Market System Measurement Toolkit

Market System Monitoring Activity

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CONTENTS

0 INTRODUCTION

0.1 PURPOSE

This toolkit's purpose is to support the measurement of system status and change in systems-oriented development projects. Measuring change in a market system (or another complex development system) is challenging because of the system's complexity: it is difficult (1) to know which parts of the system to measure and (2) how to interpret what a collection of diverse measurements tells us about change in the system.

To address both of these challenges, the System Pathways Measurement Toolkit relies on a system map to capture the structure and interconnections of the system, then layers measurements onto the system map to enable the collective interpretation of diverse data on wide-ranging parts of the system. Tools are provided to interpret the measured map by zooming in and out to understand the progression of change in the system, diagnose problems and explain success. Guidance is provided in deciding which parts of a complex system to measure and in developing indicators that can be interpreted easily on the map, based on either available or to-be-collected data.

0.2 WHEN TO USE THIS TOOLKIT

This toolkit was designed to support systems-oriented development projects in particular, in which interventions may span far-flung parts of a complex system and require several steps to reach the ultimate beneficiary. The toolkit is appropriate for several scenarios:

1. *During the design of new development projects*, to assess the evidence base and identify barriers, gaps, and leverage points as opportunities for investment (see Sections 6.5.2 and 6.5.4)
2. *At the start of a new development project*, to design a monitoring and learning strategy and/or to assess the baseline status of the system (see Sections 6.5.3 and 6.2)
3. *During a development project*, to assess changes in the status of the system, troubleshoot problems, and adapt interventions (see Section 6.5.1)
4. *During or toward the close of a development project*, to communicate its impact and challenges (see Section 6.5.5)

This toolkit may be used in its entirety to support monitoring and adapting an entire development project, or it may be used in smaller-scoped applications to support specific purposes. The purposes include:

1. Assessing data availability and data gaps (Modules 1 and 3).
2. Determining which parts of a system to measure (Modules 1 and 2)

3. Designing a monitoring and learning strategy for a development activity (Modules in Figure 1, right side)

4. Diagnosing problems with a development activity (Modules in Figure 1, either side)

5. Identifying barriers and leverage points in a system (Modules in Figure 1, either side)

6. Communicating impact or barriers (Modules in Figure 1, either side)

0.3 STRUCTURE OF THE TOOLKIT

This toolkit is divided into modules, some of which must be completed before others: for example a system map (Module 1) is required before any other modules can be completed. Figure 1 shows different orders in which the modules can be completed, depending on your purpose.

If no new data needs to be collected, for example if your goal is to understand the current status of the system, then you can complete Module 1 to create a system map as a basis for measurement, Module 3 to measure the map with existing data, and Module 6 to interpret the results. Optionally, you can add Module 2 before Module 3, if you want to focus your measurement efforts only on key parts of the system.

If you plan to collect new data, for example if you are designing a monitoring and evaluation strategy for a new development activity, then you can first complete Module 1 to create a system map as a basis for measurement. Next, you have a choice between Module 2 to determine which parts of your system to measure or Module 3 to assess existing data and data gaps first. Following the completion of both modules (or, optionally, skipping Module 3), continue with Module 4 and Module 6 to collect data and interpret the results.

0.4 HOW TO USE THIS TOOLKIT

The first step is to select the modules you need to complete based on your purpose, as described in Sections 0.2 and 0.3, above, and in Figure 1.

The activities described in each module can be carried out in multiple ways: typically, either by a single person or small team, or through a facilitated workshop or series of workshops. We have found it most effective to have a small team managing the process, but host broader workshops at key points: to identify parts of the system to measure (Module 2), to assess data availability and data gaps (Module 3), and to interpret the measured results (Module 6).

The toolkit depends on system maps with data and metadata attached to each element of the map. We have developed templates in an online tool called Kumu (kumu.io), which has proven excellent for easily interpreting maps and highlighting data in different ways. We highly recommend that you use our Kumu templates to support the process (see the System Pathways Toolkit Annex. We typically use paper maps and pens for workshops, sometimes with clear plastic over the maps

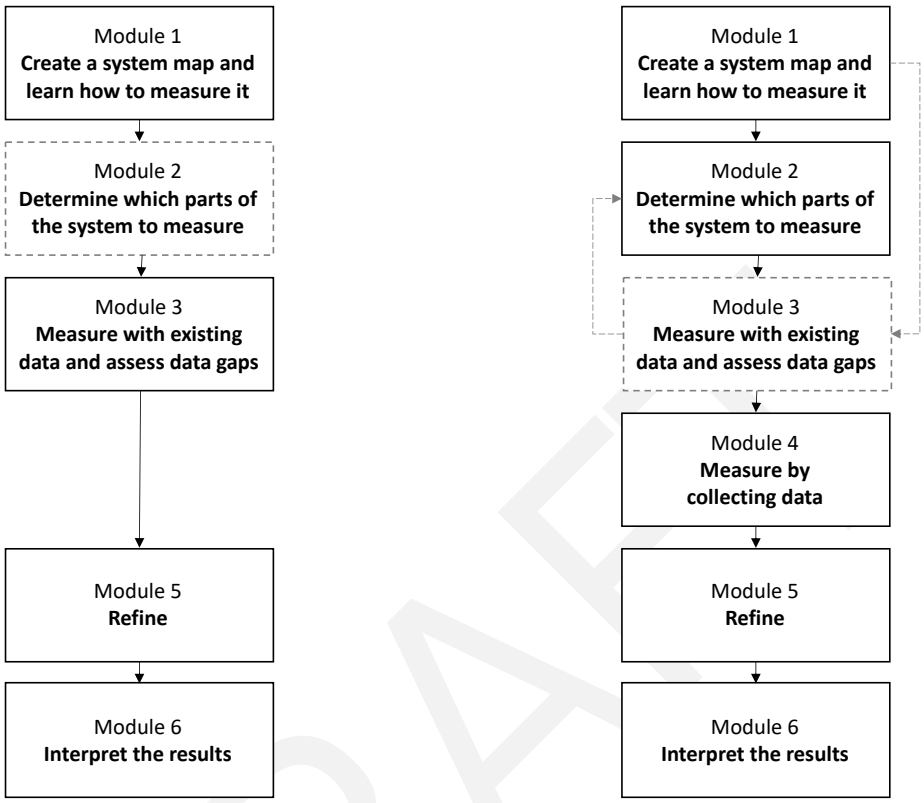

Figure 1: This toolkit can be used in different ways: measuring only with existing data (left) or by collecting new data (right).

to enable drawing and erasing, then transfer the results to Kumu for interpretation and reference. You can, of course, create maps on paper or in PowerPoint, and keep the data and metadata in Excel, but this is much more cumbersome to maintain and harder to interpret.

Finally, a warning: this process is complex. We found that simpler strategies were not able to create concrete, repeatable interpretations of system status. Good storytellers can look at any mess of data and tell a story, but this process provides a systematic approach to doing so that will be repeatable over the life of a development project and across such projects. However, carrying out these steps is non-trivial. It may be worth enlisting people with expertise in the process to support your implementation of it, and in particular to facilitate workshops and manage the process and maps.

Our team hopes that you find success and insight through this toolkit. We are very open to questions and feedback, and we consider the toolkit to be a "living document" that will change as we discover new techniques and approaches that improve it. Please contact us at msm.uganda@mit.edu.

1 CREATE A SYSTEM MAP AND LEARN HOW TO MEASURE IT

Objectives

1. Recognize why the system map is a good basis for system measurement, and find guidance for creating one
2. Understand how to measure map elements by extent of adoption

Prerequisites None

Products A system map with pathways identified. Understanding of how to measure map elements.

Steps in brief

1. Use the mapping toolkit to create a map of your system
2. Learn how to measure map elements by extent of adoption.

1.1 WHY DO YOU NEED A SYSTEM MAP?

Measuring change in a market system is challenging because of its complexity: it is difficult (1) to know which parts of the system to measure and (2) to interpret how those measurements tell us about change in the system (see Module 0 for more discussion on this topic). A system map can aid in overcoming both these challenges. The system map shows the connections between each measured element and the rest of the system, and thereby enables both a visual and analytical interpretation of the connections between measurements and the system as a whole. Therefore, a system map is used as a basis for measuring the system.

1.2 MAKING A SYSTEM MAP AS A BASIS FOR MEASUREMENT

We suggest using the type of map described in the System Pathways Mapping Toolkit, with pathways identified and labeled (as in Section 2 of the Mapping Toolkit). This will provide a clear structure for interpreting the measurement data.

The Mapping Toolkit also provides guidance and resources for reading this type of system map (see Section 2), and for creating one (see Section 4). If you do not already have a map of your system, please create one using the Mapping Toolkit. The following paragraphs provide further guidance on developing maps appropriate for use as a basis for measurement.

The system map should describe the system in a manner that captures the many possible "pathways" or sets of changes that are likely to enable (or prevent) change. This may include linear pathways from interventions to outcome and/or

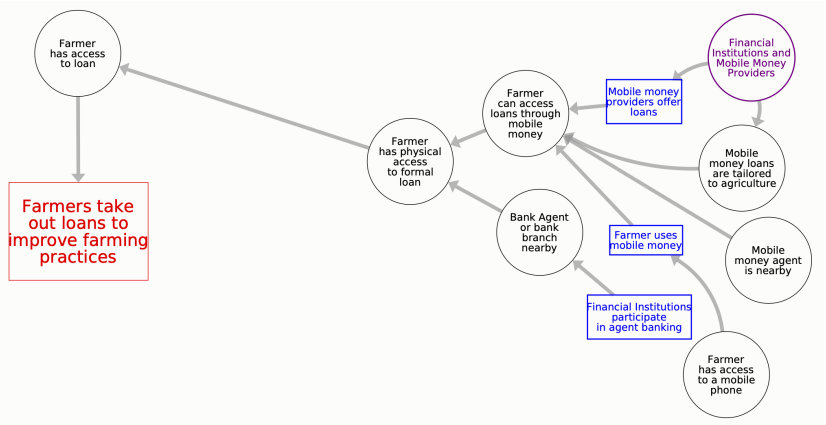

Figure 2: Example of one pathway taken from a larger system map of agricultural financing

loops in which change begets further change. For example, Figure 2 shows one linear pathway from a larger system map of agricultural financing.

1.2.1 Map scope and detail

It is worth asking how much of the system should be included (scope) and how detailed the map must be, in order to be a good basis for measurement.

In terms of **scope**, the map must include (1) the immediate outcomes of any existing or envisioned development activities, along with (2) the intervention points at which the activities act to change the system, (3) major steps from intervention to outcome, and (4) any other elements that might affect the outcomes, the interventions, and the steps in between. (If a specific development activity has not yet been defined, the map should include envisioned outcomes, potential leverage points, and any other barriers or opportunities that may affect the outcomes.)

Which outcomes should be included in the map's scope? Facilitative development activities often aim to affect some parts of the system in the short term, such as enabling input dealers to stock quality seeds. In doing so, they hope to affect other parts of the system indirectly, such as enabling increased farmer incomes. We label the latter 'long-term outcomes' because they often occur past the end of the development activity, and the former 'immediate outcomes' because they are expected to occur within the lifetime of the development activity. The system map's scope must, at minimum, encompass the immediate outcomes, and, if feasible, should also encompass the long-term outcomes.

Which interventions, leverage points, and other barriers or opportunities should be included in the map's scope? It is important to include anything that might reasonably be expected to influence the intermediate and long-term outcomes.

In terms of **detail**, we have found that maps should depict the major changes required to achieve the immediate outcome based on the intervention, and that 2-4

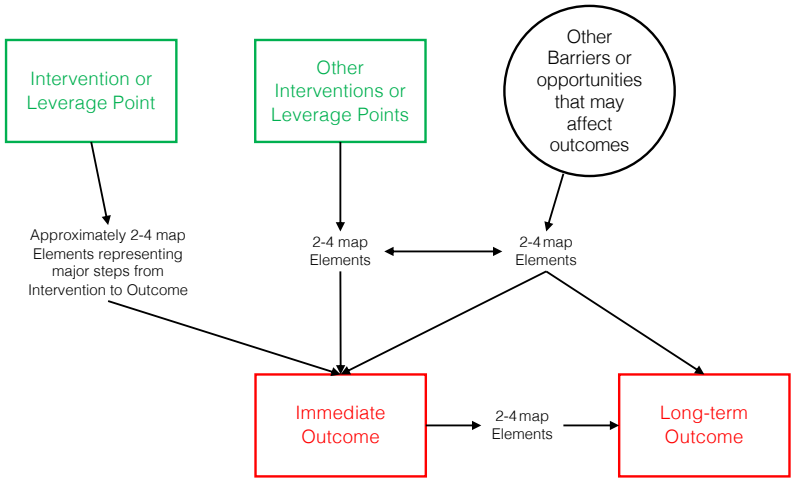

Figure 3: Illustration of appropriate scope and level of detail for system maps

map elements between the intervention and the immediate outcome are usually (but not always) sufficient. Another 2-4 map elements may be needed to reach the long-term outcome from the immediate outcome.

Figure 3 summarizes this advice on map scope and level of detail. Example 1 provides a more detailed example on choosing scope and detail, based on MSM's experience in Uganda.

Example 1: Selecting scope and detail for the finance map It is important to appropriately choose the scope and detail for a map that is to be used as the basis for measurement. Figure 2 provides an example pathway from the financial subsystem, which deals with physical access to formal loans. Many choices were made regarding scope and detail; a few examples are discussed here.

In terms of scope, which *outcomes* were included? We included the immediate outcome of farmers taking out loans, but not the longer-term outcomes of higher income and better yields for the farmer, because our focus was on financial access. Which *interventions*, *leverage points*, and *barriers/opportunities* to include? In this single portion of the map, which is focused on physical access (to formal financial institutions), it was important to include the two major routes to access: physical bank branches/agents or mobile money. (Note that this is just one portion of the larger map, which also includes many other leverage points and barriers; see Figure 10, below.) Also regarding scope, one branch of the pathway begins with 'Financial Institutions participate in agent banking'. The choice was made *not* to include the system features that enable agent banking, to preserve the simplicity of the map. This leaves the focus on the features that directly enable physical access to formal loans: agent banking and mobile money. If, however, the agent banking element were to emerge as a problem or barrier when the system is measured and analyzed,

we would add to the map the features that enable (or block) participation in agent banking, in order analyze and measure them more explicitly.

In terms of level of detail, it is possible to describe more details in most of the branches of this pathway, for example detailing different types of relationships between financial institutions and mobile money providers, or different ways mobile money loans could be tailored to agriculture. However, because our goal in measuring against this map is to understand which general pathways are working to enable access (if any), we do not need the details in each branch of the pathway, but we do need the main pathways (mobile money or agent banking) to differentiate the reasons for physical access or lack thereof. A more detailed map could be created if any of these areas emerged as particular problems or barriers.

1.2.2 Revising a system map

The initial map is only a first step, and it should be refined as much as possible to consider all relevant existing knowledge of the system. Refining a system map is described in the Mapping Toolkit, Section 6.2. Additionally, you should refine your initial map specifically to make it a more useful basis for measurement, as described below in Section 1.5.

How 'good' or 'correct' must the map be before measurement can begin? Since systems-oriented development activities often learn more about the system as the project proceeds, the map is unlikely to be perfect at the start of the project. Our approach accommodates changing the map periodically. On the other hand, if the map changes, the indicators may also need to change, limiting the longitudinal data that can be collected. The bottom line: the map need not be perfect, but it should capture the development team and stakeholders' current knowledge of the system as well as possible.

1.3 MEASURING MAP ELEMENTS BY EXTENT OF ADOPTION

Each map element may have an attached indicator that is measured by existing or newly collected data. We recommend that the **indicators measure the *extent of adoption* of the behavior change (or relationship or condition) referenced in the map element**. The *extent of adoption* means, roughly, the percent of actors who have adopted a behavior change, who have a relationship, or who meet a condition. Therefore, the indicator for a behavior change would be "percent of actors who have adopted this behavior change." For example, one behavior change on our map is 'Financial Institutions participate in agent banking.' An appropriate adoption indicator for this element would be "percent of financial institutions who participate in agent banking." (This could be weighted by the financial institution's market share, if such data were available). Table 1 show several potential adoption indicators for map elements from the formal access pathway displayed in Figure 2, above.

This type of adoption indicator ignores some of the real complexity of the system. For example, it does not measure how well or thoroughly the change has been adopted. However, its simplicity eases interpretation of the results and their comparison across the system, which is the main point of this approach. If the quality

Map Element	Potential Adoption Indicator(s)
Behavior change: Financial Institutions participate in agent banking	Percent of financial institutions who participate in agent banking (have at least one agent) Percent of financial institutions who have rural bank agent networks (have at least 50 agents in rural areas)
Relationship: Financial Institutions and mobile money providers	Percent of financial institutions that have formal relationships with mobile money providers (e.g., offer loans or access to accounts) Percent of mobile money providers that have formal relationships with financial institutions (e.g., offer loans or access to accounts) Market share of mobile money providers that have formal relationships with financial institutions (e.g., offer loans or access to accounts)
Condition: Bank agent or bank branch nearby	Percentage of farmers who have a bank agent or bank branch nearby Percentage of rural areas that have a bank agent or bank branch

Table 1: Potential adoption indicators for map elements from the formal access pathway shown in Figure 2

of adoption is crucial to measure, it can be included as part of the criteria for adoption. For example, in Table 1, the second potential indicator for 'Financial Institutions participate in agent banking' requires not just one agent anywhere but rather 50 agents in rural areas, before an institution is counted as an adopter. (If further understanding of a map element is needed, such as the range of participation levels in agent banking and their success, additional data could of course be collected and examined, but it need not be used to define the element's status on the map.)

Adoption indicators can also be developed for map elements that represent relationships and conditions. In the simplest cases, the indicator for a relationship would be "percent of actors who have this relationship," and the indicator for a condition would be "percent of actors who meet this condition." Table 1 provides several potential adoption indicators for a relationship and a condition, which surface some of the challenges that may arise in defining such indicators.

The key, in all cases, is to find a good proxy for the extent of adoption (or extent of availability, access, etc, depending on the specific map element). The final choice of indicator will often depend on data availability and/or feasibility of data collection, as discussed below.

1.4 SETTING TARGETS AND A SCALE FOR EXTENT OF ADOPTION

In order to interpret the results, it is convenient to color-code the map elements according to their adoption progress. We use red for low adoption, yellow for moderate, and green for wide adoption. To set the thresholds that divide each color, we recommend setting two target adoption levels: one to indicate that most or all directly-targeted actors have adopted, and one to indicate when a fair number of non-targeted actors have adopted. These levels correspond with the "adopt" and "expand" levels of the Springfield Centre's framework (Nippard et al., 2014). Figure 4 illustrates the concept. For example, if an intervention aims to enable input dealers to adopt a new practice, and the intervention works directly with about 30% of the region's dealers, the "adopt" target could be 30% and the "expand" target could be 65% (the latter is set arbitrarily in this case). The measured levels of the indicator will be judged against these thresholds as:

- **Red: adopting.** Not all directly-targeted actors have adopted
- **Yellow: expanding.** All directly-targeted actors have adopted along with some non-targeted actors.
- **Green: sustaining or entrenching.** A wide array of actors have adopted; supporting rules and norms are likely changing.

Going Deep 1: Sustainability and changes in norms and rules The scale shown in Figure 4 simplifies a number of complex concepts in systems approaches to development. Measuring extent of adoption does not necessarily show when a change is sustainable, when actors have adapted and responded to the changes, and when

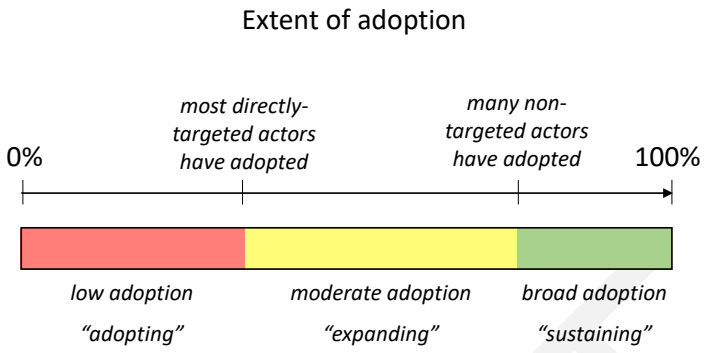

Figure 4: Scale for measuring extent of adoption

supporting rules and norms have changed. (For further discussion, see (Nippard et al., 2014) and other sources). Our scale intentionally simplifies these complex concepts, to aid interpretability. However, the map can be a "flag" for when to examine a set of changes for sustainability. As soon as the map indicates that expansion or sustainability may have been reached (e.g., when a yellow or green state is reached), we suggest a deeper investigation to understand *why* such wide adoption has been achieved, whether there is a new norm at work, and how sustainable the change is likely to be. The map is thus only the first stage in a larger analysis.

Furthermore, if changing a norm or rule is an explicit goal of a development activity, this norm or rule change should appear on the map. Its adoption can then be measured directly.

1.5 ADAPTING THE MAP FOR MEASUREMENT

A system map developed for another purpose might not be specifically adapted for measurement. Since maps will be measured by assessing the extent of adoption of the behavior changes, conditions, and relationships described in each map element (as discussed above), it is best if each map element:

- describes a single behavior change, condition, or relationship (such as 'agricultural insurance is affordable' rather than 'agricultural insurance is affordable and farmers are willing to pay for it')
- describes an absolute state (such as 'farmers take out agricultural loans') rather than a change in state (such as 'more farmers take out agricultural loans')

It is also helpful to include 'root' elements for each pathway or loop. A 'root' element collects all the branches on a given pathway and summarizes their status. For example, Figure 2 above contains a 'root' element, 'Farmer has physical access to formal loan,' which combines (is the root of) the two major branches on this pathway – access through bank branches/agents and access through mobile money.

Root elements are easier to identify on pathways than on loops. On a loop, a root element is usually the main outcome of the loop, and/or the element that intersects other loops and pathways on the map. The 'root' elements should:

- describe the status of multiple pathway branches and/or the outcome of a loop (unlike other elements)
- describe an absolute state rather than a change in state (like other elements)
- are typically measured by inferring status from the other pathways rather than measuring directly (further details are provided in SECTION)

2 DETERMINE WHICH PARTS OF THE SYSTEM TO MEASURE

Objectives Determine which parts of the system to measure

Prerequisites A system map with pathways identified (Module 1)

Products Outcomes, pathways, and elements to measure

Steps in brief

1. Identify the outcomes to measure
2. Identify the pathways to measure
3. Identify the map elements to measure

2.1 PURPOSE

This module describes how to determine which parts of the system to measure, using a system map. Your system map probably includes a number of elements, all of which may influence the key outcome(s), but it would take enormous resources to measure all of them. How do you decide which to focus on measuring? We provide guidance in the following sections.

Our approach involves three stages. The first stage is to select outcomes to measure. The second is to select pathways to measure – usually among the set of pathways that lead to the selected outcomes. Finally, the third stage is to select elements to measure along the selected pathways.

2.2 SELECTING OUTCOMES TO MEASURE

The first stage is to identify the outcomes of your development project that should be measured. Outcomes are the desired change(s) toward which the development project is working; "measured" outcomes are the outcomes on which your measurement efforts will focus. Not all outcomes need to be designated as *measured* outcomes.

If you followed our mapping methodology, the development project's outcomes should already be included in the map and identified in bold red text (see Module 1). If they are not on the map, the map should be modified to include them.

How can you select which outcomes to measure? Many development projects have already designated 2-3 outcomes of interest, and all of these can be selected for measurement.

Some larger projects, on the other hand, may have a large number of desired outcomes. There are a number of ways to select outcomes to measure from among the larger set, including:

- **Based on expert knowledge and history/plans:**
- Select the outcomes most aligned with the overall program goals.

- Select outcomes into which significant resources have been invested by donors, government, private sector, or others.
- Ask a group of stakeholders and/or experts to prioritize outcomes for measurement.
- Identify those outcomes of particular interest in the literature, and/or those for which data have previously been collected, to facilitate continuity and comparison.
- **Based on position in the map and in the system:**
- Select outcomes that are at critical junctures in the system map, such as those that enable other important outcomes or that have many paths leading to them or sit on critical loops.
- Consider whether the measured outcomes are comprehensive, in that the set of selected outcomes spans the parts of the system in which changes may be expected.
- Consider including both intermediate and long-term outcomes of the work: for example, an activity might work directly with input dealers to encourage them to stock quality inputs (an immediate outcome) with the ultimate goal of enabling higher incomes for farmers (a long-term outcome). Some measurement efforts may leave out long-term outcomes entirely; when they are included, the intermediate outcomes that enable long-term outcomes should also be included.
- When an activity does not work directly with the intended beneficiaries, include both the intermediate outcomes that lead to the intended beneficiaries along with the final outcome for the intended beneficiary. See the example in the bullet point above.

Example 2: Selecting outcomes to measure To select which outcomes to measure for our study of the financial subsystem, we chose based on position in the map and in the system. Figure 5, below, illustrates some of the points. In particular, most of the pathways in the financial subsystem map led to the key outcome 'Farmers take out loans to improve farming practices', so this was selected for measurement. In addition, we might include another outcome that represents a long-term goal: 'Higher farmer income'. The figure shows that the first outcome, 'Farmers take out loans...', is also along the enabling pathway to the second outcome, 'Higher farmer income', which provides further reason to include both. Finally, these choices are somewhat comprehensive in that they span both the financial subsystem and the farmer practices subsystems of the full map.

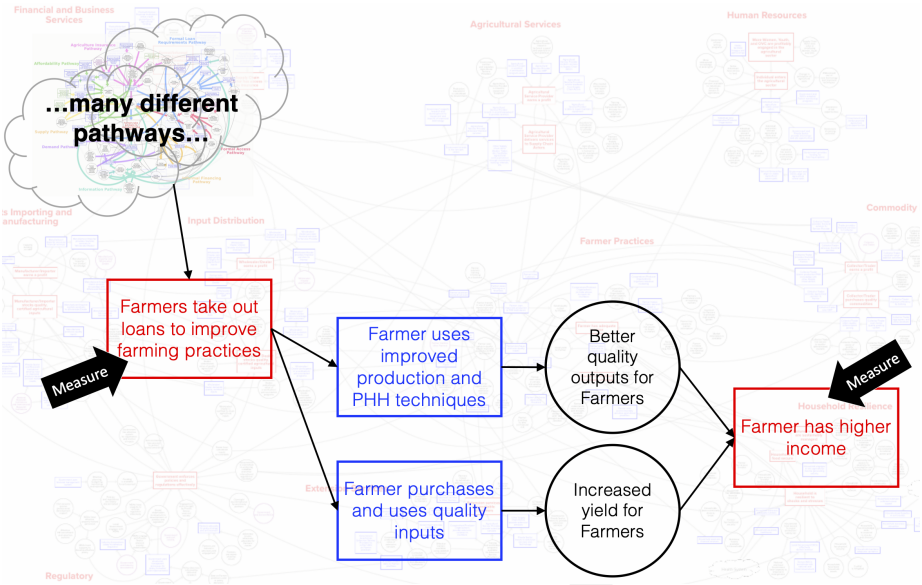

Figure 5: Identifying outcomes to measure: one short-term immediate outcome and one long-term outcome.

2.3 SELECTING PATHWAYS AND LOOPS TO MEASURE

2.3.1 Refresh: What are pathways and loops?

Pathways are sets of connected map elements that lead *to* an outcome, *from* an intervention or a leverage point. Therefore, a pathway shows a set of changes that enable the achievement of an outcome from an intervention. Pathways can be labelled for easy reference; we suggest labeling them with names that describe their influence on the system, as in Figure 6.

Another important feature is a *loop*. This is similar to a pathway except that it is a loop rather than a linear chain. Loops, too, should be labelled for easy reference. Figure 7 shows part of the same system, highlighting loops instead of pathways.

Further information on how to identify and label pathways and loops is provided in the Mapping Toolkit.

2.3.2 Selecting pathways and loops to measure

The next step is to select pathways and loops to be measured. In small maps, all pathways and loops may be measured, but in large maps, not all of them need to be measured.

If you need to prioritize the most important pathways and loops to measure, the following guidance may be helpful. See also Example 3 for an example from the financial subsystem.

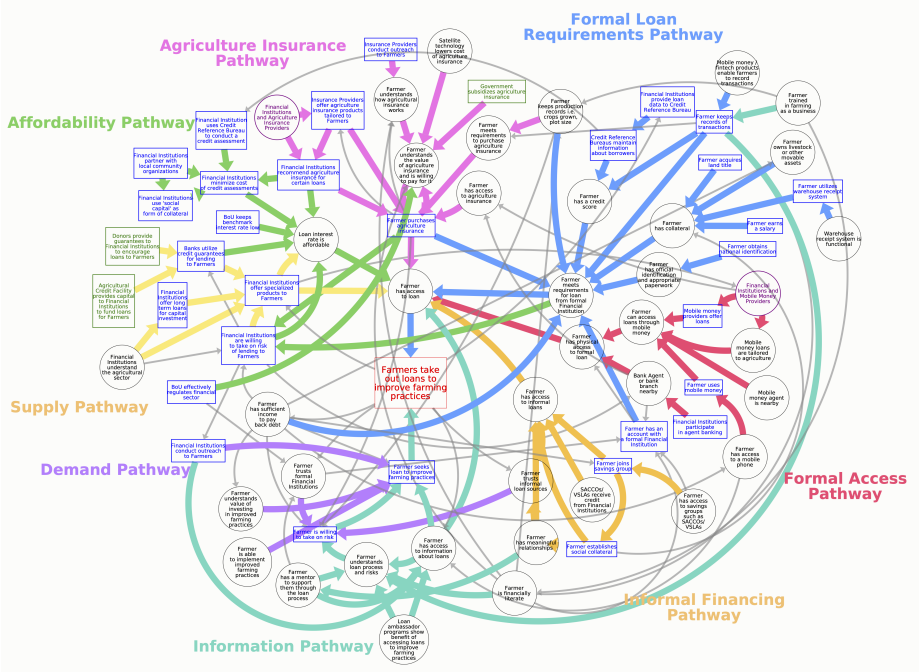

Figure 6: Several different pathways may lead to a key outcome. Pathways may be labeled for easy reference and to make sense of the system's functions.

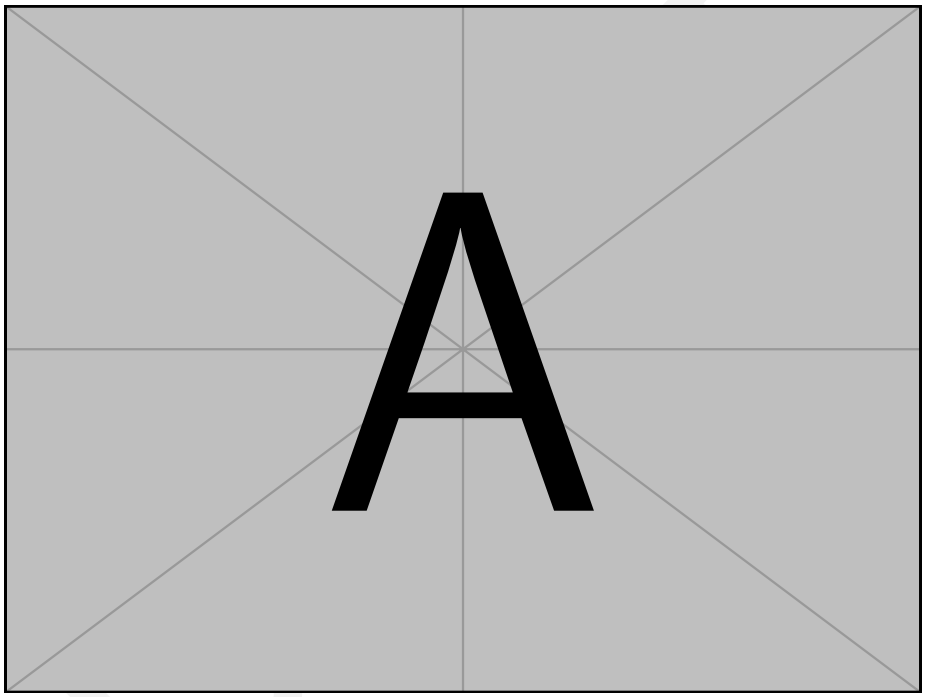

Figure 7: Loops may be labeled for easy reference and to make sense of the system's dynamics. TO BE COMPLETED

- A project MELP (monitoring, evaluation, and learning plan) usually identifies important outcomes and leverage points; select pathways and loops that include these.
- Experts and key stakeholders may be able to select the pathways and loops that are believed most critical to achieving change.
- Map elements (behaviors, conditions, and relationships) that have many arrows connecting to and/or from them are likely important to the system's behavior because they are so well-connected to other parts of the map. Therefore, select pathways that include these map elements.
- Consider potential barrier pathways that may prevent the achievement of key outcomes, in addition to those that enable the outcomes.
- Some loops may be reinforcing, in that change begets further change: for example, farmers buy quality inputs, which motivates input dealers to stock more quality inputs, which enables more farmers to buy them, which motivates more input dealers to stock them, etc. Reinforcing loops may be particularly important in achieving systemic change, since small changes can build into larger and more widespread changes as the system repeatedly executes the cycle. Reinforcing loops that influence key outcomes should be strongly considered for measurement.
- Other loops may be balancing, in that changes are limited by some opposing force. Balancing loops that influence key outcomes may prevent major changes from taking hold, and should be strongly considered for measurement.

Example 3: Selecting pathways to measure To select which pathways to measure for our study of the financial subsystem, we chose based on expert understanding of the system. Consider Figure 6, which labels and highlights all the pathways in the financial subsystem. Ideally, all the pathways would be measured, but we prioritized a subset for measurement, largely based on expert and stakeholder input. First, the "Formal Access" and "Loan Requirements" pathways were selected, because these are some of the first and strictest barriers to loans. Next, the "Informal Financing" pathway was included, in order to understand whether this alternative enabling pathway for loans was working, even if formal access was stalled. Finally, the "Demand" pathway was included, because it was considered important to understand whether there was interest in acquiring loans even if key barriers were removed. The Affordability, Information, and Supply pathways would be included if resources allowed; they were considered slightly more flexible barriers/enablers than those chosen.

2.4 SELECTING MAP ELEMENTS TO MEASURE

The final step is to select the map elements to measure. These can be outcomes, behaviors, relationships, conditions, or even interventions. Outcome elements were already chosen in Section 2.2, so we focus in this section on how to select additional map elements to measure. These map elements should come from each pathway selected in the previous section.

In choosing map elements along each pathway, unless you can easily measure everything, you will probably want to choose a subset of the map elements along the pathway. Consider the following in making the selection:

- **Ease of measurement:**
- Feasibility of measurement is important. If a map element is too vague or general to be easily measured, or it is impossible to collect data on it, then it should not be selected for measurement. A nearby element can be chosen instead.
- If data are already available or easy to acquire, the map element will be easier and cheaper to measure.
- **Based on expert knowledge and history/plans:**
- Expert opinion should be considered: stakeholders very familiar with the system may identify important and particularly difficult-to-achieve changes, and these are good candidates for measurement.
- Areas where resources have been or will be invested are useful to measure because they may be changing, and therefore influencing the system around them.
- **Based on position in the map and in the system:**
- In many maps, pathways may contain 2-3 branches that each represent an important enabling factor for the pathway. In such cases, consider measuring an element along each branch, rather than an element at the locus of the branches, because it is useful to know which branches are acting as barriers or enablers.
- If a map element seems to be an enabler of several important changes (i.e., points to many other important elements), it could be measured in order to check whether it changes as expected.
- Different levels of depth along a pathway may be useful: select some indicators that will change quickly when the intervention begins, to ensure it is working as expected, and other indicators that may take more time to change but are closer to the outcome of interest.
- Consider whether any map elements might be useful as "diagnostic indicators" that might indicate *why* an outcome is or is not being achieved. See below for further discussion of diagnostic indicators.

Example 4: Identifying map elements to measure in the finance map Consider the Formal Access pathway selected earlier for measurement. The pathway's elements are shown in detail in Figure 8; the figure also highlights four elements prioritized for measurement along this pathway. The first is the outcome. The remaining three are each intended to measure one of the three branches of the pathway.

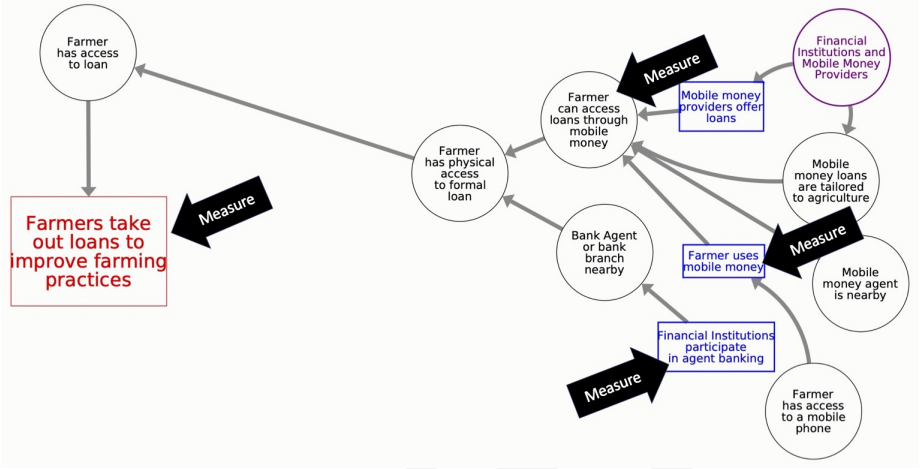

Figure 8: Formal Access pathway from the financial subsystem map, labeled to select which elements to measure along it.

For the upper branch, which deals with loan access through mobile money, we chose to measure whether 'mobile money providers offer loans'. If they do, it may be unnecessary to measure the relationship between financial institutions and mobile money providers, but if they do not, this relationship could then be measured. For the middle branch, which deals with farmer use of mobile money, we chose to measure whether 'Farmers use mobile money'. This is closer to the outcome of interest than farmers' access to mobile phones, but as before, if farmers do not use mobile money, we might then choose to measure access to mobile phones. Next, for the lower branch, which deals with proximity to a nearby access point (bank or agent), we chose to measure whether 'bank agent or bank branch nearby'; as with the other branches, if this indicator performs poorly, we could measure elements further upstream. Finally, we measure whether "mobile money loans are tailored to agriculture" because this is an important potential barrier that is not well understood.

It is worth noting two elements that we did *not* choose to measure: 'Farmer has physical access to formal loan' and 'Farmer can access loans through mobile money'. The selected elements are more concrete in pinpointing the specific causes of access problems. If we measured physical access to loans (which includes access via banks, agents, and mobile money), and if the indicator suggested this access was poor, we might not know whether the problem lay in mobile money or in banks or in agents. Therefore, it seemed a better use of resources to measure the selected elements instead, in order to enable clearer guidance on how to fix any problems identified.

Going Deep 2: Measure few pathways or many pathways? When there are a large number of important pathways and important map elements along pathways, it may be necessary to prioritize a subset for measurement. There is a trade-off between measuring many points along a small number of pathways and measuring a few points along a larger number of pathways. In situations where there are a large number of pathways that could be measured, we recommend measuring just a few indicators along each of the most important pathways, at least at the start of the project. Such measurement should reveal which pathways are most important in enabling change. Additional measurements could later be added to characterize progress along the most important pathways. In this manner, the measurement strategy may be adapted as more is learned about the system.

For example, consider Example 3 and Figure 6, above. The example gave reasons why four pathways were selected for measurement: Formal Access, Loan Requirements, Informal Financing, and Demand. Suppose our available resources for data collection allowed only four map elements to be measured. Each pathway has 5-10 elements on it. Would it be better to measure two elements along two of the pathways or one element along each? Our guidance suggests measuring *more pathways* rather than *more elements per pathway*. By picking one element on each of the four pathways, we could learn which pathways are working and which may act as barriers. In this example, we learned (see LATER MODULE) that Informal Financing was working well, but Demand was stalled. Then, we could stop measuring Informal Financing and redirect the resources to measure an additional element on the Demand pathway, in order to understand in more detail which elements were causing problems with demand.

2.4.1 Diagnostic and outcome indicators

Our methodology defines two types of indicators: ***outcome indicators*** and ***diagnostic indicators***. Outcome indicators are typically applied to the key outcome at the end of a pathway, but may also be applied to critical and intermediate outcomes anywhere on the map. For example, one key outcome might be, "Farmers access financial loans." Diagnostic indicators are applied to other map elements that might indicate *why* an outcome is or is not being achieved. Continuing the example, if farmers are not accessing financial loans, a diagnostic indicator might measure how many farmers have a financial institution within an accessible distance; a second might measure whether agriculture-suited loan products are offered by financial institutions.

Distinguishing these two types of indicators is useful because they serve different purposes and may be measured at different frequencies or at different times during the project. Outcome indicators show whether important project outcomes are being achieved. If they are, diagnostic indicators may not be worth measuring. On the other hand, the key outcomes in a systems-oriented project may take a long time to achieve. Diagnostic indicators may change more quickly, enabling progress to be measured earlier. In addition, diagnostic indicators can help explain *why* an outcome is not being achieved; for example, financial institutions may offer agriculture-suited loan products but farmers may not be able to reach financial in-

stitutions within a reasonable geographic distance, highlighting which of these two issues is a barrier to success.

3 MEASURE WITH EXISTING DATA AND ASSESS DATA GAPS

Objectives Measure map elements based on existing data and assess data gaps

Prerequisites A system map with outcomes and pathways (Module 1). Optionally, pathways selected to focus on for measurement (Module 2).

Products Measured status for map elements throughout the map, based on existing data

Steps in brief

1. Identify existing data sources
2. Match data sources to map elements
3. Display status and save metadata to the map
4. Refine the measurements
5. Assess data gaps

3.1 PURPOSE

The purpose of this module is to use *existing data* to measure the status of the system and to assess the gaps in existing data. Assessing data and gaps helps to highlight what is known and unknown about the system.

This module directly supports one of two potential approaches to measuring the system's status: to identify *existing* data and arrange it on the map. The alternative is to design indicators and collect the data. Even if you intend to collect your own data, it is often a good idea to assess existing data first, but if that is not essential for your purposes, you may skip this module and move to Module 4.

You may use this module to examine an entire system map or just a subset of the system map. An advantage of examining an entire system map is that you will understand data availability for the entire system. If you have limited time and wish to focus your efforts only on particularly important parts of the system, first use Module 2 to identify which parts to measure.

3.2 IDENTIFYING DATA SOURCES

The first step is to identify the set of data sources that might provide information about the system. Sources could include formal data sets (gathered by organizations like the World Bank), internal monitoring and evaluation data from your own organization or from others working in similar areas and sectors, or from published research papers. Such data sources can be identified through internet searches, by asking knowledgeable colleagues, and by examining relevant reports and research papers to identify the data they cite.

Source Name	Organization	Year(s)	Topics	Notes (reliability and relevance)
The Global Findex Database	World Bank	2017, 2014, 2011	Wide array of financial topics	Can separate data for rural respondents
Finscope 2018	FSDU	2018, 2013	Wide array of financial topics	Can separate data for rural, urban respondents
MSM FMES	MSM	2018	Market inclusion; 1-2 relevant financial questions	Small sample, specific regions

Table 2: Example of sources table, with a subset of the recommended columns.

It may be useful to hold a short stakeholder workshop to identify data sources, especially if the system map will be relevant to many stakeholders, who might have access to different data sets. A workshop outline is provided in the System Pathways Toolkit Annex for carrying out this process in collaboration with stakeholders.

We suggest creating a table that lists, for each data source, the following information. Table 2 provides an example with a subset of this information, for the financial sector in Uganda.

- Source name
- Source ID (an arbitrary number that you can use to refer to this source)
- Organization that published the source
- Link to the source online or a reference to the file's location
- Year(s) for which data are available or year of publication
- Format, such as a data set, a report summarizing a data set, a published paper, a website article, or a slide deck
- Topics included, preferably at a detailed level (such as loan access, mobile money, agricultural insurance, etc.)
- Notes on the source's reliability and relevance for your purposes
- Any other relevant characteristics

3.3 IDENTIFYING DATA FOR EACH MAP ELEMENT

The next step is to determine which data sources could potentially measure each element of the map.

We suggest creating a table to track, for each map element, all the potential measured indicators available from your identified data sources. Each survey question or data column in your data sources is a potential indicator for a map element.

Table 3 provides an example. We suggest noting, for each map element, all the potential indicators, their data source, and the advantages and disadvantages of each potential indicator. Criteria to consider in cataloging advantages and disadvantages include:

- Extent of adoption: does the indicator measure the extent of adoption? This requires that it measure a percent or a market share or something similar. For example, rather than measuring *how many* financial institutions offer loans through mobile money, it must measure the *market share* of such financial institutions, or less preferably the *percentage* of such financial institutions operating in the country.
- Relevance to the map element: to what extent does the potential indicator represent all facets of the map element? (This is similar to the notion of construct validity.) Note that it is not always possible to find a proxy that measures all facets of the map element, so a best available proxy may be used if it is reasonable; otherwise, the element may not be measurable. This is up to your judgment.
- Date: how recent is the data? The threshold of "recent" will vary from indicator to indicator. For example, is it measuring something static such that old data are still relevant? Were important regulatory changes made between when the data were collected and now, such that the data are now less relevant? Was a new technology introduced and widely adopted between when the data were collected and now?
- Data scope: which populations were sampled for the data? For example, is the data nationally representative or specific to particular regions? Is it focused on the type of actor named in the map element or is it more general? For example, a map element may refer to farmers, but the data may only be available for all adults or for rural adults or for small business owners. Separately, were many people sampled, and can the results be considered an accurate representation of a population?
- Collection frequency: if it is desirable to show change across time, is the data source part of a series in which the same data have been or will be collected repeatedly over time, so that a time series can be constructed?

Next, select among the potential indicators for each map element. Table 3 also includes notes on the rationale for the selection of map elements for each indicator. We suggest selecting *just one* indicator for each element, rather than aggregating multiple indicators, because it keeps interpretation simple and measurements transparent.

It would be desirable that all map elements are measured with the same data scope (nationally representative or particular sub-populations, for example), to enable comparability. However, in our experience, this restriction severely limits the number of map elements that can be measured. Our suggestion is to pick the best proxies available, whether or not the data scope matches, in order to provide the

Map Element	Potential Indicator(s) from Existing Data	Data Source	Advantages and Disadvantages
Bank Agent or bank branch nearby	"70% of all branches are in urban areas"	Uganda National Financial Inclusion Strategy 2017 to 2022, ROU (data from 2017)	Captures whether branches are in rural areas, but does not include agent banking and does not capture access per rural farmer
	"99% of all the agents recruited so far are located in urban or peri-urban areas, with Kampala having over 60% of all registered agents"	Uganda Agricultural Finance Yearbook, EPRC 2019	Captures whether agents are in rural areas and is recent, but does not include bank branches and does not capture access per rural farmer
	Neither indicator is a particularly good proxy, because neither captures access per rural farmer. We select the first, which captures bank branches, because bank agents are so new and because both indicators tell approximately the same story, but we plan to revisit this element and seek better data as it becomes available.		
Farmer has access to a mobile phone	"In rural areas, only 55% of adults own a mobile phone and 85% of adults have access to a phone."	Uganda National Financial Inclusion Strategy 2017 to 2022, ROU (data from 2017)	Captures not only ownership but also access, specific to rural areas
	"52% of adults (9.7 million) have mobile phones"	FinScope Topline Findings Report, FSDU, 2018	Does not capture access
	We select the first indicator, because it captures access rather than just ownership and because it is specific to rural areas.		

Table 3: Potential adoption indicators for map elements from the formal access pathway

most comprehensive picture of the system status across the map. However, it is crucial to include notes on the data source and scope in the metadata, as described in Section 3.4, so that those interpreting the map understand the limitations of each indicator.

3.4 DISPLAYING INDICATOR STATUS AND SAVING METADATA ON THE MAP

The next step is to display the indicator status for each map element on the map itself. Example 5 and Figures 9 and 10 provide examples. The selected indicator and its value should be assigned to the map element, and the map element should be colored to reflect whether the measured value suggests low, moderate, or broad adoption (recall Section 1.4). If you are using our customized templates in Kumu (see the System Pathways Toolkit Annex), you can simply enter the indicator and value in the appropriate metadata fields, then indicate the adoption status as red, yellow, or green, and the map element will display in the appropriate color. You can also indicate the status as white for "no data available," which highlights the elements for which you were unable to find appropriate data. If there are map elements for which you did not try to find data, the status should be grey or "chose not to measure," to differentiate it from those for which you sought data and could not find it. If you are not using our customized templates in kumu, you will need to manually color the map elements and find a way to keep track of the indicator value and other metadata for each element.

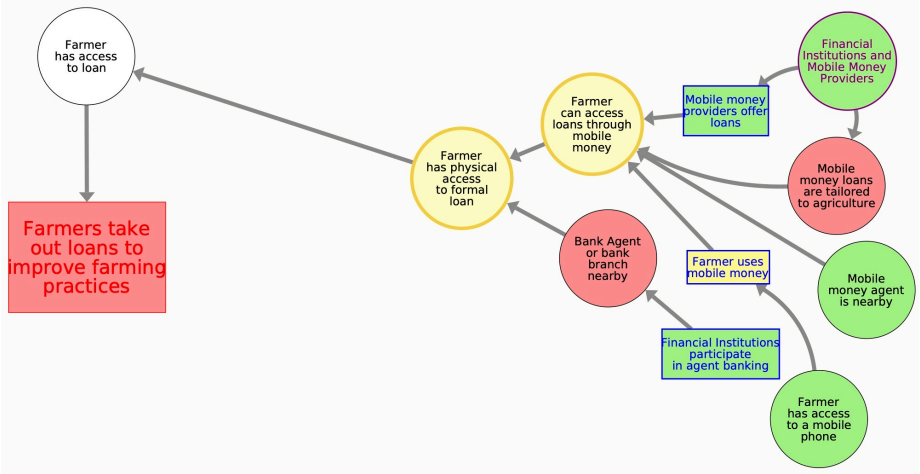

Figure 9: Displaying indicator status for the formal access pathway. Red indicates low adoption (0-32%), yellow indicates moderate adoption (33-66%), and green indicates broad adoption (67-100%).

Example 5: Finance data assessment on a map Figure 9 shows the same formal access pathway we have studied in previous examples. (Note that, for the purposes

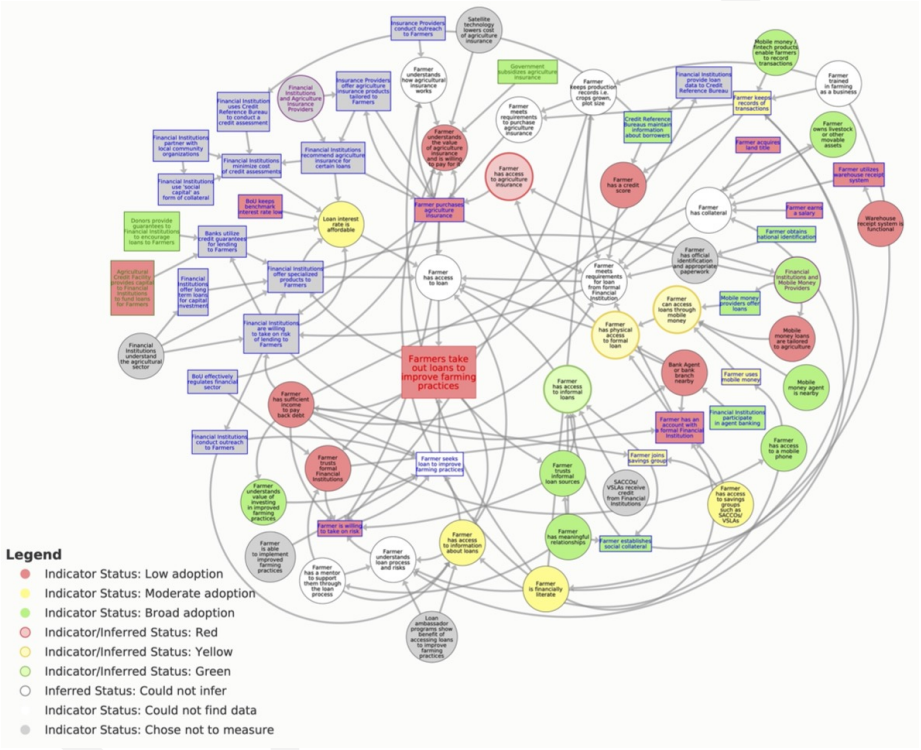

Figure 10: Displaying indicator status for the entire finance map. Red indicates low adoption (0-32%), yellow indicates moderate adoption (33-66%), and green indicates broad adoption (67-100%). White elements could not be measured due to lack of available data, and there was no attempt to measure grey elements.

of this example, we tried to measure nearly all of the elements, rather than measuring only on those we selected for measurement in Module 2.) The elements are colored according to their measured status. For example, 'Farmer uses mobile money' is yellow because our data source shows that 54.3% of rural Ugandans have used mobile money, indicating moderate adoption. 'Bank Agent or bank branch nearby' is red because our data source shows that only 29.8% of rural Ugandans live less than 5km from a formal financial institution. 'Mobile money providers offer loans' is green because our data source reports that nearly all mobile money accounts are with one of two providers (MTN and Airtel), both of whom offer loans via mobile money.

For white elements, data were sought but could not be found. In other words, white elements are those for which there is a data gap. In Figure 9, 'Farmer can access loans through mobile money' is white because we could not find data specifically on *access* via mobile money, even though there were data on the related elements nearby, such as *use of* mobile money, proximity to mobile money agents, etc.

Figure 10 has a number of grey elements as well. For grey elements, we did not try to find data. Usually, elements are left grey because they are not deemed essential to measure (when measured elements were selected in Module 2). In this example, however, we considered measuring *all* the elements, and grey elements are those for which we did not expect to find data for various reasons. 'Farmer is able to implement improved farming practices' is gray because it is such a broad element that we expected no survey would capture it adequately (and therefore did not try to find data). 'Banks utilize credit guarantees for lending to Farmers' is also grey because we did not expect public data to be available on the internal practices of financial institutions, and therefore did not try to find any. (You may note that some elements that are white or grey in Figure 9 are colored in Figure 10. These statuses were inferred based on nearby elements as described in Section 5.2, below.)

It is crucial to save metadata about how adoption was measured for each element, especially since it may be measured differently for different elements. If you are using our customized templates in Kumu (see the System Pathways Toolkit Annex), it is straightforward to save metadata; Figure 11 provides an example. The figure shows the adoption status for 'Farmer uses mobile money' by coloring the map element yellow. The metadata shows that the indicator's measured value was 54.3% and further shows how this was measured – from the Global Findex Database 2017, based on the % of rural Ugandans who reported that they have used a mobile money service for any financial activity. It is important to save this metadata to aid in interpretation of the map, for several reasons. First, the yellow color could indicate a status anywhere between the pessimistic and optimistic targets (in this case, between 33% and 66%), so saving the actual measured value is important. Second, the data source and its year is important context. Finally, it is important to know that the data, which came from a publicly available source, are not a perfect measure of the map element: the data only show how many *people*, not how many *farmers*, have mobile money accounts. Saving metadata provides important detail and context for the indicator, while displaying the simple colored adoption status enables comparability and high-level interpretation across the map (see Module 6).

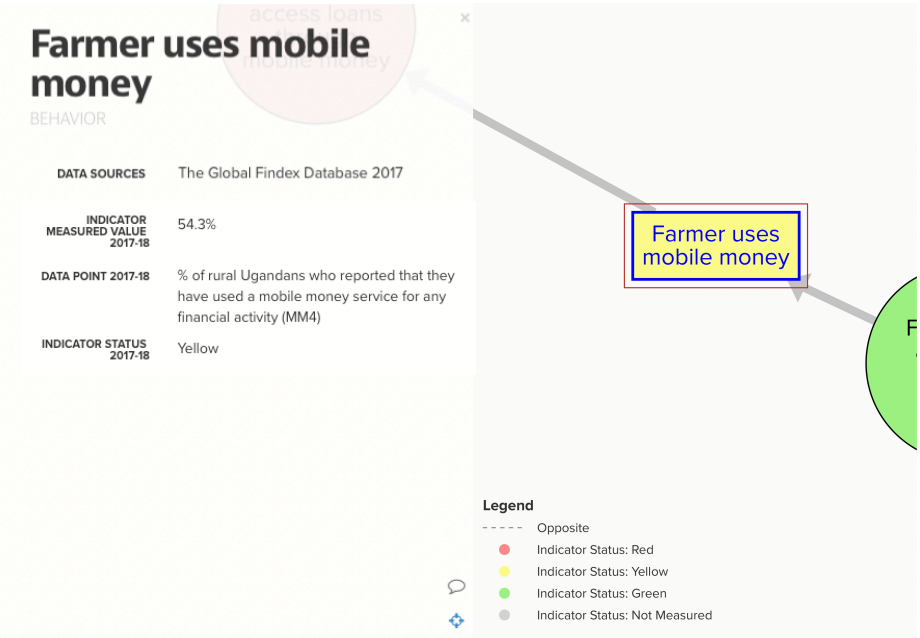

Figure 11: Displaying metadata and indicator status in Kumu

3.5 REFINING AND INTERPRETING THE MEASURED MAP

At this point, the measured map is ready to be interpreted (see Module 6), but it is useful to iterate at least once through the measurement steps, to refine the measurements. See Module 5 for guidance on refining the map. Section 5.3, in particular, is essential for maps measured with existing data: it suggests targeted searches for data on unmeasured elements and considering consistency in data sources. Once you are satisfied with the refined map and the measurements, see the guidance in Module 6 to interpret the results.

3.6 PERFORMING RAPID ASSESSMENTS WITH LIMITED DATA

In some cases, there may not be enough data to conduct as rigorous an assessment as described above. This may be the case in a crisis, when a situation might evolve rapidly. In a crisis, there can also be increased time pressure to make decisions, so collecting data may not be feasible. This is where rapid system assessment is useful.

Undertaking a rapid system assessment with limited data requires two broad steps:

1. Information processing
2. System assessment

Both of these steps are robust to different timeframes and organizational capacities. The whole point of a rapid assessment is that it can be undertaken during a crisis where timeframes may be compressed and organizations may be stretched, but need an answer quickly. This process can be considered an alternative to the process described in the preceding sections of this module, or used as a supplement to it for rapid analyses or when data are limited.

We describe this process with examples from a rapid system assessment performed in Uganda to analyze potential impacts of COVID-19. Note that this particular rapid system assessment employed a different type of map, which we call a "shock map", rather than the standard 'adoption' map described in the remainder of this toolkit. The shock map shows how map elements were impacted by a shock (in this case, COVID-19), rather than their adoption status. However, the same rapid system assessment approach can easily be used with adoption maps as well.

3.6.1 Information processing

Information processing involves taking in information from outside sources — this could include publicly available sources such as news articles, studies, or statistics, or private sources such as interviews or personal communications. Incoming information is categorized according to which map elements it corresponds to, and used to inform the status of map elements.

Information processing involves four steps:

1. *Source capture*, in which relevant sources are documented.
2. *Fact extraction*, in which documented sources are read (or processed in some other way, such as watching a video or listening to an audio recording), and relevant facts are documented.
3. *Fact assignment*, in which documented facts are assigned to elements on the system map, with an implication for the element's status.
4. *Element assessment*, in which an element's status is determined or updated based on its corresponding facts and their implications for its status.

Source capture involves looking for up-to-date information that is relevant to the system. This can involve setting specific and consistent ways to search for information, such as a Google News alert, or repeatedly checking the same sources. The places to look for information should be agreed upon with whoever will be using the system map. An example of a source could be: "*EPRC Special Issue No. 1: How has the COVID-19 pandemic impacted Ugandan businesses? Results from a business climate survey*", a study from May 2020 conducted by the Economic Policy Research Centre in Uganda, relating to the impacts of the COVID pandemic.

Fact extraction involves breaking down a source into individual facts, which are statements that provide information about part of the system. A fact should be as specific as possible. It should also be relevant to a part of the system. It is possible that a source will have multiple relevant facts, but also possible that it will have *no* relevant facts — a source may have appeared to be useful, but upon

more detailed review may not contain any information sufficiently relevant to the system. An example of a fact (from the previous source example) could be: "*55% of agricultural businesses see reduction in access to credit*".

Fact assignment involves categorizing each fact, and determining its implication on the system status. Since each fact should be relevant to a part of the system, it can be assigned to an element. For example, the fact from the previous example could be assigned to the element "*Supply Chain Actor has access to financial services*", since it clearly has implications for this element. Those implications should also be documented — in this case, the fact implies that the element may be "*Significantly impacted*".

Element assessment involves determining the *shock* status of an element based on all the facts that are associated with it. Note that this is different than a typical element status. A typical element status could be based on the level of adoption of an element, whereas a shock status is based on the how much the element was affected by the shock. A possible range of shock statuses could be:

- *Impacted to the point of being non-functional:* the element may have had some level of adoption or functionality before the shock, but now has none
- *Significantly impacted:* the element has been significantly negatively impacted by the shock, but still has some level of adoption or functionality
- *Somewhat impacted:* the element has been negatively impacted by the shock, but not significantly
- *Not impacted:* the element has not been impacted by the shock
- *Improved:* the element has been positively impacted by the shock
- *Impact unknown:* it is not known whether the shock impacted the element

Figure 12 shows an example of various elements colored by shock status.

An element's shock status can be determined from the facts that are assigned to it. For example, the element '*Supply Chain Actor has access to financial services*' may have multiple facts associated with it, each with a implication for its status. Based on these various facts, the status of the element can be determined. For example, more recent facts, and facts from more credible sources, should have more of an influence on an element's status. The various facts associated with an element will often be in agreement, but elements where facts don't agree should be given more attention, and could be a place to try to collect more information.

3.6.2 System assessment

System assessment involves the subsequent updating of the shock statuses of the elements in the system, based on the new information. This involves further interpretation of element shock statuses, and how they affect downstream elements. This is similar to interpreting a map under normal circumstances, detailed in Section 6. In the context of a rapid assessment, it is detailed in the USAID/Uganda

FtF MSM Activity document "*Conducting a Rapid System Assessment*," available at https://humanitarian.mit.edu/wp-content/uploads/2020/05/Rapid-System-Assessment-Methodology.pdf.

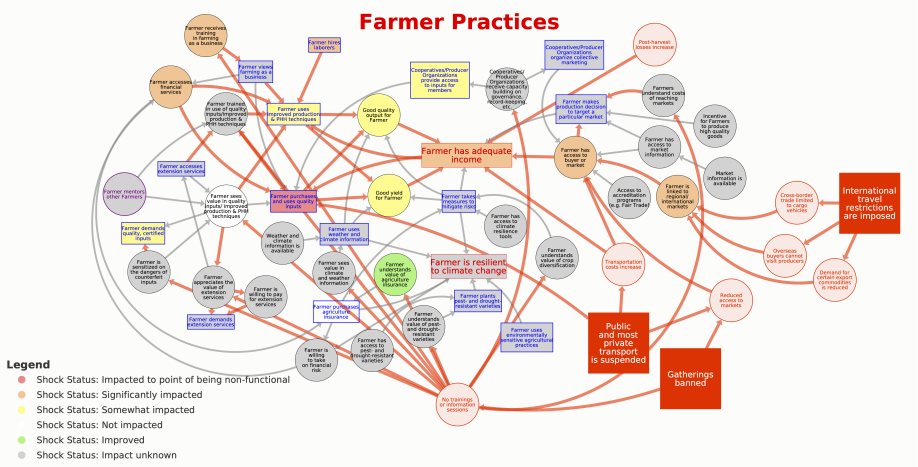

Figure 12: Displaying shock status for the COVID-19 shock. Red indicates *Impacted to point of being non-functional*, orange indicates *Significantly impacted*, yellow indicates *Somewhat impacted*, white indicates *Not impacted*, green indicates *Improved*, and grey indicates *Impact unknown*. The large red squares and pale red circles are shock-related elements that are discussed in the "*Conducting a Rapid System Assessment*" document.

Figure 12 shows the Farmer Practices subsystem of the system map used for assessment of COVID-19's impact in Uganda. The elements are colored based on their shock status.

3.6.3 Process flexibility

It is worth noting that the various steps in this process can be decoupled from each other, and repeated as needed. For example, over the course of a three month project, one could *capture sources* and *extract facts* daily to keep up with the news cycle, *assign facts* at the end of every week, and *assess elements* every two weeks. A broader *system assessment* could be conducted at the end of every month, producing three rapid system assessments over the course of the project. Conversely, if only one assessment is required, all steps can simply be taken in sequence once.

3.6.4 Information Management

Collaborative software such as Google Sheets can facilitate multiple people working concurrently on a rapid system assessment. The specific way that the information is documented should be tailored to best fit whoever is doing the work, but it is important to rigorously document all sources and facts to prevent duplication of

work, and maintain transparency for what information was used to conduct the system assessment.

The Google Sheet used for the COVID-19 rapid system assessment is available for viewing at this link. The main sheets and columns are outlined below:

- *Sources:* this sheet is used for source capture, comprising the columns:
  - *Source #:* a unique ID number for the source (inputted by user)
  - *Source link:* a URL to the source (inputted by user)
  - *Source name:* the name of the source (inputted by user)
  - *Date of source:* the date of the source (inputted by user)
  - *Facts processed?:* to document whether the source has been processed yet, *i.e.*, whether the facts have been extracted yet (inputted by user)
  - *Type:* the type of the source, *e.g.*, a study (inputted by user)
  - *Scope:* a rough scope of the source (inputted by user)
  - *# facts:* the number of the facts from the source (calculated by sheet)
- *Facts:* this sheet is used to document facts, comprising the columns:
  - *Fact:* the wording of the fact (inputted by the user)
  - *Source #:* the ID of source the fact is from (inputted by user)
  - *Source date:* the date of the source the fact is from (calculated by sheet)
  - *Source age:* the number of days since the source was published (calculated by sheet)
  - *Page #:* the page number of the source that the fact is from (inputted by user)
  - *Source type:* the type of the source the fact is from (calculated by sheet)
  - *Element:* the system map element that the fact corresponds to (selected by user)
  - *Element type:* the type of the element that the fact corresponds to (calculated by sheet)
  - *Subsystem:* the subsystem of the element that the fact corresponds to (calculated by sheet)
  - *Status:* the shock status that is implied by the fact for the element (selected by user)
  - *Last updated:* the date that the fact's status was inputted (inputted by user)
  - *Update age:* the number of days passed since the fact's status was inputted (calculated by sheet)
- *Elements master list:* this sheet contains all the elements in the system map and displays the facts that have been assigned to them, comprising the columns:

- *Label:* the name of the element (downloaded from system mapping software)
- *News, Interview, Data, Study, All, Facts:* multiple columns, each counting the number of facts an element has from a certain source type (calculated by sheet)
- *Status from Kumu:* the previous shock status of the element (downloaded from system mapping software)
- *Status to Kumu:* the updated shock status of the element, which will be uploaded to the system mapping software (selected by user, based on fact status columns)
- *Days since most recent fact:* the days that have passed since the most recent fact's status has been updated (calculated by sheet)
- *Fact status columns:* several columns, which contain the wording and dates for the facts that are associated with the element, and are colored by the fact's shock status (calculated by sheet)

- *Elements to Kumu:* a sheet that is formatted to export updated shock statuses and documentation to the Kumu system mapping software mentioned earlier

3.7 ASSESSING DATA GAPS

To assess data gaps, on either a shock map (as discussed in Section 3.6) or an adoption map (as discussed in the remainder of this Module), examine the map to identify areas where there are no or very little data available; these are the "data gaps". This makes it easy to see "at a glance" which parts of the map are well understood, which parts are only partially understood, and which parts are not understood at all (where data are missing). Recall that white elements could not be measured because data could not be found, while measurement of grey elements was never attempted. It is important to distinguish between these two cases. If an important area of the map has grey elements, this "data gap" might be easy to fix by seeking data on one or more of these elements. If an important area of the map has white elements, however, this data gap is harder to fix because no data are available; it must be collected (see Module 4).

Example 6 provides an example.

Example 6: Assessing data gaps Figure 10, above, showed the indicator status for the entire agricultural financing map. We look for important areas that are white or grey to identify data gaps.

One clear data gap is in the lower left portion of the map. There are several white elements including 'Farmer understands loan process and risks' and 'Farmer seeks loan to improve farming practices'. There are additional white and grey elements in the same area. All of these elements are related to the provision, transfer, and use of *knowledge* about loans that would enable farmers to seek them. Only one element in this area, 'Farmer has access to information about loans', has been measured,

and it is problematic: the metadata show that the only data available were about whether farmers *who received a loan* got information about it first; we found no data on whether farmers in general, whether they got a loan or not, had information about loans. This is an important data gap, because knowledge is crucial to enabling farmers to seek loans. Rectifying this data gap will be difficult because many of these elements are white, indicating that public data could not be found. Likely, new data collection efforts would be required.

A second clear data gap is in the upper left area of the map. There are a large number of grey elements here, including 'Financial Institutions offer specialized products to Farmers', 'Financial Institutions are willing to take on risk of lending to Farmers', 'Financial institutions use 'social capital' as a form of collateral', and many others. All of these elements are related to the internal practices of financial institutions – how they assess risk, what products they offer, etc. These internal practices are very important to understand, because it is clear from the map that they impact affordability and access to loans. These elements are grey, indicating we did not attempt to measure them. Therefore, rectifying the data gap might be as simple as selecting a few crucial elements and seeking publicly available data. (In this case, however, we believe there will be little public data on internal practices of financial institutions, so the elements might end up being white.)

3.8 NEXT STEPS

At this point, you can either skip to Module 6 to interpret your measured map, or you can decide to *collect* data to fill in gaps in the map or to monitor changes. In the latter case, continue to Module 4 to create a data collection strategy.

4 MEASURE BY COLLECTING DATA

Objectives Design a strategy for collecting data on map elements

Prerequisites A system map (Module 1) with pathways and elements identified for measurement (Module 2)

Products Plan for collecting data to measure key map elements, and collected data

Steps in brief

1. Define indicators for extent of adoption
2. Measure and analyze each indicator
3. Display status on the map

4.1 PURPOSE

The purpose of this module is to design a strategy for collecting data on map elements. The goal is to define a measurable indicator for each map element that you have selected for measurement, and to determine the method, population, and frequency with which it will be measured.

The process parallels that described in Module 3 for measuring the map with existing data, so we reference that section extensively. We assume that you have already selected one or more map elements that you want to measure; for guidance on how to select which parts of the map to measure, see Module 2. (Note that you may be able to measure your map entirely with existing data (see Module 3); if so, skip this module.)

4.2 DEFINING INDICATORS FOR EACH MAP ELEMENT'S EXTENT OF ADOPTION

For each map element you have selected for measurement, design an indicator that measures the *extent of adoption* of the behavior change, relationship, or condition referenced in the map element. Please refer to Sections 1.3 and 1.4 for an extensive explanation of measuring extent of adoption and setting adoption targets. In brief, measuring the *extent of adoption* involves measuring the percent of actors who have adopted a behavior change, who have a relationship, or who meet a condition.

There is a large amount of guidance to develop indicators in literature on monitoring and evaluation, much of which is relevant here. (See, for example, (USAID, 2008, 2010b).)

4.3 MEASUREMENT FREQUENCY

Measuring indicators should follow a regular schedule, so any progression of change through the system can be understood. However, the indicators need not all be

measured with the same frequency. The measurement frequency of each indicator should depend on (1) the expected speed of change and (2) the urgency of knowing the value of the indicator in order to adapt the intervention.

We suggest distinguishing two sets of indicators: some that are measured frequently (such as every three to six months) and others that are measured infrequently (such as every one to two years). Any indicators that are expected to change rapidly, and/or are critical to knowing whether an intervention is working, should be measured frequently. For example, diagnostic indicators (see Section 2.4.1) on the most critical pathways in the map should be measured frequently because they help to diagnose problems or provide quick confirmation that the intervention is working as intended. Slower-changing indicators can be measured less frequently.

Some indicators should be measured consistently throughout the development activity, but others can be dropped or added as needed. For example, once an indicator demonstrates that a particular change has taken place and is sustained, it may be dropped or measured less frequently (to save resources or to enable measuring other indicators). Similarly, diagnostic indicators may be added if the desired outcomes are not being achieved, to "diagnose" which upstream map elements are acting as barriers (see Section 6.3).

The indicators attached to the key outcomes are particularly important. They should be measured consistently throughout the entire project and (if possible) past its end-date, to demonstrate the pace and extent of change in the key outcomes. They do not necessarily need to be measured frequently.

4.4 SCOPE AND SAMPLING

Another important choice is the scope of data collection, determined by the sample and population for each indicator. In many cases, it will be infeasible to collect nationally representative data. We suggest limiting the scope based on the target populations, such as picking a small number of districts (such as two rural and two peri-urban, for example) and/or a subset of the population (such as particular vulnerable groups, for example). Development activities may be focused on particular target areas or groups; in these cases, we recommend collecting data on these areas/groups, and also collecting data on areas/groups that are not targeted but are "nearby" to check whether changes have "spilled over". We also recommend maintaining data collection after results have been achieved to see whether previously enacted changes have been sustained.

Economies of scale can be achieved if several indicators rely on the same population/sample and method: if you are already conducting a survey of farmers in a particular area, it is relatively cheap to add one more question, but it is expensive to add a second survey of a different population of farmers.

There are many trade-offs in determining the sample size and population. A survey with a very large sample size may yield the most powerful and reliable dataset, but may take so much time and resources that no other data can be collected. On the other hand, a small and poorly designed survey may not yield useful information. In measuring systems change, this trade-off is particularly difficult, because there may be several important outcomes to measure in many parts of the system,

and many other indicators to show degrees of progress along key pathways to these outcomes.

As with measurement frequency, we suggest using different approaches for different indicators. The key outcomes should be measured with more reliable methods (though less frequently), in order to demonstrate the achievement of the project's goals. Diagnostic indicators, on the other hand, may be measured using faster, less resource-intensive approaches to get a quick check on whether expected changes are taking place. For example, changes could be measured in one district, rather than country-wide, or with a smaller sample size. If the results are ambiguous, of course, further data collection could be conducted. This "tiered" measurement strategy should enable appropriate balancing of resource usage and data reliability.

Example 7: Defining indicators in the financial subsystem Recall the Formal Access pathway and the elements selected for measurement (see Example 5 and Figure 8).

Following the steps outlined in this section, we first design an indicator that measures the extent of adoption for each selected map element. The final choices for three of the elements are given in the table below, and they are discussed in the following paragraphs.

Map Element	Indicator
Outcome: Farmers take out loans to improve farming practices	Percent of farmers who have taken out a loan in the past year for the purpose of investing in agriculture. *Measured via* self-reported survey of farmers. *Sample* is Ugandan farmers in four rural districts. *Frequency* of once per year.
Diagnostic: Farmer uses mobile money	Percent of farmers who have used mobile money in the past three months. *Measured via* self-reported survey of farmers. *Sample* is Ugandan farmers in four rural districts. *Frequency* of once every 3 months.
Diagnostic: Bank agent or bank branch nearby	Percent of farmers who have a bank agent or bank branch within one hour's walk (or 5 km). *Measured via* self-reported survey of farmers. *Sample* is Ugandan farmers in four rural districts. *Frequency* of once per year.

Regarding the selection of the adoption indicator, two choices are straightforward: the outcome 'Farmers take out loans...' and the behavior change 'Farmer uses mobile money'. In both cases, we measure the percent of farmers who have adopted each practice. For the condition 'Bank agent or bank branch nearby,' two reasonable possibilities exist: the percent of farmers who can easily reach a bank agent or branch or the percent of (rural) districts that contain at least one bank agent or bank branch. The former was chosen because we are already collecting data from farmers for the other two map elements.

Regarding the frequency of measurement, the indicators are measured at two different frequencies: once per year or once every three months. The only indicator measured frequently is the behavior change "Farmer uses mobile money" because (in our hypothetical example) our intervention focuses on effecting this change, and

we want to understand rapidly whether and how well our intervention is working. The other indicators can be measured more slowly because they are not expected to change as quickly (for example, it is unlikely that many new rural bank branches will be built in 3 months, so a year is sufficient for the expected pace of change).

Regarding the sample, we survey farmers in four rural districts, two in which our development activities are focused and two nearby districts. In this manner, we can understand changes in the areas we target and also whether those changes are "spilling over" to those areas not directly targeted. While a national survey would be better, it is infeasible due to resource limitations (in our hypothetical example).

4.5 MEASURING AND ANALYZING EACH INDICATOR

The next step is to collect data to measure the indicators that have been defined. There is much guidance on how to design surveys and gather data, which we do not repeat here.

After each round of data collection, the data must be analyzed. Each indicator should be on a 0-100% scale, if defined according to our recommendations, and its score can be calculated.

If scores differ for different regions or different types of actors (e.g. urban or rural farmers), you must choose whether and how to aggregate the results. For this discussion, we assume you have aggregated the results to represent the entire region and population of interest with a single score, but it is also possible to repeat the analysis for different sub-regions and/or sub-populations.

Each indicator can be validated using standard techniques such as indicator standards and data quality assessments, if relevant (USAID, 2010a, 2014, 2008).

4.6 DISPLAYING INDICATOR STATUS AND SAVING METADATA ON THE MAP

The final step is to display the indicator status for each map element on the map itself. Please see Section 3.4 for a detailed explanation. In addition, it is crucial to save the 'metadata' for each measurement to the map as well; again, see Section 3.4 for further details.

5 REFINE

Objectives Refine and update the measurements and map

Prerequisites A map with measured elements, based on existing data (Module 3) and/or newly collected data (Module 4).

Products Refined and updated measured map and/or plan for refining data collection

Steps in brief

1. Identify measurement problems
2. Diagnose and resolve measurement problems

5.1 PURPOSE

The purpose of this module is to refine the map and the measurement of map elements. The module is relevant to maps measured with existing data and/or with newly collected data.

Four steps are involved. First, we infer the status of some elements based on the status of their enablers. Second, we consider the completeness and consistency of measurement across the map (Section 5.3). Third, we identify potential measurement problems by examining the status of map elements and how they are related to one another (Section 5.4). Fourth, we diagnose these identified measurement problems by considering their possible sources, and refine the map and/or measurement approach to resolve the problems (Section 5.5).

5.2 INFERRING STATUS FOR 'ROOT' ELEMENTS

There are some elements on the map, most commonly the 'root' elements (described in Section REFER TO IT), whose status can be inferred based on the status of the elements around them. For example, if an element has two enablers, and both are red, we might be able to infer its status to be red. Such inferences can be made only when we believe these enablers are the only influences on its status. This is not always true! But it is often true for 'root' elements because they summarize branches of the pathway.

Inferring element status for this type of 'root' element is useful because these elements are often hard to measure directly (because they are so broad) but they do not necessarily represent data gaps. Inferring their status makes it easier to interpret the map because they summarize the status of entire pathways and because we do not want to mis-classify them as data gaps.

To infer the status of an element based on its enablers, first check whether an element's enablers are the only influences on its status (based on experts' judgment and knowledge of the system).

The next step is to consider whether *all* the enablers are required or only *some of* the enablers are required. In other words, sometimes you need one enabler *and* another (e.g., loans available via mobile money *and* a mobile money agent is nearby), and sometimes you need one enabler *or* another, if the two enablers are alternatives to one another (e.g., using mobile money *or* a bank agent).

Once it is clear which enablers are required and which are alternatives, a status can be inferred based on the status of the enablers. Specifically, when all enablers are required, the element's status is equal to the *worst* status among its enablers. When all the enablers are alternatives to one another, the element's status is equal to the *best* status among its enablers.

Example 8 explains in more detail how this inference works.

Example 8: Inferring status for 'root' elements Consider Figure 13, which reproduces a relevant portion of the Formal Access pathway.

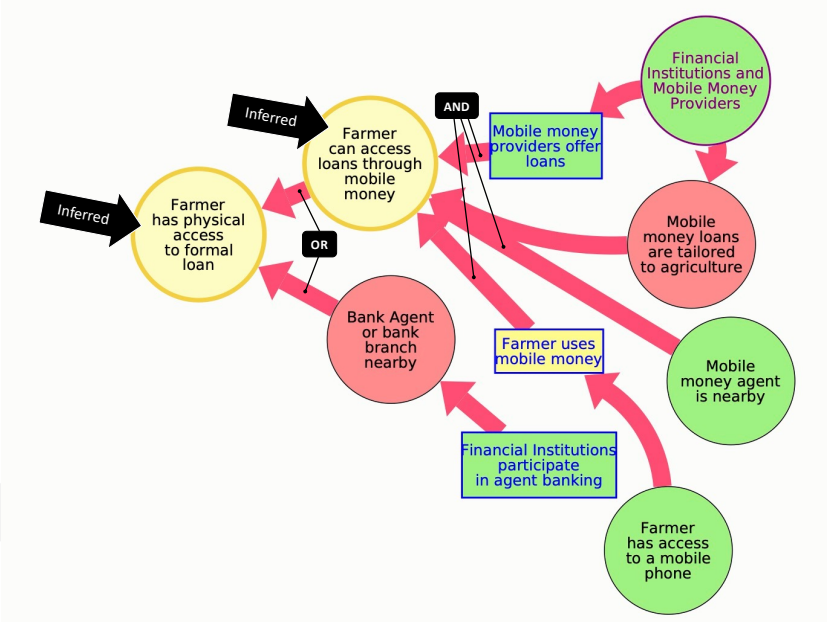

Figure 13: Inferring the status of 'root' elements based on the status of their enablers.

First, consider the element "Farmer can access loans through mobile money". This element's status was not measured with data, but we determined that it could be *inferred* based on the status of its enablers. To make this determination, first, we considered whether its enablers are the only influences on its status: since they are the main components of access, we believe that they are. Second, we considered whether all or only some of the enablers are required. In this case, all but one are required, because in order to access loans via mobile money, farmers need to use mobile money, *and* need access to a mobile money agent, *and* mobile money providers must offer loans. The fourth enabler is somewhat more optional: those

loans should be tailored to agriculture (because agricultural financing has somewhat different requirements for payback time and other terms), but this is not absolutely required for farmers to access loans. Finally, we used this information to infer the status of the element "Farmer can access loans through mobile money". Of its three required enablers, two are green and one is yellow. The inferred status of an element should be the worst status among all its required enablers, so it is yellow in this case. Logically, even if loans are widely available via mobile money (green) and lots of farmers have mobile money agents nearby (green), the number of farmers who can access loans through mobile money is still limited by the moderate number of farmers who use mobile money (yellow). (If we considered the fourth enabler required, then the inferred status for our element would be red, because so few mobile money loans are tailored to agriculture.)

Next, consider the element "Farmer has physical access to formal loan". This element's status was also inferred based on the status of its enablers. First, we considered whether its enablers are the only influences on its status: since they are the only two ways most people can physically access loans, we believe that they are. Second, we considered whether all or only some of the enablers are required. In this case, physical access to a formal loan requires only one of the two enablers: proximity to a bank agent/branch *or* loan access through mobile money. Therefore, only one of these two enablers is required. Finally, we inferred the element's status. Because the enablers are alternatives to one another – only one of them is required – the element's status is the best among these alternatives, so it is yellow. Logically, even if very few farmers have a bank agent or bank branch nearby (red), they can still physically access formal loans through mobile money, which is more widely available (yellow).

Next, consider the element "Farmer has collateral", depicted with its enablers in Figure 14, below. This element's status was not measured with data and it could not be inferred based on the status of its enablers. Why? There are two reasons: we did not know whether its enablers are the only influences on its status; and we did not know which of its enablers were required and which were alternatives. Specifically, because we do not know what types of collateral are required to get a formal loan, we could not determine whether land titles, salaries, and livestock of various types were all required or were alternatives to one another, and whether there are other forms of collateral that are not depicted on the map but are also required or act as potential alternatives.

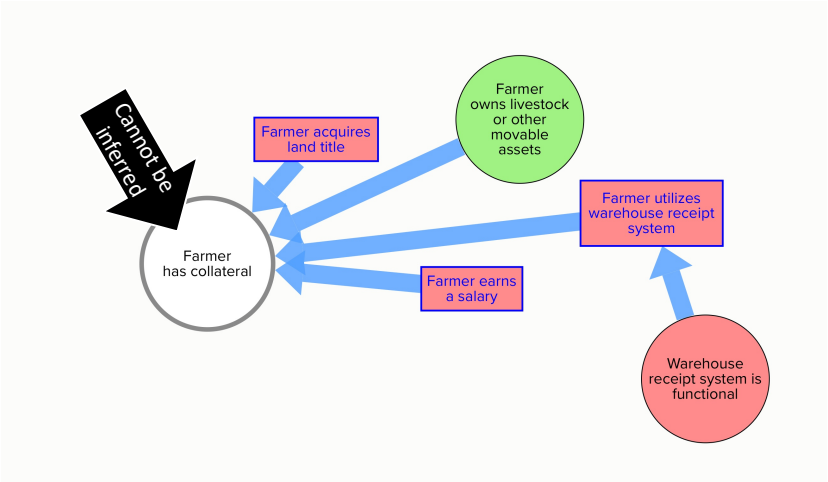

Figure 14: Inferring the status of 'root' elements based on the status of their enablers.

5.3 DATA COMPLETENESS AND CONSISTENCY

A useful step, especially when some map elements have been measured with pre-existing data, is to consider whether additional or alternative data sources or data aggregations could improve the results. Consider the following steps:

- **Seek data for some unmeasured elements.** Consider the map elements that remain unmeasured because you did not identify them for measurement. If any of them would be useful to measure, based on their position in the map, return to Section 3.2 and consider whether any of the data sources found in your search might also contain data relevant to the unmeasured elements. With the new data, repeat the remaining steps in Module 3 to add the new data to the map.

- **Consider consistency in data sources and data aggregations.** Looking across each pathway or loop, or across the map as a whole, consider the consistency among the scopes and dates for the data used to measure elements. If you have multiple potential indicators (from pre-existing data) for a given map element, or if you have aggregated data differently in different map elements, consider changing your selection to make the scopes and dates more consistent. For example, if you have a pathway in which two elements were measured using 2017 nationally representative data and one element measured using 2019 data on three regions, and if the latter element can also be measured with 2017 nationally representative data, consider changing your choice of indicator so that the whole pathway is measured with the same scope/date. As another example, you may have measured one element with a 2019 sample of six regions, and another with a 2019 sample of only three of those six regions; you may consider changing the former element to include only the three overlapping regions, for greater consistency.

5.4 IDENTIFYING MEASUREMENT PROBLEMS

The next step is to identify potential measurement problems. The following questions will help to identify common problems:

1. **Are there elements that have a better status than *all* of their enablers?** Such a situation is illustrated in Figure 15(left), below. It is unlikely for an element with only red enablers to be yellow, because this would suggest that the yellow element is somewhat widely adopted even though all of its enablers are not widely adopted. This situation is possible but unlikely, so it is worth investigating further.

2. **Are there elements that have a worse status than *all* of their enablers?** Such a situation is illustrated in Figure 16(left), below. It is surprising that an element with yellow or green enablers would be red, because all of the enabling conditions are met. This situation is entirely possible if, for example, actors do not choose to adopt a behavior change despite being able to do so. Nevertheless, it is worth investigating further.

3. **Is an element's status different than expected?** For example, does an element show as red even though you expected it to be green because your development activities have been directed toward its adoption for the past two years? Or, has an element been widely acknowledged as a problem by the stakeholder community, but is measured as green? It is important to perform this type of "sanity check" to surface potential problems.

4. **Are there elements that have not been measured but should be?** This is not, technically, a measurement problem, but it may challenge your ability to identify measurement problems. Note that not every part of the map needs to be measured, but you should identify areas that are relevant to your activity's goals, might be problematic, and yet are unmeasured.

5.5 DIAGNOSING AND RESOLVING MEASUREMENT PROBLEMS

Finally, for each of the potential measurement problems identified in Section 5.4, diagnose them in order to find ways to resolve them. The following are potential "diagnoses" or explanations for measurement problems, in roughly the order in which you should consider them.

1. **Problems with data collection or analysis**. A measurement problem could stem from problematic data collection practices, an insufficient sample size, or other standard issues.

2. **Different aggregations, populations, samples, or dates across map elements.** Since different map elements may be measured using different datasets, it is possible that the map elements may show misaligned results (e.g. problems 1 or 2 above) because they are measured in different years or with different samples/populations (such as rural or urban, or different districts). For an example of this issue, see Example 9.

To resolve this type of problem, we suggest (1) if feasible, recomputing indicator status to align populations/samples, which may resolve the problem; or either (2a) removing problematic indicators from the map and seeking alternative data with which to measure them more accurately, or (2b) leaving the data on the map as measured, but including a note in the metadata about why the element statuses appear misaligned (for example, noting that the yellow element is measured nationally and the red only for rural populations).

3. **Time delays.** An unexpected time delay may account for a lack of adoption where it was expected. Such delays are common in complex systems and are difficult to predict.

4. **Exogenous events.** Like a time delay, other exogenous events may explain apparent discrepancies, such as a poor harvest year or a free influx of seeds.

5. **Problematic choice of indicator.** It is possible that the indicator does not align with the map element. A map element describes a concept which may not be directly measurable, and/or may not have publicly available data that precisely aligns with the concept. The choice of a proxy or indicator for the concept may lead to apparent measurement problems.

   For example, the element "Farmer establishes social collateral" is difficult to measure directly; we chose publicly available data on the percentage of respondents who say they have people in the community to turn to, but this is not necessarily a good indicator of social collateral that can be used as the basis for making a loan.

   To resolve this type of problem, we suggest removing the indicator status from the map and seeking an alternative data source and/or an alternative indicator.

6. **System map is inaccurate.** The system map could be an inadequate reflection of the system's dynamics. There are several likely problems. First, barriers could be missing from the map. An element could show poor adoption even though its enablers are widely adopted because one or more additional barriers are not depicted. For an example of this issue, see Example 10. Second, enabling elements or arrows could be missing. An element could show broad adoption without an apparent enabler because the enabler is missing or not connected. Many additional problems are possible, but it is infeasible to detail all of them here.

   To resolve this problem, we suggest updating the map, preferably in consultation with experts (see the System Pathways Mapping toolkit for further guidance).

7. **Not enough parts of the system were measured.** The selection of pathways and elements to measure might have been insufficient to see the status of the system or to identify the relevant barriers to adoption. It is possible that changes are occurring through a pathway that was not measured, or are happening but not yet detected because indicators were not placed early

enough in the pathway to detect them quickly. For an example of this issue, see Example 11.

To resolve this issue, we suggest measuring additional parts of the map. See Module 2 for guidance on selecting which parts of the map to measure.

8. **Expectations were wrong, and/or an intervention is not working as expected.** When the system status indicates poor adoption where broader adoption was expected, and none of the previous diagnoses are applicable, it is likely that the expectations were wrong and/or the intervention intended to broaden adoption is not working as expected. In Section 6.3, we discuss this issue further.

Not all of these "diagnoses" represent problems that must be resolved. Diagnoses 1, 2, 5, 6, and 7 may all be resolved by changing data collection, data sources, or the map itself. Diagnoses 3, 4, 7, and 8 represent important knowledge gained about how the system works, and are relevant to your interpretation of the system status (Module 6).

Example 9: Identifying and diagnosing measurement problems: 1 The following example comes from the Formal Access pathway in the Agricultural Finance subsystem, which was shown in Figure 9, above. However, it is a *hypothetical example*, in that the status of elements has been changed to illustrate this potential measurement problem.

First, consider Figure 15(left), which shows an example of problem 1: elements that have a better status than all of their enablers. If there are only two ways to have physical access to loans, through mobile money or through bank agents/branches, and neither of these are widespread (the red elements), then it is unlikely that farmer physical access to loans could be moderately widespread (the yellow element). Therefore, this is flagged as a potential measurement problem.

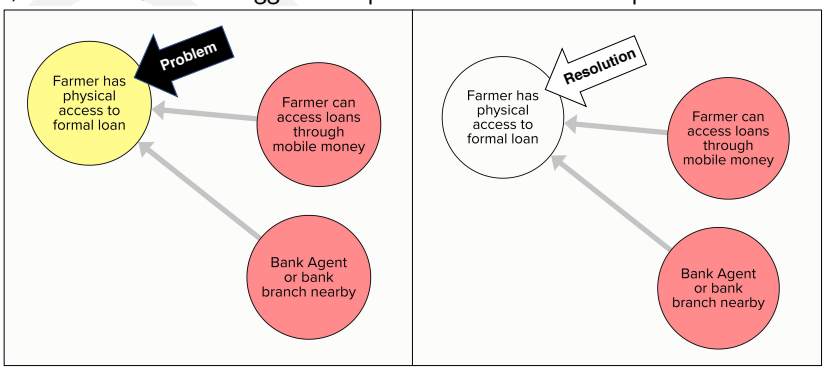

Figure 15: A potential measurement problem: an element with a better status than all of its enablers.

The next step is to diagnose this measurement problem. First, it is possible that this is not actually a measurement problem: the differences in color could be due

to values very near the cutoff between yellow and red (e.g., one at 35% for yellow and the others at 31% for red). In this case, we suggest resolving the 'problem' by making the colors consistent, according to your judgment, and noting this choice in the metadata. In this example, however, the values are not particularly near the cutoff.

Second, we consider the list of potential explanations for measurement problems. Many of them are possible explanations for this case. A particularly likely culprit here is the difference in the population between the yellow element and the red elements. The data for the two red elements focus on whether mobile money agents and bank branches/agents are available to farmers in rural areas specifically, while the data for the yellow element is measured on the entire population of Ugandans, including those in urban areas. As a result, a much higher percentage appear to have physical loan access.

To resolve this problem, the first step is to remove the measurement from the yellow element so that it appears without an indicator status. We might then seek additional data sources which could provide insight into physical access to formal loans in rural areas specifically.

Example 10: Identifying and diagnosing measurement problems: 2 The following example comes from the Formal Access pathway in the Agricultural Finance subsystem, which was shown in Figure 9, above. However, it is a *hypothetical example*, in that the status of elements has been changed to illustrate this potential measurement problem.

First, consider Figure 16(left), which shows an example of problem 2: elements that have a worse status than all of their enablers. Since all the enablers are green, it is surprising that "Farmer can access loans through mobile money" is red. In other words, since all the enablers show broad adoption –farmers use mobile money, there are nearby mobile money agents, and mobile money providers offer loans – it is surprising that few farmers can access loans through mobile money. Therefore, we flag this as a potential measurement problem.

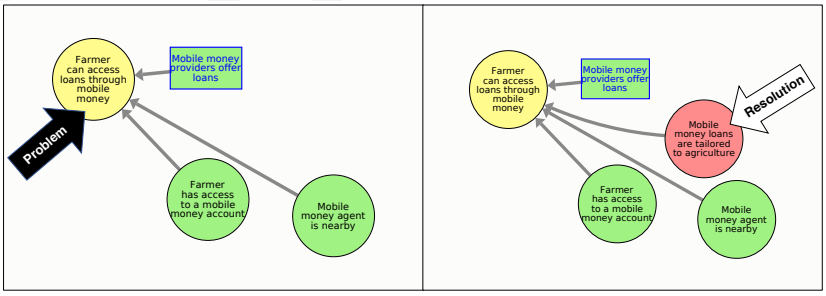

Figure 16: A potential measurement problem: an element with a *worse* status than all of its enablers.

The next step is to diagnose this measurement problem, using the list of potential explanations given earlier. There are several possible explanations. We focus on an inaccuracy in the system map. There is an enabler missing here: while loans may

be accessible via mobile money, it is also important that these loans are tailored to agriculture. This missing element likely explains why the data for "Farmers can access loans through mobile money" was measured as red.

To resolve this problem, we add an element to the map and measure it using publicly available data; see Figure 16(right).

Example 11: Identifying and diagnosing measurement problems: 3 Figure 17 shows a portion of the agricultural finance map: all the enabling elements for "Loan interest rate is affordable." The potential measurement problem is clear: the latter element has a better status than its enablers: it is yellow while the only measured enabler is red.

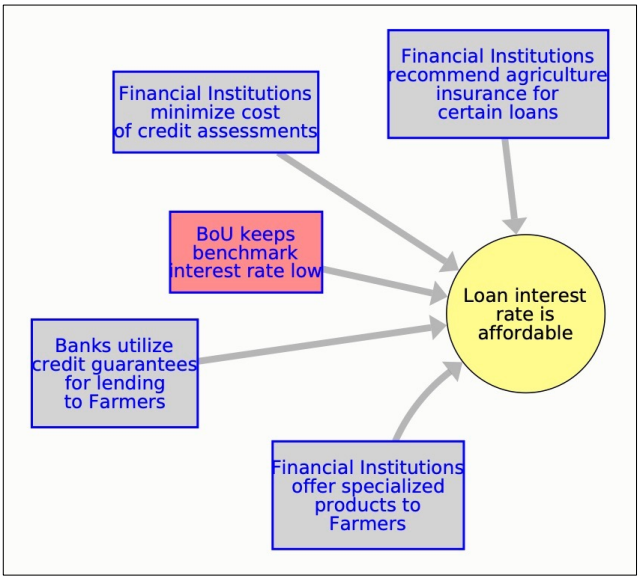

Figure 17: Measurement problems: worse status than enablers and many unmeasured elements.

To diagnose this issue, consider the list of potential diagnoses given earlier. The most likely explanation is that one of the other, unmeasured, enablers is an alternative pathway – i.e., that the red element is not a *required* enabler for the yellow element, and that one of the other grey elements is more widely adopted and acting as an alternative pathway to adoption. Therefore, our diagnosis is that not enough parts of the system were measured.

To resolve this issue, we should seek data for the unmeasured map elements, in order to understand where the enabler lies or whether we need to seek further for an explanation for this problem.

6 INTERPRET AND USE THE RESULTS

Objectives Interpret the measured map and use it to support decisions

Prerequisites A refined map with measured elements (Module 5), based on existing data (Module 3) and/or newly collected data (Module 4).

Products Understanding of system status, identified barriers and successes, and support for key decisions such as adapting or designing interventions and developing MEL strategies.

Steps in brief

1. Assess system health at multiple levels
2. Interpret change over time
3. Diagnose problems and explain successes
4. Support program and activity decisions

6.1 PURPOSE

For understanding system status and systemic change, it is not sufficient to simply measure a series of indicators: it is also necessary to interpret those indicators collectively in the context of the system. The measured system map is an excellent tool for this purpose. It is crucial to reserve time for interpreting the results and reflecting on their meaning for development activities. We suggest using a workshop to complete or review the steps in this module, after the measured map has been created.

In this module, we show how to assess the system health at multiple levels: not just for each element, but for each pathway and subsystem as well, to enable a holistic understanding of system health. We next consider how to assess change over time. Once system health has been assessed, we can identify problematic areas and diagnose the reasons for them, and identify successful areas and explain the drivers of this success. Finally, we discuss how these tools support program and activity decisions, such as adapting or designing interventions and developing MEL strategies.

Before beginning this module, we recommend completing Module 5 to create a refined, measured map. (You may skip the refining step, but you must have completed either Module 4 or Module 3.)

6.2 ASSESSING SYSTEM HEALTH AT MULTIPLE LEVELS

Analyzing and interpreting system data is challenging because of the volume and diversity of data about different parts of the system. The system map offers a very powerful way to analyze the status of the entire system, by "zooming" in and out to understand system status at the level of map elements, pathways and loops,

subsystems, and the system as a whole. The following subsections go through this process in detail.

6.2.1 Assessing map element status

You have already computed the status of measured map elements by measuring their extent of adoption on a 0%-100% scale (Section 1.3); you have set adoption targets at both pessimistic and optimistic levels (Section 1.4); and you have color-coded the map elements as red, yellow, or green, according to whether they meet the pessimistic or optimistic targets (Section 3.4 and/or 4.6).

At this point, you can either go directly to the next step (interpreting pathways), or pause to reflect on each indicator individually. Consider whether the status is expected or unexpected. Were targets met? Did you find any unexpected problem areas? Did you find any unexpected successes? It is more useful, however, to consider each element's status in the context of the pathway(s) or loop(s) in which it is contained, as we discuss next.

6.2.2 Assessing pathway and loop status

Next, consider each pathway or loop that contains measured elements. There are two steps to assessing pathway and loop status: (1) examining the pathway or loop to understand barriers or enablers along it, and (2) designating a status for the pathway or loop to facilitate further higher-level analysis of the system.

The first step is to understand the barriers and enablers within a pathway or loop. By examining all the measured indicators along the pathway or loop, one can determine where adoption is successful and where it is not. Green and yellow elements indicate different degrees of successful adoption, while red elements indicate low adoption. A pathway or loop may show green or yellow throughout, suggesting that adoption is successful. Alternatively, a pathway or loop may show green and yellow until it meets a red element, which suggests that the red element is acting as a barrier to further adoption. Some pathways have multiple branches; in this case, consider whether each branch is successful or stalled. Example 12 explains this interpretation process in more detail.

The second step is to designate a status (red, yellow, green, or unknown) for the *entire pathway or loop*. This is useful to simplify interpretation of the status of the entire system. For pathways, the pathway status is usually the same as the status of the 'root' element (see Section WHICH) – the 'root' element is the last element in the pathway before reaching a key outcome or intersection with another pathway. For example, in Figure 18, the root element is "Farmer has physical access to formal loan," because it is the last element before intersecting with other pathways.[1] In many cases, however, the root element of a pathway may not have been measured. In this case, you should *infer* its status based on the status of its enablers, as described in Section 5.2. If the status cannot be inferred, it should be designated as

[1] On the full map, shown in Figure 19 below, it is clear that many other pathways intersect the later element "Farmer has access to loan," so it cannot be the root for this particular pathway.

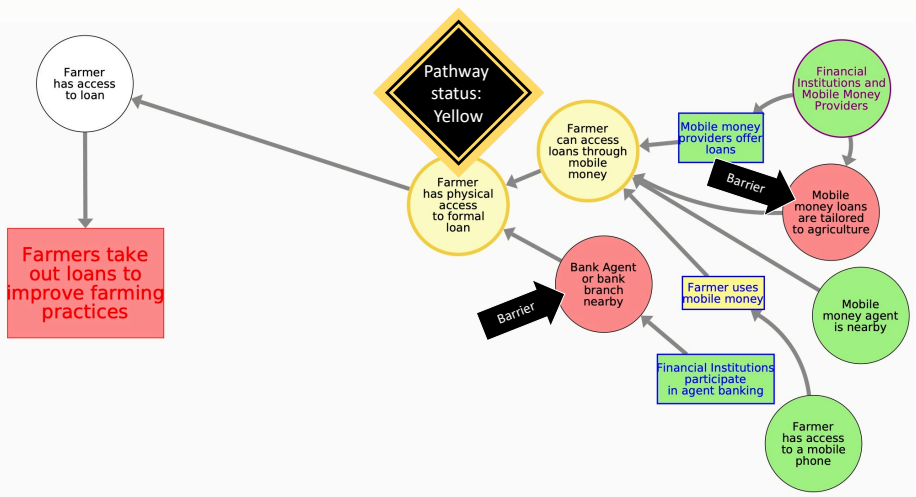

Figure 18: The Formal Access pathway with indicator status displayed.

unknown or unmeasurable, and the status of the pathway may also be considered unknown.

To record the status of the pathway, showing the status of the root element is sufficient (if it matches the status of the pathway). You may also wish to color-code the pathway's label, or color its background, or mark the root element with a colored marker (as in Figure 18), or any other method that simplifies interpretation.

Assessing the status of loops is more complex, because they do not have a clear root element. Most loops do, however, have one or several elements at which they intersect other loops or pathways. The loop's status may be assessed based on the element *just before* the intersection with other loops or pathways. If this element is not measured, its status may be inferred.

Example 12: Assessing a pathway Consider the Formal Access pathway from the finance subsystem, with indicator status displayed (Figure 18).

This pathway has several branches. First, consider the branch that begins with 'Financial Institutions participate in agent banking.' This element is yellow, indicating moderate adoption, but it stalls at the red element 'Bank agent or bank branch nearby,' indicating that proximity of bank agents/branches is a barrier to adoption.

Second, consider the remaining branches. Most elements are green or yellow, except 'Mobile money loans are tailored to agriculture.' This appears to be a second barrier, although it does not entirely prevent the branch from being successful: farmers can still access loans, just not necessarily agriculturally tailored loans (see Section **??** for a more detailed analysis of this question).

Two important conclusions can thus be drawn about this pathway: first, that while access through physical banks/agents is stalled by the lack of physical proxim-

ity to farmers, the alternative path to access via mobile money is functioning somewhat better; and second, that the key barriers are proximity of bank agents/branches and tailored loans for mobile money.

The overall status of the pathway should next be designated. The root element is 'Farmer has physical access to formal loan'. This element is not measured, but its status was *inferred* based on the status of the elements pointing to it (see Section **??**) to be yellow. Therefore, the status of the entire pathway is yellow, indicating moderate adoption.

6.2.3 Assessing subsystems

Next, consider each subsystem that was measured. There are two steps to assessing the subsystems: (1) examining the subsystem to understand barriers or enablers within it, and (2) designating a status for the subsystem to facilitate higher-level analysis of the entire system.

The first step is to understand the barriers and enablers within the subsystem. A subsystem typically contains a small number of key outcomes. Focus on one key outcome at a time. For each key outcome, consider the set of pathways leading to it and loops intersecting it. In Section 6.2.2, we flagged each measured pathway or loop as green, yellow, red, or unknown. Now, look across these pathways and loops. The goal is to identify which pathways and loops are successfully enabling the achievement of a key outcome and which are acting as barriers. Note that some pathways are necessary for achieving the outcome while others may represent different alternatives for achieving the outcome, so a red pathway leading to an outcome does not necessarily mean it cannot be achieved (as discussed in the "Going Deep" paragraph below). Example 13 discusses the interpretation of a subsystem in more detail.

Going Deep 3: AND and OR pathways When two pathways enable an outcome, there are two possibilities: two pathways may be *alternatives* to one another (need one *OR* the other), or they may *both* be necessary to achieve the outcome (need one *AND* the other). For example, access to loans requires *either* access to formal loans *or* access to informal loans. Access to the former – formal loans – requires requires *both* physical access *and* meeting loan requirements. Understanding which pathways are *alternatives*, i.e. *OR* pathways, and which pathways are *both* required, i.e. *AND* pathways, is important because a stalled *OR* pathway may be avoided by using an alternative pathway, but a stalled *AND* pathway must be fixed to remove the barrier.

The second step is to designate a status for the subsystem. We begin by designating a status for each of the key outcomes within the subsystem. If it was measured, its status is already shown. If it was not measured, infer a status as described in Section 5.2, based on your analysis of the status of the pathways leading to the key outcome. If there is only one key outcome in the subsystem, its status should be considered the status of the entire subsystem. If there are multiple key outcomes, you could assign a status to the subsystem based on the status of the

most important key outcome or some composite of all the key outcomes in the subsystem.

Example 13: Assessing subsystem status Figure 19 shows four pathways from the financial subsystem, all of which lead to a single key outcome. Before considering the pathway status, first consider which pathways are required ('AND' pathways) and which are alternatives ('OR' pathways). Demand is required, an 'AND' pathway, since there is no alternative to a farmer's choice to seek a loan. However, there are two alternatives for farmers to have access to loans: either informal financing or formal financing. Formal financing requires both Formal Access and Formal Loan Requirements pathways, but Informal Financing requires just th Informal Financing pathway.

With this background, examine the status of each pathway, which was flagged as discussed in Section 6.2.2. The Formal Access pathway is yellow, which indicates that access formal financing is moderately widespread, but the Formal Loan Requirements pathway is unknown, meaning that we do not have sufficient information to know how widely farmers can meet formal loan requirements. On the other hand, Informal Financing is green, which means that many farmers have a path to loan access even if it is not formal. However, in addition to Informal Financing, the Demand pathway is necessary, and it is red, meaning few farmers are seeking out loans.

Based on this analysis, we would flag the outcome as red, because at least one necessary pathway is red. In this case, the outcome element's status has been measured and is also red.

Finally, we identify the set of pathways acting as barriers. The Demand Pathway is the most critical barrier. The unknown pathway, Formal Loan Requirements, may also act as a barrier, but further information is needed to understand its role.

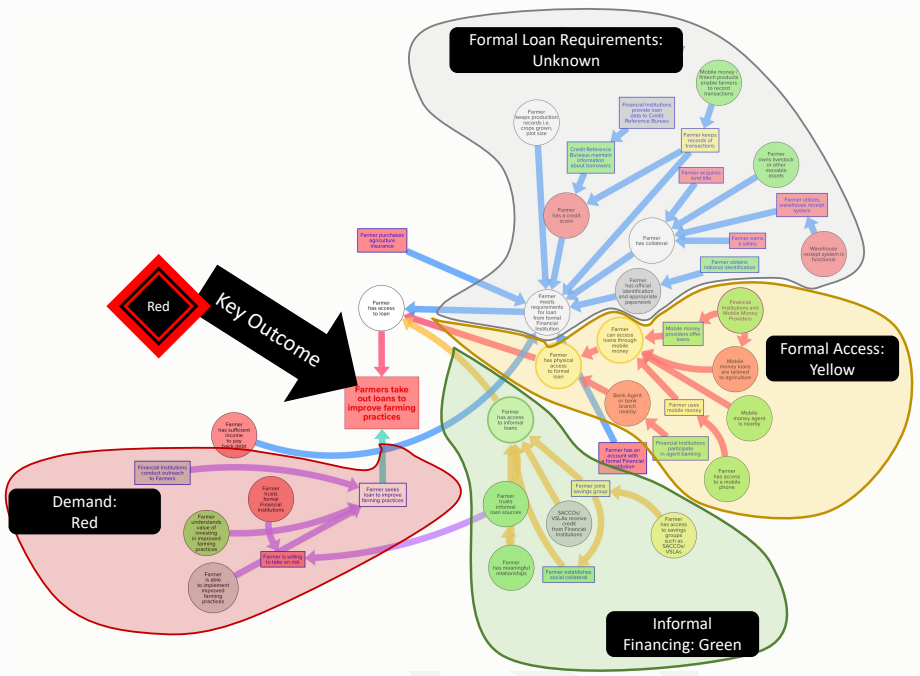

Figure 19: Four pathways from the financial subsystem.

6.2.4 Assessing the system

Some development activities may focus only on a subsystem, but if your focus is an entire system composed of multiple subsystems, the final step is to interpret change across the system as a whole. You have already assessed the status of the key outcomes in each subsystem, following Section 6.2.3. These key outcomes generally enable one another. We suggest abstracting away everything in the map other than the key outcomes and the connections between them, as depicted in Figure 20 in Example 14. This allows you to focus on the status of each subsystem and its key outcomes, and how these influence one another. The goal is to identify any problematic or barrier subsystems to achieving the overall goals of the development effort. Any subsystems that are red and influence other outcomes are likely acting as barriers and therefore worth further analysis and, likely, further investment. See Example 14 for further explanation.

Example 14: Assessing system status Figure 20 shows a notional depiction of assessing the system status based on the status of three subsystems. In Examples 12 and 13, we found that the status of the agricultural finance subsystem's key outcome, 'Farmers take out loans to improve farming practices,' was red. A similar analysis of the inputs subsystem shows that one of its key outcomes, 'Wholesaler/Dealer

stocks quality agricultural inputs,' is yellow[2]. Based on the system map, both of these key outcomes enable (via several other elements, not shown) the ultimate key outcome, 'Farmer has adequate income.' This situation is depicted in Figure 20, where the "clouds" indicate that there are steps between these key outcomes that we are not representing.

The interpretation is that quality agricultural inputs are somewhat widely available, but agricultural finance remains a barrier to farmers achieving adequate income. Of course, understanding precisely *why* agricultural financing is a barrier to income requires 'zooming in' to examine the pathway(s) between these two key outcomes. Likewise, understanding why agricultural financing has a red status requires 'zooming in' on that subsystem – back to the pathways and elements discussed in the sections above. The purpose of this high-level system view is to understand the status of the overall system and to identify problem areas for further, deeper analysis.

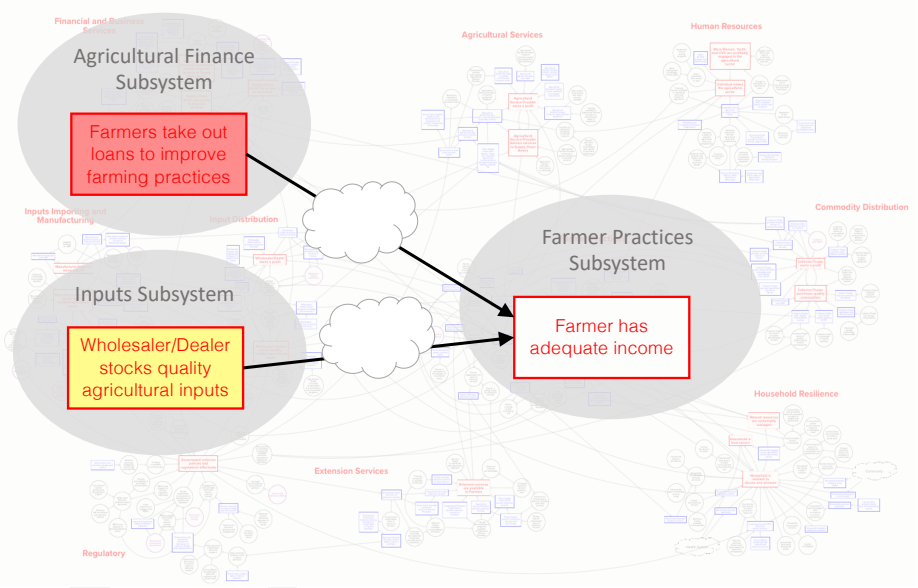

Figure 20: Status of three subsystems and how they relate to one another. The figure shows clearly that agricultural financing is not widely adopted and is therefore acting as a barrier to farmers achieving adequate incomes.

6.2.5 Zooming in and out

Of course, much information is lost when aggregating and abstracting at the level of the entire system (Figure 20), but on the other hand, the status of the system can be easily understood and barriers identified. Crucially, however, no information is actually lost, but rather it is abstracted away to ease interpretation. The map makes

[2]Based on a census of dealers in 2016; more recent events suggest a decrease in adoption of quality inputs, so the status may be turning toward more limited adoption

it possible to "zoom" in to identify *why* a subsystem's health is poor – to see which pathways are acting as barriers, then to "zoom" in again to see, on each barrier pathway, which specific elements are acting as barriers. Similarly, it is possible to start with a problematic element, then "zoom" out to understand its influence on its pathway(s), subsystem(s), and the system as a whole. See the end of Example 14 for an example of the power of this type of analysis.

This approach makes it possible to easily diagnose problems and explain successes, as discussed in Section 6.3, below.

6.3 DIAGNOSING PROBLEMS AND EXPLAINING SUCCESS

It is sometimes necessary to "troubleshoot" an intervention: to diagnose why it is not working. At the same time, an unexpected success might require some explanation. In both cases, the measured map is a useful tool.

If a key outcome is not being achieved, you can diagnose the problem by examining all the pathways leading to that key outcome to identify pathways which are acting as barriers (see Section 6.2.3 and Figure 19), then examine the elements along each barrier pathway to identify which specific elements are acting as barriers (see Section 6.2.2 and Figure 18). The following example describes the process in more detail.

Example 15: Diagnosing problems Examples 14, 13, and 12 provide a good illustration of how to diagnose problems. Suppose we note that the key outcome in the financial subsystem, "Farmers take out loans to improve farming practices," is red, and we wish to understand what is preventing this outcome from improving. We first examine the pathways leading to that key outcome, as shown in Figure 19. The most likely barrier pathway is the Demand pathway because its status is red and, as discussed in Example 13, it is a *required* pathway for achieving the key outcome. (The Formal Loan Requirements pathway, whose status is unknown, may also act as a barrier, but it may be less critical because the green Informal Financing pathway is a valid alternative, as discussed in Example 13.)

Next, we examine the Demand pathway to determine the likely barriers along it; this is shown in Figure 21. The root element is 'Farmer seeks loan to improve farming practices,' and its status is unknown. However, there are two important red elements leading to it: 'Farmer trusts formal financial institutions' and 'Farmer is willing to take on risk.' These are likely important barriers to achieving the key outcome. (The two unmeasured elements, and in particular the critical 'Farmer is able to implement improved farming practices,' may also act as barriers and could therefore be investigated.)

With this analysis, we diagnosed several likely reasons for the poor adoption status of a key outcome by investigating, first, which pathways are acting as barriers and, second, which elements along the pathways are acting as barriers.

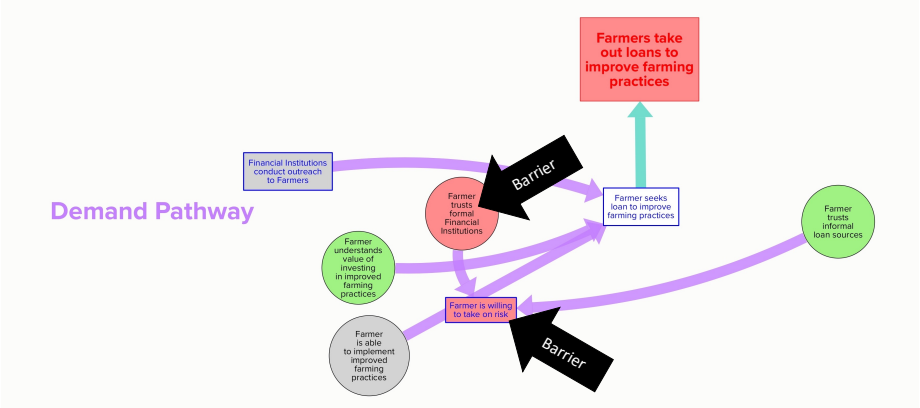

Figure 21: Diagnosing barriers in the demand pathway: trust and willingness to take on risk.

If there are no barrier pathways or elements, i.e. if all the outcome's enablers seem to have healthy statuses (green or maybe yellow), then the true barriers are either not yet measured or not included on the map (or the outcome has a measurement problem; see Module 5). For any unmeasured pathways or elements that may act as "as-yet-unseen" barriers, measure them using existing data (Module 3) or collect new data (Module 4). Even a quick, limited-scope survey can provide some insight into whether something is acting as a barrier. If there are no unmeasured pathways or elements leading to the key outcome, then your barrier is likely missing from the map; see Section 5.5, problem number 6. We suggest consulting with stakeholders to identify potential barriers that are missing from the map, then updating the map to include the barriers (see the System Pathways Mapping toolkit for guidance) and measuring them to confirm that they are acting as barriers in this case.

The process for explaining successes is similar. If an outcome is surprisingly successful, i.e. more widely adopted than expected, it is desirable to understand what specifically enabled or prompted this success. Examine the pathways leading to the outcome, along with their particular elements, to understand what combination of successful enablers led to the successful outcome.

6.4 INTERPRETING CHANGE OVER TIME

When data are available for multiple points in time – for example, if a survey or M&E data are collected every few years – it is possible to use the map to study how the system is changing over time. For example, Figure 22 shows the formal access pathway colored for change over time. Each map element was measured at two different points in time, and the color indicates how much change occurred in the element's adoption status over that time period. Blue indicates that adoption has increased over time, with darker blues indicating larger increases. Orange indicates that adoption has decreased over time, with darker oranges indicating larger decreases.

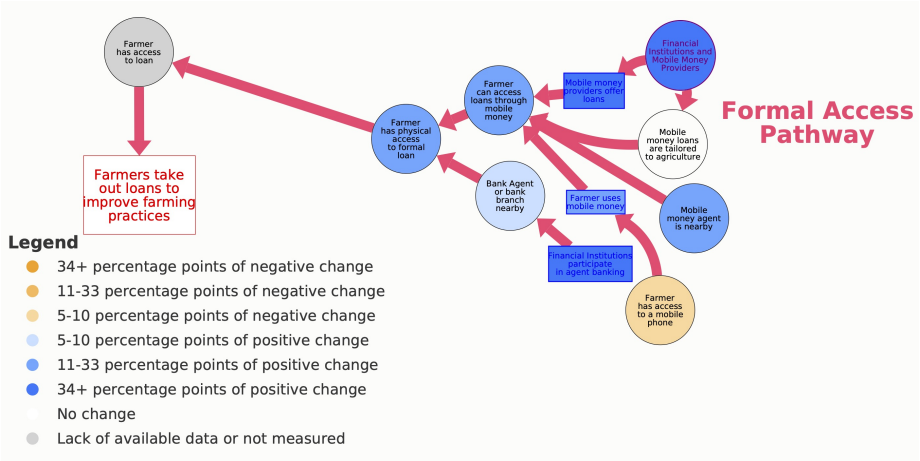

Figure 22: Delta map displaying change over time, for the Formal Access pathway.

This is very useful for testing the impact of interventions. If an intervention was designed to effect a particular set of changes, the map can show whether such changes have in fact occurred in the targeted areas of the system. For example, recent investments attempted to broaden digital access to financing. Figure 22 shows that these investments have paid off, since both mobile money usage and availability of loans through mobile money have increased significantly in the five-year timeframe shown in the map.

The delta map can also show where expected or desired changes have *not* occurred or where adoption has decreased. White elements indicate that there has been no change within the timeframe – adoption is stagnant. Orange elements show decreasing adoption. If an intervention has targeted changing these elements, then the map can give warning that the intervention is not working. White and orange areas may also indicate barriers to changes in other parts of the system.

Example 16 provides further details on how to construct and interpret a delta map showing change over time.

Example 16: Interpreting change over time First, consider Figure 22, the delta map for the Formal Access pathway. To make this delta map, we used data sources for the timeframe 2013-14 and 2017-18. Each element was colored based on how much its adoption status changed between these two timeframes. For example, the number of farmers using mobile money was measured in 2013 and again in 2017. In 2013, mobile money was adopted by about 38% of farmers, and in 2017, by about 54%. This means adoption increased by 16 percentage points. The elements are colored based on how much they increased or decreased, as shown in the legend in Figure 22. Therefore, 'Farmer uses mobile money' was colored a medium blue.

With the map colored for change over time, it is possible to identify areas where many changes have occurred and those where the system is stagnant or changing

in undesirable directions. Continuing with Figure 22, we see a large number of positive changes – increased availability of loans through mobile money and of bank agents near farmers. There are only two troublesome elements. First, the orange 'farmer has access to a mobile phone' shows a small decrease in adoption, but the adoption rate remains quite high at 78%. Second, the white 'mobile money loans are tailored to agriculture' is stagnant, which is more worrisome, since farmers cannot easily use short mobile money loans for agricultural inputs that require longer repayment periods. This analysis therefore highlights an important barrier for investment: expanding availability of ag-appropriate loans through mobile money.

As mentioned earlier, the delta map also enables "testing" whether recent interventions have succeeded in creating the desired changes in the system. To do so, we consider whether the changes over time align with the goals of these interventions. There have been recent investments in access to digital financing. The map shows that, as expected, digital access to financing, via mobile money, has expanded significantly in the past five years, suggesting these interventions were successful. (Note that this does not directly attribute effects to interventions.)

The delta map is also useful when "zoomed out" to consider the entire system. Figure 23 shows the entire agricultural finance map colored for change over time. First note that the key outcome, 'farmers take out loans to improve farming practices', is white, indicating no change in five years. This is problematic, given the abovementioned investments in increasing access to finance. The following analysis attempts to understand the reasons for this lack of change.

The areas that stand out with significant positive change (blue) are the formal access pathway just discussed (pink arrows) and the informal financing pathway (orange arrows) in the lower right. We conclude that *access* to financing, via formal or informal channels, is changing as desired. However, many of the elements on other pathways are white (stagnant) or orange. Formal loan requirements (blue arrows, upper right) contains a large number of white and orange elements, indicating little change or change in the 'wrong' direction. Likewise, the demand pathway (purple arrows, lower left) has two key elements that are orange, indicating decreasing trust in financial institutions and decreasing willingness to take on loans. Loan affordability (green arrows, upper left) has remained stagnant, without the gains in affordability that are desired.

Thus, we reach the important conclusion that *access* to loans has broadened but several other essential components have remained stagnant or decreased (demand for loans, affordability, meeting loan requirements). As a result, the key outcome has not changed, despite recent investments in access to finance.

6.5 SUPPORTING PROGRAM AND ACTIVITY DECISIONS

The measured map is a valuable tool for supporting program and activity decisions. Below, we highlight how several types of decisions can be supported.

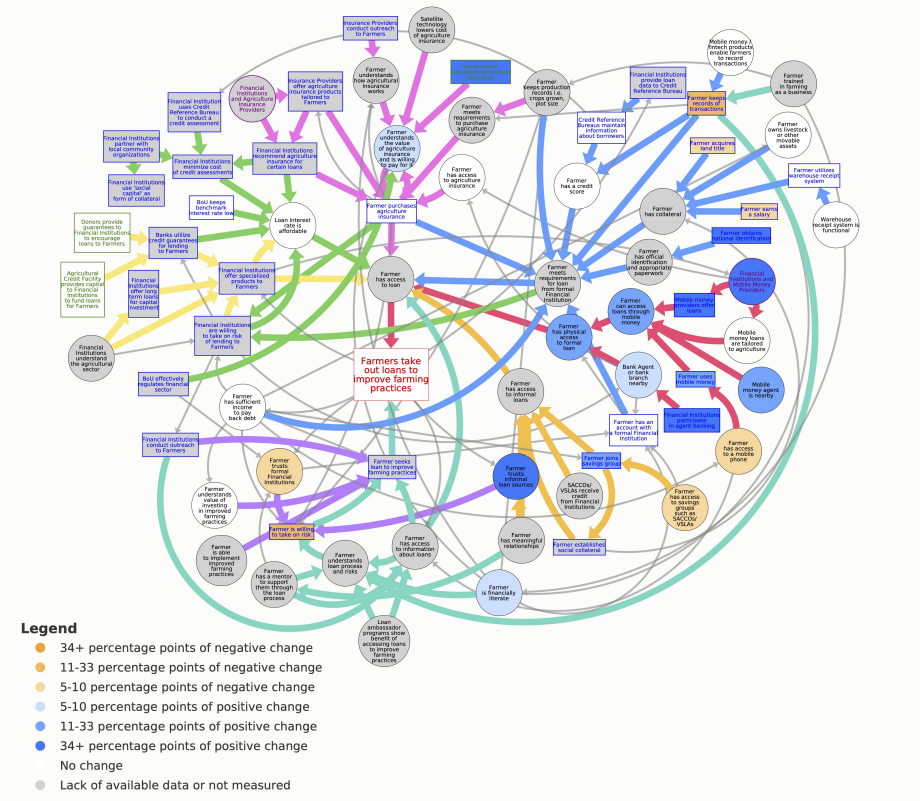

Figure 23: Delta map displaying change over time.

6.5.1 Identify challenges early and adapt interventions to meet them

In the course of a market facilitation project, it is crucial to get some early indications of whether the facilitation efforts are working, even though the ultimate impact may not be felt immediately. If challenges arise, the development project's activities should be adapted to meet them.

To get early indications of whether interventions are working as expected, select and measure diagnostic indicators that are early enough in the relevant pathway to see impact quickly (i.e., close to the intervention) (Section 2.4.1). Then, measure these indicators frequently enough to catch problems early (Module 4). Finally, set aside time on a regular basis to interpret these data, preferably in a workshop format (Module 6). Some of these regular check-ins need not include the entire map, but can focus only on the diagnostic indicators that are intended to catch problems early.

If these data indicate that interventions are not leading to the expected outcomes, the barriers can be diagnosed as described in Section 6.3, by examining the pathways leading to problematic elements to identify the upstream barriers.

Once barriers are identified, the interventions can be adapted to address them or to find ways around them. To find ways around a barrier, the map is a useful tool: consider whether there are alternative pathways that avoid a barrier.

Example 17: Identifying challenges early and adapting interventions to meet them This toolkit has already provided examples of this process. Consider again the measured formal access pathway, shown below in Figure 24. Further, consider an intervention that aims to broaden digital access to financing by working on the relationships between financial institutions and mobile money providers (top right of figure), and thus to enable more farmers to take out agricultural loans – the key outcome at the left of the pathway.

Of course, it is critical to measure the key outcome. But in addition, in order to identify challenges early, we should also measure several diagnostic indicators much closer to the location of the intervention. For example, we could measure two additional elements: the extent to which farmers can access loans through mobile money, and whether they are tailored to agriculture. Of course, other elements could be measured, but based on the data displayed in the map, the other branches of this pathway are functioning more smoothly, so we measure the critical problem areas that the intervention needs to change if the key outcome is to be achieved.

Beyond this pathway, it would also be useful for the intervention to monitor other parts of the system, since barriers on other pathways might also affect the key outcome.

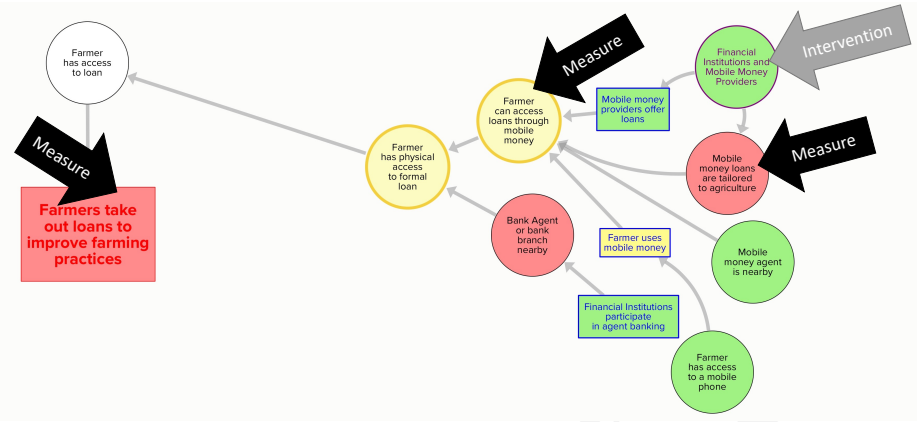

Figure 24: Diagnosing barriers in the demand pathway: trust and willingness to take on risk.

6.5.2 Understand the evidence base for learning, adaptation, and investment decisions

In market facilitation and other systems approaches to development, the evidence base for decision-making is broad and diverse because it spans many parts of a complex system. Data are collected in many ways by many entities, may not align with one another in terms of dates and populations, and span so many parts of a complex system that they are hard to consider collectively and relate to one another.

The measured system map provides a concrete approach for collecting and analyzing diverse data sources: a "data review" in the form of a map. For example, the Formal Access Pathway (discussed in many previous examples) is measured with data from seven different data sources[3]. The map provides a focus for which data to search for (Module 3), and also enables interpretation of the relevant aspects of all of this data collectively (Module 6).

As a result, the evidence base for decision-making can be understood. It is clear "at a glance" where data are available and where they are missing (Section 3.7), and it is also clear where there are gaps, opportunities, and barriers (see Section 6.5.4). Such a map can be used and cited as the basis for important planning and investment decisions.

6.5.3 Build a learning agenda and/or a Monitoring, Evaluation, and Learning strategy for a development activity or set of activities

At the start of a new systems development project, or even during the design of such a project, a strategy for learning about the system is essential. A measured map (using baseline or pre-existing data) is a useful tool for designing such a strategy.

[3]Finscope 2017, UNCDF 2019, Uganda National Financial Inclusion Strategy 2017, Financial Inclusion Brief - Twaweza East Africa 2018, The Global Findex Database 2017, Daily Monitor 2019, Strategic Plan 2015-2022

In particular, Module 2 provides guidance on selecting which parts of the system to measure. This is particularly powerful when combined with an assessment of the evidence base (Section 6.5.2) and data availability and data gaps (Module 3) because it shows where data are already being collected regularly, and where the crucial knowledge gaps lie.

6.5.4 Support the design of future development activities by identifying gaps, opportunities, and leverage points

Identifying gaps, opportunities, and leverage points is crucial in the design of development activities. This topic is discussed in the Mapping Toolkit, but it is even more powerful when using a measured map.

To find gaps, examine the map for barriers, stalled adoption, and data gaps. Look for barriers to key outcomes (Module 6 and Section 6.3). Look for areas with red status or with unmeasured status, since these indicate stalled adoption and/or a lack of knowledge about a part of the system. The map's structure provides guidance on how crucial each of these potential gaps are in achieving development outcomes, through pathways from the gaps to the outcomes. Finally, identify leverage points for each of the gaps identified, based on the structure of the map (see the System Pathways Mapping toolkit).

6.5.5 Communicate the impact and challenges of a development activity

A measured map is an excellent communication tool, particularly well suited for describing the impact and/or challenges of a systems development project, because it can relate interventions in various parts of a large system to outcomes in other parts of the system.

Using a tool like kumu (see the System Pathways Toolkit Annex), you can easily visualize progress towards different key outcomes in different areas of the map, then show how those key outcomes relate to one another (Section 6.2). Even if an intervention has not made changes that reach the ultimate beneficiary, the map can show that changes are on their way. For example, an intervention that helps agrodealers to stock high-quality seed may take time to affect farmer incomes, but may much earlier enable wider availability of high-quality seed and wider adoption by farmers of high-quality seed. These are map elements along a pathway from the intervention to the ultimate outcome, and the map can show that adoption is progressing in these intermediate outcomes even if farmer income has not yet changed.

Another useful communication approach is to explain success (or challenges) in terms of system changes. If a set of interventions in different parts of the system has resulted in a major change, the map can be used to trace the pathways from that major change back to the original (and varied) interventions that enabled it. The same approach can be used to explain challenges that prevented achievement of an outcome. You can easily "zoom" in and out from a high-level system view to a more detailed pathway or element view to diagnose problems and explain successes

(Section 6.3), which enables stakeholders and leadership to understand the story of the development activity.

6.6 WHERE TO GO FROM HERE

This measurement toolkit offers a powerful set of tools for understanding and communicating about development systems. Nevertheless, it can be complex. We are here to help. Please feel free to contact us at any time, at msm.uganda@mit.edu.

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