Service Delivery Model Analysis

AMAATI | Ghana

Public report

July 2022

Relevance of Service Delivery Models

Smallholder Livelihoods

Agriculture, including forestry, plays a key role in the wellbeing of people and planet. 70% of the rural poor rely on the sector for income and employment. Agriculture also contributes to and is affected by climate change, which threatens the long-term viability of global food supply. To earn adequate livelihoods without contributing to environmental degradation, farmers need access to affordable high-quality goods, services, and technologies.

Service Delivery Models

Service Delivery Models (SDMs) are supply chain structures which provide farmers with services such as training, access to inputs, finance and information. SDMs can sustainably increase the performance of farms while providing a business opportunity for the service provider. Using IDH's data-driven SDM methodology, IDH analyzes these models to create a solid understanding of the relation between impact on the farmer and impact on the service provider's business.

Insights and Innovations

Our data and insights enable businesses to formulate new strategies for operating and funding service delivery, making the model more sustainable, less dependent on external funding and more commercially viable. By further prototyping efficiency improvements in service delivery and gathering aggregate insights across sectors and geographies, IDH aims to inform the agricultural sector and catalyze innovations and investment in service delivery that positively impact people, planet, and profit.

Report outline

1. Executive summary
2. Strategy
3. Business case
4. Impact case
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Executive summary

About Grown Sustainably in Africa (GSA)

1 Ghana's grain markets can contribute greatly to local food security and improvement of rural livelihoods

Global development organizations like the World Bank have identified agriculture as one of Ghana's engines for economic growth and job creation due its ability to catalyze the manufacturing sector. A commercialized agricultural sector would support Ghana diversify its economy as agricultural produce could be used to grow an agro-processing sector. Despite this potential, the country's agricultural sector is underperforming

2 However, these markets function far from optimally with producers, aggregators and processing facing a range of challenges

Smallholder farmers (SHF) face challenges such as low productivity, low market prices, lack of technical expertise and experience in the consistent production of high-quality crops, and limited access to (affordable) financing. Additionally, local small and medium enterprises (SMEs) are not able to meet the requirements to supply to these large-scale off-takers for premium markets. They typically lack the managerial, technical and operational capabilities and the market development support to become commercially viable and to scale operationally

3 IDH's GSA seeks to accelerate sustainable development by strengthening the capacity of 12 SMEs in key grain value chains

Without intervention, farmers and SMEs may remain confined to producing for smaller markets that offer lower returns on agricultural activities. This proposed project, which is part of IDH's GSA partnership with the Mastercard Foundation, aims to promote sustainable economic growth in the agriculture sector through the development of inclusive value chains of maize, millet, and rice, contributing to improved livelihoods.

For the SMEs to provide these services to farmers, they should be supported in improving their managerial, technical and operational capacity, and be enabled to access high-quality inputs, services, mechanization and required technology to increase aggregation, processing and storage capacity. This will help the SMEs to increase their scale, profitability, bankability, and sustainability

4 This SDM analysis assesses the business and impact case of three of those SMEs to inform the design of effective support packages

It aims to answer the question: what structure and investments are needed to improve the livelihoods of 20,000 SHF by producing 27,500 Mt export-grade grains, while ensuring that the SDM is commercially viable, self-sustaining and inclusive?

About the Grains for Growth (G4G) program

The IDH & Mastercard Foundation G4G program

As part of the Grown Sustainably in Africa partnership, IDH and Mastercard Foundation are implementing a three-and-a-half-year grains value chain development program in Northern Ghana called Grains for Growth. Through a market-led approach, this program will contribute to the development of the grains sector (maize, rice, millet, fonio, and sorghum supply chains), support the inclusion of smallholder farmers (SHF), and create jobs with a central focus on women and youth empowerment.

Over the next three-and-a-half-years, the Grains for Growth program will partner with a dozen small and medium- sized enterprises (SMEs) in northern Ghana, high-profile off-takers, and other supply chain actors, to create 103,000 work opportunities across the maize, rice, millet, fonio, and sorghum supply chains with majority of these, targeting young Ghanaian women and men. The program will also support the inclusion of 20,000 smallholder farmers through optimized sourcing and service delivery structures, whilst aiming to significantly increase incomes for participating farmers. This contributes to the Mastercard Foundation's Young Africa Works strategy to enable 30 million young Africans, 70 percent of whom will be young women, to access dignified and fulfilling work.

AMAATI

This report focuses on one of the SMEs of the program: AMAATI. AMAATI is a Ghanaian social enterprise that pioneered the revival of Fonio in Northern Ghana. An enterprise that works with farmers, particularly women, in producing and processing Fonio, and wants to expand into millet as well. It was formed with an idea of creating sustainable livelihood for female farmers whose lands are degraded due to their excessive usage.

About the AMAATI SDM

Strategy

Objectives | AMAATI's goal is to increase their market share from 5% to 20% in the next 5 years. To achieve this, they focus on:

1. Sourcing: Increase volume of fonio sourced to 6,750 MT and volume of millet sourced to 840 MT by 2025. These volumes will be sourced from over 9,000 farmers, of which 80% are women
2. Market linkages | Improve processing capacity and efficiency and grow local and international sales volumes
3. Investment | Secure a $3 million investment to enable scale of production, processing and market penetration

Organization & partners | AMAATI has a 2-person management team, which is supported by a 5-person board of advisors. They employ 35 FTE as of 2021. They seek to actively upskill their team across the board. AMAATI actively empowers women in the value chain as well as within their own company. They work with a select group of partners to deliver training, seeds and ploughing services on credit. They work on further digitization, as well as offloading service credits via formal bank and VSLAs to farmers

Scale

Fonio | By increasing the number of farmers, acreage and yields, fonio production is expected to grow 33% year on year. Ingrowers are relatively effective as 2% of farmers are growing 24% of total fonio volumes by 2025.

By 2025, AMAATI recovers only 17% of fonio produced as repayment for the provided services, due to the low value of the service package. However, an additional 54% of production is sourced as excess supply. Because of the miniscule size of fonio and suboptimal processing methods, losses are high and processing yields are only 57% for grains and 25% for flour

Millet | Assuming a 100% recovery rate, AMAATI would need to work with 1,084 farmers growing an average of 875 kg millet on 1 acre of land to procure the target 840 MT millet for Nestlé by 2025

Yield improvements | With the right support from AMAATI, fonio outgrowers and millet outgrowers are expected to gradually improve their yields after joining the SDM, to 1,250 kg/acre (+67%) and 1,000 kg/acre (+100%) respectively, leading to higher excess supply and higher volumes sourced by AMAATI

About the AMAATI SDM

Service delivery model

Recruitment | AMAATI has no issue in recruiting new farmers, of which at least 80% are female. They should leverage the data they collect to formulate a clearer segmentation and graduation approach for their farmers

Service package | Both fonio and millet require limited inputs (18-43 USD/acre), therefore outgrowers receive a low value service package, including training and ploughing. Ingrowers get a more comprehensive package including mechanization and post-harvest services. The aim is to expand the outgrower service package with these services as well

Gender | AMAATI is assessed to be Gender Transformational, addressing gender imbalances, changing gender power relations, supporting women empowerment and actively building equitable social norms

Sourcing channels | In terms of farmer numbers (86%) and fonio volumes produced (76%), fonio outgrowers are the most important channel for AMAATI. However, fonio ingrowers are by far the most productive with 24% of all fonio grown on 11% of the land by 2% of total farmers. Millet is rolled out slowly so does not immediately play a big role, but has the potential to do so

Business case

Sourcing channel profitability | The costs per MT sourced are almost similar for all channels, varying from 469 to 483 USD/MT. Although service costs are higher for fonio outgrowers, this channel is slightly more profitable for AMAATI than fonio ingrowers (+9 USD/MT) due to a lower procurement price. The sales price for millet is lowest, but still millet outgrowers are he most profitable channel for AMAATI with a gross profit margin of 48%, due to limited processing losses

Overall profitability | The SDM is profitable, expected to increase EBT of $417k with 317% between 2021 and 2025 if AMAATI is able to reach their growth targets. This represents a compound annual growth rate of 43%, which is driven by growth in fonio volumes (on average 85% of gross profit) and the inclusion of millet (on average 15% of gross profit)

Financing needs | AMAATI's short-term finance needs for prefinancing inputs and procurement, grows to 277k USD by 2025 as it scales its fonio business and moves into millet. They require an additional 850k USD asset finance to enable storage and mechanization services

Service profitability | Services are mainly seen as necessary costs to improve productivity and sourcing volumes. These costs are earned back by commercial margins on the grains. The service costs per farmer ($12.69) are only a fraction (5%) of the sourcing costs per farmer ($259.70)

SDM business and impact case

Impact case - Fonio

Farmer performance | SDM fonio farmers are expected to have 50% higher yields (750 kg/acre vs. 500 kg/acre) than Baseline farmers due to better seeds and planting techniques. These yields can be improved even further to 1,250 kg/acre, which is 150% higher

Service package | Although the service package comes at a higher cost (+12 USD/acre), SDM farmers are expected to achieve lower post-harvest losses (-50%) and higher yields (+50%), which are expected to improve further. Due to the low cost, the risk of inability to repay is limited

Monthly cash flow | Although inputs on credit come at a cost of 9 USD/acre, it allows SDM fonio farmers to invest in their farms and improve yields. Small upfront investments (8 USD/acre) for bags and transport are still needed, so AMAATI could explore the possibility to support there as well if need be

Profitability | Cost of production per MT is almost equal for SDM and baseline farmers at ~64 USD/MT, but due to a higher farm-gate price SDM farmers make a 71% higher margin. On a per acre basis the income is almost 3 times as high ($30 vs. $88) in the first year and expected to grow further

Living income | Under the current scenarios, 1 acre of fonio could earn farmers $178 (45% of the LIB) at the maximum yield. They could potentially bridge the remaining gap by growing two seasons per year

Impact case - Millet

Production | Recent studies have mapped the production characteristics, benefits and constraints of pearl millet in Ghana and Burkina Faso and AMAATI should leverage these studies when rolling out their fonio business

Costs and profitability | The inputs that are required for millet cultivation are equal each year at 43 USD/acre. Since these costs remain stable and SDM millet farmers are expected to be able to double their yield from 500 kg/acre to 1,000 kg/acre, their profits will significantly increase

Service package | Millet requires more inputs and therefore larger investments compared to fonio (+48%). Future yields and revenues, and therefore the ability to repay these higher investment costs, are not assured, which puts farmers at risk. When they improve their yields this risk is mitigated as a smaller share of production is needed for repayment

Profitability | Due to higher costs and lower profitability (-31% per acre) millet seems less attractive than fonio, but the business case is unproven so AMAATI should roll this out slowly and closely monitor the performance

Living income | Under the current scenarios, 1 acre of millet could earn farmers $122 (31% of the LIB) at their maximum yield

Opportunities for improvement

This information is only available in the private version of the report

Insights & Innovations

Women's empowerment

- **Inclusion** AMAATI's business model has a strong focus on female farmers, with at least 80% of their farmer base being women.
- **Access to resources** They provide them with input credit, whereas otherwise they would not have access to financial services. Additionally, the SDM supports these women in gaining access to land and earning an income, often next to the work they do on their husband's farm
- **Empowerment** This increases their control over financial resources and thereby their (financial) independence, contributing to the empowerment of these women
- **Strategy** Given their gender strategy and large female representation in their board, AMAATI is expected to sustainably contribute to women's positions

Sustainable food crop

Fonio is a unique crop for multiple reasons:

- **Profitability** There is a clear business case for fonio, even on a very small scale (profits of 178 USD per year on 1 acre).
- **Sustainable** It needs very little inputs, therefore it can grow on arid lands while no high upfront investments are required. As a result, it is grown on lands that would otherwise sit idle, and therefore there are no opportunity costs of other crops involved
- **Food security** Additionally, without being treated with chemicals, fonio can be stored for a long time before it perishes. On top of that, fonio is very nutritious. This leads to high levels of home consumption (around 300 kg per farm), thereby contributing to the food security of farmers and their families

Strategy

Strategy | Objectives

AMAATI's goal is to increase their market share from 5% to 20% in the next 5 years. To achieve this, they have identified certain targets and objectives that all come with their own challenges and limiting factors

	Sourcing	Market Linkages	Investment
Objectives and targets	• Increase sourcing volumes to 6,750 MT fonio and 840 MT millet by 2025 • Source from over 9,000 farmers of which 80% women	• Improve processing capacity and efficiency • Grow local and international sales volumes	• Secure a 3 million USD investment to enable scale of production, processing and market penetration
Priorities	• Support women to increase the farm sizes and adopt improved farming technologies • Improve grain quality (training, tarpaulins, threshers) • Improve access to finance through VSLAs	• Develop the needed infrastructure to absorb and process the increased supply • Improving technology in the supply chain • Strengthen market linkages (aggregation, transportation, warehousing) • Improve packaging and marketing penetrations	• Acquire full production line • Extend production room • Finance working capital for input financing
Limiting factors	• Suboptimal farming practices (not using tarpaulins, manual harvesting and threshing) • Inconsistent supply (partly due to dependency on rain) • Lack of adequate machinery	• Inadequate transport (high haulage prices and low quality roads) • Inadequate storage capacity	• No affordable and appropriate finance available • No proven financial track records of farmers that local banks trust

Sources: AMAATI Project Proposal 2021; Company interview November 2021

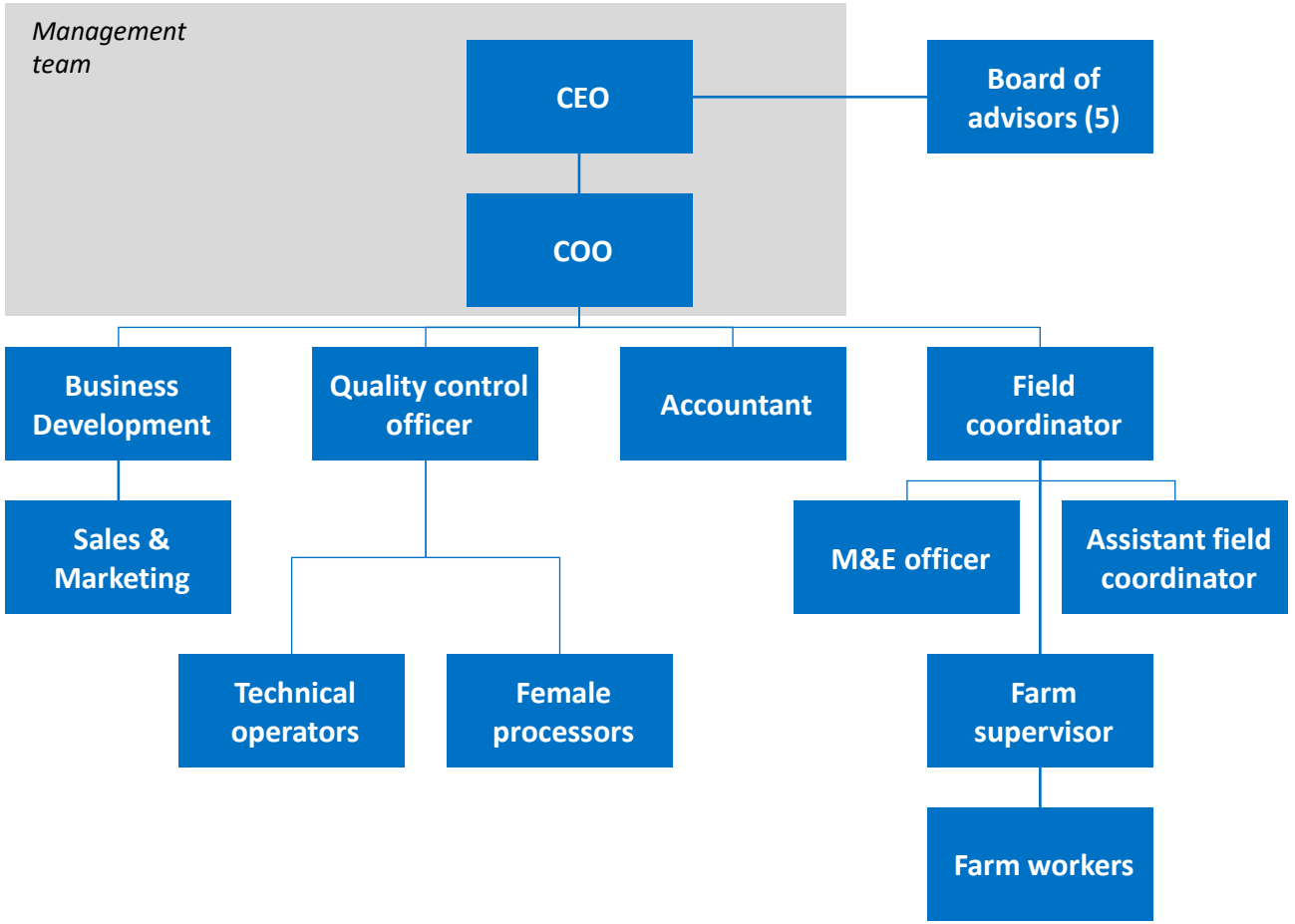
Strategy | SDM overview

This information is only available in the private version of the report

Strategy | Organogram

AMAATI has a 2-person management team, which is supported by a 5-person board of advisors. AMAATI actively aims to empower women in the value chain, which is also reflected in their own gender balance

AMAATI organogram 2021



- AMAATI's organization currently consists of 35 employees, with a management team of 2 people
- With a female CEO and a male COO, the management team is balanced in terms of gender. In the board of directors, 60% is female and 40% is male
- AMAATI is looking to upskill its staff in line with their needs regarding financial reporting, business development and marketing, as they scale up
- AMAATI aims to reduce their agent to farmer ratio from 1:400 to 1:200 by growing the number of extension by 2025

Sources: AMAATI Project Proposal 2021; Company interview November 2021

Strategy | Stakeholders (1/2)

This information is only available in the private version of the report

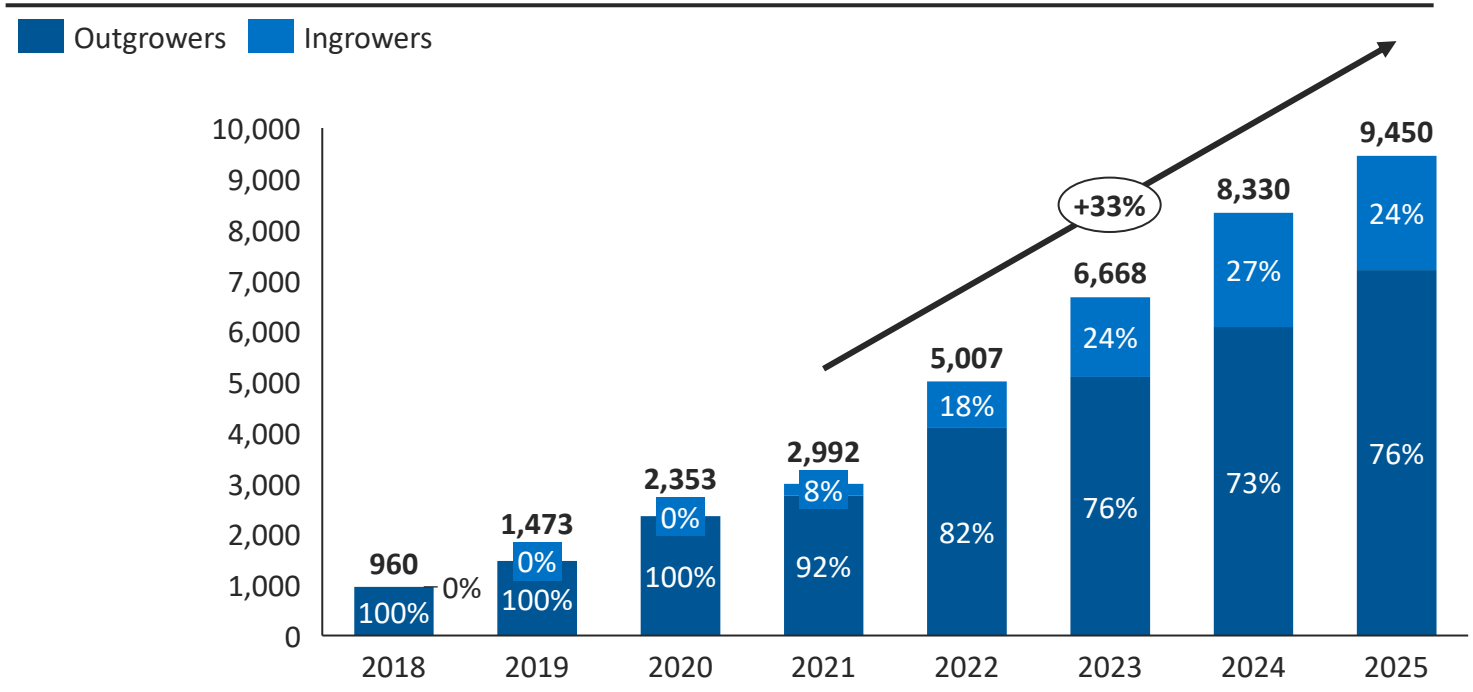
Strategy | Stakeholders (2/2)

This information is only available in the private version of the report

Strategy | Fonio production volumes

By increasing farmer numbers, acreage and yields, fonio production is expected to grow 33% year on year. Ingrowers are relatively effective as 2% of farmers are growing 24% of total fonio volumes by 2025

Actual and target fonio production, in MT per year



	2018	2019	2020	2021	2022	2023	2024	2025
Outgrowers farmers	1,600	2,100	3,100	3,100	5,000	6,000	7,000	8,000
Ingrower farmers				20	80	140	200	200
Outgrower yield (kg/acre)	750	877	949	1,116	1,027	1,061	1,086	1,125
Ingrower yield (kg/acre)				1,250	1,250	1,250	1,250	2,500

Sources: AFG AMAATI Financial Model Projections and Final Report 2021; AMAATI Project Proposal 2021

- **Production:** AMAATI's supply base produces around 3k MT of fonio as of 2021. Expected to grow farmer numbers from 3,120 to 8,200 by 2025, and acreage from 3,200 to 9,000, production volumes rise towards 9,450 MT fonio
- **Outgrowers:** the majority of farmers (97%) are scattered around the communities, managing small plots of arid, otherwise unused lands (1 acre on average). 80% of those farmers are women, supported by AMAATI in brokering those lands
- **Ingrowers:** by 2025, 2% of farmers are ingrowers, managing 11% of acreage (1,000 out of 9,000), producing 24% of all fonio, given their higher average yields (1,000 vs 2,500 kg/acre). Ingrowers manage 5 acres each and do 2 seasons a year
- **Limits to growth:** the main barriers to growth are the higher price points of other crops and potential lack of access to available land (requiring approval by communities). Number of available farmers, willingness to adopt (beyond price) and actual available arid lands do not seem to pose problems

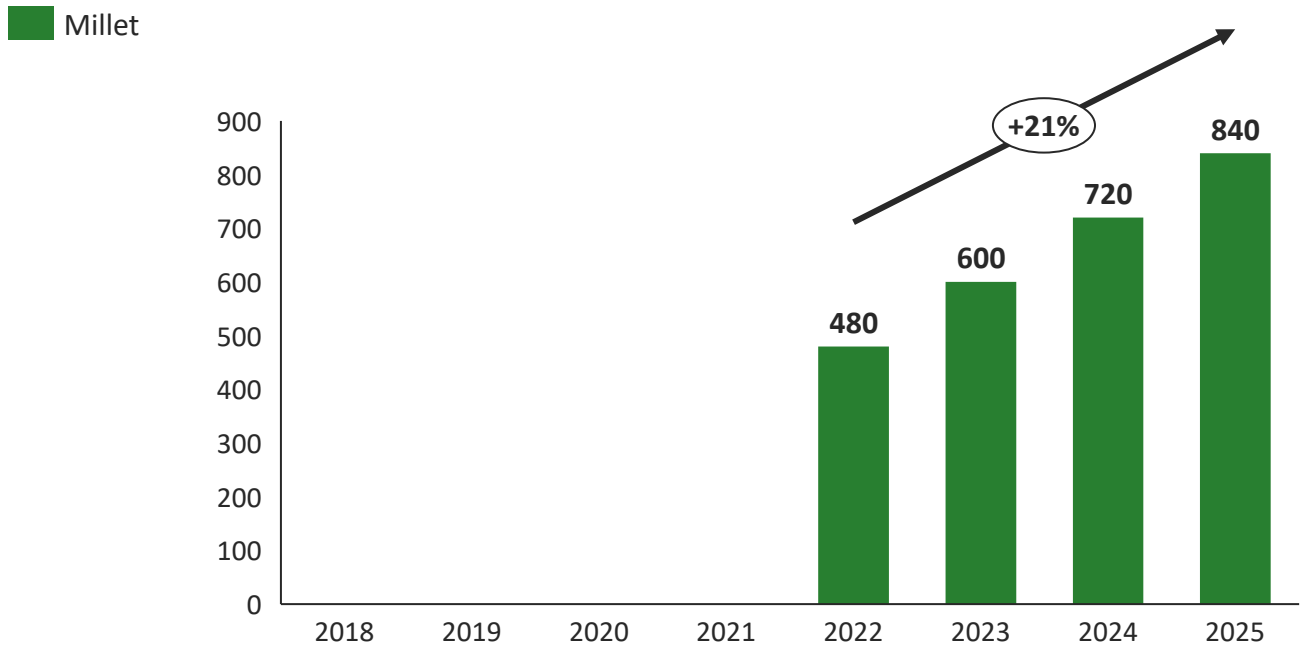
Strategy | Fonio sales volumes

This information is only available in the private version of the report

Strategy | Millet production volumes

Assuming 100% recovery rate, AMAATI would need to work with 1,084 farmers growing an average of 875 kg millet on 1 acre of land to procure the target 840 MT millet for Nestlé by 2025

Target volumes for millet, in MT per year



	2018	2019	2020	2021	2022	2023	2024	2025
Number of farmers					1,084	1,084	1,084	1,084
Average yield (kg/acre)					500	625	750	875
Recovery					100%	100%	100%	100%

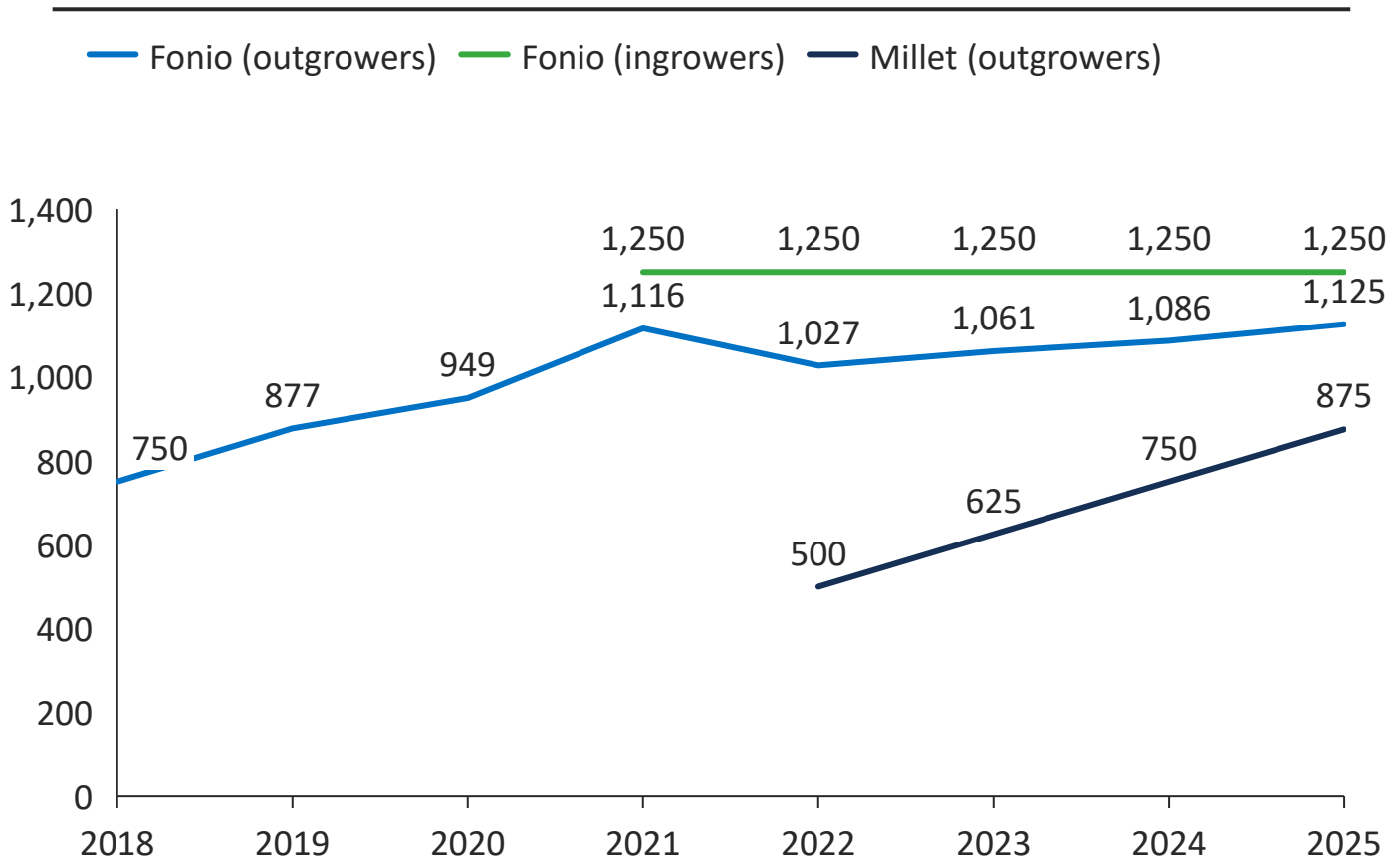
- **Demand:** so far AMAATI has not been sourcing millet due to prioritizing fonio and lack of demand. As of 2022 Nestlé is aiming to buy 480 MT millet, increasing that volume by 20% year on year. As millet can be sourced from the same farmers growing fonio, AMAATI can quickly ramp up sourcing volumes using their existing infrastructure
- **Production:** recent studies* state average smallholder yields are between 500 and 1,000 kg of millet per acre; post-harvest losses vary between 5-15% and farm sizes between 0.5 and 1.5 acres. In order to improve productivity and effectively recover millet from farmers, AMAATI will still need to develop a suitable service package
- **Recovery:** first estimates indicate a millet service package could be valued at 43 USD per acre, allowing AMAATI to recover 184 kg of millet at a price of 237 USD per MT. Assuming 100% of excess supply sourced, AMAATI needs to work with 1,084 farmers to procure 840 MT millet by 2025.

* *Postharvest losses and mitigating technologies: evidence from Upper East Region of Ghana; Assessing production constraints, management and use of pearl millet in the Guinea Savanna Agro-ecology of Ghana*

Strategy | Outgrower numbers and acreage, fonio

With the right support from AMAATI, fonio out- and ingrowers, as well as millet outgrowers, are expected to gradually improve their yields after joining the SDM, leading to higher volumes sourced by AMAATI

Total farmer average yield per farmer segment*



- **Fonio outgrowers:** traditionally working with outgrowers, AMAATI is expected to support farmers in gradually improving their yields from 750 to 1,250 kg per acre, through training on GAP, provision of improved seeds and a ploughing cash advance
- **Fonio ingrowers:** given the full service package provided to ingrowers (including weeding, threshing, mechanized harvesting) and stricter control by AMAATI, yields are expected to be around optimal levels of 1,250 from the first year of cultivating fonio on the newly developed lands
- **Millet outgrowers:** yields are expected to start off low at around 500 kg per acre, increasing quite quickly with adequate service support provided by AMAATI. Most farmers are expected to join right from 2022 onward, growing yields rather than number of farmers to satisfy Nestlé's demands

** Yield increases only gradually, as newly joining farmers each year are assumed to start with baseline yields, offsetting the yield improvements of some of the more experienced farmers.*

Strategy | Overview of services (1/2)

Although fonio and millet need limited inputs, farmers receive a comprehensive service package, including training and ploughing. In the future, the aim is to expand this service package with post-harvest services

Service		Delivery mode	Impact	Revenue model	Status
Trainings	**Training**	• AMAATI provides technical training on GAP, CSA and PHHM to farmer groups	• Improved yields and quality • Reduced post-harvest losses • Improved farm sustainability	• Included in COGS of SME grains	Fully operational
	Financial training	• AMAATI provides farmers organized in VSLAs with financial training	• Improved financial management • Access to loans	• None (operational expense)	Fully operational
	Youth program	• AMAATI trains youth on farm and financial management and shows machinery and successful commercial farms	• Trained and motivated youth • Increased retention of youth in agriculture	• None (operational expense)	Not yet operational
Inputs	**Seeds on credit**	• A commercial seed grower delivers seeds to AMAATI warehouse • AMAATI agents deliver seeds on credit to farmer groups	• Improved yields • Ability to pay for seeds through credit	• At harvest, cost of seeds + interest are deducted from grain sales revenues	Operational, but depending on capacity
	Land brokerage	• AMAATI supports women in finding plots of unused family land suitable for fonio cultivation	• Increased access to land for women • Transformation of unused lands into productive lands	• None (operational expense)	Operational, but depending on availability
Equipment	**Ploughing on credit**	• AMAATI provides tractor and ploughing services on credit at farm-level	• Increased ploughing efficiency and greater reach (farm size) • Ability to pay for mechanized ploughing (credit)	• At harvest, ploughing costs are deducted from grain sales revenues	Fully operational

Sources: AMAATI Project Proposal 2021; Company interview November 2021

Strategy | Overview of services (2/2)

Although fonio and millet need limited inputs, farmers receive a comprehensive service package, including training and ploughing. In the future, the aim is to expand this service package with post-harvest services

Service		Delivery mode	Impact	Revenue model	Status
Handling and Storage	**Farming and processing equipment**	• A yet to be determined partner company provides tarpaulins to farmer groups • A yet to be determined partner company provides threshing services going round with their mini threshers	• Increased quality of harvest (fewer stones and sand) • Increased harvesting efficiency and greater reach (farm size)	• To be determined	**Not yet operational operational**
Market access	**Aggregation**	• Alhaji Wahabu aggregates grains and transports them to AMAATI facilities using lorries. In remote villages some grains are aggregates by bicycle	• Grains get picked up	• Transport costs are paid by km and volume	**Fully operational**

Sources: AMAATI Project Proposal 2021; Company interview November 2021

Strategy | Farmer relationships

AMAATI has no issue in recruiting new farmers, of which at least 80% are female. They should leverage the data they collect to formulate a clearer segmentation and graduation approach for their farmers

Outreach

- AMAATI hosts entry events in communities where it has no presence yet, and ongoing sensitization events in existing communities
- Farmers sign up through these events and word-of-mouth from other farmers
- AMAATI prefers expanding the farmer base in existing communities before moving to new communities

Selection

- Farmers willing to work with AMAATI must grow fonio and/or another grain
- 80% of farmers must be women
- Women with limited access to land are given priority

Contracting

- There are contracts in place that specify the amount of fonio that is required for repayment, as well as the corresponding price
- If the quality (share of fonio versus share of other matter) is high, farmers receive a premium of 0.2 GHS/kg

Segmentation

- AMAATI offers a fonio and millet service package. The only difference is the additional pesticides for growing millet
- Farmers organized into VSLAs receive additional financial management training

Graduation

- When farmers reach a certain yield, they are eligible for support for larger farm sizes

Data collection

- AMAATI uses CRM software to collect data
- They capture personal farmer data, production data and details of signed contracts

Sources: AMAATI Project Proposal 2021; Company interview November 2021

Strategy | Operational review

Based on a diagnostic study carried out by AFG, certain performance gaps concerning production and processing have been identified

Activity	Assessment
Farmer selection	Targeted gender sensitive farmer selection, community entry and sensitization. Farmers willingly register
Outgrower Management	No evidence of written contract, no support services except seed, extension and recovery
Provision of Inputs	No input support except fonio seed to some farmers (depending on cooperation with donors/NGOs)
Mechanization	No mechanization support provided (yet)
Extension services	Limited extension on the agronomy of the fonio crop (production, harvesting and post harvest handling)
Embedded services	Does not provide any credit support but has an E-platform for the promotion and marketing of products
Knowledge management	Minimal evidence of knowledge management in the form of training manuals. No evidence of information storage, retrieval and sharing.

Activity	Assessment
Quality Management	A good inhouse quality management system is in place (equipment available and procedures respect quality standards). Serious delays in 3rd party lab analysis of mycotoxins
Processing Efficiency	State-of-the-art equipment for dehulling and processing of fonio available. Its capacity of 1 ton per hour is not being used efficiently due to inadequate supply of raw material
Packaging	Adheres to international standards for packaging its products in hygienic packaging materials of 1 kg, 5 kg and 10 kg
Warehousing & Storage	State of the art prefabricated warehouse, with good ventilation and all produce packed on pallets
Transport & Logistics	The company relies on local 3rd party haulage companies which may not respect quality procedures in transporting food items

Strong | Average | Weak

Sources: AFG Diagnostic Study 2022. Data collected by conducting company interviews

Strategy | Gender assessment

AMAATI is assessed to be Gender Transformational, Addressing gender imbalances, changing gendered power relations, and actively building equitable social norms and structures

Category	Answer	Explanation
Gender Strategy Is gender equality a strategic goal for AMAATI which is communicated in documents?	**Yes**	AMAATI uses quotas to (60%) to ensure women have majority of representation in Management and Board. AMAATI uses quotas to allocate women jobs.
Data Collection Does AMAATI collect data on staff or customers / farmers disaggregated by gender?	**Yes**	AMAATI uses CRM software for data collection: farmer characteristics including gender, production, contracts, etc.
Inclusive workplace Does AMAATI have policies or practices to make the workplace inclusive for both women and men?	**Yes**	AMAATI reserves the processing roles for Kayayo women (female head porters) returning from Accra, to encourage these young ladies trapped in Accra to return home for permanent jobs.
Inclusive consultation Does AMAATI speak to or consult both male and female customers (farmers) to learn about their different needs and preferences when designing a product	**Yes**	AMAATI has reduced the female farmer quota from 100% to 80%, allowing some men to access services and land as they urged AMAATI to not exclude them after observing initial success by the women growing fonio.
Inclusive tailoring If services are tailored based on customers' needs and preferences, does AMAATI tailor these based on how needs may be different for men and women?	**Yes**	AMAATI prioritizes working with vulnerable women with lack of access to land and helping them broker arid, otherwise unused community lands for fonio cultivation. They seek to support women groups (VSLAs) in providing commercially viable threshing services
Independence and control over resources Does AMAATI provide services that allow women to have more independence and control over resources or move into roles in which they can gain more value?	**Yes**	AMAATI provides training such us financial management that is not often available or accessible to women, to help them benefit more in Fonio cultivation and marketing.

Sources: AMAATI Project Proposal 2021; Company interview November 2021

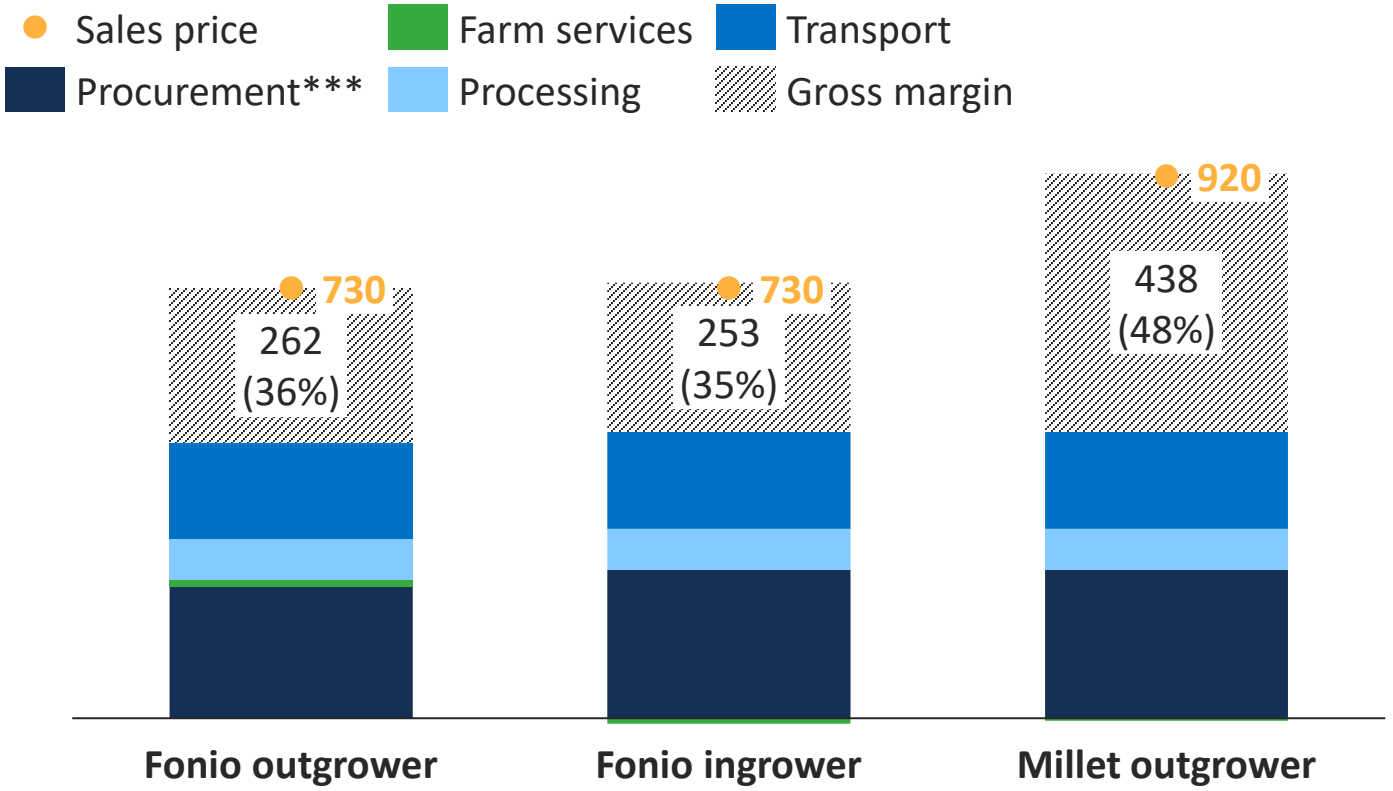
Business case

Business case | Sou

DISCLAIMER: Millet sales price and processing efficiency are currently based on assumptions, which still need to be confirmed

Costs per MT sourced are almost similar for all channels. Fonio outgrowers are more profitable than ingrowers due to a lower procurement price. Millet outgrowers are most profitable due to limited processing losses

Sourcing channel* gross margin in USD per MT sourced and % of sales price**



** The assumptions for the different sourcing channels can be found in the annex*
*** Prices and costs are converted from GHS to USD using an exchange rate of 7.6 GHS/USD. The fonio sales price is a weighted average of the sales price of the different end products*
**** The procurement cost includes interest costs*

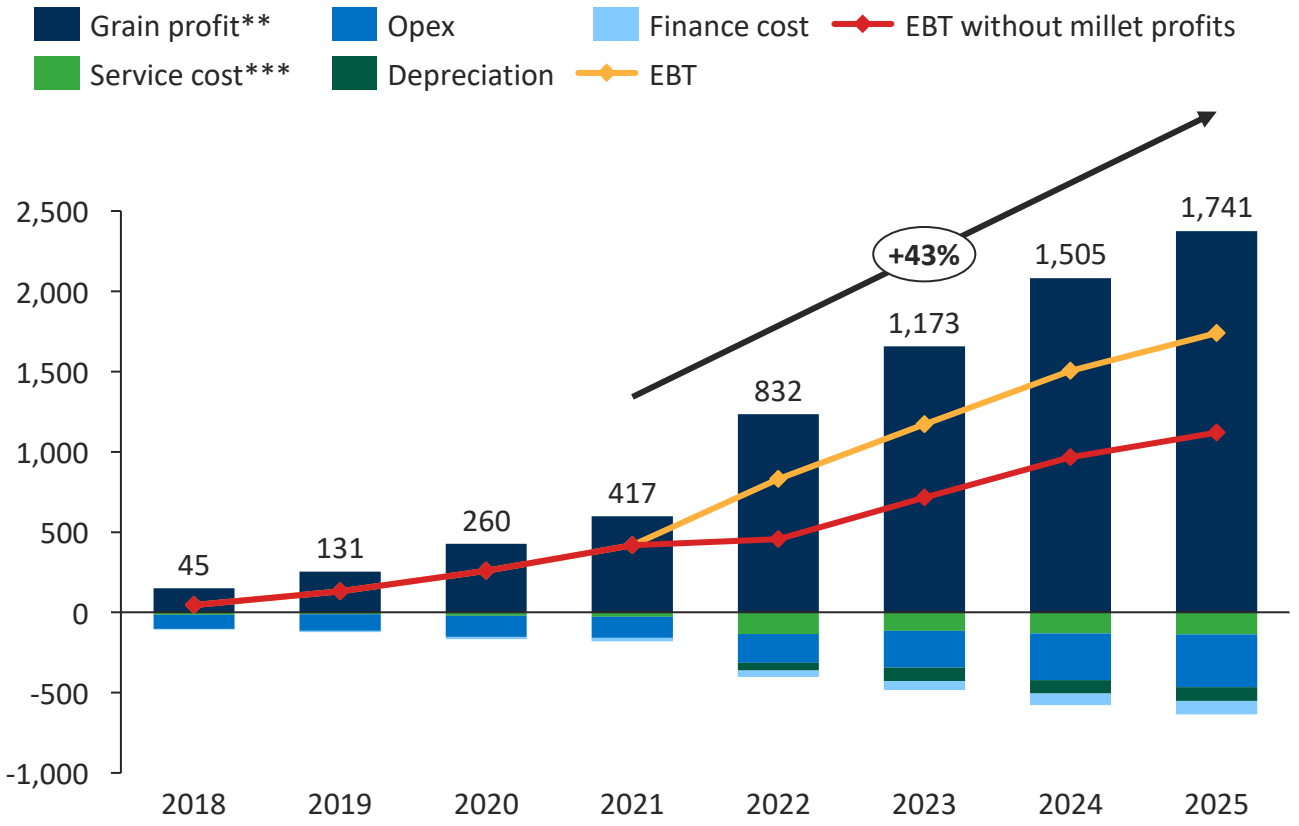
- **Fonio farmers:** the profitability of sourcing from fonio outgrowers and fonio ingrowers is very comparable, but the profit margin is slightly higher for outgrowers. Although for this channel the service costs are higher than the service revenues, the procurement costs are 11% lower
- **Processing efficiency:** margins are 67-73% higher for millet outgrowers, while the sales price for millet is lowest. This is mainly a result of processing efficiency: 1.00 MT of raw fonio can be processed into 0.57 MT of fonio grains or 0.25 MT of fonio flour, whereas no processing losses are incurred for millet
- **Transport costs:** a third of total costs are transport costs, partly because farmers are scattered. If AMAATI could find a way to reduce these costs or make transport more efficient, this could significantly improve their margins

Business case | SDM P&L

DISCLAIMER: Grain revenues are currently based on price assumptions, which still need to be confirmed

The SDM is profitable and the CAGR of EBT is 43% between 2021 and 2025, mainly driven by volume growth and the inclusion of millet. The recuperation of service costs increases once most farmers are onboarded

Profit and loss* in '000 USD (2018 – 2025)



- **EBT growth:** AMAATI will grow their EBT with 317% in total in the coming years if they are able to reach their growth targets. This represents a compound annual growth rate of 43%, although growth slowly declines after a jump between 2021 and 2022
- **Millet:** this jump is mainly caused by the fact that AMAATI will start sourcing millet from that year onwards, which on average represents 15% of gross grain profits. Since the millet results are mainly based on assumptions, the EBT without millet profits is also depicted
- **Cost recuperation:** the increase in farmer numbers (and thereby the costs for acquisition and training) is biggest in 2022, therefore the SDM only recuperates 52% of the service provision costs through input provision in 2022. This share increases to 86% by 2025

** An overview of all assumptions and KPI's can be found in the annex*

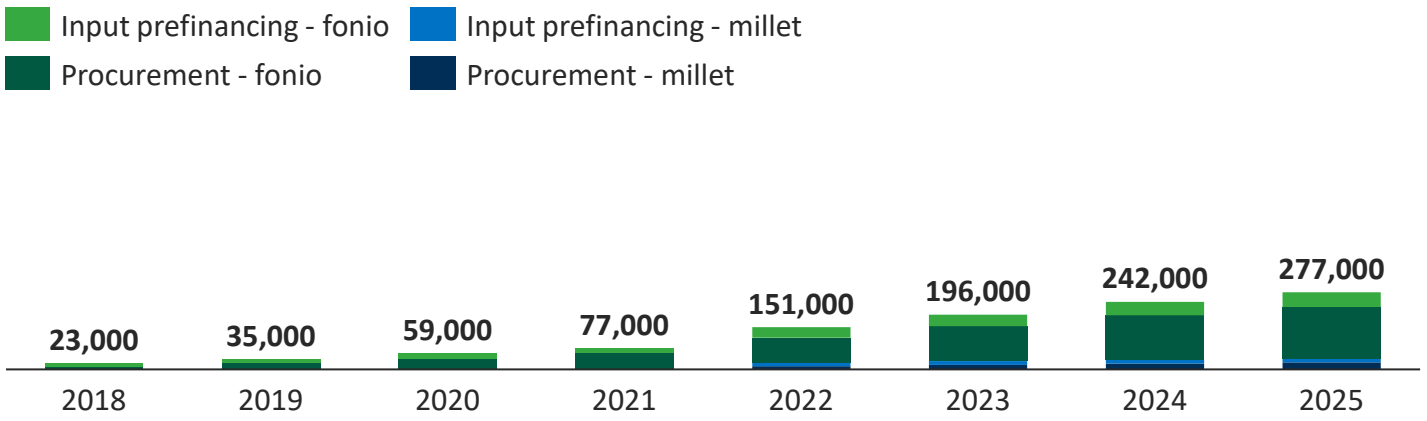
*** The sourcing volumes are based on the assumption that farmers use a fixed volume of fonio for home consumption, and the full surplus is sourced by AMAATI*

**** Service cost includes the interest charged on working capital to prefinance farmer inputs*

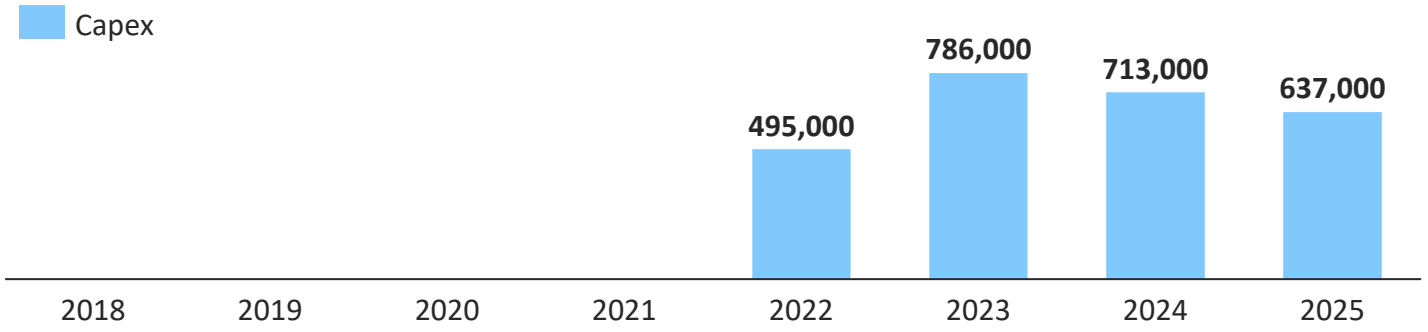
Business case | Financing needs

AMAATI's short-term finance needs grow to $277k by 2025 as it scales its fonio business and moves into millet. Additionally they require 850k USD asset finance to enable storage and mechanization services

Average annual short-term loans outstanding (< year) in USD*



Average annual long-term loans outstanding in USD*



- **Short-term finance:** working capital (inputs on credit and procurement) rapidly increases between 2021 and 2022 due to volume growth. However, due to low input costs and small farm sizes, total amounts remain relatively small. Due to the seasonality, it is crucial that financing is received timely
- **Long-term finance:** AMAATI is also aiming to invest around $850k in a new warehouse and machinery** in the coming years
- **Cost reduction:** if AMAATI would be able to decrease their current cost of capital of 40%, they would save $11k for working capital and $26k for CAPEX with every percentage point decrease

** Assumptions can be found in the annex*

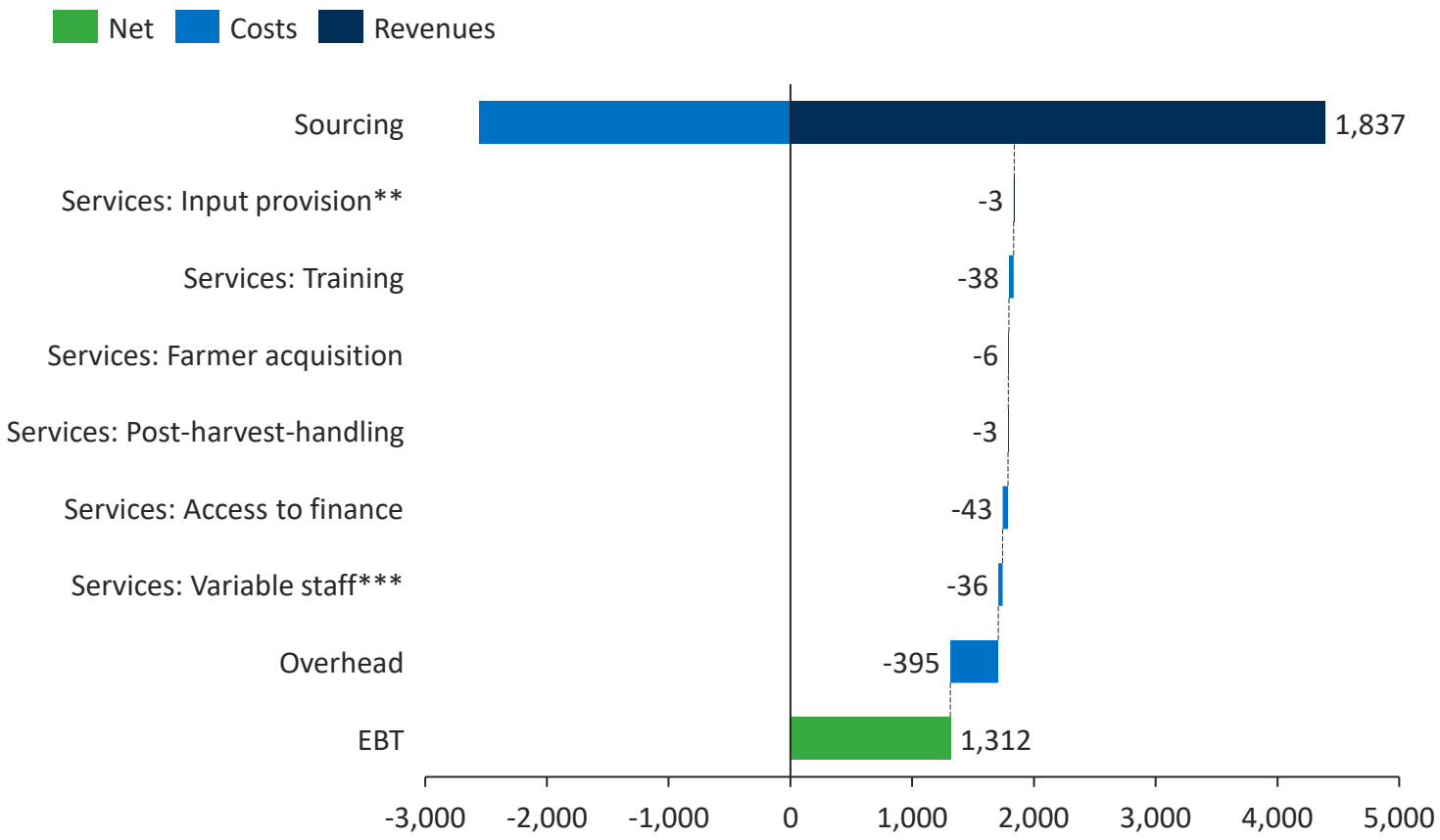
*** AMAATI is looking to buy warehouses, a production line, combine harvesters, tractors, planters, cultivators and some other smaller equipment*

Business case | Service pr

DISCLAIMER: Grain revenues are currently based on price assumptions, which still need to be confirmed

Input provision is profitable, but the profits are not sufficient to fully cover the other service costs. The service costs per farmer ($13.77) are only a fraction (5%) of the sourcing costs per farmer ($286.50)

Profit and loss in '000 USD, annual average 2022 – 2025*



- **Cost to serve and source:** due to the low service costs, the average cost to serve ($12.69 per farmer) is only 5% of the average cost to source ($259.70 per farmer)
- **Profitability of services:** the majority of services do not provide any revenues. Therefore, service provision as a whole is lossmaking. AMAATI does make a 40% margin on the provision of inputs through the recovery grains, which exceeds the cost of prefinancing, making this service profitable and allowing them to recuperate a share of the total service provision costs
- **Staff costs:** of the costs not directly related to sourcing, staff costs make up more than 50% on average

** An overview of KPI's can be found in the annex*

*** Since the margin on input provision is obtained through recovery grains, these profits are reflected as sourcing profits*

**** For this analysis, the costs for service related staff are not proportionally allocated to the different services, but are treated as a service itself*

Impact case

Impact case | Farmer segments - Fonio

SDM fonio farmers are expected to have 50% higher yields than Baseline due to better seeds and planting techniques. This can be improved even further to yields that are 150% higher


Characteristics*	Baseline**	SDM fonio farmer**
Farm size	1 acre	1 acre
Current yield	500 kg/acre	750 kg/acre
Post harvest losses	30%	20%
Own consumption	300 kg	300 kg
Farmgate price	0.15 USD/kg	0.21 USD/kg
Cost of input package	17 USD/acre	29 USD/acre
Inputs used		
	Ploughing	
	Seeds* **	

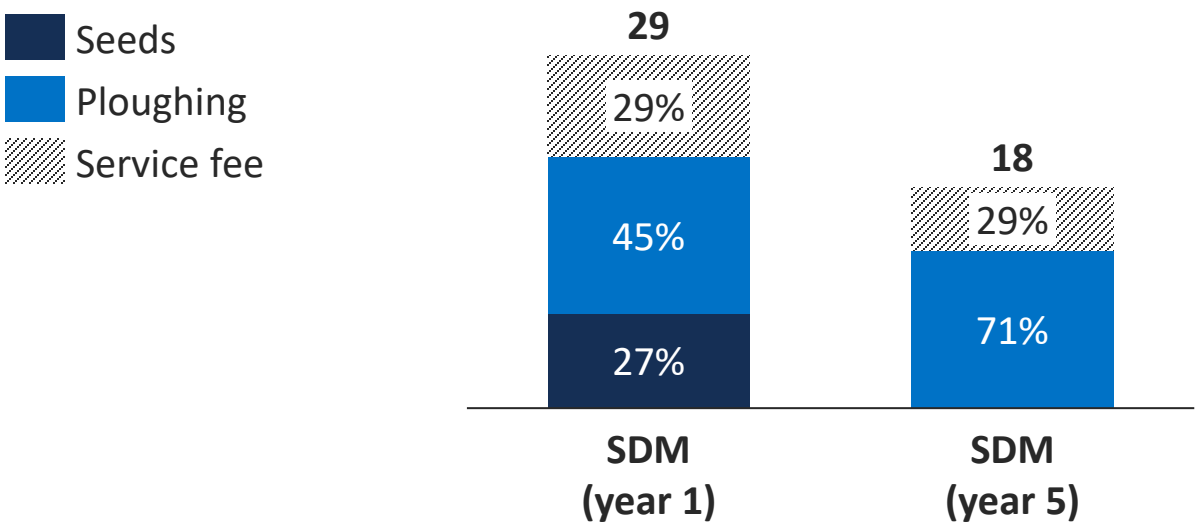
- **Improved performance:** the 50% higher yield for SDM fonio farmers compared to baseline farmers is a result of better seeds and the way these seeds are planted
- **Yield increase:** SDM fonio farmers are expected to be able to grow their yield further to a maximum of 1,250 kg/acre within 3 years as they become more adept in cultivating fonio
- **Cleanness premium:** most of the fonio that is supplied to AMAATI is not fully clean and contains sand, rocks, and other matter. This is mainly due to the fact that farmers harvest and thresh manually, and they dry fonio directly on the floor instead of on a tarpaulin. Cleaner fonio would provide SDM farmers with a higher farm-gate price

** Assumptions are based on the 2021 season. Prices and costs are converted from GHS to USD using an exchange rate of 7.6 GHS/USD*
*** A Baseline farmer is a farmer not receiving services from AMAATI. An SDM farmer is a farmer that does receive services from AMAATI*
**** Fonio seeds are only required in the first year*

Impact case | Service package cost - Fonio

Although the service package comes at a cost, farmers are expected to achieve lower post-harvest losses and higher yields, which are expected to improve further. Due to low cost, the risks for farmers are limited

Service package cost in USD per acre, 2021 prices



	SDM (year 1)	SDM (year 5)
Farm-gate price (USD/MT)	210	210
Marketable surplus** (kg/acre)	600	1,000
Repayment volume (kg)	140	87.5
Recovery as % of surplus	23%	9%
Profit (USD/farm)	25	115

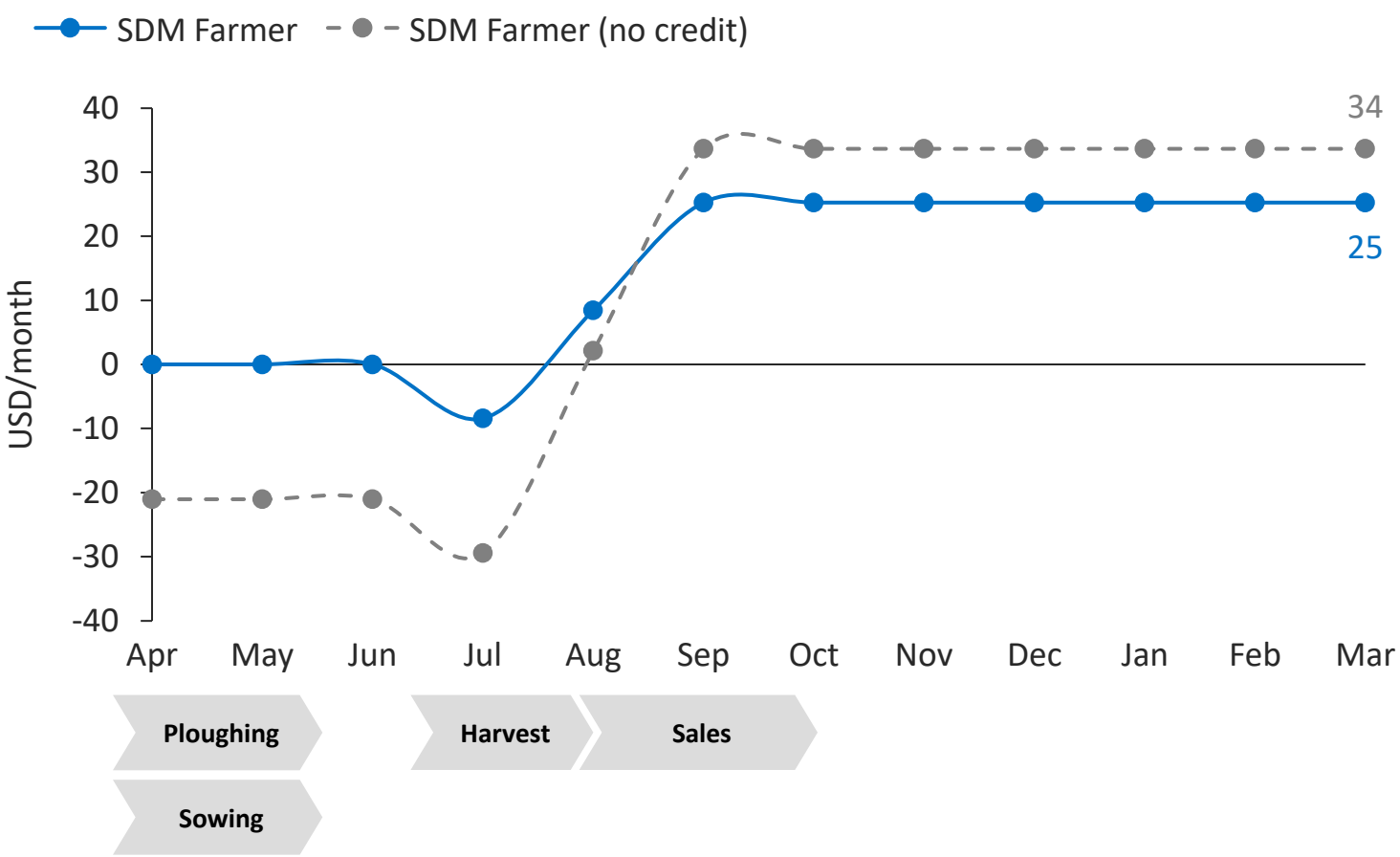
- **Low input crop:** fonio is a low input crop, making it accessible for many farmers. Seeds are only needed in the first year. From the second year onwards AMAATI only provides ploughing credit to their fonio farmers
- **Ploughing credit:** AMAATI provides SDM farmers with the cash for ploughing. After harvest, the farmers pay this back in-kind with a 40% margin for AMAATI
- **Decreasing risk:** since the cost of the input package decreases after the first year and yields are expected to increase with 67%, the share of marketable surplus that is needed for repayment decreases from 23% in year 1 to only 9% from year 3 onwards, leading to lower risks for fonio farmers

** Assumptions are based on the 2021 season. Prices and costs are converted from GHS to USD using an exchange rate of 7.6 GHS/USD*
*** This analysis assumes no home consumption, but in reality, around 300 kg is used for home consumption*

Impact case | Monthly cash flow - Fonio

Inputs on credit allow SDM fonio farmers to invest in their farms and improve yields. However, small investments are still needed and AMAATI should explore the possibility to support there as well if need be

Cumulative net cash flow* for fonio farmers in USD per farm per month, Year 1*



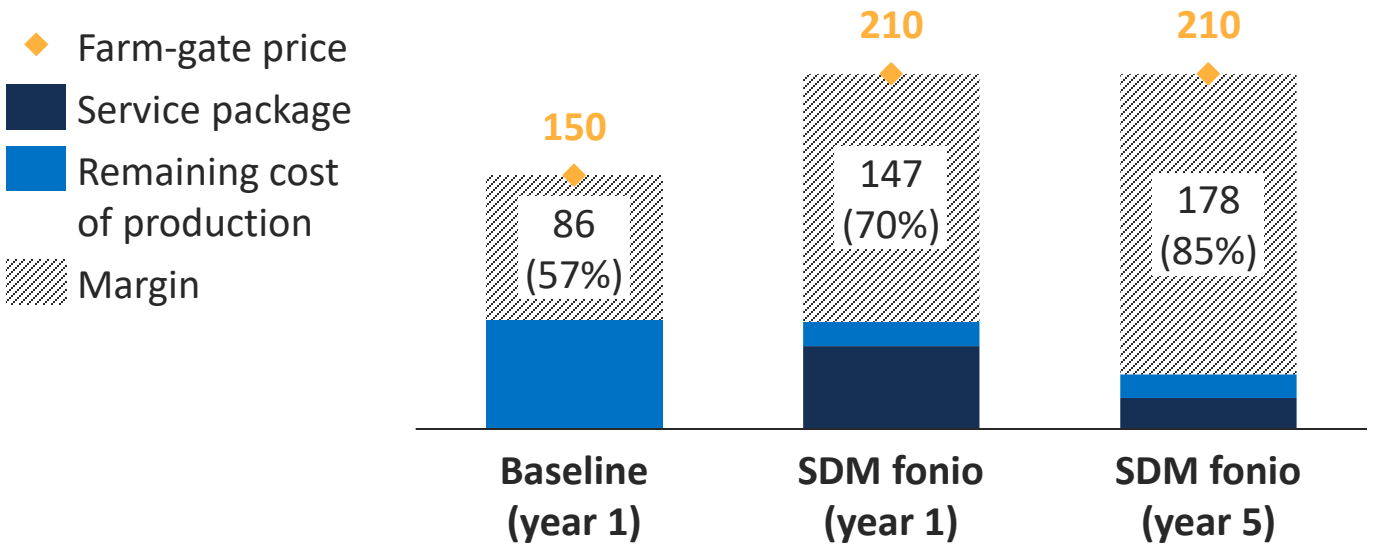
- **Required investments:** although relatively small, farmers need to make investments in their farm in terms of ploughing and seeds. These investment will be earned back relatively quickly, but farmers will still be cash strapped from April until August
- **Credit:** to make these required investments that are needed to reach their maximum yield, SDM farmers receive credit from AMAATI. Although this credit comes at a cost of $9 (29% of total costs), it allows them to smoothen their cashflow
- **Extra support:** as a result, SDM farmers are better off than baseline farmers. However, they still incur costs for bags and transport, so they need to make a small investment in July. AMAATI should explore if this is a barrier for farmers, and support them if needed

** Farmer cashflows do not factor in household expenses such as school fees, medical expenses etc. These expenses could lead to a different result if considered.*

Impact case | Crop profitability - Fonio

Cost of production per MT is equal for SDM and baseline farmers, but due to a higher farm-gate price SDM farmers make a margin which is 71% higher. On a per acre basis the income is almost 3 times as high

Total production cost in USD per MT and % of farm-gate price, 2021 prices



	Baseline (year 1)	SDM fonio (year 1)	SDM fonio (year 5)
Marketable surplus (kg/acre)	350	600	1,000
Profit (USD/MT)	86	147	178
Profit (USD/acre)	30	88	178
Profit margin (%)	57%	70%	85%
Profit (in kg produce)***	200	419	846

** Assumptions are based on the 2021 season. Prices and costs are converted from GHS to USD using an exchange rate of 7.6 GHS/USD*
*** This analysis assumes no home consumption, but in reality, around 300 kg is used for home consumption*
**** As a reference, the maximum amount of produce a household could keep for own consumption while not making a loss is provided*

- **Profit margins:** due to the low costs, fonio is relatively profitable and farmers can achieve high profit margins
- **Labor costs:** since fonio farmers rely on communal labor for weeding and harvesting, there are no costs incurred for hired labor
- **Limited profits:** SDM farmers are expected to increase their total income fivefold compared to baseline, but profits remain relatively low due to small farm sizes
- **Opportunity costs:** fonio is grown on arid lands where no other crops grow, so there are no opportunity costs for fonio farmers
- **Profit in produce:** as a reference, the maximum amount of produce a household could keep for own consumption while not making a loss is provided

Impact case | Mechanized harvesting - Fonio

This information is only available in the private version of the report

Impact case | Laminated bags - Fonio

There is an economic benefit of $2.02 per 100 kg in using laminated bags compared to regular bags. AMAATI should consider providing these bags as part of their input package

Cost-benefit analysis for laminated bags versus regular bags*

	Regular
Capacity	100 kg
Cost per bag	0.39 USD
Post-harvest losses	20%

	Laminated
Capacity	50 kg
Cost per bag	0.24 USD
Post-harvest losses	10%

	Comparison
Additional cost per 100 kg	0.08 USD
Value of reduced PHL	2.10 USD
Net difference	**2.02 USD**

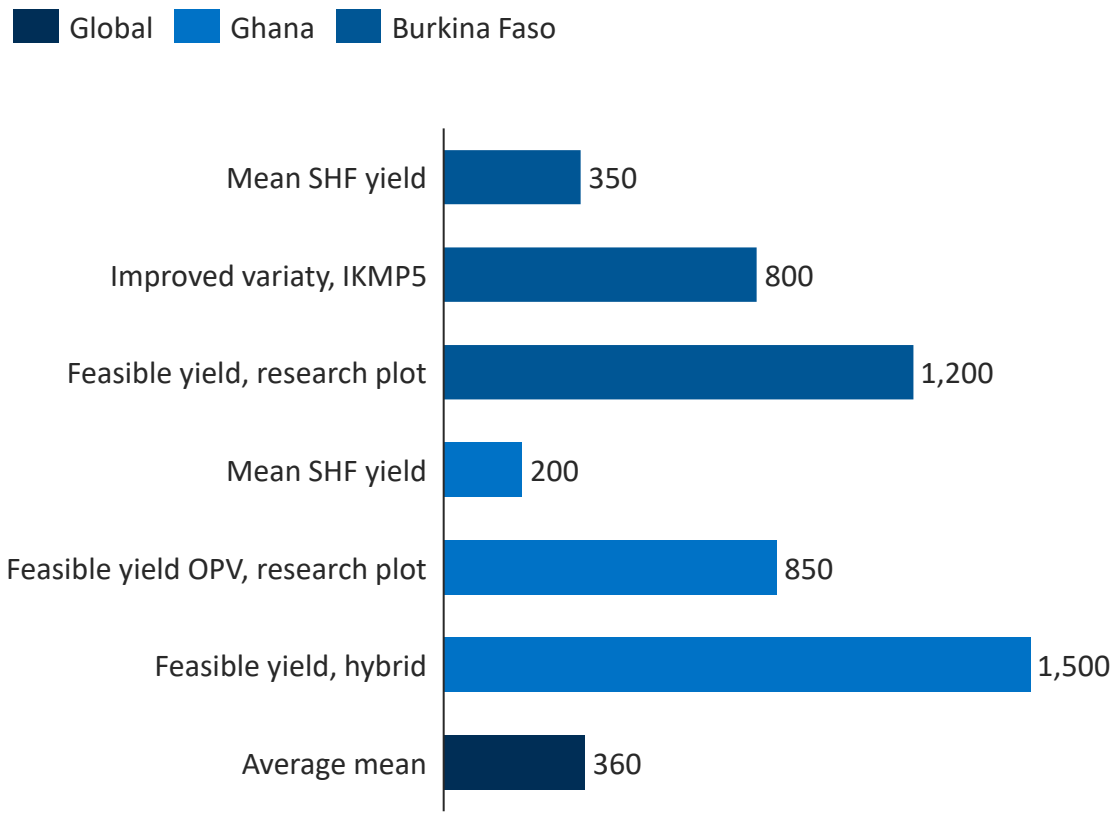
- **Post-harvest losses:** because of the miniscule size of fonio, a large share is lost through the meshes in the bags that are commonly used on farms
- **Laminated bags:** this problem can be addressed by using laminated bags that the fonio cannot get through
- **Net benefit:** although these laminated bags are 20% more expensive, they reduce the overall post-harvest losses with 50%. The value of these reduced post-harvest losses ($2.10) outweighs the additional costs ($0.08) with $2.02
- **Add to input package:** AMAATI could consider supplying farmers with these laminated bags as part of the input package they provide. Considering the clear economic benefit, there is room for AMAATI to make a margin on this while still leaving the farmers better off as well

** Assumptions are based on the 2021 season. Prices and costs are converted from GHS to USD using an exchange rate of 7.6 GHS/USD*

Impact case | Millet production characteristics

Recent studies have mapped the production characteristics, benefits and constraints of pearl millet in Ghana* and Burkina Faso**

Millet yields under various conditions



Benefits

- Well adapted to the short and erratic rainfall, high temperature and low soil fertility that characterize northern Ghana. Millet fits well into any cropping system.
- Given their early maturity (65-70 days), often harvested during periods of food shortage, mid-July to late August.
- As a food, it provides relatively high amounts of iron and zink.

Constraints

- Reduced yields due to downy mildew disease, head insects, bird attacks and high dependency on own own seed. Limited access to resistant, high yielding varieties.
- Post-harvest losses of 5-15% as a result of labor scarcity given overlap of harvesting of various crops and limited access to equipment such as threshers.
- Striga infestation and low soil fertility are not seen as main constraints due to early harvesting and low crop nutrient needs.

* Assessing production constraints, management and use of pearl millet in the Guinea Savanna Agro-ecology of Ghana (2021); Postharvest losses and mitigating technologies: evidence from upper East Region of Ghana (2021)

** Constraints to Pearl Millet (Pennisetum glaucum) Production and Farmers' Approaches to Striga hermonthica Management in Burkina Faso (2021)

Impact case | Farmer segments - Millet

The inputs that are required for millet cultivation are equal each year. Since costs remain stable and SDM millet farmers are expected to be able to double their yield, their profits will significantly increase

Characteristics*	SDM millet farmer** Year 1	SDM millet farmer** Year 5
Farm size	1 acre	1 acre
Yield	500 kg/acre	1,000 kg/acre
Post harvest losses	11%	11%
Own consumption	0 kg	0 kg
Farmgate price	0.24 USD/kg	0.24 USD/kg
Cost of input package	43 USD/acre	43 USD/acre

Inputs used
Seeds
Fertilizer
Agrochemicals
Manure

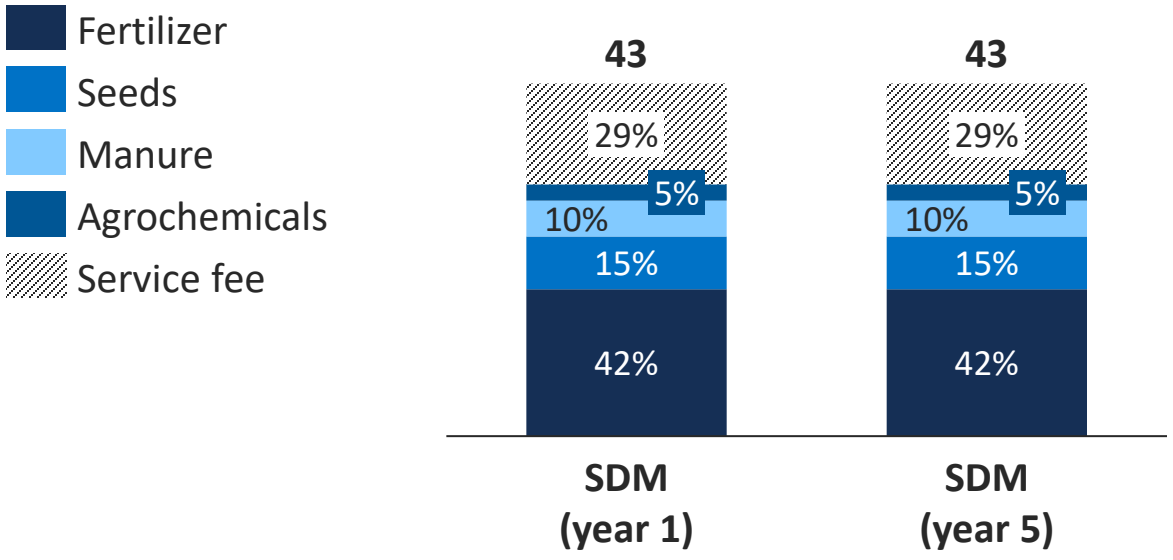
- **Costs and yield:** since more inputs are required, the costs for millet are higher. Additionally, the volume produced is lower compared to fonio. This is only partly compensated by a higher farmgate price
- **Yield increase:** SDM millet farmers are expected to be able to double their yield to 1,000 kg/acre within 4 years as they become more adept
- **Limited appetite:** in Ghana, farmers are moving away from millet due to low yields, limited market, and the promotion of maize, soy, and rice
- **Rollout:** AMAATI is currently not yet working with millet farmers, but they are exploring the possibilities and profitability due to high demand for millet

** Assumptions are based on the 2021 season. Prices and costs are converted from GHS to USD using an exchange rate of 7.6 GHS/USD*
*** An SDM farmer is a farmer that receives services from AMAATI*

Impact case | Service package cost - Millet

Millet requires more inputs and therefore larger investments are needed, which puts farmers at risk. When they improve their yields this risk is mitigated as a smaller share of production is needed for repayment

Service package cost in USD per acre, 2021 prices*



	SDM (year 1)	SDM (year 5)
Farm-gate price (USD/MT)	237	237
Marketable surplus** (kg/acre)	443	886
Repayment volume (kg)	184	184
Recovery as % of surplus	42%	21%
Profit (USD/farm)	25	122

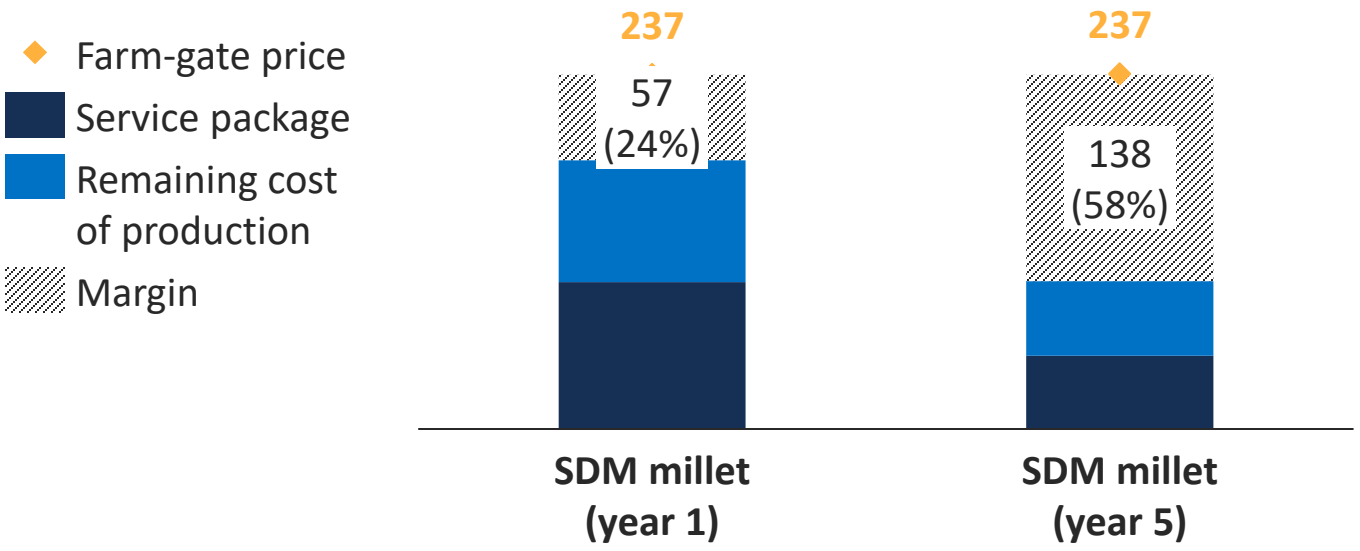
- **Inputs:** input requirements for millet are high compared to fonio. Seeds are required every year, and additionally fertilizer, agrochemicals and manure are needed
- **Decreasing risk:** SDM millet farmers are expected to double their yields in 4 years time and the need for inputs remains stable over these years. As a result, the share of marketable surplus that is needed for repayment decreases from 42% to 21%, leading to lower risks for millet farmers
- **Input package:** since AMAATI is not yet working with millet farmers, it is currently not fully clear what the input package should look like and where these inputs would be purchased

** Assumptions are based on the 2021 season. Prices and costs are converted from GHS to USD using an exchange rate of 7.6 GHS/USD*

Impact case| Crop profitability - Millet

Due to higher costs and lower profitability, millet seems less attractive for farmers than fonio. However, this business case is unproven, so AMAATI should roll this out slowly and closely monitor the performance

Total production cost in USD per MT and % of farm-gate price, 2021 prices*



	SDM millet (year 1)	SDM millet (year 5)
Marketable surplus (kg/acre)	443	886
Profit (USD/MT)	57	138
Profit (USD/acre)	25	122
Profit margin (%)	24%	58%
Profit (in kg produce)**	107	517

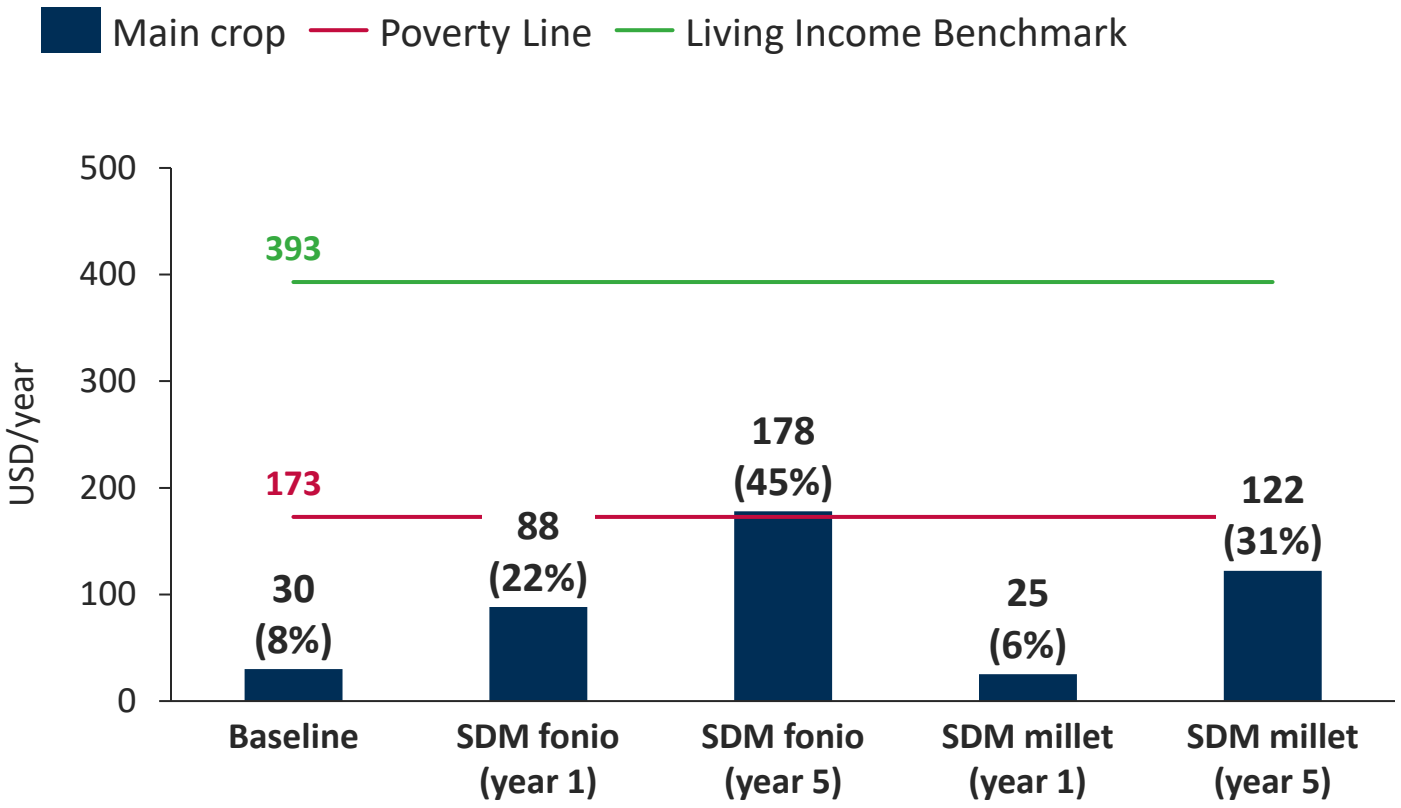
- **Profitability:** the costs for cultivating an acre of millet remain stable, but farmers can potentially double their yields and thereby significantly increase their profitability. However, profits remain limited due to small farm sizes. Additionally, millet is less profitable compared to fonio.
- **Higher risk:** the cost of the input package for millet is higher than for fonio. Future yields and revenues, and therefore the ability to repay these higher investment costs, are not assured. This poses a risk for the farmer as well as for AMAATI
- **Monitoring:** because of AMAATI's lack of experience with millet and an unproven business case, AMAATI should roll this out slowly and closely monitor the performance of the millet farmers

** Assumptions are based on the 2021 season. Prices and costs are converted from GHS to USD using an exchange rate of 7.6 GHS/USD*
*** As a reference, the maximum amount of produce a household could keep for own consumption while not making a loss is provided*

Impact case | Gap to living income

Under the current scenarios, a severe LI gap remains. Fonio farmers could potentially bridge this gap by growing two seasons or doubling their farm size. Millet farmers must triple their farm size to bridge the gap

Poverty line*, LI Benchmark, and crop income*** in USD and % of LI**



- **Poverty line:** under the current scenarios, only fonio farmers that reach their maximum yield earn an income above the poverty line
- **LI gap:** even if SDM farmers are able to reach that maximum yield, they are still far from earning a living income. Fonio and millet earns farmers 45% and 31% of the LIB respectively
- **Closing the gap for fonio:** if fonio farmers would be able to do 2 seasons in 1 year, or increase their farm size to 2 acres, they could double their fonio income and decrease the LI gap to only 3%
- **Closing the gap for millet:** millet farmers can only do 1 season in a year. However, if they can grow their farm size to 3 acres they are able to complete close the LI gap

** Data on poverty line is obtained from Ghana Bureau of Statistics*

*** The Living Income (LI) is an approximate income needed to meet a family's basic needs including food, housing, transport, health, education, tax deductions and other necessities. The difference between the LI benchmark and actual income is referred to as the living income gap Wage Indicator (Sept 2019). The living income benchmark depicts a typical family of eight members (2 parents and 6 children)*

**** This analysis assumes no home consumption, but in reality, around 300 kg of fonio is used for home consumption*

Annex

Annex

Scale assumptions (1 of 2)

Farmer numbers	Unit	2018	2019	2020	2021	2022	2023	2024	2025
Fonio outgrowers	# of farmers	1,600	2,100	3,100	3,100	5,000	6,000	7,000	8,000
Fonio ingrowers	# of farmers	0	0	0	20	80	140	200	200
Millet outgrowers	# of farmers	0	0	0	0	1,084	1,084	1,084	1,084
TOTAL	**# of farmers**	**1,600**	**2,100**	**3,100**	**3,120**	**6,164**	**7,224**	**8,284**	**9,284**
Share of female farmers	%	80%	80%	80%	80%	80%	80%	80%	80%
Acreage									
Fonio outgrowers	Acres	1,600	2,100	3,100	3,100	5,000	6,000	7,000	8,000
Fonio ingrowers	Acres	0	0	0	100	400	700	1,000	1,000
Millet outgrowers	Acres	0	0	0	0	1,084	1,084	1,084	1,084
TOTAL	**Acres**	**1,600**	**2,100**	**3,100**	**3,200**	**6,484**	**7,784**	**9,084**	**10,084**
Production volumes									
Fonio outgrowers	MT	960	1,473	2,353	2,767	4,107	5,093	6,080	7,200
Fonio ingrowers	MT	0	0	0	225	900	1,575	2,250	2,250
Millet outgrowers	MT	0	0	0	0	480	600	720	840
TOTAL	**MT**	**960**	**1,473**	**2,353**	**2,992**	**5,487**	**7,268**	**9,050**	**10,290**

Annex

Scale assumptions (1 of 2)

Sourcing volumes	Unit	2018	2019	2020	2021	2022	2023	2024	2025
Fonio outgrowers – recovery	MT	224	210	324	271	537	578	665	753
Fonio ingrowers – recovery	MT	0	0	0	90	356	613	870	856
Millet outgrowers – recovery	MT	0	0	0	0	199	199	199	199
Total – recovery	**MT**	**224**	**210**	**324**	**361**	**1,092**	**1,389**	**1,733**	**1,807**
Fonio outgrowers – excess	MT	256	633	1,100	1,565	2,069	2,716	3,315	4,048
Fonio ingrowers – excess	MT	0	0	0	105	424	752	1,080	1,094
Millet outgrowers – excess	MT	0	0	0	0	281	401	521	641
Total – excess	**MT**	**256**	**633**	**1,100**	**1,670**	**2,774**	**3,869**	**4,917**	**5,783**
TOTAL	**MT**	**480**	**843**	**1,423**	**2,032**	**3,867**	**5,258**	**6,650**	**7,590**

Sales volumes									
Fonio grain	MT	233	409	690	984	1,641	2,257	2,873	3,270
Fonio flour	MT	18	31	52	75	125	172	218	249
Millet	MT	0	0	0	0	480	600	720	840
TOTAL	**MT**	**250**	**440**	**742**	**1,059**	**2,246**	**3,029**	**3,812**	**4,359**

Annex

Sourcing channel assumptions

Variable	Unit	Fonio outgrowers	Fonio ingrowers	Millet outgrowers
Number of farmers by 2025	MT	8,000	200	972
Total acreage by 2025	MT	8,000	1,000	972
Recovery volume year 1	Kg/farmer	140	902	184
Recovery volume year 2>	Kg/farmer	88	856	184
Excess supply year 1	Kg/farmer	160	1,048	259
Excess supply at maximum yield	Kg/farmer	613	1,094	702
Average share of production sourced	%	62%	87%	100%
Farm-gate price	USD/MT*	210	237	237

** Prices and costs are converted from GHS to USD using an exchange rate of 7.6 GHS/USD*

Annex

Key performance indicators

This information is only available in the private version of the report

Annex

Financing assumptions (1 of 3)

This information is only available in the private version of the report

Annex

Financing assumptions (2 of 3)

This information is only available in the private version of the report

Annex

Financing assumptions (3 of 3)

This information is only available in the private version of the report

Annex

Farmer assumptions – fonio

Variable	Unit	Baseline	Outgrowers	Ingrowers
Farm size main crop	Acres	1.0	1.0	5.0
Yield | current	Kg/acre	500	750	1,250
Yield | potential	Kg/acre	500	1,250	1,250
Seasons per year | current	#	1	1	2
Seasons per year | potential	#	2	2	2
Post-harvest losses | current	%	30%	20%	10%
Post-harvest losses | potential*	%	15%	10%	10%
Home consumption	Kg	300	300	0
Farm-gate price	GHS/Kg	1.14	1.60	1.80
Cost of input package | Year 1	GHS/acre	130	224	1,624**
Cost of input package | Year 2>	GHS/acre	100	140	1,540**
Ploughing on credit	Yes/No	No	Yes	Yes
Harrowing on credit	Yes/No	No	No	Yes
Seeds on credit	Yes/No	No	Yes	Yes
Mechanized harvesting on credit	Yes/No	No	No	Yes
Training	Yes/No	No	Yes	No

** Post-harvest losses can be cut in half when harvesting is done mechanically instead of manually*

*** These costs reflect two seasons in one year*

Annex

Farmer assumptions – millet

Variable	Unit	Outgrower
Farm size main crop	Acres	1.0
Yield | current	Kg/acre	500
Yield | potential	Kg/acre	1,000
Post-harvest losses | current	%	11%
Post-harvest losses | potential	%	6%
Home consumption	Kg	0
Farm-gate price	GHS/Kg	1.80
Hired labor cost	GHS/acre	154
Cost of input package	GHS/acre	330
Seeds on credit	Yes/No	Yes
Fertilizer on credit	Yes/No	Yes
Agrochemicals on credit	Yes/No	Yes
Manure on credit	Yes/No	Yes
Training	Yes/No	No

Annex

Mechanization assumptions

Manual harvesting

Yield	750 kg/acre
Post-harvest losses	20%
Marketable surplus	600 kg

Mechanized harvesting

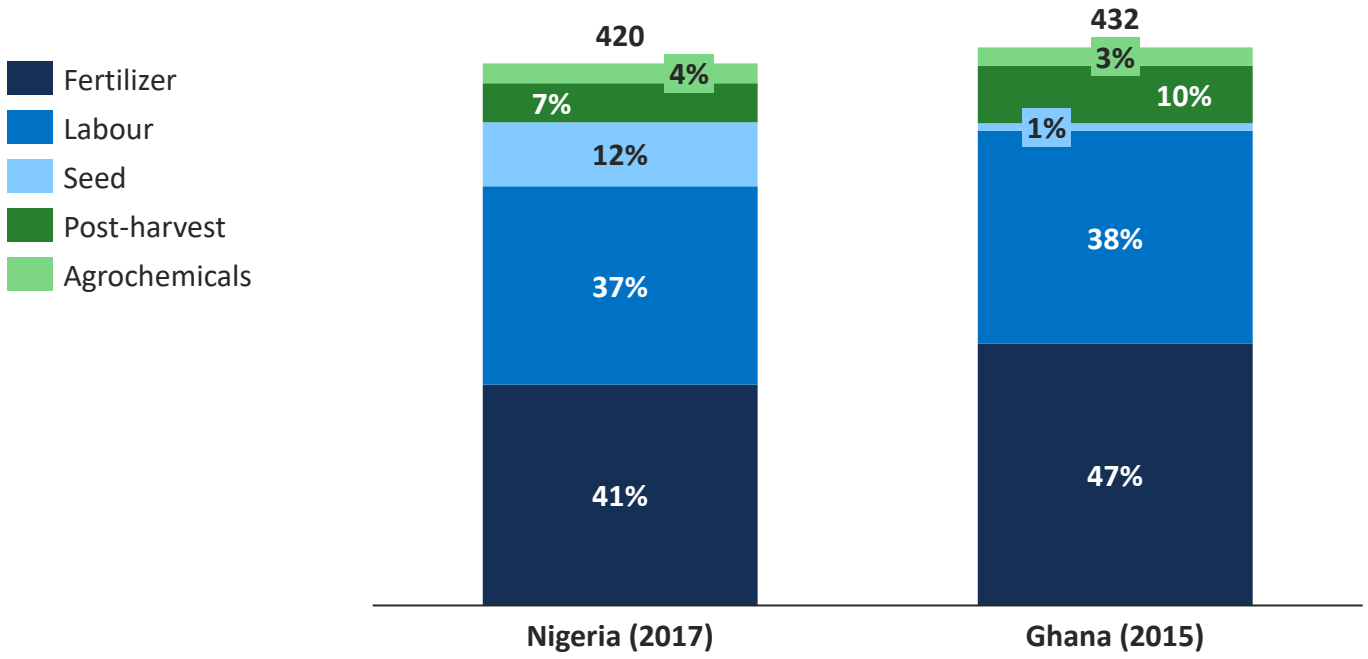
Post-harvest losses	10%
Marketable surplus	675 kg
Additional marketable surplus	75 kg

Cost & benefit

Farmgate price	0.21 USD/kg
Value of additional marketable surplus	15.77 USD
Cost of mechanized harvesting	32.86 USD
Net difference	**-17.08 USD**

Annex

Average millet cost of production in GHS per acre



* Mukhtar, U., Mohamed, Z., Shamsuddin, M. N., & Sharifuddin, J. (2017). Impact of inputs costs on farm profitability: an evaluation of pearl millet production in North-Western Nigeria. Journal of Asian Scientific Research, 7(12), 471-482.

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