



Benchmarking, Visualising and Strengthening ICTs’ Impact on Urban Community Resilience: A Costa Rica Case Study

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Summary

This case study is about “e-resilience”: the impact of ICTs on community resilience. It is based on pilot testing of RABIT – the University of Manchester’s Resilience Assessment Benchmarking and Impact Toolkit – in a vulnerable urban community in Costa Rica. It aims to help ICTs increase resilience to external shocks: particularly, but not exclusively climate change stressors.

The case describes three things:

- *how we measured the role of ICTs vis-a-vis resilience in the community*
- *how e-resilience benchmarking metrics can be visualised*
- *how we used these metrics to prioritise future actions that will strengthen ICTs’ contribution to resilience.*

It provides an outline guide for those wanting to understand and enhance the links between ICTs and resilience in vulnerable communities.

The Urban e-Resilience Challenge

As the 21st century proceeds, urban communities – particularly those with low-income residents – will face a growing series of short-term shocks (economic crises, climate events, violent attacks, health epidemics, etc) and long-term trends (climate change, migration, economic restructuring, new technologies, etc). In abstract terms, we know the solution: urban communities must become more resilient.

That is because resilience is defined as the ability of vulnerable systems – including communities – to withstand, recover from, adapt to, and potentially transform amid change and uncertainty. Resilience will therefore play a crucial role in the achievement of urban development outcomes. It provides a holistic, long-term and community-centred approach that is rising up the urban development agenda.

Simultaneously, information and communication technologies (ICTs) – mobile phones, tablets, PCs, Internet connections – are becoming more prevalent and more extensively-used in urban communities. ICTs increasingly mediate economic, social and political life in cities, and this role will grow further in future. As such ICTs have an accelerating impact on resilience: increasing opportunities for, but also threats to, urban communities. For shorthand, we can call this relationship 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 urban community in Costa Rica with local partner Cooperative Sulá Batsú. As described below, this benchmarked the role of ICTs vis-a-vis resilience in the community, 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: Barrio Luján in Costa Rica

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 Barrio Luján, a neighbourhood of c.1,900 inhabitants in the South-East of Costa Rica’s capital city, San José.

Barrio Luján was selected on four grounds: a) relatively accessible and safe as a pilot location; b) mixed in terms of housing stock (houses, apartments, and some temporary/fragile structures) and demographics (c.60% born in the neighbourhood and 40% migrants from other parts of the country or region); c) subject to climate-related events such as flooding, and with involvement in wider resilience initiatives; d) significant access and use of ICTs.

A random sampling approach was used but, given the requirement for enumerators to undertake survey work during the day, this did skew the profile. In all fifty respondents were surveyed: 60% female; 36% 16-25 years, 20% 26-45 years, 44% 46+ years; with occupation of student (25%), employee (24%), pensioner (20%), houseworker (16%), self-employed (12%), unemployed (2%).

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, six of the 24 markers were not separately and explicitly incorporated into this version of the survey.

96% of survey respondents owned at least one mobile phone; of whom just over half use their phone to access the Internet. 76% of respondents had access to the Internet via computer or tablet, of whom 89% access the Internet mainly at home.

Benchmarking Urban 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 resilience in this urban community. 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	Aggregate Score
Robustness	Physical Preparedness	29% use ICTs to look for climate change information	39%
	Institutional Capacity	51% use ICTs to report problems / emergencies to institutions or authorities	
	Multi-Level Governance	36% use ICTs to access external information to better prepare for emergencies	
Self-Organisation	Collaboration and Consensus	23% use ICTs to organise / participate in activities and projects in the community	48%
	Social Networks	88% use social networking tools	
	Local Leadership and Trust	32% consider that ICTs contribute to trust-building	
Learning	Capacity Building	21% use ICTs for capacity building	16%
	New and Traditional Knowledge	11% use ICTs to identify ideas for community improvement	
	Reflective Thinking	n/a	
Redundancy	Resource Spareness	30% use ICTs to generate additional income	39%
	Functional Overlaps and Interdependency	n/a	
	Resource Substitutability	49% use ICTs to access emergency resources	
Rapidity	Rapid Resource Access	70% consider access to emergency support is faster with ICTs	48%
	Rapid Resource Assessment/Coordination	n/a	
	Rapid Resource Mobilisation	26% use ICTs to access early warning systems	
Scale	Multi-Level Networks	22% use ICTs in local collaborative work	35%
	Resource Access and Partnerships	n/a	
	Cross-Level Interactions	49% use ICTs to contact different institutions	
Diversity & Flexibility	Different Actions/Opportunities	85% use ICTs to identify options and opportunities	72%
	Adaptable Decision-Making	60% use ICTs to access new information and inform decisions	
	Innovation Backbone	n/a	
Equality	Competency Gap Reduction	66% consider ICTs enable opportunities for vulnerable people	38%
	Inclusiveness	10% consider ICTs strengthen community belonging	
	Openness and Accountability	n/a	

Table 1. Summary of quantitative data on ICTs and resilience

Visualising Urban e-Resilience

Deriving from the survey metrics, the benchmarking of urban community 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 0-33%; yellow for mid-priority (34-66% current ICT use); and green for low-priority (67-100% current ICT use). (Blue markers require further investigation.)
- Figure 3 presents the Table 1 data overall as a wheel of urban e-resilience.

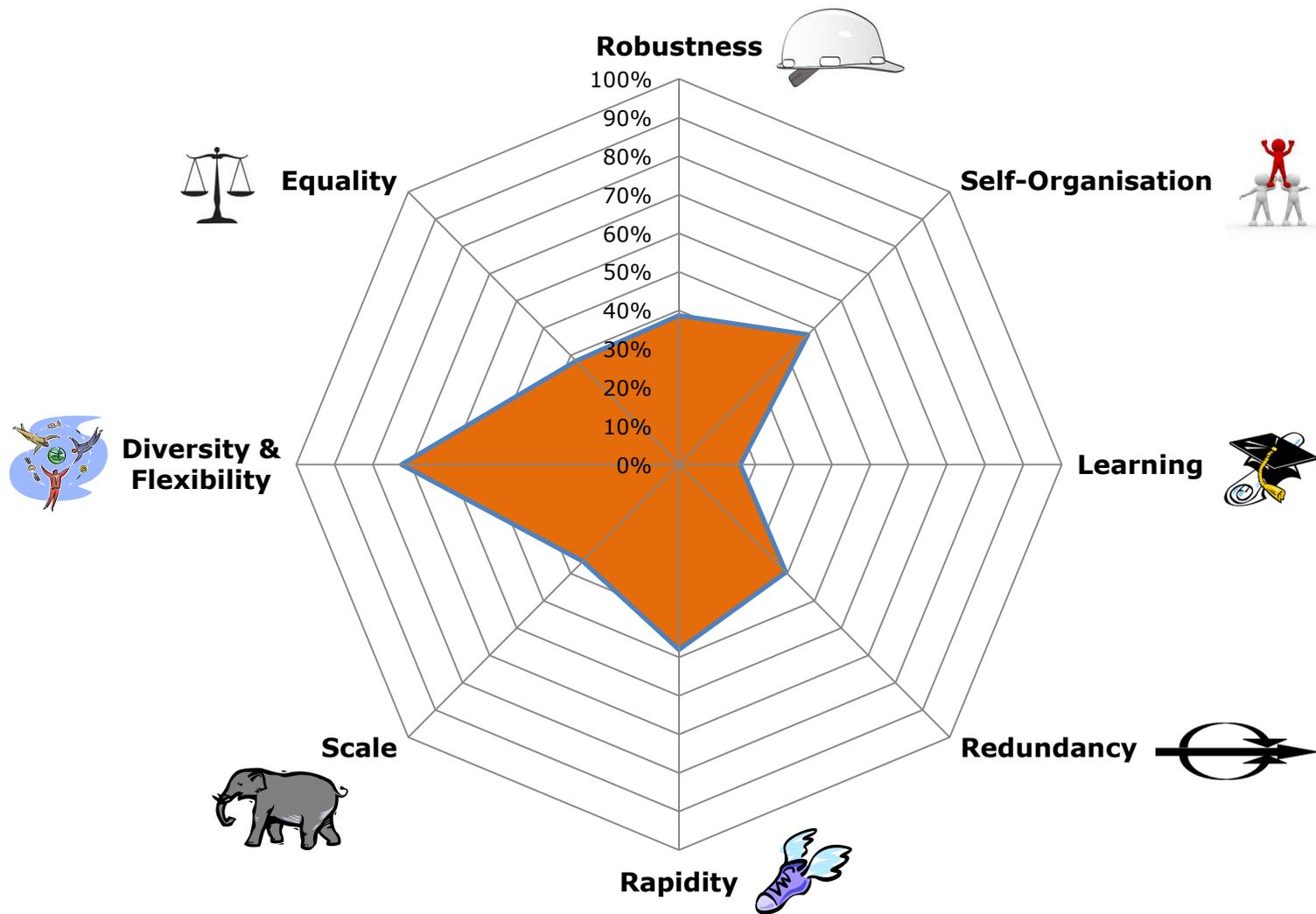


Figure 1. Contribution of ICTs to resilience attributes



Figure 2. Bubble visualisation of priority e-resilience markers for future action

Resilience Wheel

ICT Usage Towards Resilience Attributes (based on survey data)

0-9% = 0 No use
 10-40% = 1 Some used
 41-70% = 2 Mostly used
 71-100% = 3 Highly used
 N/A = Data not available

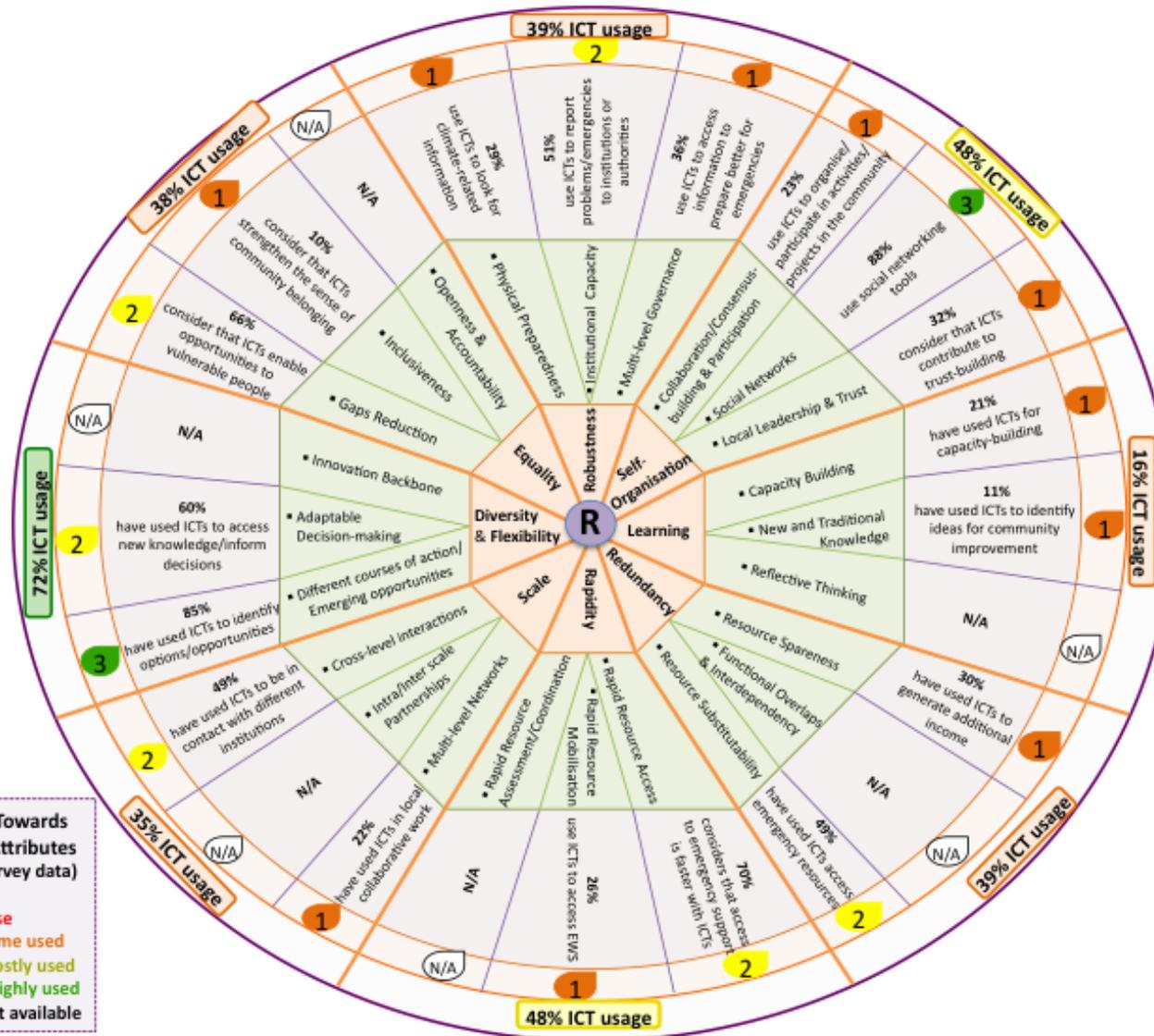


Figure 3. Resilience wheel for Barrio Luján

Strengthening Urban e-Resilience: Action Priorities

The traffic light approach of Figure 2 can be combined with a similar perspective on the attributes but using a composite index (see [main case study for explanation](#)) that includes benchmarking of e-resilience overall. This produces the prioritisation of actions outlined on the left side of Table 2 below. Future interventions – shown in the middle of the table – are only included for the high- and mid-priority markers. 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 Urban Community Resilience: Piloting the Resilience Assessment Benchmarking and Impact Toolkit (RABIT) in Costa Rica* <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>

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RESILIENCE ASSESSMENT BENCHMARKING and IMPACT TOOLKIT

Resilience Attribute Priority	Resilience Marker Priority	e-Resilience Intervention	Level of Involvement		
			C	M	N
Robustness	Physical Preparedness	<ul style="list-style-type: none"> Provide to the community well-visualised overviews of climate change impacts, and priorities for adaptive actions 		X	X
	Institutional Capacity	<ul style="list-style-type: none"> Make greater use of geographic information systems to map climate change, and to plan development of physical defence infrastructure Provide training to Risk and Disaster Prevention Group on uses of ICT in risk identification and emergency response 	X		X
	Multi-Level Governance	<ul style="list-style-type: none"> Utilise ICTs to support community youth training and engagement workshops on community development Ensure National Network of Community Resilience (UNESCO-led, local coordination by San José Municipality) incorporates ICTs into future plans and proposals Work with San José Municipality and National Emergency Commission to ensure effective use of ICTs in communications with local communities 	X	X X	X X
Learning	Capacity Building	<ul style="list-style-type: none"> As part of 'Green Barrio' activity, produce awareness-raising and information campaign on environmental issues and impacts (including climate change) in local community Develop interactive e-learning course on climate change, community impact, and adaptive practices Develop broader interactive e-learning course on community environmental issues and actions (e.g. garbage disposal, pollution, housing) Use ICTs to help record, visualise and share the community mapping exercise Use ICTs to develop and support the community of practice on local development actions 	X		X
	New and Traditional Knowledge		X X		X X
			X X	X X	X X
	Reflective Thinking				
Scale	Multi-Level Networks	<ul style="list-style-type: none"> Post an updateable (e.g. as wiki) list of relevant community, municipality and national institutions of relevance to environmental and community development: their contacts and responsibilities and resources 	X		
	Resource Access and Partnerships				
	Cross-Level Interactions	<ul style="list-style-type: none"> Use ICTs to support interactions e.g. cross-community and cross-level community of practice to exchange resources, adaptive practice ideas, case examples, lessons learned, events, etc 	X	X	X
Equality	Competency Gap Reduction	<ul style="list-style-type: none"> Develop specific ICT training for more marginalised members of the community including seniors, women and unemployed 	X		
	Inclusiveness	<ul style="list-style-type: none"> Investigate development of local youth as 'environmental knowledge brokers', using ICTs to access environmental information, to train others, to create environmental awareness within the community, to capture and share traditional knowledge of seniors, to participate in broader networks Create a Barrio Luján community Facebook page to foster community identity 	X X		
	Openness and Accountability				
Redundancy	Resource Spareness	<ul style="list-style-type: none"> Run a basic e-entrepreneurship training programme to show current and potential entrepreneurs within the community how to use ICTs to increase income 	X		X
	Functional Overlaps and Interdependency				
	Resource Substitutability	<ul style="list-style-type: none"> See 'multi-level networks' idea about online list of resource-providing institutions; ensure inclusion of volunteer resources 	X		

Resilience Attribute Priority	Resilience Marker Priority	e-Resilience Intervention	Level of Involvement		
			C	M	N
Rapidity	Rapid Resource Access				
	Rapid Resource Assessment / Coordination				
	Rapid Resource Mobilisation	<ul style="list-style-type: none"> Develop an effective early warning system e.g. via SMS to key community members 	X	X	
Self-Organisation	Collaboration and Consensus	<ul style="list-style-type: none"> Design e-deliberation applications to allow online, considered participation in development of community plans Develop an SMS/email/social media alert list to share community activities and projects 	X		X
	Social Networks				
	Local Leadership and Trust	<ul style="list-style-type: none"> Train local community leaders in use of ICTs for community organising Use ICTs to specifically create local 'Green Champions' who could run the 'Green Barrio' initiative, and be trained around climate change and other environmental issues, develop plans with the community through social media, coordinate campaigns and actions with municipal and national stakeholders, and disseminate information to the community via social media 	X	X	X
Diversity & Flexibility	Different Actions / Opportunities				
	Adaptable Decision-Making	<ul style="list-style-type: none"> Actions above on new access to environmental information, sharing of ideas, knowledge brokering, etc should provide new information to enable new decisions 	X	X	X
	Innovation Backbone				

Table 2. Priority actions to improve community e-resilience in Barrio Luján

Annex 1: Understanding and Measuring Resilience

Resilience Attribute	Definition	Key Markers/ Indicators
FOUNDATIONAL ATTRIBUTES OF COMMUNITY RESILIENCE		
Robustness	<ul style="list-style-type: none"> Ability of the community to maintain its characteristics and performance in the face of environmental shocks and fluctuations. 	<ul style="list-style-type: none"> Physical Preparedness Institutional Capacity Multi-level Governance and Networking
Self-Organisation	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Collaboration/Consensus-building and Participation Social Networks Local Leadership and Trust
Learning	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Capacity Building New and Traditional Knowledge Reflective Thinking
ENABLING ATTRIBUTES OF COMMUNITY RESILIENCE		
Redundancy	<ul style="list-style-type: none"> Extent to which community resources and institutions are substitutable; for example, in the event of disruption or degradation. 	<ul style="list-style-type: none"> Resource Spareness Functional Overlaps and Interdependency Resource Substitutability
Rapidity	<ul style="list-style-type: none"> Speed at which assets can be accessed or mobilised by community stakeholders to achieve goals in an efficient manner. 	<ul style="list-style-type: none"> Rapid Resource Access Rapid Resource Assessment/Coordination Rapid Resource Mobilisation
Scale	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Multi-level Networks Resource Access and (intra/inter) Partnerships Cross-level Interactions
Diversity and Flexibility	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Different Courses of Action/Emerging Opportunities Adaptable Decision-making Innovation Backbone
Equality	<ul style="list-style-type: none"> Extent to which the community provides equal access to rights, resources and opportunities to its members. 	<ul style="list-style-type: none"> Strengthened Competencies/Gaps' Reduction Inclusiveness Openness and Accountability

Table 3. The RABIT Model of Resilience¹

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.