ResilientAfrica Network (RAN)
State of African Resilience Report 2017

CONTENTS

Preface

University-led partnerships like the ResilientAfrica Network (RAN) are important because they promote greater collaboration among development professionals and university communities, harnessing their collective talents and energies to more effectively address some of the world's most complex development challenges.

Five years ago, a group of stakeholders from African and U.S. academic institutions came together in Kampala, Uganda, to create a network that draws on the knowledge and expertise of African scholars, students, and researchers to give voice and agency to vulnerable communities and address development challenges in Africa. Through the years, the RAN has engaged 20 universities across 13 countries in Africa as well as two United States-based universities to build and sustain the resilience of target communities by nurturing and scaling up innovations driven by each community's needs.

This Second State of African Resilience Report 2017 discusses the RAN methodology used by universities to engage with communities to understand drivers of vulnerability and adaptive capabilities and develop innovative solutions to address shocks and stressors.

We want to thank the RAN management team members for their dedicated leadership. The team is composed of Prof. William Bazeyo, Deputy Vice Chancellor for Finance and Administration, Makerere University and Chief of Party for the RAN; Higher Education Solutions Network (HESN) Development Lab Director; Prof. Ky Luu, Executive Director of the George Washington University's Institute for Disaster and Fragility Resilience (GW/IDFR), and RAN Co-Chief of Party; Dr. James Fishkin, Professor of International Communication and Director of the Center for Deliberative Democracy at Stanford University; and Ms. Jennifer Cooke, Director, Africa Program, Center for Strategic and International Studies.

We would also like to express our appreciation to the RAN Secretariat, which includes Dr. Roy William Mayega, Deputy Chief of Party; Dr. Dorothy Okello, Director of Innovations; Christine Muhumuza, Research Manager; Deborah Naatujuna Nkwanga, Engagement Manager; Grace Mongo Bua, Community Liaison Officer; Joseph Mukaawa Lubega, Multimedia Developer; Harriet Adong, Communications Manager; Deborah Namirembe, Program Administrator; Harriet Namata, Director of Monitoring and Evaluation and Learning; Herbert Ampeire, Accountant; Loyce Twongyeirwe, Administrative Assistant; and Natasha Kassami, Engagement Officer.

We are grateful to the RILabs and their partner universities who conducted the research and analysis on which this report is based. Leading the RILabs are Dr. Lekan Ayo-Yusuf, Deputy Vice Chancellor for Research & Innovations, Sefako Makgatho Health Sciences University (SMU); Nathan Tumuhamye, Director of the Eastern Africa RILab; Dr. Etienne Rugigana, Head of the Epidemiology and Biostatistics Department, University of Rwanda College of Medicine and Health Sciences; Dr. Dennis Chirawurah, Director of the West Africa RILab and lecturer in the School of Medicine and Health Sciences at the University for Development Studies, Tamale, Ghana; Dr. Kifle Woldemichael, Director of the Horn of Africa RILab and Professor of Epidemiology at Jimma University; and Mr. Mohamed Osman Mohamoud of the Somalia Innovation Hub.

Important contributions were also provided by Prof. Banny Banerjee, Director of Stanford ChangeLabs; Kathleen Giles, Manager of the Center for Deliberative Democracy, Department of Communication, Stanford University; Deborah Elzie, Program Director, GW/IDFR; Dr. Apollo Nkwake, GW/IDFR Associate Research Professor; Dr. Eric Corzine, GW/IDFR Assistant Research Professor; Courtni Blackstone, GW/IDFR Program Manager; and Benjamin Hubner, Program Coordinator of the Center for Strategic and International Studies (CSIS) Africa Program.

Finally, we would like to thank USAID and especially Maggie Linak, Program Manager for HESN and AOR for the RAN who has been tireless in her support and guidance.

We are grateful for the experience and judgment of all the dedicated colleagues mentioned here, the officials who were generous with their time and insights, and the focus communities that have been with us each step of the way as partners. From the outset, the RAN has been committed to sharing the results of our investigations. We hope that the experience chronicled in this report will contribute to creating stronger and safer African communities. The test will be to sustain the unity of purpose to meet future challenges.

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Overview 1.0

The ResilientAfrica Network (RAN) , www.ranlab.org, is the largest network of African universities for advancement of resilience of communities to recurrent shocks and stresses by leveraging science and technology to innovate transformative solutions. RAN's Theory of Change states, "The resilience of people and systems in Africa will be strengthened by leveraging knowledge, scholarship, and creativity to incubate, test, and scale innovations that target capabilities and reduce vulnerabilities identified by an evidenced-based resilience framework."

RAN is a multi-country, multi-sectoral platform headquartered at Makerere University, Uganda, established in 2012 in partnership with USAID. RAN brings together 20 universities across 13 countries in Africa as well as two United States-based universities. The George Washington University supports RAN in resilience framework development and operationalization, while Stanford University provides support in innovation process development. Functionally, RAN universities are clustered around four regional Resilience Innovation Labs (RILabs), centers for sourcing and incubating innovations. The Eastern Africa RILab is led by Makerere University, the Southern Africa RILab by the University of Pretoria, the West Africa RILab by the University for Development Studies in Ghana, and the Horn of Africa RILab by Jimma University in Ethiopia. Each RILab is semi-autonomous, hosts a sub-network of three to five universities, and has an established physical innovation space.

The goal of the RAN is to contribute to strengthening the resilience of targeted communities in sub-Saharan Africa to priority shocks and stresses through innovative technologies and approaches. This is accomplished by leveraging the expertise of scholars, researchers, and innovators from RAN's university network to apply science and technology to strengthen the resilience of African communities to natural and man-made shocks and stresses. The findings and conclusions of these efforts are the basis for policy and program recommendations as well as continual learning at the community, national, and regional levels to improve the impact of public and private resilience activities and development assistance.

The RAN's First State of African Resilience Report, The State of African Resilience: Understanding the Dimensions of Vulnerability and Resilience (2015), described the creation of a pan-African network of four Resilience Innovation Labs (RILabs) in Eastern Africa, the Horn of Africa, West Africa, and Southern Africa; a contextual analysis of resilience factors based on extensive literature reviews; a selection of targeted resilience themes and communities; and the development of contextual resilience frameworks based on qualitative data collection.

This Second State of African Resilience Report (2017) discusses the development of resilience pathways based on further quantitative data analysis and highlights interventions and innovations to strengthen community resilience developed by RILab collaborative teams informed by this analysis.

One of the RAN's objectives is to design and operationalize a scientific, data-driven, and evidence-based resilience framework for sub-Saharan Africa that builds on the resources engaged through the RAN. For this reason, this report first discusses RAN's methodological approach, which is organized around the RAN conceptual resilience framework. This is followed by a discussion of the findings from the four RILabs, which present the resilience pathways as well as the innovations.

Section 2.0
Methodological Account

The RAN defines resilience as "the capacity of people and systems to mitigate, adapt to, and recover and learn from shocks and stresses in a manner that reduces vulnerability and increases wellbeing" (RAN 2015). Understanding resilience involves determining the appropriate, contextually relevant resources and capacities that individuals, households, and communities use to prepare for, respond to, and recover from shocks and stressors. The relationships between these resources and capacities create systems that serve to support individuals, households, and communities.

The RAN conceptual resilience framework in **Figure 1** involves an iterative, multi-method process to determine and prioritize resilience dimensions and pathways to guide policy makers and practitioners to identify weaknesses, strengths, and leverage points in systems to target interventions and innovations that expand on existing capabilities and build capacity in areas of need.

Figure 1: The RAN conceptual resilience framework

Stockholder engagement, ownership, sustainability, and institutionalization

1 CONTEXTUAL ANALYSIS

Resilience of whom, what, where, and when?

2 RESILIENCE DIMENSIONS AND PATHWAYS

What makes you capable of living a fulfilled life? What makes you vulnerable? What strategies are used to mitigate, adapt to, recover, and learn from a shock/stress?

3 RESILIENCE INNOVATIONS

What innovations would most effectively address resilience in this community?

4 MONITORING AND EVALUATION

To what extent did interventions improve capacities and address vulnerability?

Selective application of DP to determine the most appropriate resilience interventions

Sections II (Resilience Measurement), III (Deliberative Polling®), IV (Linking Resilience Measurement to Innovations), and V (Monitoring and Evaluation) provide a detailed account of how the RAN conceptual resilience framework was applied by the RILabs, followed by Section VI (Illustrative Findings) in Section VI.

Section 2.1
Resilience Measurement

A. Contextual Analysis

During the contextual analysis, the RILabs used desk-based literature reviews, university-based expertise, and engagement with community leaders to identify the sources and nature of shocks, stresses, and vulnerability in targeted communities in the four regions. These contextual data were analyzed to extract multi-level dimensions, and commonalities across communities and were used to generate a lexicon to define core resilience dimensions. Resilience dimensions are themes or components that describe a combination of similar or related resilience aspects. Workshops further clarified refined these dimensions, and resulting in the creation of a "Lexicon of Common Resilience Dimensions," that provided the structure for resilience study throughout the RAN. The lexicon defines nine core resilience dimensions: 1) wealth, 2) human capital, 3) security, protection, and advocacy, 4) social capital/community networks, 5) psychosocial health, 6) infrastructure, 7) natural resources/environment, 8) health/health services, and 9) governance.

Each of the RILabs used this resource to further explore and clarify local resilience dimensions through focus group discussions and key informant interviews. These exercises were conducted simultaneously in 19 communities across Africa, allowing local contextualization of the common lexicon and clarifying key thematic issues for each region **(Table 1)**.

Table 1: Resilience focus areas, by country

COUNTRY	SHOCK/STRESSOR OF KEY RESILIENCE FOCUS
RWANDA	Climate variability leading to adverse climate events, especially floods and landslides. Chronic conflict resulting in refugee populations.
UGANDA	Climate variability leading to adverse climate events, especially floods alternating with drought, landslides, and disease epidemics. Effects of chronic conflict.
ETHIOPIA	Recurrent droughts and displacement.
SOMALIA	Chronic internal displacement, conflict, climate change.
MALAWI	Drought, floods, and HIV/AIDS affecting food security.
SOUTH AFRICA	Poverty, food insecurity, and HIV/AIDS.
ZIMBABWE	Poverty, food insecurity, and HIV/AIDS.
GHANA	Rapid urbanization, climate change, and food security.

B. Theoretical Framework and Indicators

The qualitative data collection and supportive contextual research provided a foundation for the respective countries to understand resilience at the local level and generate resilience dimensions for each country context. **Box 1** shows the structure used to describe the resilience dimensions emerging from the qualitative data.

BOX 1. STRUCTURE FOR DIMENSION DESCRIPTION

1. **Country and Geographic Area**

2. **Focus Issue**

3. **Dimension Description:**
   Definition of resilience dimension with reference to RAN's dimension lexicon.

4. **Adaptive Strategies:**
   · What sort of coping behaviors that improve resilience were mentioned in the data?
   · What types of positive support do people rely on to go about applying these adaptive strategies?
   · What ideas for possible interventions or ways people could adapt to the shock/hazard would make people/households/communities more resilient?

5. **Coping Strategies:**
   · What coping behaviors are used (as mentioned in the data) to mitigate and absorb the impacts of the shock/hazard (particularly those that do not necessarily improve resilience and those that may have a negative impact on resilience)?
   · How do these coping strategies affect people, households, and communities? Can these coping strategies be used long-term?

6. **Vulnerability Factors:**
   · In this dimension, what characteristics of people/households/communities make them more susceptible to the negative impacts of the shock/hazard?

7. **Causes and Effects:**
   · How does the shock/hazard impact this dimension?
   · How do the impacts of the shock/hazard on this dimension and the subsequent adaptive strategies affect this dimension?
   · How does this dimension and associated adaptive and coping strategies in turn impact (drive) other dimensions?
   · How do characteristics in other dimensions affect/impact (drive) this dimension? For example, if we are describing the dimension of *wealth*, there may be information about how poor *human capital* (a different dimension) in the form of illiteracy makes it harder for people to access better jobs (part of the *wealth* dimension).

The resilience dimensions then informed the creation of a context-specific conceptual framework that illustrates the relationships between factors that support and enable resilience, the underlying causes of vulnerability, the immediate causes and impacts of a shock or stressor, and the outcome relevant to each resilience dimension. **Figure 2** is an example of a conceptual framework, focusing on issues related to resilience to the impacts of HIV/AIDS in South Africa.
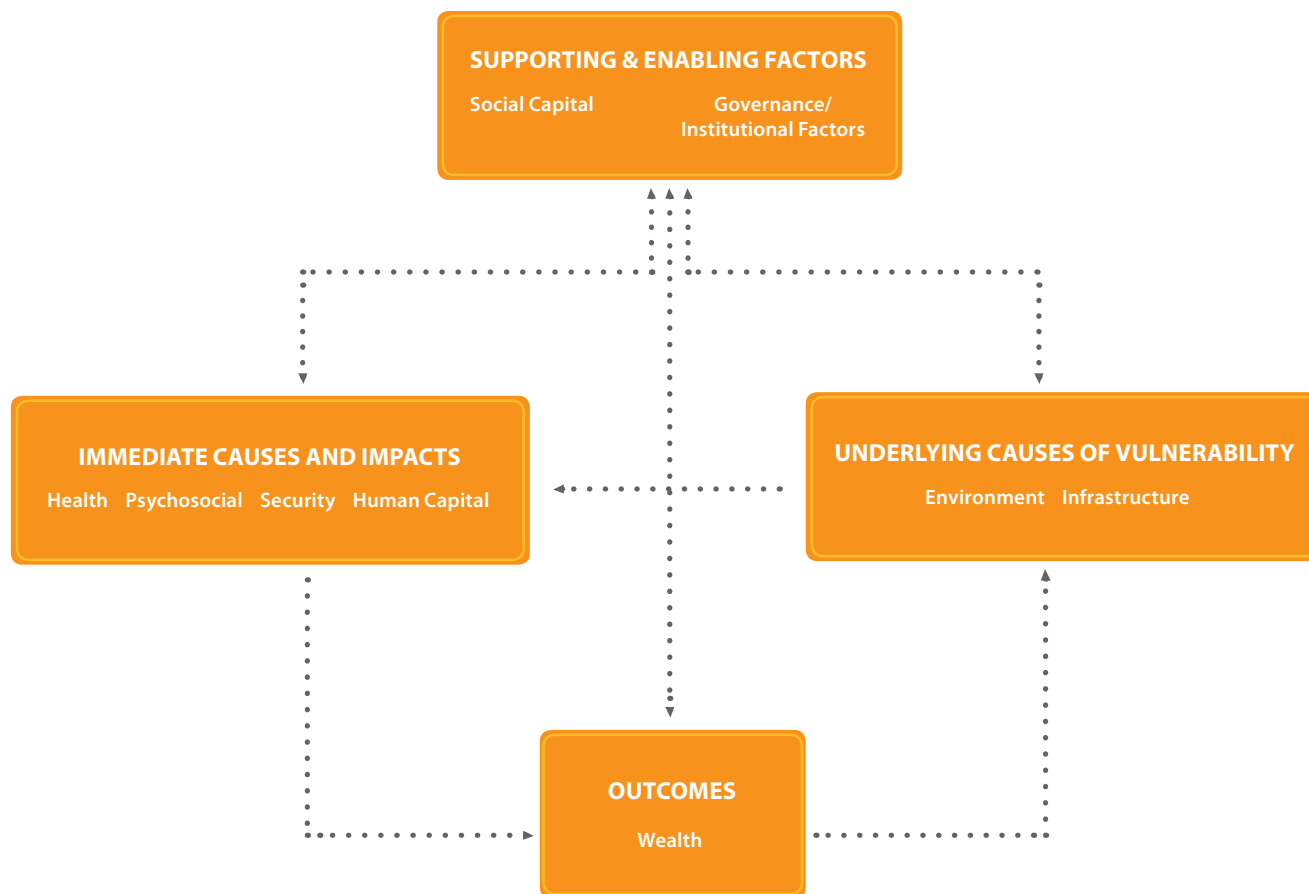
Figure 2: Resilience framework for factors related to HIV/AIDS in Limpopo Province, South Africa

In this contextualized resilience framework, the nine resilience dimensions are categorized as underlying causes of vulnerability, factors supporting and enabling vulnerability, immediate causes and impacts of vulnerability, and outcomes of adaptation, of which wealth is one dimension.

Building on the qualitative data findings and the localized resilience frameworks, the RILab teams then translated the qualitative resilience dimensions into measurable quantitative dimensions. Each country team used the context-specific resilience framework it developed in the qualitative data analysis as its starting point for developing indicators for the quantitative resilience assessments. The frameworks outlined both the dimensions that would be measured and the links between the dimensions that would be explored in analysis. The assessment included important contextual factors (such as demographics) that were not well represented in the frameworks.

Some indicators were derived from credible existing indices used to measure these dimensions (e.g., the MEASURE Demographic and Health Survey (DHS) Wealth Index,

the World Food Programme Food Security Index, and the index for access to health used in the Living Standards Measurement Surveys (LSMS) for Uganda). Others were derived from the qualitative data, drawing on unique local contexts. This amalgamation of existing indices and context-specific additions ensured that the unique local context was fairly represented in the quantitative surveys, to increase the validity of the pathway analyses.

For example, for pastoralist communities in the Borana Zone of Ethiopia, indicators selected to assess the Wealth dimension included the household assets used in the MEASURE DHS for construction of wealth quintiles, as well as locally relevant assets such as oxcarts, ox ploughs, and grazing land. The contextualized nature of the measurement allows for a baseline understanding of resilience that can be used in a wide range of resilience programming and research contexts. In that way, these products may inform local resilience interventions, evaluations, and research in future projects. The RAN provided guidance and structure to RILabs to ensure that indicators used for the same dimensions across contexts were consistently defined and measured.

C. Quantitative Resilience Measurements

1. Quantitative Surveys

Based on the theoretical frameworks and context-specific indicators, the RILabs conducted quantitative micro-resilience surveys to understand relationships among resilience dimensions in the target communities. Survey tools were developed to gather and measure information specific to each indicator. The resulting household survey questionnaires were applied to the same communities affected by shocks and stressors that were involved in the formative qualitative studies. **Table 2** shows the location dates, and sample sizes of the RILab quantitative data collections by RILab teams, the dates of data collection, and the sample size of each survey.

RILAB	STUDY LOCATION	STUDY PERIOD	SAMPLE SIZE
EASTERN AFRICA (EA) RILAB	Uganda	Sept. - Nov. 2015	Uganda (n=2,020) Amuria, Bududa, Hoima, Lamwo
	Rwanda	Dec. 2015 - Jan. 2016	Rwanda (n=423) Musanze, Nyabihu, Rubavu
SOUTHERN AFRICA (SA) RILAB	South Africa	Sept. 2015 - Jan. 2016 / Sept. - Oct. 2015 / Jul. - Sept. 2015	South Africa (n=1,945) / Dikgale, Limpopo (n=568) / Pretoria, Pyramid (n=455)
	Malawi	Sept. - Oct. 2015	Malawi (n=484) Chikwawa
	Zimbabwe	Sept. 2015 - Jan. 2016	Zimbabwe (n=423) Beitbridge
WEST AFRICA (WA) RILAB	Ghana	Oct. - Dec. 2015	Ghana (n=1,200) Ashaiman, Navrongo, Tamale
HORN OF AFRICA (HoA) RILAB	Ethiopia	Oct. - Dec. 2015	Ethiopia (n=1,174) Borana Zone
	Somalia	Mar. - Apr. 2016	Somalia (n=800) Hamarweyne, Hodan, Wadagir

Table 2: Survey locations, time periods, and sample sizes

2. Analytical Framework

In collaboration with George Washington University's Institute for Disaster and Fragility Resilience, the RAN developed an analytical framework to measure resilience that consists of a set of measurable resources and capabilities in varying contexts that individuals use to respond to shocks and stressors. This framework is shown in the mathematical equation below, in which R = resilience, IPPC = individual physical and psychological capacities, HHC = household capacities, and CC = community capacities. The framework represents the resilience index that comprises individual, household, and community resources and capacities.

$$R_t = f(IPPC_t, HHC_t, CC_t)$$

This measure of resilience considers all the resilience dimensions included in the theoretical model and captured in the quantitative survey. A composite score of resilience is created for each dimension and its sub-component, as relevant. These newly created scales or indices are then combined in a statistical model to provide a total measure, or composite score, of resilience. These scores were created using Principle Components Analysis (PCA). Inclusion in the scales depended on high loadings on at least one rotated PCA component, as well as, high Chronbach's alpha scores. An alpha score for each of the individual scales that measured various elements of resilience below 0.5 was considered unreliable.

To refine measures of resilience and support the development of targeted programs and applications, the RAN's analytical plan includes a second statistical model to explore "resilience pathways." These pathways examine how resilience extends through systems and how resilience factors affect each other. Studying resilience dimensions through relationships allows specific recommendations on viable pathways to achieve desired resilience outcomes and applications and to identify leverage points in the system where investment of scarce resources should be prioritized. These pathway models are built on the theoretical model and tested for significance through a statistical analysis process called Structural Equation Modeling (SEM). This analysis confirms relationships, both direct and indirect, among the resilience dimensions. This approach to resilience pathways allows programs to identify areas where they may strengthen specific factors and ultimately build resilience in a targeted manner. It also allows the RAN to validate and modify its

C. Quantitative Resilience Measurements *cont.*

2. Analytical Framework cont.

initial theoretical models, by assessing whether they remain the same or change. This has important implications for development agencies that rely significantly on assumption-based theories of change by providing more evidence to support the identified pathways.

While SEM analysis is useful for identifying causal pathways, it cannot provide concrete programmatic recommendations. However, as a starting point, SEM analysis can signal the "leverage points" in a complex system. Further investigation is necessary to identify the elements of the scales and indices that are significant predictors of resilience. Regression analysis is run on specific scales and indices to identify items that are significantly associated with the desired outcome. This added layer of detail indicates specific drivers of resilience that interventions should target. **Table 3** summarizes of the levels of analysis.

| LEVEL OF ANALYSIS	WHAT IT TELLS US	WHAT IT DOESN'T
Big "R"— resilience cumulative score	Where activity is needed in terms of geographic location by comparison	What type of activity is needed in terms of sector or systems level
Individual scores across resilience dimensions	What type of activity is needed, by sector and systems level	How the resilience dimensions and factors are related
Pathways analysis	How the resilience dimensions and factors are related—direct and proximal associations	What specific sub-factors or items predict desired child resilience outcomes
Unpacking the scales/indices	What specific sub-factors or items (of a scale or index) predict desired child resilience outcomes	Whether these pathways to resilience hold true in other similar or dissimilar contexts

Table 3: Levels of analysis

Section 2.2
Determining Priority Interventions Through Deliberative Polling®

To further deepen understanding of resilience in the targeted communities in Africa, the RAN employed an alternative approach to resilience assessment, focusing on resilience of policies related to risk mitigation of adverse events. With the hypothesis that community acceptance of risk mitigation policies could change if community members were adequately informed, the RAN implemented Deliberative Polling® in Ghana, Malawi, Senegal, and Uganda (2). This involved community deliberation on policy options that included topics such as climate-centered development, rapid urbanization, and food security/water, sanitation, and hygiene (WASH).

The innovative Deliberative Polling® method was developed and supported by the Center for Deliberative Democracy at Stanford University. It is a method of public consultation in which a scientifically representative sample of the target population is selected to participate in a detailed evaluation of policy options. The process allows communities to express their opinions about which policy options they support after they have received a full explanation of the pros and cons of each. A scientific random sample of the population is taken to ensure that the community members involved are representative of the entire target population, unlike in other methods of rural appraisal that often target potentially biased "community gate-keepers" (or opinion leaders).

The method begins with a baseline oral opinion survey of how communities perceive the policy options. Participants then receive detailed information about the options and deliberate their merits and demerits through peer discussion and feedback. The process does not seek to influence people to change their opinion or to reach a consensus, but rather to gather their informed opinions. Traditionally with this methodology, participants are given a briefing document drafted by a diverse committee of experts and stakeholders knowledgeable about the issues at stake. In each of the polls conducted by the RAN, the briefing document was turned into a briefing video to accommodate populations with low literacy. The small group discussions are moderated by a neutral arbiter who ensures that debates are not dominated by vocal participants. Following the small group discussions, the participants generate questions to be responded for experts to answer during a plenary session. Usually over two days, the Deliberative Polling® event alternates between small group discussions and plenary until all topics have been discussed. Finally, the respondents answer the same oral opinion questionnaire as they did before deliberation to assess whether their views on the policy options changed as a result of the deliberations. The Deliberative Polling® results have enhanced understanding of the resilience pathways and innovations. In this report, findings from Deliberative Polls for Uganda, Ghana, and Malawi are discussed in Section VI.
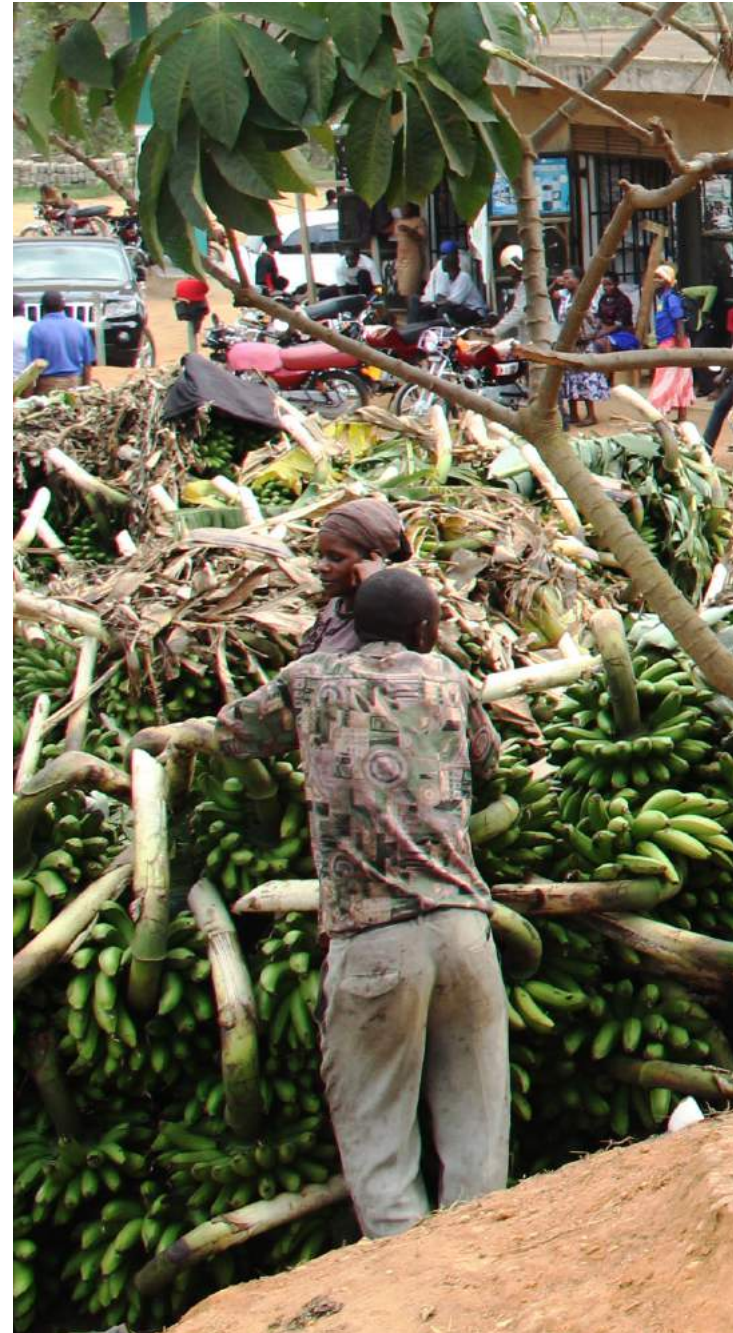
Section 2.3
Linking Resilience Measurement to Innovations

Building on resilience dimensions and pathways and in-depth community insights from Deliberative Polling®, the RAN collaborated with ChangeLabs at Stanford University to develop a university-driven innovation ecosystem that stimulates, builds, and supports innovations focused on community resilience needs. The RAN regularly monitors six key milestones along the innovation pipeline to ensure that innovations are aligned with the resilience needs they seek to address. These milestones are described below for the RILab activities:

1. Developing Resilience Problem Sets

Analysis of resilience data identified six context- specific resilience problem sets under six focus themes. Problem sets captured summaries of insights, patterns, findings, and conclusions from the data analysis in a way that best informed innovations and interventions.

2. Conducting Intervention Strategy Workshops

Using the problem sets, the RAN facilitated interactive Intervention Strategy Workshops (ISWs) for representatives of communities, civil society, and development agencies to synthesize problems into priority intervention pathways. The process involved mapping the system and its boundaries and relationships; identifying leverage points for intervention, and identifying intervention pathways and viable projects with the highest transformational potential for resilience building in targeted communities through brainstorming.

The Intervention Strategy Process, adapted from Stanford University's ChangeLabs framework, is a critical stage in the resilience intervention process. It is a bridging step between, distilling information about a resilience gap and translating it into intervention pathways and viable projects with the highest transformational potential for resilience building in targeted communities. The Intervention Strategy Workshops (ISWs) are designed to tap into and elicit the immense potential of vibrant discussions among practitioners, experts, and communities to discover the best course of action given limited resources. Rapid-paced structured ideation is used to critically analyze a resilience issue in a specific context, identifying key resilience issues, underlying causes and effects, stakeholder roles, and potential to determine where best to intervene in the ecosystem to develop solutions with transformational impact on the resilience of communities. For the RAN, the output of the Intervention Strategy Process was 15 priority intervention pathways for resilience building in Africa.

3. Formulating Intervention Pathways into Innovation Challenges and Putting out Grant Calls

Following the identification of the evidence-based challenges, the RAN developed innovation challenges that were packaged into grant calls put out across Africa and beyond, supported by live and recorded webinars to provide interested applicants with additional information.

4. Sourcing Innovations

The RAN sourced innovations using resilience innovation challenges, providing grants to further develop the best ideas and/or solutions to achieve widespread usage and reach full scale. Building on the priority intervention pathways identified in the ISWs, the RAN used three mechanisms to select innovations.

a. Crowd-sourcing (also known as the Resilience Innovation Acceleration Program, or RIAP)

This bottom-up approach underscores the RAN's conviction that great ideas come from everywhere and from anyone. The RAN acknowledges the existence of promising prototypes/proofs of concept under development within its network of universities, in-country innovation hubs, and communities at large. Using open innovation exhibitions to crowd-source ideas, the RAN identifies promising projects, assesses their progress, and supports them to advance to the next level.

b. Design thinking-based ideation (also known as the Resilience Innovation Challenges, or RICs)

In this top-down approach, the RAN uses the Intervention Strategy Process to conceptualize, select, and launch innovative solutions designed for impact and scale. Through the ISWs, technical experts and stakeholders collaboratively use findings from community resilience assessments to develop critical intervention pathways for resilience building and identify the potentially most impactful projects within these pathways. This information is then used to develop resilience innovation challenges that attract multi-disciplinary teams of innovators to develop new solutions. Many of the solutions developed under this approach are freshly ideated to respond to the grant calls.

4. Sourcing Innovations *cont.*

c. Collaborative Resilience Innovation Design (CRID)

Co-created by the RAN and ChangeLabs innovation models, this is a highly collaborative intervention design process in which multi-disciplinary teams of experts, scholars, and stakeholders are invited to workshops to develop system-level interventions. CRID is based on the belief that innovative ideas can be co-created collaboratively by experienced stakeholders working with targeted communities. The point of departure for project formation is the set of priority intervention pathways identified in the ISW. While the RIC approach uses the pathways to call for innovative project ideas from the wide innovator community, CRID involves teams of stakeholders working together to create innovation projects that address the targeted pathways.

Projects developed through CRID are designed to address system-level challenges rather than single aspects of a system and to generate solutions that result in a platform that can facilitate multiple development functions rather than discrete projects. It expands beyond single technologies, activities, or services to aggregate community needs around an integrated set of interventions that can progress to multiple intervention pathways and/or platforms that are more than the sum of the set of interventions. A CRID challenge call seeks to attract multi-disciplinary teams of innovators and stakeholders to collaboratively identify, develop, and incubate a combination of innovative projects to support system-level, platform-oriented interventions in targeted communities.

Disclosure Agreements (NDAs) before the review. The judges are people of repute drawn from a wide base of credible external resources representing the private sector, civil society, development agencies, and RILabs. Projects are reviewed for innovation, scientific plausibility, and potential contribution to resilience building. The best projects are shortlisted and invited to make live pitches to a panel, where they are assessed for feasibility, transformative potential, and cross-disciplinary team composition. Before the RAN recommends select projects for grants, it determines where they should be placed in the innovation development pipeline (**Box 2**) and how much seed funding they will need. The projects undergo additional reviews by the funder.

BOX 2. RAN INNOVATION PIPELINE

Ideation → Design → Developments → Testing → Piloting/Iteration Adoption → Transition → Scale → Widespread → Adoption → Transformation

NB: Many innovations do not run linearly

| COMMUNITY CONSULTATIONS | INTERVENTION STRATEGY WORKSHOP | CRID WORKSHOP | SYSTEM-LEVEL CO-CREATED SET OF COMPLEMENTARY INNOVATION PROJECTS AND PROCESSES |

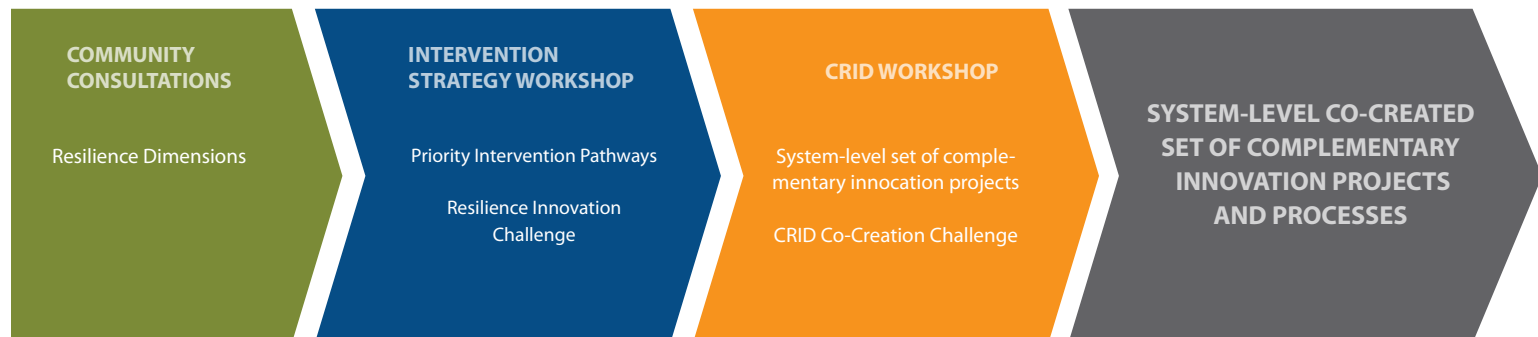| Resilience Dimensions | Priority Intervention Pathways / Resilience Innovation Challenge | System-level set of complementary innocation projects / CRID Co-Creation Challenge | |

Figure 4: Collaborative Resilience Innovation Design (CRID) process

4. **Sourcing Innovations** *cont.*

d. Inducting innovators, need-finding, managing innovations, and monitoring and evaluation

Before RAN innovators make plans to pilot innovations in one or more of the 26 RAN partner communities, they go through a detailed support process that includes an induction workshop, training in human-centered design, development of a theory of change and M&E strategy, need finding, design refinement, and business model development. During this process, the RAN provides innovation management support and stage-by-stage evaluations of the projects' potential impact.

Following the formal grant awards, the innovators break down and challenge early stage ideas in the inductive seminars and then rebuild them after they have interacted with the communities. Community engagement is so important for the RAN that it pilot tests even early stage ideas to address community resilience challenges with partner communities to increase the potential impact of innovations.

Another key precondition for innovators selected by the RAN is a theory of change that aligns with the priorities of the associated resilience intervention pathways. Starting from the project aim, the RAN guides all projects to develop theories of change that show the preconditions necessary to attain the project objectives in targeted communities. The theory of change approach is also used to formulate monitoring and evaluation (M&E) plans that indicate what change is expected, how the change might come about, and what underlying assumptions explain how and why the desired change is expected. The theory of change approach requires achieving vital outcomes before the long-term expected result of the innovation project can be accomplished.

The RAN also takes all new projects to targeted communities to "ground-truth" the relevance of the ideas and capture user perspectives. It guides project teams on how to interact with the communities to discover their needs, whether explicitly stated or hidden beneath the surface. It is key that teams do not presuppose solutions but instead use insights from the need-finding to inform the design of innovations to address resilience challenges in an impactful way. This need finding is one of the key components of the five-stage design thinking methodology in Stanford's model: Empathize (with the support of need-finding), Define (the problem), Ideate, Prototype, and Test (in consultation with the targeted community).

Section 2.4

Monitoring and Evaluating the RAN Program and Specific Innovations

M&E is central to the RAN Innovation Management process. RAN M&E workshops train innovators to develop theories of change for their innovations and solutions that are relevant, fit for purpose, and valuable. Innovators are supported to achieve interim markers and indicators of success for each innovation.

The RAN sets up an innovation monitoring system at all RILabs that includes innovation mentorship, novel use of physical spaces for social engagement, idea exchange, and stimulation of new innovations. An aggregation program across levels of the ecosystem allows real (short) time review, correction, and refinement.

The M&E strategy developed by innovators during induction, together with an Impact Potential framework and scoring mechanism co-created by the RAN and ChangeLabs, facilitates dynamic tracking of projects along the innovation pipeline from ideation to diffusion and scale.
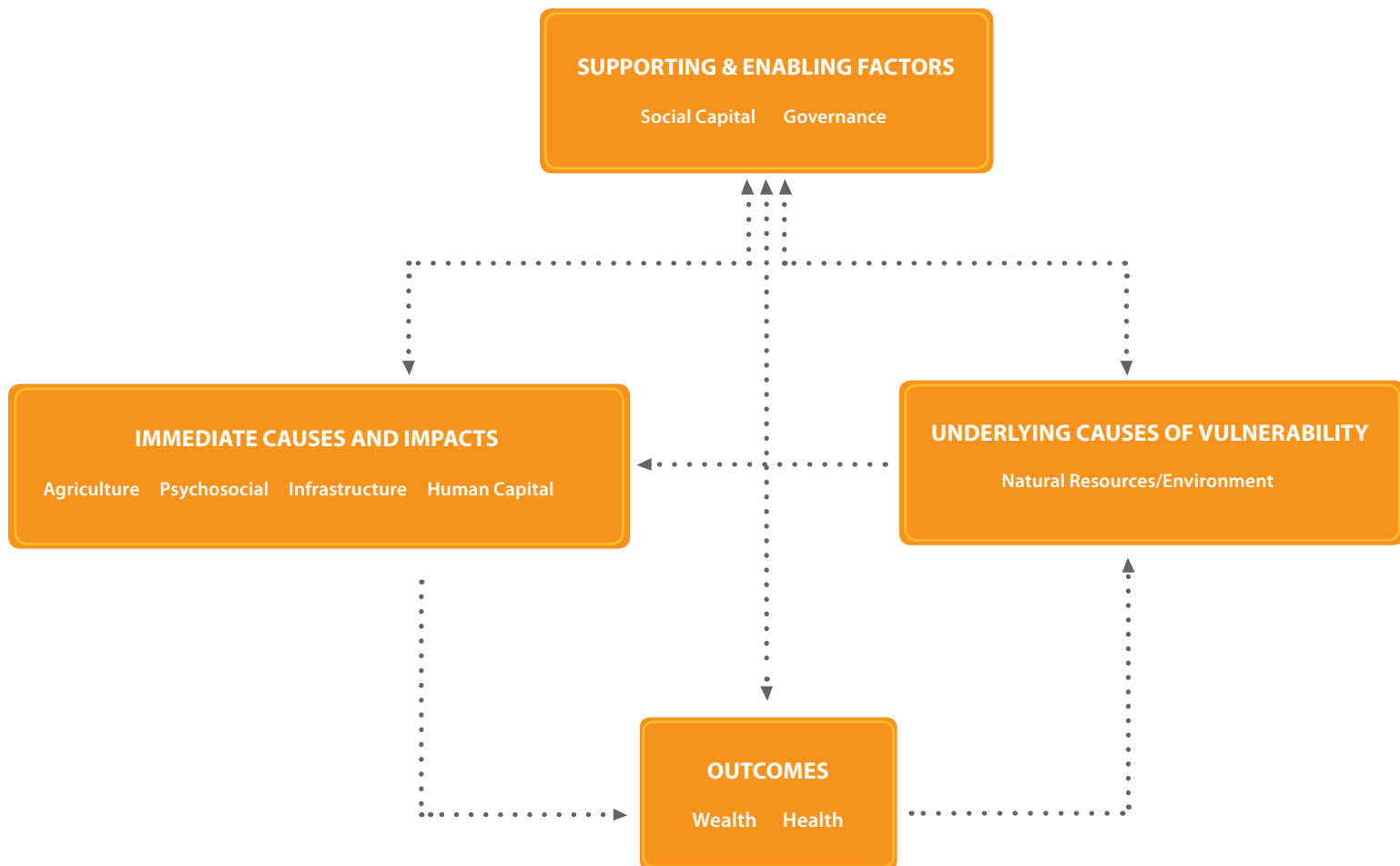

SUPPORTING & ENABLING FACTORS

Social Capital   Governance

IMMEDIATE CAUSES AND IMPACTS

Agriculture   Psychosocial   Infrastructure   Human Capital

UNDERLYING CAUSES OF VULNERABILITY

Natural Resources/Environment

OUTCOMES

Wealth   Health

Figure 5: Conceptual framework for resilience factors associated with climate variability in Uganda

Section 3.0
RILab Findings

Context-Specific Resilience Frameworks and Opportunities for Resilience Innovation

This section describes the work of the four RILabs to develop resilience frameworks and pathways and the resulting innovations to strengthen the resilience of African communities to natural and man-made shocks and stresses.

A. East Africa RILab

1. Context

Uganda faces numerous shocks and stresses that affect the resilience of communities. Through an extensive literature review, as well as, community consultations through qualitative interviews, the RAN identified two priority thematic issues of focus for resilience interventions in communities in Uganda: 1) resilience to the adverse effects of climate variability and 2) resilience to acute and chronic conflict and its effects.

2. Theoretical Framework and Indicators

Through community consultations and qualitative assessments, the Eastern Africa Resilience Innovation Lab (EA RILab) developed the theoretical framework in **Figure 5** to understand resilience in communities affected by the above themes. Communities prioritized wealth and health as key resilience outcomes. This framework was used to guide analysis of the results of a follow-up quantitative survey to benchmark indicators of resilience.

The nine resilience dimensions were then systematically converted into measurable indicators using 1) validated tools and indices (for example, the assets index used in DHS studies adopted for the wealth dimension) and 2) sub-variables identified from the qualitative analysis (for example, additional assets that people value locally but are not included in existing tools). The indicators and variables were translated into measurement tools to assess the prevalence of key resilience factors in the communities. Quantitative surveys were then conducted in four districts of Uganda: Amuria, Bududa, Hoima, and Lamwo.

3. Quantitative Survey

A representative sample of 2,020 households from the districts of Amuria (544), Bududa (544), Hoima (770), and Lamwo (253) was used to estimate baseline indicators of the drivers of vulnerability and capacity of the target communities to adapt to priority shocks or stresses. These indicators informed the development of resilience dimensions and metrics so that projects could develop innovations to improve the resilience of the targeted communities.

The RAN implemented SEM in Mplus to examine whether the six latent variables were predictive of health and wealth outcomes in communities faced with the effects of climate change and chronic conflict. All the models controlled for the respondents' age, gender, and district of residence. Model fit was evaluated using Comparative Fit Index (CFI) values greater than 0.95 and Root Mean Square Error of Approximation (RMSEA) less than 0.05.

Most (51 percent) of the respondents were male. Amuria District registered a slightly higher percentage (53 percent) of female respondents than the other districts. Almost half of the respondents were between 25 and 44 years of age. The overall median age was 38 years (IQR±18). More than a third (78 percent) of the respondents were married, and 16 percent had no formal education. Amuria had the highest proportion (26 percent) of respondents with no formal education, followed by Lamwo (16 percent) and Hoima (10 percent). Christianity was the dominant religion in all four districts, with 43 percent Catholic, 36 percent Anglican, and 13 percent Pentecostal. Less than 5 percent of the respondents were in full-time employment, and most were engaged in work related to subsistence agriculture.
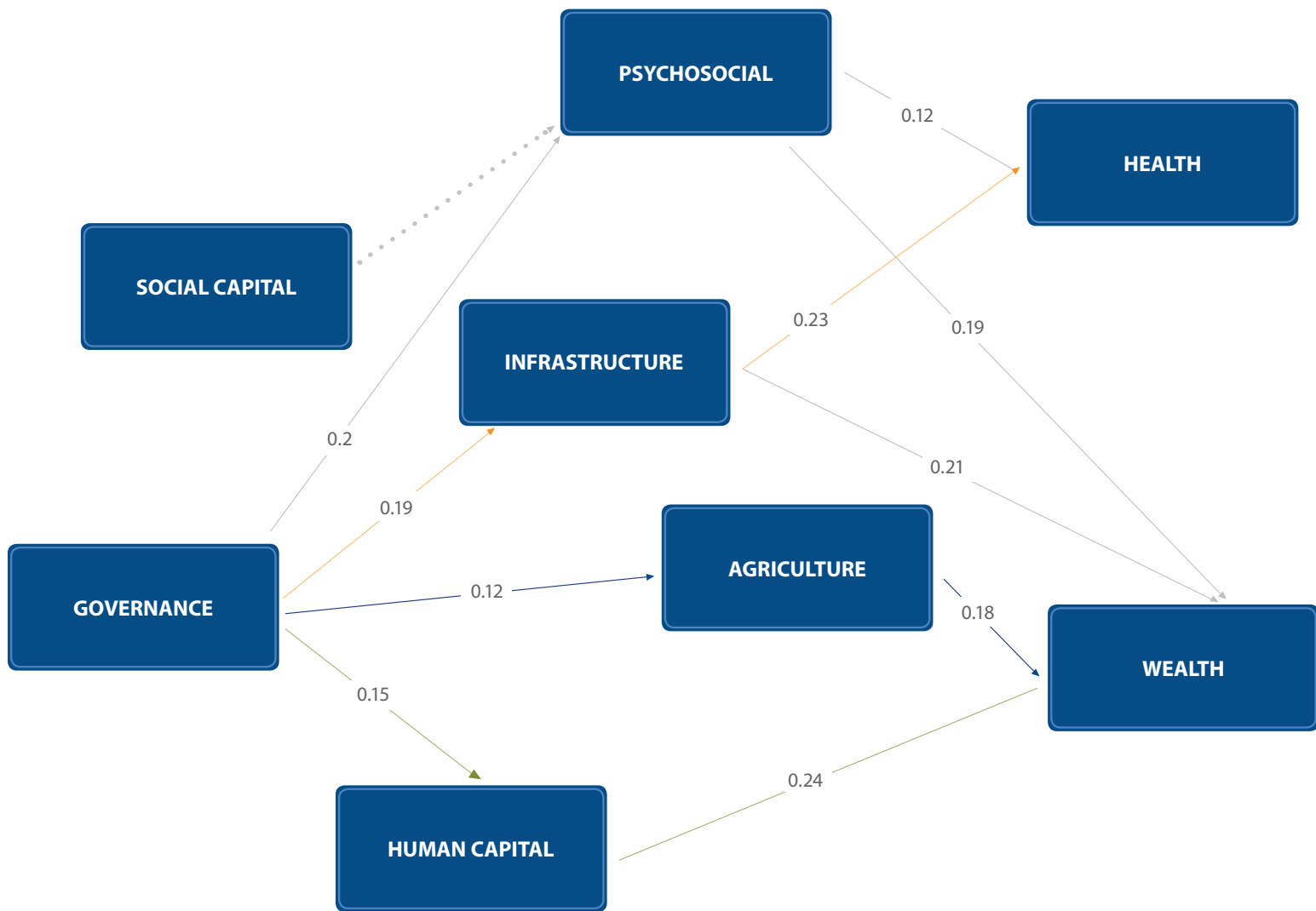
Figure 6: Pathway model — Uganda RILab

A. East Africa RILab *cont.*

4. Findings (Resilience Pathways and Innovations)

Pathway 1: Governance » Infrastructure » Health

The orange arrows in **Figure 6** show that good governance through equitable distribution of resources for health (medicines, equipment, and personnel) and prioritization of infrastructure including road networks and construction and maintenance of health service delivery points such as health centers and hospitals can lead to better access to and quality of health services. In the communities surveyed, governance included community involvement in decision making at central and local government levels, prevention and control of corruption and bribery, settling of land disputes, and delivery of public services. The infrastructure dimension was measured as access to a better road network, bridges, clean water, better housing conditions, markets, and telecommunication. Infrastructure therefore relates to accessibility, functionality, and linkages to productivity and services. In these communities, the health dimension related to physical health (illness/disease, epidemics, and injuries), physical and financial access to health services, quality of health services, human resources for health, access to safe water, and sanitation-related behaviors that drive illness and disease.

One innovation developed and tested in the RAN target communities to address infrastructure was community radio. The low-cost RootIO radio stations broadcast over a radius of 20 km on an FM frequency using a mobile phone, a transmitter installed in a bucket, and a shorter tower. Radio as a communication platform can give communities access to information on climate-centered early warning, markets, and health and mobilize communities for development programs. Innovations developed in the health dimension for infection prevention and control included the Pedaltap non-touch hand washing tap, non-invasive and low-cost Matibabu rapid malaria diagnostic kit, and BVKit rapid test to screen for bacterial vaginosis.

Pathway 2: Governance » Agriculture » Wealth

The navy arrows in **Figure 6** show the relationship between the dimensions of governance, agriculture, and wealth. Governance involves the exercise of political, economic, and administrative authority to manage community affairs, for example, land dispute settlement. Most agricultural activities involve growing crops or rearing animals, both of which depend on land. Good governance through fair handling of land disputes makes land available to communities for production and has a direct impact on wealth creation, especially for communities that depend on agriculture. Agriculture was measured in terms of livestock, poultry, food crops, agricultural markets, quality of soils, use of fertilizers, storage facilities, and access to extension services. In these communities, the link between land availability and fertility, reliable climate-centered early warning systems, and access to modern technologies to increase agricultural yields and reduce post-harvest losses can enhance resilience.

The wealth dimension was assessed in relation to both financial and non-financial assets, access to savings and credit, sources of livelihoods, and food security. Livelihoods included activities required to make a living and have a good quality of life, including formal and informal employment, sources of income, and activities and choices in households and local populations that provide food, health, income, shelter, and other tangible and intangible benefits, such as comfort, safety, respect, and fulfillment.

One innovation proposed in this pathway to address governance was a platform for inclusive participation in good governance and best practices to address community governance issues. The project offered communities an opportunity to revitalize cultural leadership and systems to address conflicts, including land disputes. Innovations targeting the agriculture dimension included improved push and pull technology to control weeds on maize farms and increase yields; a solar irrigation system to increase productivity during the dry season; and winnowing maize threshers, digital grain moisture, and solar and biomass dryers to reduce post-harvest losses. Innovations developed to address the wealth dimension included the Village Egg Bank model, which involves pooling eggs from households for better market leverage, and the Akellobanker web- and mobile-based digital banking platform that links local Savings and Credit Cooperative Societies (SACCO) to deliver inclusive financial services, especially to the rural poor. These innovations have great potential to diversify livelihoods by acting as platforms for launching highly profitable businesses in rural communities.

A. East Africa RILab *cont.*

4. Findings (Resilience Pathways and Innovations) cont.

Pathway 3: Governance » Human Capital » Wealth

In the pathway indicated by the green arrows in **Figure 6**, governance augmented by human capital can translate into wealth in the communities studied. Through good governance, human capital development systems such as education infrastructure (schools, colleges, technical institutions, and universities) can enhance the quality of education and subsequently create a skilled labor force. The labor force can meaningfully engage in production and service delivery to earn and consequently generate wealth. The human capital dimension included skills, knowledge, and labor that together enable people to pursue different strategies to earn their livelihoods.

Human capital includes employment, labor, the labor force, and education, skills, and knowledge that directly or indirectly affect employment. In this study, the human capital dimension included indicators of access to quality education such as 1) access to and quality of formal schooling, including technical or vocational training, 2) mentoring of children and youth by family members and community elders (informal education), 3) educational infrastructure and materials/resources such as classrooms, textbooks, and teachers, and 4) the influence of systems such as leadership, community involvement in education, and food supply on educational outcomes. Issues related to governance and wealth were described in the previous pathways.

Innovations developed to bridge the gap in human capital included Yiya Engineering Solutions (YES!) to improve the quality of education by training teachers to use project-based learning modules and media-based financial literacy to educate secondary students in financial matters through clubs using weekly financial pull-outs (pakasa) in the newspaper. The financial information includes lessons on saving, budgeting, investing, loans, and financial service providers. The goal of the project is to create a generation of fiscally savvy youth equipped with the knowledge, skills, and attitudes to deal with complex financial situations and cope with financial pressures.

5. Findings from the Uganda Deliberative Polls

The EA RILab conducted Deliberative Polling® in Uganda to deepen understanding of prioritized entry points for resilience innovations. The first Deliberative Polls (DPs) in Africa were conducted in July 2014 in Bududa and Butaleja districts in Uganda's Eastern Region, with technical support from Stanford's Center for Deliberative Democracy (CDD). The two DPs engaged scientific random samples of 201 people in Bududa and 232 in Butaleja. The participants spent 2 days deliberating topics of resettlement management, land management, and population pressure in alternating moderated small group discussions and plenary sessions where experts answered the groups' questions. The opinions of the participants were collected using confidential questionnaires given both before and after the deliberations. In the discussion below we highlight some policy impacts of these projects. More information about the Uganda DPs can be found in Cooke, JG, ed. 2015. The State of African Resilience: Understanding Dimension of Vulnerability and Adaptation. Washington, DC: Center for Strategic and International Studies and Fishkin JS, et al. 2017. "Applying Deliberative Democracy in Africa: Uganda's First Deliberative Polls." Daedalus 146(3): 140–154.

Following the deliberations and analysis of the findings, the RAN developed two policy briefs with recommendations for policy makers. The briefs were disseminated at both district and national levels. The RILab also engaged with the Office of the Prime Minister, which is responsible for coordinating disaster responses in Uganda, to further deliberate on how to implement the recommendations. Below are the policy changes implemented or planned by different government departments as a result of these activities.

Resettlement of communities affected by landslides in the same socio-cultural area: After the DP findings and recommendation on resettling landslide-affected people in the same geographical setting were disseminated, the Office of the Prime Minister constituted a committee to identify alternative land in the Mt. Elgon District to resettle these community members. The government began preparations for resettlement of at-risk populations in Bulambuli District after visits by community representatives, community sensitization, land preparation, and establishment of social amenities, among others. This program is expected to succeed because it was informed by community voices.

Land ownership and compensation for the resettled people: Based on the findings on how land ownership issues were hindering the success of the resettlement program, the Office of the Prime Minister reviewed the current resettlement policy and found there were no provisions for compensation and land ownership. As a result, the government is amending the law to include them. Stakeholder consultations are planned for financial year 2017/2018.

Natural resources, environment, and land management: The Office of the Prime Minister in Uganda directed the Natural Resources Officers in disaster-prone districts to prepare a comprehensive sensitization campaign on tree planting, ecological conservation, and land management. The DP results also showed a need for more community sensitization on tree planting and land management practices in the region. This program was mainstreamed by the Disaster Response Programs in the districts.

Section 3.0

RILab Findings *cont.*

B. Horn of Africa RILab

1. Context

Many disadvantaged communities in sub-Saharan African countries are vulnerable to natural and anthropogenic shocks and stresses. Drought is one of the shocks that often affect communities in arid and semi-arid regions. Building resilience to recurrent droughts is an increasingly important element in development efforts. Despite decades of remarkable efforts by governmental and non-governmental organizations, recurrent droughts have eroded the resilience capacity of Borana pastoralists in drought-prone southern Ethiopia, while Somalis have suffered chronic internal displacements due to conflicts. The HoA RILab is focusing on strengthening the resilience of Borana pastoralists to recurrent droughts by identifying major intervention pathways and actions to take in collaboration with various partners and stakeholders.

2. Theoretical Framework and Indicators

Figure 7 shows the eight resilience dimensions that emerged from qualitative study with a grounded theory approach. Environment was found to be the underlying cause of vulnerability to shocks and stresses of recurrent droughts. This dimension directly affects livestock, wealth, infrastructure, and human capital, which in turn affect psychosocial health. These relationships were verified through household surveys to validate the hypothetical model.

3. Quantitative Survey

In the subsequent resilience survey, data were collected from 1,058 randomly sampled households in Arero and Dhas districts of Borana Zone using an interviewer-administered structured questionnaire and observational checklist. Principal component analyses were done to develop composite scores of the different resilience dimensions.

The questionnaires were processed using Epi-Data software. To ensure data quality, four data entry clerks were paired, each pair initially entering approximately 300 questionnaires and then swapping with their paired counterparts for double entry so that each entered 600 questionnaires. The step-wise analysis guide provided by the RAN Secretariat was used in the analysis. Basic tabulations were conducted to estimate frequencies, and regression modeling was done to tease out relationships. Guided by the initial identification of the resilience dimensions, principal component analysis was conducted using a series of related variables captured under the different dimensions. This was then used to generate composite scores for the various dimensions and then to generate coefficients, which were further used to generate Spider Graphs. The Spider Graphs enabled the identification of prominent resilience dimensions by study location.

4. Findings (Resilience Pathways and Innovations)

The theoretical model verified by SEM **(Figure 8)** shows that environment and peace and security play a major role in resilience building, affecting almost every other resilience dimension in the form of direct and latent variables. The infrastructure and livestock dimensions directly affect human capital, psychosocial health, wealth, and food security. Livestock, which is a central resilience dimension in SEM, is affected by infrastructure, environment, peace and security, and social capital, which in turn affect food security and psychosocial status.

The pathway model shows the following strong dimension connections:
- Environment with infrastructure (0.31)
- Peace and security with wealth (0.26)
- Livestock with food security (0.24)
- Infrastructure with food security (0.21)
- Peace and security with livestock (0.19)
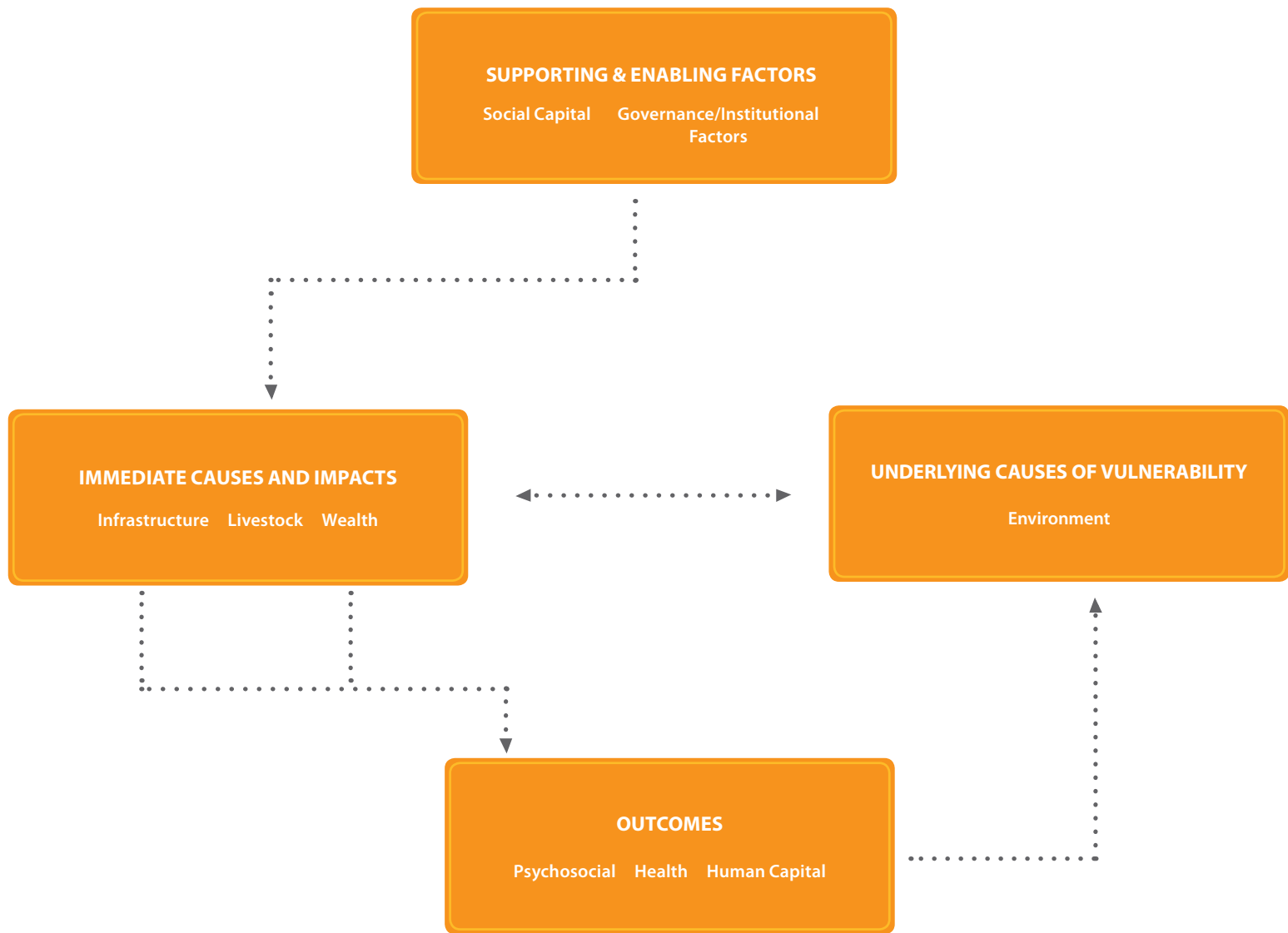- Infrastructure with human capital (0.16)

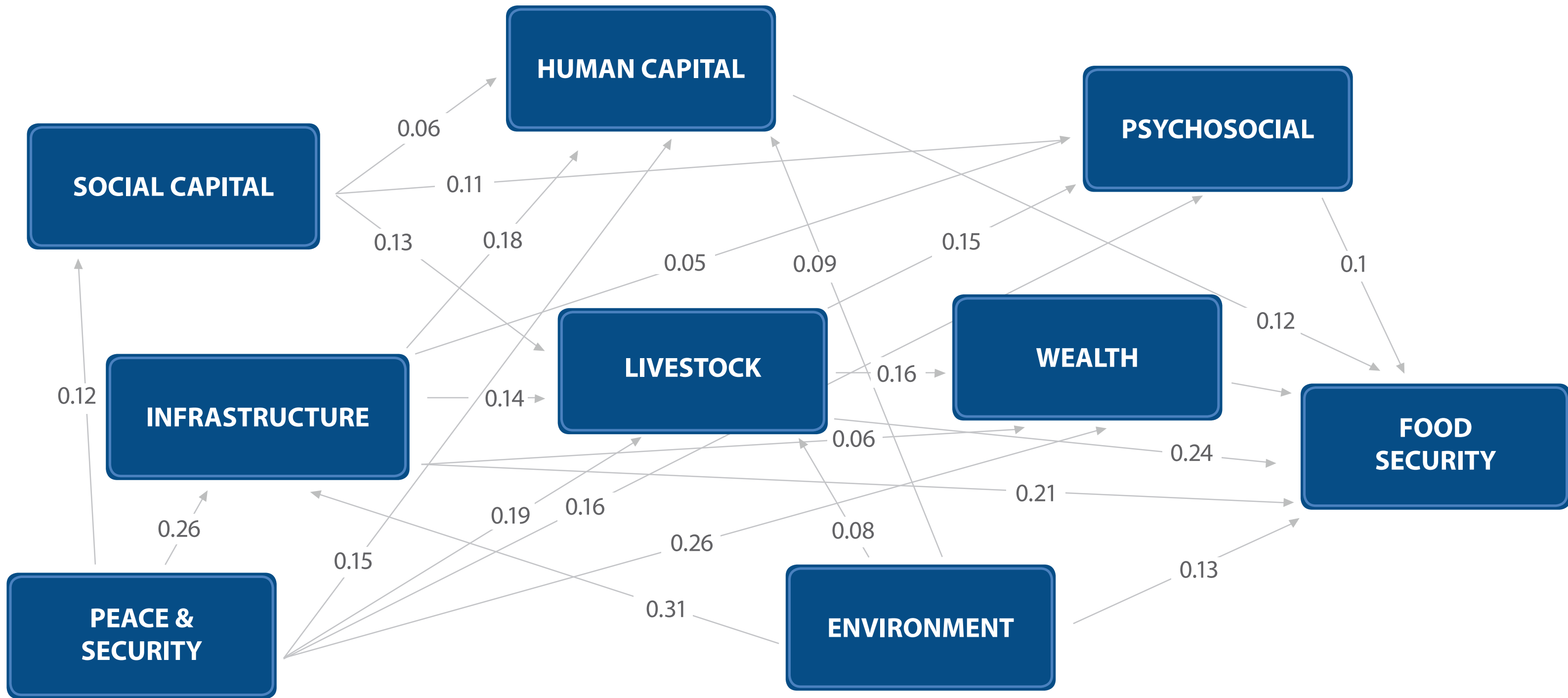Figure 7: Resilience dimension framework, Borana Zone, southern Ethiopia

Figure 8: Structural Equation Model showing the relationship of resilience dimensions, Borana Zone, southern Ethiopia (also simplified in figure 9)

Two Intervention Pathways
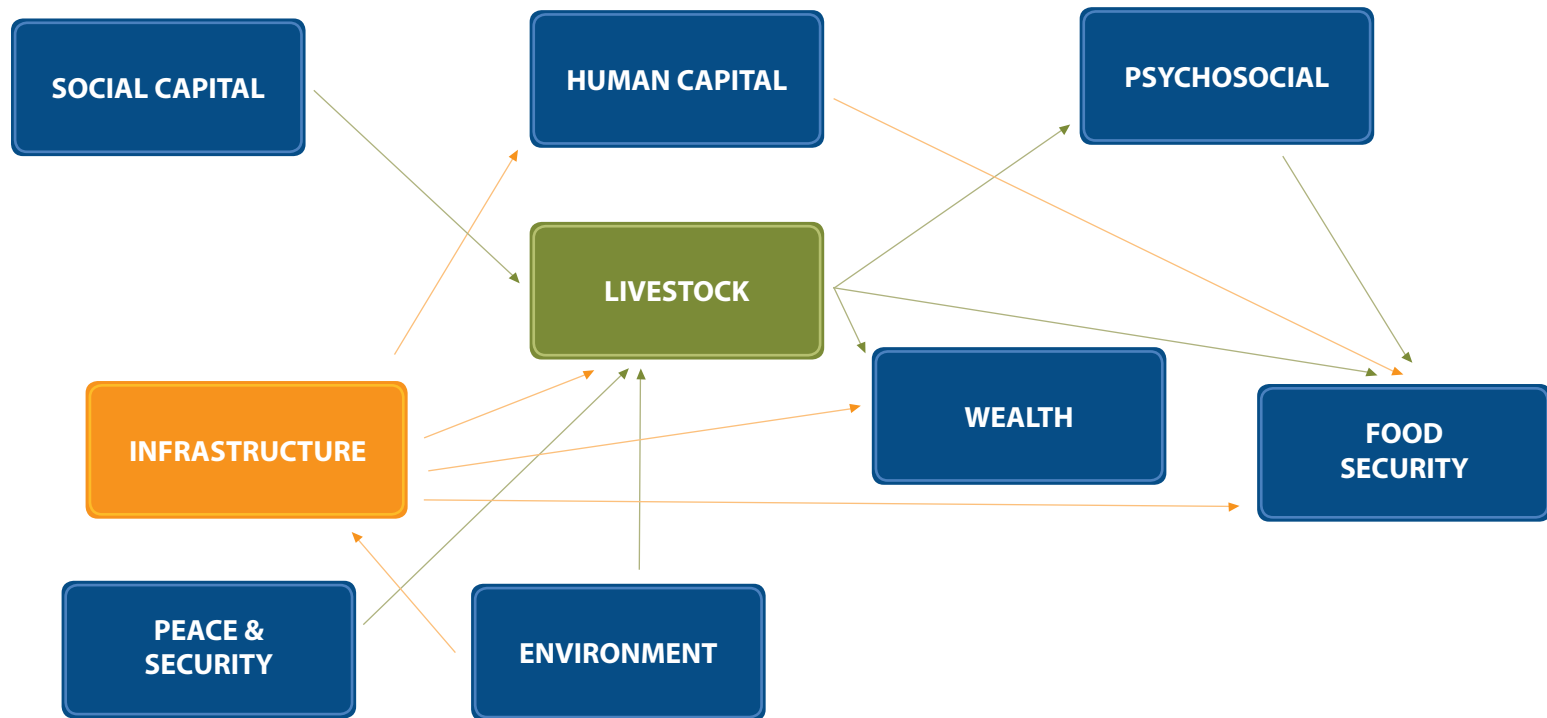
Infrastructure Path **Livestock Path**

Figure 9: Intervention pathways to enhance the resilience of Borana pastoralists to recurrent droughts

B. Horn of Africa RILab *cont.*

4. Findings cont.

The highest correlation was between the environment and infrastructure dimensions, a clear indication that stable environmental conditions strongly correlate with better water infrastructure. In addition, infrastructure such as schools and roads is vital for improvement of human capital, for example, educational status. The fact that the main livelihood of Borana pastoralists is livestock raising is confirmed by the strong correlation between livestock and food security.

Two intervention pathways **(Figure 9)** were identified for infrastructure (red) and livestock (green). These two dimensions could serve as leverage points to enhance resilience of the pastoralists. Improved water infrastructure and access to livestock markets, health facilities, and schools will help improve human capital and food security status. In addition, livestock investment to improve quality of stock, productivity, and diversity will help improve psychosocial status and food security.
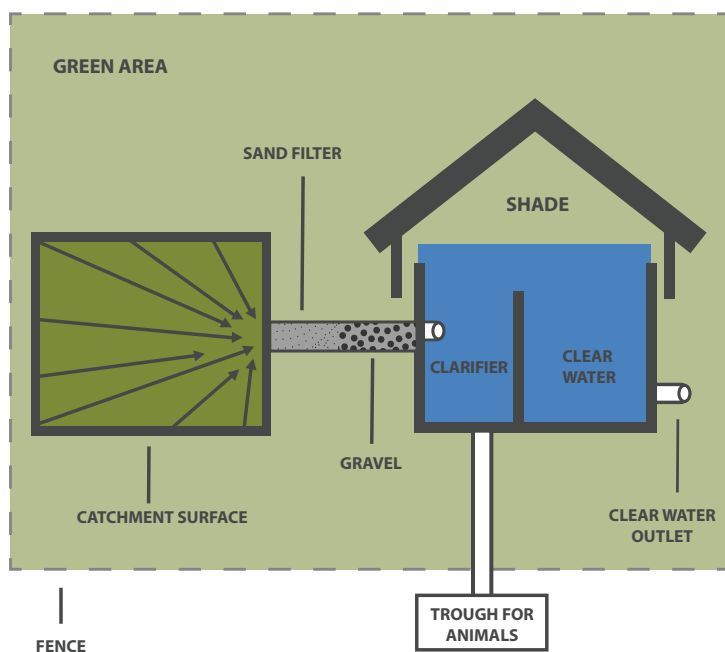
Under the HoA RILab, a rainwater harvesting project was designed to improve water infrastructure and access to water in the harsh environmental conditions in Arero District **(Figure 10)**.

Another technology to improve household water quality was a "smart" water filter **(Figure 11)**, a conical clay pot with a filter and an electronic sensor embedded in the bottom. When the water quality drops below the acceptable standard, the sensor sends a signal to a mobile application for further action.

If they are successfully incubated, tested, and scaled up, these projects will improve livestock production, human capital, and food security. Other innovation projects that are not yet funded are water source improvement (to improve infrastructure and environmental conditions) and enhancing the productivity and marketability of livestock products to improve the wealth and food security status of the pastoralists.
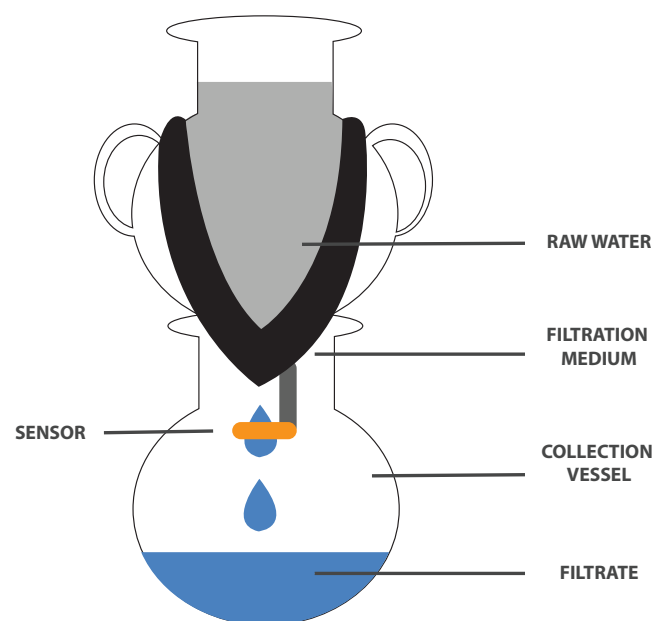

Figure 10: Site plan, rainwater harvesting project, Borana Zone, Ethiopia

Figure 11: Smart conical clay pot water filtering device, Borana Zone, Ethiopia

Section 3.0
RILab Findings *cont.*

C. West Africa RILab

1. Context

West Africa is the fastest urbanizing sub-region in Africa, experiencing vast movements of people across borders and within countries. These movements have significant implications for food security, sustainable livelihoods, and the provision of water, hygiene, sanitation, and health services. The region's location in the Sahel—the transitional zone between the desert and the forest—makes West Africa particularly vulnerable to the adverse effects of climate change.

In 2014, a series of community consultations were conducted in three geographically distinct communities in Ashaiman, Navrongo, and Tamale in Ghana. Of the 1,198 people interviewed, 47 percent were female and 53 percent male. Most respondents were younger adults, predominantly illiterate in Navrongo and Tamale but much less so in Ashaiman. Respondents from Navrongo were predominantly farmers, while those from Ashaiman and Tamale were mainly traders

The West Africa RILab interviewed a scientific random sample of 243 people in the Tamale Metropolitan Area through random selection of households and of participants in the households. Of this sample, two people declined to take the baseline survey, and 35 completed the baseline survey but did not attend the deliberations. Therefore, 208 people completed the 2 days of deliberations. There were few significant differences between the participants and non-participants in either demographics or attitudes. The sample was 48 percent male and 52 percent female, with an average age of 33.7 years. Whereas 27.9 percent of the participants had never been to school, 3.9 percent were first degree holders. The response rate was 85 percent, high by world standards for surveys, and even more remarkable for 2 days of deliberation. The random sample of Tamale residents assessed 39 competing policy options in a pre-deliberation survey and a post-deliberation survey. The survey results were presented as means from pre-deliberation and post-deliberation, with the difference between the post- and pre-deliberation mean and statistical significance. All questions were on a 0 to 10 scale, where 0 was "extremely unimportant" and 10 was "extremely important."

2. Theoretical Framework and Indicators

The community consultations identified wealth, security/protection, natural resources/ environment, human capital, social capital, psychosocial health, infrastructure, health/health services, governance, and spirituality as the main dimensions of resilience **(Figure 12)**.

3. Quantitative Survey

As a follow-up to the qualitative study, a quantitative study was conducted to understand the distribution of resilience factors to set indicators to measure change over time. The main dimensions of resilience identified during the initial quantitative study were wealth, food security, natural resources and environment, community networks, social capital, and spirituality. In Navrongo in Upper East Region, the most prominent resilience dimensions were spirituality and food security. In Ashaiman in the coastal belt, the key dimensions of resilience were wealth and community networks, while in Tamale, the key dimensions were wealth, community networks, natural resources and environment, and social capital. The quantitative study confirmed that these were the most salient dimensions of resilience.

Statistically significant differences were found with respect to wealth, or socioeconomic security (SES) by location of residence. As expected, residents of Ashaiman enjoyed the same wealth status as those of Navrongo (odds ratio of 1.235). Residents of Navrongo scored slightly higher on the SES index than residents of Tamale. Finally, for the spirituality score, a linear regression model was estimated to determine the predictors of spirituality. A basic model was first estimated where only the location variable was included. The objective was to determine whether spirituality is associated with a specific location, as shown by the qualitative analysis. The conclusion was that spirituality was more predominant and increasing in Navrongo than in Ashaiman and Tamale, and these results did not change when controlled for the effects of confounders.

4. Findings (Resilience Pathways and Innovations)

The main dimensions of resilience identified from the qualitative data were used to model the pathways to resilience related to the vulnerability factors. This enabled estimation of the structural equation model in **Figure 13**.

SUPPORTING & ENABLING FACTORS

Social Capital   Governance

IMMEDIATE CAUSES AND IMPACTS

Human Capital   Security

UNDERLYING CAUSES OF VULNERABILITY

Natural Resources   Spiritual   Wealth
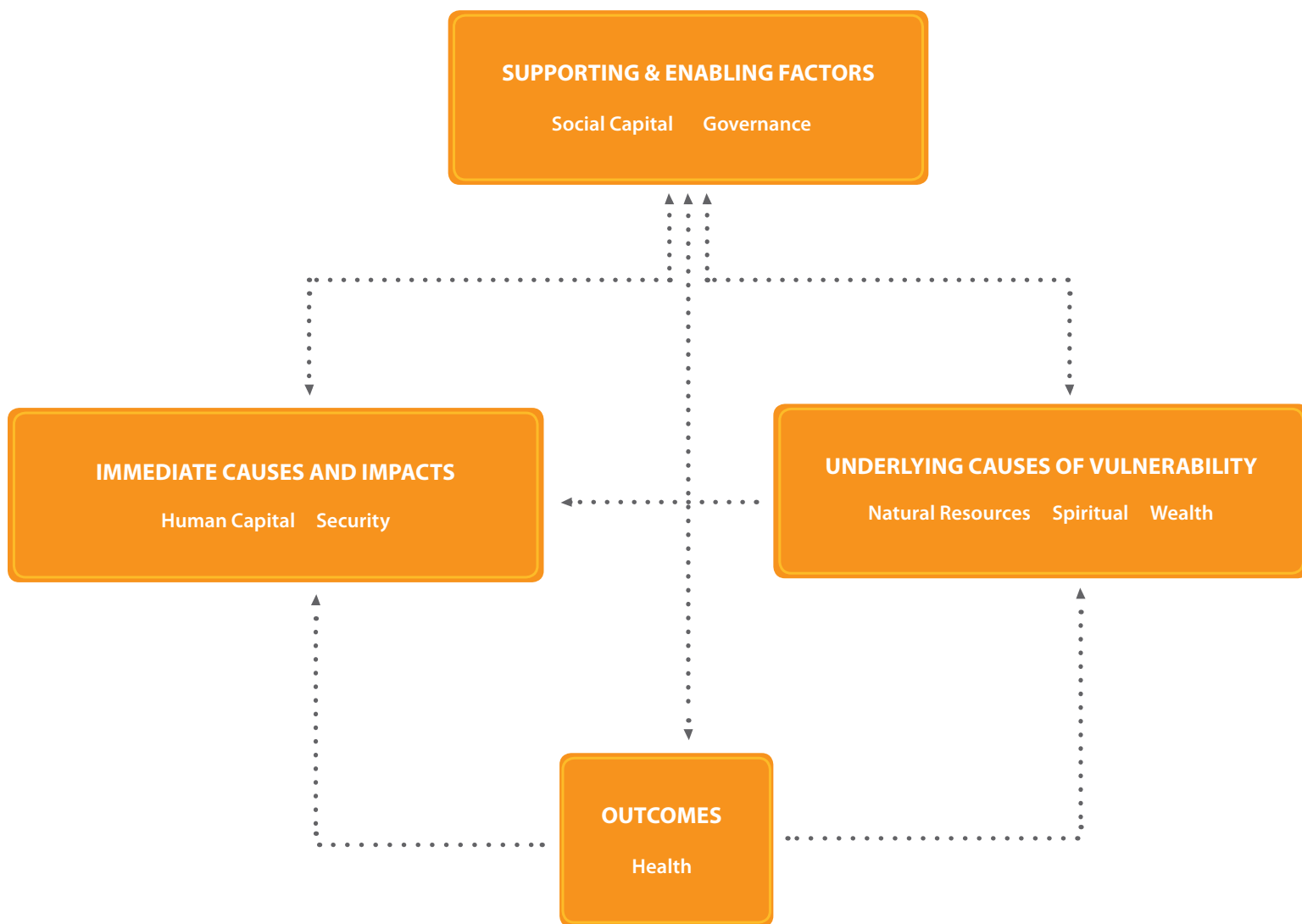
OUTCOMES

Health

Figure 12: Resilience dimension framework, Ashaiman, Navrongo, and Tamale, Ghana

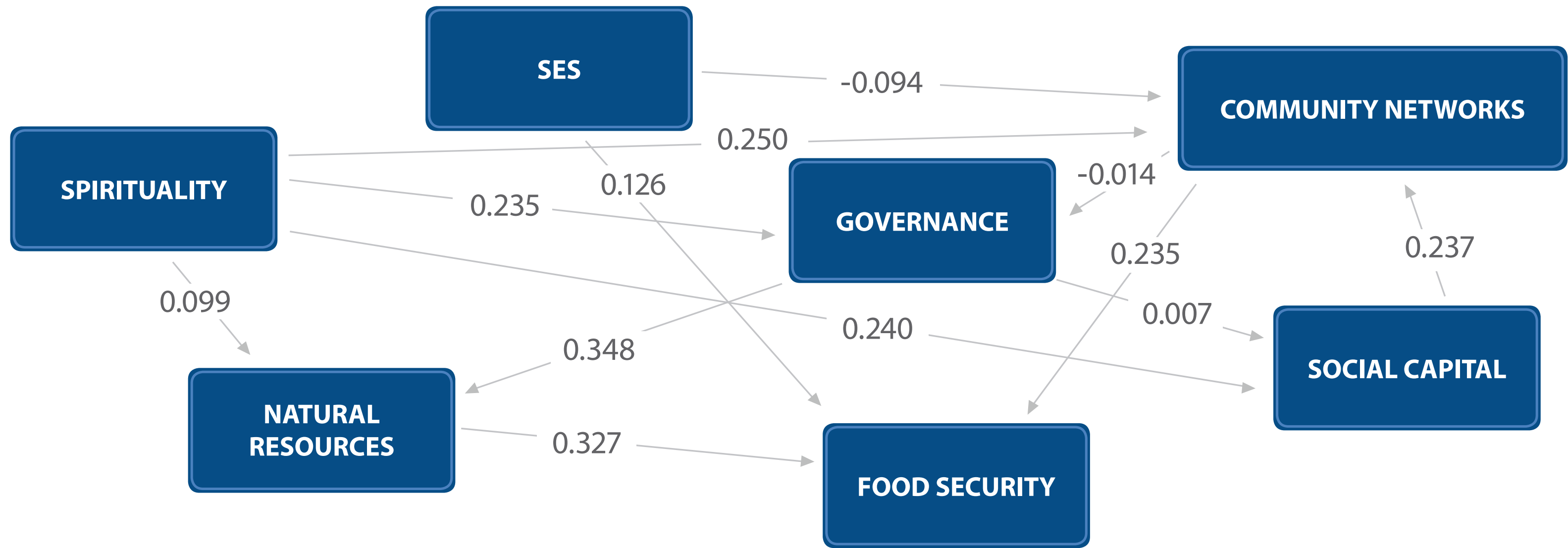*Figure 13: Structural Equation Model showing the relationship of resilience dimensions, Ashaiman, Navrongo, and Tamale, Ghana*

In the pathway diagram, wealth is represented as SES and directly relates to food security. Other pathways suggest connections and causal links that are explored below.

Pathway 1: Spirituality » Natural Resources

The spirituality » natural resources pathway was probably the most noteworthy. Social taboos and other beliefs set expectations, and when these expectations are not met, elders or spiritual leaders attribute negative outcomes to the violation of these taboos. This may be complicated by biological and scientific views of the world that attribute changes in weather and other patterns to larger structures not heavily influenced by individual or behavioral practices. Nonetheless, these communities abide by belief systems in which social actions are related to storms, rain patterns, and vegetation. When there are storms or drought, people rely on their traditional and spiritual leaders for solutions. At the individual level, people pray for the rains to fall, whereas at the communal level, rituals are performed to stop or reduce the impact of the shock. People may not build or farm in certain locations because they block the path of the divinities, which may manifest their anger in the form of rainstorms and blow off their roofs. The upsurge in western religious sects seeks to usurp ancestral worship with prayers.

Spirituality directly influences how natural resources are used, which in turn affects food security. This suggests that spirituality is a central feature of resilience, at least insofar as it focuses on preserving the natural environment. The attribution of living characteristics to certain groves, rocks, and rivers, as well as the identification of certain animals as totems, is an ecological conservation strategy. The strategy obligates humans to take care of these resources to ensure their continued existence. As climate change effects increase, attachment to spiritual values discourages deforestation because people are forbidden to enter sacred grooves to cut wood for fuel or commercial purposes. However, disrespect for these taboos has led to the wanton felling of trees, indiscriminate bush burning, and the use of harmful chemicals for fishing, all of which have had the cumulative adverse effect of increasing the fragility of the ecosystem. Although the spirituality dimension may not be easily comprehensible to many, it has spurred the innovations described below to curb environmental degradation.

The Grass Fuel Project (Promass) promotes the use of grass, a widely available, environmentally friendly, socially acceptable, and affordable resource, as an alternative to charcoal for fuel for both domestic and commercial use. Grass is burned in the dry season, resulting in loss of property and sometimes human lives. The grass is harvested, dried, and compacted in charred or raw form. The inputs are grass, binding material, a compressing machine, and a cutter. Grass is preferable to charcoal because it is scent free, smoke free, harder, and cleaner. The project is implemented under a Youth Spark Innovation Grants (YSiG) award and has trained over 20 people and five groups who are in the charcoal business to adopt and expand the new fuel technology.

The Ecosafe Energy Stove is a green stove that utilizes concentrated heat radiation for cooking and converts excess heat for electricity. The stove uses a wide range of fuel such as briquettes, sawdust, and liquefied petroleum gas (LPG) and only a quarter of the biomass needed for an equal heating task as other traditional stoves. It is suitable for communities that rely heavily on wood fuel. The stove addresses food security concerns because it helps minimize the felling of trees for fuel wood and charcoal, a major source of environmental degradation resulting in low agricultural productivity. The stove was judged the most innovative project in a crowd-sourcing event organized by the WA RILab.

Pathway 2: Spirituality » Governance » Social Capital

Spiritual awareness enables community knowledge holders such as chiefs, lineage heads, land overlords (tiga-tiina), and women's leaders (magazias) to exercise their governance responsibilities to mobilize social capital in times of need, with community members pooling resources to help the most vulnerable to or affected by natural or human-induced shocks. Good governance can also ensure better management of natural resources, thereby ensuring food security. However, local governance systems have broken down because of disrespect for traditional authority and family values.

4. Findings (Resilience Pathways and Innovations) cont.

The spirituality » governance » social capital pathway has induced the adoption of unsustainable agricultural practices such as the overuse of chemical fertilizers and wanton exploitation of natural resources, both of which compromise food security. To address these gaps in human knowledge, attitudes, and practices, the Real Problems, Real Solutions innovation aims to mobilize local artists to use drama to modify agricultural practices and strengthen environmental responsibility. The innovation has huge potential to enhance the positive aspects of spirituality, such as the preservation of groves and wood lots, and the use of organic fertilizers to improve community resilience.

Pathway 3: Improved WASH and Health

The Eco-Safe Toilet System addresses resilience challenges on all three platforms. The technology is a convenient and integrated waste management system that converts human excreta into energy. It involves flushing household waste (excreta) with minimal water and effectively separating the solid component of the waste from the liquid. Aerobic transformation turns the solid parts into compost, and filtration of the liquid component is recycled for non-edible purposes including vegetable farming and gardening. The Eco-Safe Toilet is ideal for backyard poultry and vegetable farming using organic manure. It can also be a reliable source of income for urban households where land for farming is scarce. The water and compost can be used to grow flowers and fruit trees and to green the environment. In the Ashaiman municipal area, where local governance poorly manages public sanitation facilities, the Eco-Safe Toilet is a user-friendly facility for every home to help keep the environment clean and diseases at bay. Ties project is under consideration for funding.

Pathway 4: Transformation of Agricultural Practices and Markets

The Tamale Metropolitan Area is grappling with scarce natural resources as farmland in peri-urban areas has been converted into residential facilities for the rapidly increasing population of the city. Climate change has also adversely affected crop yields, which has exacerbated hunger and nutrition and thereby compromised food security. To transform agricultural practices and markets, the Save the Climate, Eat Millet innovation develops strategies to increase the use of millet, a climate-compliant crop regarded as the healthiest cereal and crop of agricultural security, along its value chain by increasing the production and marketing of millet-based meals and beverages. It also addresses resilience challenges on the "promote livelihood diversification and financial inclusion" platform. Millet-based recipes will meet the needs of a health- and nutrition-conscious population, raise the incomes of farmers, create jobs for young people, and help mitigate climate change. This project is being assessed for funding under an Innovations Grants Call (CRID4FAL).

The Black Soldier Fly (BSF) Project addresses the dimensions of food security, WASH, and agriculture. The BSF (Hermicia illucins) is a harmless insect whose larvae feed on organic waste and convert it into protein. The concept of the project is to collect organic waste from markets, restaurants, and fruit sellers and inoculate it with BSF eggs. The eggs hatch into voracious larvae that feed on the waste to grow. The larvae, after maturing, are harvested, processed, and fed to poultry and fish to boost livestock production. The residue after harvesting the BSF larvae is good organic fertilizer.

5. Findings from the Ghana and Senegal Deliberative Polls

Deliberative Polling® was also used in Ghana to deepen understanding of priority entry points for strengthening resilience. A scientific sample of the Tamale Metropolitan Area was recruited through random selection of households and 243 participants within the households. Only two household members who were selected declined to take the initial survey, and 208 completed the 2 days of deliberations; 35 respondents who completed the baseline survey did not attend the deliberations. The sample was 48 percent male and 52 percent female with an average age of 33.7 years. Whereas 27.9 percent of the participants had never been to school, 3.9 percent were first degree holders. There were few significant differences between the participants and non-participants in either demographics or attitudes.

The response rate was 85 percent, high by world standards for surveys, and even more remarkable for two days of deliberation. The Tamale residents assessed 39 competing policy options focusing on health and food security in a pre-deliberation survey and post-deliberation survey. The survey results were presented as means from pre-deliberation and post-deliberation, with the difference between the post- and pre-deliberation mean and statistical significance. All questions were on a 0 to 10 scale, with 0 "extremely unimportant" and 10 "extremely important."

After analysis of the Tamale DP results, a diverse group of experts convened to discuss the findings and develop intervention pathways for platform projects to be implemented in communities across Ghana facing similar challenges of rapid urbanization. The platform project approach assumes that resilience dimensions are affected by several system-level factors, which, if addressed simultaneously, could lead to large-scale transformation of a community over a relatively short time. The innovation projects are built around a system rather than a single pathway, working simultaneously on multiple change levers and pathways to transform the system. The platforms identified as innovation challenges were 1) Improve Water, Sanitation, Hygiene, and Health, 2) Transform Agricultural Practices and Markets, and 3) Promote Livelihood Diversification and Financial Inclusion. The WA RILab launched an Innovations Grant Call, CRID4FAL, seeking multifaceted projects to enhance intervention pathway synergies in a way that maximizes the achievement of multiple resilience outcomes. Innovations were further solicited to address the resilience challenges highlighted in the DP results.

The WA RILab also collaborated with Cheikh Anta Diop University in Dakar, Senegal, to conduct Deliberative Polling® in the community of Tivaouane-Peulh/Niaga near Dakar. On September 24 and 25, 2016, 167 participants (56 participants in the baseline interviews did not attend) deliberated issues of food security and WASH. As there were few significant differences in policy attitudes or demographics between the attendees and non-participants, the deliberators were a good microcosm of the citizens of Tivaouane-Peulh.

C. West Africa RILab *cont.*

5. Findings from the Ghana and Senegal Deliberative Polls cont.

The 18 policy proposals related to food security included promoting micro-gardening through women's groups and training in small craft trades and small livestock raising. The 24 WASH policy proposals included offering low-cost pit toilets to households, connecting more households to the municipal sewage system, and closing the Mbeubuess landfill. All but nine (80 percent) of the policy proposals changed significantly with deliberation. Three of the nine non-significant changes were likely due to the already high mean before deliberations (hence there were ceiling effects). A proposal to "suggest that the town hall contract with community-based organizations for the collection of waste" had a mean of 0.961 out of 1 before deliberation, and the mean increased to 0.963. As the highest possible mean is 1, this result could not be statistically significant. The non-significant changes were due not to lack of support, but rather to very high support both before and after deliberations. Participants had already reached the threshold for nearly the highest possible scores. Most of the proposals had overwhelmingly high support even after people had discussed in depth all the arguments for and against. These are the thoughtful recommendations of a representative microcosm of the community.

Seven of the top 10 proposals after deliberations were among the top 10 prior to deliberations. The number one proposal before and after deliberation was to "request that the local government increase household connection (taps) to water." The proposal mean was 0.974 out of 1 before deliberation and 0.986 after deliberation. The three proposals from before deliberation that made it the top 10 list after deliberation were training in processing and packaging agricultural products (from 16 to 6), developing transport near Lac Rose (from 13 to 9), and facilitating access to microcredit for processing local agricultural products such as cereal, fruit, and vegetables (from 18 to 10).

Participants were also asked about tradeoffs in these proposals, for example, whether the government should pay for household water connections "even if it means the government will charge fees or taxes," or private companies should pay for the connections "even if it means those companies will charge the households." More participants before and after deliberations were in favor of the government paying for the household connections, even if that meant charging fees or taxes. The mean was 0.296 before deliberation and 0.243 after deliberation. The change was not statistically significant.

Section 3.0
RILab Findings *cont.*

D. Southern Africa RILab

1. Context

The SA RILab concentrates on analyzing the impact of chronic diseases, especially HIV, on access to livelihood assets and understanding local adaptive strategies to environmental stressors and shocks such as drought and floods to promote food security. The SA RILab envisions resourceful people in targeted communities that effectively harness individual and community agency, local adaptive capabilities, and innovative solutions to diversify their livelihoods in a manner that guarantees food security and sustainable income generation.

2. Theoretical Framework and Indicators

The resilience framework in **Figure 14** includes eight resilience dimensions derived from a prior quantitative study in the same communities in Southern Africa (The State of African Resilience, 2015). Wealth and food security were the main resilience outcomes. Health, psychosocial status, security, and human capital were the immediate causes and impacts, with environment and infrastructure hypothesized as the main underlying causes of vulnerability. Social capital and social support/network were further dimensions hypothesized to interact with the underlying causes of vulnerability. The immediate impact, and to a lesser extent, the resilience outcomes, were thus categorized as supporting or enabling factors/dimensions.

3. Quantitative Survey

Data from household surveys (n=1948 households) in four communities in Malawi, South Africa, and Zimbabwe were fitted to an a priori specified model using Structural Equation Modeling (SEM) to derive two context-specific resilience pathways. Social capital and social support/network were further dimensions hypothesized to interact with the underlying causes of vulnerability, the immediate impact, and to a lesser extent, the resilience outcomes. They were thus categorized as supporting or enabling factors/dimensions.

4. Findings (Resilience Pathways and Innovations)

The first SEM was constructed in the context of a population with no reported HIV-positive household members (**Figure 15)**, and the second in a population with households with HIV-positive members (**Figure 16**).

The dotted lines with a cross in **Figure 16** show pathways in the larger population with no HIV-positive household members that were found not significant in the population with HIV-positive household members. The red arrow indicates a pathway that was only significant in this context.

In the final structural models, human capital (years of schooling and vocational training) and wealth (household and productive asset ownership) remained central to the pathway to food security (food diversity index) for all households, while natural environment (self-reported extent of droughts/floods), health (self-rated health status), and human capital were all directly linked to wealth. However, the strongest antecedent of human capital development was the level of infrastructure development, defined by access to reticulated water and electricity. Conceivably, these context-specific indicators of infrastructure are important for schools to function or for people to practice their trades.

The results of the analysis supported the hypothesis that environmental stability and infrastructure are the underlying causes of vulnerability in these communities. The importance of infrastructure and environment as underlying factors in resilience building were demonstrated by direct linkages to wealth and food security (infrastructure to food security = 0.14, environment to wealth = 0.12). For the general population without HIV-positive household members, the six strongest pathway connections were:

–   Environment and infrastructure (0.52)
–   Infrastructure and psychosocial status (0.36)
–   Psychosocial status and health (0.27)
–   Wealth and food security (0.24)
–   Human capital (skills) and wealth (0.23)
–   Infrastructure and human capital (0.22)
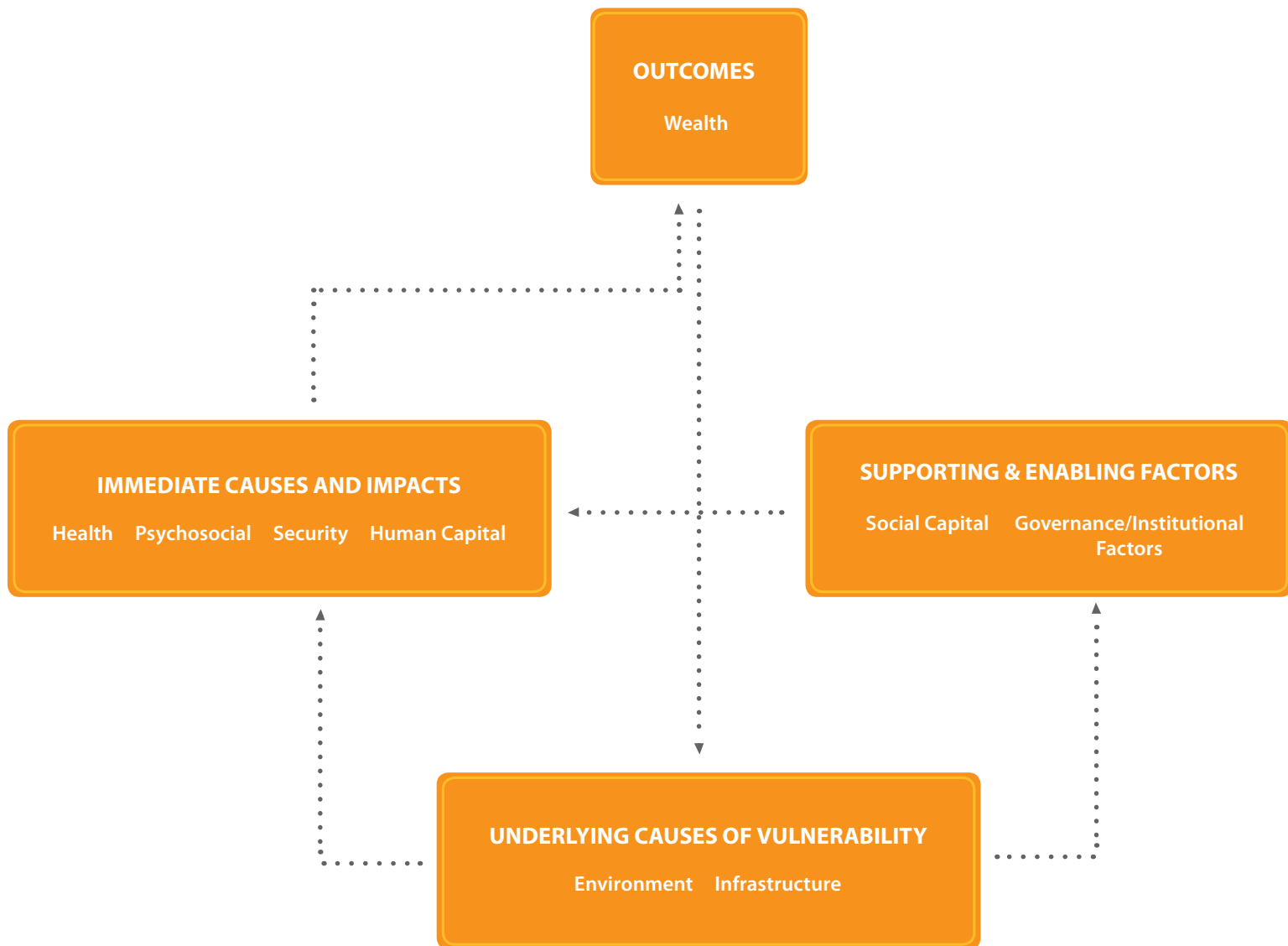
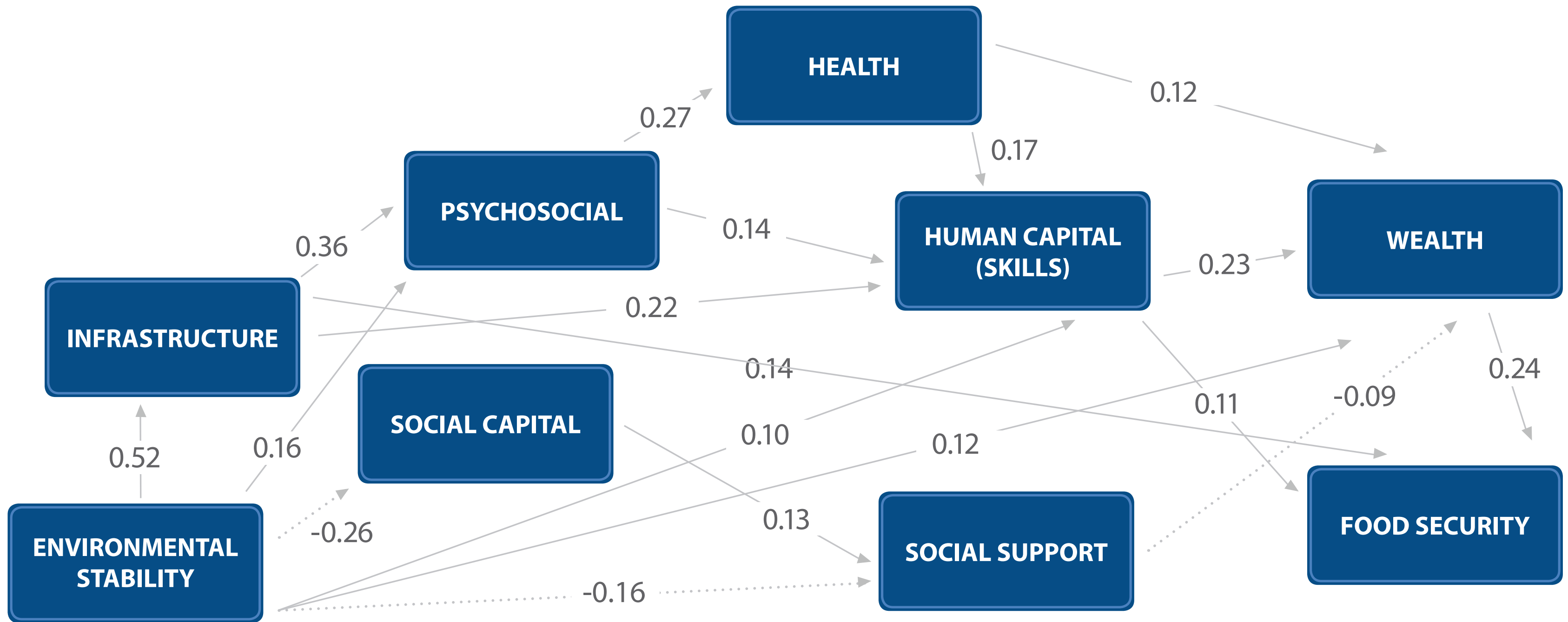*Figure 14: Structural Equation Model showing the relationship of resilience dimensions, South Africa*

Figure 15: Resilience pathway for improved income and food security for the general population without any household members with HIV, Malawi, South Africa, and Zimbabwe
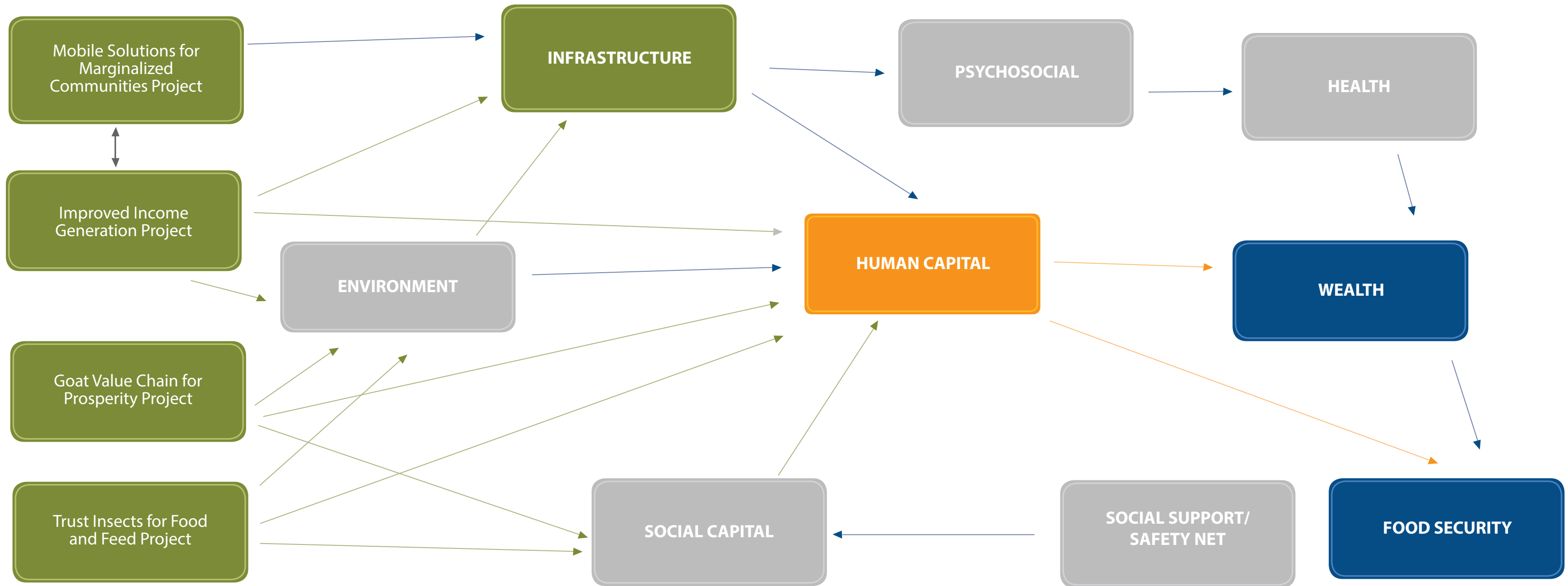
Figure 16: Resilience pathway for improved income and food security for households with HIV- positive members

Figure 17: Innovations and dimensions linkages, SA RILab

4. Findings (Resilience Pathways and Innovations) cont.

The resilience pathway model also confirmed that social capital and social support could be considered enabling short-term coping strategies or absorptive capacity rather than adaptive capacities represented by the other six dimensions of resilience. The negative coefficient suggests that a higher score for social capital would be the response to environmental instability or shocks/stressors. Furthermore, these absorptive pathways were not by themselves directly associated with wellbeing outcomes as defined by wealth/assets in the longer term (in fact, they were negatively associated with wealth), but they indirectly lead to wellbeing when linked to human capital development, as observed in the context of people with HIV. This significant linkage or transformative capacity observed in HIV-burdened households might reflect some of the gains of several years of investment in the implementation of resilience-focused HIV prevention interventions at community level, either by default or by design, and should be a lesson to transfer to the general population.

For households with HIV-positive members, the key pathways were similar to those of the larger population with no HIV-positive household members. As noted, the difference in the pathway model in the context of households with HIV-positive members was the direct linkage between social support and human capital development, which in turn was the only direct link to food security. The other unique aspect of this population was the fact that the only path to wealth and in turn to food security was successful exploitation of the natural environment and improved infrastructure.

These findings suggest that in the context of a high burden of HIV, it would be important to focus on innovations or interventions that successfully exploit the natural environment (e.g., drought-resistant crops) to generate income (wealth) to promote food security. However, for all populations, innovations, or interventions linked to human capital development would be important to promote food security, especially if they are built around social connections (social capital) in the communities.

Based on the results of the analysis and identification of the strongest pathway relationships, the SA RILab identified and incubated four innovations (interventions) with the greatest potential to strengthen the resilience of the targeted communities by reducing their vulnerability to environmental shocks/stressors and promoting food security regardless of the burden of HIV or other chronic diseases. **Figure 17** shows the pathway relationship between dimensions and four related innovation entry points.

Mobile Solutions for Marginalized Communities (MOSMAC) (**Figure 18**) proposes to use a set of digital tools (a mobile app, web-based service, and knowledge center [infrastructure]) to enhance coordination among smallholder farmers and increase their access to alternative markets and information to improve decision making (human capital development). By developing agricultural networks and encouraging knowledge sharing, MOSMAC seeks to achieve market restructuring to accommodate marginalized groups and thus improve their potential to generate income and promote food security (infrastructure » human capital » wealth pathway).

Mopane Worm for Improved Income Generation (MW4IIG) (**Figure 19**) is a systematic innovation for natural resource management (primarily mopane worms on mopane trees) (environment), underpinned by technology development in a Centralized Business Facility (CBF) co-developed with communities in Beitbridge, Zimbabwe (infrastructure). It uses nodular innovation intervention development at every stage (conservation, harvesting, processing, packaging, and marketing) of the value chain for natural resource management to improve income generation. Human capital will be achieved by developing a natural resource management training curriculum for skills development aimed at conserving and improving the natural habitat of mopane worms and other forestry products (environment » infrastructure » wealth pathway). There is potential for MW4IIG to collaborate with the MOSMAC project on knowledge sharing and dissemination of agriculture and natural forestry products using information, communication, and technology. The integration of the MOSMAC and MW4IIG innovations shifts the potential effect of interventions from individual and household levels to a more cohesive systems-level innovation with potential to transform the innovation and entrepreneurship ecosystem.
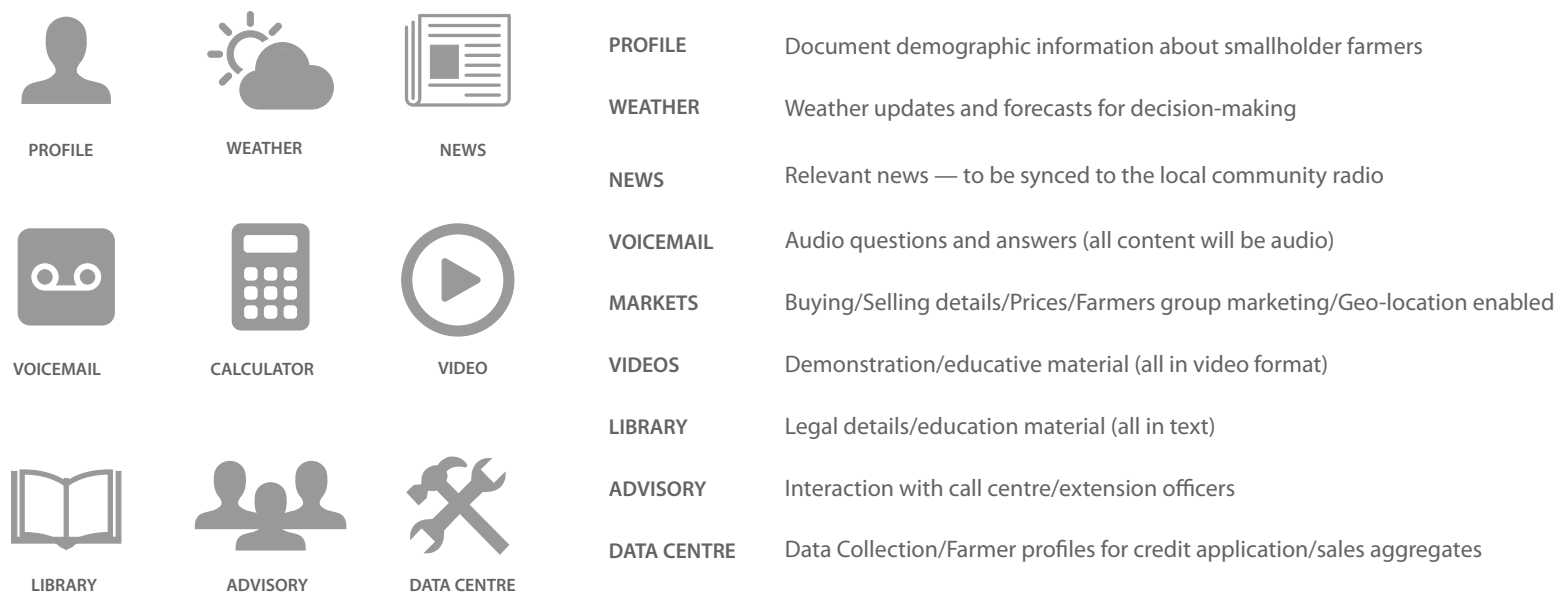
PROFILE	Document demographic information about smallholder farmers
WEATHER	Weather updates and forecasts for decision-making
NEWS	Relevant news — to be synced to the local community radio
VOICEMAIL	Audio questions and answers (all content will be audio)
MARKETS	Buying/Selling details/Prices/Farmers group marketing/Geo-location enabled
VIDEOS	Demonstration/educative material (all in video format)
LIBRARY	Legal details/education material (all in text)
ADVISORY	Interaction with call centre/extension officers
DATA CENTRE	Data Collection/Farmer profiles for credit application/sales aggregates

PROFILE · WEATHER · NEWS · VOICEMAIL · CALCULATOR · VIDEO · LIBRARY · ADVISORY · DATA CENTRE

Figure 18: Mobile Solutions for Marginalized Communities (MOSMAC)

Goats Value Chain for Prosperity (G4P) seeks to diversify the local economy by developing interventions to improve production, value addition, and commercialization of indigenous goat products for improved income (wealth) for poor rural households. The environment dimension will be impacted through common management of water and grazing resources for small livestock (goats). In addition, recognition and use of small livestock for enhanced income for local communities will lead to sustained wealth creation. Human capital, livestock rearing, and production and marketing skills for local community members will lead to wealth creation (environment » human capital » wealth pathway).

The Trust Insects for Food and Feed (TIFF) project seeks to develop a farming system that targets the commercial production and valorization of drought-resistant grain sorghum (environment) as well as to develop enterprise value chains from a single crop through training smallholder farmers (human capital) to raise mealworms at community level (social capital). This will be achieved by intertwining crop production and edible insect farming (for mealworm production) and processing the edible insects itself into nutrient-rich human food (food security), fish feed, poultry feed, and animal feed (**Figure 20**). This will result in small enterprise development, income generation (wealth), and substantial job creation in the rural communities (environment » social capital » human capital » wealth » food security pathway). The TIFF project can collaborate with G4P in producing sorghum to feed goats for improved milk and meat production.

ECOLOGY

Mopane

NATURAL RESOURCE PRODUCTS

Mopane

VALUE ADDITION

Snack Canned Dye

Baobab

Fruit & Bark

Juice Mats

Mlala

CONSERVATION

Mlala

NR BY-PRODUCTS

Basket Mats

SKILLS & TRAINING

Figure 19: Mopane Worm for Improved Income Generation (MW4IIG) Project

TECHNOLOGIES

Gloves

Solar Dryer

Skills Building

CBF (Warehouse & Retail)

Knowledge Building

ASSET BUILDING

OUTCOMES

Improved resilience to shocks

IMPROVED INCOME

Stripped sorghum stems crushed to extract
fermentable sugars in juice

3

Waste bagasse feedstock

3B

1

1A

3A

3C   **3D**

2

1B

Leaves for livestock feed

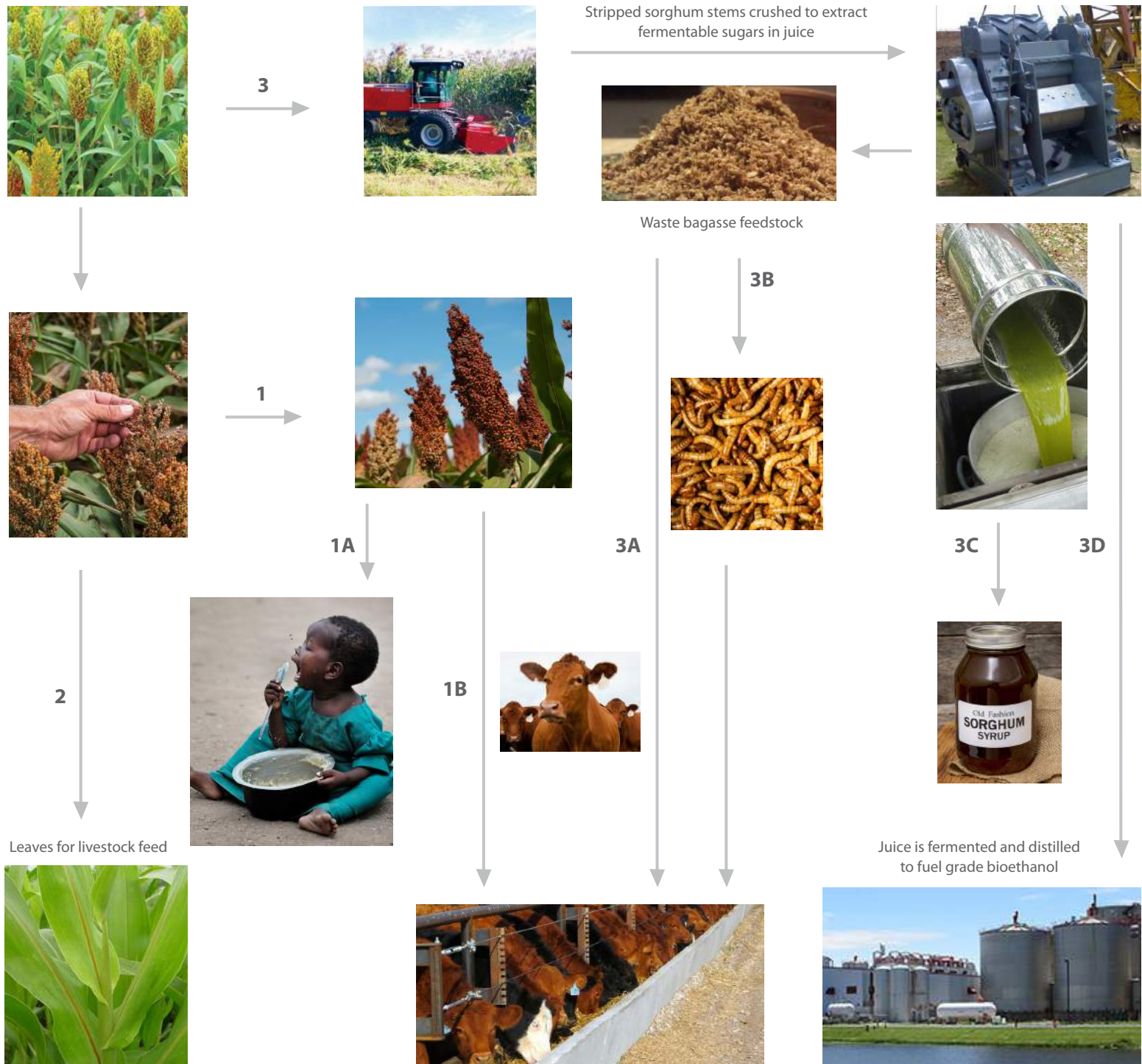Juice is fermented and distilled
to fuel grade bioethanol

Figure 20: Trust Insects for Food and Feed (TIFF) Project

D. South Africa RILab *cont.*

5. Findings from the Malawi Deliberative Poll

Malawi is one of the three countries where Deliberative Polling® was used to deepen understanding of priority entry points for resilience interventions. Nsanje District is home to two traditional areas (TAs) that face recurrent flooding. TA Nyachikadza experiences frequent flooding and lacks social services. During floods, the lowland community seeks refuge in the upland, where TA Ndamera is located. In 1997, the Government of Malawi declared TA Nyachikadza a flood-prone area and prohibited people from living there. However, the community refused to relocate for a variety of reasons, including livelihood and population pressure. The problems have worsened over the years, and it has become more and more dangerous to live there. Because government policies have been ineffective and unenforced, government leaders opted to try Deliberative Polling® to inform both communities about the issues at stake.

In June 2017, the SA RILab led the first Deliberative Poll in Malawi, in which a random, representative sample of 480 residents of both TAs completed 2 days of deliberation. All 254 participants drawn in the initial sample for TA Nyachikadza and 226 of 230 participants drawn in the initial sample for TA Ndamera attended the Deliberative Poll. The participants were recruited by stratified random sampling of households and random selection within the households.

The 480 participants discussed 32 policy options focusing on relocation and resettlement, reducing vulnerabilities in the existing communities, and population pressure related to gender and access to social services. A briefing video presented the pros and cons of each policy option. The DP agenda was carefully vetted by an advisory committee and checked for balance and accuracy. The participants alternated between moderated small group discussions and plenary sessions in which their questions were answered by a panel of experts. At the end of the process, the views of the participants were captured in their response questionnaires.

The results showed statistically significant changes in 18 of the 32 proposals after deliberation. The topics of population pressure, gender, and access to social services changed in 11 of 14 policy proposals. In five of nine policy proposals, the topic of reducing vulnerabilities changed significantly. Two of nine policy proposals relating to relocation and resettlement changed significantly.

Both communities supported the policy option to "allow TA Nyachikadza communities to 'access' land upland to temporarily relocate during floods and return afterwards." Before the event, the upland community's mean opinion of this policy option was 5.77 on a 10-point scale, in which 10 was "extremely important." After deliberation, the mean increased to 7.38, showing much higher support. The lowland community had a mean opinion of 6.51 before deliberation and 7.64 after deliberation. This proposal showed an area of agreement post-deliberation about at least one of the options to address the difficult issue of resettlement. For the sample as a whole, the top five policy options after deliberation all related to issues of population pressure and social services:

1. Use community by-laws to restrict child marriages
(pre-deliberation mean = 8.73, post-deliberation mean = 9.29)

2. Promote village savings and loans to provide alternative income sources for women
(pre-deliberation mean = 8.93, post-deliberation mean = 9.18)

3. Provide wide access to free family planning services
(pre-deliberation mean = 8.48, post-deliberation mean = 9.17)

4. Provide adequate security in evacuation centers to ensure that women and girls are protected from abuse and rape
(pre-deliberation mean = 9.08, post-deliberation mean = 9.10)

5. Give poor families with children of school-going age a cash transfers only if they enroll their children in school
(pre-deliberation mean = 8.83, post-deliberation mean = 9.08)

The SA RILab plans to continue data analysis for this DP project and develop policy briefs for submission to local and national policy makers to enact policy changes.

Section 4.0
Conclusions and Lessons Learned

Repeated emergencies in chronically vulnerable communities and regions have led to a strategic focus on resilience—helping communities recover but at the same time strengthening their capacity to mitigate and withstand future shocks. Integrating resilience mechanisms into relief and development efforts can help break the cycle of vulnerability and identify locally driven solutions for more sustainable impacts. The RAN focuses on delivering practical, real-time, and enduring solutions to Africa's most vulnerable communities by identifying pathways of vulnerability and resilience and potential entry points for resilience building.

This section synthesizes the learning from the four RILabs about resilience in the targeted communities and draws lessons for how the methodology and results can help other vulnerable communities improve their resilience to natural and man-made stresses and shocks.

In each country, the RILabs used a common resilience analytical framework to identify and prioritize resilience dimensions and pathways and then determine where to target interventions to strengthen or build community resilience. This iterative resilience framework involved the following steps:

1. Analyzing the local context through community consultations and qualitative assessments
2. Identifying resilience dimensions and pathways, including strategies used to mitigate, adapt to, and recover from shocks and stresses
3. Determining relationships among resilience dimensions in the targeted communities through quantitative surveys of the same households involved in the qualitative assessments
4. Using Structural Equation Modeling (SEM) to identify and confirm relationships, both direct and indirect, among the resilience dimensions, i.e. resilience pathways. This enabled RILabs to identify entry points for building resilience of targeted communities
5. In four countries, using Deliberative Polling® to solicit more informed and representative policy options, from local communities, related to risk mitigation of adverse events to support resilience interventions
6. Building on resilience dimensions and pathways and Deliberative Polling® results, facilitating Intervention Strategy Workshops to identify intervention pathways and innovations with the highest potential for resilience building
7. Calling for grants to address innovation challenges
8. Selecting innovations through crowd-sourcing, design-thinking-based ideation (Resilience Innovation Challenges), and Collaborative Resilience Innovation Design (CRID) and assessing their feasibility and transformative potential
9. Supporting grant awardees with training in human-centered design, development of a theory of change and M&E strategy, need finding, design refinement, and business model development
10. Monitoring and evaluating projects at all stages to allow correction and refinement

The following lessons from this process can inform interventions to address resilience challenges in other vulnerable communities:

· The findings from all four RILabs confirm that resilience measurement can drive more targeted and contextualized solutions.
· Deliberative Polling®, which elicits the thoughtful recommendations of representative microcosm of communities, demonstrated that initiatives informed by community opinion are more likely to succeed and that community sensitization is necessary for effective land management. The RAN's use of videos as well as written briefing documents for Deliberative Polling® has proven to be successful for low literacy populations.
· The Intervention Strategy Process is critical to translate information about resilience gaps into viable projects to strengthen resilience in targeted communities.
· The CRID approach can be used to design projects to address system-level development challenges.
· Community engagement is critical to "ground-truth" the relevance of innovations to address resilience challenges and increase their potential impact, underscoring the need for governments to include community voices in policy formulation.
· Developing theories of change helps innovators align interventions with the priorities of resilience innovation pathways and achieve vital short-term outcomes.
· The RAN's innovation monitoring system at all RILabs allows real (short) time review, correction, and refinement of innovations along the innovation pipeline from ideation to diffusion and scale.
· The RAN can help address climate change by conducting studies and analyses to support climate adaptation policies. To avoid duplication, there is a need for the government to work with the RAN to develop a harmonized framework for resilience and to use the RAN approach to resilience to support harmonization of resilience frameworks among stakeholders in the agriculture, tourism, infrastructure, and human capital development sectors.

In Uganda, following the analysis of the EA RILab finding, the RAN developed policy briefs with recommendations for policy makers and disseminated them at district and national levels. The EA RILab also engaged with the Office of the Prime Minister, which is responsible for coordinating disaster response, to further deliberate on how to implement the recommendations. Government department planned or implemented several policy changes regarding resettlement of at-risk communities, land ownership and compensation for resettled populations, community sensitization on natural resources and land management as a result of these activities.

In Ethiopia, innovations developed to improve water infrastructure and quality, including a rainwater harvesting project and a "smart" water filter, if successfully incubated, tested, and scaled up, can improve livestock production, human capital, and food security in countries facing similar resilience challenges. In Ethiopia, an area of potential collaboration with the RAN is to leverage an innovation grant under the Ministry of Science and Technology. Strong advocacy is needed to place focal persons in each concerned ministry or separate directorate to coordinate the efforts of the Prime Minister's Office under disaster management. There is also a need to increase collaboration with the government and other local and international partners to develop a holistic approach to resilience.

In Ghana, which is affected by rapid urbanization and the adverse effects of climate change, the WA RILab identified a resilience pathway between the dimensions of spirituality and natural resources: spiritual beliefs influence how natural resources are used, which in turn affects food security. This finding informed innovations to modify agricultural practices and strengthen environmental responsibility (e.g., mobilizing local artists to use drama to enhance the preservation of groves and wood lots associated with spiritual forces). Deliberative Polling® identified intervention pathways for platform projects to implement in other communities facing rapid urbanization.

The platform project approach assumes that resilience dimensions are affected by several system-level factors, which, if addressed simultaneously, could lead to large-scale transformation of a community over a relatively short time. Innovations are built around a system rather than a single pathway. Opportunities to address rapid urbanization and climate change include scaling up the Deliberative Polling® methodology, fostering joint program development through public-

private partnerships, and including additional indicators in the Ghana Living Standards Survey. RAN can engage the government in understanding key resilience issues, creating enabling environments for innovation and deepening dialogue between policy representatives and parliamentarians.

In South Africa, which faces unemployment, low literacy levels, food insecurity, and the impact of high HIV prevalence on livelihoods, the SA RILab's resilience analysis found that environment and infrastructure were the underlying causes of vulnerability and that social capital and social support could be considered enabling short-term coping strategies rather than adaptive capacities represented by the other six dimensions of resilience. The SA RILab focused on analyzing the impact of chronic diseases, especially HIV, on access to livelihood assets and understanding local adaptive strategies to environmental stressors and shocks such as drought and floods to promote food security. Opportunities for RAN include evaluating the land registration program to strengthen landowners' skills to manage farming areas and developing cooperatives to encourage young people to participate in agricultural production. RAN can also use Deliberative Polling® to evaluate current interventions and deepen dialogue among policy makers.

The results of the work of the four RILabs described in this report showed that the RAN can help governments improve data- and community-driven policy formulation and resource allocation. African universities are well positioned to support national governments in fostering scientific research innovations to address development challenges. The four RILabs should more vigorously identify what they can contribute to government departments and clearly state the role of universities in serving communities. Governments can tap RAN's piloted tools, policy briefs, resilience data, transformative innovations, and multi-disciplinary human resources for better service delivery.

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