Lean
TOOLKIT

WINROCK INTERNATIONAL

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KEY TERMS

APPROACHES

DIRECT IMPLEMENTATION

In a traditional direct implementation project, the program staff have a direct and hands-on role delivering services and goods to the target beneficiaries (the population the project is trying to impact). Examples of direct implementation include delivering inputs or extension information directly to farmers, either one-on-one, through field days or farmer field schools, or through other activities.

DIRECT BY PROXY IMPLEMENTATION

In direct by proxy implementation, the project engages an organization or entity (e.g., a public/government agency, a privately owned business or trade association, or a community-based or international non-governmental organization (CBO or NGO)) to deliver goods or services to the target beneficiaries. Direct by proxy is characterized by a local intermediary delivering the same type of goods or services as the project would under a direct implementation approach and would not occur without financial support and direction of the program. The program may have little to no direct relationship with the beneficiaries but is highly directive in the goods or service being delivered. The relationship between the program and the 'partners' may be defined through contracts, subawards, grants, or some other appropriate mechanism, and may involve a cost share component.

INCREMENTAL IMPLEMENTATION

Incremental implementation is a term used to contrast a traditional project approach with an approach specifically seeking scale. In an incremental approach (or an incremental beneficiary approach), a limited number of beneficiaries, within the manageable interest of the program's resources, are identified for the project to reach directly. Beneficiary reach is achieved by the project 'graduating' those beneficiaries from the direct program activities. The program then identifies and delivers project activities for the next incremental group of beneficiaries, often anticipated to occur in a subsequent phase of the program. An incremental implementation approach expects to reach beneficiaries one group, or set of, beneficiaries at a time, expanding impact incrementally.

MARKET SYSTEM

The market system is "a dynamic space—incorporating resources, roles, relationships, rules and results—in which public and private actors collaborate, coordinate and compete for the production, distribution and consumption of goods and services" (Campbell 2014). The market system includes all the firms in interrelated value chains—input providers, producers, traders, processors, wholesalers and retailers; the supporting services (e.g., finance, transport, information services) for those actors; and the formal and informal enabling environment in which they operate. The relationships between these actors help to determine the efficiency of the system. The prevailing cultural and business norms influence how decisions are made that affect the functioning and responsiveness of market systems to stimuli. The market system also interacts with a wide range of other systems including household systems, social systems and ecological systems.

MARKET SYSTEMS DEVELOPMENT

A project that uses market systems facilitation methodology may convene, introduce, demonstrate, explain, coach, mentor, provide proof, help link market actors to each other, or build capacity to help others. A facilitation approach avoids any direct or overly directive 'doing'. The program is not a part of the value chain or market and does not play a significant role in it.

SYSTEMIC CHANGE

Market systems are interconnected with other systems, have soft boundaries, are complex, and are self-organizing. Assuming farmers are logical actors within the existing market system also leads one to conclude that they cannot and will not make different decisions unless the market system in which they exist experiences some type of change. Because of these dynamic and relational characteristics, a program cannot anticipate simple linear cause and effect in isolation within the market system. Systemic change within the market system will be necessary for sustained behavior change by farmers and other actors while creating conditions for scaling impact.

KEY TERMS

UNDERSTANDING LEAN

CUSTOMER SEGMENT
In lean, the customer is the individual paying for the product. This could be an individual or individuals within an organization who make decisions to buy or not. The customer segment is the group of similar 'buyers' or decision makers who are specifically making purchasing decisions within that market channel.

GEMBA
This Japanese term literally translates as 'the real place'. This includes the people working on the farm or within an agriculture-based enterprise, including those performing the work. In the lean approach, workers play an important role in continuous improvement because they are closest to waste and thus in the best position to identify the waste and develop ideas for eliminating it. On farms, the gemba might include farmers or farm workers; the manual laborers who prepare the land, plant the crops, spray herbicides, harvest, thresh, winnow, and transport crops to market. Identifying and interviewing those who are most involved in the work encourages transparency and trust, facilitates open communication, and improves understanding of the value stream.

KAIZEN
This Japanese term means 'continuous improvement'. The goal of kaizen activities is to discover improvements and banish waste until a firm achieves zero waste production. That goal might never be attained, but it still provides inspiration to improve.

MARKET CHANNEL
The market channel consists of the people, organizations, and activities necessary to transfer the ownership of goods from the point of production to the point of consumption. For most products (commodities), there will be multiple market channels, each a smaller, more defined categorization of customers and actors who share similar characteristics, such as business model, end consumer market, and/or supply needs. For example, a particular rice market may be segmented into the following market channels: parboiled rice processed by large-scale integrated rice mills, parboiled rice processed by artisanal Small-and-Medium Enterprise- (SME-) owned rice mills, and plain, non-parboiled milled rice. A maize market might be segmented into the following market channels: animal feed mills (regardless of size), large- scale food processors, and artisanal SME-owned hammer mills.

MAIN MARKET CHANNEL
The market channel that moves the largest volume of product for the largest number of producers.

MUDA
This Japanese term means waste. This includes any steps or activities that do not create value.

MURI
A Japanese term meaning overburdening. Muri often creates waste in a system by putting too much stress on a particular point in the process. For instance, gemba may be overburdened because the amount of work is greater than is physically possible.

POKA-YOKE
This is a Japanese term meaning 'mistake proofing.' By systematizing processes, you can eliminate waste by eliminating the possibility for mistakes and errors.

VALUE STREAM MAP
A visual process map that outlines the steps necessary to create value for the customer. Such maps usually are created based on direct input from those performing the work.

INTRODUCTION TO LEAN

Developed by Toyota and widely credited with turning the company into the world's largest and most profitable auto manufacturer, the lean approach is among the most powerful production systems in the world. It is now used globally in industries ranging from manufacturing to health care, and increasingly by non-profit organizations and in agriculture.

At its core, ***the lean approach maximizes productivity by minimizing waste.*** It sounds simple - right? Yet when applied to agriculture programs, lean suggests a market systems approach that looks radically different. Whereas most agricultural development programs focus on maximizing productivity by doing or using more – more inputs, more information, more resources – the lean approach attempts to achieve those same aims by taking away. Imagine a farmer working a plot of land. The goal of a traditional program would be for that farmer to maximize the yield from that land by incentivizing the farmer to purchase better seeds, adopt new technologies, apply improved fertilizers, etc. But all those additions require additional resources (like money) that the farmer often doesn't have. Rather, the goal of the lean approach is to increase productivity and profit by maximizing the use of already available resources.

As described in this toolkit, lean agriculture identifies and eliminates waste and inefficiencies in the market system. This toolkit provides practical tools for Winrock programs to meet their objectives of achieving sustainable, scaled impact, both during the project period and beyond, through a facilitative market systems approach incorporating lean principles and tools.

The toolkit is designed to guide implementers in the field, with support from home office staff, through the process of applying the lean approach, from capture and project design to work planning, identifying market opportunities, and working with beneficiaries.

This toolkit includes:

- Background and training guides to understand the lean approach and its applications in the agricultural development context.
- Planning and strategy guides to facilitate project staff to identify value within the market system.
- Guides for scaling solutions, what it means and how to engage partners in achieving it.

The training guide provides basic explanations of key concepts for understanding lean. This is followed by the toolkit, which offers step-by-step instructions for how to apply lean in program implementation.

Applying the lean approach will help Winrock to eliminate inefficiency in our programming while maximizing benefits for our target populations. So let's get to it – there's no time to waste!

WHAT IS LEAN? A TRAINING GUIDE

This guide will introduce the user to the lean approach for application to international agricultural development programs. It can either be self-guided or used as a facilitation guide for team trainings.

WHY LEAN?

KEY CONCEPTS

- The goal of lean is to maximize value by eliminating waste.
- Lean is a sequenced, process-based approach for achieving optimal productivity.

Lean concepts originated in Japan in the manufacturing sector. The term was coined in a 1996 book, 'Lean Thinking'[1], that outlined the famously successful (and legendarily profitable) 'Toyota Production System'. (See Box 1)

To break lean down into an equation, it would look like this:

Present Capacity = Work (or Value) + Waste

To consider the potential inherent in lean and why it might be useful to apply to any kind of production system (including agriculture), let's rearrange that equation and see what happens:

Work (or Value) = Present Capacity – Waste

In other words, practitioners can gain value by eliminating waste from what they currently do. Work, of course, can be considered to be anything that adds value to the customer, while waste can be considered as anything that doesn't add value. The elimination of waste is at the center of Toyota Production System, helping Toyota to elevate its net profit margin substantially higher than the industry average in the 2000's. As is true for both manufacturing, agriculture, and economic development, to apply lean "… is to find waste, root it out, and turn it into capacity to produce more."[2]

While lean was first adopted throughout manufacturing, in the last 15 years lean has increasingly been applied in agriculture – first widely in Europe, increasingly in the U.S. and is now taking root in global agriculture as well.

DISCUSSION QUESTION: Can you name an example in agriculture where waste can be eliminated? Can you name an example from another sector?

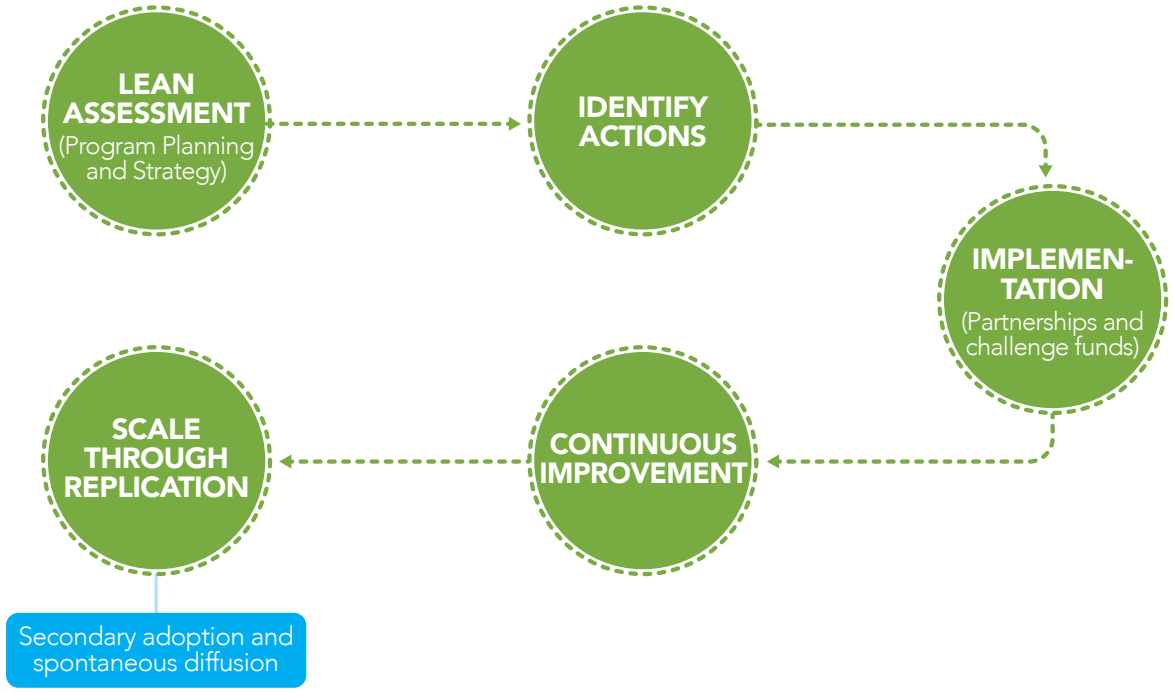
The principles of lean rely upon a continuous cycle of identifying and ensuring focus on value while reducing waste and understanding that there is always room to improve. Such principles can be applied to production, administration, and service. This toolkit provides a guide to applying lean principles to identify priority opportunities for agriculture program intervention, to enhance understanding of production systems and market channels, and to inform the process of reflection and adaptation over the course of a program.

BOX 1

Lean is basically "looking at the time line from the moment the customer gives us an order to the point when we collect the cash. And we are reducing that time line by removing the non-value-added wastes." Taicchi Ohno, Author, Toyota Production System: Beyond Large-Scale Production.

1 Womack, James P. Lean Thinking: Banish Waste and Create Wealth in Your Corporation. New York, NY: Simon & Schuster, 1996.
2 Hartman, Ben. The Lean Farm: How to Minimize Waste, Increase Efficiency, and Maximize Value and Profits with Less Work., 2015.

LEAN CYCLE



Lean principles pursue perfection through continuous improvement. It's analogous to collaborating, learning, and adapting (CLA), an approach that is now built into nearly every successful project strategy and design. Lean is incorporated into the project's CLA through the repeated application of lean tools and principles, as the project works to support the business and market system model. A continuous cycle of adaptation, replication, and scaling over each production period is a built-in feature. Application of lean assessment tools is not intended to be a single activity at the beginning of a program, rather an iterative (repetitive) activity to assist both field staff, program managers and stakeholders to identify "What's next?" Ideally, assessment tools should be applied by the program each season or two, as production or other shifts occur, to identify and discuss changes, brainstorm adaptations, proactively identify inefficiencies and eliminate waste, and plan ahead.

Within agricultural projects, production system shifts are most likely to come through simple, one-off changes between seasons rather than complex, high-risk packages of production practice investments in a single season. Producers may typically try out – and hopefully adopt – one or two new technologies or approaches at a time as a way to manage the risks associated with something unfamiliar. The lean analysis within this toolkit provides a clear means of identifying and prioritizing those one or two new technologies, approaches, or practices that are most likely to be examined and adopted. It does so by developing an improved understanding of the most critical pain points for farmers, right at the production (farm) level.

Lean is not only for farmers. Business and market system models for supporting improved producer access to, or adoption of, those one or two new technologies or approaches are intended to be iterative. That is, Small and Medium Enterprises (SMEs) and related market actors will need to test new, producer-focused engagement and relationship models, repeatedly, to see if they make sense and to ensure that as market dynamics change, proposed new approaches and technologies continue to help producers increase efficiency and profitability.

DISCUSSION QUESTION: Where, within our program's implementation, could lean be applied? Who is our customer? What do they value? Could lean principles assist us in delivering more value from our present capacity?

THE LEAN FARM

KEY CONCEPTS

- The smallholder farmer makes rational decisions based on economic, environmental, and social conditions, e.g. inputs/crop prices, weather, labor availability.
- Lean seeks to understand what influences a farmer's decisions rather than assuming the farmer doesn't know better.

In agricultural market development projects, common wisdom holds that farmers don't access technologies and services because the costs are too high, the services aren't available, or the farmers simply aren't aware of the existence of new and better technologies and services.

LET'S LOOK AN EXAMPLE.

Farmers must have planting material at the beginning of the season. Legume farmers typically have three options – seed they have saved, informal 'seed' purchased from the grain market, or certified seed. The farmer will logically choose the certified seed for the optimal yield, right? In the real world, why aren't more farmers purchasing certified legume seed? Often the informal seed purchased from the grain market has a retail price above the price of grain, but below the price of certified seed. It has likely been set aside from better farmers and has been hand cleaned and selected to improve germination and viability over what would be sold as grain. Given environmental (uncertain rains) and social (labor availability) difficulties in planting on time and with proper spacing, the farmers choose the informal seed as offering them the best value for money, over saved seed or certified seed, even though the genetic potential and quality of the informal seed will be less than the certified seed available. Taking all factors into consideration, the informal seed is the rational choice.

This leads to an important principle of lean: The smallholder farmer is a logical actor with sound economic, social, or environmental reasons for choosing alternatives to the 'agronomically ideal' approach to crop production.

Agricultural stakeholders sometimes focus excessively on the 'right' production approach with an emphasis on boosting productivity outcomes, even though sound reasons exist for the producer choosing an alternative approach. **If we instead assume that the farmer is making a sound, rational decision, then we focus on why the farmer is making that choice, rather than educating the farmer on the choice we think they should make.**

Lean production principles don't minimize new/additional investment in crop farming. Instead, they seek to increase value from the time, money and other resources that are already being invested. By boosting value from existing resource investments, lean production improves a producer's ability to capture the potential value of additional production investments in future seasons. This is not to suggest that a farmer has complete information. Information asymmetry is often stark for women farmers, who may lack access to training, inputs, and technology. Rather, lean assumes that the farmer is making a logical decision based on the information available to them.

DISCUSSON QUESTION: Can you think of any examples where projects have asked farmers to apply more – or 'do more' -- on the farm? Can you name any technologies promoted by projects that were never adopted outside of demonstration plots or farmer field schools? Did any of those technologies require additional time, money, or labor from the farmer? Who do projects typically consult to identify the technology or extension services needed by farmers? Do those consultations focus on what the farmer is doing wrong and what the 'right' production approach should be? In the local production system, how are women disadvantaged by making rational decisions without complete information?

LEANING IN TO IDENTIFY WASTE

We've established that waste is an inefficiency that costs time, money, or other resources, and often all three at once. By reducing waste in the production system, producers and market actors can capture more value from their businesses. Lean identifies 10 typical categories of waste in production systems. Do any of these sound familiar?

DISCUSSION QUESTION: Consider some typical smallholder farms where you've worked. Can you identify an example of each type of waste? See the below example.

EXAMPLES OF WASTE IN RAIN-FED GRAIN

(rice, cowpeas, maize, soybean). These were common wastes that farmers and experts identified during the creation of value stream maps within a Nigeria agricultural development project.

1. **Overproduction:** Producing more maize while applying Afla-Safe than the premium paying market can absorb.
2. **Waiting:** The presence of storage pests in cowpeas that are stored on farm using traditional woven polypropylene sacks.
3. **Transportation:** Driving small loads of grain to find a market when farmers could have consolidated their harvests and their delivery to save on transportation.
4. **Overprocessing:** (No major overprocessing waste identified in Nigeria. Examples would include use of excess packaging or cleaning a product beyond what the customer is willing to pay for.)
5. **Inventory:** (No major inventory waste identified in Nigeria. Examples would include storing too much fertilizer or herbicide on the farm. Lean encourages buying "just in time" to avoid the costs of storing too many supplies.)
6. **Defect:** Poor yield from rice paddies due to poor land preparation (ridges not high enough to keep root zone consistently moist).
7. **Motion:** Cultivating soybeans manually after spraying herbicides (because of poor quality herbicide).
8. **Overburdening:** When workers become worn out after hand threshing rice and cowpeas. Mechanical tools for this work not widely available.
9. **Uneven production/sales:** When the workload is very heavy in one season with no work in another season (this cannot be avoided with rainfed crops)
10. **Unused talent:** In some parts of Nigeria, access to land was a hurdle for women and young people starting out without inherited land.

One cautionary note is that there is no point in spending too much time in classifying a waste, though it is important to understand the root cause of the waste. Taicchi Ohno at Toyota used to say, "Costs don't exist to be calculated. Costs exist to be eliminated." So in terms of the lean analysis, the most important thing is to hear from the farmers where they see waste on their farms (and what are their improvement ideas), and categorizing the waste is of secondary importance.

LEAN AND THE DEVELOPMENT PROJECT

KEY CONCEPTS

- Lean is applied within a market systems development approach, whereby the project uses facilitative strategies to strengthen existing market players.

How can lean be applied on a project? What are the differences between lean and other, more traditional development strategies?

Lean is principally a process-driven approach. This toolkit uses those processes for development program planning and strategy. It offers an alternative lens through which to identify, understand, and help others to seize opportunities for program prioritization and intervention. Lean is not just a set of tools to tack on to a traditional development approach, but rather, a school of thought that can change the entire paradigm. To better understand this potential paradigm shift, let's first break down the market systems development approach.

In a traditional, or *direct implementation* approach to agriculture development work, the project is almost always the main interface (communicator/trainer/opportunity bringer) with farmers, suppliers, processors and other stakeholders. In other words, the project's own staff (and sometimes consultants) directly interact with stakeholders, and even, arrange and deliver useful or new products or services. Some projects have pursued a *'direct by proxy'* approach, where local partners are hired to directly implement activities on behalf of the project. Proxy work may be conducted through grants or contract mechanisms, but the project itself remains highly prescriptive and directive in execution and finances the work.

DISCUSSION QUESTION: Based on your project experience, can you name an activity that the project implemented directly? Can you name an activity or two that were implemented directly by proxy?

A *market systems* or facilitative approach is less directive. In such an approach, the project has no direct or ongoing relationship with producers.[3] Instead, the project partners with a range of other stakeholders, particularly the private sector, to identify aligned interests to achieve desired outcomes that contribute to responsible, sustainable growth. The project may contribute financially to pilot or test activities, but the priority is to provide breadth of experience, advocacy, influence, business development services , and coaching to partners to assist them in pursuing their own initiatives around shared objectives and mutually identified opportunities, along with aligned incentives. In employing such an approach, for sustainability's sake, it is critical to work largely with partners who have an already – *existing presence and relationships with producers in the area of intervention (or the Zone of Influence)*, to build upon – rather than to replace the existing market system by building a new one.

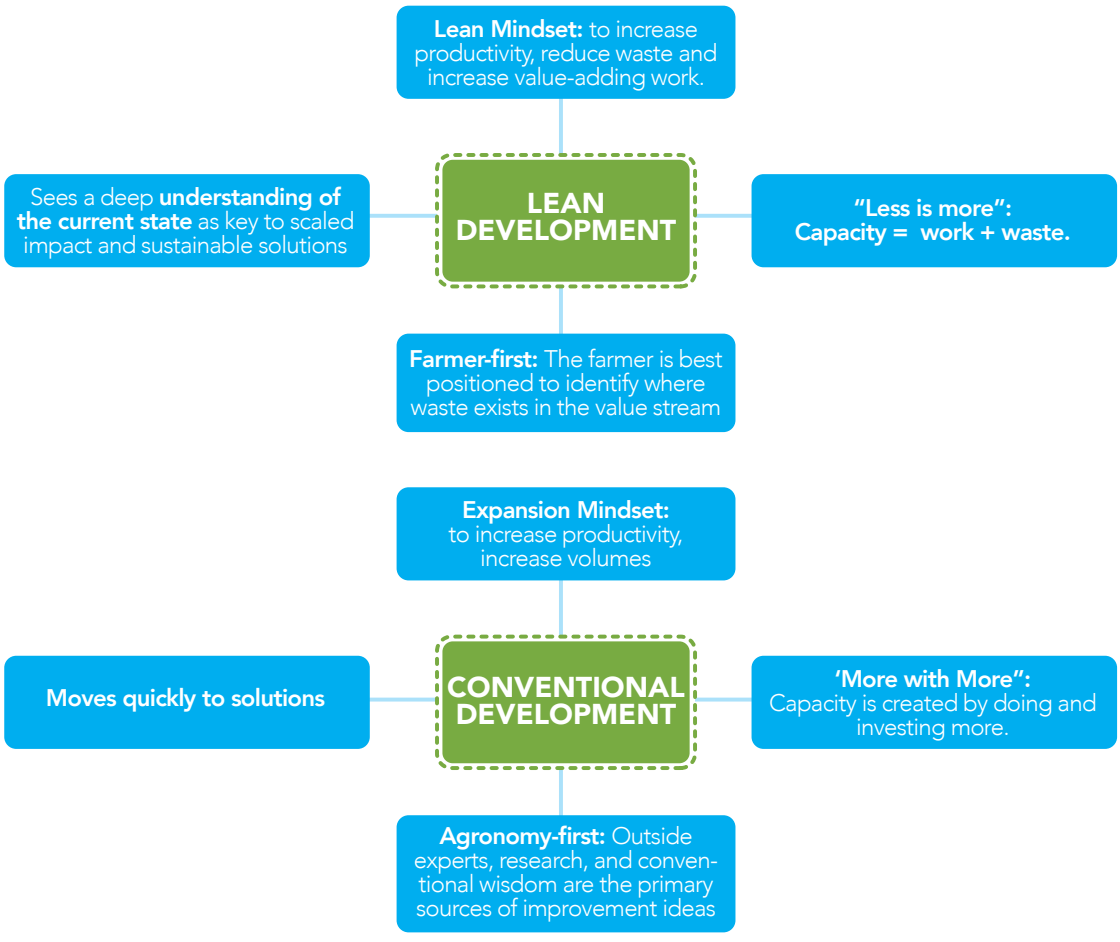
3 The project's Monitoring, Evaluation, and Learning activities may have direct farmer interactions in confirming partner activities, program impact, and capturing learnings.

TABLE 1: DIRECT INTERVENTION VERSUS MARKET SYSTEMS DEVELOPMENT APPROACHES

Direct Intervention Approach	Market Systems Development Approach
Seeks to actively intervene in markets by inserting new (at times nonprofit or public sector) actors into a market system.	**Seeks to stimulate or nudge existing market actors** (introducing ideas, brokering relationships, etc.) **while still remaining outside the market.**
Adoption through direct training: farmers will adopt through direct observation or experience.	**Access and adoption through market actors:** Who has an economically aligned interest in seeing farmers use a new process or technology? These should be the **primary influencers.**
Partners are often non-profit or public sector actors (demonstration farm owners, training institution representatives, etc.).	**Partners are market actors** with aligned economic interests in adoption (e.g. retail marketers, traders, tool/equipment suppliers, seed/fertilizer dealers, etc.).
Project staff and consultants are pulled from **the nonprofit, development, or public sector.**	**Project staff and consultants** are pulled from **private sector** as well as nonprofit/public sector. Private sector expertise is essential to successful solutions for development and implementation.
Budget allocations are fixed.	**Funds are dynamically managed** in response to constantly changing market conditions.

DISCUSSION QUESTION: Can you provide an example of a situation where a project used a facilitated approach to influence market system actors? Did it work?

TWO TYPES OF DEVELOPMENT



LEAN AND THE MARKET SYSTEM

KEY CONCEPTS

- Lean is a tool for evaluating and prioritizing project interventions under a market systems development approach.

Now that we've considered the differences between traditional and market systems approaches, how does lean fit in? Whereas a facilitative market systems approach provides an implementation structure for systemic impact and sustainability, lean offers a framework through which to identify and understand opportunities for program prioritization and intervention. In other words, **lean is a lens through which to focus a market systems development approach.** Under lean, the core principles of facilitative, market systems development still apply, but lean can help us thoughtfully and intentionally prioritize specific interventions within the broader system.

Donors across the globe are increasingly seeking theories of change that embrace 'sustainable systemic change for scaled impact'. The market systems development approach applies a systemic framework to market development, which translates into more sustainable (long-term) and transformative development outcomes for donors and their implementing partners. This includes more inclusive development outcomes, such as those empowering women and children through market development strategies that increase agency and opportunity for typically marginalized members of developing economies.[4]

This toolkit builds on the market systems approach by layering lean principles and tools for market development and growth through efficiency and value, which will result in increased competitiveness and profits. **Traditional** business and market growth theories, and development approaches, are based on a 'More is More' focus on increasing investment and capital into the system to achieve increased output, productivity, and incomes. **Lean** is a process-driven approach to growth through a 'More with Less' focus which maximizes value and profits for market actors and function.

4 The United States Agency for International Development (USAID) has published many resources related to "inclusive market systems development", which represents the continued evolution of USAID's thinking around private sector development. It builds on the Making Markets Work for the Poor (M4P) approach implemented by the United Kingdom's Department for International Development (DfID) and Australia's Department of Foreign Affairs & Trade (DFAT), among others, on the delivery of goods and services through market actors; and on the subsequent value chain approach developed by USAID and its implementing partners.

TABLE 1: CONVENTIONAL VERSUS LEAN APPROACHES

Conventional Development Approach	Lean Approach to Development
Expansion mindset: To increase productivity, increase volumes.	**Lean mindset:** To increase productivity, reduce waste and increase value-adding work.
Capacity is created by doing and investing more:'More is More'	**Capacity = work + waste.** The way to increase capacity is to reduce the waste: 'Less is More'
Agronomy-first: Outside experts, research, and conventional wisdom are the primary sources of improvement ideas.	**Farmer-first:** The farmer is best positioned to identify pain points for improvement ideas. The farmer knows where waste enters the value stream.
Moves quickly to **solutions**.	Sees a deep understanding of the **'current state'** as key to identifying waste-reducing interventions.
Relies on input from **multiple actors** (seed companies, tool suppliers, extension agents, etc.) to **define product value**.	**Precisely specifies value from the viewpoint of one actor: the customer**—the person writing the check to the farmer: 'Start with the customer and work backwards from there.'
Output focused: Sees increasing output (yields) and production as metrics of success.	**Process-focused:** Sees better process (reducing waste and increasing value-adding activity) as the key to increasing incomes, competitiveness, and value.
Depends upon farmers' **fidelity** to a **complete and complex package** of technologies and practices.	Encourages flexible adoption of technologies and practices depending on the specific conditions of individual farms. Farmer choice and agency are key.

LEAN AND SCALED SOLUTIONS

KEY CONCEPTS

- The aim of a project is not to achieve targets. The aim of the project should be to achieve sustained, scalable impact, with targets as a measurement to evaluate the level of project success over time.
- Market systems development establishes a framework for accruing continued benefits, including after the project ends.
- Lean can be built into this framework to maximize gains and contribute to sustainability.

Lean principles and tools can be powerfully applied to achieve scaled impact. USAID and the development community have increasingly recognized that a market systems approach is critical to achieving impact at scale,[5] with scale defined as sustainable impact at a population level across a target geography.

In a traditional, incremental beneficiary project approach, a limited number of beneficiaries, within the manageable interest of the project's resources, are identified for the project to reach directly. Beneficiary reach is achieved by the project graduating those beneficiaries from the direct program activities and moving on to work with the next incremental group of beneficiaries, often anticipated to occur in a subsequent phase of the program. In this incremental approach, near-term wins might focus on including early adopters in that initial group of beneficiaries, which may or may not represent the middle of the pack or average producer. The result is that broader adoption of promoted technologies or models through alternative and systemic scaling, such as secondary adoption or spontaneous diffusion, may not occur beyond the early adopters.

Indicator targets for projects are useful for gauging progress toward pre-identified (and often very specific) objectives, but meeting or exceeding such targets are not the end objective. Rather, successful achievement of scaled impact, defined as impacts that continue to accrue beyond the project's duration, is the ultimate goal. In other words, targets can be considered as milestones that tell us whether we are heading in the right direction.

So what might 'scaled impact' look like? In a project focused on scaled impact, all activities consider *relevance and replicability* for the average producer (or target population). In other words, for the 65-70 percent of producers that are neither the best resourced, nor the least resourced, of the producing households. To measure scaled impact, we need first to quantify what population level impact means; that is, how many people (households) should positively benefit from the systemic change we are working to achieve. One caveat: It simply isn't possible to obtain 100 percent reach or impact, though we can use a bell-curve (see figure below) across any population to attempt to quantify and characterize the population to which we are targeting our facilitative interventions. The methodology for characterizing 'population level' targets can also be applied to partner selection and building business models for scaled adoption.

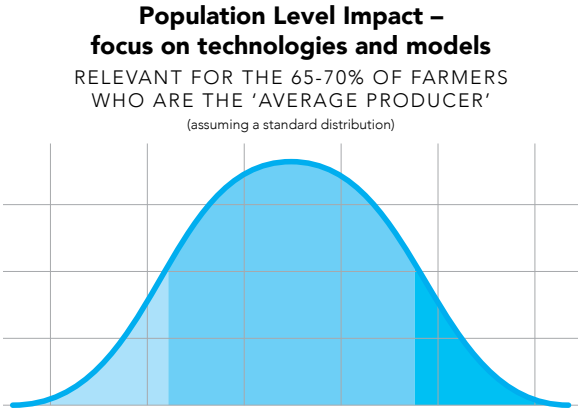
Quantifying and characterizing target populations can provide a critical lens for identifying both:

Where to apply lean tools to identify and understand opportunities and systemic points for program prioritization and intervention; and

How and with whom to partner during implementation for systemic impact and sustainability.

This toolkit layers scale-centered considerations within the sections that follow.

FIGURE 1. EXAMPLE OF IDENTIFYING AGRICULTURAL BENEFICIARIES ASSUMING A STANDARD DISTRIBUTION TO A POPULATION TO IDENTIFY THE 'AVERAGE'



5 A Framework for Inclusive Market System Development. LEO Brief. Leveraging Economic Opportunities. July 2014. https://www.marketlinks.org/library/framework-inclusive-market-system-development

LEAN AND GENDER AND SOCIAL INCLUSION

KEY CONCEPTS

- Rather than excluding women, youth, and other marginalized groups, lean provides insight into how to ensure they benefit from project interventions.
- The lean approach to GESI is based on engaging women and youth where they're already working, not forcing them into project interventions.

With a lean approach to development, gender equity and social inclusion (GESI) is not an afterthought. It is integral for a very pragmatic reason. According to lean, the gemba—those on the shop floor performing the value-adding work—are the closest to and likely most knowledgeable about the waste in a production system. Therefore, they are in the best position to offer solutions for rooting it out.

In global agriculture, women, young people, and others often underrepresented in agronomy and agribusiness leadership circles can be found in fields, preparing plots, hoeing soybeans, or winnowing rice, for example. With a lean approach to development, those voices are centered because their placement in the value stream—on the "shop floor," so to speak—gives them unique access to process knowledge that outside experts don't have. Therefore, finding program solutions to improve efficiency and reduce waste require their active inclusion, and ongoing input. They are, of course, integral to the process.

We need to consider who the producers are and with whom we will engage. Agricultural production systems may vary amongst smallholder producers with female farmers experience different pain points or waste than their male counterparts. We need to consider the diversity of producer profiles and production systems, including how female producers may differ in their experiences and prioritization of accessing labor-saving technologies, reduced time drudgery, and improved agricultural inputs. When considering how lean principles can assist women, youth, or traditionally marginalized populations, consider asking the following questions:

What are the roles of female farmers in the region the project is working? Do they tend to be concentrated in specific commodities?

Are there households headed by women who are not married, divorced or widowed who have distinct production system variations from other producers targetted? Is it possible that different prioritizations would emerge from applying the lean assessment tools separately with these households?

What about female farmers whose spouses are away from home because of men who have left rural areas to seek jobs elsewhere or other family disruptions?

Are there barriers to entry for youth that exclude them from participating in the production or market systems? How could the lean tools be used within the production system to identify these barriers to entry and potential solutions?

Are there other historically marginalized groups who experience exclusion from technology, inputs, or training that could impact?

Understanding the unique needs of these different groups could be a game-changer in terms of increasing value and impact.

HOW TO APPLY LEAN: VALUE STREAM MAPPING

The following set of tools are designed to support project teams and staff in planning and strategy, specifically to identify and understand opportunities and systemic points for program prioritization and intervention using a value stream mapping methodology. These are adapted from mainstream lean tools, with a specific focus for agricultural programs, to identify wastes and solutions for market development and growth through efficiency and value, which will result in increased competitiveness and profits.

The lean approach as adapted in this Toolkit is structured around four integrated steps. These steps are intended to be used together and in the order presented. This section thus provides a step-by-step guide to conducting lean analysis. By completing these steps, your project will be able to identify and design interventions that eliminate waste while creating the most value at the least cost.

The steps are:

- Identify the customer.
- Precisely specify what customers value.
- Deeply understand the value stream in three steps:
  1. Chart the flow of value;
  2. Name the wastes; and
  3. Brainstorm continuous improvement ideas (kaizen).
- Identify actions, priorities, and points of intervention.

PRODUCT:

List of customers in the Main Market Channel

Who are farmers and buyers in the Main Market Channel (the market segment moving the largest volume of product for the largest number of producers)?
Goal= Scaled Impact

IDENTIFY THE CUSTOMER

PRODUCTS:

1. Market Map (includes Main Market Channel) that details upstream and downstream supporting functions

2. List of Program Actions

3. Scaling strategies document (the roadmap for implementation)

What intervention will remove the most waste while adding the most value at a low cost to producers?

IDENTIFY ACTION

PRECISELY IDENTIFY VALUE

What do customers what, when do they want it, how much?

PRODUCT:

Value Sheet based on customer interviews

MAP THE CREATION OF VALUE

How is value being created by the average farmer in the main market channel?

PRODUCT:

Value Stream Map that details value-adding steps and wastes, based on farmer interviews.
Goal = elevate and center the farmer perspective on value creation

LEAN STEP 1: IDENTIFY THE CUSTOMER

KEY CONCEPTS

- A precise understanding of customer value is central to applying lean principles.
- The first step in identifying the right customer for your program's context is to understand the producer or beneficiary where impact is anticipated.
- For scaled impact, identify the main market channel (market opportunity) for moving the largest volume of product for the largest number of producers.

Lean is a demand driven, or market driven, process approach that begins with a precise understanding of customer or market value. Identifying the specific customer or customer segment is a critical and foundational step in this process. In lean, the customer is the individual who is paying for the product. The customer could be an individual or the specific role within an organization responsible for making the buy/no buy decision from the producer. The *customer segment* is the group of similar buyers or actors who are specifically making buy/no buy decisions within that market channel. The *market channel* consists of the people, organizations, and activities necessary to transfer the ownership of goods from the point of production to the point of consumption. For most products (commodities), multiple market channels exist.

In applying the subsequent analytical tools, it is useful to consider who the project intends to benefit, and then use this information to identify the specific customers or target customer segment of relevance. While market systems projects typically work beyond the smallholder producer level, the impact is intended to benefit a specific group of the population. These could include:

- Smallholder producers of a certain commodity or within a particular geography;
- SMEs within a specific value chain or market system; and/or
- Specific vulnerable populations, such as women or youth, within a value chain or geography.

Note: In the following steps, the terms 'producers' and 'farmers' are used interchangeably, but both refer to these potential beneficiary populations.

BOX 1: PROVIDES EXAMPLES OF DIFFERENT POPULATIONS OF BENEFICIARIES FROM ACTUAL PROJECTS.

What percentage is your beneficiary target (expressed as a total of households) within your geographic area of intervention or zone of influence (ZOI)?

OR

If you have specific commodities of focus, what percentage does your beneficiary target represent of the total number of households producing your target commodities within your geographic area of intervention or ZOI?

Scaled project impact within a specific commodity and/or geographic area of intervention:

The Feed the Future Nigeria Agricultural Extension Activity has a reach target of 2 million life-of-project individuals within a geographic area, with 4.4 million households producing the target crops. In this circumstance, priorities and interventions emerging from the application of the following tools must be applicable to as many individuals and households within the target crops as possible. Thus the existing/main market channel becomes the focus of the project.

Identified market niche the project believes offers an opportunity for the project beneficiaries:

The U.S. Department of Agriculture Laos Creating Linkages for Expanded Agricultural Networks project supports government initiatives to distinguish Laos horticulture products amongst larger competitors. Rather than compete with Thailand, which can produce cabbage cheaper and more efficiently, the project is supporting growth of GAP-certified cabbage, which represents a small portion of overall cabbage consumption. Thus, the target market channel for the project is organic markets and buyers, a relative niche market.

WORKSHEET

ESTABLISH YOUR CONTEXT:

CRITICAL QUESTIONS:

Who is your project trying to positively impact? What is their profile, geographic location (density can be a useful consideration), and principal crop (or crop production system)?[6]

Does your project have any specific niche markets pre-identified that are new markets for the target beneficiaries? For example, export vegetables or specialty coffee? If yes, what profile of producer beneficiary is most likely to be able to achieve competitiveness, quality, or productivity within the life of the project? Who are the main customers making buy/no-buy decisions in these new markets?

Is your target beneficiary representative of the majority population of the area or value chain?

IF YES – it may be that scaled impact is possible and desirable. The tool for identifying the main market channel for scaled impact immediately follows.

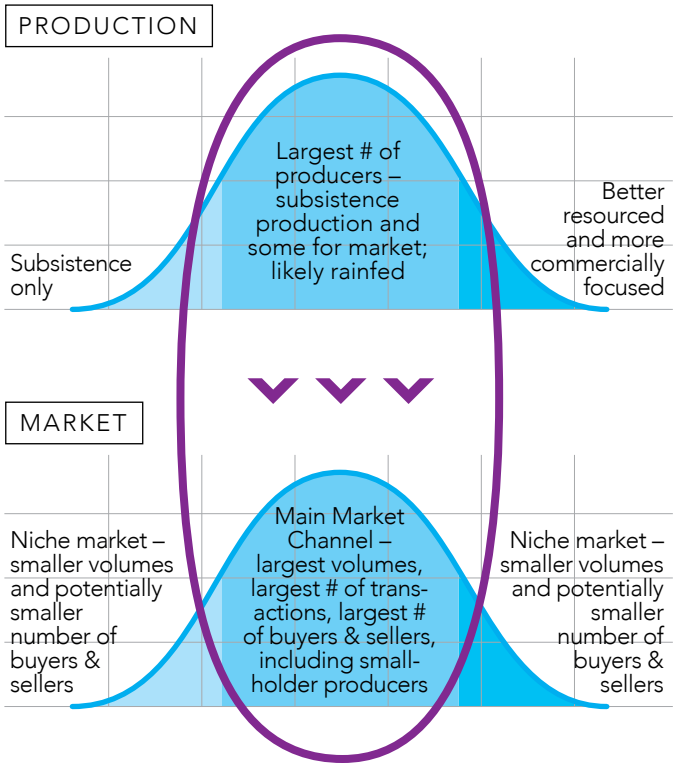
IF NO – (for instance, if the target beneficiary is just a segment of the majority population, such as women, youth, or other vulnerable populations) – identify both the main market channel using the following tool and, through direct consultation with these target beneficiaries, identify what market channel the target beneficiaries are selling through at present. Discuss which market channel (main market channel or present market channel) offers the better (profit, volumes, access, social inclusion, terms, etc.) opportunity for the target beneficiaries to select which customer segment to drive the subsequent lean steps.

IDENTIFY THE MAIN MARKET CHANNEL:

For scaled impact, the following lean steps must be applied to the most significant set of actors or most significant (biggest) market channel for scale to be possible. This can be called the *main market channel*, or *the market opportunity moving the largest volume of product for the largest number of producers*. Focusing the subsequent analysis on this market channel (both producers and associated market actors) ensures relevance and potential replication of smallholder-focused business models and solutions.

As an example, consider the bell curve distribution of agricultural beneficiaries.

Targeting to achieve impact at scale



6 For example the principal crop might be rice, but it can be useful to specify rainfed lowland or irrigated as the production system, as the supporting systems, and perhaps even the resulting crop itself, can be unique. Another example might be maize, where 80 percent of maize is rainfed white maize, so it can be useful to specify white versus yellow, etc.

Three pieces of information or types of information are needed to be able to identify that main market channel.

First: Identify the market channels: These are a smaller, more defined categorization of customers and actors who share similar characteristics, such as a shared business model, end-consumer market, and/or supply needs. The market channel may include aggregators, wholesale buyers, local or weekly markets, etc. Often, different kinds of market channels exist for different consumer segments, so *it makes sense to start from the consumer and work one's way back.* For example potential market channels in rice might be a channel for parboiled rice milled in large-scale industrial mills, a channel for parboiled rice milled by SME artisanal mills, and non-parboiled rice. Catfish may have two market channels – fresh fish and smoked fish, and so on.

Second: Quantify each market channel. Each market channel should be quantified by breaking down volume moved, the number of transactions completed, the number of farmers selling into each segment, and the number of other actors involved in the channel.

Third: Generalize trade flows and patterns. Assess, discuss and map generalized trade flows and patterns in order to better understand smallholder participation and to ensure that various steps along the channel are identified and understood.

After working your way through the three steps, identifying the main market channel is a matter of taking a step back in order to 'see' the big picture. That includes identifying:

- **Where is the middle of the curve currently located?**
- **Where is the current scale?**
- **Where is the most product from the most farmers currently moving?**

For scaled project impact, it is this main market channel (both farmers and customers), who will be the focus for the subsequent lean stages. See the Annex for a visual example of charts used to identify Main Market Segments.

List Main Market Segments				
Relative significance of each segment: Total volume of production moved into this market segment (% of total this segment represents), # of transactions, number of farmers (or target beneficiaries) active in the market segment				
Characterization of segment within value chain: number, size, and general location of other key market actors (specifically customers and intermediaries)				
Trade flows, patterns, and other considerations: are there known technical or geographic considerations restricting entry or exit into the market, average size of transactions, other donor or public sector activity				

LEAN STEP 2: PRECISELY SPECIFY WHAT CUSTOMERS VALUE

Note: Once Step 1 has been completed (identification of the relevant market for a product), Step 2 entails talking to those customers to determine and understand what they value.

KEY CONCEPT

- A precise understanding of customer value is central to a lean analysis.
- A poor understanding of value leads to waste, where the wrong products are produced for the wrong markets and delivered at the wrong times.
- A goal of lean production is to bring production in line with what customers are willing to pay for.
- Interviews with buyers and observations of transactions in the identified customer segment (see above) develop a clear understanding of what buyers value from farmers.

Why is it important to understand value?
A precise understanding of value is critical because if producers do not know with certainty and precision what their customers want, their production is less likely to be rewarded by the marketplace. According to lean thinking, a producer should aim for tight alignment between production and demand. There is no greater form of waste than investing time and money into products that have no value in the marketplace.

Likewise, a lean development project prioritizes knowledge of the 'current state' as the starting point for identifying potential change for impact. In lean, value and waste are two sides of a coin. To understand waste—and to identify and understand opportunities and systemic points for project prioritization and interventions that reduce waste and increase efficiency—planning must first understand which actions on farms and/or in an agricultural system contribute to waste and which actions contribute value.

What is value as it relates to lean?
To start with, focus on identified customers (Lean Step 1) to assess as precisely as possible what those customers want from farmers. How dry do they prefer their maize? What is an ideal weight for fresh market catfish? In what kind of package and in what specific conditions should cowpeas be stored? Precise answers to these types of questions define *value* and provide a 'north star', or guide, that enables farmers to steer their production towards value.

For example: Think about yourself as a consumer. When you buy bananas, what do you look for? What color is ideal for you? What size do you prefer? What taste do you prefer? When do you like to shop for bananas? How many pounds do you purchase with each trip to the store? Answers to these questions define value for you, the customer, as you shop for bananas. This type of analysis can be used to understand the value for any consumer and product.

Who is best positioned to define value?
According to lean thinking, *the customer is the only one suited to define value.* The customer is paying for the product, and so the customer is in the best position to say which product attributes add value to agricultural goods. Farm service providers, seed and fertilizer dealers, equipment sellers, and others might play crucial rolls in creating value, but only the paying customer can define it.

TO IDENTIFY VALUE...

THE CUSTOMER (THE PERSON PAYING THE FARMER) IS THE ONLY ONE ALLOWED TO DEFINE VALUE.

Customer value is assessed through a consultative and observational process that characterizes the identified customer. The product to be created is a *customer value sheet*. See worksheet below. Examples to be found in the Annex.

These sheets precisely identify three **value attributes**:

1. **What do customers want?**
2. **When do they want it?**
3. **How much do they want?**

To create a customer value sheet, first identify who is the **paying customer within the customer segment identified in the previous step**. Remember, this will include multiple customers for a commodity, such as aggregators and the wholesale market; it is unlikely to be the end-consumer. They will have the best insight into the three questions above. *Who is making the buy/no buy decision and purchasing from the 'middle of the bell curve' smallholder farmer?* A representative sample of buyers from this main market channel should be identified and consulted.

Identifying a representative sample, by the way, will require multiple conversations within a specific market. Once the consultations consistently return similar responses, (between 12-20 customer consultations in most cases,) the client value sheets may be considered complete. Outlier responses may be discarded as not representative of the customer segment.

Important: Make sure those you consult are really representative of the main market channel and not just people you know or customers who live or work close by. For example, if you determine that fresh market catfish (instead of dried, smoked, or otherwise processed catfish) is the main market segment, then interview only buyers of catfish destined for the fresh market end consumers. Who is paying the 'middle of the bell curve' smallholder fresh catfish producer? Other catfish buyers, such as those for the smoked market, will not give you accurate information about value attributes for the fresh catfish market.

To find answers to the three questions above, the interviewers will want to ask *leading questions* to guide the conversation. Going into an interview, hypothesize what attributes customers might want in their products. Does size matter? Weight? Smell? Taste? When do customers want their product delivered? In what kind of package? Then write out leading questions to steer the interview.

HERE ARE EXAMPLES OF LEADING QUESTIONS:

1. **What do customers want? (The characteristics preferred in the product.)**

   What size of commodity do you prefer? Do you have a preferred weight or length?

   Do you have a preference in terms of color or other relevant attributes?

   Does taste matter? What should it taste like?

   What kind of package or container do you prefer the commodity be delivered in?

   What other attribute are you willing to pay more for? What premiums or discounts do you pay for these attributes?

2. **When do they want it? (Time, duration, season.)**

   When do you prefer to purchase the commodity? Is there a season, a month, or even a day of the week?

   How many times do you purchase?

   What times of year is there less supply (and thus the fish might be worth more to you?)

3. **How much do they want? (Unit/price, volume in order, total demand/time.)**

   When you purchase the commodity, how many kilograms/tons do you purchase each time?

   Do you purchase more at certain times of the year, such as festivals or holidays, and less in others?

In addition to these interviews, it is also very important to directly observe market behavior. You can do this by:

- Going to a market where the crop or commodity under review is sold. Remember to observe markets only in the main market segment.

- Observing buyer behavior and actual commercial transactions. Do customer patterns and transactions match what you heard in the interviews?

According to lean, if a customer truly values an attribute of a product, he or she *will be willing to pay more for the product if it includes that attribute.* Observe and record the attributes that cause value to change. For example, if retail catfish sales peak over the weekend, then wholesale buyers will likely be willing to pay more for catfish delivered to them on Fridays than on Mondays. The Friday delivery is an attribute that increases value. On the other hand, most grain customers will say they value clean grain, but in actual practice most do not pay a premium for grain cleaned beyond a certain minimal grade. Observation of market practice will allow you to understand actual market behavior beyond the first stated 'wish list' of values mentioned by a customer.

Reminder: Remember to focus on the customers *in the main market channel*. The 'customer' as defined by lean is the individual paying cash to the farmer, making the 'buy/no-buy' decision.' It is quite possible that buyers outside of this narrowly-defined group (who are not representative of the main market channel) might be willing to pay more or less for the same product.

CUSTOMER VALUE WORKSHEET

TIPS FOR CUSTOMER VALUE SHEETS:

- **Try to get precise answers**. If a customer says they prefer large fruit or vegetable, follow up by asking, how many grams?
- **There is a difference between value and preference**. If customers truly value an attribute of a product, they will be willing to pay more for the product. For example, a customer might say they want a specific type of packaging. But it is important to follow up and ask, *are you willing to pay more* if that product arrives in such packaging? If so, the type of packaging is truly a value attribute.
- **Keep track of gender as you interview customers**. Gender data will aid in the 'Identify Actions' stage (see below). A goal in creating customer value sheets is to deeply understand the current state of production—including who makes the 'buy/no-buy' decisions – so that solutions can be tailored to the reality on the ground. Example: If women typically purchase smallholder-produced goods from the fresh market, they might communicate with customers through different avenues and in a different way than a male buyer might. A successful waste-reducing intervention that involves streamlining customer-buyer communications should account for this.

Here is a template for a customer value sheet that can be used by field staff to conduct interviews with customers in the main market channel:

CUSTOMER VALUE SHEET

CUSTOMER NAME: (who pays) _____

CONTACT INFO: _____

Note: Each value attriute must cause the sales value to increase (i.e., the customer is willing to pay more). Gather specific answers.

ITEM	WHAT DO YOU WANT?	WHEN DO YOU WANT IT?	HOW MUCH DO YOU WANT?
Value attributes			

Once several sheets are collected, synthesize the data into a single list of what most customers said they wanted, along with prices. Compare with your observations of market behavior. This synthesized customer value attribute sheet will be central to the next step, mapping the creation of value.

LEAN STEP 3: VALUE STREAM MAPPING (VSM)

The next step of a lean analysis is to visualize, or map, the existing production system to identify waste and inefficiency.

KEY CONCEPT

- VSM is a visual representation of the current state of production.
- VSMs offer an alternative lens for identification and analysis of production 'pain points.'
- The value stream includes all the activities, materials, people, and information that must flow and come together to provide your customers the value they want, when they want it, and how they want it.
- Lean VSMs are typically visual and colorful. Consider using sticky notes that cover a wall.

What is VSM?
When value creation is systematically documented, the process is called VSM. Production systems in an agricultural value chain contain many steps. VSMs simply chart those steps.

The idea behind the VSMs is to distinguish value creation from waste in order to develop a deep understanding of the current state of production. Oftentimes the '*gemba*'—or the people doing the work—have the best ideas for improvement, and they will offer nuanced insights into the time, costs, or labor involved in each step. The maps illuminate 'pain points' where wastes, like unnecessary movement, defects or overburdening, commonly creep in. It is crucial, therefore, to hear directly from producers about where they perceive and/or identify waste present in their production systems.

What do VSMs achieve in the lean context?
In previous steps, this Toolkit showed how to identify main market channels for scaled impact and how to interview customers within those channels to gain a deep understanding of value. The purpose of a VSM in the context of this Toolkit is *to give project staff and leadership accurate information to inform decisions about where to place resources*. Specifically, VSMs (at least, those that are done well!) will show where waste most often enters into agriculture production systems, thus *suggesting where solutions might exist to root out waste and increase productivity and wages*. Analyzing VSMs is like taking a 'bird's eye view' of a production system, enabling staff within projects to see the entire system at once. These maps allow a kind of analysis that is not possible on the ground, where only one or two parts of a system may be viewed at a time. The maps, in fact, will allow us to move from simply identifying and cataloguing value and waste, to actually designing project interventions that reduce or eliminate waste and enhance value.

Who should be interviewed for VSM?
Since the *gemba* – those performing the actual work – will typically have the most nuanced insights into the steps of production, *it is important to choose experienced producers from within the customer segment and market channel identified above,* for mapping interviews. For example, if fresh catfish is the main market channel, then it will be important to consult catfish farmers who sell the majority of their production into the fresh catfish market. If the vast majority of the rice produced and sold into the milled parboiled rice market is from rainfed, lowland rice producers with an average 1 hectare plot size in rice, then those are the producers (most representative of the production system) who should be interviewed.

Because VSM is an interactive, consultative process resulting in a visual output, ideally, you should conduct mapping exercises in person, using small focus groups, but taking care to include at least three individuals and no more than six. For these exercises, ask producers themselves to chart what actually happens on their farms to create value for the customer. This directly documents the experience of the producer.

Consulting experts while doing a VSM
While farmers should provide most of the VSM data, it may also be useful to interview a group of experts to gain additional insight. Experts could be interviewed before conducting field interviews with producers, in order to create a 'hypothetical' VSM; that is, a map that projects what experts suspect happens in the field and where they think those 'pain points' most likely exist. This hypothetical map can help inform and structure interviews with farmers, which will generate evidence and add texture, detail, and information to help inform prioritization of facilitative activities that strengthen the targeted market system(s).

Consider organizing experts into focus groups that include key influencers in the specific smallholder production system being assessed—in other words, the production system that is representative of those selling into the identified market and customer channel. These may include specialists from the Ministry of Agriculture or state extension offices, researchers from relevant academic or agriculture research institutes, technical leads from other development organizations, and the private sector. Experts external to the project may be useful as consultants both to provide input and ideas, and to introduce the lean approach while building buy-in for outcomes.

THERE ARE THREE PARTS TO A VSM:

1. CURRENT STATE MAP

Create a 'current state' map that records how a crop is currently being produced by the average farmer selling into the main market channel. To collect data, interview farmers or experts and record their answers on sticky notes posted on a wall.

2. FUTURE STATE MAP (ADDING IMPROVEMENT IDEAS)

Create a 'future state' map. Take your current state map and add ideas for improvement. Start by reviewing your current state map with interview participants, asking them, '*Where does the most waste exist, currently? What goes wrong and where? What could be improved?*' As you do this, coach participants on the concept of the 10 different types of waste, explaining that we want to identify where waste is most present (or most likely to occur/recur) in the current workflow. The ideas collected here are called '*kaizen bursts,*' or continuous improvement ideas, and should be recorded on your map in a visually noticeable way, such as by using colorful stars. When the stars are added, the map transforms into a future state map because it offers a glimpse of a leaner (future) production process.

3. CONSOLIDATED VSM

Combine your future state maps from various farmer and expert interviews together into one 'consolidated VSM.' For example, if your team chose to conduct four farmer interviews and one expert interview, then pull data from those five into one single map. The goal is to show in one map how an average smallholder farmer selling into the main market channel produces his or her crop, and where waste is most present.[7] This consolidated VSM will contain powerful data to guide decision-making in Step 4 ('Identify Actions'), as described below.

The VSM is NOT an interview methodology with a questionnaire. Instead, it is intended to be an interactive discussion. To ensure engagement and two-way dialogue, it is critical to pose 'open ended' and process-related questions, in order to document and to develop a detailed understanding of the key activities within the production system. As interviewers, your task is to be an objective reporter, much like a journalist recording observations of an event. Instead of filing a report, however, your deliverable will be a visual map, with color, shapes, and arrows that show the flow of value from the very beginning of production (i.e., from the 'concept' stages of planning and research) to the very end (the point of sale). These interviews will typically take two-to-three hours to complete.

7 Priority within the consolidated value stream map should be given to points of waste and improvement ideas that were mentioned in multiple maps and to producer-generated inputs over any expert-oriented maps. The differences between producer-focused maps and any expert-focused maps can provide the project with insights into stakeholder perceptions of the 'current state' that may need to be overcome in order to bridge gaps in understanding between experts, other key stakeholders, and producers.

HOW TO CONSTRUCT A VSM

1. CURRENT STATE MAP

To make current state maps, first collect several dozen sticky notes. On each sticky note, record a value-adding step in the production of the crop or food item.

What activities are required to bring a crop or product to market? How do farmers add value for their customers? You will need to ask your interview participants (experts or farmers) to provide details for the sticky notes.

Sticky notes are recommended because they can help you to build a simple, easy-to-arrange and rearrange visual map; you can also stick them on almost any wall, tabletop or even the floor! However, if sticky notes are unavailable in the market, you may also opt to use pieces of paper taped to a wall, or virtual bulletin boards like Miro.

FILL OUT YOUR STICKY NOTES IN THE FOLLOWING MANNER:

Activity: This refers to the action taken by a farmer along the production line. Examples might include 'feed fish,' 'prepare field for planting,' or 'harvest cowpeas.' When several activities are lined up together in chronological order of execution, this is called the value stream map.

EXAMPLES OF OPEN-ENDED OR LEADING QUESTIONS TO LEAD THE CONVERSATION:

- *What critical actions are required for this step?*
- *Where does this work take place?*

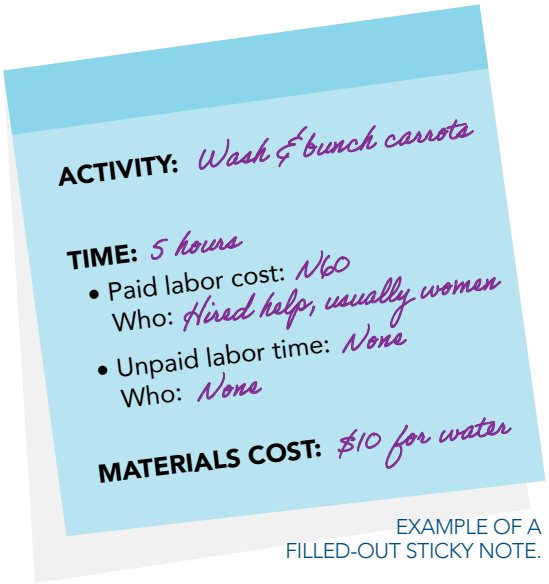
Time: This refers to who is performing the work, how long it takes, and, in the case of paid labor, the cost of the work. Please note and record whether men or women typically perform the task.

- *Is the person performing the task a farmer, a hired professional, or unpaid labor (such as a family member)?*
- *How much time is required to perform the task?*
- *Is this task performed just once, or is done weekly, monthly?*
- *What is the role of women in this task?*
- *In the case of paid labor, what is the typical cost for the service?*

Materials cost: Include a list of materials required for the project, and the cost of those materials. It is not necessary to record the value of incidental materials, such as pens and paper.

- *What is the cost to the farmer to perform this task?*
- *What is the cost of seeds/feed/fertilizer, etc.?*
- *Are major pieces of equipment required for the task? How much do they cost?*
- *Financing: What are the terms of the transaction? Do farmers pay cash at the point of purchase? Is it financed? If so, by whom?*

Additional notes that explain a process can be added at the bottom of the main map of sticky notes; you can also use additional sticky notes around the periphery to capture important background information.



EXAMPLE OF A FILLED-OUT STICKY NOTE.

TIPS FOR CREATING VALUE STREAM MAPS

- **Start at the very beginning and finish at the very end of production.** For example, start with "concept" stages, such as planning, market research, land acquisition, etc. End with cash—the steps that are involved all the way up to the point of money transfer or exchange for products.
- **Use the same titles on the sticky notes, for example** "Feed Fish" or "Clear Land and Bush"—across multiple interviews because later you will synthesize the VSMs into one composite map.
- **Choose a standard unit of measurement, for example 1,000 fish, 1,000 lbs. of cowpeas, or 1 hectare of cowpea production.** This way, you can compare answers from different value stream maps.
- **Revisit the previous Lean step – Precisely define customer value.** Continually remind the group of the customer value attributes from the previous step. It is important to understand which aspects of production directly contribute to those value specifications.
- **Keep the conversation moving along as appropriate.** It can be easy to go into too much detail about any one step. Remember, you are trying to create a complete map of the entire process. Keep the big picture in mind.
- **Solicit ideas from everyone in the room.** It can sometimes be the case that one or two farmers speak more frequently, but for this exercise it is important to collect the wisdom of everyone present.
- **Work in two steps.** First, outline the current state (also called a current state map). Then add the stars, or improvement ideas (future state map). This helps keep the conversation focused. Working in two steps is usually better than trying to brainstorm improvement ideas as you go along.
- **It can be helpful to break the map up into stages or headings.** For example, with catfish, the work was divided as follows:
    - Planning and site acquisition
    - Pond construction
    - Fish stocking and management
    - Harvesting and sale

Under each of these stage headings, sticky notes detailed the work, or action steps, required. For example, under *Fish stocking and management*, sticky notes were created for the following actions: Stock Fish, Install Fence Protection, Feed Fish, Sort Fish, Check and Change Water. See 'Nigerian Catfish Production: Current State Map' below for a visual example.

In cases where in-person interviews are not possible or practical, one solution is to create virtual VSMs using digital applications such as Miro, a virtual whiteboard project. Miro allows subjects to be interviewed remotely while their answers are charted on cards placed on a virtual white board. Miro also allows for virtual team collaboration by enabling multiple team members to add cards and allowing experts from around the world to view a production system and provide analysis, if needed.

2. FUTURE STATE MAP (ADDING IMPROVEMENT IDEAS)

After you have finished outlining the production steps on sticky notes, next, you can introduce (to interviewees) the concept of the 10 wastes. Note: It's a good idea to share this list as part of the interviews.

Explain that in lean production, the goal is to identify wastes and root them out to increase productivity. Ask them questions such as:

- *Where do you see wastes?*
- *What goes wrong on these farms?*
- *Where could something be improved?*
- *If you were a farmer looking to increase productivity by five percent next season, what would you do differently?*

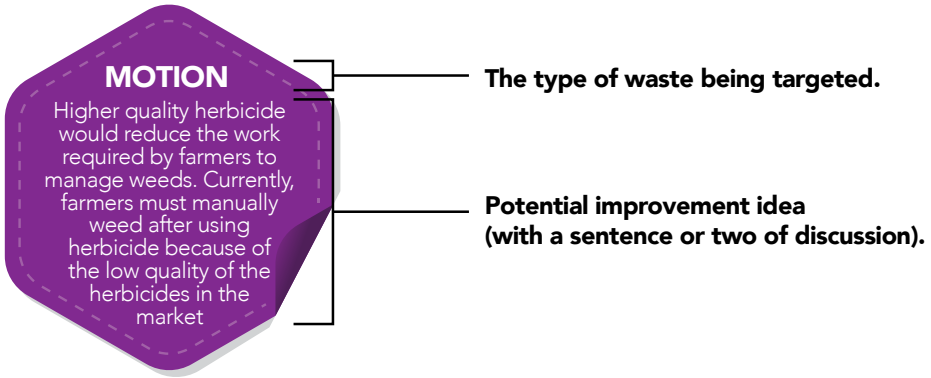
10 TYPES OF WASTE

1. **Overproduction**: crops that went unsold
2. **Waiting**: crops picked but sitting around
3. **Transportation**: too much driving
4. **Overprocessing**: packaging more than needed
5. **Inventory**: too many supplies, tools on hand
6. **Defect**: product failure
7. **Motion**: too many steps
8. **Overburdening**: when people or tools wear out
9. **Uneven production/sales**
10. **Unused talent**: any good idea that goes unspoken

Collect their answers on another color of sticky note. Write the type of waste that is being targeted (motion, overburdening, etc.) at the top. Then add commentary describing the waste and a proposed solution. **A good goal is to collect at least four to six areas for improvement per map.** Place these sticky notes next to production steps that could be improved.

EXAMPLES OF AREAS FOR IMPROVEMENT FROM THE NIGERIA PROJECT:

THE 2 PARTS OF AN IMPROVEMENT IDEA



AN EXAMPLE OF AN AREA FOR IMPROVEMENT NEXT TO ITS CORRESPONDING PRODUCTION STEP:

3. COMPOSITE VSM

Finally, create a composite map that synthesizes the data from maps created with different focus groups, (i.e., from farmer focus groups or expert groups, if conducted.) While no two farms are alike, this composite map will attempt to show what food production might look like on an average farm. Having one map instead of several will simplify the work that comes next in the lean analysis.

To create a composite VSM, follow these steps:

1. **First, create a new VSM with headings and action steps from the interviews**. It is possible a team will want to do this in a conference room with a large white board or blank wall. One option is to use oval shapes for headings (like *Fish Stocking and Management*) and square shapes for activities (like *Feed Fish*). Also, change up the colors to denote different stages of production. The idea here is to create a board that is easy to comprehend and that visually breaks up the stages of production.
2. **On each sticky note, under 'Time,' record the average amount of time the action took**. For example, if one farmer said six days and another said eight days, then record the average, or estimated average (seven days.) It is not important (or even possible) to be 100 percent accurate here. Rather, the goal is to find a length of time that realistically approximates what happens on many farms.
3. Be sure to **document *who* typically completes each action**, whether they are paid or unpaid, and, if applicable, whether they are typically male or female, and how much they are paid.
4. **Record the materials used and their average costs, based on all of the interviews**. Again, don't spend too much time agonizing over 100 percent accuracy. The idea is to create a good, composite picture of a typical farm.

Once these steps are completed, you have a complete composite value stream map.

Next add the areas for improvement. You now have a future state map, where the flow of production is made smoother by the removal of wastes from the value stream. This composite value stream map incorporating improvement ideas visually documents and decribes smallholder production which can form the basis for program decision making.

See the Annex for examples of value stream maps.

LEAN STEP 4: IDENTIFY ACTIONS

KEY CONCEPTS

- Program actions are at the 'sweet spot' between identified waste reduction opportunities at the producer level as identified by the VSM methodology, and the potential for the project to achieve scaled, sustainable impact through facilitative strategic partnerships.
- The VSM provides an alternative lens to identify and understand opportunities and systemic points for project prioritization and intervention.
- Producers will typically try and adopt only one or two new technologies (products, services, or practices) or approaches at a time, in order to minimize risk.
- Market mapping is needed to identify market system segments and actor populations where the program can add value and implement through strategic partnerships.

RECAP:

Step 1 identified the relevant market while Step 2 helped us to precisely define customer value within that market. The VSM (Step 3) provides us with a visual map of the existing production system; that is, the system that produces value for identified customers within the target market channel. The VSM illuminates 'pain points' where wastes, like unnecessary movement, defects or overburdening, commonly creep in, helping us to identify key points of waste and inefficiency within the existing production system. This next and final step of the lean analysis process identifies opportunities and systemic points for project prioritization and intervention.

Key considerations for prioritization and intervention

The outcomes of the previous three steps of the lean analysis comprise a set of potential focal areas that can eliminate waste while *creating the most value at the least cost* for the producer. This set of potential areas for intervention needs to be filtered for further analysis, however particularly with regards to where the project can achieve sustainable and scaled impact through a facilitative market systems approach. This 'sweet spot' of priorities and interventions is identified by first assessing and prioritizing potential pain points identified in the VSM, based on a set of three lean questions (see below).

A basic market mapping process is also needed to understand who the market actors are in the various parts of the relevant market, particularly as they relate to potential pain points. Market maps typically include information on each of the processes in a sector and which key actors are playing which roles. Specific market systems questions to be considered and discussed are presented in the worksheet below. It's helpful to keep in mind that market mapping should focus on both qualitative *and* quantitative contexts for those questions.[89]

The following worksheet can be used as a discussion guide for a larger, project-wide discussion, with the individual or team who conducted the lean assessment presenting the outcomes of the previous steps and facilitating dialogue about them. The worksheet provides a set of questions through which to winnow or filter the longer list of pain points within the production system and opportunities for intervention priorities for the coming period.

The VSM provides not only the potential focal areas where waste exists, but also a preliminary set of potential solutions. It is important to note that the solutions identified through the VSM may not be exhaustive in the developing market context. Note the solution ideas identified through the VSM, but maintain the focus on the specific points of waste and inefficiency. Solutions may come from within the specific market, but there might be solutions or models elsewhere in the country or in very similar markets that can be introduced by the program; a breadth that can come from the program while the farmers have the unique perspective of depth that identifies the prioritized production points for intervention.

8 Often the program team has sufficient market and context experience to be able to answer the market systems questions posed in the worksheet. If not, then a rapid market mapping will be needed to complete this final step of the lean analysis. The 'Developing a Scaling Strategy' component in the next section of this toolkit will also require a market mapping of processes and key actors around each of the priority technologies, models, or interventions. It may make sense to read that section prior to completing the market mapping to ensure that all of the necessary information can be captured at once.

9 There are various market mapping / value chain mapping tools available online that can be used to support this process. For example:
- Emerging Market Mapping and Analysis (EMMA) Toolkit's online mapping program: https://www.emma-toolkit.org/market-system-mapping-tool
- MarketLinks value chain mapping guide: https://www.marketlinks.org/good-practice-center/value- chain-wiki/value-chain-mapping-process
- Making Markets Work for the Poor (M4P) Approach: https://www.enterprise-development.org/wp- content/uploads/m4pguide2015.pdf

As noted above, producers will typically try and/or adopt only one or two new technologies, products, services, or practices or approaches at a time. And projects will need to select a set number of priorities and actions that are within their manageable interest and resources. The questions that follow are intended to identify opportunities and systemic points for project prioritization and intervention with the best potential to achieve sustainable, scaled impact through facilitative partnerships.

ANALYSIS:

PHASE 1: REVIEW THE VALUE STREAM MAP

Review the composite value stream map and list the identified points of waste and initial identified solutions (combined referred to as most impactful practices (MIPs)).

For the set of identified potential intervention priorities, answer the following questions:

1. **What intervention would remove the most waste?** Now is the time to analyze production and ask: Where do farmers spend the most money and the most time time in production? Where did farmers say the most waste existed? How could that waste be most easily removed? How might a cost burden for farmers be reduced?
2. **What intervention would add the most value?** Remember the Step 2 - *Customer Value Sheets*? Now is the time to use them. The goal now is to tightly align production with customer value. What intervention will increase the value of the product even as the intervention removes waste?
3. **What intervention would have the most impact at a reasonable cost to the producer?** Any intervention requires a strong business case. If an intervention (for example, introduction of a new technology) adds cost to the producer, is the cost justified—and if so, specifically why is it justified?

Note: It is more impactful to reduce wastes identified at the end of a value stream rather than at the beginning. The VSM is a linear map of value creation with the beginning of the process on the left and the end on the right. By the end of a product cycle (on the right hand side of the VSM), a producer already has a lot of time and money invested. Waste reduction at the end can have a significantly bigger impact on the production system than waste reduction at the beginning, when less time and money has been invested.

Do any of your answers to the above questions change the identified potential intervention priorities?

The outcome of this should be a shorter list of potential intervention priorities.

PHASE 2: SCALE

Review Step 1: *Establish your Context* worksheet with the profiles of target beneficiaries.

For each of the remaining potential intervention priorities, answer the following questions:

1. **What are the characteristics of a producer with this pain point (identified waste)?**
2. Quantify the relevance of this potential intervention priority in terms of number of farmers. **How many farmers share this challenge or waste? Is it equally significant to all farmers?**
3. **In terms of our total target beneficiaries, is this a significant potential intervention?** This is an opportunity to eliminate any potential intervention priorities that are insignificant in relation to your total target beneficiaries – or at least to lower the priority level.
4. **If a potential solution has been identified from the VSM, is adoption of the solution principally a demand or a supply constraint?** That is: Are farmers aware and ready to adopt if it were accessible and available? Or is there another immediately known constraint to access and adoption?

The outcome of this will be a shorter list of potential intervention priorities with some initial ranking in terms of potential scale (relevance to total number of producers.)

PHASE 3: MARKET SYSTEMS AND PARTNERSHIPS

Using the expertise of your team and any rapid market mapping conducted, answer the following questions:

1. **Which types (profiles) of market system actors have a role to play and economic incentives to reduce waste and adopt potential solutions?** For example, if labor costs, availability, and quality were identified as points of waste in row crop land preparation, and the potential identified solutions include mechanized land preparation and animal traction services, then tractor and oxen owners would have roles to play and economic incentives for these potential intervention priorities. Traders and commodity buyers might have roles to play and economic incentives to help farmers reduce time and labor costs associated with manual threshing by a farm family.
2. **How many of these types of actors exist?** Is there an opportunity to partner in the near term with additional similar actors who may adapt and adopt learnings through replication in future seasons?

3. **What would the potential 'target beneficiary reach' be for a cohort or portfolio of partnerships with this type of actor?**
4. **If a solution or set of partnerships aren't apparent at this point in the analysis, is this a candidate for an 'Innovation Challenge' or other type of grant funding to develop a solution or incentivize innovation to improve economic alignment for investment?**

The outcome should be a shorter list of potential intervention priorities with further ranking of potential partners. This stage might also eliminate some potential intervention areas if it is determined that those interventions do not present identified solutions within the market or with partnership potential. These interventions are still worth considering, though, as they might be potential areas to address through knowledge management, challenge or innovation grant activities that aren't intended to achieve scale within the project period, but which still contribute to stakeholder engagement for potential solutions.

Remember, the goal of partnerships is not to distort the market through handouts and/or direct implementation. Rather, the project goal is to nudge actors towards adopting behaviors and tools that eliminate waste.

PHASE 4: CROSS-CUTTING

Projects operate in complex, sometimes crowded environments and spaces where, often, other donors, projects, and even local governments are active. Other project constraints or objectives (social conditions, migration patterns, conflict, gender inequities, etc.) also may influence final prioritization and selection of interventions.

For each of the remaining potential intervention priorities, it is useful to discuss the following questions:[10]

1. **Are other donors actively pursuing the same or similar potential invention priorities with the same potential types of partners/market actors?** If so, in what way(s)? Does space exist for your project to add value? How difficult might it be to meet partner expectations with the project's proposed approach (i.e., assuming there is no grant funding or direct implementation)?
2. **Do the potential intervention priorities generate positive impacts on vulnerable communities?**
3. **What other roles does your project play that add value to increased access and adoption of new approaches, other than (or in addition to) direct intervention through a cohort or portfolio of partners?** (Here, 'other roles' can be defined as influencing, networking, advocating, convening power, contributing to improved knowledge management, etc.)
4. **Does internal or external conflict, or other execution challenges, influence prioritization or implementation?**
5. **What thoughts or ideas related to addressing nutrition deficiencies or climate change might influence prioritization?**

The discussion of the above questions should result in a *short* list of prioritized areas for project action aimed at achieving sustained and scaled impact at the producer level, using a facilitative partnership approach.

Finalizing solutions for action:

As noted in the introduction section for this step, the VSM provides not only the potential focal areas where waste exists, but also generates a preliminary set of potential solutions identified by farmers. We have already acknowledged that the solutions identified through the map may not be exhaustive –in other words, they will not solve every single problem or comprehensively eliminate all waste – in the developing market context. The discussion questions focus on specific points of waste and inefficiency, and result in a short list of *prioritized areas for project action* with some potential solutions (and also, possibly some gaps.) But don't worry. Good solutions may come from within the specific market, but they might also come from elsewhere in the country, or from similar markets that offer models that can be adapted and introduced by the project. In other words, remember to remain flexible, open minded, and receptive to all good ideas that contribute to your goals.

Other potential solutions for prioritized areas of project action (those that have not already been identified through assessment or mapping) may come from consultations with internal staff who have experience or expertise, a brief literature review of relevant contexts, and select consultations with international experts. The following 'Lean Tools for Tackling Waste' can assist the team in final selection of potential solutions for action.

10 This list of questions can be modified to the specific context of your program as needed.

LEAN TOOLS: TIPS FOR TACKLING WASTE

Because all businesses and farms are different, there is no single magic bullet to eliminate wastes. However, across decades, lean managers have developed powerful waste-eliminating tools that help businesses thrive even in challenging economic environments. Below are a few tools that apply well in this context.

LIGHTEN THE LOAD (ELIMINATE 'MURI')

Farming is hard, physically demanding work. But with careful thought, and with improved processes, demanding or tedious tasks can be made easier. In lean, the Japanese term '*muri*' refers to overburdening. *Muri* can take its toll on people, animals, and machines. In fact, one of the barriers to expanded, profitable agriculture enterprises for many farmers, especially young producers across the globe, is the simple fact that many production systems require an unrealistic amount of work. Use the following tool to assess potential solutions to the short-list of key points of waste and reduce the *muri* load!

One tactic to eliminate *muri* is to measure it. ('Know your enemy,' right?) In lean factories, engineers actually measure the total amount of weight a line worker must lift during a given shift, as well as the angle at which objects are lifted. Workstations are then assigned numerical ratings that reflect the *muri* level workers encounter. They then re-design workstations to reduce *muri* in places where workers are being tasked with too much.

On farms, the farmers themselves, of course, are always the best sources of data and other information used to determine where and how much *muri* exists in an agricultural value stream. They know, often quite literally, where the pain points are. Using data gathered during the mapping process related to specific potential solutions identified, let's compare the amount of *muri* in the present production system with the *muri* of the potential solutions. Be as specific as possible.

As an example, let's consider the case of some soybean farmers who were interviewed in one location in Nigeria. They reported that threshing the soy usually takes four people a total of 30 days to complete. In this instance, multiple options for reducing *muri* could be considered, including both alternative manual processes or introducing affordable/mechanized threshing tools and services. In another example, broadcast seeding was identified as a source of waste in a local rice production system. Experts recommended establishing of rice nurseries and transplanting as a way of reducing the seed waste. This potential solution was discounted, however, because it would actually *increase* the amount of work involved over the present practice (broadcasting). Applying a 'lighten the load' approach eliminated the proposed solution because it significantly increased the *muri.*

For scalable solutions, it is important to understand *muri* precisely, and then to engage and work closely with those market actors who have an economically aligned interest, (and real-world experience) in reducing that *muri.*

ASK WHY FIVE TIMES. (YES, FIVE.)

Taicchi Ohno, the lean manager at Toyota, instructed his engineers to ask 'Why?' five times whenever a problem occurs. 'By repeating *why* five times, the nature of the problem, as well as the solution, becomes clear.' Cause and effect is better understood with each iteration. As many parents understand, a child who asks 'Why?' repeatedly is simply trying to gain a better understanding of the world around himself or herself, and the causes or effects of his or her experiences or observations. Even the most patient parents can get annoyed, but the persistent child gets a truer picture of reality, and acquires a bit of wisdom in the process.

This method of inquiry is an effective tool to understand farmer and business motivation. Below is a real world example of how simply asking why, multiple times, can help to exponentially improve understanding of the root causes of a problem:

Intervention prioritized through lean analysis: Soy farmers choose to hand-thresh rather than use mechanical threshers, even though mechanical threshing would be cost-competitive (about the same cost as manual threshing) and result in fewer wasted beans.

Why? *Because mechanical threshers are not widely available in the region.*

Why? *Because mechanical threshers are sold in specific markets and are not available in markets near farmers.*

Why? *Because they are imported by a select few businesses and are only manufactured in a few industrial hubs thousands of miles away.*

Why? *Because that is where design and engineering expertise is located.*

Why? *Because that is where the need is perceived.*

In this case, the root of the problem (as we can see after drilling down five degrees) is not the naivete of the farmers. It is the lack of market intelligence regarding potential farmer demand in actual soybean production geographies, as well as the lack of established distribution channels for importers and retailers of threshers. A market systems solution might involve partnering with potential SMEs in soy-producing regions – but only those who have an economically-aligned interest (incentive) in seeing more farmers use mechanical threshers, as well as an interest in linking them (and providing market intelligence) to importers and retailers in the distant markets.

Use the 'Five Whys' tactic to more deeply understand the prioritized waste and inefficiency (previously identified) and to develop the most relevant solutions.

CUT COSTS TO GROW PROFIT MARGINS

This Toolkit introduced the following lean equation:

Present capacity = work (value) + waste

The implication of our simple equation is that any business, including a farm or a farm-based business, is bounded by limits. A producer cannot grow his or her profits until those limits are stretched—i.e., until capacity increases. Also implied here is the assumption that only two activities ever occur within businesses: 1) those that add value; and 2) activities that create *muda*, or waste. VSM is essentially an exercise to parse out which activities add value versus waste. A VSM thus provides a high-level view of present capacity.

The above equation can *also* be expressed as follows:

Work (value) = present capacity – waste

Arranging the equation in this way puts more focus on waste. This equation makes clear that a producer can increase productivity and profits (the yield of all value-adding work) by reducing waste. Producers don't necessarily need to 'grow' in the traditional sense of getting bigger or doing more business. Producers can also grow by getting smarter and being more efficient.

This type of growth—lean growth—occurs when a business owner puts her or his mind to cutting costs as a legitimate avenue to higher profitability. Often, development solutions focus on encouraging farmers to do more: Grow on more land! Use more herbicides! Use better genetics or this new technology! Lean is not opposed to growth by these means, ***as long as there is a strong business case*** for them. However, lean emphasizes growth opportunities by sometimes doing *less*, not more.

Let's apply this concept of cutting costs to grow profit margins to evaluate potential solutions. In our Nigerian catfish production example, it was discovered that cloudy water resulting from overfeeding had become a significant cost for many fish farmers. It took a lot of time to change the water, and cost a lot of money to constantly refill the tanks with fresh water. The potential solutions discussed initially focused on technologies that added costs—for example, by encouraging farmers to build better tanks with more easily controlled inlets and outlets. And that *seemed* to make a lot of sense, though it also involved a lot of extra costs to producers. However, the project team, motivated by a lean mindset (and taking advantage of global lean and catfish production experts) had also learned about biometric feeding, a technique for carefully rationing feed through a more scientific approach, thus eliminating the problem at its source. This 'process adaptation' helped producers to both cut their costs *and* increase their profit margins at the same time. It is a classic example of a lean solution.

A helpful exercise is to total up and compare costs to producers across *the entire value stream*. For example, the team working on Nigeria soybeans created a pie chart of costs associated with soybean production (see Annex XXX), which showed that hand-threshing accounted for 31 percent of total farm expenditures, followed by land preparation at 23 percent, and harvesting, cultivating, and fertilizing at 14 percent, 13 percent, and 14 percent, respectively. The goal of a lean intervention is to cut costs. This data helped shine a light on the 'low-hanging fruit' in the production stream—on

those places that represent the best (and sometimes, even enormous) opportunities for cost-cutting.

EMPLOY MISTAKE PROOFING ('POKA-YOKE')

Mistakes are an inevitable part of bringing a product to market. No field of maize, soy or rice will ever yield a perfect harvest from every single plant. However, from a lean point of view, mistakes can always be reduced, and mistake-proofing (known as '*poka yoke*' in Japanese) is a key lean tool for increasing profits with less work and investment.

At Toyota, assembly line managers facilitated *poka yoke* in the form of cords, which hung directly above workstations. Whenever line workers encountered a mistake, they pulled the cords to stop production, enabling the mistake to be isolated quickly and fixed, and preventing a potentially defective product (or an entire series of defective products) from leaving the factory. According to Ohno, mistake-proofing was *everyone's* job: 'Workers should not be afraid to stop the line.' Today, the cords are gone, but the practice remains. For example, lasers can now be programmed to detect if a widget is cut to the wrong shape, and to trigger a stop before machines keep working and cause further errors and malfunctions.

Use this approach when analyzing potential solutions, comparing them to the point in the VSMs they would fit. Where in the map do mistakes occasionally or commonly happen? Where is there a defect? Look at the entire value stream. It's common to see farmers expanding their land area, but if they have not eliminated waste in their production practices to optimize their existing land, then they are simply increasing their inefficiency.

For example, in Nigerian rice production, defects were identified early in the value stream with poor land preparation, including inadequate ridging. Poorly-constructed ridges allowed water to escape paddies, increasing the likelihood of dry roots and insect pressure. Defects also were found in the seeding process, when farmers sometimes over- and/or under-seeded paddies, resulting in sub-optimal yields. At the end of the value stream, further mistakes were noted, including rice that was sometimes harvested at varying grain maturity levels, and when it was sometimes threshed before it was adequately dried. Both of these mistakes required farmers to over-beat their rice, causing significant losses.

Compare potential solutions to points you have identified where mistakes occur, then ask: What might be a mistake-proofing solution be—a solution to eliminate or at least minimize the chances that the error will recur? A lean approach prioritizes doing *better,* not more. Conventional development approaches usually emphasize growing the size and output of a business. Does the solution improve efficiency or simply do *more* of the same old thing?

MAXIMIZE FIXED COSTS, MINIMIZE VARIABLE COSTS

Fixed costs within a business or on a farm are costs that don't change, no matter your level of production. Think tools, equipment, storage facilities, and transportation equipment. Variable costs are those that rise and fall with the rate of production. They include labor, seeds, fertilizer, and storage bags. Lean encourages improvements that fully utilize fixed costs while reducing variable costs to their lowest possible level.

In manufacturing, Toyota again provides a model. Instead of sprawling out its manufacturing across large factories, Toyota produces its vehicles in relatively small spaces, compared to its competitors. The reason? Maximizing the fixed costs of their buildings. More space is added *only* when existing factory room is truly at full capacity. Underutilized fixed costs are opportunities to increase productivity at a low cost.

The takeaway for agriculture is this: When identifying solutions, select those that build upon existing investments before jumping to interventions that require considerable fixed cost investments from farmers or SME partners. For example, in Nigerian catfish production, a potential intervention included encouraging the use of tarpaulin ponds for farmers currently raising fish in dug ponds or in plastic tanks. However, after discussion, the team came to understand that farmers had largely already made their investments in tanks or pond construction, so the costs of changing to tarpaulin ponds was a significant limiting factor for existing producers. In other words, the tarpaulin pond intervention would have increased costs for these farmers. Instead, the team pivoted to looking at solutions—like biometric feeding—that reduced variable costs while maximizing the benefits from previous investments (or fixed costs.)

THE LEAN PROJECT

The previous sections provided a set of lean tools for prioritizing project interventions using a VSM methodology. The following set of market systems tools are designed to support project teams and staff to apply lean thinking in project implementation. The focus is on formation of strategic partnerships that use market systems development, or facilitated, approaches. Remember, market systems are the complex and dynamic spaces in which target beneficiaries (producers) exist. A market systems approach prioritizes partnering with existing networks and stakeholders, as much as possible. It is built upon a partnership strategy aimed at scaling impact across multiple businesses and partners.

This section provides the following four tools specifically for project planning and implementation when applying lean under a market systems project:

- Developing a scaling strategy
- Prioritizing market actors
  - 'Potential Partner Introduction' worksheet
- Structuring and managing partner agreements
- Project Budgeting for Partnerships including Partner Funding

GUIDE TO DEVELOPING A SCALING STRATEGY

KEY CONCEPTS:

- Scaling strategies follow the market by targeting interventions, partnerships and activities to existing actors, market channels, and relationships, rather than attempting to create new ones.
- Scale through replication of models across actors is strongly aligned with a lean market systems approach to growth that maximizes value and profits for market actors and function.
- Not everything is scalable, and scaling access and adoption of a technology or model typically has trade-offs.

A written scaling strategy for each program identifying priority interventions or models can provide a roadmap for project implementation and a knowledge sharing product for partner engagement.

In a project focused on scaled impact, resources and activities should be focused on relevance and replicability for the 65-70 percent of producers and market actors who are neither the best nor the least resourced of the producing households, farms, or businesses. In Lean Step 1: Identify the Customer, this focus on the middle helped us identify and apply lean analytical tools to *the market opportunity moving the largest volume of product for the largest number of producers or main market channel.* Focusing implementation on these particular producers and associated market actors ensures relevance and increases the potential for replication of smallholder-focused business models and solutions across the largest number of actors.

Developing a scaling strategy utilizes a traditional value chain analysis approach with a specific scaling lens – in other words, it frames each of the key analytical components in terms of the 'middle' or 'average' majority population, the main market channel, and the specific market system ecosystem. It is important to note that interventions intended to achieve scale (lean-identified technologies or efficiency opportunities, strategic partnerships, etc.) 'follow the market.' That is, these projects focus on systemic change where density of actors and beneficiary producers or commercial relationships *already* exist – not on creating new actors or new market system functions.

As we've established, in a truly facilitative approach, the project has **no** direct ongoing relationship with producers.[11] Rather, the project partners with stakeholders, particularly the private sector, around aligned interests to achieve desired outcomes. From a general scaling perspective, several traditional pathways to scaling through partners exist. This can be achieved either through *growth* in the number of producers each partner can reach, or through *replication* of business/dissemination models across more businesses and partners. **A lean market systems scaling approach prioritizes** the latter (***replication***), **as** the optimal **pathway to scale.** A partnership strategy that intentionally focuses on replication of models, with adaptation and adoption across multiple actors, can mitigate risks posed by individual partners who may be less effective or successful, and decrease potential negative market interference, such as disruption to the competitive business

SCALING STRATEGIES THAT 'FOLLOW THE MARKET'

If the majority of target beneficiaries sell their crops at the farm gate, then the scaling strategy will focus on those actors involved and their existing relationships. This might include partnerships with active traders to extend post-harvest processing services to increase volumes beyond current purchasing activities. Or it could include cost-competitive, labor-saving services for producers. A scaling strategy would not include resources for creating new trading relationships outside the current main market channel, such as a contract growing arrangement or certification to enter a completely new niche market.

Scaling strategies 'follow the market' by focusing on a smaller impact per individual actor over a larger number of existing actors and relationships, versus a larger impact per actor over a relatively small number of the market actors and relationships.

11 The project's Monitoring, Evaluation, and Learning activities may have direct producer interactions in confirming partner activities, impacts, and capturing learning.

environment. Replication can be particularly effective among SMEs, where a larger number of similar actors may be present, and where less competition may exist within a particular market. SMEs are likely to have similar businesses and customer bases in neighboring markets across a project's geography.

Scaling is important and, in some ways, represents the ultimate success of a project. Still, it is important to recognize that not everything is scalable, and that scaling strategies usually trigger tradeoffs between:

- **Scale vs impact**: Scaled reach and adoption are more likely to have smaller individual returns or impact. Simpler, more broadly applicable and easier-to-adopt technologies, with lower returns on investment, are more likely to achieve broader acceptance than more complex, higher-investment, and higher-return technologies. The quantifiable benefit per adopter may be higher with more complex interventions and higher costs, but the number of people who will adopt will be exponentially smaller.

- **Cost vs equity**: To achieve scale, focus must be maintained on the broad middle. This means that pursuing opportunities to achieve impact at either end of the distribution curve may divert resources away from achieving real scale. Cost effective scale can be a tradeoff in achieving equity for those outside of the broad middle.

- **Fidelity vs adaptation**: Strict fidelity to the technology, model or innovation introduced may be seen as necessary to achieve the most impact and benefits. But scale more often requires flexibility and adaptation, which may vary the potential benefit between adopters. If cost or fidelity are significant barriers to achieving the underlying potential benefit of the technology or model, then scale is less likely to be achieved.

Understanding and discussing these trade-offs during project analysis and decision making should inform expectations and direct resources appropriately for desired outcomes. Scaling trade-off discussions should be incorporated during analyses, decision points, and reflection points to maintain focus on the objective of scaled, population-level reach and impact.

CONSIDER YOUR CONTEXT

Start with the **'Establish Your Context' worksheet** from Lean Step 1.

What percentage does your overall target (total number of project beneficiaries) represent of the total potential population? For example, what percentage of total farming households within the ZOI or geographic area of intervention does your total project number of beneficiaries represent? Is this realistic? As an example:

For a Feed the Future agricultural development activity in Nigeria, the life of activity total number of beneficiaries target was 2 million individuals. The total number of farming households in the target crops within the activity's zone of influence was 4.4 million. This means the project expected to reach 45 percent of the total potential population within five years, in a systemic and sustainable way.

Ask the following questions:

- Are your project interventions focused on improving efficiency, competitiveness, return on investment, or function of existing commercial relationships – or do they focus on encouraging the creation of new relationships? How would priorities and interventions change if the focus was on working through a broader set of existing actors, and working on existing commercial relationships?

- Are project partners considered and selected based on whether they are representative businesses among their peers? Are partnerships selected and designed around clear learning agendas for potential replication by other market actors?

- How might market mapping prior to intervention planning and partner selection change to better align with scaled impact objectives?

- Does focusing on impact, equity, or fidelity (strict adherence to the interventions/changes introduced) affected the project's ability to achieve scale? Discuss how the trade-offs related to achieving scale can better inform strategy, planning, and implementation of priorities and interventions.

DEVELOPING A SCALING STRATEGY

Documenting a scaling strategy for each project-identified MIP intervention or model can provide a roadmap for implementation as well as a knowledge sharing product for partner engagement.

Such a strategy serves to a) introduce the technology or model; b) present the business case from the perspective of the producer; c) highlight potential for scale; and d) assess supporting market systems for access and adoption. Two completed examples of a strategy are included in the Annex.

COMPLETING A SCALING STRATEGY:

TECHNOLOGY, INTERVENTION, BUSINESS MODEL TO BE SCALED:

Clearly define the 'what' is to be scaled. Sharpen and define the 'what' is to be scaled. This might be an individual product, service, or practice and/or simple package.

POTENTIAL TO SCALE:

Quantify the relevance of the 'what' to either the specific geography of intervention or country. How many producers could or should adopt? If adoption will significantly impact, volume of product entering the market) then will the market be able to absorb increased output?

BUSINESS CASE:

Define the cost/benefit of the 'what is to be scaled' from the perspective of the producer (target impact). Quantify, where possible, comparing with existing practices and other alternatives. This should include some indication of the qualitative assessment from the perspective of the producer as well as any potential increase or mitigation of the producer's risk profile. The business case should be clear and documented, with a significant improvement over existing practices or alternatives.

ECOSYSTEM:

Using a standard value chain assessment as a guide, identify and characterize the market system processes and actors that will be necessary to scale the 'what' to population level and benefit. These spaces to assess include, but are not limited to, the upstream space, downstream space, financial and fiscal space, policy and enabling environment space, partner and value chain organization and capacity space, cultural space, partnership space and learning space. Include consideration of potential constraints from the supply of the 'what' – particularly if it is a technology: product, service, or practice. Only the most relevant to the specific 'what' should be detailed. (This will include capacity and capability needs of the market system and actors that the project or others can support for scaling.)

PRIORITIZING MARKET ACTORS AND SELECTING PARTNERS

KEY CONCEPTS:

- Scale through replication of models across actors requires identifying clusters of actors from which to identify partners to ensure learnings can be shared, adapted, and adopted by market system peers.
- Partners should be prioritized from existing actors and market channels, and through commercial relationships with target beneficiaries that are already proven, rather than attempting to create new ones.
- Partners' commercial interests and incentives should align with project-identified opportunities for increasing producer access and application of target technologies and models. Understanding key business drivers and strategic objectives from the earliest market mapping will assist in partner prioritization and selection.
- Setting and managing partner expectations should occur from the earliest conversations. This may be most important and most challenging with partners who have previous experience with donor programs.

Within a market systems approach, a project has no direct ongoing relationship with producers. The project partners with stakeholders, particularly the private sector, around aligned interests to achieve desired outcomes. While the project may contribute financially to certain pilot activities and tests, the priority is to provide breadth of experience, advocacy, influence, business development support, and coaching to partners to assist them in pursuing their own initiatives around shared objectives, identified opportunities, and with aligned incentives. For sustainability, it is critical to work largely with partners who have an existing presence and who already have relationships with producers in the area of intervention, *to build on rather than to replace the existing market system.*

How and with whom to partner are critical considerations for systemic scaled impact and sustainability. The two stages of the partner identification process are:

Identification of clusters of actors to form a pool from which to identify partners, and through which partnership learning can be shared, adapted, and adopted by market system peers; and

Selection of direct partners whose key business drivers and strategic objectives align with the project's scaling strategy.

IDENTIFYING CLUSTERS OF ACTORS

Two activities within the toolkit assist in identifying clusters of actors: Lean Step 4: Identify action questions within Phase 3: Market Systems and Partnerships, and The 'Ecosystem' section from the 'Developing a Scaling Strategy' section.

Review the potential market system actor types and clusters identified from the above two tools.

In most markets, hundreds, if not thousands, of existing businesses provide goods, services, and information to target beneficiaries and producers, many of which are SMEs. These can include formal and informal agro-dealers and input suppliers, mechanization and irrigation service providers, traders, millers, transporters, information and communications technology start-ups, consumer goods retailers, and many others. Existing actors who already have proven commercial relationships with the target producers may have broader business and strategic objectives for increasing customer value and loyalty and/or increasing the number of customers served. For more immediate potential impact and learning, as well as sustainability, it is important to prioritize existing actors and business networks rather than to create new actors and commercial relationships.

Should any additional market system actor types or clusters be added to partner consideration, based on existing commercial relationships with the target producers?

Identification of clusters of market actors results in both a pool of potential direct project partners and a pathway for adoption and replication of learnings and models which emerge from the direct partnerships. One-off partnerships with very unique partners may offer limited potential for replication or scale.

Within the identified potential actor clusters, how many actors are active within each? Are there enough actors within the pool from to select a subset of direct project partners while offering a scaling pathway through replication?

These clusters of market actors represent the pool for project partner and stakeholder engagement.

SELECTION OF PROJECT PARTNERS:

Project partners should be selected from among the market actors in the previously identified clusters of market actors. It is necessary and intentional to connect with multiple partners who have similar business models and/or business drivers, to test producer-focused business and engagement models. For management efficiency, to encourage peer learning, and to encourage replication and adaptation of successful models, portfolios or cohorts of partners can be developed around key identified interventions. While the initial set of partners won't be inclusive of everyone within the market actor cluster, a concerted effort should be made to offer a similar opportunity to many market actors in order to avoid negatively impacting market competitiveness or other market dynamics.

To select partners, a potential partner's commercial interests and incentives should align with project-identified opportunities for increasing producer access and application of target technologies and models. Understanding key business drivers and strategic objectives from the earliest market mapping will assist in partner prioritization and selection.

A general set of criteria follows which will assist in prioritizing potential partners:

- Existing commercial relationship with producers;
- Experience with technologies or services for producers;
- Institutional strength (management, finances, quality of operations);
- Coachability;
- Willingness to participate in a peer learning network;
- Takes a business-based approach to technology dissemination and/or commercialization; and
- Demonstrates potential to grow in reach and scope over time.

The following partner characterization worksheet will assist in understanding key business drivers and alignment with the above-listed general partner criteria. A short list of potential partners should emerge after completing the partner characterization worksheets.

Following completion of worksheets through direct consultation with key individuals (owners, managers, key personnel) employed by the potential partner, further prioritization can occur by placing potential partners within a 'skill versus will' matrix. Does consideration of skill versus will affect your perspective and prioritization of each potential partner? Can it affect a partnership strategy for that potential partner?

HIGH WILL/LOW SKILL Capacity or Capability Problem?	**HIGH WILL/HIGH SKILL** Why aren't they already pursuing the model of opportunity?
LOW WILL/LOW SKILL Can't avoid them?	**LOW WILL/HIGH SKILL** Incentive problems? Expectation issue?

WORKSHEET

POTENTIAL PARTNER CHARACTERIZATION

Use this worksheet when interviewing potential project partners to thoroughly understand the key drivers of the potential partner's business, and the incentives that might align with a proposed project.

With each of the following questions use the 'Five Whys' methodology[12] to gain a deeper understanding – asking 'why' up to five times after each question.

- **How long have you been in business?**
- **What is the size of your business?** (E.g., revenue size and staff size.)
- **What is the key focus of your current business?**
- **What are your product offerings?** (Can they be categorized by percent share of business, or by volume, number of transactions, revenue, and/or dedicated staff?)
- **What is the key input (cost) or revenue generating activity that contributes most to achieving financial results for your business?**
- **Who are your customers?** (How many total customers per year or season? Can they be segmented? What percent of your customer base are representative of the project's target producer? (Tip: provide a description of the target producer for context.)
- **Do you have systems to track customer behavior?** (Purchases? Repeat customers or customer loyalty? Marketing which converts to sales?)
- **What do your customers value?**
- **What is your geographic reach?**
- **Who are your suppliers?**
- **In what ways would you like to see your business develop in five years?**
- **Who is your primary competition?**
- **Have you partnered with donor projects previously?** If yes, quantify and qualify business objectives reached through those partnerships.

12 Introduced in Lean Step 5: Identify Actions section – Lean Tools to Tackle Waste

STRUCTURING AND MANAGING PARTNER AGREEMENTS

KEY CONCEPTS:

- Agreements should be oriented to the specific interests and needs of the partner as a market actor and be within the capability of the partner to manage.
- Agreements should align with the project's systemic change objectives.
- Procurements should support and encourage market actors to maintain focus on their commercial interests.
- Agreements should be structured to allow the project to allocate resources in response to partner behavior.
- A larger number of smaller agreements is often preferable to manage performance risk, establish proof of concept across actors, and reduce negative impact on competitiveness within the market. This may require more administration resources.

Within the market systems approach, the project partners with stakeholders, particularly the private sector, around aligned interests to achieve desired outcomes. The project may contribute financially to certain pilot activities and tests, but the priority will be to provide breadth of experience, advocacy, influence, business development support, and coaching to partners to assist them in pursuing their own initiatives around shared objectives, identified opportunities, and with aligned incentives. Partner agreements between the project and the market actor should not disrupt overall market function or distract the partner from their main business objectives, but rather support the specific interests and needs of the partner around shared objectives.

It is important to structure agreements that are within both the business interests and the capability of the partner organization. At times, development projects set unrealistic social and business expectations of private sector partners which are outside of their manageable interests. For example, a project may require data collection and detailed reporting from a partner that is beyond the partner's staffing resources and outside their principal business interests. Reporting requirements mandated by development project partnerships are often described by partners as onerous and excessive. Another example of unrealistic expectations would be to require a private sector partner to significantly alter their purchasing patterns, causing them to incur new logistical and staffing costs. It is important for the project to understand the key drivers and objectives of prospective partner businesses during the selection process, to ensure partner agreements are realistic in their expectations. Ideally, agreements will both define and incorporate financial and/or other types of value generated by the partner for contribution to project objectives.

While structuring the agreement realistically for the partner is critical to success, it is obviously also important to maintain alignment with the project's systemic change objectives. Partnerships should be adaptable and, ideally, initiated on a short-term basis around clear milestones and shared objectives that will not only contribute value to the partner, but also inform project learning and support scale and sustainability.

RELATIONSHIPS, OWNERSHIP, AND INTENSITY[13]

Relationships, Ownership, and Intensity (ROI) is a framework to ensure that partnership agreements actually support partners and other market actors, enabling them to own, continue to adapt, and to invest in models and producer-focused businesses supported by the project.

Consider the following as partnership agreements are discussed and developed with partners. Projects can also use the following framework to reflect upon their existing partnership agreements.

R = RELATIONSHIPS

Who are the key relationships between?

Do partnership activities and objectives (and funding, where relevant) strengthen relationships between market actors, particularly between market actors and target beneficiaries?

Agreements (and the entire procurement process) should be structured so that the project supports market actors as change agents in their market contexts, rather than as entities delivering goods or services on behalf of the project. Establishing partnerships between the project

13 "Creating Manageable Steps for Complex System Changes: A Guide for Market Facilitation Practitioners," USAID, https://www.marketlinks.org/sites/marketlinks.org/files/resource/files/Creating_Manageable_Steps.pdf.

and other market actors (and beneficiaries) is not the goal, here. If the agreement outcomes emphasize a direct relationship and/or significant visibility between the project and market actors and/or target beneficiaries, then agreements should be redesigned.

O = OWNERSHIP

Who feels ownership of the activities?

Do agreement activities and objectives support the partner in leading, for their own purposes, an internal change process? Will agreement outcomes assist them in meeting their own objectives, and be within their manageable interests (even if it stretches their capability and capacity)?

IF the agreement emphasizes the project's objectives and interests over the partner's, then the project should redesign the intervention and agreement. Reporting, metrics, and deliverables should be considered within the ownership question. Have these requirements been tailored to align with the partner's processes and interests or are they principally driven by the project's needs?

I = INTENSITY

What is the level of project investment in terms of roles and resources?

Does the level of resources, either financial or technical, focus the partners on relationships with other market actors and on their interests in testing and trying a new practice, model, or producer-focused business objective? Resource intensity can shift the sense of ownership of an agreement and the sustainability of its learnings and outcomes. Partnership agreements with significant partner contributions (staff, financing, activity, outputs) are more likely to be aligned with their interests.

Cost share is one way agreements can increase partner intensity. Often, projects accept a very wide definition of cost sharing to meet externally imposed requirements. Intensity is about understanding key drivers within a partner's operations, and ensuring roles and resources are balanced in relation to project roles and resources.

Introduced in Lean Step 4: 'Identify Actions – Lean Tools for Tackling Waste,' the tool 'Cut Costs to Grow Profit Margins' is particularly relevant in structuring partner agreements.

Traditional business growth theories and development approaches are based on a 'More is More' focus on increasing investment and flushing capital into the system to achieve increased output, productivity, and incomes. Lean is a process-driven approach to growth through a 'More with Less' focus, which maximizes value and profits for market actors.

The lean equation implies that any business is bound by limits:

Work (value) = present capacity – waste

Lean emphasizes growth opportunities by sometimes doing less, not more. In structuring partner agreements, particularly relevant to intensity, it is important to avoid a 'more is more' approach to resource investment. Lean agreements will tend to be resourced at smaller levels by both the project and the partner and focused on not adding new costs, but rather improving value generation from existing costs or through waste reduction.

If the proposed agreement would add a cost for the partner, then ask, is there any way the business might pay for this cost themselves in the future? Would there ever be a business case for this cost? If not, the agreement will not succeed at scale or in the long term. If so, then how might you buy down risks for this cost? The agreement might focus work on reducing specific costs in the long term as strategic objectives. Market systems interventions, like increasing use of existing assets or reducing variable costs, will yield more sustainable results than paying for extra meetings, travel, publicity, and other "nice to haves." Costs are low-hanging fruit. Reducing them is a well-founded and effective way to grow a business and to engage partners.

PROJECT BUDGETING FOR PARTNERSHIPS – INCLUDING PARTNER FUNDING

KEY CONCEPTS:

- In budgets, the more flexibility, the better!
- In systems thinking, you are not funding a partner to provide the project with a service or a product.
- Consider including a line item for a fund in budgets, which could be called something like an Innovation or Facilitation Fund.
- Project funds should ideally be intertwined within normal business interactions of the market actors, without distorting the partners' roles or business objectives.

Traditional development project budgets often include grant or subcontract funds to finance partners' implementation of work (delivering products or services) to the target beneficiaries. This might include grants or subcontracting for partner-provided extension services and extension agents, installation and management of demo-plots or farmer field schools, delivery of subsidized production inputs, or purchase/construction of capital infrastructure. This can be considered 'direct implementation by proxy.' It is characterized by a local intermediary (which could be from the private sector) delivering the same type of goods or services that the project would have delivered under a direct implementation approach. In other words, delivery of those goods or services would not occur without the direct financial support and involvement of the project.

A market systems project avoids any direct or overly directive 'doing.' As noted in the structuring partnership agreements section above, the project partners with stakeholders, particularly the private sector, around aligned interests to achieve desired outcomes. The project may contribute financially to certain pilot activities and tests, but the priority is to provide breadth of experience, advocacy, influence, business development support, and coaching to partners to assist them in pursuing their own initiatives around shared objectives, identified opportunities, and with aligned incentives. This can make budgeting and budget management more difficult, however, because it is challenging to anticipate the exact type of support needed by partners and to scale the identified waste reduction opportunity.

It is important not to 'lock in' the purpose of the funding to specific types of support or types of market actors (to the extent possible.) Projects can build flexibility into proposal budgets through Innovation or Challenge funds, Short-Term Technical Assistance pools, and performance-based sub-contracts. Local or international expertise in lean principles and tools, as well as for partnership development and partnership support, are likely to be needed. These line items can be called upon in partner identification, structuring and executing partner agreements.

As noted above, a key lean concept is '*kaizen*,' a Japanese word defined as 'continuous improvement.' *Kaizen* activities aim to discover improvements and banish waste until a lean business or organization achieves zero waste production. That goal might never be attained, but it still provides inspiration to improve. This principle of continuous improvement can influence partnership budgeting and funding to prefer short-term term activities and agreements. In a more conventional development project, highly prescriptive annual work plans are apt to pre-determine activities and partners' responsibilities with significant specificity, and to lock in funding for those activities and partnerships for at least a year at a time, if not longer. While some private sector partners might prefer this level of predictability, such agreements are less conducive to learning-based adaptation and lack the flexibility necessary to allow the project to pivot for continuous improvement.

CONSIDER YOUR CONTEXT:

What budget line items does your project rely upon in supporting partnerships?

Does the project adequately allocate technical staff's time and expertise to partnership identification, agreement development, and management? Or are these tasks delegated to the project's operations team? Considering the information and skills presented in the other three 'Impact through Partnerships' sections, would you anticipate a shift in partnership-focused human resources time and expertise needed between project staff or short-term technical assistance (STTA) versus operations time and expertise?

How long is the time frame for your project's partnership agreements, typically? Does this time frame increase project flexibility or reduce it? Does it increase budget flexibility or reduce it?

PARTNER FUNDING

As noted above, partnership agreements can include a variety of support levers, including the project's own breadth of experience, advocacy, influence, business development support, and coaching. Including an 'Innovation' or 'Facilitation' fund mechanism in partnerships may also be useful. These could be a grant fund, a sub-contract fund, or a combination of types of funds. Project funds (used for partnerships) should ideally be intertwined within normal business interactions of the market actors, without distorting the partners' roles or business objectives.

Introduced in Lean Step 4: 'Identify Actions – Lean Tools for Tackling Waste,' the tool titled '*Maximize fixed costs, minimize variable costs*' is particularly relevant to partner funding. Lean encourages improvements that fully utilize fixed costs while reducing variable costs to their lowest possible level. Where possible, partner funding should support the testing and proving of models and business activities using existing fixed costs, with only those new variable costs that are required. For example, in Mozambique, staff managing a market systems development project there agreed with tractor owners that their existing smallholder customer base would likely be interested in threshing services. The tractor owners did not own threshers, but the harvest period was traditionally slow in terms of tractor usage, and their existing customer base had expressed interest in threshing services. In response, the partnership agreement included some grant funding to cover the cost of specific marketing and promotion of threshing services, with tractor owners agreeing to locate and rent unused or underutilized (and privately owned) threshers in their geographic area. These partnerships focused *on improving utilization of existing underutilized assets,* serving to both test and prove the business model before any investment of new capital for additional equipment was suggested or made.

The lesson: Partner funding should select those specific variable costs that build upon existing investments before jumping into interventions that require considerable fixed-cost investments from farmers or SME partners. In addition, it will be helpful to review partner funding budgets to check for variable costs that partners would not be able to continue to cover *with their own revenues* after the conclusion of the partner funding. (Examples include costs associated with meetings, signage, public relations, etc.). It's important to minimize variable costs within partner funding budgets (including both cost share and direct project contributions) to only those direct variable costs needed to achieve the objectives or learnings. This contributes to sustainability by the partner and adaptation by others.

Managing partnership funding through a grant fund can present challenges due to grant policies and procedures. Cost share is a very important principle in market systems projects, but many grant-making policies place a high administrative burden on the grantee to prove their cost share. This can increase the administrative burden on

both the partner and the project, and disincentivizes establishment of a larger number of smaller agreements of shorter duration, which would better support a lean and more dynamic market systems program. Fixed-award, milestone-based agreements are one way to use grant funding to reduce the administrative burden on both sides. Cost-share contributions can be included in the proposal evaluation process, moving the administrative investment to the beginning of the grant. Milestones would be defined at the beginning of the agreement development process, *aligned with the partner's own business metrics and objectives*. Fixed payments would be made upon achievement of each performance milestone.

Sub-contracts can also be used to support partnership objectives. In particular, procurement contracts can be used for inclusion of cost-share components as long as the project is very specific in what it is procuring. One example of this would combine procurements through a Blanket Purchase Agreement (BPA) with in-kind grants to individual producers or entrepreneurs. This is more complex, but less disruptive of the competitive landscape, by offering buyers and sellers competition for potential sales. (See an example from Mozambique in the box below.)

Iterative funding is essential to structuring partnership agreements. Rather than outlaying a large amount of funds up front, consider funding work in small increments as the project develops and evolves. This helps to ensure learning is adopted before moving on to the next stage.

CONSIDER YOUR CONTEXT:

To what extent are your project's funds intertwined within the normal business activities of partners, and in their relationship with other market actors?

What variable costs do your project's partners typically include in funding proposals, that they would not include in their normal business activities? What types of costs are these?

What types of performance-based milestones could be considered in funding agreements with your project's partners? (Milestone examples could include the number of smallholder sales/purchases made, or the number of repeat smallholder customers.) Do milestones align with both the project's objectives and the partners' business interests?

How might partner funding disrupt the competitive landscape between market actors? How can we design and implement funding agreements that minimize favoritism or market disruption between competitors?

A market systems program in Mozambique identified three vendors with the potential to sell customized alternative irrigation pumping solutions (solar and/or generator based.) They were offered an opportunity to sell systems, following technical assistance provided by a program-funded expert, who trained vendor staff in designing small- scale custom irrigation pumping solutions. Two vendors chose to participate, and BPAs were negotiated which included options to purchase four different styles of customized water pumping kits at 50 percent of the retail cost of each system.

At the same time, the project conducted a survey across three districts to identify surface water sites and individual entrepreneurs (lead farmers) who had both capacity and interest in developing water pumping service businesses. Eight individuals were identified and expressed interest in receiving an in-kind grant valued at 50 percent of the retail cost of a tailored kit. Each individual was offered the in-kind grant, requiring their payment of the remaining retail value, and had the option to purchase from either of the retailers with whom the program negotiated BPAs.

The agreement required grant recipients to pay their 50 percent cost share to the retailers before the program paid its 50 percent share negotiated within the BPA. The individuals had the option to choose between the retailers. Interestingly, the retailer offering the slightly higher price actually sold more units under the agreement (due to more proactive marketing and customer service) than the retailer with a lower price. This innovative use of a combination of BPAs and in-kind grants allowed for market relationships to be developed between retailers and customers, without program interference in market function and the competitive landscape, while supporting the introduction and adoption of new technologies.

ANNEX

HOW TO APPLY LEAN: EXAMPLES OF THE 4 TOOLS IN PRACTICE

FIELD EXAMPLE: NIGERIAN RICE

LEAN STEP 1: IDENTIFY THE CUSTOMER

The first step in a Lean value stream mapping assessment is to identify the main market channel, or the market opportunity moving the largest volume of product for the largest number of producers. The following table summarizes the answers to the main questions presented in the tool on page 15. ***Note: the table includes a quantification of the market channels from 2016, but it was determined during the Lean Assessment in 2020 that the relative importance and proportions remain relevant.

Imported Parboiled	Integrated Rice Miller – Milled & Parboiled	Artisanally Milled & Parboiled	White Rice Milled, but not Parboiled	Broken Rice
1.8 million MT milled rice enters the market	200,000 MT paddy milled	1.3 million MT paddy milled and parboiled for market**	Insignificant volumes	Insignificant volumes
Not relevant for domestic rice producers	20 IRMs ~80,000 rice farmers* Significant donor funding of extension activities to date	~275 artisanal rice mills per major rice producing State (at least 1,000 artisanal rice mills) ~520,000 rice farmers*	Insignificant volumes	Insignificant volumes
Completely separate channel of distribution into market	Mills location influenced by convenience, politics and access to transport of imported brown rice	Artisanal rice milling hubs located in several main rice producing areas with the largest in Abakaliki in Ebonyi		

THESE ARE THE CUSTOMERS AND FARMERS FOR THE LEAN NEXT STAGES

80% of domestic volume goes into artisanal rice milling destined for domestic market

*# of farmers calculated by milling throughput divided by average yield and average plot size (2.5MT/ha; 1ha/farmer). Total farmer numbers are underestimated due to differences in plot size between areas. Artisanal mills likely pulling from significantly more producers. But gives an accurate sense of differences in scale.

** Total milled and parboiled is estimated at 1.7 million MT, but the difference in volume is 'fee for service' for households.

LEAN STEP 2 – PRECISELY SPECIFY WHAT CUSTOMERS VALUE

A precise understanding of value is critical because if producers do not know with certainty and precision what their customers want, their production is less likely to be rewarded by the marketplace. The customer is the only one suited to define value. Customer value is assessed through a consultative and observational process that characterizes the identified customer. The following synthesized customer value sheet includes interviews in Ebonyi and Kebbi with a total of 42 traders and artisanal rice millers (18 men and 24 women.)

What do you want?	When do you want it?	How much do you want?
long and slender (narrow) grains	purchase from markets on market days	Smaller scale female traders buy 15-80 bags/ week
Little to no breakage	most purchased during harvest (November - February)	Most buy at least 15 bags but up to 100 bags/week
limited stones	end of year holidays especially high (December and Easter)	availability in market significantly affects volumes purchased outside of harvest season
clean paddy with little chaff and limited stones		prices not reported to fluctuate significantly from month to month
Note: Few women involved in artisanal milling and they are typically smaller scale. Some processors provide production finance (N50,000 to N200,000 per season) to small scale farmers which they recover when purchasing the rice at harvest. This supports their best producers and secures their volumes. No default reported. One woman actually is offered paddy on credit from her farmers and she pays them on the next market day - social capital is present in the commercial relationship.		

LEAN STEP 3 – VALUE STREAM MAPPING

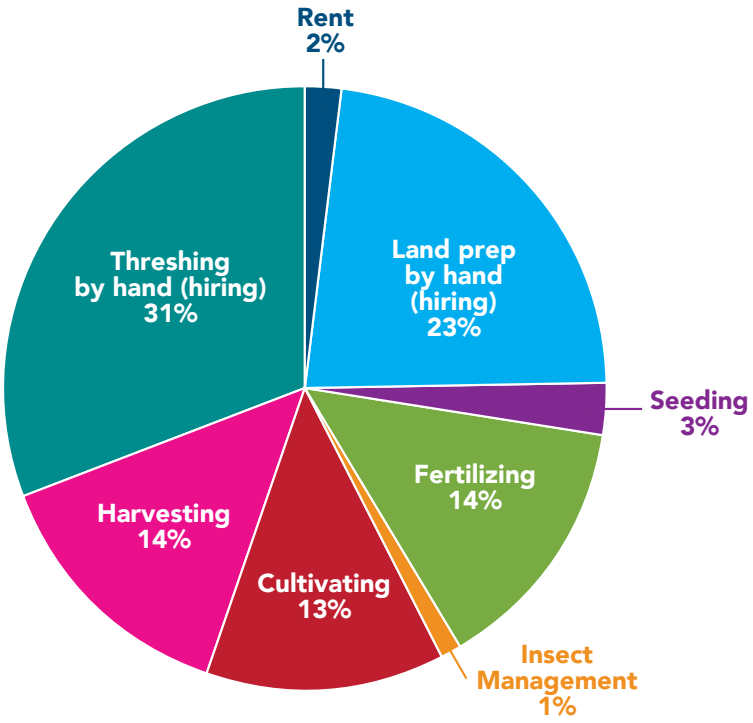
The Value Stream Mapping is an interactive, consultative process resulting in a visual output. The following Value Stream Map is a consolidation of one virtual consultation with rice production expert stakeholders with X farmer focus groups held in person in Ebonyi and Kebbi.

The following is a sample section of the Nigerian rice production value stream map:

The following is an image of the consolidated value stream map with the use of red stars to highlight points of waste and potential solutions – with the number of small stars indicating frequency of mention among the focus groups consulted. This visual map of the smallholder rice production system illuminates 'pain points' where wastes, like unnecessary movement, defects or overburdening, commonly creep in, helping to identify key points of waste and inefficiency within the existing production system.

LEAN STEP 4 – IDENTIFY ACTIONS

The outcomes of the previous three steps of the lean analysis comprise a set of potential focal areas that can eliminate waste while creating the most value at the least cost for the producer. It can be useful to extract additional information from the value stream map to facilitate the discussion (see the key questions on Lean Step 4 on pages 27-28.). In particular for rice, two charts were developed from the VSM to highlight the allocation of out of pocket costs within the production system and the frequency of 'pain points' mentioned in the consultative process of value stream mapping. Threshing was determined to the be best near-term opportunity for the program to intervene for farmer production impact, with SME led mechanical threshing services.



FIELD EXAMPLE: NIGERIAN CATFISH

LEAN STEP 1: IDENTIFY THE CUSTOMER

The first step in a Lean value stream mapping assessment is to identify the market opportunity moving the largest volume of product for the largest number of producers. The team conducted research to find the main market channel – the 'middle of the bell curve' – for Nigeria catfish production. They concluded that the largest number of catfish are sold into the fresh catfish market, and that interventions within this market segment represented the greatest potential for impact at scale.

List Main Market Segments	Fresh Fish Market	Smoked Fish Market
Relative Significance of Each Segment	**70% Delta State; 55% Cross River**	30% Delta State; 45% Cross River
# of farmers in each segment	12,000-15,000 total farmers between the two States, but only a minority sell exclusively into one market channel or the other	
Characterization of Segment	**diverse customer type including small and larger retail markets, informal and more formal food service businesses such as bbq kiosks and restaurants**	up to 3,000 smoked fish processors between the two States, with many small informal businesses
Trade Flows and other considerations	**a higher value market channel with a typical premium of 150N/kg over fish destined to the smoked fish processing segment. Preference for more consistent size and quality of fish**	many smoked fish processors are women; smoked fish is marketed significantly outside of the producing States as it is a less perishable product.

LEAN STEP 2 – PRECISELY SPECIFY WHAT CUSTOMERS VALUE

Next, the team identified customers—those making the buy/no-buy decisions—in the fresh fish market, and interviewed them to determine precisely what they value from the farmer. **Here is the synthesized list of what 24 female and 15 male fresh catfish customers said they valued:**

NIGERIA FRESH CATFISH: VALUE ATTRIBUTES

24 female | 15 male

What do they want?

- Hard fish that stay strong after cooking (possibly to type of water/feed being used)
- Large in size (a few preferred medium but most wanted large)
- Thick skins
- Dark skin color (customers feel darker skins contain more nutrition)
- Big heads
- Clean fish ("cleaned at farm gate," I.e., not "slimy" or dirty at point of purchase)
- Good taste

When to they want it?

- In most cases, toward the weekend (Thursday or Friday)
- 2-3 times per week

How much do they want?

- Most of purchased 10 to 25 kg per visit to a farm/market; 20 kg was the most commonly preferred amount
- Some purchased up to 200 kg per work

Prices

- N500-N820/kg for fresh fish, with N700-750/kg being most common (dried fish prices were N400-N450)
- One buyer commented they will pay N600/kg in the market and N750-800/kg if supplied to point of business, suggesting a value-add in delivery

LEAN STEP 3 – VALUE STREAM MAPPING

LEAN STEP 4 – IDENTIFY ACTIONS

Finally, the team invited expert guests and potential non-profit and SME partners to join in a meeting to review data collected in the previous three steps, with the goal of choosing one or two MIPs. The group also reviewed actor landscape data. After review and discussion, the group determined that **the following 3 points of intervention** represent opportunities for solutions that, if widely adopted, would have the greatest potential to increase productivity, to decrease waste, and to achieve scaled impact.

1. **Juveniles/fingerlings (availability and quality):** Stocking juveniles (bigger than fingerlings) would assure uniform sizes and growth within each pond and reduce sorting time and cost. The period between the fingerling growth into juveniles is delicate and highly prone to mortality. There are, however, fewer hatcheries than the demand in both States. There is also a perception at the farmer level that hatcheries vary widely in the quality of the fingerlings and juveniles offered. This offers an opportunity for hatcheries to both improve availability (quantity) of juveniles and fingerlings and address the quality concerns of the farmers (understanding if it is a perceived or real issue and how the hatcheries themselves can address the customer concern.).
2. **Water management (practice and technology):** Water management in aquaculture ponds is usually done routinely. It is also labor and cost intensive especially when running the earthen pond systems. The use of pH and oxygen measure instruments to determine the oxygen and pH levels help regulate the water changing regimes, saves time and reduces the environmental effect of effluent from the discharged pond water.
3. **Feeding practices (efficiency and effectiveness):** Like pond water management, it is regimented and labor and cost intensive. Over 50% of cost of fish production is spent on feeding alone. Inasmuch as it is a good practice to feed the fishes *ad-lib*, it is sometimes wasteful and can contribute to water pollution. Adopting the Biometric (feeding by body weight) feeding will result in lower cost both in feed and labor and impact water quality.

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Feed the Future Resilient Agricultural Markets Activity – Nacala Corridor

TECHNOLOGY BRIEF:

Mechanized land preparation

Preparing fields with tractors can increase productivity, yields, and profitability of smallholder farmers. The practice has the potential to unlock the value potential of other improved agricultural technologies and practices such as crop specific recommended plant spacing, improved seeds, and fertilizers. Mechanized land preparation services are competitively priced in comparison with hired labor for traditional land preparation practices.

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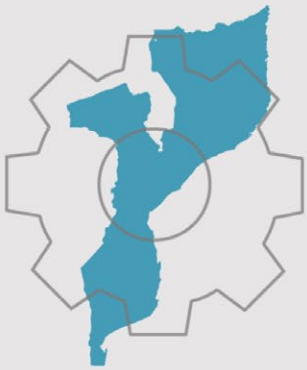

TECHNOLOGY DESCRIPTION

Land preparation prior to planting is intended to develop appropriate soil conditions for the sowing of seeds, and plant establishment and growth. Traditional mechanized land preparation is often thought of as plowing; a package could include subsequent disking, although it may only involve disking with a heavy disk. Mechanized planting can be considered within a mechanized land preparation package although it is far less common in Mozambique.

Mechanized land preparation, using tractors and implements, can:

- increase labor productivity,
- save significant time – critical for on-time sowing,
- where arable land is available, facilitate the expansion of land under cultivation,
- control weeds, and facilitate incorporation and decomposition of organic matter
- facilitate drainage, and
- create good soil conditions for seeds to be sown and plant establishment.

Mechanized land preparation can increase productivity, yields, and profitability of smallholder farmers for a variety of cereal and legume crops.

Traditionally, small farmers in Mozambique prepare the ground using a short-handled hoe, which may not create a consistent soil texture. Labor availability, reliability, and productivity, the time required, as well as the cost are key challenges with traditional land preparation practices. These challenges constrain the size of cultivated land per farmer and farm family, and decrease the yield per hectare. With arable land generally available in Mozambique, mechanized land preparation using a tractor has the potential to expand the capacity of the average farm family to cultivate a much larger surface area and thereby extensively increase production. In addition, the time saved by using mechanization services assists farmers to plant their seeds at the optimal time, not missing the early rains. There is anecdotal evidence that mechanized land preparation facilitates adoption of other technologies, such as sowing in lines at optimal spacing and density. The business case for mechanized land preparation services from the perspective of the small farmers is considered below, but it is important to note that purchase and ownership of tractors by the smallest farmers is not likely a viable solution. Mechanized land preparation services, the hire of mechanized land preparation, is the most viable means of accessing and adopting mechanized land preparation by smallholder farmers.[1]

BUSINESS CASE

For smallholder farmers currently paying for hired labor during land preparation, the cost of mechanized land preparation services is cost competitive with the cost of labor as well as saving time and resulting in a more consistent seed bed. Even small farmers with cultivated areas of 1 hectare or less may hire labor for traditional land preparation. For those farmers using unpaid family labor hiring mechanization services may not be within their capability to pay cash upfront; even if the opportunity cost/benefit is still positive due to the time savings, the ability to expand the area of production, and the quality of the prepared field. Unpaid family labor also often falls to women, taking them from other important responsibilities and opportunities.

The main deciding factor in unpaid labor versus hired labor for the traditional practices is the destination of the crop produced. While there is intercropping in many fields, if the field is predominately destined for household consumption, there is no anticipated cash flow, and unpaid family labor is most often used. If most of the field's production is destined to be sold into a cash market, it is more likely that hired labor will be used, regardless of whether the field is 0.5 hectares or 5 hectares. (Farmers with larger than 5 hectares per cultivated field are considered emerging or small commercial farmers and can be a slightly different customer segment for the mechanization service provider.) The issue of access to the mechanization services is discussed further in the technology ecosystem section below.

Mechanized plowing costs are currently estimated to be between 3,000 MZN and 4,000 MZN/ha (between $50 – $67/ha), and possibly more if the small farmer being serviced is located at some distance from where the service provider is based. Hiring labor for traditional tillage practices costs between 4,500 MZN/ha to 5,000 MZN/ha (between $85 - $75/ha) as shown in the table 1 below:

Table 1. Comparison of plowing cost using human power and mechanization[1]

	Hired labor – traditional tillage practices			Mechanized plowing
	Area (m^2)	Cost (MZN/area)	Total Cost (MZN/ha)	cost per hectare
Tillage in highland region	15m*3m = 45m^2	20	4,440	3,600
Tillage in coastal region	10m*20m=200m^2	100	5,000	3,600

Many producers and service providers start with plowing because this is the most well-known and demanded of the implements. Disking or some type of further labor is also required to break up the large soil left by the plow and create a smoother seedbed for planting. Disking costs an average of an additional 3,000MT/ha. Including plowing and disking within a package may have a higher cash cost than hired labor for traditional practices, but a simple cash comparison does not account for the saved time and other non-cash cost benefits.[2]

[1] Based on Eficiencia de Maquinas Agricolas; K. Vaz, 2017 and compared to the data collected in the field.
[2] There is now some experience where service providers recommend only 'heavy' disking (placing large weights on the disk to increase the depth) as a cheaper and more appropriate option in certain soils. This experience should be promoted if producers repeat the purchase of this service in subsequent seasons as it will reinforce the smallholder farmers are finding value in the practice.

In addition, traditional land preparation practices often involve the hilling or ridging of fields with crops planted atop. Where this practice occurs, the producers are most often not able to follow crop specific plant spacing or optimal plant density recommendations. Planting in line and following plant spacing recommendations is the technology or practice most often mentioned by producers in conjunction with their adoption of mechanized land preparation. While there hasn't been research within Mozambique specifically looking at mechanized land preparation alone or which technologies and practices are most likely adopted with mechanization, producers are sharing stories of significant yield increases from adopting only these two practices together (with adoption of plant spacing only possible after utilization and purchase of mechanized land preparation): producing from 4 bags of rice to 43 bags of rice and from 10 bags of maize to 34 bags of maize, on the same area, using their same farmer saved seed.[3]

Mechanized land preparation has the potential to unlock the value potential of other improved agricultural technologies and practices for smallholder farmer investment. But this is likely only true for fields where the majority of the production is destined for cash markets.

POTENTIAL SCALE

As noted above, one key factor in determining the potential scale of demand for mechanized land preparation services is the area under production of crops destined for cash markets. This would include extensively raised cereals and legumes such as soy, maize, common beans, and significant areas of groundnut production. Demand for mechanized land preparation services for fields largely producing products for household consumption will remain very limited. The general experience in the Nacala Corridor is that many smallholder farmer families will have plots that fit into each of these categories; for cash markets and for household consumption. As such, many farmers might be expected to hire mechanization services for some of their cultivated area, but not all of it. With tractor ownership still very limited, even emerging farmers (those with at least 5 hectares of production destined for cash markets and in a block) are likely to be a potential market for mechanized land preparation services, until they grow and can access affordable credit terms for purchase of their own equipment.

Producers who would normally pay hired labor to traditionally prepare land save time and money as well as significantly increasing crop yields by hiring local tractor services to prepare their land.

On the supply side, there are still relatively few tractor and implement owners across the Nacala Corridor. There are very few completely privately owned and privately financed tractors and most of these are not oriented to providing services to paying smallholder customers. TechnoServe has facilitated some emerging farmer tractor and implements purchases with a combination of donor funded grant contributions, farmer down payments, and commercial bank finance. There is an assumption that at least part of the tractor operation hours will be used to sell mechanization services to smallholder farmers near the emerging farmers' lands.

[3] Individual smallholder farmer experiences documented during FTF RAMA-Nacala Corridor field consultations.

The World Bank funded SUSTENTA program intends to build on this experience by facilitating an additional 100+ emerging farmers with concessionary finance to purchase productive equipment which may include tractors and implements (although other equipment and infrastructure is also available through the program.) Public sector institutions, namely the FDA and ADVZ, facilitated concessionary finance and equipment rates for the purchase of tractors and implements by individuals, institutions, and service provider businesses (who competed and were awarded the rights.) Finally, ETG, a large grain trading company active across the region, recently built and opened warehouses and input shops with USAID support. A part of that agreement was equipment rental operations, but it isn't clear when or if that will be implemented in each district.

The main constraining factor to access to the services is the number and location of service oriented tractor and implement owners in the Corridor. The supply side of mechanized land preparation services is the principal constraining factor and will likely grow slowly, as discussed in the section below.

TECHNOLOGY ECOSYSTEM

In order for smallholder producers to utilize mechanized land preparation, there must be both sustained and reliable access to affordable services, and a supporting framework of complementary services and information. With the supply of mechanization land preparation services an important constraining factor, the ecosystem analysis that follows initiates with consideration for the service providers, critical in terms of providing access.

Service provider landscape

Reliable access to mechanized land preparation services by smallholder farmers requires profitable and efficient service oriented service providers. Potential service providers include both current and future tractor owners.

Current owners include individuals who received the technology from an FDA program that established a total of 90 Agricultural Services Centers (CSAs) to complement the 44 CSAs established by the Agência de Desenvolvimento do Vale de Zambeze (ADVZ), 17 private CSAs and, 27 public CSAs. Altogether these CSAs resulted in the provision of 584 tractors and complementing agricultural implements. Depending on the conditions of that program, these could contribute significantly to agricultural development in Mozambique.

Table 2. Number of tractors with CSAs in Mozambique in the period of 2016 to 2017[4]

	# of machineries or implements per region			
Machinery / Implement	South	Centre	North	Total
Tractors	162	294	138	584
Plows	162	294	138	584

[4] Modified from Ponto de Situação do Programa Nacional de Mecanização Agrária; 2017

While these might be assumed to be completely service oriented, the strength of the service centers as businesses as well as their orientation to smallholder service provision varies significantly.

Some emerging and larger commercial farmers and non-farmer private entrepreneurs possess the necessary financial resources to privately purchase tractors or are able to access some type of concessionary financing through donor funded programs (such as FinAgro.) The risk associated with the considerable investment in the technology is shifted to wealthier members of society. Anecdotal evidence suggests that a very limited number of large farmers, after the purchase of a tractor for use on their own farms, provide commercial mechanization services to smaller farmers. Even medium or small commercial farmers that may own tractors are primarily focused on their own production; and may only provide inconsistent or unreliable service to a few other farmers, depending on their schedule and personal production needs and priorities.

Other critical factors for service provider success includes knowledge of and rigorous adherence to maintenance schedules and routines. Because there isn't a strong culture of tractor ownership and tractor owners may be quite distant from each other, there are misperceptions and lack of exposure to the maintenance requirements and cost effective operational due diligence required by these businesses. Also, particularly outside of Maputo and to some extent Manica Province, there are very, very limited skilled and experienced mechanics or mechanic services. Parts must be flown in, if the tractor owner or operator is able to diagnose the particular issues. This adds both cost and time to operational expenses.

Because the FDA and ADVZ have supported a single tractor brand, there is the beginning of a volume of equipment that at some point should warrant a parts outlet and the development of skilled mechanics, but this has been a significant challenge and ultimately a critical flaw in previous mechanization promotion schemes, both here in Mozambique, as well as in other parts of Africa.

The commercial banks have been involved in some of the smallholder focused service oriented tractor and implement purchases, but they have been complemented by subsidized donor down payments, concessionary rates or purchase prices, and may still lack information on what a successful and efficiently executed business should have as turnover. There are also seasonality concerns for the business model, as land preparation, the focus on this technology brief, is the most well-known and demanded of the mechanization services. A tractor and implement owner will need to have the asset operating over more of the year in order to reach profitability and ultimately provide cost competitive services to the smallholder customer.

Demand characteristics

Smallholder farmers are showing significant interest in hiring mechanized land preparation services for cultivated fields producing for a cash market. That said, there has been limited direct experience with mechanized land preparation services among this market. Some smallholder farmers are aware of mechanization services that might be procured in their areas, but may have the perception or previous experience that tractor owners prioritize their own production first, and thus the smallholder farmers are left without reliable scheduling and unmet expectations. Consistent and reliable service will be critical for building and meeting smallholder demand.

Smallholder farmers are not familiar with what tractors of different sizes and with different implements are able to do or not do. In clearing land for cultivation, small farmers will often leave trees in the field and work around them or cut the tree and leave the stump. When small farmers are told they need to remove the stump prior to

a tractor entering, they may believe that cutting the tree and stump to ground level or just below ground level, (perhaps covering the remaining stump and leaving the root mass intact) is sufficient. This is a fairly common cause of tractor damage, and tractor service providers are now improving their scoping of fields prior to entering. Stumps pose a significant hazard to their equipment. At times, the operators themselves are not well trained on the importance and risks, and enter fields if farmers offer a few more meticais as a personal incentive resulting in tractor damage.

To make service provision more economically viable to them, some service providers require a certain number of hectares be either co-located in a block or that neighboring farmers organize a minimum demand within close vicinity of each other. The SDAEs and extension agents in some areas are working to provide this facilitation and information to the smallholder producers on behalf of the service providers.

Finally, smallholder farmers who pay for hired labor often pay piecemeal over the period of the month or even 3 months that it takes to complete the preparation. Paying out each day as the units are completed spreads out the total cost. Many farmers will initially comment that the hiring of mechanization services if very expensive, as it is a lump payment of cash up front. But with basic consultation, the producer quickly adds the total cost (as well as inconvenience) of hired labor and develops an interest in mechanized land preparation services. Alternative payment models being tested by service providers include credit (one individual service provider with a single tractor is providing his services on credit as he has strong personal relationships) and pre-payment during the previous harvest. Another partnership that could be useful would be to utilize savings groups in smallholder demand development (with the above information regarding field preparation, prices, and co-locating and organizing service demand.)

Sizing and segmenting of the mechanization service market will assist the service providers to have more confidence in the demand for their service and help them to identify areas and individual farmers or groups of farmers who are able and willing to pay cash for the service. Ultimately both the customer demand and the consistent and reliable access must be served by the technology ecosystem to facilitate utilization and adoption by smallholder farmers.

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Feed the Future Resilient Agricultural Markets Activity – Nacala Corridor

TECHNOLOGY BRIEF:

Optimal Plant Density and Spacing

Achieving optimal plant spacing and density within a producer's field can increase productivity, yields, and profitability of smallholder farmers for a variety of cereal and legume crops. Achieving optimal plant spacing and densities for each crop produced may increase planting associated costs slightly, but will result in higher efficiencies and lower costs in subsequent aspects of the production cycle. It is also a required practice to maximize return on other production related investments.

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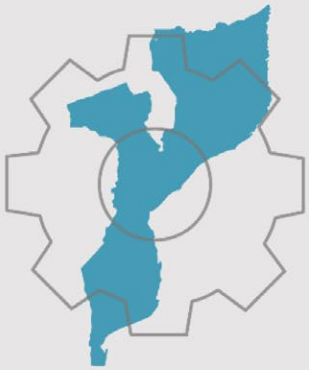

TECHNOLOGY DESCRIPTION

Planting seeds as a fundamental agricultural practice is intended to evenly space plants within the production area, so that each plant performs and produces to its potential. Plant spacing and plant density are factors that determine crop yields and can influence production efficiency. Sowing practices to achieve optimal plant spacing for field crops involves planting in rows and may be either by hand or mechanical seeding, although mechanized planting is very rare in Mozambique.

Achieving optimal plant spacing and plant densities for the crop under production can:

- allow each plant to achieve its productivity potential with its share of water, space, and nutrients,
- reduce time spent weeding and in other production practices through use of rows,
- control weed growth as plant canopies close and reduce seed waste.

Achieving optimal plant spacing and density within a producer's field can increase productivity, yields, and profitability of smallholder farmers for a variety of cereal and legume crops.

Traditionally, small farmers in Mozambique plant either using broadcast sowing or sowing seeds in individually dug shallow holes. Broadcast sowing is most common in rice, sorghum, and sesame, where the seeds are particularly small. Maize and legumes are usually sown in a random pattern of shallow holes dug for a few seeds in each. This random planting may be used along the tops of irregularly prepared ridges, which further inhibits achieving optimal spacing and density. Convenience and speed during sowing are the principal factors in the traditional planting practices, while convenience, speed, and productivity are most often negatively impacted later in the growing cycle by the same practices.

Optimal planting densities vary widely between different crops and may vary between varieties of the same crop. In addition, adjustments are needed based on the soil and climatic conditions. Small farmers in Mozambique may plant up to 50% below the recommended plant density for the crops. Having too high a plant population, over the optimal recommendations, can have an equally negative effect on yields and profits. But the sowing practices of using rows and following basic spacing guidelines by type and variety of seed are important for the main cereals and legumes in Mozambique and are easily implemented either by hand or using mechanized planting services.

In Mozambique, many farmers plant multiple crops in the same field. Optimal plant spacing recommendations are available for many of the common intercropping combinations and therefore intercropping is not a constraint to adoption of this practice.

BUSINESS CASE

There are four main aspects to evaluating the business case for small farmers in applying the planting practices necessary to ensure optimal plant spacing and density for a given crop:

- cost and labor associated with achieving optimal plant spacing,
- the efficiency of other production practices impacted by planting practice,
- plant productivity, and
- the optimization of seed and other purchased inputs.

As noted previously, the traditional planting practices of randomly planting in shallow holes across the field or on prepared ridges is largely for convenience and to save the time and labor required during planting. This practice results in relatively low plant populations and uneven plant spacing. Planting in rows at optimal spacing will require additional time and attention to detail. In the event that planting utilizes hired labor, this will be an additional cost over traditional practices due to increased time required. Hired labor often is less efficient or attentive to planting specifications than the farmer and the farming family themselves. Utilizing mechanized planting services can decrease the time required and ensure that optimal plant spacing and planting in rows is quickly achieved.

Traditional planting practices which are lower cost and prioritize convenience and time often result in higher time and labor requirements at other points in the production cycle. The uneven and low density traditional planting practices do not allow for the plant canopy to develop and close and result in increased weed production. Proper spacing reduces weed growth resulting in lower labor requirements during weeding, and planting in rows increases the efficiency of weeding motions and therefore labor savings.

In addition, excessively low or high plant densities within a field result in poor yields. Low plant populations often have increased plant competition from weed development or may simply have an overall low yield due the low number of plants per area available for the harvest. In addition, some moisture loss due to evaporation may result from exposed soil within the field. Excessively high plant populations result in competition between plants for the water, space, and nutrients required for production. Yields per plant will start to reduce after optimal plant densities are exceeded. Crop and variety specific plant spacing recommendations are intended to address these variables and optimize the productivity potential of the seed. Optimal plant spacing and density recommendations exist for all crops and varieties, and general guidelines can even be obtained for farmer saved seed (the landrace varieties most commonly used.)

Other cash investments in purchased inputs likely will not deliver expected results without following the recommended plant spacing for the crop. Purchased seed, fertilizer, and agro-chemicals will almost always be at the wrong application rate with traditional planting practices. Achieving recommended plant spacing and densities for the crop and variety being produced is complementary to investments in purchased inputs. The investment in purchased inputs (seeds, fertilizers, and agro-chemicals) will likely not achieve the positive return on investment expected.

Achieving optimal plant spacing and densities for each crop produced will likely increase planting associated costs slightly but result in higher efficiencies and lower costs in subsequent aspects of the production cycle, including weeding. It is also a required practice to maximize return on other production related investments, particularly purchased inputs such as seeds, fertilizer, and agro-chemicals.

POTENTIAL SCALE

The majority of small farmers in Mozambique use traditional planting practices resulting in uneven, and, most often, relatively low plant populations. Applications of optimal plant spacing and density recommendations are found, although in small areas relative to overall production, in monoculture production of more recently introduced crops or in crops having received a significant and extended extension investment. The cereal and legume crops where some application of optimal plant spacing recommendations are observed include small farmer monoculture production of sesame, soy, and maize. Extending application of optimal plant spacing recommendations within monoculture production is likely to represent earlier adoption of the technology. Plant spacing and density recommendations for monoculture crop production are also largely available for both highlands and coastal soils and production contexts here in Mozambique.

While monoculture cereal and legume producers are likely earlier adopters of optimal plant spacing recommendations, general plant spacing and density recommendations are available for common intercropping combinations practiced here in Mozambique (producing multiple crops in the same field with plant spacing, density, and crop selection guidelines can be considered intercropping). Each farmer that produces multiple crops in a single field may prioritize one or more crops over the others planted for practical household or market reasons. This results in variations in emphasis of one crop over another between fields that have similar cultivar choices. As an example, one farmer may choose to use a single field to produce groundnut, pigeon pea, and cow pea, but prioritize groundnut, the main crop for market. The next farmer may produce more cowpea and pigeon pea, but only limited groundnut. These variations increase the complexity of applying optimal plant spacing recommendations.

There are two dimensions to potential scale within the context of intercropping – the availability of researched and context specific (at least general highlands, coastal, mixed soils and agro-ecological zone) intercropping plant spacing and density recommendations AND the ability of the small farmers to access and apply the recommendations as they shift the crops under production and the prioritization of each crop within their field with each crop cycle. Two crops with equal prioritization in terms of area is a relatively easier set of guidelines both to produce and follow than more crops in a single field with varied prioritization in area per crop. Most small farmers produce multiple crops in a single field and vary the combination of crops and their prioritization of area devoted to each crop with each crop cycle. While research and agronomic expertise have developed plant spacing and density guidelines for the possible crop combinations, they tend to be general OR specific to a particular agro-ecological or soil context.

The utility of optimal plant spacing and density recommendations are unquestionable, even in these intercropping situations, but the dynamic nature of the different crop combinations, varieties, and prioritization, even at the individual farmer level, creates complexity that will likely limit potential scale outside of a few common intercropping combinations. Identifying the most common intercropping combinations will be required to unlock additional demand (application) and supply (research and dissemination) of optimal plant spacing recommendations.

TECHNOLOGY ECOSYSTEM

For smallholder producers to apply optimal plant spacing, the optimal plant spacing recommendations for the crop or intercropping must exist and those recommendations must be easily accessible and implementable.

The ecosystem analysis that follows initiates with consideration of the research and availability of the recommendations, and then considers the dissemination options available to communicate them to producers.

Research

Agricultural research is done by national agricultural research services, IIAM (Instituto de Investigacao Agraria de Mocambique), the main agricultural universities and technical institutes, seed companies, and a handful of seed and fertilizer-related donor programs. Optimal plant spacing research should span numerous crops, varieties, agroecological contexts, soil types and conditions, and even production practices, such as conventional tillage versus no-till. However, the overall level of investment in agriculture in Mozambique remains fairly low, which limits the resources available for research and increases the cost of such an undertaking.

Due to the higher cost and limited resources available for research, researchers must prioritize the lines of inquiry. In the public sector particularly, agricultural research inquiries are heavily influenced by funding interests. For instance, the international agricultural research institutions in Mozambique such as the International Institute of Tropical Agriculture (IITA) and the International Maize and Wheat Improvement Center (CIMMYT) are active with donor-funded programs. Due to the many potential variables that can affect optimal plant spacing, research in Mozambique must prioritize general recommendations over more specific and tailored recommendations.

Resources and priorities within public sector and private sector research generally limit the available specific recommendations to monoculture and newer seed varieties. The complexity of agroecological zones, soils, intercropping, and farmer saved varieties (or planting material) are often not considered with sufficient detail and only dated or general guidelines exist. On the other hand, optimal plant spacing recommendations often come from varietal breeders whose research fields involve several production practices, such as fertilizer, irrigation, land preparation, weeding, that are not common in farmer's fields. While different spacings are often included as points of analysis in this research, all research institutions are particularly constrained in the level to which they are able to test one particular production practice.

Donor funded programs and the private sector have largely focused on monoculture production research. While the potential scale characterization above emphasized monoculture production as the likely focus of earlier adoption of the optimal plant spacing practice, it remains less common among smallholder producers and largely focused in only a few crops. Multiculture, or the production of multiple crops within the same production area is most common. IIAM and public-sector research do have general plant spacing recommendations for the most common intercropping combinations of a single legume with a single cereal. Even these recommendations though are general agro-ecological zone and may not include research involving the most common farmer saved seed.

Because formal agricultural research investment has received significant funding for crop genetics and improved varietals, more of the plant spacing and plant density recommendations are specific to the newer varieties, including the intercropping recommendations. Formal sector seed though does not yet have any significant market share. According to the African Seed Access Index's Mozambique Brief 2017, the adoption of improved varieties for maize, rice, and cowpea are below 10%. Only soy production has any significant adoption of newer genetics, with 89% of production using improved varieties.

While varieties are one variable for optimal plant spacing, soil types and production systems are others. Soil testing and mapping is both dated and overly general in Mozambique. Individual donor investments in updating and improving soil mapping with tests have not been comprehensive enough to be broadly useful to research in spacing or shared in an easily accessible way.

Private sector agricultural research in Mozambique is largely limited to the seed companies. They are in close communication with public sector research but also rely heavily on regional research, including from neighboring countries, to source general plant density and spacing recommendations. One local seed company has shared their own challenges to multiply the seed under the best existing production recommendations and successfully obtain the yield potential of the varieties. They are running their own localized plant spacing and plant density trials to better adapt the more generalized recommendations to their soils and agro-ecological context.

Even with these limitations and challenges, public and private sector research plays a critical role in the agricultural ecosystem, with public sector extension programs, donor funded extension programs, and more formalized farmer associations relying upon this research as the source of agricultural practice recommendations, including optimal plant spacing and plant densities.

Dissemination

Optimal plant spacing recommendations can be disseminated to producers through various means and by various ecosystem players, each with its own benefits and limitations. Broadly speaking, the optimal planting spacing recommendations can be disseminated verbally or through written form.

Recommendations that are written can be standardized and easily copied in mass, diminishing the possibility of human error as the information is disseminated to the producer. According to the Feed the Future Mozambique Zone of Influence Baseline Report (2014), about 55% of the rural households in the districts surveyed have only primary education level or less. These households, as well as even some with higher education levels, will struggle to understand and apply practices communicated in written form. Another constraint of non-digital written communication is that it is a one-way communication too l- it is not be possible to assess comprehension or to answer questions and further engage the producers.

Verbal communication is helpful in that it can potentially be understood by a larger population that includes illiterate people. Viamo's Mozambique based 3-2-1 cellphone-based information platform reports that IVR, interactive voice response, is accessed significantly more frequently than their written information options. In-person communication allows for a dynamic exchange of information, where producers can ask questions and disseminators can address doubts. The risk to verbal dissemination is that the optimal plant spacing recommendations can be distorted between as it is communicated from person to person. For instance, recommendations initiated from research conducted by a seed company, may be passed to various company employees, who in turn train agrodealers that work with the company, and ultimately, perhaps with a few more exchanges, passed onto farmers in their local villages. In practice, information should be disseminated in both forms, as they compliment and reinforce each other, and through multiple ecosystem players.

Seed companies and agrodealers are two ecosystem players that have access to producers and a vested interest in optimal plant spacing. Optimal plant spacing and plant density recommendations could be communicated verbally to producers at the point of sale or through seed packaging. The seed companies and agrodealers would benefit from an increase in seed sales and the improved perceived success of the seeds as

the optimal spacing increases crop yields. However, the low adoption of improved varieties and even lower formal seed sales severely limit the usefulness of this pathway for practice dissemination. As noted above, soy enjoys perhaps the highest adoption of improved varieties, at 89%. But soy is still a fairly new crop in Mozambique, having grown from a minimal production of about 1,000 MT about ten years ago to approximately 50,000 MTs this year. While the production has largely adopted improved varieties, there is still significant farmer seed saving from year to year.

Donor extension programs and private sector seed companies also rely heavily on demonstration plots to transmit recommended production practices to producers. Various production practices and products can be simultaneously implemented in these demonstration fields, making it difficult for the farmer to evaluate the impact of each individual practice or component. Even if optimal plant spacing were to be practiced in these demonstration plots, there is no guarantee farmers would attribute value to the practice and would be interested in adopting it.

Public sector extension agents have limited resources or incentives to proactively engage the smallholder farmers within their areas. The Ministry of Agriculture estimates that public extension services reach only eleven percent of producers. Typically, extension workers' information is outdated, does not target high potential crops, and is not informed by national development plans. In Nampula province, thirty-eight government extension agents serve 80,000 producers, a ratio of 1:2,105. The extension system at the district level do have outreach days to encourage interaction and information dissemination, which typically takes the form of district level field days at periodic points in the agricultural calendar. That said, farmers often must be proactive to procure extension information from extension agents, which is not usual.

Another way that production practices are disseminated is through community radio, though community radio interest and resources are also limited. While the public sector extension intends to develop relationships with community radio to facilitate the dissemination of relevant agronomic information, radio dissemination is often limited to intervention by NGOs and donor funded programs.

Finally, it is important to note the informal information dissemination as farmers share their practices and new learnings with other farmers. Optimal plant spacing recommendation dissemination from farmers is powerful in that it can have a broad reach and because their recommendations may hold more weight with other farmers. The risk is, as with any verbally disseminated communication, that the recommendations will be distorted in the process.

Strengthening optimal plant spacing recommendations, combined with complementary dissemination strategies that utilize existing networks and overcome limitations of resources will support farmer access to the necessary practical information for increased adoption.

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