Benchmarking, Visualising and Strengthening ICTs' Impact on Agricultural Livelihoods' Resilience: A Ugandan Case Study

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Table of Contents

Summary

This case study is about "e-resilience": the impact of information and communication technologies (ICTs) on vulnerable systems' resilience. It is based on pilot testing of RABIT – the University of Manchester's Resilience Assessment Benchmarking and Impact Toolkit – in an agricultural livelihood system in Uganda. The study was conducted in collaboration with Lutheran World Relief (LWR) and Gumutindo Coffee Cooperative Enterprise (GCCE), and focused on resilience to climate change stressors.

The case describes three things:

- *how we measured the role of ICTs vis-a-vis resilience in an agricultural livelihood system*
- *how e-resilience benchmarking metrics can be visualised*
- *how we used these metrics to prioritise future actions that will strengthen ICTs' contribution to climate change resilience.*

It provides an outline guide for those wanting to understand and enhance the links between ICTs and resilience in vulnerable systems, and strengthen the impact of ICT for development interventions.

The Agricultural Livelihoods Resilience Challenge

Due to the complex set of challenges that characterise the 21st century, we must redefine the way in which we understand and approach development, particularly for vulnerable agricultural livelihoods. For millions of people whose livelihoods depend crops, livestock, and other natural resources, adaptation to short-term shocks (e.g. economic crisis, violent conflicts, health epidemics, climate events) and long-term trends (e.g. climate change, migration, new technologies) is becoming the norm.

Agricultural livelihoods are at the core of developing country economies, and play a critical role in food security and in the sustainability of small producers and rural inhabitants. They are closely linked to the conservation of natural habitats and vulnerable ecosystems, and to the cultural identity of developing nations. Yet, often characterised by poverty and marginalisation, they are particularly vulnerable to the impacts of both rapid- and slow-onset events, which disproportionally affect the availability and access to resources, the capacities, institutions, and quality of life of the rural poor. Building resilience is recognised not only as mechanism to survive and cope with these impacts but, increasingly, as an enabler for the achievement of development outcomes.

Defined as the ability of vulnerable systems – including agricultural communities – to withstand, recover from, adapt to, and potentially transform amid change and uncertainty, resilience plays a crucial role in rural development. It provides a holistic, long-term and system-wide approach that is rising up the development agenda, offering a new perspective on the challenges and the opportunities faced by agricultural livelihoods.

Simultaneously, information and communication technologies (ICTs) – mobile phones, tablets, PCs, Internet connections – are becoming more prevalent and more widely adopted in rural communities. Mobiles have been the dominant technology to date in rural areas, characterised by relatively low adoption costs and flexibility of application. Given the scarcity of alternative communication technologies (i.e. fixed telephony), and the general lack of infrastructure, ICTs such as mobile have rapidly come to play an important role in agricultural livelihoods. Increasingly, ICTs have impacted rural resilience to external stressors such as climate change: strengthening some aspects of resilience but potentially weakening others. For shorthand, we can call the linkages that exist between ICTs and resilience, “e-resilience”.

The challenge arises because there are no e-resilience guides: to explain how to measure e-resilience, how to visualise e-resilience metrics, and how to use those metrics to guide actions that will strengthen ICTs’ contribution to resilience. This case study provides such a guide. It explains how one aspect of the University of Manchester’s Resilience Assessment Benchmarking and Impact Toolkit (RABIT) was piloted in an agricultural region in Uganda, in collaboration with Lutheran World Relief (LWR) and a local partner, Gumutindo Coffee Cooperative Enterprise (GCCE). As described below, this benchmarked the role of ICTs vis-a-vis resilience of coffee producers to climate change; developed different ways to visualise the benchmark; and then used that as the basis for prioritisation of future actions.

What is e-Resilience?

RABIT identifies nine attributes – or sub-properties – of resilience. Three are primary foundations of resilience: robustness, self-organisation, learning. Six are secondary enablers of resilience: redundancy, rapidity, scale, diversity, flexibility, equality. The stronger these are in a community, the more resilient it will be. As summarised in Annex 1, each attribute has a series of key markers: indicators that we can use to assess the strength or weakness of each attribute.

e-Resilience represents the impact that ICTs have on those resilience attributes and markers.

Measuring e-Resilience in Context: Coffee Producers in Uganda

The RABIT model of e-resilience can be taken forward via various different approaches to measurement. In this case, a structured-questionnaire, enumerator-applied, survey-based approach was used. This was applied in Mount Elgon, a coffee-growing region in Eastern Uganda. Heavily dependent on the production of Arabica coffee by smallholder farmers, the region is densely populated, and its vulnerability to stressors such as climate change is closely linked to prevailing conditions of poverty and marginalisation.

Mount Elgon was selected on four grounds: a) relatively accessible and safe as a pilot location; b) good level of organisation of the participating coffee grower cooperatives, to facilitate the coordination of interviews, surveys and focus groups; c) subject to climate-related events such as flooding and landslides, and with involvement in wider resilience initiatives, d) significant access and use of ICTs, particularly mobile phones.

A purposive sampling approach was used, focused on the participation of members of three coffee cooperatives located in the Mount Elgon region. Fifty-four respondents were surveyed: 67% male, 33% female; 24% 46 years old or older, 52% 36-45 years, 22% 26-35 years, 2% 18-25 years; all of them coffee farmers.

Each of the markers shown in Table 1 was converted into a question about use of ICTs for a marker-related activity – e.g. 'Collaboration and consensus' led to a question on use of ICTs to help organise or participate in community activities; 'Cross-level interaction' led to a question on use of ICTs to contact different institutions. Iteration after pilot implementation led some questions to be removed due to concerns about length of survey and respondent feedback about repetition. As a result, three of the 24 markers were not separately and explicitly incorporated into this version of the survey.

94% of survey respondents owned at least one mobile phone. Only 6% of the survey respondents reported using a computer to access the Internet.

Benchmarking Agricultural Livelihoods' e-Resilience

The percentage of those who indicated they used ICTs for the particular resilience marker activity (or, for four markers, who considered ICTs were being used by others for the activity) was used as a metric to measure the extent to which ICTs were currently contributing to climate change resilience of Mount Elgon coffee producers. Table 1 summarises these results, also including an aggregate score for each of the eight resilience

attributes (combining diversity with flexibility) calculated as the average of those marker scores which were present.

Resilience Attribute	Resilience Marker	ICT Usage	Aggre-gate Score
Robustness	Physical Preparedness	43% use ICTs to look for climate change information	**62%**
	Institutional Capacity	78% use ICTs to report problems / emergencies to institutions or authorities	
	Multi-Level Governance	65% use ICTs to access external information to better prepare for emergencies	
Self-Organisation	Collaboration and Consensus	89% report that ICTs have improved organisation / participation in activities and projects in the community	**91%**
	Social Networks	94% use ICTs to strengthen social networks	
	Local Leadership and Trust	*N/A*	
Learning	Capacity Building	*N/A*	**76%**
	New and Traditional Knowledge	81% report that ICTs have improved the identification of ideas for community improvement	
	Reflective Thinking	72% use ICTs to access ideas to improve farming practices	
Redundancy	Resource Spareness	76% use ICTs to generate additional income	**73%**
	Functional Overlaps and Interdependency	54% have used ICTs to access emergency resources	
	Resource Substitutability	89% use ICTs to obtain/provide help in emergencies	
Rapidity	Rapid Resource Access	87% report that access to emergency support is faster with ICTs	**84%**
	Rapid Resource Assessment/Coordination	91% report that organising support is faster with ICTs	
	Rapid Resource Mobilisation	74% use ICTs to access early warning [i.e. alerts]	
Scale	Multi-Level Networks	67% use ICTs to interact with multi-level institutions	**71%**
	Resource Access and Partnerships	57% report that ICTs have allowed them to work with new groups/organisations	
	Cross-Level Interactions	88% report that ICTs have improved their involvement in projects/initiatives	
Diversity & Flexibility	Different Actions/Opportunities	83% use ICTs to identify options and opportunities	**80%**
	Adaptable Decision-Making	78% use ICTs to access new information and to inform farming decisions more than before	
	Innovation Backbone	78% use ICTs to access innovative ideas	
Equality	Competency Gap Reduction	*N/A*	**89%**
	Inclusiveness	85% report that ICTs enable opportunities for vulnerable people	
	Openness and Accountability	93% use ICTs to inform themselves about local activities	

Table 1. Summary of quantitative data on ICTs and resilience (survey data)

Visualising Agricultural Livelihoods' e-Resilience

Deriving from the survey metrics, the benchmarking of agricultural livelihoods' e-resilience can be visualised:

- **Figure 1** uses just the data on attributes and adds icons for each attribute; a similar radar plot can be undertaken for all of the individual markers.

- **Figure 2** uses a 'traffic light'-type approach that signals red for high-priority markers where current ICT usage levels are only 0-60%; yellow for mid-priority (61-80% current ICT use); and green for low-priority (81-100% current ICT use). (Blue markers require further investigation.)

- **Figure 3** presents the Table 1 data overall as a wheel of e-resilience.

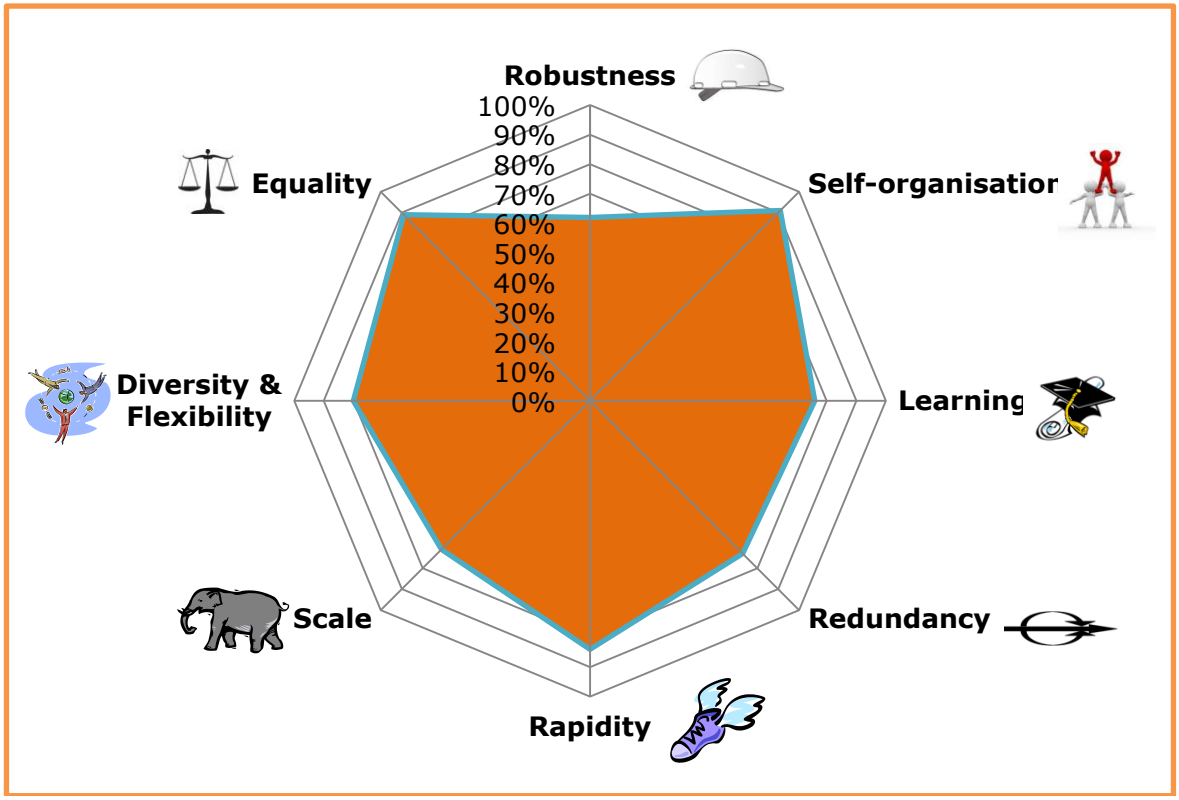

Figure 1. Contribution of ICTs to resilience attributes, Mount Elgon, Uganda

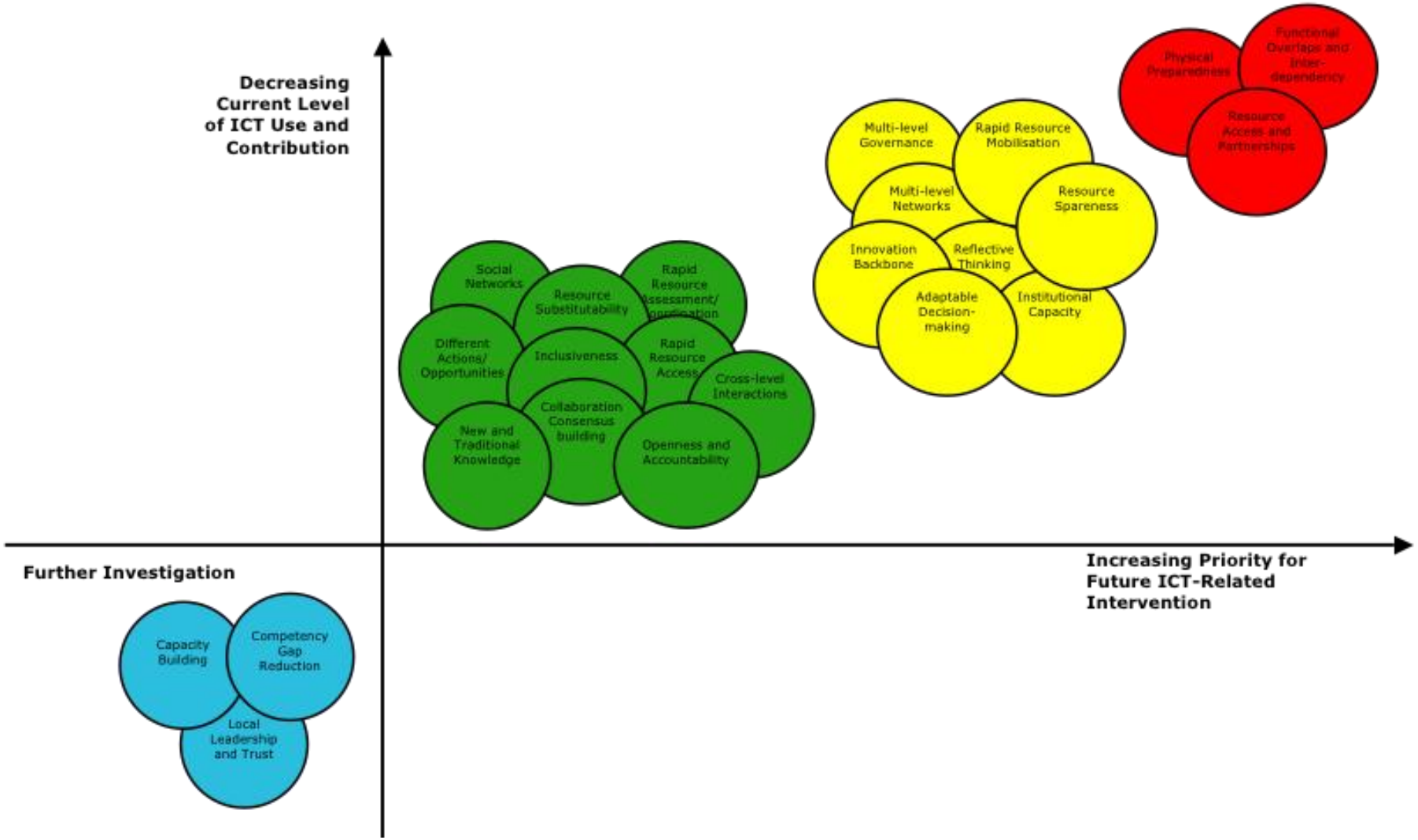

Figure 2. Bubble visualisation of priority e-resilience markers for future action, Mount Elgon, Uganda.

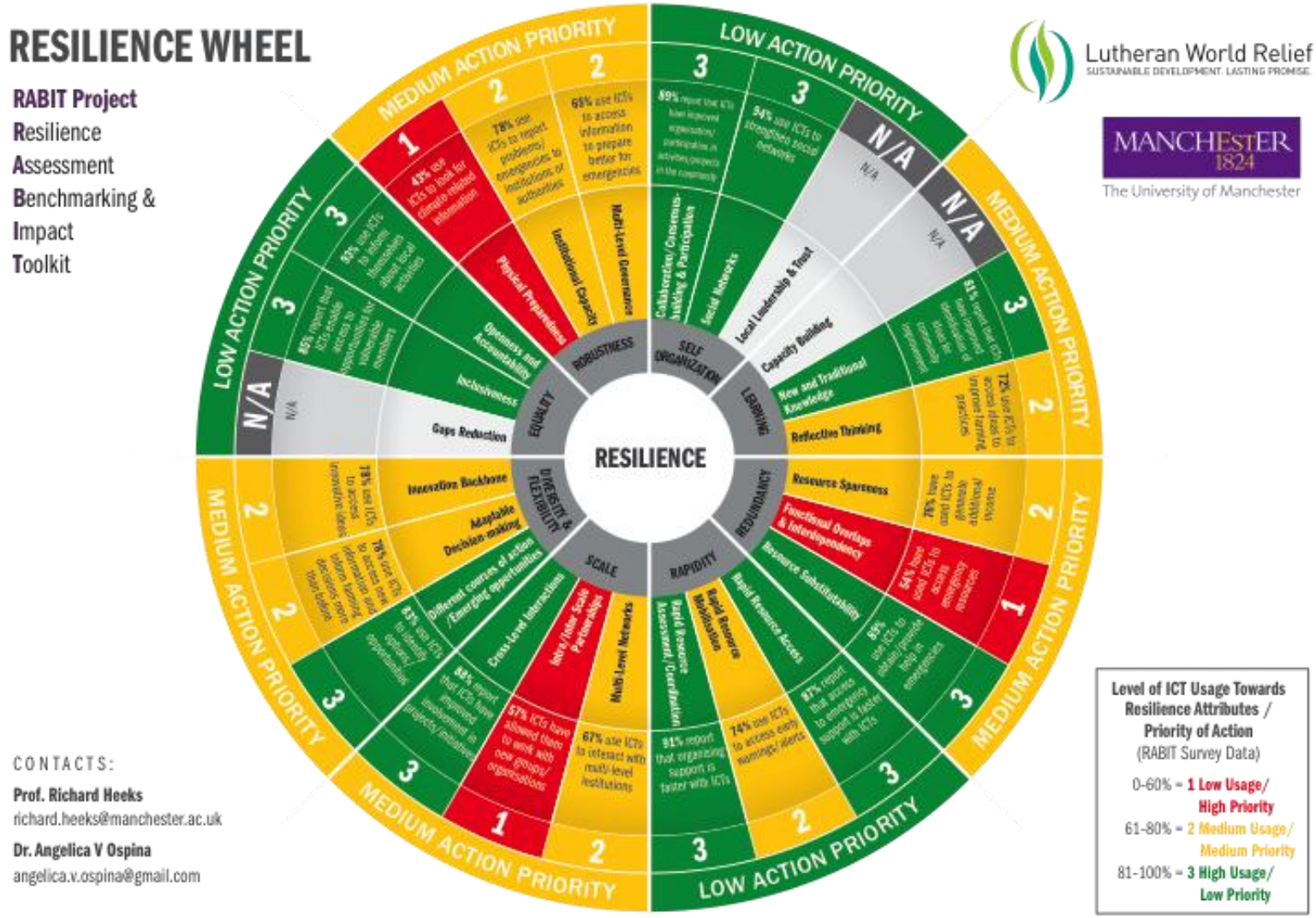

Figure 3. e-Resilience wheel – Mount Elgon coffee farmers, Uganda

Strengthening Agricultural Livelihoods' e-Resilience: Action Priorities

Table 2 presents an overall, combination approach to prioritising future actions on e-resilience.

The left-most column is a weighting of resilience attributes based partly on the aggregate e-resilience scores in Table 1 but then modifying these to take account of resilience benchmarking: giving a lower weight to attributes of reslience that were already strong among Mount Elgon farmers, and a higher weight to attributes that were seen as weak (see main case study for explanation). The next column presents the traffic light approach of Figure 2, with a weighting of 0 for green items, 1 for yellow items, 2 for red items. The next column adds the first two to produce an overall weighting – i.e. prioritisation – for each resilience marker.

Future interventions – shown in the middle of the table – are included for all markers though one might focus first on the higher priorities (weighted 4 and 3). On the right side, 'Level of involvement' indicates which of community-level, municipality-level and national-level stakeholders would be involved.

Further Information

For full case study details, see: Ospina, A.V. et al (2016) *Benchmarking Resilience of Agricultural Livelihoods: Piloting the Resilience Assessment Benchmarking and Impact Toolkit (RABIT) in Uganda* http://www.niccd.org/resilience

For full details of how to utilise the RABIT toolkit, see: Ospina, A.V. & Heeks, R. (2016) *Resilience Assessment Benchmarking and Impact Toolkit (RABIT): Implementation Handbook* http://www.niccd.org/resilience

RABIT

RESILIENCE ASSESSMENT BENCHMARKING and IMPACT TOOLKIT

Resilience Attribute Priority	Resilience Marker Priority	Overall Priority Weighting	e-Resilience Intervention	Level of Involvement		
				C	M	N
RAPIDITY (2)	Rapid Resource Access (0)	**2**	• Implement a system to track the performance of e-payments for farmers' coffee (introduced by LWR/GCCE), and its impact on the rapidity of local responses to stressors such as climate change. • Ensure rapid resource access through the improvement of information delivery to farmers (e.g. by sending relevant information directly to farmers' mobile phones, from different sources).	**X**	**X**	
	Rapid Resource Assessment/ Coordination (0)	**2**	• Strengthen and formalise early warning systems by maximising the CKW network to disseminate information quickly, and collect information about emergencies at early stages.	**X**	**X**	
	Rapid Resource Mobilisation (1)	**3**	• Develop an effective early warning system combining diverse communication methods and technologies e.g. alerts via SMS, radio and face-to-face interactions among community members and institutions.	**X**	**X**	**X**
EQUALITY (2)	Competency Gap Reduction	**-**	-	**-**	**-**	**-**
	Inclusiveness (0)	**2**	• Use ICTs to improve women's access and participation in the various stages of the coffee supply chain, including their understanding of the coffee market and financial services. • Use ICTs to foster a more inclusive engagement of community members in projects and activities, especially youth, elders, and people with disabilities. • Use ICTs to increase access of women, elders and other vulnerable groups to locally-relevant information, directly (e.g. providing extra support to use of new technology by elders) and indirectly (e.g. providing extra support from CKWs or youth). • Identify and implement ICT applications that help vulnerable groups to better adapt to the impacts of climate change.	**X**	**X**	
	Openness and Accountability (0)	**2**	• Use ICTs to improve accountability and transparency (at the household level and within farmers' groups) by providing updated information accessible to all farmers about coffee prices offered locally. • Design a mobile app to increase the transparency and accountability of community savings schemes (e.g. for members to be able to track their balance, the amounts owed by the members, and the transactions made).	**X**	**X**	
DIVERSITY AND FLEXIBILITY	Different Actions/ Opportunities (0)	**2**	• Use ICTs to provide access to a database of insurance companies and banking institutions that offer services to farmers, allowing them to identify diverse services / opportunities. • Use ICTs to match the demand and supply of services to coffee farmers, fostering partnerships with private sector institutions and the identification of new business opportunities.	**X**	**X**	

	Adaptable Decision-Making (1)	3	• Ensure that actions aimed at fostering new access to weather information, agricultural practices, sharing of ideas, knowledge brokering, etc, provide new information to enable new decisions.	X	X	
	Innovation Backbone (1)	3	• Use ICTs to foster local access to best farming practices/adaptive experiences from other regions of Uganda and/or other countries, ensuring that the content is appropriate and from trusted sources, and that farmers can adapt it or gain inspiration to address local priorities.	X	X	X
SCALE (2)	Multi-Level Networks (1)	3	• Use ICTs to facilitate multi-stakeholder dialogue and information sharing on climate change-related projects/issues in the Mount Elgon region (e.g. sharing project information and local activities through Facebook, mailing list, Twitter, etc).	X	X	X
	Resource Access and Partnerships (2)	4	• Foster farmers' ability to make use of external weather information from national-scale organisations such as FEWSNET (a well-established food security system that provides seasonal forecasts and makes the information available online). • Use ICTs to engage stakeholders at multiple levels in the development of climate information services that address local information needs. • Use ICTs to raise farmers' awareness about financial services that are available at various levels (e.g. local, regional).	X	X	X
	Cross-Level Interactions (0)	2	• Work with national and local governments to ensure effective use of ICTs in communications with coffee farming communities.	X	X	X
ROBUSTNESS (1)	Physical Preparedness (2)	3	• Foster investment in the improvement of network coverage, including the use of local signal boosters to expand connectivity in rural areas. • Use ICTs to provide coffee farming communities with well-visualised overviews of climate change impacts, and priorities for adaptive actions at the local level. • Make greater use of geographic information systems to map climate change, and to plan development of physical defence infrastructure. • Use ICTs to strengthen meteorological services, including the localisation of climate science for non-scientific audiences.	X	X	X
	Institutional Capacity (1)	2	• Use ICTs to strengthen the institutional capacity of farmers' organisations, and to make them more efficient (for example by using mobile money to reduce cash-based transactions).	X		
	Multi-Level Governance (1)	2	• Use ICTs to improve multi-level governance by fostering information sharing from farmers to primary and secondary cooperative societies. • Use ICTs to create and maintain an updated database of farmers' organisations.	X	X	
SELF-ORGANISATION (1)	Collaboration and Consensus Building (0)	1	• Post an updateable (e.g. as wiki) list of relevant community, municipality and national institutions of relevance to environmental and community development (e.g. including contacts, responsibilities and resources). • Use mobile phones to share information between coffee cooperatives and to coordinate actions.	X	X	

	Social Networks (0)	**1**	• Foster peer-to-peer learning and interactions among farmers using social networking tools (e.g. "Coffee Farmers' Facebook"). • Use ICTs to inform and involve local leaders in local projects and initiatives, improving their ability to mobilise community members and strengthen existing networks.	**X**		
	Local Leadership and Trust	**-**	-	**-**	**-**	**-**
LEARNING (1)	Capacity Building	**-**	-	**-**	**-**	**-**
	New and Traditional Knowledge (0)	**1**	• Develop an interactive e-learning course on climate change, local impacts, and adaptive practices. • Use ICTs to document, visualise and share existing/traditional knowledge on adaptive practices. • Use ICTs to disseminate, share and explore local/community knowledge on adaptation, and to strengthen local adaptive capacity. • Use ICTs to document traditional climate-resilient farming methods, and to assess if they can be adapted and adopted under different scenarios. • Use ICTs to improve the synthesis, structure and management of information, including information about market prices for coffee farmers. • Use ICTs to enhance learning of young people (from primary school upwards) particularly on innovative agricultural practices, contributing to their involvement in farming, and to the generational transfer of farming activities and knowledge. • Provide access to technologies and capacity-building opportunities on ICTs to strengthen the technical assistance provided by CKWs and extension officers.	**X**	**X**	**X**
	Reflective Thinking (1)	**2**	• Implement programmes that combine mobile-enabled information and face-to-face dissemination, to foster discussion among farmers/peer-to-peer learning and reflective thinking.	**X**		
REDUNDANCY (0)	Resource Spareness (1)	**1**	• Run a basic training programme to create capacity among farmers on how to use ICTs to increase their income level. • Foster the use of mobile phones to disseminate information about intercropping and organic farming practices, to increase farmers' income.	**X**	**X**	**X**
	Functional Overlaps and Interdependency (2)	**2**	• Use ICTs to raise awareness about organic farming practices that contribute to multiple purposes (e.g. shade trees, organic manure).	**X**		
	Resource Substitutability (0)	**0**	• Create local awareness on how to use ICTs to access emergency resources from various sources/institutions. • Design an online list of resource-providing institutions; including voluntary resources that are available to local organisations and farming communities.	**X**	**X**	**X**

Table 2. Priority actions to improve coffee farmers' e-resilience in Mount Elgon region

Annex 1: Understanding and Measuring Resilience

Resilience Attribute	Definition	Key Markers/ Indicators
FOUNDATIONAL ATTRIBUTES OF COMMUNITY RESILIENCE		
Robustness	• Ability of the community to maintain its characteristics and performance in the face of environmental shocks and fluctuations.	• Physical Preparedness • Institutional Capacity • Multi-level Governance and Networking
Self-Organisation	• Ability of the community to independently re-arrange its functions and processes in the face of an external disturbance, without being forced by external influences.	• Collaboration/Consensus-building and Participation • Social Networks • Local Leadership and Trust
Learning	• Capacity of the community to generate feedback with which to gain or create knowledge, and strengthen skills and capacities. Closely linked to the community's ability to experiment, discover and innovate.	• Capacity Building • New and Traditional Knowledge • Reflective Thinking
ENABLING ATTRIBUTES OF COMMUNITY RESILIENCE		
Redundancy	• Extent to which community resources and institutions are substitutable; for example, in the event of disruption or degradation.	• Resource Spareness • Functional Overlaps and Interdependency • Resource Substitutability
Rapidity	• Speed at which assets can be accessed or mobilised by community stakeholders to achieve goals in an efficient manner.	• Rapid Resource Access • Rapid Resource Assessment/ Coordination • Rapid Resource Mobilisation
Scale	• Breadth of assets and structures a community can access in order to effectively overcome or bounce back from or adapt to the effects of disturbances.	• Multi-level Networks • Resource Access and (intra/inter) Partnerships • Cross-level Interactions
Diversity and Flexibility	• Ability of the community to undertake different courses of actions with the resources at its disposal, while enabling them to innovate and utilise the opportunities that may arise from change.	• Different Courses of Action/Emerging Opportunities • Adaptable Decision-making • Innovation Backbone
Equality	• Extent to which the community provides equal access to rights, resources and opportunities to its members.	• Strengthened Competencies/ Gaps' Reduction • Inclusiveness • Openness and Accountability

Table 3. The RABIT Model of Resilience[1]

[1] Ospina, A.V. (2013) *Climate Change Adaptation and Developing Country Livelihoods: The Role of Information and Communication Technologies*, PhD thesis, IDPM, University of Manchester, UK.