Aflasafe Technology Transfer and Commercialization (ATTC)

Market Assessment and Strategy Development

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Aflasafe Technology Transfer and Aflasafe Commercialization (ATTC):

Market Assessment and Strategy Development

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IITA is a non-profit institution that generates agricultural innovations to meet Africa's most pressing challenges of hunger, malnutrition, poverty, and natural resource degradation. Working with various partners across sub-Saharan Africa, we improve livelihoods, enhance food and nutrition security, increase employment, and preserve natural resource integrity. It is a member of the CGIAR System Organization, a global research partnership for a food secure future.

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Acronym List

ATTC	Aflasafe Technology Transfer and Commercialization
BCC	Board of Cereal Crops
BIP	Business Incubation Platform
COGS	Cost of Goods Sold
EGAD	USAID Global Bureau's Center for Economic Growth and Agriculture Development
FAOSAT	Food and Agriculture Organization Corporate Statistical Database
GAIN	Global Agriculture Information Network
ha	hectares
IA	Intellectual Assets
IITA	International Institute of Tropical Agriculture
IP	Intellectual Property
M&D	Manufacturing and distribution
MT	Metric tons
NFRA	National Food Reserve Agency
PACA	Partnership for Aflatoxin Control in Africa
R&D	Research & Development
ROI	Return on Investment
TTLA	Technology Transfer Licensing Agreement
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
WFP	World Food Program

I. Introduction

The International Institute of Tropical Agriculture (IITA) has developed a unique solution, Aflasafe, to address aflatoxin contamination in major staple cereal crops in Africa. Through more than a decade-and-a-half of research and development, IITA and its partners have developed this product by identifying friendly fungi that are highly effective at reducing aflatoxin levels, then testing them in farmers' fields. This testing has helped IITA create the best composition of Aflasafe for each country while providing data needed for the registration and regulatory process. The widespread application of Aflasafe in aflatoxin-affected areas has the potential to significantly increase quantities of aflatoxin-safe maize, sorghum, and groundnuts, and significantly reduce health effects of aflatoxin, including stunting in children and liver cancer. Through Aflasafe, IITA seeks to contribute not only to improving food safety but also increasing the income of smallholder farmers.

To achieve these goals, IITA must widely deliver Aflasafe to agricultural value chain actors. However, developing an extensive production, distribution, and marketing operation throughout Africa to commercialize Aflasafe is not in line with the CGIAR Intellectual Assets (IA) Principles or the mandate of IITA as a non-profit research institution. After considering various options for manufacturing and distribution, IITA decided to pursue Aflasafe commercialization, led by the private sector and supported by the public sector, to turn this scientific innovation into a commercial product.

Exhibit 1. Science to Scale Commercialization

To facilitate the commercialization process, IITA received a grant from the Bill & Melinda Gates Foundation and the United States Agency for International Development (USAID) for implementation of a five-year initiative entitled Aflasafe Technology Transfer and Commercialization (ATTC), which is managed by IITA through the Business Incubation Platform (BIP). IITA hired Chemonics International, Inc. and Dalberg Advisors to support the implementation of ATTC. Aflasafe commercialization began in 2016 and has since expanded. Aflasafe is currently commercially registered and available in seven countries: Burkina Faso, The Gambia, Ghana, Kenya, Nigeria, Senegal, and Tanzania. As of October 2019, 12 more countries across Africa are at different stages in the pipeline for eventual Aflasafe

commercialization: Benin, Burundi, Cameroon, the Democratic Republic of the Congo, Ethiopia, Malawi, Mali, Mozambique, Rwanda, Zambia, Uganda, and Zimbabwe. In each country, ATTC researches the potential for commercialization, identifies and attracts potential investors, transfers the Aflasafe technology to an investor, and supports the manufacturing, distribution, and marketing efforts in such a way that the Aflasafe product will be available locally in an economically viable, sustainable, and independent way for many years to come.

To enable the continued commercialization of Aflasafe and potentially support IITA or other CGIAR institutions in commercializing other products in the future, IITA, Chemonics, and Dalberg, under ATTC, have created four guides which outline the core processes of commercialization, i.e., how to take scientific research products to market. These guides include Market Assessment and Strategy Development, Investor Selection, Structuring the Business Relationship, and Implementation of the Business Development Strategy. A summary of the four guides is presented below in the order of the commercialization process.

1. **Market Assessment and Strategy Development**: This guide describes the process that the ATTC initiative created for developing a commercialization strategy for Aflasafe, demonstrating how it can become a marketable farm input for sale in a specific country. The guide introduces the concept of commercialization and how it relates to IITA's activities, outlines the desired outcomes of the market assessment and strategy development process, and suggests steps to be taken to develop a high-quality document featuring findings and conclusions backed by data—including the country context, market analysis, forecasts of Aflasafe uptake, a review of manufacturing potential, and identification of potential investors. The process should take approximately 4-6 months in total—if assigned to a dedicated team with no unforeseen delays. Once the commercialization strategy is in place, there should be a clear understanding of how to commercialize Aflasafe in the country by prioritizing core market segments that are sensitive to aflatoxin and thus more likely to adopt Aflasafe. The strategy also informs the capacities and expertise needed by an investor to undertake manufacturing, marketing, and distribution.

2. **Investor Selection:** This guide discusses the ATTC initiative's recommended process for sourcing potential partners, analyzing investor options, and ultimately selecting the investor(s) in a specific country with the best potential for success in the manufacturing, marketing, and distribution of Aflasafe. The initial ideas for partner identification will be generated during the strategy development process, with multiple submissions from partners and reviews by IITA, culminating in a final selection by an advisory board based on presentations and recommendations. The selection process should take approximately 4-6 months if completed efficiently and without delays.

3. **Structuring the Business Relationship:** This guide shares the ATTC initiative's experiences navigating CGIAR policies and practices and partner motivations to structure a business relationship with the private sector investor selected to become the manufacturing and distribution (M&D) partner for Aflasafe. It provides guidance to a non-legal audience on crafting the legal document needed for the transfer of the Aflasafe technology: a Technology Transfer Licensing Agreement (TTLA). The guide covers why this type of license agreement was selected by IITA as the core legal document for the process, provides questions to consider when tailoring the TTLA template, and offers

insights into negotiations with M&D partners to date. The TTLA process can take 1-2 months, depending on the level of negotiation required.

4. **Implementation of the Business Development Strategy**: This guide captures ATTC's experiences working with the selected M&D partner to hand over valuable business knowledge developed throughout this process. This guide provides background information, lessons learned, and the recommended process for developing the key deliverables, including consumer profiles of potential buyers, a business case for the marketing of Aflasafe, and a handover memo for the selected partner. The guide addresses each of the key sections of these documents and shows their importance in facilitating the marketing and sales of Aflasafe to potential buyers. The development, consolidation, and handover of this information should take a total of 3-4 months using the standardized templates and tools.

Please note that these guides are not exhaustive manuals, and thus should not be considered a complete list of steps to take. Also keep in mind that the approaches and guidance should be modified and contextualized for each target market and adjusted for changing dynamics. The guides have been designed with Aflasafe in mind but may be a starting point to adapt for other IITA or CGIAR products. As such, we have included considerations for products beyond Aflasafe throughout the guides.

This guide goes into detail on the recommended steps to be taken by a strategy development team to assess a specific market for Aflasafe and develop a complete commercialization strategy. The steps, research questions, and suggested outputs reflect a process tried and tested over three years by the Dalberg, IITA, and Chemonics team in developing commercialization strategies for Aflasafe in Burkina Faso, The Gambia, Ghana, Kenya, Nigeria, Senegal, and Tanzania.

II. Overview of the Market Assessment and Strategy Development

Why commercialization?

Commercialization is the process of making a new product available on the open market. The majority of innovations are created in a research laboratory or workshop, which are controlled environments and require significant resources to run and operate. While research funding can be obtained from a range of different sources, commercializing innovations is a way to earn revenues from selling to targeted customers/buyers, which can then help fund more research. In addition to financial incentives, entrepreneurs or research organizations can experience societal benefits if the innovation has a social impact, reputational benefits if the innovation attracts publicity and is popular, and rewarding partnerships as the entrepreneur engages with the wider market. One of the primary objectives at the start of the ATTC initiative was to determine the commercial value for Aflasafe, and how to work with the private sector to get this product to market. There was significant interest and discussion prior to the start of the ATTC initiative among the CGIAR institutions, donors, economists, and government liaisons weighing various options for how to get a product with health, social, and economic benefits to the market. The commercialization partnership options for Aflasafe are summarized at the end of this guide, in Section V, providing insightful background if you are curious to explore alternative approaches.

In the case of Aflasafe, a strongly advocated alternative to commercialization was making Aflasafe a public good and using donor or public resources to distribute it widely, either through IITA directly, through local governments, or a combination of the two. Many believed this was—and continues to be—the best way to ensure distribution directly to smallholder farmers who are the most vulnerable to aflatoxin-related health risks. However, making a product free doesn't mean the product is available to everyone, nor does it mean it will be valued or used, and it also ties uptake of Aflasafe directly to the unpredictable availability of philanthropic funding or subsidies from governments already strapped for resources. Private sector-driven commercialization was determined to be the best approach for treating the maximum number of hectares (ha) with Aflasafe, as profitability is a proven incentive to catalyze private financing to market a new product. IITA's approach is to leverage the power of the free market supported by appropriate policies, while also structuring deals to ensure that Aflasafe is accessible to those who need it.

Partnering with the private sector to scale the manufacturing and distribution allows limited CGIAR funds to be used primarily to support scientists in the development of the product, and prove its efficiency, before the necessary proof and protocols are transferred to a private sector partner. Working within market forces fosters market-driven demand and a business approach to distribution that focuses first on the target segments willing to pay for Aflasafe. This enables the private sector partner to reinvest and expand distribution channels and marketing to reach second- and third-tier markets. Getting the goods to the last mile, an original and continual goal of IITA, is only possible by working through and with the private sector. Without regenerating financial support, established and sustainable distribution channels, and innovative marketing strategies, scaling will be limited and the product will face an untimely demise.

Successfully working with and through the private sector creates a cycle of financial support to regenerate and sustain the operations, while simultaneously allowing IITA to maintain credibility by focusing on producing high-quality innovations and research rather than chasing a profit margin and diverting resources from early-stage innovations. Thus, developing a strong

economic case for Aflasafe and properly executing commercialization can be much more effective and sustainable than donor-driven “push”-centric models, which often have limited longevity beyond the initial donor support.

Why commercialize through a license with a private sector company?

There is a variety of paths entrepreneurs can take when determining how to introduce a new product or technology to the public and grow its utilization. An innovator could decide to manufacture and distribute the product itself to maintain control of the process and key decisions—but they would need to have the business acumen and resources to start and manage a business. Or, an innovator could sell the rights to the technology, thereby cashing in on its intellectual property—but then they would have to renounce decision-making rights and the ability to maintain quality standards.

Thus, following careful internal deliberations when Aflasafe reached the proof of concept stage, IITA determined that a Technology Transfer and Licensing Agreement (TTLA) is the best instrument for commercialization of Aflasafe. A license maintains IITA’s umbrella ownership of Aflasafe’s intellectual property and ensures quality control over a product whose manufacturing process has been refined and calibrated by scientists and engineers. The decision is also in accordance with CGIAR’s Principles on the Management of Intellectual Assets[1] and reflects the public good potential of Aflasafe. For more information about the CGIAR management principles, please follow the hyperlink above or the website link in the footnote at the bottom of this page; for information about the TTLA, please see the guide on Structuring the Business Relationship; and for the analysis of various licensing options with private sector partners, please see the Investor Selection guide.

What is the goal of a commercialization strategy?

The commercialization strategy is the first step in taking a private sector approach to disseminate Aflasafe to farmers. It is the roadmap IITA used—and will continue to use—to understand the drivers of demand and the practicalities of supplying to meet demand, with the overall goal of maximizing uptake of Aflasafe. At this stage, the research & development (R&D), proof of concept, and registration/patent work has already been completed for Aflasafe, so the focus can now turn to understanding the market dynamics and economics that potential private sector manufacturing and/or distribution partners will want to know prior to investing in a factory and marketing efforts.

The goal of developing a commercialization strategy is to answer three questions:

1. What is the rationale for users to purchase and companies to invest in an innovation like Aflasafe?
2. What does this rationale suggest for which market segments will drive demand?
3. Based on expected demand, what are the manufacturing and distribution options?

[1] https://cgspace.cgiar.org/bitstream/handle/10947/4486/CGIAR%20IA%20Principles.pdf?sequence=5

Once these questions are thoroughly researched and answered, and the findings synthesized into a formal document, the Strategy can be used as a roadmap during the commercialization process—and can be used to persuade potential partners to invest in Aflasafe.

Why is commercializing Aflasafe so complex?

Aflasafe is a difficult product to sell, primarily because most potential users and many consumers of affected crops are unaware of the aflatoxin problem, and see no need to purchase a "solution" for a problem they don't believe exists. Although anecdotal reports by farmers indicate an increase in yields, the product is not designed to directly increase yields and long-term data is not available to show a link between Aflasafe use and an increase in farmer's yields. Instead, Aflasafe's purpose is to combat aflatoxin, which is an often-unknown form of crop contamination that has three challenging features:

1) It normally cannot be seen by the naked eye.
2) It contributes mainly to very long-term damage that has yet to be publicly recognized as an issue by many local governments, let alone costed out by public health experts.
3) It may be amenable to treatment by other practices or products (toxin binders, good agricultural practices) that may already be prevalent in the market, thus calling into question the need for a specific anti-aflatoxin product.

Because of the absence of an immediate impact of aflatoxin, and the lack of a proven yield increase from Aflasafe, a typical smallholder farmer is not likely to prioritize spending any of his or her limited input budget on Aflasafe. Furthermore, given the obligation of IITA to protect product quality, years of testing and trials are required for each country-specific strain of aflatoxin, and so Aflasafe cannot simply be manufactured in bulk and distributed internationally. The highly technical science behind Aflasafe means that registration and public-sector involvement in commercialization are steps that must be navigated carefully as mistakes can mean months or years of delays in product approval and go-to-market.

To attract potential private sector partners to invest in Aflasafe you will need to demonstrate the economic value; quantify the potential demand; identify the missed market opportunities; and show the potential return on investment after investing in the production, distribution, and marketing of the product. One of the first questions IITA hears when explaining the value of Aflasafe is "Who will buy Aflasafe and why?" Scientists have attempted to extensively demonstrate the benefits of Aflasafe and the significant breakthrough it represents, but without knowing how that translates into economic impact—science-led dissemination efforts have been largely ineffective (or at scale); in some cases, these efforts failed to attract potential M&D partners and may even have turned off potential processor and farmer customers. In many countries, the economic value is not easily recognizable, which is why we have explained the approach to conduct detailed economic research and analysis in this guide and subsequent guides.

However, before being able to recognize the positive economic incentives of using Aflasafe, potential partners and buyers must already be aware of the risks of aflatoxin contamination. Thus, market prioritization of those who are already aware of aflatoxin risk or whose businesses are experiencing the negative effects of contamination is key; experience shows that uptake of Aflasafe will largely depend on promoting success stories from one or more "first mover" champions who integrated Aflasafe into their supply chains. From Day 1 of launching the commercialization process, your team should seek to determine who these champions will be

by segmenting demand into different types of market actors, each with different characteristics. For more information on market segmentation see Section IV. Process, Step 6 and see the guide on the Implementation of the Business Development Strategy for our recommended process on recruiting buyers.

Since Aflasafe is so difficult to sell, we needed a strong methodology and approach to developing a comprehensive commercialization strategy. Other BIP innovations, such as bio-stimulants and improved seeds, will be easier to sell given their direct impact on yields and plant survival rates. IITA is still in the learning process of commercializing Aflasafe and in the process of completing the initial five-year licensing and investment plans for Kenya, Nigeria, Senegal, and Tanzania. While the methodology used to date and outlined below was the starting point, this process will be continually refined as IITA gleans additional lessons learned, gathers economic impact and sales data, and receives feedback from investors.

III. Roles and Responsibilities

The commercialization strategy team should include several core functions and skillsets. Individuals with complementary functions, and varying experiences, insights, and aptitudes, are needed. IITA and other members of the CGIAR System Management Organization are internationally renowned scientific research institutions conducting cutting-edge research in the areas of food security, health and nutrition, and resilient natural resources. However, these institutions historically have not had a mandate to commercialize their innovations and thus have not directly employed personnel with extensive business strategy experience and acumen. It behooves IITA and the other CGIAR centers to partner with similarly strong, internationally recognized external consultancy and strategy companies to assess market demand. One could even argue that without two separate institutions with complementary skillsets, there could be a conflict of interest or insufficient distance from the innovative product to conduct an unbiased analysis of the market potential of a new product. In order to complete each step in the process detailed below, be sure to identify and mobilize the requisite human resources.

Exhibit 2 below outlines the essential roles and responsibilities, but keep in mind that different resources may be required based on the specific needs of a particular country. The list below does not indicate the role best associated with an external consulting team, but ideally, at least three of the agribusiness, strategy, and financial team members will be employed by a company external to IITA for this initial analysis. The Team Leader, Strategy Manager, and Financial Analyst will play important ongoing roles throughout the strategy development process, supported by other key roles.

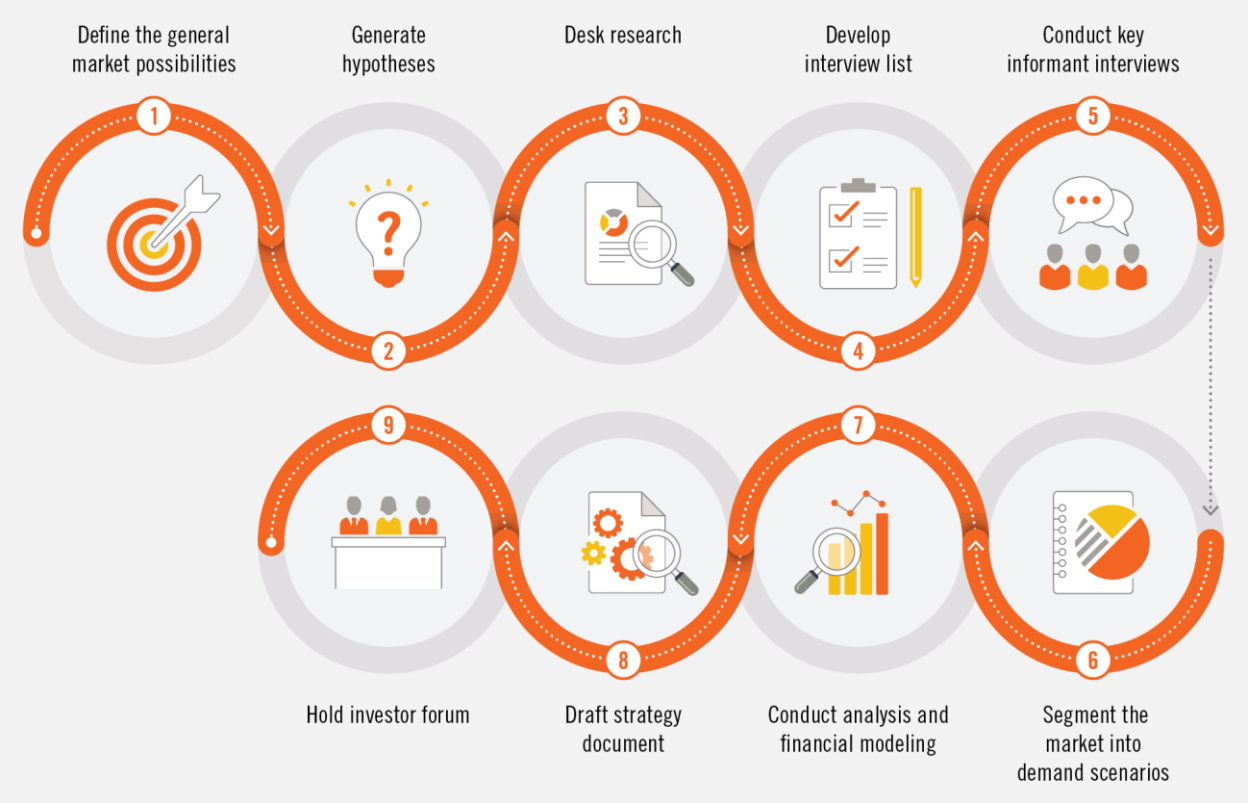
Exhibit 2. Illustrative Roles and Responsibilities for Market Assessment and Strategy Development

Role	Illustrative Skills	Responsibilities
Team Leader	Expertise in agribusiness market dynamics, strong management skills	Overall quality control of the process. Liaison with partners
Strategy Manager	Experience in private sector engagement, knowledge of field research practices, critical thinking	Coordinates and contributes to each step of the process, managing the overall development of the strategy
Junior Strategy Associate	Experience in international development and economic research	Supports the Strategy Manager with research tasks, brainstorming, and operational tasks
Financial Analyst	Mastery of Excel, understanding of corporate finance principles	Own financial model, identify data gaps, and develop financial slides
Scientist	Involvement in Aflasafe R&D and/or testing, as well as prior product development in the country	Provides key information and fact checking on science behind Aflasafe
Engineer	Expertise in Aflasafe manufacturing	Provides financial analyst with initial investment required for Aflasafe production, and verifies other cost inputs as well as cost of establishing the Aflasafe factory. Advises on design as well as instrumental in initial technology transfer training
Advisory Board	Individuals mostly from outside your organization who bring diverse experience in agribusiness, science, experienced business acumen, financial analysis and donor representative perspective	Periodic validation of outputs on a TBD schedule. Approves final strategy document. Serves as external checks and balances consistently across each market assessment and strategy development process, ensuring that lessons learned are applied.

IV. Process

The commercialization strategy process described in the following sections is about defining the market opportunities for Aflasafe, designing interventions to seize those opportunities, and convincing the private sector to invest in manufacturing and distribution. It is an iterative process. As shown in Exhibit 3 below, this guide attempts to break the components of the process into manageable steps for users who may be new to commercialization and private sector partnership development.

Exhibit 3. Market Assessment and Strategy Development Process



As you reference this guide, keep in mind several general objectives for the strategy development work:

- Gathering basic information to gauge the overall market for Aflasafe.
- Gathering intelligence to logically segment the market for Aflasafe and formulating some hypotheses about what might drive members of each segment to buy Aflasafe.
- Understanding the risks of incentives faced by buyers of crops susceptible to aflatoxin (i.e., maize and groundnuts) and formulate hypotheses about their awareness and motivation for dealing with Aflasafe.
- Understanding the key players in the value chain, and the role of government, to ensure that your team speaks to the right people during field visits.

Using this guide for developing a commercialization strategy for a product other than Aflasafe will come with its own challenges, as you will need to develop hypotheses on the economic

rationale for the product from scratch. However, this guide can still be used as a framework for how to approach commercialization of other such products, keeping in mind that specific process steps or tasks could change considerably.

Step 1. Define the general market possibilities

Objective	Initial brainstorm of types of actors to engage within the sectors and commodities impacted by aflatoxins. This will provide a framework for hypothesis generation and detailed market segmentation further in the process
Things to keep in mind	• What product are we selling? • Where can Aflasafe be sold?
Projected timeline and resources *	If this is the first time conducting this exercise, may require a week of pre-work by the Strategy Manager or associate to review previous commercialization strategies and summary reports on the target country by all participants. The brainstorming exercise can be done in a one-day kick-off meeting attended by all members of the strategy development team

*Note that all timelines assume full time commitment by team focused on Aflasafe commercialization. New products may require significantly more time

Based on ATTC's strategy and work to date, the target market will almost always be a country's maize and groundnut value chains. As of the writing of this guide, all commercialization strategies were written for individual national markets in maize and groundnuts, the only exception being Senegal/The Gambia, where a single strategy encompasses both countries given their many similarities in market dynamics and culture.

Lessons Learned

Carefully review Aflasafe registration information for the target country market to understand the conditions and rights for selling Aflasafe. The licensee (IITA) and licensor (private investor) could have different obligations and rights that can greatly affect go-to market strategies.

Once the target market is defined, the commercialization team should gather preliminary information readily available from IITA and identify IITA's present relationships in the target market to understand the landscape and enabling environment. In the case of a new product, it should be clear from the start who owns the Intellectual Property (IP) (see lessons learned box). If it is not clear, then the entire process needs to be paused until the IP owner is identified and becomes part of the process. Through the R&D and registration process, IITA will have connections in the scientific community and in certain government bodies. Importantly, you will know which crops Aflasafe is registered for in-country to begin to focus on specific value chains—typically maize, groundnuts, and some cases, soy. There may be many hypotheses already developed internally at IITA regarding marketing strategies, sales opportunities, and M&D partners; the commercialization team's job is to verify this speculation and their own structured hypotheses with facts and informed assumptions.

Step 2. Generate hypotheses

Objective	Brainstorm the dynamics in the target market to develop initial ideas and research framework to be followed for strategy development
Things to keep in mind	• What do we already know about the market? • How does what we know about the market influence demand? • What are initial ideas on how to commercialize in the target market
Projected timeline and resources	1-2 day brainstorm with entire strategy team and other key invitees (IITA members or IITA contacts in-country), with at least one person familiar with the agribusiness sector in the target market (see tip box)

The next step in the commercialization strategy development process is to generate hypotheses regarding the incentives and risks faced by actors in a value chain if Aflasafe were to be introduced. In the context of Aflasafe, the strategy development team should conduct this exercise for the crops Aflasafe is registered to treat (maize and groundnuts) within the target market. These hypotheses will guide development of the strategy as each hypothesis is confirmed, refined, or discarded. The exercise can be conducted in three general steps:

Step 2a. Identify the market actors and potential market segments

Make a list of value chain actors for each of the target crops, carefully considering what types of actors can be found at each link of the chain (inputs, production, transport/aggregation, processing, retail/export, enabling environment, etc.). Previous commercialization strategies can help inform value chain stakeholder lists, but, as all markets have their unique characteristics, knowledge of country context at this stage can be useful. Time and information permitting, it can be helpful at this stage to develop a rudimentary value chain map that shows the links between each actor, from input providers to consumers, to help visualize the role of each actor in the market and hypothesize how they are affected by aflatoxin and if they might be willing to pay for Aflasafe. During Step 3. Desk Research, you may also find detailed value chain maps developed by academics or research institutions that will serve as important references throughout the commercialization process.

Tips and Tricks

Team members should have a rough understanding of the agribusiness sector of the target market to participate effectively in hypothesis generation. A little pre-reading will make discussions more fruitful and lead to higher quality hypotheses.

Market segmentation is perhaps the most important part of the commercialization strategy, as each segment has specific characteristics and addressable demand that will require a unique marketing approach. A market segment is any group of actors whose interest in Aflasafe is expected to be roughly similar because they all face similar risks and incentives regarding aflatoxin. These groups could be defined in terms of actors/buyers with similar interests (institutional buyers, such as World Food Program [WFP], national strategic reserves, or public sector buyers) or farmers with similar behavior (smallholder farmers consuming on-farm being one segment, and large export farms being another), or even a mix.

Attempt to group the market actors you identified into different market segments. As more information is gathered throughout the commercialization strategy process, periodically revisit the segments to evaluate if any should be redefined, if a new segment should be added after encountering a new market actor, or if actors should be regrouped (see lessons learned box).

Lessons Learned

Market actor and market segmentation information are key reference points throughout the process and will provide value to the selected investor. Keep refining lists of value chain actors, notes gathered about behaviors, relationships, and pathways for sourcing, and pass them on through every step in the process. At some point, most likely during the business case and marketing strategy development phases, all of the notes will be compiled into value chain maps and sourcing pathways.

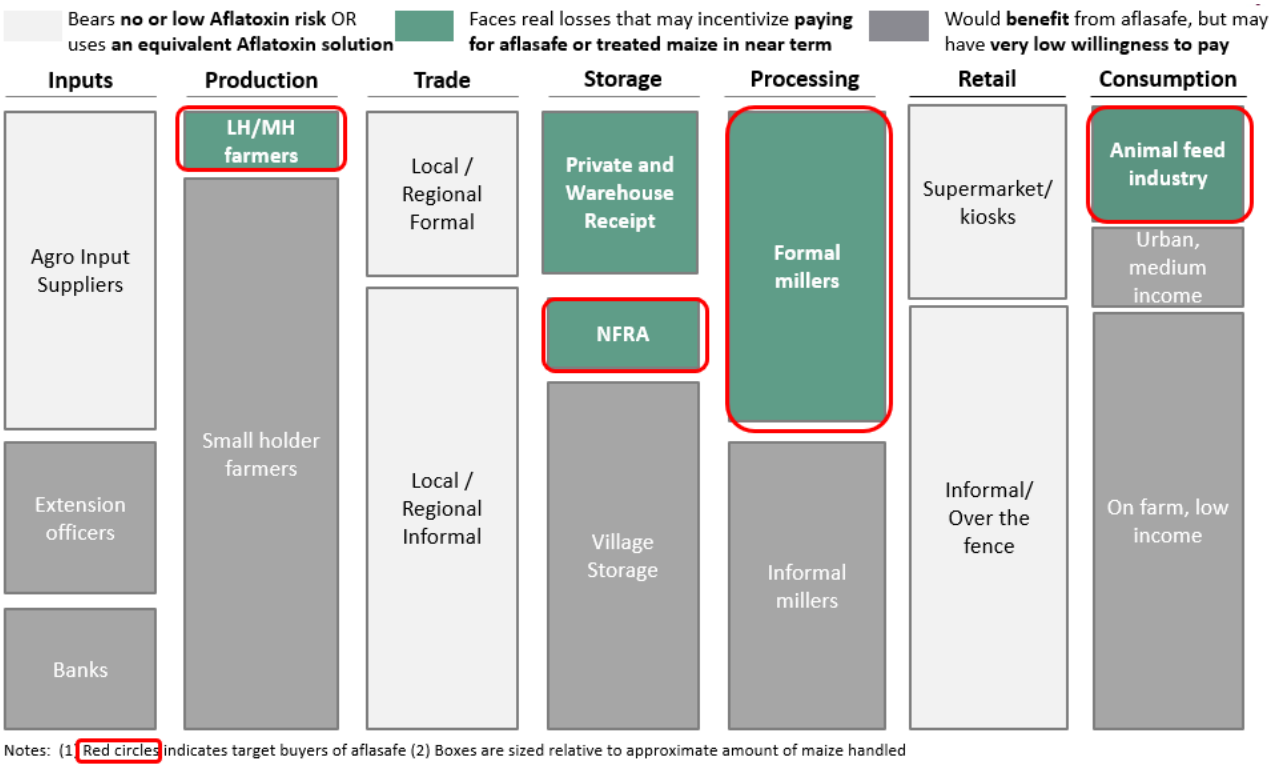
Step 2b. Prioritize potential buyers

Once the value chain actors and market segments are identified, the next step is to estimate the relative size of each segment. It is not necessary to precisely quantify the size of a market segment at this stage, but rather, establish which actors in the value chain handle the largest

segment of the targeted commodity, and thus, which types of actors/segments should be prioritized when conducting desk research or planning interviews.

Exhibit 4 shows a sample output of such an exercise. For each stage of the value chain, the team made an assumption as to how much of the market's total maize or groundnuts were consumed or handled by a given market segment. The team conducting this exercise then hypothesized the level of aflatoxin risk or existing economic incentives to use Aflasafe for that market segment. A very important step here is to make a clear distinction between market segments that would benefit for non-economic reasons—like health—but might not be willing or able to pay versus those that would benefit for economic reasons—like market premiums or avoiding government penalties—and thus would be willing to pay. Finally, they prioritized their hypotheses as to which segments should be targeted first as potential Aflasafe users.

Exhibit 4. Sample Tanzania Market Segment Prioritization Exercise



Once the three steps above are completed, you will have a general framework to follow as data is gathered. The goal for the rest of the process is to validate initial hypotheses: validate the segments of the market for the target crops, identify risks and incentives related to aflatoxin and how they influence behavior for potential purchase of Aflasafe, and prioritize core market segments that could drive Aflasafe uptake. As more details are gathered in the steps below, you will eventually be able to make a defensible estimation for uptake and design interventions that could shift how each key actor perceives Aflasafe risks and incentives to maximize uptake (i.e., intervention scenario).

Step 2c. Categorize risks and incentives actors may face

Each actor will be impacted differently by Aflasafe. After determining and prioritizing market segments, develop hypotheses for how they will perceive the potential incentives or risks of Aflasafe's introduction. These will be different from segment to segment, and could even vary among actors within the same segment. Note that these are not general risks and incentives as they relate to the wider value chain for the target crops, but are specific to aflatoxins and Aflasafe. Some examples to consider are:

Table 1. Incentives and risks for Aflasafe

Market Segments		
Category	Risk/incentive considerations	Examples
Financial 	• Could Aflasafe increase the actor's profitability? • Does Aflasafe cost-effectively substitute another product or process? • Is Aflasafe cost-prohibitive?	• Price premium paid for quality conscious buyers • Access to export markets • Access to guaranteed market to leverage finance for all agricultural inputs • Substitute toxin binders that reduce nutrition value of feed. For example, in Nigeria, analysis revealed that purchasing Aflasafe-treated maize was cheaper than using toxin binders in cases where maize yields were greater than 2.5MT/ha – which is slightly above the national average yield. • Aflatoxin testing requirements
Moral/Cultural 	• What are local perceptions of aflatoxin? • How do buyers react to new crop treatments and products?	• Smallholder farmers are reluctant to change traditional practices • Low awareness of aflatoxin issue • Sorghum is valued food to some communities, hence using it as an ingredient for Aflasafe manufacturing amounts to wasting food.
Health 	• What is the documented health impact of aflatoxin in the market? • Is aflatoxin-contaminated feed a local issue?	• The quantity of target market-specific data on health impact of aflatoxin • Dissemination of aflatoxin health information. (For example, in Kenya, there was a recent case of acute aflatoxin poisoning causing many deaths, and this was covered extensively in local papers before the commercialization work kicked off.) • Existing case studies of effect on livestock
Regulatory 	• How are aflatoxin levels in products regulated, if at all? • If levels are regulated, how strong is enforcement? • Is there any penalty for selling contaminated products?	• Government regulations, and penalties, on aflatoxin content in crops or processed goods. (For example, in Nigeria, the regulator (NAFDAC) imposes strict standards on retail sale of aflatoxin-contaminated grains, but testing is limited and most retailers are not worried about the standards.) • Mandatory testing for aflatoxin • Subsidies for agricultural inputs • VAT exemption

Manufacturers/distributors		
Category	Risk/incentive considerations	Examples
Financial 	• Does Aflasafe have the potential to be profitable and scalable?	• Products similar to Aflasafe have been sold in the market • Addressable demand appears large enough to reach economies of scale
Reputational 	• How is Aflasafe and aflatoxin viewed in the market place? • What kind of decontamination rate is required to be considered successful?	• Perception of Aflasafe's effectiveness in the market • Political economy of agricultural inputs market
Operational 	• How difficult is it to access inputs, capital, trained human resources, and reliable delivery?	• Enabling environment to start a new business line, such as registration process and access to credit • Human resource availability for lab technicians and manufacturing • Infrastructure to produce and distribute
Regulatory 	• What are your standards for production compared to local norms? • How involved will local regulatory bodies be for Aflasafe production?	• Role of government in setting up and managing a manufacturing plant • Ownership of Aflasafe IP in the target market
Strategic 	• Are shifts in consumer demand away from maize or groundnuts foreseen? • Are substitutes to Aflasafe likely in the future?	• Cheaper or more effective substitutes to Aflasafe been introduced elsewhere • Price shocks for maize and groundnuts • National and global consumption trends of target crops

Step 3. Desk Research

Objective	Gather basic quantitative and qualitative information that can be used to size the overall Aflasafe market, estimate uptake, estimate manufacturing costs, and prepare for field visits (See sample questions below)
Things to keep in mind	• Who is the audience for the commercialization strategy? • What do they need to know to change behaviors and drive adoption? • What questions might a potential investor have about Aflasafe commercialization?
Projected timeline and resources	3-5 days by Junior Strategy Associate, with subscriptions to the right databases and periodicals. 1-2 days of quality control by Strategy Manager and Team Leader

Below are sample research questions that should be explored during desk research, and likely sources for obtaining relevant data (see lessons learned boxes):

Research Question: What is the total addressable demand for Aflasafe?

Potential data sources:

- Crop production maps for maize and groundnuts, and other crops that may be registered for Aflasafe treatment
- Production statistics for key crops. The Food and Agriculture Organization Corporate Statistical Database (FAOSTAT) and other databases, along with reports from the United States Department of Agriculture (USDA) Global Agriculture Information Network (GAIN) can provide data on:
  - Annual production in Metric Tons (MTs) and hectares
  - Imports and exports values and quantities
- National Agricultural Statistics of the target market
  - Ministries of Agriculture annual reports
  - International Organization reports and surveys

Tips and Tricks

Availability of reliable information online can vary widely across markets, particularly those targeted by Aflasafe. Research should be thorough, but realize that data available for one country may not be available in another. Gaps should be noted, and interview questions adjusted accordingly. Keep a tracker of different estimates for the same data point; in Tanzania, animal feed sector production estimates were based on a mix of desk research and interviews.

Research Question: Who is producing the target crops, and thus would be applying the Aflasafe?

Potential data sources:

- Research and reports featuring value chain maps, such as FAO reports
- National agricultural statistics
- Production reports, such as USDA GAIN reports
- Other sources to determine breakdown of farmers by crop type, size (hectares or MTs), and organization membership

Research Question: Who is buying the target crops, and what are their quality expectations (see boxes)?

Potential data sources:

- Value chain reports (USDA GAIN)
- Industry association reports for buyers (e.g., milling, processing, brewing, poultry)
- Project reports (government or donor-funded) working with target crop farmers

Research Question: How aware is the target market of Aflatoxin? How does this vary across market segments and across regions in-country? Is there any testing happening in-country?

Potential data sources:

- Aflatoxin contamination maps
- IITA and Partnership for Aflatoxin Control in Africa (PACA) reports
- National regulatory body information on ppb thresholds
- News media

Lessons Learned

Keep an eye on the dates associated with each data source. For example, a key issue found in Tanzania was that the contamination maps that were available were relatively old, and more recent testing results had not been published.

***Research Question: What is the government's role in* agricultural markets, particularly for the target crops?**

Potential data sources:

- Analysis of subsidies, import/export controls, or other government intervention policies
- Reports of donor-funded projects working in target crops
- Established price minimums or maximums of crops, inputs, or food
- Government purchase of surplus or strategic reserves

Research Question: Who are the major players in the target crop markets?

Potential data sources:

- Membership of industry associations
- Recurring names in reports

Research Question: How much would it cost to set up and run a manufacturing plant?

Potential data sources:

- Grain or price reports on the cost of white sorghum, for example from WFP's online Food Prices Monthly database or market monitoring reports available on ReliefWeb
- Cost estimates from Aflasafe plants in other countries (see lessons learned box)
- Reports on the costs of doing business, such as real estate and regional transportation
- Average salaries for manufacturing workers and managers

Lessons Learned

Cost information for the manufacturing analysis is difficult to gather. Businesses tend to consider cost and revenue data as proprietary to guard against competitors. While some data could be found through desk research or from interview informants, you may need to make educated guesses on costs and ask investor forum participants to validate the assumptions.

Research Question: Does the target market have any unique factors compared to other markets?

Potential data sources:

- Crop season maps and reports
- Reports and analysis on the history of the maize or groundnut sector

Desk research should be compiled into a document that is easily referenced and digestible. Key pieces of information and figures should be highlighted. More importantly, missing, incomplete, or questionable data points should be noted so they may be addressed in the next stage of the commercialization strategy process.

Step 4. Develop Interview List

Objective	Determine who can help validate hypotheses and fill data gaps
Things to keep in mind	• Who can help fill in the information gaps that are unfilled after desk research? • What types of categories of actors should we speak to in order to determine how to commercialize Aflasafe in the market? • How will we schedule and confirm interviews?

Projected timeline and resources	1 day of preparation/synthesis by Strategy Manager and Associate, followed by 1-2 week validation period by Team Leader, and possibly Advisory Board, IITA, and other stakeholders if applicable.

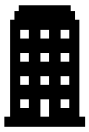
Completing desk research will help develop a list of key informants to interview (see tips box). Researchers should be sure to keep a record of organizations, businesses, or individuals that may be positioned to provide nuance and deeper detail on target market dynamics (e.g., those who were quoted in a local newspaper article or mentioned in a donor report). You will also be able to evaluate what kind of information gaps they face, and thus the ones you should focus on, after reviewing the information available online.

Tips and Tricks

The key informant list should be modified as interviews progress. Ask follow-up questions when you hear about new actors that may help fill information gaps and meet interview objectives. Request introductions if possible and end all interviews by asking who the informant recommends you speak with next.

To help develop interview questions, which will need to be adapted to the key informant, attempt to categorize key informants and lay out objectives for the interview and/or information to be sourced. Some possible categories build upon the value chain and market segmentation developed earlier in the process. Illustrative categories and objectives are:

Primary Influencers		
Group Type	Example Interviewees	Objectives
Farmers and farmer organizations (i.e. end users) 	• National farmer organizations for target crops • Regional farmer organizations in areas with high aflatoxin contamination • Large commercial farmers	• Identify possible price point at which Aflasafe would be affordable and desirable • Determine farm input buying behavior • Understand their interest and/or suitability for using an aflatoxin solution. Ask if they are already using GAP, GHP, or other solutions • Discuss risks and incentives that could impact their purchase of Aflasafe (especially awareness and concern of health risks)
Processors and Traders  	• Target crop exporters • Businesses using target crops as key inputs (millers, brewing, poultry or animal feed, oil cake, etc.) • Crop aggregators • Agricultural warehousing or transportation businesses • Business associations e.g, Cereal Millers Associations	• Understand awareness of aflatoxin and interest in a solution • Identify how aflatoxin impacts their product • Understand competitive landscape - what other solutions exist to aflatoxin and what is their cost • Understand where and how they source their maize or groundnuts, and if aflatoxin is a factor • Determine if there is a potential for a price premium, or other incentives • Learn if maize/groundnuts are ever rejected upstream or downstream for aflatoxin issues • Identify opportunities for directly engaging farmers on quality issues through processors/traders • Understand strength of enforcement of anti-aflatoxin regulations
Government and Regulators	• Ministry of Agriculture, Environment, and/or Health and Trade • National Food and Drug Authority and National Standards Bodies • Export or Port Authority	• Understand the government's awareness of aflatoxin • Understand the government's history in intervention in agricultural markets and quality regulation • Detail the type of current government involvement that could either incentivize aflatoxin control (e.g., through testing facilities) or discourage aflatoxin contamination (e.g., through revoked certification), as well as government appetite for future involvement

		• Discuss risks and incentives that could be addressed to gain their buy-in on regulation
Secondary Influencers		
Group Type	Example Interviewees	Objectives
Input Suppliers 	• Input importers • Seed producers • Fertilizer traders • Input distributors	• Establish what a reasonable price could be for Aflasafe • Identify potential Aflasafe buyers, if any • Uncover current challenges in supplying inputs to farmers • Assess how the market is currently fighting aflatoxin (if at all) • Identify potential entry-points for Aflasafe sale/ distribution • Determine if/how Aflasafe be bundled
Donors and development agencies 	• USAID Global Bureau's Center for Economic Growth and Agriculture Development (EGAD) or Food Security Regional/Country Rep • World Food Program • Food and Agriculture Organization • Country office of DFID or the country's other major ag-focused donor(s) – could be BMZ, AfD, DANIDA, etc. • Bilateral donor agencies	• Learn about current aflatoxin awareness levels • Identify who is working on aflatoxin solutions • Learn if/how the development sector is currently fighting aflatoxin • Seek out potential opportunities to integrate Aflasafe into existing programs • Understand how donors/development agencies could help engage end-users (i.e., farmers) of Aflasafe
Non-Profits working directly with farmers 	• International NGOs • Local NGOs	• Learn how farmers are combatting aflatoxin • Understand if aflatoxin is a major health issue for farmers • Learn if NGOs are currently engaged in behavior change activities targeting farmers, and / or if such activities might be feasible for Aflasafe
Industry Associations 	• Industry Associations in milling, processing, poultry, brewery sector etc.	• Determine the current quality requirements for aflatoxin • Map who is testing for aflatoxin, how aware are industry segments of aflatoxin issues, and how they are tackling the issue • Assess if buyers are paying a price premium, and if so, which buyers • Understand strength and relevance of enforcement of anti-Aflatoxin regulations

Once the list of potential key informants is completed, depending on the market, the list may need to be validated by IITA or local government counterparts. Feedback at this stage is a great way to weed out potential informants to create the initial short-list; it won't be possible to interview everyone! When creating an interview shortlist, ensure that the list covers each region in the market, includes actors in each value chain, and has a balanced representation of each interviewee category mentioned above (see lessons learned box).

Lessons Learned

Some governments may have been very involved in trials and development and thus see Aflasafe as a public good. It is critical that you determine the relationship with authorities early to decide when information should be shared before launching a key step. Local authorities can be a great resource for creating and validating the key informant list. In Tanzania, the team created a strategic partners team comprising key institutions that had supported the development of Aflasafe in Tanzania. These institutions were informed of all decision points to increase their buy-in to the overall process and ensure that their feedback was solicited.

At the same time you are cutting down the list of actors to be interviewed, prepare a formal interview request letter (sample letter available in the IITA database/toolkit) to be sent to potential key informants, especially government stakeholders, as soon as a field research plan is approved (sample field research plan available in the IITA database/toolkit). An interview request letter may include: introduction to IITA, introduction to Aflasafe, purpose of requested interview (you may wish to nuance this for the different categories), who will conduct the interview, and suggested timeframe. The request letter would ideally be signed by a senior member of IITA or a locally recognized official with the gravitas to ensure a response. Your team should make a judgment call on whether to send a formal hard-copy letter or an email, depending on the stakeholder/interviewee in question. The letter should also introduce all team members who will be conducting interviews and working on the strategy so that there is no confusion from interviewees regarding who they are sharing (sometimes sensitive) information with, and how the information will be used.

Step 5. Conduct key informant interviews

Objective	Validate hypotheses, verify desk research, fill in gaps, and glean new relevant information
Things to keep in mind	• What is the objective of this interview and what information do we want to gather? • What follow-up questions should we ask based on findings?
Projected timeline and resources	1 week to schedule interviews. 1-2 teams (depending on size of market) of 2 spending approximately 2 weeks in the field. Strategy Manager to lead, supported by Associate and/or local consultants (see tips box). Team Leader to provide daily feedback on findings

The key informant interviews are the most important data and information source for the final commercialization strategy. This is your opportunity to gather raw information from core actors in the target market and synthesize it into findings and recommendations for the final commercialization strategy. Interviews may also help identify possible investors or other actors to be invited to the investor forum.

The interviews are your opportunity to validate, reject, or refine the hypotheses established on Day 1 in terms of the structure of the value chain for the target crops, the risks and incentives Aflasafe presents, and what these perceived risks and incentives suggest for the size of key market segments that can drive uptake. There may be various interpretations of data or anecdotes gathered during interviews, so it is very important to triangulate data where possible and carry out regular (ideally daily) syntheses of emerging findings so that subsequent questions seek to build out and refine analyses and ultimately recommendations (see below for possible structure of a daily update).

Tips and Tricks

Managing the logistics for interviews takes a lot of work. Your field team will be focused on synthesizing information and reviewing notes. It may be a good use of resources to hire a local consultant to help obtain interview confirmations, manage the schedule, and arrange travel between interview locations.

While waiting for responses on interview request letters (see lessons learned box below), develop interview questions based on the key informant categories established in the last phase, the interview objectives for each category and based on gaps in the desk research phase (sample questions available in the IITA database/toolkit). When conducting interviews, a team of two helps ensure a maximum amount of content is recorded. One team member can focus on asking questions, the other on notetaking.

When conducting interviews, feel free to go beyond your interview questions! If you hear an interesting piece of information, ask follow-ups to get to the heart of the issue and gather the maximum amount of data possible. This may be the only opportunity you have to be in a room with the informant. Be alert if you hear the following things during the interview—and probe deeper when you hear them:

- Someone has incentive structures to help commercialize Aflasafe in the target market
- Someone is paying a price premium for aflatoxin-free target crops
- Someone might be interested in investing in Aflasafe manufacturing
- Some company / government body is testing for aflatoxin in the target market
- Someone is trying to build awareness among farmers / consumers for aflatoxin
- Someone has found success using other methods (including traditional) to combat aflatoxin

Lessons Learned

Trying to get a meeting with a high-level informant or someone critical to gleaning a missing piece of information or data? Ask someone else to reach out or make a connection through their network. Heavy hitters, such the Director, Advisory Board member, Members of the Strategic Partners team or IITA leadership might help you get in the door you might not be able to open on your own.

The interviewers should share updates with the wider team on a daily basis, as interviews are completed. This is particularly important if there are multiple interview teams or supporting team members who have begun work on the analysis. Contents of a daily update may include:

- Key challenges for Aflasafe
- Key opportunities
- Data and numbers to be used for analysis
- Remaining gaps in understanding
- New interview leads

Step 6. Segment the market into demand scenarios

Objective	Develop scenarios for what types of buyers will drive Aflasafe sales, and how quickly those buyers are likely to adopt Aflasafe
Things to keep in mind	• When data is not readily available, are informed assumptions made can be defended logically? • What is the rationale behind uptake assumptions? • Do the market segments reflect the market and add up to total addressable demand?
Projected timeline and resources	Brainstorming session by entire strategy team over 1-2 day after desk and field research are completed. Segments and scenarios should constantly be refined as the team gathers more information or gleans new insights

Revisit your market segments and their risks/incentives—this was first addressed in Step 2 (and should have been revisited and refined many times since then!). Now begin brainstorming how to assign the total addressable demand in the target market across the segments. Some things to keep in mind when assigning addressable demand to market segments include:

1) Normally, total addressable demand is just the total land area planted with maize plus the total land area planted with groundnuts (in ha) in the target market. We describe addressable demand in hectares (rather than MT of crop) because Aflasafe quantities are sold in based on the land area to which the product will be applied.
2) If a market segment is defined by a buyer type rather than a farmer type, you will probably start with a figure in MT—for example, 60,000 MT of maize in Market Segment "X." You will therefore need to convert this to hectares of production area. The simplest way is to use the average yield for that segment—for example, if buyers (like brewers) in Market Segment X normally buy from commercial farms with a yield of 2.0 MT/ ha, then Market Segment X represents 30,000 ha of addressable demand. It's fine to use the average national yield in the absence of regional specific information.
3) It is very important that all the segments be discrete insofar as they add up to the total hectares of production in the target crop, and no hectare appears in more than one group—which would create a double-count of addressable demand. Continuing with the example above, imagine that you think "large farms" are another market segment, and there are 100,000 ha of large farms in your target market. But you have already assigned 30,000 ha of maize to Market Segment X, and you think that this maize is grown by large farmers, so you need to remember to subtract this 30,000 ha—leaving only 70,000 ha in the general "large farms" market segment.

Table 2 shows the output of the market demand segmentation exercise for Tanzania's commercialization strategy. Based on desk research (see blue-colored numbers in table), the Tanzania team identified a few critical data points: Tanzania's recent annual production of maize was 5,314,000 MTs and 725,000 MTs for groundnuts (making a total addressable demand of 6,039,000 MT of target crops), average yields were 1.4 MT/ha for maize and 0.95 MT/ha for groundnuts, and about 3.8M MTs of maize are consumed on the farm. While this data was a good start, it left considerable gaps regarding how the remaining maize and groundnuts were distributed across the other segments. Determining how to distribute the remaining MTs of maize and groundnuts was one of the primary objectives of desk research. For example, based on interviews, the team learned that about 60,000 MTs of maize per year were bought by institutional buyers, and the feed industry processed about 600,000 MTs/year. While the

Tanzania team did not glean any specific data for the other segments' total MTs, the team was able to approximate distributions for the rest of Tanzania's maize and groundnuts across segments by analyzing existing information and relying on the expertise of the team members.

Table 2. Total Addressable Demand (hectares) by Tanzania's Seven Market Segments

Legend: X=desk research, Y=field research, Z=analysis

KEY SEGMENTS	ASSUMPTIONS/DESCRIPTION	Total (MT)	Yield (MT/HA)	Equiv HA (Total/Yield)
Institutional buyers of maize (WFP, National Food Reserve Agency (NFRA) and the Board of Cereal Crops (BCC))	Suppliers of the main institutional buyers (WFP, NFRA and BCC) e.g., Musoma Foods; NFRA sells 80% of its maize to WFP (average 2,800 MT/year), so not included in the estimate of the segment total;	60,000	1.40	42,857
Industrial processors of maize (breweries)	Contract farmers of the main Tanzania's breweries (Tanzania Brewery Ltd. and Serengeti) who are either contracted directly by the breweries or indirectly through their key suppliers	14,000	1.40	10,000
Animal feed processors	Farmers who grow maize for animal feed	600,000	1.40	428,571
Medium maize processors	Farmers who grow maize and sell to medium processors	840,000	1.40	600,000
Groundnut processors	Farmers who grow groundnuts and sell to processors	67,000	0.95	70,526
On-farm consumption - maize	Farmers who produce maize mainly for consumption at home	3,800,000	1.40	2,714,286
On-farm consumption - groundnuts	Farmers who produce groundnuts mainly for consumption at home	658,000	0.95	692,632
Total		6,039,000		4,558,872

Once the market demand is segmented, make informed assumptions about the percentage of each market segment that will be purchasing Aflasafe in years 1 through 5. This exercise should be based on the initial hypothesis exercise, desk research, and informant interviews. Based on the commercialization team's work to date, the assumed percentage of uptake should be based on how strong the risks and perceived incentives are for each segment. For example, institutional buyers face higher risks if they do not control for aflatoxin than medium-sized maize processors do, and thus we would expect higher uptake percentages and/or faster increases in uptake over years 1 to 5 for the institutional buyers segment.

The total addressable demand for each segment, multiplied by the percentage of that segment who is expected to purchase Aflasafe, will equal the Aflasafe sales forecast. For the calculation, note that the application rate for Aflasafe is 10 kg per hectare, or 0.01 MTs per hectare. So, a segment with an addressable demand of 100 hectares and with 100% likelihood to purchase Aflasafe will equal a sales forecast of 1 MT of Aflasafe. An example of how this works in practice is given on the following page in Table 3 (note, all segment information linked to Table 2).

Table 3. Sample Aflasafe "Liberal" Uptake Scenario for Tanzania's Market Segments

Segment Info		Uptake, %					Uptake, MTs of Aflasafe				
Segment	**Area (HA)**	**Y1**	**Y2**	**Y3**	**Y4**	**Y5**	**Y1**	**Y2**	**Y3**	**Y4**	**Y5**
Institutional buyers	42,857	30%	40%	60%	70%	75%	129	171	257	300	321
Industrial processors (breweries)	10,000	30%	40%	60%	70%	75%	30	40	60	70	75
Animal feed processors	428,571	5%	10%	20%	30%	40%	214	429	857	1,286	1,714
Medium maize processors	600,000	0%	0%	5%	10%	10%	-	-	300	600	600
Groundnut processors	70,526	0%	0%	5%	10%	10%	-	-	35	71	71
On farm consumption - maize	2,714,286	0%	0%	5%	5%	10%	-	-	1,357	1,357	2,714
On farm consumption - groundnuts	692,632	0%	0%	5%	10%	15%	-	-	346	693	1,039
Total	**4,558,872**						**372**	**640**	**3,213**	**4,376**	**6,534**

Develop at least two uptake scenarios to adequately plan for different adoption rates across segments as Aflasafe is introduced to the market. Each scenario will have varying percentage uptake assumptions by segment to reflect optimistic vs. pessimistic forecasts of Aflasafe sales. It is advisable to name each scenario for ease of reference and discussion among team members (see lessons learned box). Some example scenarios used for previous strategies were:

- Liberal: Based on adoption rates driven by public and private sector interventions, such as increased aflatoxin awareness campaigns, establishment and enforcement of regulatory standards, public-good/ subsidized Aflasafe for identified markets. In this scenario, uptake could be as high as 75-100% for very motivated market segments with a strong economic interest, as high as 30-40% for market segments with some economic interest, and as high as 10-20% for market segments with mainly a non-economic interest such as health. However, it's important to realize that these estimates are only guidelines and are highly dependent on country context. For example, very remote smallholders in a large country might have low or no adoption even in a liberal uptake scenario.

- Conservative: Based on adoption rates that would be observed if market is expected to drive demand. Assumes minimal aflatoxin awareness, non-regulation of domestic consumption, limited availability, accessibility and affordability (non-subsidized) of Aflasafe. In this scenario, uptake could be as high as 40-50% for very motivated market segments with a strong economic

Lessons Learned

Smallholder farmers will tend to have by far the highest addressable demand hectarage. Thus, adjustments in uptake of even fractions of a percentage for this market segment can have an impact on estimated sales and financial projections. Given smallholders' low economic incentives and willingness to pay for Aflasafe, be particularly careful estimating smallholder uptake of Aflasafe.

interest, as high as 20-30% for market segments with some economic interest, and as high as 5-10% for market segments with mainly a non-economic interest such as health.

- Downside scenario: Based on unanticipated shocks or obstacles that bring demand below the conservative scenario, which may be the case in terms of economic recession, emergence of a new substitute, reduced demand for the target crop, etc. In this scenario, uptake might be limited to 30% or less even for very motivated market segments with a strong economic interest, 10-20% for market segments with some economic interest, and less than 5% for market segments with mainly a non-economic interest such as health. These estimates are only guidelines and are highly dependent on country context. For example, an actor supplying WFP might have very high uptake even in a downside scenario.

Developing different uptake estimates will allow for effective contingency planning based on forecasted return on investments across scenarios. During the financial modeling step, being able to quickly compare scenarios will help you determine how profitable Aflasafe can or cannot be based on the model's input assumptions and how quickly you expect Aflasafe uptake to be across segments.

Step 7. Conduct Analysis and Financial Modeling

Objective	Answer the following: • What is a realistic unit price range for Aflasafe in the target market? • How much will it cost to set up a manufacturing plant in the target market? How much will it cost to run? • When can a business investing in a plant expect to break-even at certain price ranges and sales scenarios, and will Aflasafe be affordable?
Things to keep in mind	• Has input data been validated by more than one source? • Are assumptions reasonable and defensible? • Does the target market have any complexities (like different sorghum and maize / groundnut seasons, multiple centers of demand located far apart) that would require special analysis?
Projected timeline and resources	Financial Analyst owns a complex financial model for the entirety of the strategy development process. Engineer to provide inputs on production assumptions

A financial model is a tool, generally built in Microsoft Excel, to forecast a business' financial performance in the future based on existing data and informed assumptions. In the case of Aflasafe, a financial model is used to generate five-year financial statements based on the costs of setting up and running an Aflasafe manufacturing plant, and anticipated revenue generated from Aflasafe sales. The output of a financial model will help you answer some guiding questions many of which investors will ask when gauging their interest in a partnership.

The ATTC team has already created a financial model template tailored for Aflasafe and built to answer the aforementioned questions if populated with the correct data. While a template may be available, it is highly recommended that those working on the model have experience with

Excel-based financial modeling, or at the very least have a high level of comfort with complex Excel spreadsheets (see tips box).

Tips and Tricks

One team member should "own" the model and share versions on a regular basis. Financial models are complex, and a minor unintended change can have a major impact on the accuracy of calculations. Delegating model responsibility to one team member reduces the risk of mistakes.

The model is only as good as the data entered into it. It's critical that you start making note of key data points from the desk research stage, continue gathering data through interviews, and revise data and assumptions as more information is collected. Key data points that should be gathered are:

- Capital expenditures, such as purchasing the land, warehouse, and equipment required for Aflasafe production. This should be prepared by your Engineer.
- The unit costs of goods sold (COGS) to produce 1 kg of Aflasafe, the most important COGS being white sorghum. The cost of casual labor for production and packing is also included in this calculation. This should be reviewed by your Engineer.
- Personnel costs required to run a plant, along with information about whether any personnel costs might increase if production increases (e.g., having to add a second supervisor or technician over a certain production threshold).
- Other business costs, such as maintenance, depreciation, taxes, and financing.
- Implied/equivalent total hectarage of maize or groundnut production per market segment based on demand and, and average yield per crop (note that yield can vary widely on large or small farms).
- Required rate of return (i.e., cost of capital) in the target market.

While COGS and cost of capital are important for accuracy of the financial model, forecasted revenues will have a much larger impact on income statements. To forecast revenue as accurately as possible, establish a list of key market segments and distribute the total market demand across them.

- Once a basic financial model is completed with input assumptions and revenue forecasts based on uptake scenarios, the financial modeler and the rest of your team can determine what other analyses are required to refine the strategy and anticipate investor questions. Some examples of additional analyses are shown in Table 4 below, but the Financial Modeler and strategy team should consider other possible analyses based on the key questions and hypotheses raised during the research process.

Table 4. Financial Analysis Exercises to Consider during Modeling

Analysis	Key Questions Answered	*Why It's Important*
Pricing scenarios	• What is a breakeven price on different time horizons? • What types of costs, margins, or assumptions are driving up the price?	Establishes if breakeven price meets the market's pricing expectations, or what margins/costs need to be reduced (or could be increased) to meet affordable target price. For example, in Senegal, we modeled break-even prices under various demand scenarios and found that the target price for Year 1 (at 600MT / yr) was $1.40 / kg, but with a sustained push to increase demand to 5x that, the break-even price could be reduced to $1.00 / kg.

Analysis	Key Questions Answered	*Why It's Important*
Plant capacity	• How many hours/shifts per day and days per year must a plant be active in order to meet demand under each scenario? • What does this mean in terms of the size of the plant that should make up the initial investment? • Should additional capacity be added after?	Establishes what annual Aflasafe output must be to meet demand scenarios, which will influence plant size, operating costs, and any planned increases in capacity (through plant size or output). For example, in Kenya, the team had to choose between recommending two small plants (one near Aflasafe demand and one near sorghum production) vs one central plant; the key question to analyze was whether savings in transportation costs outweighed the extra fixed costs of a 2nd plant, at the expected demand level.
Plant location	• Where is demand for Aflasafe concentrated? • Where is the supply or sorghum concentrated? • Are there multiple planting seasons across the target market	Determines strategic and cost significance of plant location, from its distance to markets, suppliers, distribution channels, or investor HQ. For example, in Nigeria, the team had to choose between recommending a plant in Lagos (where manufacturers have existing operations) vs in the North near sorghum production and Aflasafe demand. The team had to analyze whether transportation cost savings where outweighed by the cost of building new storage facilities in the North.
Cost of inventory	• What are the warehousing costs associated with holding and managing unsold inventory?	Analyzes additional costs should sales not keep up with production. For example, in Kenya, there was a long gap between sorghum purchase and the second Aflasafe sale season, meaning sorghum needed to be held for up to 8 months. Financing this inventory added more than 10% to the break-even cost of Aflasafe.
Breakeven sensitivity analysis (or other sensitivity)	• What combination of price and Aflasafe sales would an investor need to reach a certain return on investment? • What combination of assumptions affects another key metric?	Helps quantify tradeoffs between two varying assumptions, and how they affect key financial metrics (e.g., how does price and uptake assumptions affect cashflow or return on investment (ROI)? How does the cost of capital (%) and number of plants affect annual cost of capital ($) or ROI? For example, in Senegal the team needed to choose between recommending a small modular plant vs a large plant. The larger plant was cheaper per MT of capacity, but it was unclear if all the capacity would be used. The analysis revealed that a small plant was better (i.e., lower breakeven price) in the conservative and baseline demand scenarios, while the two strategies were equal in the upside scenario. Because the larger plant was always equal or worse than the smaller plant, we recommended the smaller plant.

Step 8. Draft Strategy Document

Objective	Synthesize findings into a digestible document
Things to keep in mind	• Who is the target audience (e.g., Advisory Board, investor forum participants, government)? • Would readers want to invest in Aflasafe? • What key information gathered in research and interviews needs to be conveyed?

Projected timeline and resources	Each section/slide should be assigned to a team member, who will have 1 week to complete their draft, 1 week feedback round, and 1 week to finalize

The final deliverable of commercialization strategy development is a Strategy Document, typically compiled in PowerPoint format (see box). The Strategy is a compilation of all findings and key information gathered throughout the desk research, interviewing, and modeling process. Most importantly, it should present a convincing case for why a potential partner should invest in Aflasafe's production and distribution for the target market. The Strategy should be presented in a highly polished and professional format, with an emphasis on data, analysis, findings, commercialization options and recommendations, to catch the attention of potential investors, the advisory board, and the wider audience that your recommendations for Aflasafe commercialization are well thought out and backed by data.

Tips and Tricks

Complete slides as you go! As your team starts the commercialization strategy process, familiarize yourselves with the strategy document template and fill out sections as you gather data and flesh out the financial model. This will save time down the road and ensure no key points are forgotten.

Table 5. Commercialization strategy to Document Audience Profiles

Audience	Why are they reading?	What are they reading?
Potential Investors	Determine if Aflasafe is a business opportunity with more rewards than risks	Economic rationale, market segmentation, manufacturing analysis, interventions to increase uptake
Advisory Board	Evaluate if strategic approach for entering a new market is well thought-out and meets ATTC's priorities	Entire document
Government Counterpart	Learn more about Aflasafe and how it may be introduced to the national market and how this can help the general public	Country context, economic rationale, interventions, and potential investors
Donors	Learn how Aflasafe could solve public health issues or increase incomes for smallholder farmers, and what donors can do to help	Country context, economic rationale, interventions to increase uptake
IITA	Learn how their science can be brought to scale within a country context they know very well	Country context, interventions, potential investors

From a strategic perspective, recommendations should involve some degree of prioritization in terms of market segments to focus on, robust evidence to justify this prioritization, and an indication of what this means for the phasing of next steps (sample strategies available in the IITA database/toolkit).

Each target market is different, and thus the deliverables will vary widely in conclusions and recommendations. However, strategies should be sure to include the following sections so that the documents present a complete picture of the potential market and commercialization opportunity:

1. Executive Summary
    - If a reader only reads this section, what key information should they know about the Aflasafe opportunity in the target market?
2. Country context

- What is the total addressable demand?
- What are the target market's unique dynamics?

3. Economic rationale for Aflasafe uptake forecast
   - Is there a premium for Aflasafe treated products?
   - What substitutes are competitive and what are Aflasafe's advantages over them?
   - Are there any major initiatives by the public or private sector on Aflatoxin?
   - Are there any major movements by public and non-profit sector around aflatoxin?
4. Market segment analysis
   - Who are the key market segments?
   - What is each of their potential and forecasted demand?
   - How should they be prioritized?
5. Manufacturing analysis based on financial model
   - What is the level of investment required?
   - When can an investor expect to break even?
   - What level of production is required to meet demand? What size and number of plants are right to meet this demand?
   - How should Aflasafe be priced? What are potential break-even prices under a variety of scenarios?
6. Interventions to increase uptake
   - What interventions are already ongoing?
   - What "quick wins" exist to quickly achieve sales?
   - How can buyers of Aflasafe be recruited?
   - How can awareness be raised among the population and market segments?
7. Potential investors
   - What investors have already expressed interest?
   - Who are businesses with the potential to invest in Aflasafe, and what are their respective strengths and weaknesses?
   - What role might the public sector need or want to play in production of Aflasafe?

Once the draft Strategy is completed, submit it to IITA leadership and key stakeholders for feedback or approval (see box). Certain questions from IITA leadership or stakeholders regarding the analysis or recommendations contained in the Strategy may require follow-up with key informants or other stakeholders, so be sure to maintain relationship established through interviews and other discussions.

Tips and Tricks

Consider synthesizing the Strategy into a two-page document with the key findings and translate it into the local language. The two-pager will be easier to disseminate to the target audience prior to the investor forum, and pique the interest of serious investors. See the IITA database/toolkit for a sample summary.

Step 9. Hold Investor Forum

Objective	Present the draft commercialization strategy to a wide audience of actors operating in the target market, solicit feedback, fill any remaining gaps, validate key assumptions, and begin 1-on-1 conversations with investors to determine level of interest
Things to keep in mind	• Who is attending and why are they important to Aflasafe commercialization? • What are the key messages? • What conclusions reached are based on data or assumptions that should be validated by participants? • What facts will participants want to know before investing in Aflasafe?
Projected timeline and resources	2 weeks of part-time prep work by Strategy Manager and Associate. Recommended to hire a short-term consultant or task an operations colleague to handle logistics. All strategy team members to attend the forum

Holding an investor forum is a crucial part of launching commercialization of Aflasafe in the target market. It will be your team's first formal marketing and communications opportunity to promote Aflasafe as a new innovation in the target market that can bring financial value to users and provide wider social and health benefits for the population. The forum will bring together members of the commercialization team, IITA leadership, local authorities, regulators, and key players in the maize, groundnuts, and/or agricultural inputs industries. Be looking to achieve the following objectives when planning the forum:

- Increase awareness of the science behind Aflasafe and its potential to resolve aflatoxin issues
- Validate key assumptions in the commercialization strategy
- Respond to questions and feedback on the strategy to increase its credibility
- Receive informal expressions of interest from businesses who may invest in manufacturing and distribution

Once logistics are sorted out for the forum, the commercialization team should publicize the event and invite a wide array of actors and stakeholders to attend (see lessons learned box). Document all invitations that are sent and follow up at least once with high-level participants and potential investors, as you want to avoid accusations of leaving someone out or playing favorites. Some examples of potential invitees include:

Lessons Learned

It is critical to have the right balance of representation across stakeholders, with an emphasis on members of the business community. In Tanzania, discussions during the forum leaned a little too heavily on the scientific aspects of Aflasafe. During an investor forum, business aspects should be emphasized to get investors excited. See IITA database/toolkit for a sample forum agenda.

- Actors from the long list for interviews, particularly those who indicated interest in the product or investing in Aflasafe
- Firms who have formally expressed interest in investing
- Key members of each market segment
- Members of the scientific community working on Aflasafe/aflatoxin
- Government stakeholders, such as ministers of agriculture, environment, and health or their representatives
- International community members and donors, such as USAID, AGRA, PACA, UN, WFP
- IITA representatives, in country and regionally
- Media, who can be helpful in promoting the forum and Aflasafe

The media is a critical invitee to the investor forum, and engagement with media contacts and journalists should begin as soon as an investor forum date is selected. IITA should prepare a press release to be distributed to media contacts that summarizes the aflatoxin issue, the science behind Aflasafe and its potential impact, the intention of IITA to award a license for manufacturing and distribution of Aflasafe, and any other important details relevant to the target market context. Scoring a media posting in a national publication about a week prior to the investor forum could drum up interest, ensure attendance by high-level participants, and even start increasing market awareness and demand for Aflasafe; be sure to share the press release or story with your invitees.

The larger the attendance at the forum, the more feedback you will receive on the strategy and the wider pool of investors potential investors. While the format of the forum can vary, it is essential that the executive summary of the commercialization strategy be presented and participants be given the opportunity to ask questions. Another important session is an introduction to Aflasafe by a member of the IITA research team, with a focus on the science behind the product and the manufacturing process, although be careful to avoid lingering too long on the science and research background at the expense of emphasizing the business opportunity Aside from those two sessions, organizing breakout sessions is critical to the forum. Participants can be split into discussion groups (e.g., firms interested in manufacturing, potential buyers, and members of enabling environment) and be asked to discuss tailored questions on the key challenges for Aflasafe uptake. Participants should also be provided a list of input assumptions from the financial analysis and be asked for their feedback on whether they consider them to be reasonable (see IITA database/toolkit for sample breakout session questions).

Depending on feedback received from participants, you may need to revise certain assumptions you made when preparing the commercialization strategy, analyzing information, and forming your recommendations. Some of the slides may need to be refined even after IITA leadership has reviewed and approved the commercialization strategy to reflect new information shared by the stakeholders attending the forum. For example, manufacturers or agribusinesses may have more accurate manufacturing cost or sorghum price information than you were able to gather during desk and field research, and updating these figures could impact rates of return or the time horizon until an Aflasafe investor would break even. Another example is learning about an aflatoxin risk or Aflasafe incentive that a market segment faces that was not previously considered, such as the cost of aflatoxin testing for a specific processor, which could impact prioritization of core market segments. If post-forum revisions are required, be sure to recirculate the commercialization strategy to IITA leadership, flagging the updates.

Use the opportunity provided by the investor forum to start compiling a list of firms who you think have the right profile to become investors in manufacturing and distribution of Aflasafe in the target market (see tip box). Firms that send C-suite executives who actively participate in sessions can be a good indicator of their level of interest, and side-conversations can help gather details that will be useful for the investor selection stage. However, be sure not to make any promises or commitments about a future role in Aflasafe commercialization; a competitive and transparent selection process is important for getting the eventual buy-in of Aflasafe buyers and government champions.

Tips and Tricks

Organize one-on-one meetings with businesses showing the most potential as investors, and large potential buyers of Aflasafe. These organizations can be identified earlier in the process. These meetings will help establish initial relationships critical to keep momentum going after the forum.

The process for competitively and transparently selecting an investor can begin now that you have developed a detailed and insightful Aflasafe commercialization strategy for your target market that has been reviewed by key stakeholders. The final output of the investor forum is a questionnaire tailored to the private sector asking them to indicate if they are interested in investing in Aflasafe production, and if so, what additional information they may need to make an informed decision. A review and filtering of the questionnaire and investor forum outputs will be the first step for selecting an investor to manufacture and distribute Aflasafe in the target market.

V. Commercialization Partnership Options for Aflasafe

The potential alternatives for commercializing new innovations and/or new technologies are outlined in the exhibit below in no particular order. As indicated in this analysis, IITA and the Advisory Board determined there was only one viable option in a given situation—licensing the technology to a commercial company. While the preferred option is to grant a license to a private sector partner to both manufacture and distribute Aflasafe (Option 6 below), IITA is also testing an alternative option: to grant a license to a distributor on a trial basis through a limited distribution, limited duration license (Option 5).

Exhibit 5. Commercialization and Partnership Options for Aflasafe

Options	Pros	Cons	Determination by IITA
1. Open Source license	Available to whomever wants to replicate the Aflasafe manufacturing process and distribute through commercial or subsidized channels.	• Process to share mother culture would require significant vetting. • Changes in manufacturing process could decrease Aflasafe's efficiency, thus hurting its reputation. • Would still require registration country-by-country, which may be difficult if not sponsored by an international research institution like IITA.	Unrealistic option given complexities of the Aflasafe technology.
2. Sell the technology, science, mother culture, and process to one company	IITA could potentially demand a high price for the technology and reinvest the funds into future innovations, without the need to remain involved in the continual improvement of Aflasafe.	• IITA would not be able to ensure that quality standards for Aflasafe are maintained. • Impossible to be sure if marketing interventions will target smallholders who are most at risk of aflatoxin contamination. • No guarantee that the private sector partner would invest in continuous product improvements instead of maximizing profit margins.	Option does not fit the values and mission of IITA, nor its objective with Aflasafe to share lessons learned, continuously improve the production process, and expand use of Aflasafe to new crops through more testing.
3. Maintain full ownership and responsibility within IITA, including further research, testing, process improvement, manufacturing, marketing, and distribution	• IITA would maintain quality standards and control over usage. • IITA retains all profits long-term to finance research • IITA maintains operational control of all elements of research, production, and commercialization.	• Insufficient working capital or financial structure to indefinitely support the business operations of scaling Aflasafe production and investing in marketing strategies and distribution channels. • Would shift IITA into an international business instead of a non-profit research institution, requiring significant changes—from how the product is registered to obtaining tax-free status, diplomatic status, and status as a CGIAR institution. • Fails to leverage the resources and experience of	Unrealistic option as it is not feasible within IITA's structure, and would entirely change the organization's mission, mandate, and operations structure. Also, does not fit within the classification of IITA as a non-profit institution. Taxes are not levied on products developed by IITA in the IITA-controlled production facilities. Attempting to operate a business circumventing taxes would jeopardize IITA's legal standing and

		the private sector, whose business it is to commercially scale new products.	primary mission as a research institution.
4. Transfer technology to one or more public institutions, such as a government agency	• Public institution could potentially maintain quality standards and control over usage of technology. • Access to public financial resources. • Government would have stronger incentives to implement regulations and laws to enforce aflatoxin contamination minimums and create compliance incentives to buy Aflasafe. • More closely aligned with IITA's social impact mission than private sector actors.	• Most governments do not have the business skills or agility to operate like a results-oriented private sector business. • Governments should already be incentivized to implement and enforce aflatoxin regulations.	Tested as an option in Kenya, with little success. Very difficult for public institution to manufacture, market, and distribute efficiently and effectively, and fully invest in the facility and process as required.
5. Limited Distribution License	• Relationship with distribution partner allows IITA and the partner to test the market potential for Aflasafe over a limited duration of time before a longer-term commitment. • IITA maintains control of manufacturing process, ensuring quality control and quantity to meet demand. • Reduces risk for IITA and distribution partner before the former commits to a manufacturing partner and the latter commits to a significant financial investment.	• In the long term, not in IITA's interest, nor a fit with their institutional mission, to manufacture products for public sales. • May lead to disagreements and negotiations regarding certain types of costs, such as who will fund marketing efforts and how the product will be branded. • Creates negative incentive for distributor to ever invest in manufacturing or take on longer-term risk if they are already making an acceptable margin on distribution.	Currently being tested as option in Ghana and Burkina Faso. Potential interim solution when a manufacturing partner is not available or a good fit, but not a long-term solution. Questions regarding sharing costs and responsibilities, marketing, and engagement with third parties should be discussed before a limited license is executed. IITA should evaluate if they have the time and resources for such an engaged partnership.
6. Preferred Option: Licensed Manufacturing & Distribution (M&D) partner with exclusivity for 5 years: IITA transfers Aflasafe production know-how to the licensed M&D partner. License includes production, quality control, sales, and marketing. Partner makes a financial investment and	• Allows IITA to focus on core mission of research and improving the Aflasafe technology and solution. • M&D partner brings their investment and expertise in manufacturing, marketing, and other business functions. • Licensing allows IITA to remain involved in the business; hence, can monitor their goal of maximizing uptake by those who are most vulnerable to aflatoxin poisoning. IITA retains a royalty fee, and M&D partner captures	• Difficult to change course if M&D partner is underperforming given significant investor selection process, due diligence required, and financial investment by the partner. • IITA has to staff and maintain a highly skilled team to closely work with, support, and monitor the performance of the M&D partners.	Win-win relationship, where each party focuses on what they are good at. Most realistic option, given IITA's mission and structure. Licensing is a logical compromise between the original CGIAR mandate and strategy to work through private sector on commercializing Aflasafe.

commitment to the Aflasafe business.	profit margin as sales increase.