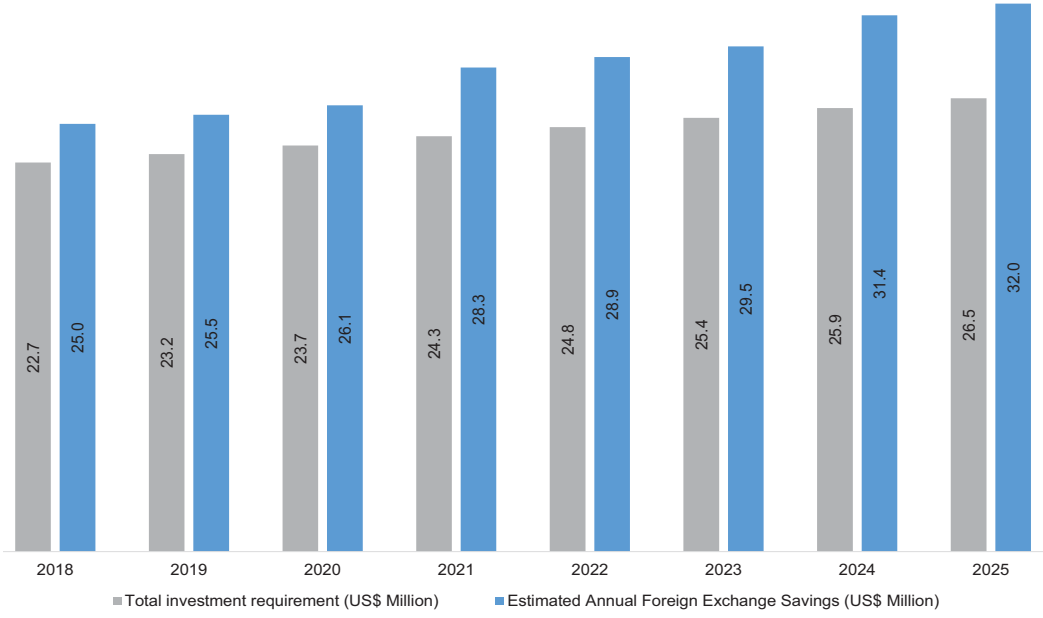


Figure A10.7: Estimated annual new costs versus annual foreign exchange savings for Tanzania (US$ million)

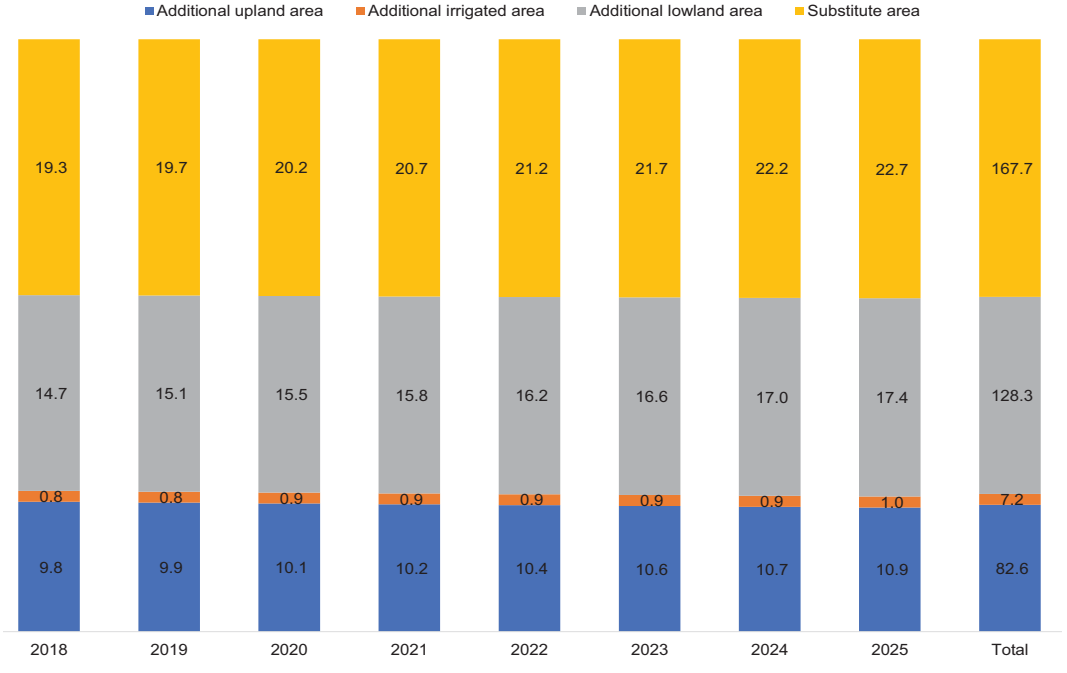


Figure A10.8: Expected gains from CIPRiSSA in Tanzania 1: Rice area expansion per ecology ('000 ha)

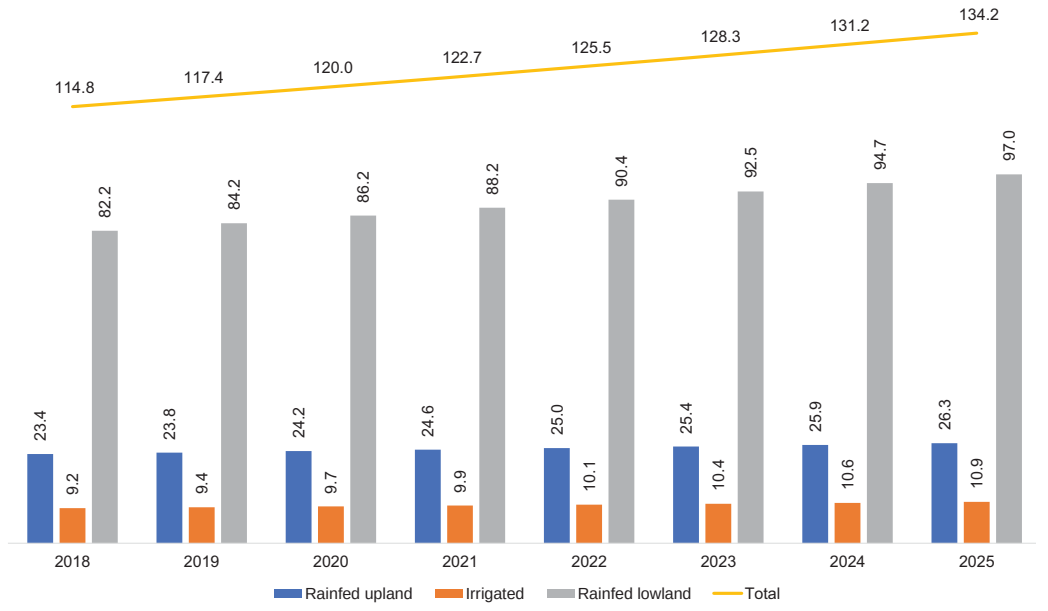


Figure A10.9: Expected gains from CIPRiSSA in Tanzania 2: Expected additional production per ecology ('000 tons)

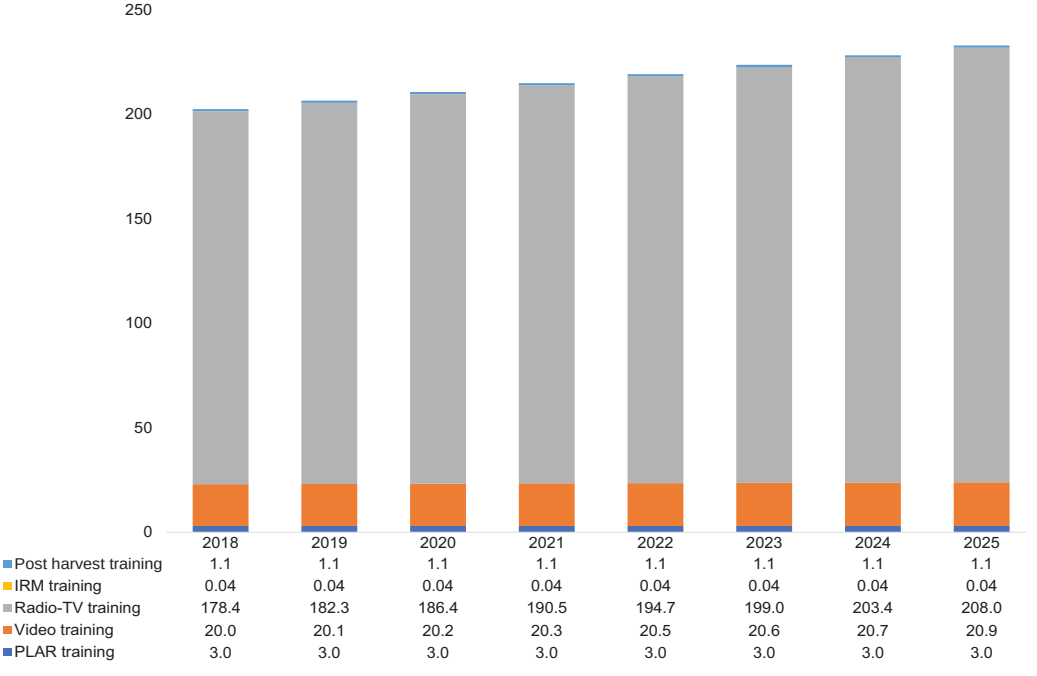


Figure A10.10: Expected gains from CIPRiSSA in Tanzania 3: Number of farmers and other actors targeted in training ('000 persons)

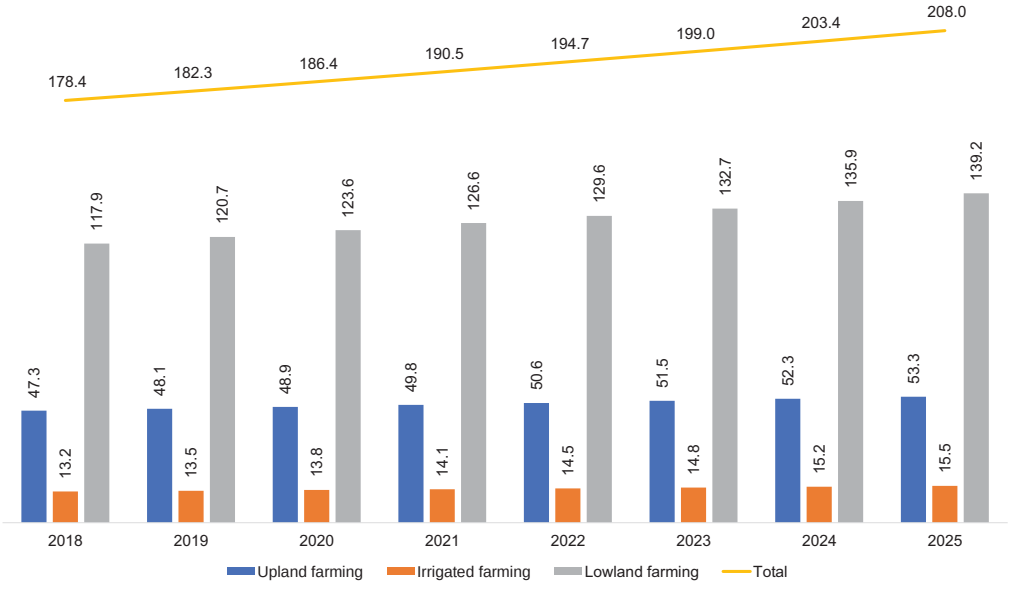


Figure A10.11: Expected gains from CIPRiSSA in Tanzania 4: Number of beneficiary households targeted ('000 households)

Table A10: Projected estimates in required investments, production gains, hectarage, and farming households for Tanzania (2018-2025)

TANZANIA	2018	2019	2020	2021	2022	2023	2024	2025
PROJECTED STATISTICS ON RICE (production, consumption import)								
Rice, paddy production (T)	3,904,081	4,271,954	4,674,490	5,114,956	5,596,926	6,124,311	6,701,390	7,332,846
Rice, production milled equivalent (T)	2,342,449	2,563,172	2,804,694	3,222,422	3,526,063	3,858,316	4,355,903	4,766,350
Rice, food (milled equivalent) consumption (T)	1,056,642	1,098,908	1,142,864	1,188,579	1,236,122	1,285,567	1,336,989	1,390,469
Self-sufficiency ratio	2.22	2.33	2.45	2.71	2.85	3.00	3.26	3.43
ADDITIONAL GAIN FROM THE PROGRAM								
Expected additional production from rainfed upland (T)	23,444	23,823	24,211	24,609	25,016	25,433	25,860	26,297
Expected additional production from irrigated (T)	9,212	9,432	9,657	9,888	10,124	10,366	10,613	10,867
Expected additional production from rainfed lowland (T)	82,185	84,156	86,174	88,240	90,356	92,523	94,742	97,014
Expected additional production from the 3 ecologies (T)	114,840	117,410	120,042	122,737	125,496	128,322	131,215	134,178
Expected additional production from technology adoption (T)	4,494	4,501	4,508	4,516	4,523	4,531	4,539	4,547
Expected additional paddy production from the program (T)	119,334	121,911	124,550	127,252	130,019	132,853	135,754	138,725
Expected additional rice, food (milled equivalent) from the program (T)	71,601	73,147	74,730	80,169	81,912	83,697	88,240	90,171
Estimated foreign exchange savings (US$ per year)	25,010,573	25,546,881	26,096,060	28,305,700	28,917,375	29,543,730	31,356,676	32,039,096
PRODUCERS AND AREA TARGETED								
Number of upland rice farming households targeted	32,893	33,678	34,483	35,306	36,150	37,013	37,897	38,803

TANZANIA	2018	2019	2020	2021	2022	2023	2024	2025
Number of substitute farming households targeted (upland rice)	14,450	14,450	14,450	14,450	14,450	14,450	14,450	14,450
Total number of upland rice farmers	47,343	48,128	48,933	49,756	50,600	51,463	52,347	53,253
Number of irrigated rice farming households targeted	13,157	13,471	13,793	14,123	14,460	14,805	15,159	15,521
Number of lowland rice farming households targeted	117,912	120,740	123,635	126,600	129,636	132,745	135,928	139,188
Total number of farmers/trainees targeted	178,413	182,340	186,361	190,479	194,695	199,013	203,435	207,962
Number of farmers targeted by PLAR training	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Number of farmers targeted by Video training	19,958	20,077	20,199	20,324	20,452	20,583	20,717	20,854
Number of farmers targeted by Radio-TV training	178,413	182,340	186,361	190,479	194,695	199,013	203,435	207,962
Number of trainees targeted by IRM training	40	40	40	40	40	40	40	40
Number of trainees targeted by post-harvest training	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050
Number of villages targeted by PLAR training	100	100	100	100	100	100	100	100
Number of villages targeted by Video training	263	264	265	267	268	269	271	272
Number of villages targeted by Radio-TV training	1,784	1,823	1,864	1,905	1,947	1,990	2,034	2,080
Total rice area targeted (ha)	44,603	45,585	46,590	47,620	48,674	49,753	50,859	51,991
Total additional upland rice area (ha)	9,780	9,927	10,078	10,232	10,391	10,552	10,718	10,888
Total additional irrigated rice area (ha)	822	842	862	883	904	925	947	970

TANZANIA	2018	2019	2020	2021	2022	2023	2024	2025
Total additional lowland rice area (ha)	14,739	15,092	15,454	15,825	16,204	16,593	16,991	17,399
Total additional rice area (ha)	25,341	25,862	26,394	26,940	27,499	28,071	28,657	29,257
Total rice areas already on rice (ha)	19,262	19,723	20,196	20,680	21,175	21,682	22,202	22,734
INPUTS (quantity and cost)								
Seed								
Total foundation seed equivalent (T)	49	50	51	52	53	54	55	56
Total certified seed requirement (T)	2,316	2,366	2,417	2,470	2,524	2,579	2,636	2,694
Production cost of the foundation seed (US$)	95,504	97,536	99,616	101,747	103,928	106,162	108,450	110,792
Production cost of the certified seed (US$)	4,861,468	4,965,117	5,071,254	5,179,938	5,291,231	5,405,195	5,521,894	5,641,393
Cost of storage, weighing, packaging of certified seed	315,170	322,012	329,018	336,192	343,538	351,060	358,763	366,651
Cost of distribution of certified seed ((US$)	3,771	3,854	3,939	4,026	4,115	4,206	4,299	4,395
Total cost of certified seed package (including, packaging and distribution)	5,180,409	5,290,983	5,404,211	5,520,156	5,638,884	5,760,461	5,884,956	6,012,439
Total cost of seed (certified and foundation)	5,275,913	5,388,518	5,503,827	5,621,902	5,742,812	5,866,623	5,993,406	6,123,232
Fertilizer								
Total Urea (T)	6,099	6,236	6,377	6,521	6,669	6,820	6,974	7,133
Total NPK (T)	4,460	4,558	4,659	4,762	4,867	4,975	5,086	5,199
Total Fertilizer (T)	10,559	10,795	11,036	11,283	11,536	11,795	12,060	12,332
Total cost of Urea (US$)	2,530,954	2,587,994	2,646,404	2,706,215	2,767,462	2,830,179	2,894,401	2,960,164
Total cost of NPK (US$)	3,354,156	3,427,985	3,503,586	3,581,001	3,660,274	3,741,449	3,824,573	3,909,692
Total cost of fertilizer (US$)	5,885,110	6,015,979	6,149,989	6,287,216	6,427,736	6,571,628	6,718,974	6,869,856
Cost of fertilizer transport and distribution	2,464,470	2,519,465	2,575,779	2,633,445	2,692,495	2,752,962	2,814,880	2,878,285

TANZANIA	2018	2019	2020	2021	2022	2023	2024	2025
Total cost of fertilizer (including, packaging and distribution)	8,349,580	8,535,444	8,725,768	8,920,661	9,120,230	9,324,590	9,533,854	9,748,141
Technology transfer and capacity building								
Cost of PLAR training	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
Cost of Video training	78,925	79,282	79,648	80,022	80,405	80,798	81,200	81,612
Cost of Radio-TV training	3,568	3,647	3,727	3,810	3,894	3,980	4,069	4,159
Cost of IRM training	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Cost of Post-harvest (GEM, ASI/ATA thresher-cleaner) training	74,500	74,500	74,500	74,500	74,500	74,500	74,500	74,500
Total technology transfer and Capacity Building cost	516,993	517,429	517,875	518,332	518,799	519,278	519,769	520,271
Machine/Equipment (quantity and cost)								
Number of tractors (for a fraction of the additional areas)	3	3	3	3	3	3	3	3
Number of power tiller (for a fraction of the additional areas)	204	208	213	217	222	226	231	236
Number of ASI/ATA thresher-cleaner (for a fraction of the additional production)	199	203	208	212	217	221	226	231
Number of mini-milling machine	40	41	42	42	43	44	45	46
Number of GEM parboilers (for a fraction of the additional production)	22	23	23	24	24	25	25	26
Total cost tractor (US$)	181,882	186,224	190,672	195,226	199,889	204,664	209,554	214,561
Total cost of power tiller (US$)	1,278,218	1,304,320	1,331,049	1,358,419	1,386,447	1,415,147	1,444,535	1,474,629
Total cost of ASI/ ATA thresher-cleaner (US$)	924,760	944,730	965,179	986,119	1,007,561	1,029,518	1,052,002	1,075,026
Total cost of mini milling machine (US$)	1,008,829	1,030,615	1,052,923	1,075,766	1,099,158	1,123,111	1,147,639	1,172,755

TANZANIA	2018	2019	2020	2021	2022	2023	2024	2025
Total cost of GEM (US$)	441,979	451,524	461,297	471,305	481,553	492,047	502,793	513,797
Total cost of machine/ equipment (US$)	3,835,668	3,917,413	4,001,119	4,086,835	4,174,607	4,264,486	4,356,523	4,450,768
Marketing and upgrading (cost)								
Cost of training/meeting on branding and packaging (US$)	4,116	4,116	4,116	4,116	4,116	4,116	4,116	4,116
Cost of participation to exhibition in trade fair (US$)	7,473	7,473	7,473	7,473	7,473	7,473	7,473	7,473
Cost of marketing campaigns ((US$)	50,655	50,655	50,655	50,655	50,655	50,655	50,655	50,655
Cost of high quality bags for the packaging of the additional milled rice (US$)	595,308	608,163	621,327	666,547	681,041	695,882	733,654	749,710
Total cost of marketing and upgrading (US$)	657,552	670,407	683,571	728,791	743,285	758,126	795,898	811,954
TOTAL COST WITHOUT IRRIGATION SCHEMES	18,635,706	19,029,211	19,432,161	19,876,521	20,299,734	20,733,104	21,199,449	21,654,365
Total additional irrigation scheme by 2025 (ha) planned by each country (a)	Not available	Not available	Not available	Not available	Not available	Not available	Not available	Not available
Annual additional irrigation scheme by 2025 (ha) planned by each country (b) = (a)/8	-	-	-	-	-	-	-	-
Total annual additional irrigated rice area (ha) from CIPRiSSA (c)	822	842	862	883	904	925	947	970
(b)-(c)	(822)	(842)	(862)	(883)	(904)	(925)	(947)	(970)
Cost of new irrigation schemes from CIPRiSSA (US$)	4,111,626	4,209,803	4,310,336	4,413,281	4,518,698	4,626,644	4,737,181	4,850,371

Uganda

Country Background

Uganda[116] is a landlocked country of about 32 million inhabitants occupying an area of 241,559 km^2, "of which 18% is open inland waters and wetlands, and 37.8% is arable land"[117]. The country's neighbors are Kenya (east), Sudan (north), Democratic Republic of Congo (west), Rwanda (southwest), and Tanzania (south). The southern part of the country includes a substantial portion of Lake Victoria, which it shares with Kenya and Tanzania. The country occupies a portion of the East African plateau, which averages about 1,100 meters (3,609 ft) above sea level. The climate is generally equatorial, although this is not uniform since the altitude modifies the climate. Uganda has huge potentials in agriculture due to elevation, soil types, and predominantly warm and wet climate. The climate also explains the country's large variety of forests, grasslands, and wildlife reserves.

The country became independent on 9 October, 1962, but soon went into prolonged unrest lasting up to 1985.[118] The National Resistance Movement (NRM), led by President Yoweri Museveni, managed to stabilize the country in 1986; he has ruled it since then, winning all successive elections. Uganda liberalized its economy and adopted pro-market policies in the 1980s as part of its structural, economic, and public-sector reforms. This resulted in "remarkable improvement in its economic performance,"[119] "sustained high economic growth and poverty reduction between 1987 and 2010",[120] and improvements in government effectiveness, especially in the last three years. The policy and regulatory environment has also improved significantly, "notably through the Public Financial Management Act (2015), although gaps in implementation in procurement and anti-corruption remain".[121]

The economy grew at an average of 7% per annum throughout the 1990s and early 2000s, but this has slowed to a (still) decent average of 4.5% in the five years to 2016, due to difficulties caused by "the civil unrest in South Sudan, global economic uncertainties, and private sector credit constraints,"[122] as well as uncertainties related to the 2016 elections. The main driver of economic activity of recent has been the large-scale development of oil-related infrastructure, and this will continue to be so in the short-run. Improved execution of these public projects,

[116]This paragraph borrows extensively from the official government website, http://www.gou.go.ug/about-uganda/, sourced on September 27, 2017, except as otherwise indicated.
[117]FAO. 2015. Uganda Country Fact Sheet On Food And Agriculture Policy Trends. http://www.fao.org/in-action/fapda/publications/country-fact-sheets/en/.
[118]http://www.gou.go.ug/about-uganda/.
[119]FAO. 2015. (*Op. cit.*).
[120]http://www.worldbank.org/en/country/uganda/overview .
[121]Ibid.
[122]Ibid.

recession of the impact of the recent drought, and addressing the banking sector distress would lead the economy to grow by 4 – 5% in 2017, 5.1% in 2018, and 5.6% in 2019, according to the World Bank's prediction. However, delays in the public infrastructure program, regional instability, global uncertainty, credit market constraints, and weather- and climate-related changes remain credible sources of risks to the economy.[123]

Uganda has huge, but untapped potentials for diversified economic development, with its abundant natural resource endowments: ample fertile land, regular rainfall, and mineral deposits, etc. Thus far, he avy investments in infrastructure (especially between 2006/07 and 2012/13) were the big boost for economic development, as already explained. Agriculture has not received similar attention, despite the sector providing "employment to over 72% of the active population, equally divided between men and women".[124] Indeed, agriculture-specific public expenditure actually declined to an average of 5% during the boom period, i.e., half of the 10% recommended by CAADP.[125] Uganda's economy comprises three sectors - 24.2% agriculture, 25.5% industry, and 50.3% services.[126] The agriculture sector includes fisheries, animal husbandry, dairy, and crop sub-sectors.

CIPRiSSA Results for Uganda

Self-Sufficiency

The CIPRiSSA baseline study revealed that rice production in Uganda grew by 6% annually during 2006-2015. Thus, with the proposed investments, Uganda could attain 80% self-sufficiency in rice in 2018 and 100% by 2025 (Figure A11.1). Although Uganda could fully satisfy its milled rice food requirements by 2025, it would not be in a position to export rice.

Paddy and Milled Rice Production

Under CIPRiSSA, Uganda will increase rice production progressively from 283,700 T in 2018 to 426,580 T in 2025 and milled rice equivalent 170,220 T in 2018 to 277,277 T in 2025. The milled rice food equivalent will range from 211,698 T in 2018 to 278,580 T in 2025 (Figure A11.1; Table A11).

[123]Ibid.
[124]FAO. 2015. (*Op. cit.*).
[125]Ibid. Citing FAO. 2014. Analysis of public expenditure in support of food and agriculture in Uganda, 2006/07–2012/13. MAFAP Technical notes series, Rome. Available at www.fao.org/3/a-i4544e.pdf.
[126]http://www.gou.go.ug/about-uganda/ (*Op. cit.*).

New Investments

To achieve the foregoing projections, Uganda needs to invest US$ 94.78 million between 2018 and 2025, comprising non-irrigation investments (US$ 74.68 or about 79% of total investment) and new irrigation costs (US$ 20.09 or 21% of total investment) (Figures A11.2 and A11.3).

The priority areas for non-irrigation investments include (i) fertilizer procurement and distribution ((US$ 26.88 or 36.0% of non-irrigation investment); (ii) machines/equipment (US$ 21.91 million or 29.3%); (iii) quality seed production and distribution (US$ 18.87 or 25.3%); (iv) technology transfer/capacity building (US$ 4.03 or 5.4%); and (v) product marketing and upgrading of the value chain (US$ 3.00 or 4.0%) . The annual cost of new non-irrigation investments will range from US$ 8.71 in 2018 to US$ 9.99 in 2025 (Figures A11.2, A11.4 and A11.5)

The annual new investments in irrigation are US$ 2.31 million in 2018, and progressively increase to US$ 2.72 million in 2025 (Figure A11.2).

Benefits

The new irrigation facilities will develop 2,304 ha, ranging from 265 ha in 2018 to 312 ha in 2,025 (Figure A11.6) and save Uganda US$ 110.70 million in foreign exchange, with annual targets ranging from US$ 12.31 million in 2018 to US$ 15.52 million in 2025 (Figure A11.7).

The number of new farming households reached by the program will increase annually from 68,731 in 2018 to 79,496 in 2025 (Figure A11.11). These households will be empowered through training in PLAR, video, radio-TV, IRM, and post-harvest practices (Figure A11.10). CIPRiSSA will expand rice land by 147,972 ha across all ecologies (Figure 11.8). This expansion will increase paddy production by 54,673 T (33,632 T of milled rice) in 2018 and 63,055 T (41,896 T of milled rice) in 2025 (Figure A10.9).

Profitability

To achieve 100% self-sufficiency by 2025, Uganda needs to invest US$ 74.68 million, excluding the cost of new irrigation schemes, with an average annual operational cost of US$ 9 million. These investments will generate a benefits/costs ratio (NPV ratio to investment) of 1.35, an NPV of US$ 47.58 million, and an MIRR of 61.82%. Eac h dollar invested in the program will generate a net benefit of US$ 1.35. With an NPV higher than zero, CIPRiSSA is profitable and will remain viable as long as the financial rate of alternative investment projects in the country is less than 61.82% (Table A12).

The estimated payback period of the investments is 3 years (by 2020), meaning that all investments will be recovered before the end of the program. These indicators imply that investments required to achieve self-sufficient in rice by 2025 are profitable for private sector involvement.

The estimated gross domestic value-added (which measures the real monetary contribution of the project to the economy of the country in terms of direct and indirect generated value added) is US$ 109.88 million. This represents the contribution of the program to the GDP. The estimated net national value added (which represents the contribution to national welfare) is US$ 84.51 million. The economic internal rate of rate return is 19.54%. In total, the program will create 17,907 direct employments.

Sensibility analysis shows that the proposed investments are profitable under both pessimistic (-10% of the price) and optimistic (+10% of the price) scenarios. The NPV ratio is greater than zero in both cases. Under optimistic scenarios, the investments will generate a benefits/costs ratio (NPV ratio to investment) of 1.71, a net profit of US$ 60.32 million, and an MIRR of 82.66%. Under pessimistic scenarios, the investments will generate a benefits/costs ratio (NPV ratio to investment) of 0.98, a net profit of US$ 34.83 million, with an MIRR of 43.05%. In addition, the break-even point analysis shows that the investments remain profitable even with a 67.72% reduction of the market price.

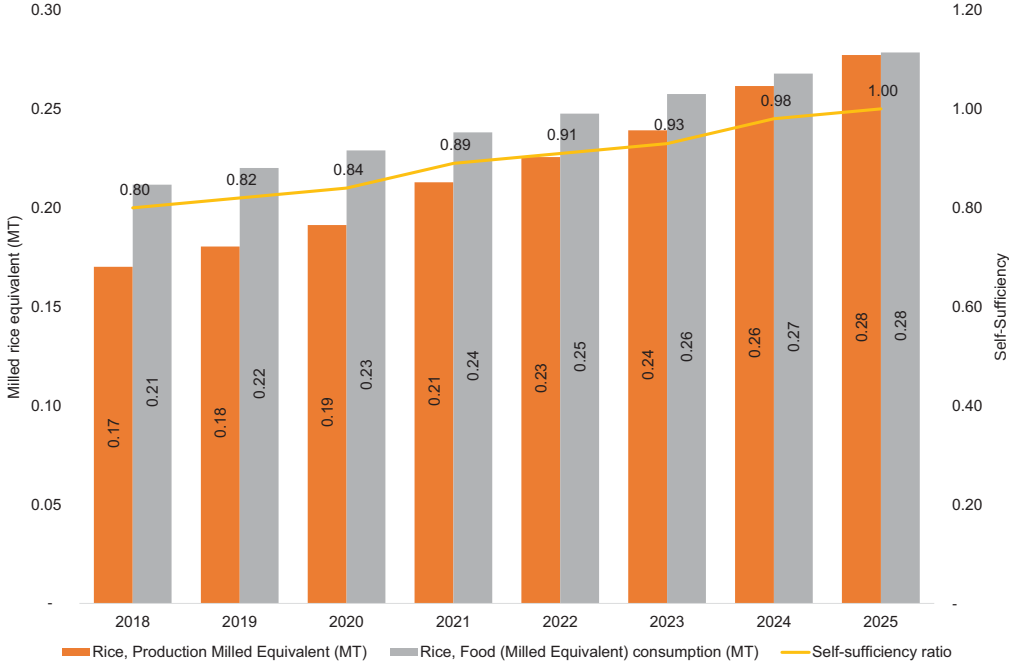


Figure A11.1: Milled rice production and consumption versus self-sufficiency in Uganda

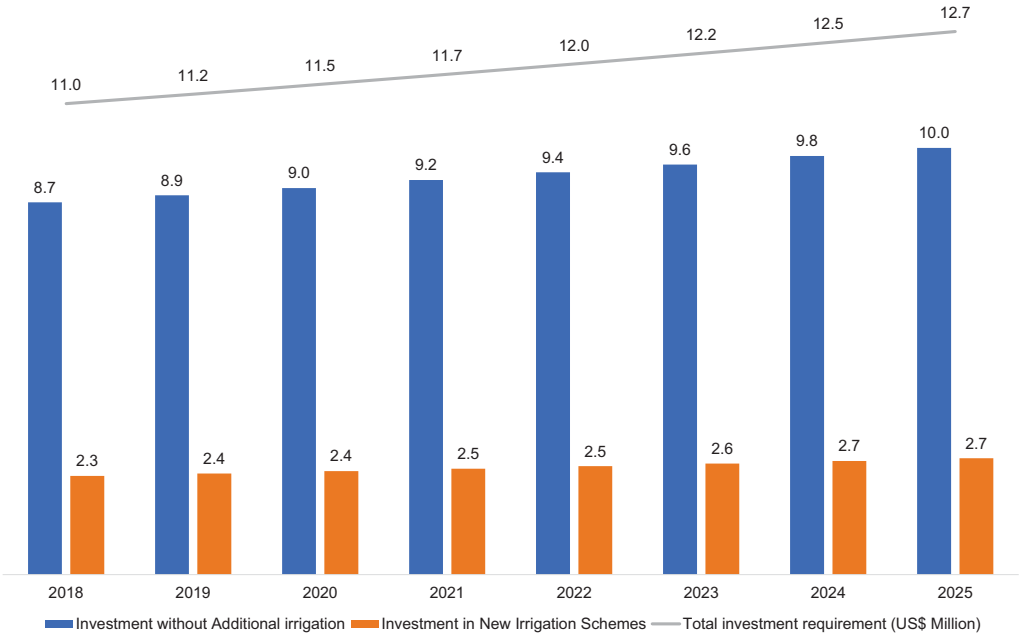


Figure A11.2: Additional irrigation and non-irrigation investments required by Uganda (US$ million)

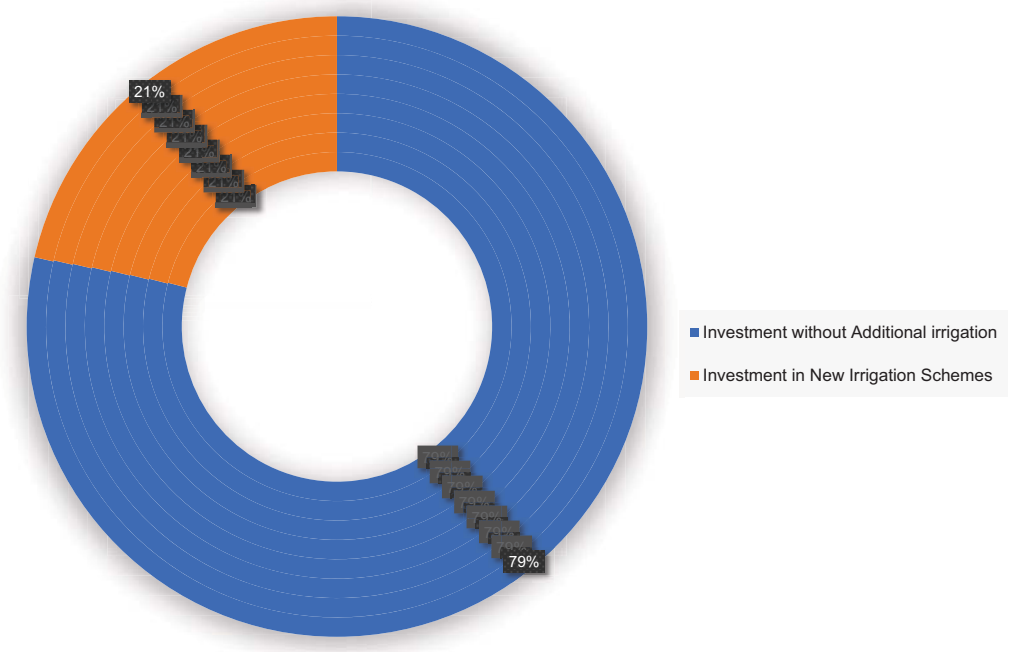


Figure A11.3: Additional irrigation and non-irrigation investments required by Uganda (%)

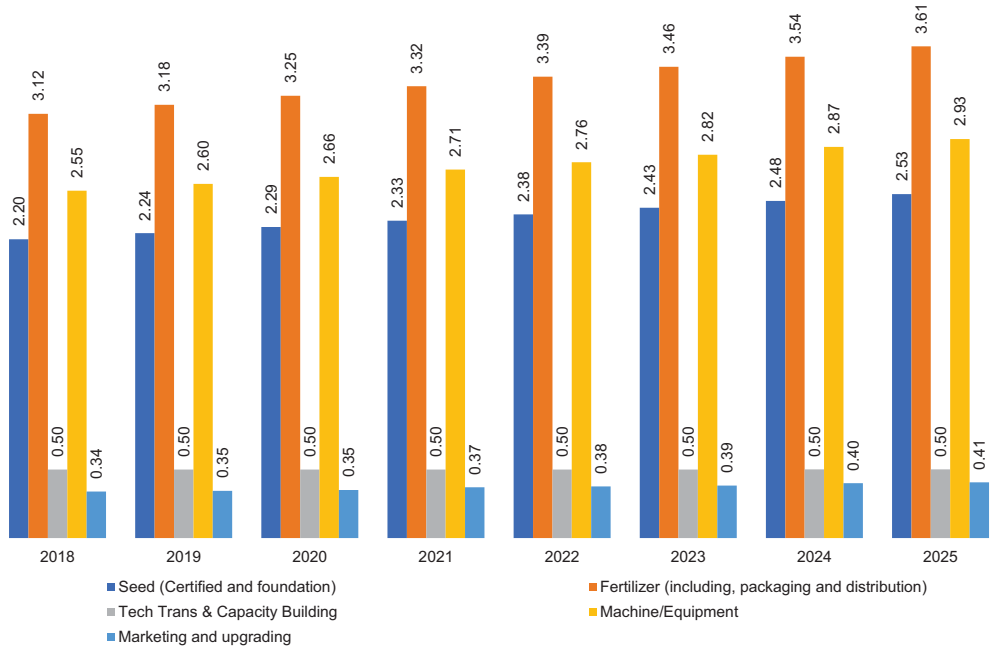


Figure A11.4: Composition of new non-irrigation investments required by Uganda (US$ million)

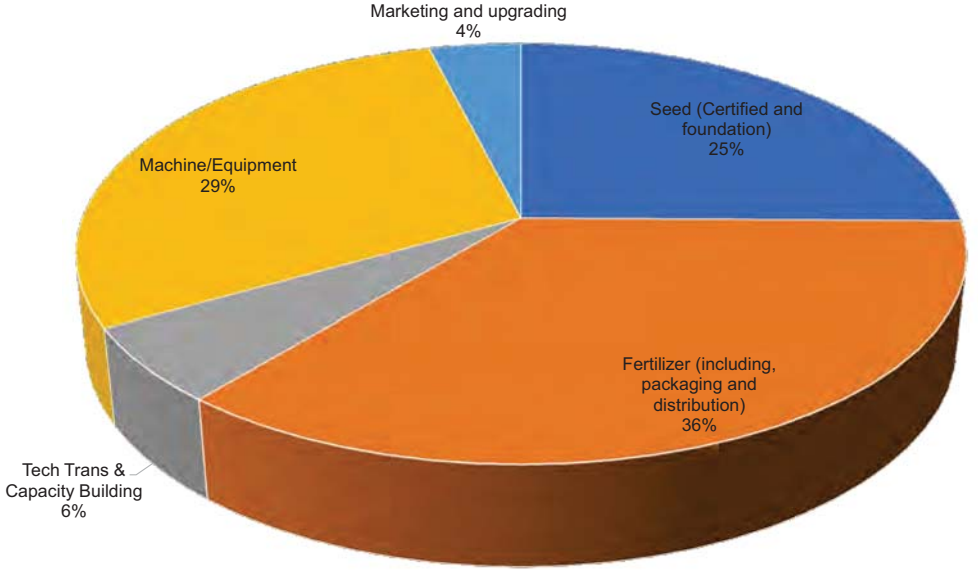


Figure A11.5: Distribution of new non-irrigation investments required in Uganda (%)

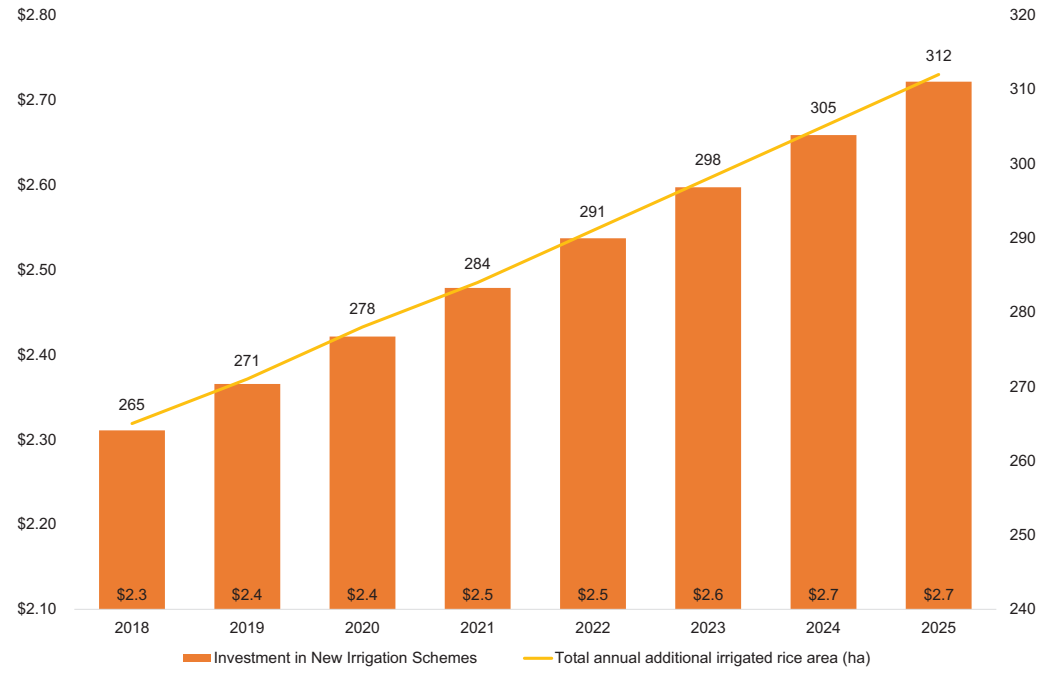


Figure A11.6: Additional irrigated rice area (ha) versus new irrigation investments (US$ million) in Uganda

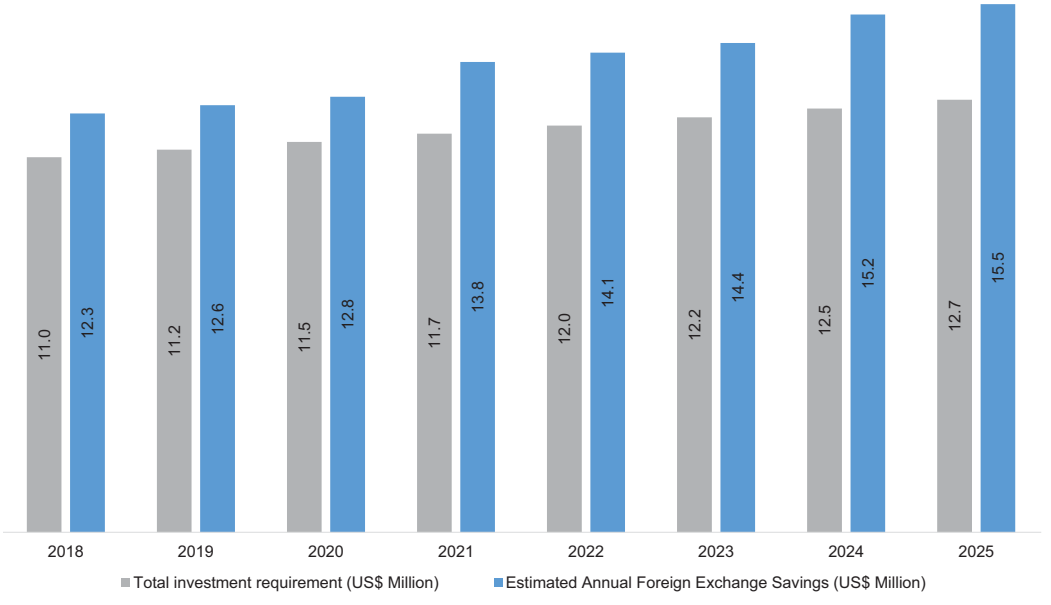


Figure A11.7: Estimated annual new investments costs versus annual foreign exchange savings for Uganda (US$ million)

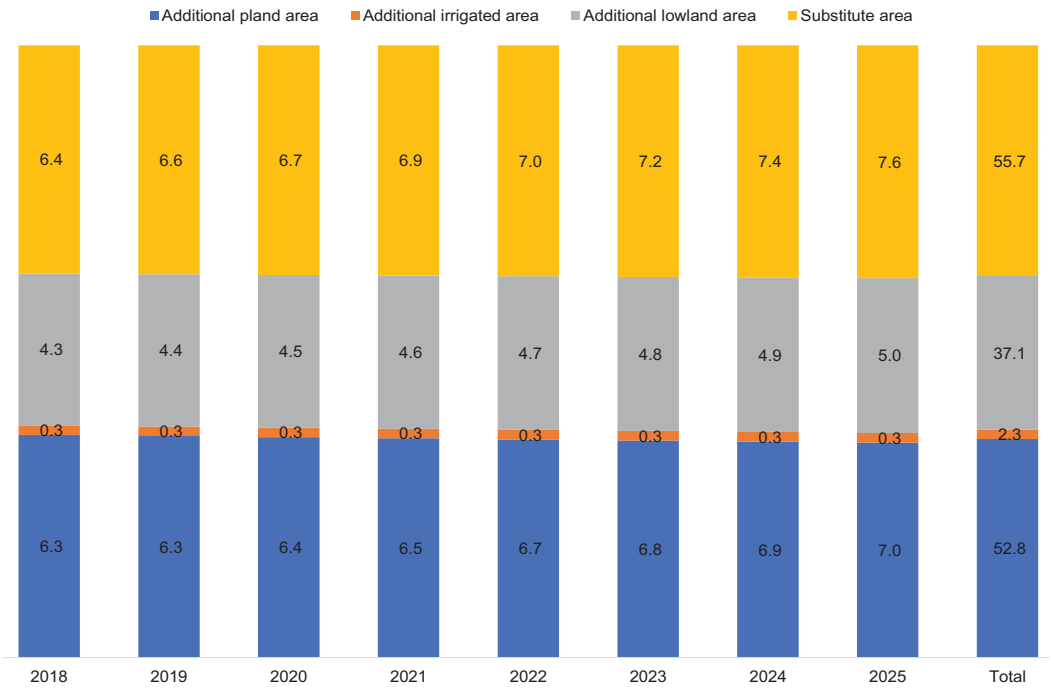


Figure A11.8: Expected gains from CIPRiSSA in Uganda 1 - Rice area expansion per ecology ('000 ha)

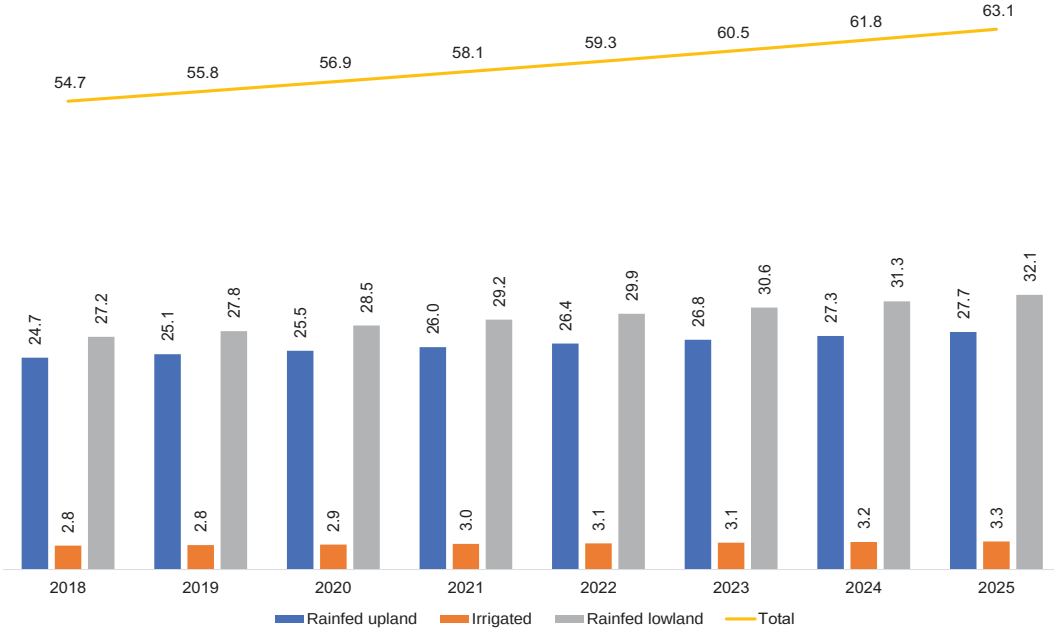
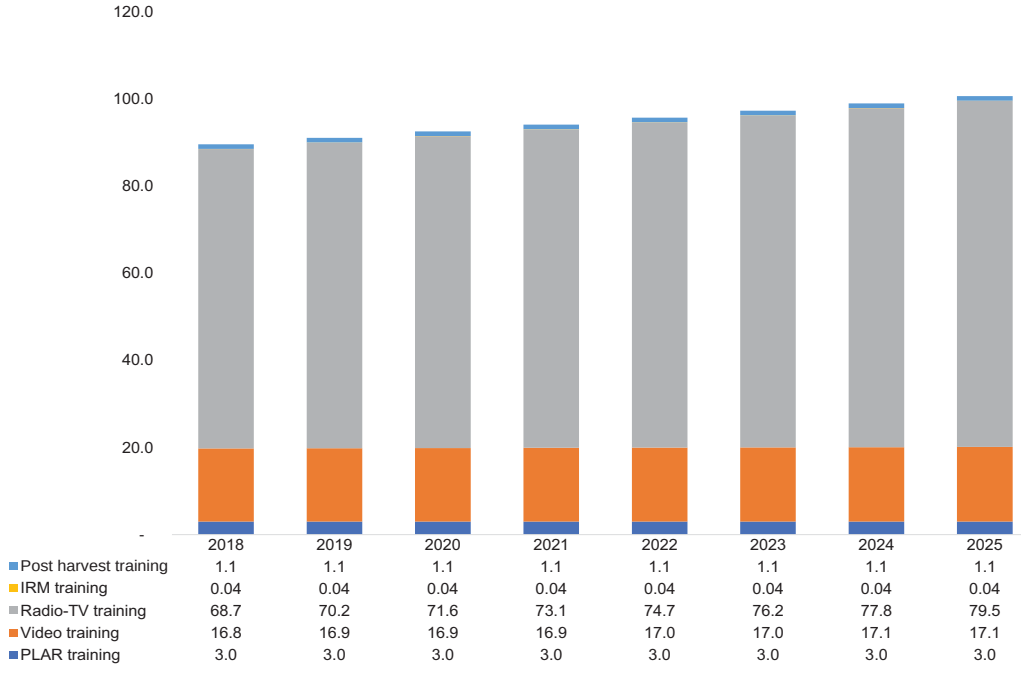


Figure A11.9: Expected gains from CIPRiSSA in Uganda 2: Expected additional production per ecology ('000 tons)



	2018	2019	2020	2021	2022	2023	2024	2025
Post harvest training	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
IRM training	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Radio-TV training	68.7	70.2	71.6	73.1	74.7	76.2	77.8	79.5
Video training	16.8	16.9	16.9	16.9	17.0	17.0	17.1	17.1
PLAR training	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0

Figure A11.10: Expected gains from CIPRiSSA in Uganda 3: Number of farmers and other actors targeted for training ('000 persons)

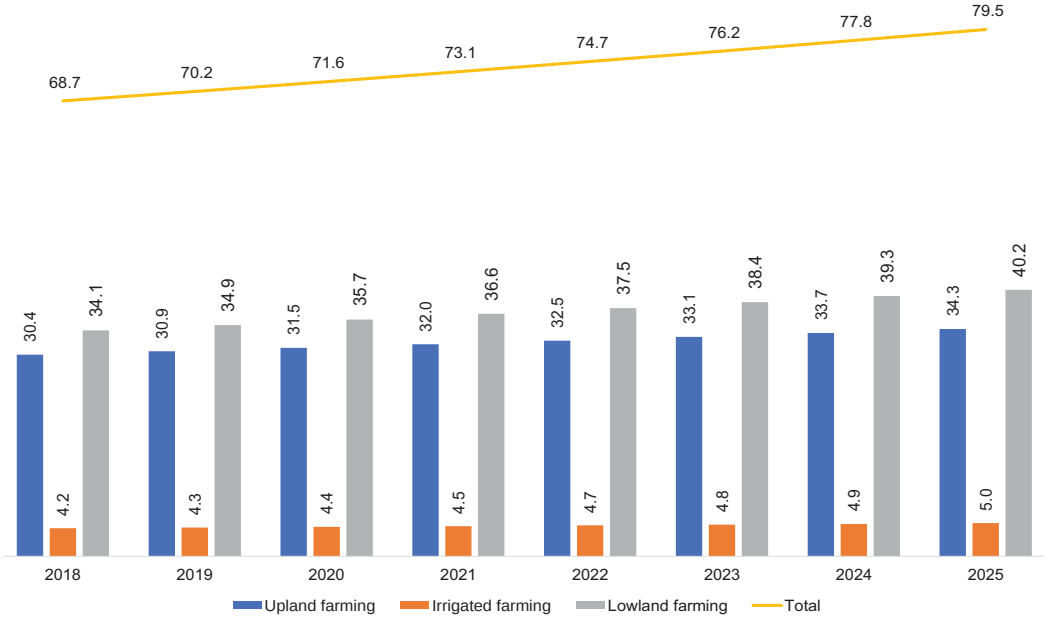


Figure A11.11: Expected gains from CIPRiSSA in Uganda 4: Number of beneficiary households targeted ('000 households)

Table A11: Projected estimates in required investments requirement, production gains, hectarage, and farming households for Uganda (2018-2025)

UGANDA	2018	2019	2020	2021	2022	2023	2024	2025
PROJECTED STATISTICS ON RICE (production, consumption import)								
Rice, paddy production (T)	283,700	300,722	318,765	337,891	358,165	379,655	402,434	426,580
Rice, production milled equivalent (T)	170,220	180,433	191,259	212,871	225,644	239,182	261,582	277,277
Rice, food (milled equivalent) consumption (T)	211,698	220,166	228,972	238,131	247,656	257,563	267,865	278,580
Self-sufficiency ratio	0.80	0.82	0.84	0.89	0.91	0.93	0.98	1.00
ADDITIONAL GAIN FROM THE PROGRAM								
Expected additional production from rainfed upland (T)	24,728	25,127	25,535	25,952	26,380	26,818	27,267	27,726
Expected additional production from irrigated (T)	2,783	2,849	2,916	2,985	3,056	3,128	3,202	3,278
Expected additional production from rainfed lowland (T)	27,161	27,811	28,477	29,158	29,856	30,571	31,303	32,052
Expected additional production from the 3 ecologies (T)	54,673	55,787	56,928	58,096	59,292	60,517	61,771	63,055
Expected additional production from technology adoption (T)	1,380	1,383	1,385	1,388	1,391	1,393	1,396	1,399
Expected additional paddy production from the program (T)	56,053	57,169	58,313	59,484	60,683	61,910	63,167	64,455
Expected additional rice, food (milled equivalent) from the program (T)	33,632	34,302	34,988	37,475	38,230	39,003	41,059	41,896
Estimated Foreign exchange savings (US$ per year)	12,308,038	12,550,638	12,799,060	13,823,459	14,099,470	14,382,104	15,216,657	15,524,131
PRODUCERS AND AREA TARGETED								
Number of upland rice farming households targeted	21,628	22,143	22,670	23,211	23,764	24,330	24,910	25,504
Number of substitute farming households targeted (upland rice)	8,783	8,783	8,783	8,783	8,783	8,783	8,783	8,783

UGANDA	2018	2019	2020	2021	2022	2023	2024	2025
Total number of upland rice farmers	30,411	30,926	31,454	31,994	32,547	33,113	33,693	34,287
Number of irrigated rice farming households targeted	4,240	4,340	4,443	4,548	4,655	4,765	4,878	4,993
Number of lowland rice farming households targeted	34,080	34,895	35,730	36,585	37,461	38,358	39,276	40,216
Total number of farmers/ trainees targeted	68,731	70,161	71,627	73,127	74,663	76,236	77,847	79,496
Number of farmers targeted by PLAR training	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Number of farmers targeted by Video training	16,806	16,850	16,894	16,940	16,986	17,034	17,083	17,133
Number of farmers targeted by Radio-TV training	68,731	70,161	71,627	73,127	74,663	76,236	77,847	79,496
Number of trainees targeted by IRM training	40	40	40	40	40	40	40	40
Number of trainees targeted by post-harvest training	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050
Number of villages targeted by PLAR training	100	100	100	100	100	100	100	100
Number of villages targeted by Video training	226	226	227	227	228	228	229	229
Number of villages targeted by Radio-TV training	687	702	716	731	747	762	778	795
Total rice area targeted (ha)	17,183	17,540	17,907	18,282	18,666	19,059	19,462	19,874
Total additional upland rice area (ha)	6,251	6,348	6,447	6,548	6,651	6,758	6,866	6,978
Total additional irrigated rice area (ha)	265	271	278	284	291	298	305	312
Total additional lowland rice area (ha)	4,260	4,362	4,466	4,573	4,683	4,795	4,909	5,027
Total additional rice area (ha)	10,776	10,981	11,190	11,405	11,625	11,850	12,081	12,317
Total rice areas already on rice (ha)	6,407	6,560	6,716	6,876	7,041	7,209	7,381	7,557

UGANDA	2018	2019	2020	2021	2022	2023	2024	2025
INPUTS (quantity and cost)								
Seed								
Total foundation seed equivalent (T)	20	21	21	22	22	22	23	23
Total certified seed requirement (T)	925	943	963	983	1,003	1,024	1,045	1,067
Production cost of the foundation seed (US$)	40,029	40,830	41,650	42,490	43,349	44,230	45,131	46,055
Production cost of the certified seed (US$)	2,029,272	2,069,965	2,111,635	2,154,305	2,197,999	2,242,741	2,288,557	2,335,473
Cost of storage, weighing, packaging of certified seed	125,839	128,414	131,051	133,751	136,517	139,348	142,248	145,217
Cost of distribution of certified seed (US$)	1,453	1,483	1,514	1,545	1,578	1,611	1,645	1,680
Total cost of certified seed package (including, packaging and distribution)	2,156,563	2,199,862	2,244,200	2,289,602	2,336,093	2,383,700	2,432,450	2,482,370
Total cost of seed (certified and foundation)	2,196,593	2,240,692	2,285,850	2,332,091	2,379,443	2,427,930	2,477,582	2,528,425
Fertilizer								
Total Urea (T)	2,197	2,244	2,293	2,342	2,393	2,445	2,498	2,553
Total NPK (T)	1,718	1,754	1,791	1,828	1,867	1,906	1,946	1,987
Total Fertilizer (T)	3,916	3,999	4,083	4,170	4,260	4,351	4,444	4,540
	0	0	0	0	0	0	0	0
Total cost of Urea (US$)	911,864	931,458	951,521	972,066	993,105	1,014,648	1,036,708	1,059,298
Total cost of NPK (US$)	1,292,139	1,319,036	1,346,579	1,374,782	1,403,663	1,433,237	1,463,520	1,494,530
Total cost of fertilizer (S$)	2,204,003	2,250,494	2,298,100	2,346,849	2,396,768	2,447,885	2,500,228	2,553,828
Cost of fertilizer Transport and distribution	913,885	933,253	953,086	973,394	994,190	1,015,485	1,037,291	1,059,620
	0	0	0	0	0	0	0	0

UGANDA	2018	2019	2020	2021	2022	2023	2024	2025
Total cost of fertilizer (including, packaging and distribution)	3,117,888	3,183,747	3,251,185	3,320,243	3,390,958	3,463,369	3,537,519	3,613,449
Technology transfer and Capacity building								
Cost of PLAR training	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
Cost of Video training	67,769	67,899	68,033	68,169	68,309	68,452	68,598	68,748
Cost of Radio-TV training	1,375	1,403	1,433	1,463	1,493	1,525	1,557	1,590
Cost of IRM training	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Cost of post-harvest (GEM, ASI/ATA thresher-cleaner) training	74,500	74,500	74,500	74,500	74,500	74,500	74,500	74,500
Total technology transfer and Capacity Building cost	503,644	503,803	503,965	504,131	504,302	504,476	504,655	504,838
Machine/Equipment (quantity and cost)								
Number of tractors (for a fraction of the additional areas)	1	1	1	1	1	1	1	1
Number of power tiller (for a fraction of the additional areas)	88	89	91	93	94	96	98	100
Number of ASI/ATA thresher-cleaner (for a fraction of the additional production)	93	95	97	99	101	103	105	107
Number of mini-milling machine	19	19	19	20	20	21	21	21
Number of GEM parboilers (for a fraction of the additional production)	52	53	54	55	56	57	58	60
Total cost tractor (US$)	58,611	59,995	61,413	62,865	64,351	65,873	67,432	69,028
Total cost of power tiller (US$)	547,959	558,307	568,904	579,756	590,867	602,246	613,897	625,829
Total cost of ASI/ ATA thresher-cleaner (US$)	434,370	443,023	451,884	460,957	470,248	479,762	489,504	499,481
Total cost of mini milling machine (US$)	473,858	483,298	492,964	502,862	512,998	523,377	534,005	544,888
Total cost of GEM (US$)	1,038,013	1,058,691	1,079,865	1,101,547	1,123,750	1,146,486	1,169,767	1,193,607

UGANDA	2018	2019	2020	2021	2022	2023	2024	2025
Total cost of machine/ equipment (US$)	2,552,810	2,603,314	2,655,030	2,707,987	2,762,215	2,817,744	2,874,606	2,932,833
Marketing and upgrading (cost)								
Cost of training/ meeting on branding and packaging (US$)	4,116	4,116	4,116	4,116	4,116	4,116	4,116	4,116
Cost of participation and exhibition in trade fair (US$)	7,473	7,473	7,473	7,473	7,473	7,473	7,473	7,473
Cost of marketing campaigns (US$)	50,655	50,655	50,655	50,655	50,655	50,655	50,655	50,655
Cost of high quality bags for the packaging of the additional milled rice (US$)	279,623	285,193	290,897	311,575	317,855	324,286	341,375	348,332
Total cost of marketing and upgrading (US$)	341,867	347,437	353,141	373,819	380,099	386,530	403,619	410,576
TOTAL COST WITHOUT IRRIGATION SCHEMES	8,712,802	8,878,992	9,049,171	9,238,271	9,417,015	9,600,050	9,797,981	9,990,120
Total additional irrigation scheme by 2025 (ha) planned by each country (a)	11,918	11,918	11,918	11,918	11,918	11,918	11,918	11,918
Annual additional irrigation scheme by 2025 (ha) planned by each country (b) = (a)/8	1,490	1,490	1,490	1,490	1,490	1,490	1,490	1,490
Total annual additional irrigated rice area (ha) from CIPRiSSA (c)	265	271	278	284	291	298	305	312
(b)-(c)	1,225	1,218	1,212	1,206	1,199	1,192	1,185	1,178
Cost of new irrigation schemes from CIPRiSSA (US$)	2,310,855	2,365,440	2,421,334	2,478,569	2,537,179	2,597,194	2,658,651	2,721,582

Table A12. Profitability analysis for the 10 initial CIPRiSSA countries

	Cameroon	Côte d'Ivoire	Ghana	Madagascar	Mali	Nigeria	Senegal	Sierra Leone	Tanzania	Uganda
Self-sufficiency (%)	107	156	115	156	139	131	113	167	343	100
Total Investment without new irrigation schemes (US$)	1,845,692	282,228,448	26,313,087	402,351,345	225,184,717	291,418,790	82,137,726	186,443,134	160,860,251	74,684,401
Average annual operational costs (US$)	7,730,711	35,278,556	3,289,136	52,543,918	28,148,089	36,427,348	10,267,215	23,305,391	20,107,531	9,335,550
Benefits/Costs Ratio (BCR)	1.78	1.29	2.65	1.07	1.55	1.54	1.64	1.07	1.26	1.35
BCR under optimistic scenarios	2.24	1.72	3.19	1.41	1.95	1.93	2.02	1.46	1.66	1.71
BCR under pessimistic scenarios	1.32	0.85	2.11	0.73	1.16	1.15	1.26	0.67	0.85	0.98
Net Present Value (NPV) (US$)	43,755,037	204,371,113	39,508,242	227,904,102	168,517,654	202,143,723	72,718,826	78,807,052	84,566,876	47,578,644
Net profit under optimistic scenario (US$)	55,063,186	272,971,070	47,598,903	300,305,135	211,308,488	253,743,243	89,353,729	108,201,988	111,843,205	60,321,446
Net profit under pessimistic scenario (US$)	32,446,889	135,771,157	31,417,582	155,466,457	125,726,819	150,544,202	56,021,368	49,412,116	57,290,547	34,835,841
Modified Internal Rate of Return (MIRR)	116.18	70.44	141.27	41.92	74.29	71.88	54.76	47.89	54.62	61.82
MIRR under optimistic scenario	159.93	106.25	176.55	56.73	97.92	95.24	68.04	70.86	76.76	82.66
MIRR under pessimistic scenario	75.74	41.36	106.62	28.54	52.34	50.49	41.92	28.84	35.32	43.05
Gross Domestic Product (GDP) (US$)	89,436,534	553,586,424	70,809,449	595,341,697	369,722,148	424,912,118	142,676,460	218,084,124	209,513,168	109,878,731
Net National Value (contribution to national welfare) (US$)	69,501,907	415,968,482	59,337,663	450,100,069	293,977,632	331,579,999	116,807,234	161,914,820	159,919,406	84,512,401
Economic Internal Rate of Return (EIRR)	30.10	28.43	58.34	10.89	24.35	23.61	23.70	6.71	11.95	19.54
Direct employment created	16,767	80,951	5,952	127,686	62,555	75,347	21,686	52,333	46,590	17,907

	Cameroon	Côte d'Ivoire	Ghana	Madagascar	Mali	Nigeria	Senegal	Sierra Leone	Tanzania	Uganda
Market price reduction rate which remain investment profitable (Break-even point)	57.89	67.00	54.05	80.64	67.38	65.65	76.08	75.15	73.85	67.72
Total Investment with new irrigation scheme (US$)	_	_	36,009,520	674,258,296	282,477,877	432,601,273	_	_	196,638,190	_
Annual Investment with new irrigation scheme (US$)	_	_	4,501,190	84,282,287	35,309,734	54,075,159	_	_	24,579,773	_
NPV with new irrigation scheme (US$)	_	_	32,972,620	112,165,514	142,382,045	137,786,032	_	_	68,256,032	_
CBR with a new irrigation scheme	_	_	1.22	0.26	0.91	0.55	_	_	0.70	_

Concluding remarks

The CIPRiSSA study identified the following domains for priority investments in the rice value chain in Africa: fertilizer procurement, distribution and appropriate use; mechanization (procurement of machines/equipment for production and post-harvest processing); quality seed procurement and distribution; value chain upgrading and capacity building; and irrigation. The level of investment in each domain depends on each country's achievements, capacities and targets; these priority domains should form the basis for preparing future detailed investment projects involving both public and private investments in each country.

A strategic policy system for sustaining the CIPRiSSA momentum is imperative. Such a system will provide and update real-time strategic and analytical information on aspects of the rice value chain for investments to attain sustainable rice self-sufficiency by 2025 and contribute to improving Africa's share in the international rice trade. The Support System for Accelerating Rice Self-Sufficiency in Africa (SSARSSA) will strive to assist countries in collecting, updating and analyzing data needed for making policies and decisions on rice, including investments in different segments of the rice value chain. SSARSSA will also generate and provide knowledge on the status of rice self-sufficiency in Africa. These two outputs will be generated from four strategic interventions: knowledge management (database, rice self-sufficiency e-atlas, policy dialogues, policy advice); strategic analyses (annual outlooks on rice self-sufficiency, analyses on emerging issues, policy briefs); monitoring, evaluation, and learning (M+E for CIPRiSSA, joint sector review); and capacity mobilization (establishing in-country SSARSSA unit, capacity development).

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AfricaRice is a leading pan-African research organization working to contribute to poverty alleviation and food security in Africa through research, development and partnership activities. AfricaRice is a CGIAR Research Center — part of a global research partnership for a food-secure future. It is also an intergovernmental association of African member countries. The Center was created in 1970 by 11 African countries. Today its membership comprises 26 countries, covering West, Central, East and North African regions, namely Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Côte d'Ivoire, Democratic Republic of Congo, Egypt, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Madagascar, Mali, Mauritania, Niger, Nigeria, Republic of Congo, Rwanda, Senegal, Sierra Leone, Togo and Uganda. AfricaRice headquarters is based in Côte d'Ivoire. Staff members are located in Côte d'Ivoire and also in AfricaRice research stations in Benin, Liberia, Madagascar, Nigeria, and Senegal. For more information, visit www.AfricaRice.org

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