Making Policy on ICTs and Climate Change in Developing Countries

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Executive Summary

As climate change gains momentum within the global agenda, there is an increasing need for the development of policies that enable coherent, innovative and flexible climate change responses. This need is particularly acute in developing countries, where the magnitude of climate change impacts calls for novel policy approaches and regulatory environments that foster effective mitigation, adaptation and monitoring strategies.

The rapid diffusion of information and communication technologies (ICTs) within low-income contexts, the most vulnerable to climatic manifestations, is adding a new dimension to the climate change policy debate. Emerging experiences suggest that ICT tools are playing an increasing role in the capacity of developing countries to withstand, recover from, and adjust to climate change impacts. But they also suggest that policies which acknowledge and build on the linkages between ICTs, climate change and development are pivotal in enabling innovative responses to mitigate, monitor, and adapt to climatic impacts and uncertainty.

Recognising these linkages, as well as the embryonic nature of national policy approaches that explicitly integrate ICTs and climate change, the objective of this paper is two-fold. It identifies the key climate change issues that ICT policy-makers should address within developing country environments, and also the key ICT issues that climate change policy-makers should integrate in order to ensure coherence, innovation and flexibility in the implementation of climate change actions.

The paper is aimed at an audience of ICT/telecommunications and climate change/environment policy-makers and strategists. It explores the ICTs, climate change and development (ICCD) policy context, identifying key policy domains and principles. Based on that, the analysis suggests that three main components should be in place for the formulation and implementation of effective ICCD policies, namely (a) content, (b) structures and (c) processes. After exploring each of those components, the paper presents key opportunities and challenges faced in the integration of ICCD policies, suggesting key entry points for developing country policy-makers and strategists in this field.

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Introduction

The unprecedented impacts and level of uncertainty posed by climate change are redefining the way in which policies and strategies are designed and implemented at the international, national and local levels. Emerging evidence suggests that the impact of acute weather events (e.g. floods, droughts and cyclones) and long-term changes in the environment (e.g. sea level rise, melting glaciers and changes in seasonality) are magnifying existing development challenges in areas such as livelihoods and finance, food security, health, water supply, habitat, migrations, and governance (IPCC, 2007; Ospina & Heeks, 2010). They are also placing additional constraints on the capacity of developing countries to overcome poverty and marginalisation.

Within vulnerable contexts affected by more frequent and intense climatic manifestations, traditional policy approaches are no longer sufficient to effectively anticipate and respond to unforeseen climatic impacts, while at the same time striving to achieve development objectives. Innovative, flexible and coherent policies are required to tackle both the challenges and the opportunities posed by climate change.

Considering the urgency of undertaking actions to mitigate, adapt to, and monitor the impacts of climate change, developing country governments must exercise new roles as leaders, enablers, conveners and facilitators of climate change information, action and collaboration among a highly diverse group of stakeholders. Governance within a changing climate implies the design of policies that recognise and build upon the multi-disciplinary nature of the climate change field, that consider climatic impacts and actors from multiple sectors, scales (local, national and international) and timeframes (short, medium and long term), and that help developing countries to anticipate and prepare, but also to adapt and change amidst new climatic stressors and livelihood options.

Thus, developing country governments are starting to explore new tools and approaches to face the magnitude and uncertainty posed by climate change within challenging socio-economic and political contexts. Among them, the use of widely diffused information and communication technologies (ICTs) such as mobile phones, community radio and Internet-based applications, is emerging as a new area of research and practice that can foster innovative climate change responses utilising readily available and low-cost tools.

ICTs are a key source of greenhouse gases but they simultaneously offer a significant potential to mitigate emissions[1], reduce energy consumption and improve the performance of a number of sectors of the economy (Labelle, 2008; ITU, 2010). Further to their role in mitigation and energy efficiency, ICTs are being increasingly adopted as part of local adaptation strategies, including disaster management (e.g. early warning, prevention and relief) and monitoring (Ospina and Heeks, 2010; Yap, 2011). But while increasing evidence is being built on such ICT applications[2], less is known about the policy approaches that are required to address the adoption and use of ICT tools within climate change strategies and vice versa (i.e. to address climate change priorities within ICT strategies).

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[1] According to the Broadband Commission for Digital Development (2012) ICT solutions have the potential to reduce 15% of global emissions by the year 2020.
[2] See: www.niccd.org.

Policy instruments of governance and management (e.g. legal norms such as laws, decrees and enforcement actions, licensing, planning and funding regulations) help create an enabling environment where ICTs can effectively contribute to the achievement of climate change goals, and more generally, of development objectives. Policies are key in the provision of frameworks for resource mobilisation, and can provide the necessary incentives for private sector investment in infrastructure and low-cost connectivity required to bridge the digital divide. Policies can also facilitate access to the financial and human capital resources required to align and integrate ICTs, climate change and development strategies (e.g. through budget allocation, identification of roles and responsibilities or capacity building goals).

Thus, new policies are required to integrate the productive, informational and transformative potential of ICTs into emerging and ongoing climate change strategies, and at the same time, to ensure articulation between ICT policies and climate change priorities in order to strengthen the achievement of development goals.

This paper responds to the growing need to develop innovative policy mechanisms that ensure coherence and articulation between climate change responses, ICT tools and development strategies (i.e. by integrating ICTs into climate change policies and strategies, and integrating climate change into ICT policies and strategies). It provides guidance to developing country policy-makers and strategists working at the intersection of ICTs, climate change and development, contributing to the process of design, adoption and implementation of new policies aimed at realising ICTs' potential to mitigate, adapt to and monitor climate change impacts within vulnerable contexts.

1. The ICT, Climate Change and Development (ICCD) Policy Context

The ICCD policy context is characterised by the close linkages and interactions that exist between the ICTs, the climate change and the development fields. Within this context, ICCD policy making refers to the design, development and implementation of policies, laws, decisions and regulations that acknowledge and integrate the use of ICTs in international, national, sectoral or local responses to address the impacts of climate change, while acknowledging existing and future development needs. More concretely, ICCD policies foster the use of ICTs in climate change mitigation, adaptation, monitoring and strategising, articulating climate change needs and development priorities from different sectors, such as agriculture, food security, water management, health or human habitats, among others.

> *The aim of **ICCD Policies** is to provide courses of action that integrate ICTs into climate change responses within specific development contexts. ICCD policies consist of laws, regulations, decisions and actions carried out by government and other agencies. These foster use of ICT tools to help mitigate, adapt to, and monitor the impacts of climate change, and design strategies to develop climate change resilience and the achievement of development outcomes with the support of ICTs.*

The interactions that take place between these three domains, and that ultimately characterise the ICCD policy context, are reflected in Figure 1.
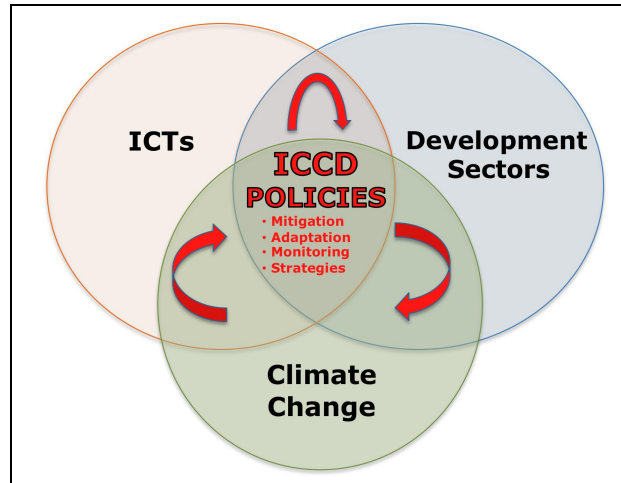
Figure 1. Overlapping Fields of Action of ICCD Policies

The uncertainty of climatic manifestations and the magnitude with which they are felt within vulnerable contexts, evidences the need for innovative policies that acknowledge and take advantage of the porous boundaries that exist between climate change impacts, existing development needs, and emerging tools such as ICTs. The acknowledgement of these porous boundaries constitutes the first step towards ICCD policy making.

This section explores the main characteristics of the ICTs, climate change and development (ICCD) policy context in developing countries. It focuses on identifying the key stakeholders and areas of action at three policy levels or domains: international, national and sub-national, and concludes suggesting the key principles for policy-making at the intersection of ICT, climate change and development fields.

1.1 ICCD Policy Domains

The design and implementation of ICCD can be categorised according to three levels of action, which correspond to the international, the national and the sub-national policy domains. In practice, climate change, ICTs and development issues interact closely at each of these levels, as represented in Figure 2. Thus, they can be used as reference domains in order to explore further the current state and future perspectives of policies in the ICCD field.
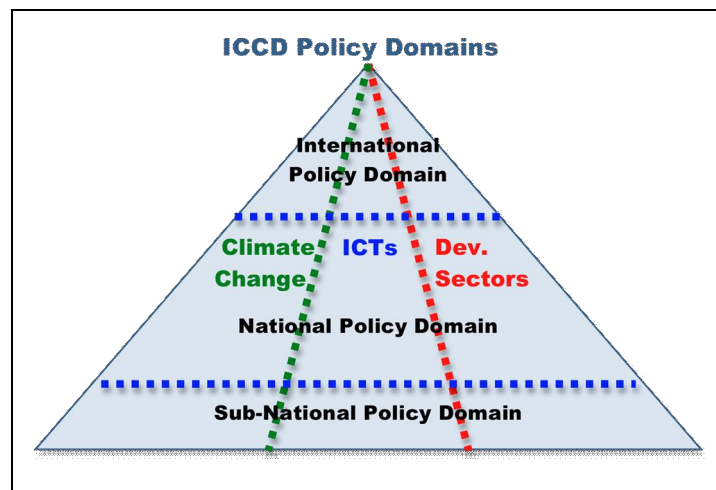

Figure 2. ICCD Policy Domains

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Each of these domains is characterised by the role of distinctive actors and areas of action, which can be summarised as follows:

1.1(a) ICCD International Policy Domain

The United Nations Framework Convention on Climate Change (UNFCCC) is the global mechanism for the coordination of intergovernmental efforts in the climate change field. The Convention's goal is to achieve "the stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (U.N, 1992, p.4). With 195 country signatories and Conferences of Parties (COP) held on a yearly basis, the UNFCCC provides the main framework within which long-term emission reduction targets are negotiated and agreed between governments. The issue of public policies for the information society is very young (UNESCO, 2009), even more so in regards to topics of environmental sustainability and climate change.

Within the ICT international domain, information society forums such as the World Summit of the Information Society (WSIS) have integrated general issues related to 'sustainable development' since 2003. The 'e-environment' was introduced more prominently during the 2011 WSIS forum[3], with a one-day event focused on issues of ICTs and the environment, predominantly from the emissions reduction and e-waste perspectives[4]. Within the climate change international domain, ICTs gained momentum at the 2011 United Nations Climate Change Conference (COP17), held in Durban, South Africa.

At COP17, a newly formed Coalition on ICTs and Climate Change[5] mobilised efforts to give visibility to the use of these tools for mitigation and adaptation, highlighting the importance of coordinating actions, at both the policy and the practice level among diverse stakeholders working in the field[6]. Key international stakeholders, such as the International Telecommunication Union (ITU), have played an active role in the development of the Coalition, suggesting increasing collaboration and articulation of efforts in this field.

ITU is the UN specialised agency in ICTs, with the mandate to exercise leadership in the application of ICTs to address the causes and effects of climate change (ITUb, 2010). With 192 government members and more than 700 private sector entities[7], the ITU is one of the most influential stakeholders in the ICTs and climate change international policy domain. In addition to awareness raising and training on key ICT and climate change related issues, ITU's efforts include (a) the formation of a Dynamic Coalition on Internet and Climate Change (DCICC) in 2007, a body aimed at moderating the environmental impact of the Internet and at harnessing its potential to reduce greenhouse gas emissions; (b) several study groups involved in the development of recommendations, handbooks and reports on ICT and climate

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[3] For further information about this event, visit http://groups.itu.int/wsis-forum2011/Agenda/Highlights/EEnvironmentDay.aspx

[4] The World Summit on the Information Society (WSIS) is a United Nations (UN) summit aimed at creating a multi-stakeholder platform to address the issues raised by ICTs through a structured and inclusive approach at the national, regional and international levels. The goal of WSIS is to achieve a common vision, desire and commitment to build a people-centric, inclusive and development-oriented Information Society. http://groups.itu.int/Default.aspx?tabid=1227

[5] Organisations in the coalition include the International Telecommunication Union (ITU), the Global e-Sustainability Initiative (GeSI), the UNFCCC Secretariat, the UN Global Compact, TechAmerica, as well as high-level representatives from the governments of Ghana, South Africa and Egypt.

[6] ICT-related actions implemented at COP17 included two side meetings focused on ICTs, mitigation and adaptation, an 'ICT Day', a Digital Media Lounge showcasing experts and practitioners via tele-presence, and the launch of a 'PoliWiki', aimed at raising awareness on the potential of ICT tools within international climate change negotiations.

[7] http://www.itu.int/ITU-T/climatechange/

change issues including ICTs' contribution to energy consumption and standardised measures of ICT industry emissions; (c) a 'Joint Coordination Activity on ICTs and Climate Change' (JCA-ICT&CC) established in 2009 to coordinate ITU 's work in this field with that of other key sectors and institutions[8], and (d) a series of ICT and climate change symposiums hosted by the Ministry of Communications / Telecommunications of member countries[9], among others.

During these international symposiums, policy-level discussions tackle issues related to the role of ICTs in mitigation and adaptation to climate change, disaster planning, and e-waste; and on cost-effective ICT technologies, methodologies for environmental impact assessment of ICTs, as well as the key challenges and opportunities faced in the transition to a green and resource-efficient economy (Government of Ghana, 2011). The Ghana symposium held in July 2011 concluded with a Call to Action to address the linkages between ICTs and climate change at the COP17 meeting held in Durban, and the 2012 United Nations Conference on Sustainable Development (UNCSD 2012 or Rio+20), focusing on two main issues: the adoption of an agreed methodology for measuring the carbon footprint of ICT equipment and industry, and its inclusion in National Adaptation and Mitigation Plans.

Considering the current state of policy development in the ICCD field, issues such as these are emerging as important policy objectives at both the international and the national policy domains. They also evidence the close linkages and interactions that characterise these two levels of policy design and implementation, as explained below.

1.1(b) ICCD National Policy Domain

The national policy domain constitutes the most pivotal level for policy action in the emerging field of ICTs, climate change and development (ICCD). Evidence from the field (IPCC 2001; IPCC 2007) suggests that the impacts of both acute climatic shocks (e.g. extreme events, flooding or landslides) and chronic trends (e.g. changing temperatures, sea-level rise) are exacerbating a wide-range of development challenges, including livelihood and finance, food security, water, health, socio-political conditions, and habitat and migrations. For example, extreme floods simultaneously jeopardise the livelihood of vulnerable communities that depend on agriculture and their access to food and clean water for consumption, damage infrastructure, and motivate migrations to urban areas, contributing to poverty and possibly to social unrest. Thus, policy-makers at the national level are encountering increasingly overlapping areas of action in the management and response to climate change mitigation, adaptation and strategising, which require articulated responses and multi-sectoral coordination.

Climate change has gained momentum in the agenda of a wide range of policy stakeholders at national level, reflecting the increasing number of areas and sectors vulnerable to or affected by climatic manifestations. The key national policy actors in the ICCD field are reflected in Table 1.

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[8] http://www.itu.int/en/ITU-T/jca/ictcc/Pages/default.aspx
[9] ICTs, the environment and climate change symposiums have been organised in Kyoto, London, Quito, Seoul, Cairo and Ghana.

National Level	ICCD Policy Actors
Ministries	Highest-level national authorities in the climate change, ICT and development fields. They provide policy guidance and national directions, and are responsible for the process of policy development and implementation at the national level. Examples of Ministries involved in ICT, climate change and development policies include: • Ministry of the Environment and Natural Resources (leads the climate change agenda at the national level). • Ministries of key development sectors affected by climatic impacts (e.g. the Ministry of Agriculture and Rural Development, Commerce, Industry and Tourism, Transportation, Housing and Territorial Development, among others). • Ministry of ICTs, Science and Technology and/or Communications (responsible for the design of national ICT policies and strategies).
National-level Coordination Commissions, Councils, Units or Secretariats	Responsible for coordinating the actions of the national/federal administration on national policies concerning ICTs, climate change and development issues. Often formed by representatives from several Ministries and experts, and focused on the operationalisation and oversight of Ministerial mandates. Examples include: • Coordination Unit for the Development of the Information and Knowledge Society • Inter-sectoral Commission on Climate Change • Advisory Council on Climate Change • Energy Efficiency and Climate Change Unit • Clean Development Mechanism Authority • REDD+ Secretariat
National-level Agencies	Specialised agencies that are designated as lead bodies in all matters concerning the environment, including the implementation and monitoring of government policies, mainstreaming the environment into development processes and emergency response. This category also includes regulatory agencies that exercise functions aimed at promoting infrastructure investment, penetration and accessibility in the telecommunications field. • Environmental Protection Agency • National Regulatory Agency for Telecommunications • National IT and Telecom Agency
National Research Institutions	Research institutions that are linked to national Ministries and that can serve as thematic advisors in the process of policy design and implementation. Examples include: • National Institute of Meteorology • National Institute of Climate Change Research • National Institute of Ecology and Biodiversity • National Institute of Agricultural Research
House of Representatives and Senate	Generally involved in the process of policy design and ratification into laws through specialised Commissions. Examples include: • Commission on Climate Change • Commission on the Environment and Natural Resources • Science and Technology Commission • Digital Access Commission
Private Sector	Private sector companies from the natural resource, telecommunications or related industry sectors. • Telecommunications Service Providers

	Internet Service Providers
	E-waste Management Companies
Civil Society Organisations	Civil society organisations that have experience on ICTs, climate change and development issues at the national and/or local level. • ICT4D Non-Governmental Organisations (NGOs) • Climate Change and Natural Resources NGOs • Civil Society Networks on ICT, Climate Change and/or Environmental issues.

Table 1. National Level ICCD Policy Actors

Considering the complexity of stakeholders, interests and agendas at the intersection of the ICT, climate change and development fields, national ICCD policy making can follow different routes, often related to the lead stakeholders involved and the areas of climate change impact that are tackled. Thus, ICCD policies can be developed (a) in response to the specific needs and priorities or role of key development sectors affected by climate change, and/or (b) according to the four main areas of climate change action where ICTs can make a contribution (i.e. mitigation, adaptation, monitoring and climate change strategy).

These two approaches to the process of national ICCD policy making are illustrated in Tables 2 and 3.

Development Sector	Example of Climate Change Priorities	Example of ICCD Policy Focus
Agriculture and Food Security	• The increased frequency and intensity of severe events such as floods and droughts threaten the livelihoods of populations that depend on natural resources (e.g. crop and livestock production, fisheries and forestry), and jeopardise the access, intake and production of food from the local to the national levels. The development of more tolerant/resistant crops, the diversification of crops and the strengthening of the supply chain, constitute imperatives for this sector.	➡ ICCD policies can strengthen local agriculture and livestock production systems through improved access to climate-related and agri-related information and knowledge through ICTs. • ICCD policies can support the implementation of an ICT-based national system that combines the use of the Internet, mobile phones and radio in order to provide farmers with information on agro-meteorology, new varieties of crops, crop diseases, production processes, prices and consumer trends, among others, fostering productivity and market access, and enhancing the capacity of the sector to respond to the impacts of climate change.
Human Health	• The impact of extreme events (e.g. cyclones) and chronic trends (e.g. temperature rise), have a negative impact on the emergence and the spread of vector-borne (e.g. malaria and dengue) and waterborne diseases, affecting human health.	➡ ICCD policies can improve the capacity of national health systems to respond to and prepare for the challenges posed by climate change to the health sector, with the support of ICT tools. • ICCD policies can foster the use of ICTs to help Ministries and national agencies to coordinate actions and implement national-level health campaigns. ICCD policies can also foster the provision of mechanisms of prevention and response, including decentralised disease surveillance, remote information and assistance, and monitoring of disease prevalence associated with climatic impacts.

Education	• The occurrence of extreme climatic events can affect provision of, and access to education. In some cases, school closures are extended for indefinite periods of time, when the resources required to recover damaged infrastructure and re-engage teaching personnel are not available.	➜ ICCD policies can strengthen the ability of the education sector to face the challenges posed by climate change and uncertainty. • ICCD policies can promote flexible approches to the delivery and access to education at the primary, secondary and tertiary levels, based on the use of ICT applications (e.g. online courses, radio programming).
Habitat and Infrastructure	• Climate change manifestations such as sea-level rise, extreme precipitation, extensive flooding and desertification affect the condition of human habitats and endanger vulnerable infrastructure.	➜ ICCD policies can help to reduce the vulnerability of vulnerable habitats and infrastructure by strengthening planning and response in face of climate change impacts. • ICCD policies can foster the adoption and use of ICT applications that allow advanced mapping and visualisation, piloting and modelling, among national agencies involved in habitat and infrastructure. ICT applications such as GIS and remote sensing can be used to reduce the vulnerability of human settlements to climatic threats, protect vulnerable infrastructure, design more efficient transportation systems, and improve the implementation of building standards in areas of high exposure to climatic impacts.
Terrestrial and Coastal Ecosystems	• Terrestrial and coastal ecosystems are highly sensitive to climate-induced changes and events such as glacier melting and storm surges, which affect local species and biodiversity.	➜ ICCD policies can strengthen the capacity of local ecosystems to withstand and recover from the effects of climate change. • ICCD policies can foster use of ICT applications to identify and monitor natural reserves and protected areas, assess ecosystem vulnerability, monitor the impacts of climate change on local biodiversity, and implement new planning and zoning practices for the protection of coastal ecosystems.

Table 2. **Approaches to ICCD Policy Making: ICCD Policies Focused on Development Sector Priorities** (adapted from Ospina and Heeks, 2010; 2011)

Climate Change Action Area	Example of Climate Change Priorities	Example of ICCD Policy
Mitigation	• Reduce greenhouse gas (GHG) emissions.	→ ICCD policies can promote the use of ICTs to tackle the main causes of GHG emissions: • Policies aimed at reducing physical consumption, through dematerialisation of goods/services and journey substitution. • Policies aimed at reducing physical production, by fostering the shift to the knowledge economy. • Policies aimed at improving energy generation and distribution, utilising ICT for smart power/grid. • Policies aimed at improving energy use, by fostering the production of green IT, smart motors/logistics, smart building design and transport.
Adaptation	• Develop the capacity to withstand, recover from and adjust to the impacts of climate change and uncertainty.	→ ICCD policies can strengthen national adaptive capacities by promoting the use of ICTs to enable improved access to climate change information and knowledge, improve networking and awareness raising, strengthen decision making processes (e.g. predicting, planning and coping), as well as transacting, producing and mobilising resources. • ICCD policies can also foster the use of ICTs towards climate change adaptation in specific vulnerability areas (e.g. livelihoods and finance, water, health, food security).
Monitoring	• Design and implement appropriate mechanisms to track, measure and document the impacts of climate change at multiple levels.	→ ICCD policies can contribute to innovative climate change monitoring mechanisms by enabling improved data collection and management. • ICCD policies can foster the use of ICTs in more participatory and transparent methods of climate change data collection, processing and dissemination, thus improving the effectiveness of monitoring mechanisms.
Strategy	• Develop innovative strategies to identify and address climate change needs and priorities, in accordance with national priorities and international commitments.	→ ICCD policies can support and strengthen the implementation of National Mitigation and Adaptation Programs of Action, fostering the use of traditional (e.g. radio, TV) and emergent (e.g. mobile phones, social media) ICT tools towards the accomplishment of their goals. • ICCD policies can enable the use of ICTs as part of national strategies to improve the efficiency of carbon markets, decision-making processes, climate change policy networks, awareness and capacity building, and technology transfer, among others.

Table 2. **Approaches to ICCD Policy Making: ICCD Policies Focused on Key Areas of Climate Change Action** (adapted from Ospina and Heeks, 2010; 2011)

While the two approaches suggested for the design of ICCD policies place their emphasis on different climatic impacts and areas of action, the two are not exclusive but rather complementary. Thus, policy-makers can choose to engage in the process

of ICCD policy design based on either specific sectoral priorities (e.g. ICTs and climate change impacts on agriculture, ICTs and climate change impacts on infrastructure), and/or on climate change areas of action (e.g. ICTs and climate change adaptation, ICTs and climate change mitigation).

In addition to the design and enforcement of policies, laws, decrees and regulations at the national level, ICCD policies can also be implemented at the sub-national level, as explained below.

1.1(c) ICCD Sub-National Policy Domain

The ICCD sub-national domain involves specific development programmes and projects that are being implemented by regional and local governments or territorial authorities (e.g. departments, municipalities, territories of indigenous peoples), and that involve the use of ICTs in climate change mitigation, adaptation, monitoring and strategising. Examples of sub-national policy initiatives include:

- A state-level initiative to reduce government carbon emissions via use of ICTs in one Indian state (Mahalik, 2012).
- Regional government programmes to incorporate ICT-based climate change monitoring and modelling data into climate change and development strategies (Anderton, 2012).
- City-wide use of electronic sensor stations to enable monitoring and reporting of climate data in Cairo (Hassanin, 2012).

As experiences linking the role of ICTs with climate change mitigation, adaptation and monitoring strategies continue to emerge, particularly in developing contexts, ICCD policy making will continue to gain momentum within the international, national and sub-national domains. This includes the increasing exploration of ICTs' potential towards emissions reduction and adaptation actions at the national and sub-national levels, as well as broader international policy dialogue toward the explicit mention of ICTs as part of UNFCCC agreements, and as such, as part of the umbrella topics that are included as part of global climate change funding mechanisms.

Based on the increasing importance of policy processes in this emerging field, the following section identifies a series of key ICCD principles that should be taken into account in the design and implementation of policies at the intersection of ICTs, climate change and development.

1.2. ICCD Policy Principles

As the analysis conducted thus far suggests, the increasing linkages between ICTs, climate change and development require new policy approaches that foster more holistic, coherent and innovative ICT-enabled responses to the challenges posed by climate change.

Policy and decision makers involved or interested in promoting the process of ICCD policy design and implementation, should consider the following guiding principles:

- ***ICCD Policy as a Process, not a Blueprint***

The availability and use of ICT tools, the magnitude of climate change impacts and the range of prevailing development needs, are unique to each country and context of implementation. Thus, ICCD policies cannot be completely blueprinted or

prescribed, as there is no single 'best' approach to tackle the challenges that lie at the intersection of these three fields. Instead, ICCD policy design should be approached as an iterative *process* that involves multi-stakeholder dialogue, learning, capacity building and facilitation (Heeks, 2001).

- #### *ICCD Policy as a Reflection of Local Priorities*

Via a process-based approach that allows feedback and contributions by experts and practitioners from the climate change, the ICT and the development fields, ICCD policies should be 'localised' in order to respond to both national and local priorities. This translates into ICCD policies that reflect and respond to local patterns of ICT usage and appropriation, to the climate change issues that are prioritised by local actors, and to the development challenges and opportunities that characterise the context of implementation, and that acknowledge the role of existing institutions, past and ongoing programmes and strategies in order to avoid the duplication of efforts and build upon lessons learned. Localised ICCD policies may be designed by providing them with their own separate identity (i.e. separate from existing policies in the ICT, climate change or development fields), or alternatively, by integrating them into existing climate change or development approaches.

- #### *ICCD Policy as an Opportunity for Innovation*

The momentum gained by climate change issues at the international and national levels, as well as the growing visibility of ICTs' potential, should be used to leverage the development of innovative policy approaches in this field. ICCD policies should be seen, especially by developing countries, as an opportunity for innovation and pioneering in an area where there is ample room to learn. Project and policy experience already acquired by both developed and developing countries in the e-governance field can provide useful lessons to draw upon.

- #### *ICCD Policy as an Integrated Approach*

The integration of ICTs into ICCD policies must be driven by broader climate change objectives. The climate change vulnerabilities experienced in different development sectors, and the consequent need to mitigate, adapt, monitor and strategise in face of climatic impacts and uncertainty, must remain at the core of ICCD policy-making processes. Within them, ICTs are a means towards the achievement of climate change-related goals and development outcomes. They are not an end in themselves. Recognising the need to articulate the use of ICT tools with different stakeholders, institutions, processes, information and knowledge (i.e. traditional and emergent), all within broader climate change goals, the notion of '*i-climate change*' – integrated climate change (instead of the technology-biased 'e-climate change') – could better reflect the aims of policy making in this field (Heeks, 2003).

- #### *ICCD Policy Based on a "Climate-Smart Development" Vision*

There are many important lessons that can be drawn from the progress achieved by Ghana's government in the field of ICTs and climate change. As the government moves forward with the design of its National Climate Change Policy Framework, the notion of '*climate smart economic development*' (i.e. development to build climate resilience with a low carbon footprint) (Asiamah, 2012) is being used as the basis to mainstream climate change into national development planning. The comprehensiveness of this approach suggests that ICCD policy design can be facilitated if there is a unifying, holistic vision of "Climate-Smart Development", shared between stakeholders at the national, sectoral and local levels.

2. ICT, Climate Change and Development Policy Components

Building on the policy domains and principles identified, this section explores the three main components required in the design of coherent ICCD policies, namely *policy content*, *policy structures* and *policy process*, represented in Figure 3.
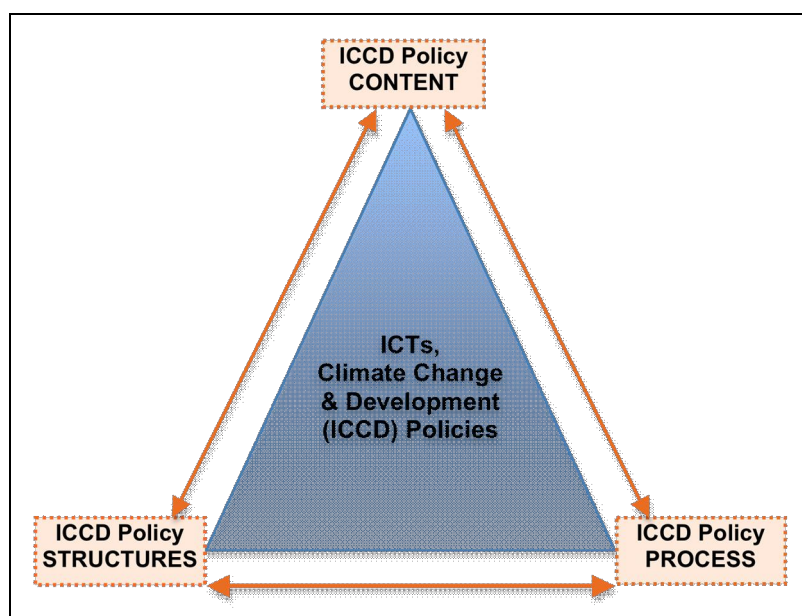

Figure 3: Key Components of ICCD Policies

Each of these policy components will be examined in the following sub-sections.

2.1. ICCD Policy Content

Located at the intersection of three fields, ICCD policy content integrates issues regarding (a) ICTs (e.g. infrastructure, connectivity, ICT use and appropriation), (b) climate change (e.g. climate change impacts and viable mitigation, adaptation and monitoring responses), and (c) development (e.g. prevailing development vulnerabilities and priority areas in the context of policy implementation). The underlying issue in the process of ICCD content development is the provision of *relevant* and *useful* policies that reflect the climate change priorities at the national and local levels; that build upon the availability, use and potential of ICT tools, and that address the prevailing development challenges that characterise the context of policy implementation.

The development of ICCD policy content can be explored from the perspective of each of these fields, as illustrated below. While the development of policy content is required at the international, national and sub-national domains, the examples provided below focus on the national level, given the importance of policy action in this domain (examples of ICCD content at the international and sub-national domains are provided in Boxes 1, 2, 3 and 4).

2.1(a) ICT Policy

The following examples illustrate the integration of **climate change** into **ICT policies.** The content proposed focuses on three key areas for policy action, namely the recognition of the linkages between ICTs and climate change, ICTs and climate change mitigation, and ICTs and climate change adaptation. We also acknowledge the role of generic ICT policy.

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1. Policy Content Aimed at Recognising ICT & Climate Change Linkages

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This area of action refers to the development of policy content aimed at acknowledging and raising awareness on the linkages that exist between ICTs and climate change. Building awareness is a key step in integrating ICTs and climate change within decision-making processes, and in mobilising action at the international, national and sub-regional domains. At a general level, policies can aim at fostering the use of ICTs to raise two kinds of public awareness: (a) initial/generic awareness of climate change issues (e.g. national radio and TV programmes used to disseminate key climate change concepts and terminology), as well as (b) specific awareness of local issues (e.g. digital videos used to raise awareness on community risks/vulnerabilities to climate change such as crop diseases, production levels, or water availability) (Ospina and Heeks, 2012).

More specifically, the development of policy content should focus on the following key components (Table 4):

Components	Aim	ICT and CC Linkages Policy Content
AWARENESS RAISING	*Raise public awareness on the linkages between ICTs and climate change*	ICT policies can generate a better public understanding on the potential of ICT tools with regards to climate change mitigation, adaptation, monitoring and climate change strategies. Towards this end, national ICT policies should include content on: • Programmes to raise awareness and build a knowledge base about the relevance of climate change mitigation and adaptation in developing countries, and about the relevance of ICTs (a) in the delivery of mitigation and adaptation goals, (b) in the achievement of development objectives within a changing climate, and (c) in the fulfilment of international and national commitments in this field.
CAPACITY BUILDING	*Use ICTs to generate capacities among the stakeholders involved in ICCD policy design and implementation*	• Promote and sponsor training programmes to build capacity within government, organisations and communities for understanding and undertaking action on e-mitigation, e-adaptation, and e-monitoring of climate change. This includes "the capacity to conduct ICT-related assessments such as energy audits and e-environment readiness studies, which provide baseline carbon emissions and related data" (Roeth et. al, 2012).

e-ENABLED ACCESS TO CLIMATE CHANGE INFORMATION	Use both traditional and emergent ICT tools to ensure universal access to climate change information	• Use a wide range of digital and non-digital ICT tools (e.g. radio, Internet, TV, video, mobile phones) to ensure ample access to climate change information that is reliable, context-specific, targeted to local audiences, delivered in non-technical language and in user-friendly formats. • Encourage access to ICT-enabled climate change information in public community points of access (e.g. libraries, post offices, museums, archives and schools) to foster broader availability and production of local content on the subject.
SYSTEMATISING AND COMPILING KNOWLEDGE	Provide e-enabled national information systems to systematise, preserve and share information and knowledge on the linkages between ICTs and climate change	• Facilitate and generate ICT-based systems to compile, order, store and disseminate information and knowledge generated from experiences and lessons learned from the use of ICTs in climate change mitigation, adaptation and monitoring initiatives. • Foster the use of ICT tools to conserve and share traditional knowledge on adaptation practices, including intangible heritage such as life stories on adaptive practices.

Table 4. Integrating Climate Change Awareness and ICT Policies

2. Policy Content Aimed at Integrating ICTs & Mitigation

This area of action refers to the development of policy content aimed at moving rapidly to low-carbon solutions, and at reducing operating costs alongside carbon emissions by investing in e-mitigation. Policy content should acknowledge the challenges faced within developing country contexts (e.g. lack of resources, awareness, appropriate technologies and market/policy regimes). Thus, ICT and mitigation policies can play a key role in "building new capacity and partnerships, and to create a business environment that incentivises innovation and the adoption of e-mitigation applications" (ibid, p.1).

ICT and climate change mitigation policy content should focus on three main components: green ICT, smart ICT and community ICT, as reflected in Table 5.

Components ICTs & Mitigation Policy	Aim	ICT and CC Mitigation Policy Content
GREEN ICT	Reduce the carbon emissions from ICT production and consumption	ICT policies can contribute to climate change mitigation by fostering the development of a **green ICT strategy** that seeks to minimise emissions from ICT production and consumption. Towards this end, national ICT policies should include content on: • Adoption of ICT components that are as energy efficient as possible, including the incorporation of green criteria into ICT procurement. • Innovation by ICT firms of new components that use even

		less energy.
		• Transfer of data centres to cooler locations and/or close to greener energy sources such as hydropower, and more effective management of data centre energy design and use.
		• Lifecycle analysis and planning of ICT production including the minimisation of e-waste and maximisation of component recycling.
		• Use of smart technologies within ICT production and logistics.
		• Virtualisation: moving both server and desktop services to the cloud.
		• Use of renewable energy sources to power ICT-related infrastructure, with a significant potential contribution relating to green, off-grid mobile base stations in developing countries.
SMART ICT	*Use ICTs in other sectors -energy, buildings, transportation, logistics, manufacture and forestry - to shrink their carbon footprint*	ICT policies can contribute to climate change mitigation by fostering the application of **"smart" ICT applications** in other sectors to save both money and emissions, particularly in urban areas. Towards this end, national ICT policies should include content on: • **Smart Energy:** Foster ICTs' potential to help decarbonise energy supply and use, and to realise carbon reduction opportunities through the use of applications for energy generation (e.g. smart grids to monitor power consumption and use), energy transmission and distribution (e.g. ICTs for remote measurement and monitoring of energy use), efficient end-use technologies (e.g. smart meters), and decentralised energy production (ICTs for both energy control and connection). • **Smart Buildings:** Promote the use of ICT-based technologies to enhance the efficient use of energy in buildings, through applications such as building information modelling (BIM), wireless sensor networks to control energy consumption, and building management systems (BMS). • **Smart Transportation:** Support the implementation of ICT-driven applications across transportation systems, including software to improve the design of transport networks (e.g. eco-driving, route optimisation, inventory reduction), and improve systems integration (e.g. smart charging and vehicle-to-grid systems). • **Smart Commerce:** Foster the use of ICT applications in the development of "smart logistics" to monitor, optimise and manage operations, as well as in "smart manufacturing" solutions to increase manufacturing process efficiency. • **Smart Forestry:** Foster the use of ICT to improve land-use change and reduce deforestation through applications for data capture via remote sensing, geographic information systems, wireless sensor networks and "participatory sensing" by local citizens or activists, for example using mobile devices.

COMMUNITY ICT	*Apply ICTs at the community level to reduce energy consumption and substitute for journeys*	ICT policies can contribute to climate change mitigation by fostering the use of ICTs within developing country communities in which, as yet, green and smart ICT applications play little role. Towards this end, national ICT policies should include content on: • Actively implementing ICTs in **community awareness raising campaigns,** using broadcast and narrowcast media to make individuals and groups aware of climate change issues and mitigation strategies. • **Local contributions to deforestation:** Support the use of ICT applications such as participatory sensing, as well as community radio to encourage replanting and more efficient use of wood burning for heating and cooking. • Foster the adoption of **"climate-smart' agricultural practices,** to contribute to the reduction of methane and related emissions. • Actively engage the use of ICTs towards **journey substitution** and other **energy savings to be adopted at the community level,** through use of dematerialised services such as e-government, e-commerce and e-health initiatives. (e.g. use of videoconferencing - including Skype - to substitute for journeys that require meetings with government or other officials, use of renewable energy sources such as solar chargers and panels to power ICT devices within the community).

Table 5. Integrating Climate Change Mitigation and ICT Policies. Adapted from Roeth et al. (2012).

**Box 1. ICTs and Climate Change Mitigation
Policy Content - International Domain**

Policy content at the ICCD international level should aim at incorporating ICTs more clearly into low-carbon technology transfer and global financing initiatives. Example:

"Develop a long-term international strategy, including financing options and incentive programs for the development and localisation of low-carbon technology and applications that provide solutions to major GHG-emitting sectors".

**Box 2. ICTs and Climate Change Mitigation
Policy Content - Sub-regional Domain**

Policy content at the ICCD sub-regional level should aim at incorporating ICTs explicitly into low-carbon technology transfer and financing plans of territories/regions. Example:

"Develop a sub-regional strategy in support of green, smart and community ICT applications that can support the socio-economic development of the sub-region, including the adoption of specific measures in support of carbon-saving initiatives, to spur innovation and sub-regional level adoption of e-mitigation practices".

3. Policy Content Aimed at Integrating ICTs & Adaptation

This area of action refers to the development of policy content aimed at supporting the design and implementation of e-adaptation applications at the national level. ICT and climate change adaptation policy content can be developed in support of national adaptation plans (across the different stages of implementation) (Ospina and Heeks, 2011), as well as in support of specific sectoral strategies (focusing on key areas affected by climate change such as poverty, water, agriculture, and food security, health, disasters, etc). These two approaches to e-adaptation policy content development are reflected in Table 6.

ICTs & National Adaptation Plans	Aim	ICT and CC Adaptation Policy Content
INFORMED DECISION MAKING	*Use ICTs to inform decision-making within climate change adaptation processes*	ICT policies can contribute to National Climate Change Adaptation Plans by identifying the specific needs and priorities at the local and national level, as well as the vulnerabilities, resources and capacities available in support of informed decision making processes. Towards this end, national ICT policy content should include content on: • The use of applications such as (GIS) and meteorological information systems to understand both the current extent of climate change, but also to model future impact on not just weather but also agricultural productivity, health and disease, disaster incidence, etc. • The application of traditional and emerging ICT tools to draw on a wide range of information and knowledge perspectives, and present them in appropriate languages and user-friendly formats • The use of ICTs to localise adaptive actions and to strengthen the capacity of local actors to analyse climate models and predictions.
STAKEHOLDER ENGAGEMENT	*Use ICTs in the consolidation of partnerships between public, private and civil society sectors, towards the formulation and implementation of National Adaptation Plans*	ICT policies can contribute to National Climate Change Adaptation Plans by facilitating the inclusion of multiple voices in the design of adaptation strategies at various levels. Towards this end, national ICT policies should include content on: • The use of ICTs to broadcast and raise awareness on the issues to be decided as part of adaptation plans, including the use of social media and online polling amongst those likely to be affected; and the use of group decision-support systems to model and analyse different scenarios, and enable decisions to be made. • The use of ICTs to foster new forms of engagement and participation in climate change adaptation and crisis response.
ADAPTATION DELIVERY	*Use ICTs in the delivery of adaptation priorities, in regards to key sectors/issues*	ICT policies can contribute to National Climate Change Adaptation Plans by supporting the delivery of adaptation priorities in regards to specific development vulnerabilities, sectors or issues. Towards this end, national ICT policies should include content on: • The use of ICTs in support of adaptation

		measures in sectors such as agriculture and food security, human habitat and health, water resources, terrestrial ecosystems, marine and coastal ecosystems, and disaster management, among others.
		• Examples of ICTs and sector/issue-based policy approaches to adaptation delivery include:
		❖ **Food Security:** Promote the use of ICTs to access information about resistant seed varieties and planting methods, or to access agro-meteorological information to protect crops.
		❖ **Water Supply:** Promote the use of ICTs to build local capacity for the conservation of water sources and more efficient water management during the production cycle.
		❖ **Income Generation:** Promote the use of ICTs to explore/access alternative sources of income generation, including the productive use of ICTs (e.g. to access agricultural markets, prices, or to commercialise products).
		❖ **Health:** Foster ICT adoption to disseminate information on prevention and treatment of new diseases triggered by climatic impacts, or in early warning systems on disease forecast and control.
		❖ **Infrastructure:** Promote the use of ICTs to share lessons on safe building practices in areas of high risk for rural communities.
FEEDBACK AND LEARNING	*Use ICTs in the generation of feedback, the creation of new knowledge and the dissemination of existing and emerging adaptation experiences*	ICT policies can help to strengthen adaptation plans by facilitating the generation of feedback on the impact of adaptive actions through geographical and sectoral information systems, while facilitating continuous adjustment of adaptation actions. Towards this end, national ICT policies should include content on: • The use of ICT tools such as Web 2.0 and online media to document traditional adaptation practices, and to convene different sources of expertise in joint efforts towards the creation of climate adaptation tools. • The use of ICTs for environmental observation, monitoring and networking, in order to involve users in the analysis, translation and use of climate change information. • The use of e-governance systems to provide transparency and accountability of the resources invested in adaptation.
INSTITUTIONAL CAPACITY BUILDING	*Use ICTs to strengthen the institutions involved in adaptation strategies*	ICT policies can help to the strengthen adaptation plans by building the capacity of institutions to enable the flow of assets, skills and values necessary for undertaking adaptive actions Towards this end, national ICT policies should include content on: • The use of ICTs as part of capacity-building processes aimed at providing a digital institutional infrastructure that can readily develop, share and utilise a wide range of digital climate change data.

		• The use of ICTs as part of multi-level networking and coordination of intra/inter-institutional actions in the adaptation field. • The use of ICT applications to strengthen efficiency and transparency in the assignation of adaptation resources. • The use of ICTs for e-learning, capacity building and skills-update programmes on climate change issues, particularly among institutional actors/employees located in remote areas.

Table 6. Integrating Climate Change Adaptation and ICT Policies. (Adapted from Ospina and Heeks, 2011; 2012)

**Box 3. ICTs and Climate Change Adaptation
Policy Content - International Domain**

Policy content at the ICCD international level should aim at incorporating ICTs explicitly into global adaptation strategies. Example:

"Develop innovative approaches to climate change adaptation through the integration of traditional and emerging ICTs, including the development of 'e-adaptation' applications that foster new mechanisms for information and knowledge sharing, capacity building, networking and collaboration towards adaptation goals".

**Box 4. ICTs and Climate Change Adaptation
Policy Content - Sub-regional Domain**

Policy content at the ICCD sub-regional level should foster the use of ICTs in the design and implementation of sub-regional projects and initiatives. Example:

"Integrate the use of ICT tools as an integral component of sub-regional strategies, projects and initiatives. The use of ICTs should be based on the specific needs and priorities of the sub-region, and should build upon and complement the ICT, the human and the economic resources available within the context of implementation".

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4. Generic ICT Policy

Alongside the specific policy areas identified above, it should also be recognised that "generic" ICT policy has a relevance to climate change and to climate change action. The growing diffusion of ICTs adds to the sector's carbon footprint (something, as noted above, that needs addressing via green ICT policies). More generally, the "informatics infrastructure" of a nation will be the foundation for any low-carbon or carbon-smart future. Hence, governments must recognise that generic policies – e.g. facilitating broadband or next-generation network infrastructure; enabling e-services; building informatics design and use capacity; addressing the digital divide – are all "climate-relevant", and all need to be considered in light of their climate impact.

2.1(b) Climate Change Policy

Where Section 2.1(a) dealt with the integration of climate change issues into ICT policy, this section deals with its mirror image: the integration of ICT issues into climate change policy. Given that mirror-imaging, we will not repeat what has already been laid out. The content discussed above is equally required in climate change policies, which should make explicit reference to the role of digital technologies and their abilities to:

- Build the foundations of data, awareness and knowledge through awareness raising, capacity-building, enabling access to climate change information, and knowledge-building (see Table 3).

- Address climate change mitigation through green ICT, smart ICT and community ICT initiatives (see Table 4).

- Address climate change adaptation by enabling better decision-making, stakeholder engagement, adaptation delivery, feedback/learning, and institutional capacity building (see Table 5).

Additional ICT roles that should be explicitly recognised within climate change policies are related to the areas of climate change *monitoring* and *disaster management*, as explained below.

- **Climate Change Monitoring**

Monitoring systems based on ICTs play a key role in tackling the emerging challenges posed by climate change. Policy makers should develop climate change policies that reflect the following areas of ICT potential:

(a) Strengthen decision making processes: Climate change policies should promote the use of ICTs to improve the reliability and comparability of climate change data, to evaluate the outcome of actions, and guide law enforcement actions in regards to key natural resources, such as forest conservation (e.g. satellite based monitoring systems can provide deforestation estimates based on actual observations of land-use change, informing decisions about strategies to reduce greenhouse emissions) (Rajão, 2012).

(b) Improve the understanding of climate change impacts on the most vulnerable: Policies should support the adoption of ICTs such as satellite imagery, mapping and modelling technologies to gather and monitor real-time, location-specific climate change impacts, particularly among remote and vulnerable populations. ICT-based monitoring systems should also be used to better integrate knowledge of future climatic impacts into mitigation, adaptation and development planning (Anderton, 2012).

(c) Foster projects based on demand-driven information needs: ICTs should be supported as part of demand-driven initiatives aimed at providing localised climate-related information for monitoring, modelling and related uses. Demand-driven e-monitoring initiatives should pay attention to the access, uptake and utilisation of data by communities and decision makers, as well as to the enactment of those decisions (ibid).

(d) Provide resources to ensure e-monitoring quality and sustainability: Policies should ensure access to the financial and technical resources required for the design, implementation and maintenance of e-enabled monitoring systems, including building local capacities in the management of hardware, software or data techniques, as well as in the analysis and interpretation of climatic data (Hassanin, 2012).

- **Disaster Management**

Information and communication play a critical role within disaster management strategies. From enabling rapid access to reliable data, to the capacity to analyse and integrate information from varied sources in local responses, and the ability to mobilise and coordinate efforts among a myriad of stakeholders, ICTs are key tools for disaster preparedness, response, recovery and reconstruction (Yap, 2011).

Climate change policy makers should focus on the integration of four key ICT roles in policies related to disaster management:

(a) Ensure a 'last mile' communication approach: Integrate ICTs into disaster management strategies in order to ensure timely and effective communication of disaster alerts to the 'last mile' (e.g. using a wide range of technology tools – such as television, radio, satellite radio, mobile phones, short message service (SMS) and remote sensing, among others – to reach vulnerable "people who, for reasons of age, gender, culture or poverty, are not reached by disaster preparedness") (ibid. p.13).

(b) Enable rapid two-way communication within contexts affected by disasters: The use of ICT tools (e.g. mobile phones, wireless ad-hoc mesh networks with GPS, e-mail and radio) (ibid.) should be fostered among front-line disaster responders, affected communities, diaspora communities and other key stakeholders, in order to facilitate the access and distribution of critical information, effectively mobilise aid resources and deploy rescue operations (ibid).

(c) Foster the use of integrated/standardised geospatial data to ensure the coordination of disaster management efforts. This to be done by promoting the development of a common set of geospatial data resources based on ICTs (e.g. geographic information systems, GIS, satellite remote sensing and global positioning systems, GPS) to facilitate the coordination of disaster preparedness and response among institutions and agencies (ibid).

(d) Contribute to transparency and accountability: ICTs should be fostered as enabling tools of transparency and accountability in the allocation of disaster management resources. Emphasis should be placed on policies that foster the use of Web 2.0 tools as part of citizen-led monitoring mechanisms that oversee and share real-time information about the allocation and use of resources in the field.

2.1(c) Development Sector Policy

Development sector policies – on agriculture, health, water, education, transport, housing, etc – face what we might see as a "triple requirement": to incorporate the potential of ICTs; to incorporate the challenge of climate change; and to specifically incorporate the potential of ICTs vis-à-vis climate change. It is beyond the scope of this policy paper to address the first two issues and, in any case, sectoral policies

have been steadily adapting to both the diffusion of ICTs, and the growing awareness and impact of climate change.

To incorporate the ICT/climate change intersection is where the main current policy challenge lies. Sectoral policy makers can best start with the overview model shown in Figure 4. They need to identify which of the component parts are priorities, and then incorporate those into policy as specific statements, programmes and/or objectives.
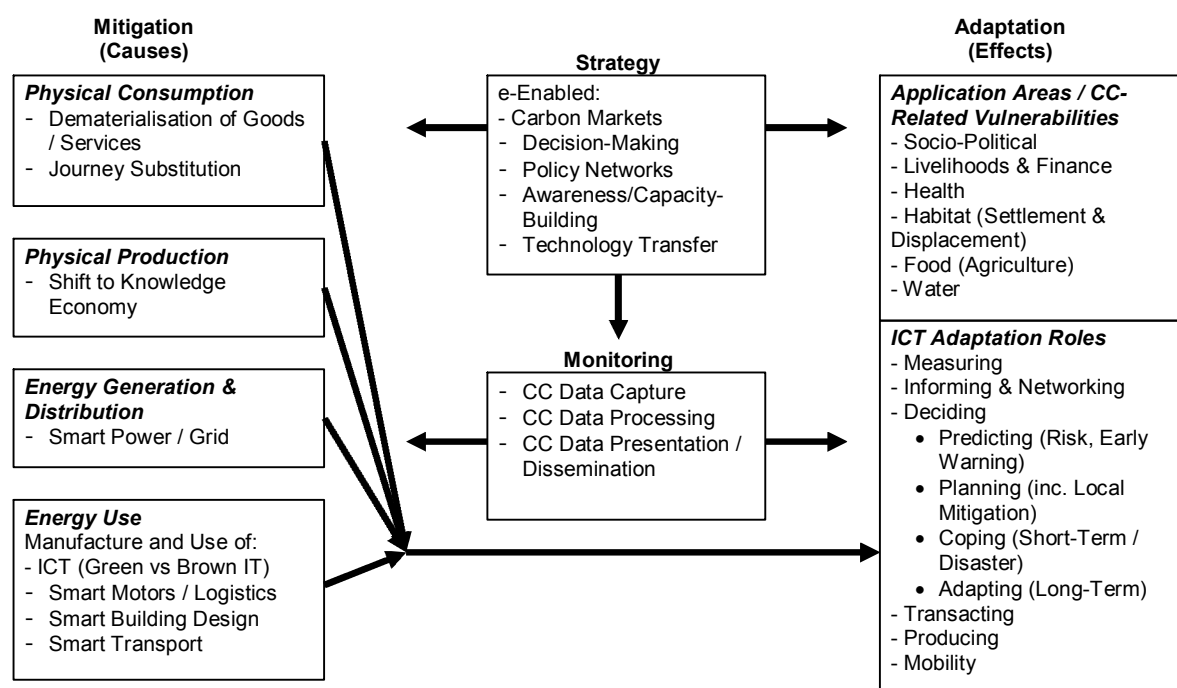
Figure 4. Overview Model on ICTs, Climate Change and Development (ICCD)

Overview guidance on most of these components can be taken from the content already provided in this paper; for example Tables 3-5 in looking at overall awareness, mitigation and adaptation measures. These can readily be converted to sector-specificity (and, indeed, there are some sector-specific pointers already within the Tables).

However, each sector will require also require its own detailed analysis to identify the particular role of the ICT-climate change nexus and, hence, appropriate policy components. It is beyond the scope of the current paper to illustrate such an analysis, but one is provided for ICTs and climate change adaptation in the water sector by Ospina et al (2012).

2.2. ICCD Policy Structure

Policy structure refers to the availability of effective institutional arrangements, including stakeholder capacities, roles and responsibilities, required for the design and implementation of ICCD policies. Generally, the basic structure required for ICCD policy making involves four main groups of stakeholders representing the State, the scientific community, the business sector and the civil society, as reflected in Figure 5.
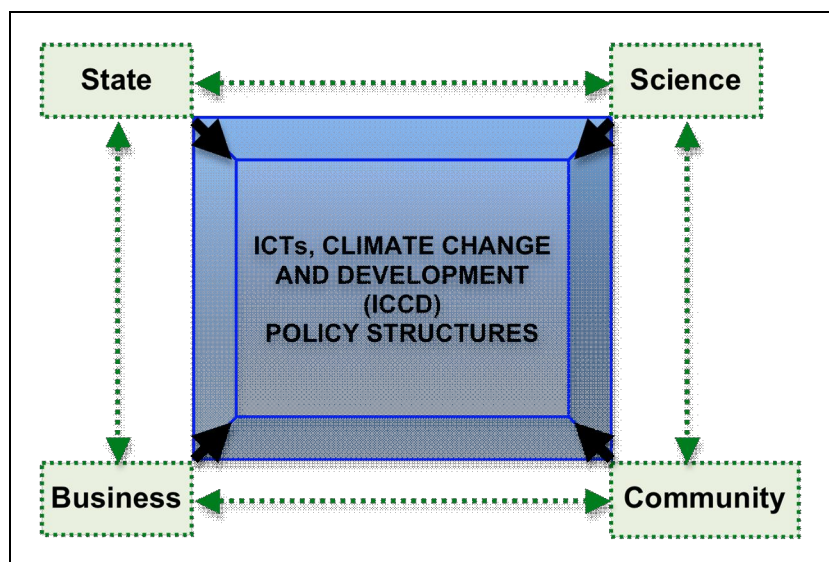
Figure 5. Key Stakeholders in ICCD Policy Structures

The coordination of actions between these stakeholders faces challenges related to the existence of a myriad of 'divides' between the four groups, which include the differential access to information and knowledge, and the different skills and languages used by each group, among others. Examples include the lack of a common 'language' between the different groups (e.g. the terminology and concepts used by the scientific and the government groups), the lack of (participatory / consultative) mechanisms to integrate traditional/community-based knowledge within policy-making processes, as well as the information gaps that exist between and within groups (e.g. between the Ministry of Environment and other Ministries, or between the private sector and civil society groups), among others.

Thus, representativeness and relational factors play a key role within policy structures, and involve the effective participation and interaction between the different groups towards policy making, as well as the forums through which they are brought together (Heeks, 2010).

An effective ICCD policy structure ensures that the views of these different stakeholders are represented and that their interests are balanced in the process of policy design and implementation. Thus, structures are needed that provide cross-sectoral and inter-institutional coordination mechanisms between ICT, climate change and development policy stakeholders at both the strategic and operational levels of the policy process. An effective structure involves clearly defined roles and responsibilities for each institution/stakeholder involved in policy design and implementation, as well as the availability of an agreed organisational arrangement for multi-stakeholder collaboration.

ICCD structures can take multiple forms. Institutional arrangements can be based on different domains of policy influence (i.e. international, national or sub-regional), or built upon pre-existing systems of institutional collaboration (e.g. national climate change committees, national environmental systems). Ultimately, they should reflect the variety of ICT, climate change and development stakeholders that are present in each context.

Building on different examples of institutional arrangements available for the coordination of ICT and climate change activities in developing countries (Asiamah,

2012), Figure 6 provides an example of an ICCD policy structure that could be considered by policy-makers in this emerging field.
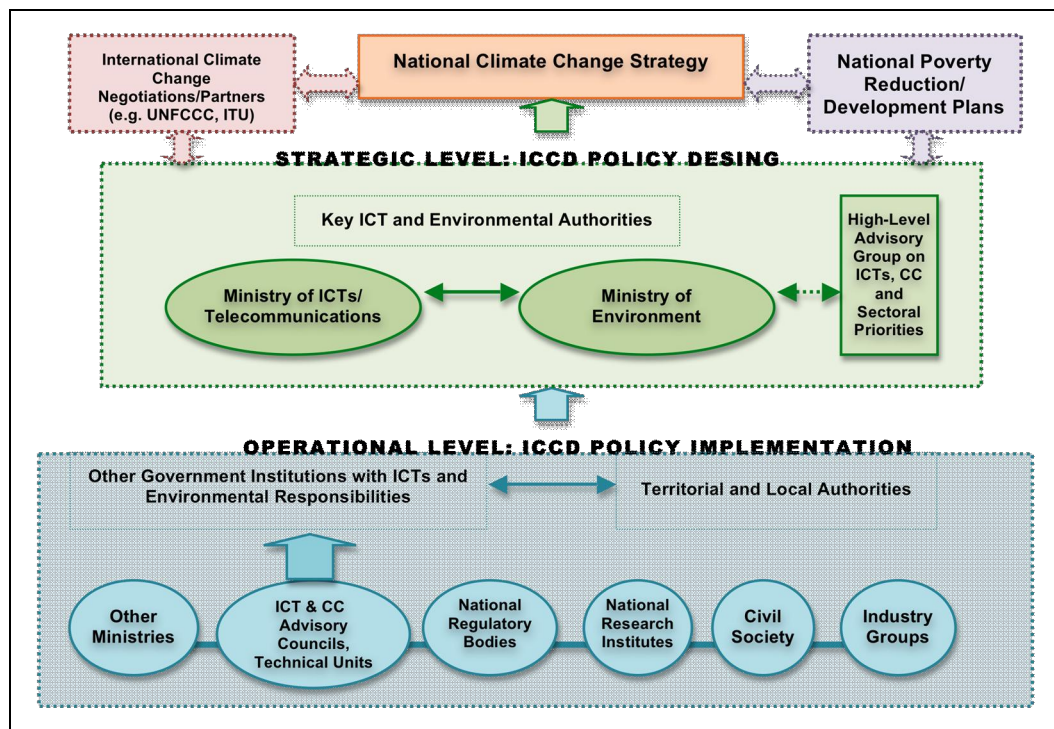

Figure 6. Example of a National ICCD Policy Structure

The ICCD policy structure reflected in Figure 6 has several important characteristics for the consideration of decision-makers:

- The structure distinguishes between two main levels of the ICCD policy process, namely the strategy level of policy design, and the operational level of policy implementation. In doing so, the structure facilitates the identification of roles, responsibilities and areas of competency of the different stakeholders involved.

  - At the *strategic level*, the two national authorities of the ICT and climate change fields (e.g. Ministry of ICT/Telecommunications and Ministry of the Environment) are supported by a high-level advisory group that includes development sector representatives.

  - At the *operational level*, stakeholders from other government institutions with ICT and environmental responsibilities and implementation mandates, interact with a variety of actors from the state, the private sector, the scientific and civil society communities. These institutions also interact with territorial and local authorities that not only have the mandate to exercise policy actions at those levels, but can also contribute to the understanding of local priorities.

- The Figure also reflects that, while the goal of the ICCD policy structure is to articulate ICT and climate change policies within broader climate change national strategies, articulation also needs to be achieved with national development and poverty reduction programmes, ensuring coherence with agreements reached at the international domain (e.g. UNFCCC) and with the support of international partners and institutions (e.g. ITU).

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The design of ICCD policy structures should build upon experiences from the ICT for development (ICT4D) and the climate change fields, drawing best practices and strategies to overcome the challenges involved in the design and implementation of inter-institutional/cross-sectoral collaboration mechanisms. Such challenges may concern the absence of effective representative bodies for key stakeholder groups (e.g. civil society groups, micro-enterprises), or the shortage of institutional capacities and technical competencies in the ICT and/or climate change fields.

Regardless of their specific design, ICCD policy structures must be flexible to reflect and adapt to the changing nature of the ICCD field (i.e. integrating emerging actors and issues, as well as emerging technologies, trends and patterns), in order to reflect ICT4CC coherence (the role of ICT in climate change policy, and also the role of climate change in ICT policy).

2.3. ICCD Policy Process

ICCD policy *process* refers to the coherent implementation of the overall policy cycle, from the process of content development and structure design, to the actual integration of ICT, climate change and development issues in policy implementation This translates into processes that ensure both horizontal and vertical policy coherence between the ICT and climate change fields (Figure 7).

Horizontal coherence of ICCD policy processes refers to the alignment of the different components that are necessary for ICTs' impact as part of climate change mitigation, adaptation and monitoring responses. It involves ensuring the "e-readiness" of the context of policy implementation (i.e. the elements necessary for making ICT tools available, such as awareness, infrastructure, human capacities, economic resources, motivations and political support, among others) as well as providing conditions for ICT availability, uptake and development impact (Heeks, 2010) (e.g. climate change awareness through the delivery of appropriate content via mobile, Internet-based applications, etc).

Vertical coherence of ICCD policy processes refers to the steps taken to ensure policy articulation between the sub-regional, the national and the international policy domains, considering the ICT and the climate change and the development fields. It requires ICCD policies to acknowledge or build upon existing policies in the fields of ICT and climate change, including climate change and information society legislation, national laws, planning strategies and declarations, international documents and agreements (UNESCO, 2009).
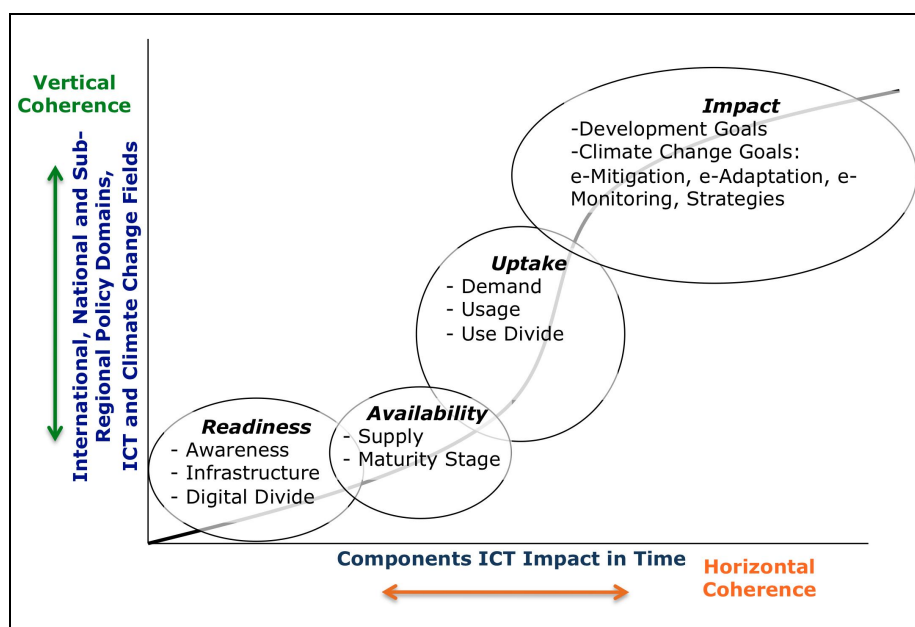
Figure 7. ICCD Horizontal and Vertical Policy Coherence. Adapted from Heeks (2009)

In addition to consideration of vertical and horizontal policy coherence issues, the operationalisation of ICCD policy process involves six main stages, namely awareness raising and strategy, problem definition, identification of ICT-enabled solutions, identification and selection of policies, implementation of those policies, and then their evaluation. The main tasks involved in each of these stages are reflected in Figure 8.

AREAS OF ICCD POLICY FOCUS	ICCD POLICY CYCLE STAGES					
	Awareness Raising Strategy	Problem Definition	Identification of e-Mitigation, e-Adaptation & e-Monitoring Options	Identification and Selection of Policies	Implementation of Policies	Evaluation of Policies
ICT and CC Linkages *e-Mitigation* *e-Adaptation* *e-Monitoring* *Sector-Specific Climate Change Priorities*	Raise awareness among policy-makers/key policy stakeholders on the climate change needs and priorities in regards to specific issues of focus, sectors or contexts.	Define the problem of focus through vulnerability and technology needs assessments, in consultation with multi-sector/cross-level stakeholders	Identify ICT tools/ applications to tackle the mitigation, adaptation or monitoring issues identified. Identify the stakeholders that need to be involved in design and implementation	Design or identify adequate policies (e.g. laws, regulations, decisions) to respond to the problem (i.e. climate change impacts), integrating the use of ICTs	To be conducted in the appropriate domain (i.e. international, national or sub-regional), in collaboration between different stakeholders (e.g. national and local governments)	Identify an external body to conduct an assessment of ICCD policies and provide strategic recommendations for improvement

Figure 8. ICCD Policy Cycle Stages. Adapted from Hagemann et. al, 2011.

It is important to note that the boundaries between these different stages are porous, and their implementation often overlaps (i.e. some of the tasks involved in different stages may occur in parallel, for example, awareness raising and problem definition, or the identification of ICT-enabled options). This reflects the need for ICCD policy processes to be flexible, and to be able to respond and adapt to the changing priorities, uncertain climatic impacts, emerging technologies and actors that play a role in the ICCD field.

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3. ICCD Policies: The Way Forward

Having identified the main components of ICCD policies, this final section elaborates the potential benefits and challenges that may be encountered in the integration of ICT and climate change policies within developing contexts. The section concludes with a series of key entry points that policy-makers in the ICT and climate change fields can consider in order to foster the adoption of an integrated ICCD approach forward.

3.1. Potential Benefits and Risks

A recent report by the Broadband Commission for Digital Development (2012) identifies key challenges faced by ICT policy processes at the national level. These include the lack of policies and cross-Ministry co-ordination for the adoption of greener ICT solutions and the reduction of emissions within large industries (p. 14), as well as the 'silo' approach of current regulatory environments, where key ICT sector decisions are taken in isolation. The report also suggests that the fast pace of technological advances in the ICT field poses a challenge for policy-makers, which reinforces the importance of adopting flexible, forward looking policy approaches to the role of ICTs in the achievement of climate change goals.

Within this context, the adoption of an integrated policy approach to ICTs, climate change and development (ICCD) poses a series of potential benefits and risks, as reflected in Table 7.

Potential Benefits of ICCD Policies	Potential Risks for ICCD Policies
Strengthen Informed Decision-Making ICCD policies could foster the use of new and emerging ICT tools (e.g. GIS, remote sensing, Internet-based climate models) to inform decision-making processes within contexts characterised by increased climatic risk and uncertainty.	**Add Complexity to Decision-Making** Without measures aimed at building local capacities, fostering the appropriation of ICT tools, and producing locally-appropriate content, ICCD policies could add new complexity to local decision-making processes.
Avoid Duplication of Efforts ICCD policies could help coordinate efforts and build upon existing experiences and expertise of stakeholders from the climate change, the ICT and the development fields, towards integrated responses.	**Require New Institutional Roles/Structures** Ensuring a coordinated policy approach that integrates ICTs, climate change and development sectors may require the redesign of certain institutional structures and/or roles, identifying clear responsibilities among climate change and ICT stakeholders, as well as mechanisms for information-exchange and inter-agency consultation.
Foster New Livelihood Opportunities within Vulnerable Contexts Within resource-dependent/agricultural livelihoods, the integration of ICTs into climate change strategies could lead to the identification of alternative livelihood opportunities (e.g. by accessing information on credit programmes, new seed varieties and substitute/more resilient crops, by having access to extended networks and skills, by accessing new markets, etc).	**Disconnect Livelihood Needs and Information Supply** Fostering livelihood opportunities amidst a changing climate requires the provision of information that is updated, reliable, locally appropriate, and relevant for a broad set of audiences that have different needs and priorities. In order to ensure that ICT tools help create and strengthen livelihoods, ICCD policies need to narrow the gap between local needs (information demand) and information supply.

Help to Integrate Short-term Responses and Long-term Climate Change Strategies	Failing to Anticipate/Integrate Emerging Technologies and Climatic Uncertainty
By acknowledging the role of existing and emerging ICT tools within climate change responses, an integrated ICCD policy approach can contribute to tackle both short-term responses (e.g. mobile based early-warning systems) and long-term strategies (e.g. Internet-based climate change models and projections).	The fast pace of technological innovation poses the challenge of designing policy frameworks and regulatory approaches that tackle both existing *and* emerging technologies. Given the fast pace that characterises technological development, the future is particularly hard to predict or anticipate from a policy perspective. Similarly, the uncertainty of climate change impacts requires policies that provide an enabling environment to respond to both present *and* future climatic impacts, which are uncertain.
Bridge the Divide Between Local, Sectoral and National Policies	**Competing Policy Agendas/Perspectives**
Due to its innovative nature, the first step in the design of an integrated ICCD policy approach involves the review of roles and responsibilities, past and ongoing projects, regulations and areas of expertise of actors involved in ICTs and climate change fields at the local, the sectoral and the national level. Thus, the design and implementation of ICCD policies could help to identify and formalise the collaboration among a varied set of actors who otherwise would not work together, as well as to bridge policy approaches.	Stakeholders working in the ICT, climate change and development fields respond to different institutional mandates and priorities. Coming from diverse backgrounds, stakeholders use distinct scientific, academic and/or technical languages and lack a shared understanding of concepts and issues. Integrating ICTs, climate change and development priorities requires a long-term process of collaboration and trust-building, the identification of a common language and a common understanding of key issues, as well as the articulation of often diverging objectives, timing and priorities.
Enhance Local Adaptive Capacity	**Deepen Existing/Create New Inequalities**
Policies, regulations and strategies play a key role in the provision of an enabling environment for the implementation of innovative climate change actions. The integration of ICT tools can help to strengthen the creation, management and dissemination of climate change information and knowledge, enhancing the capacity of local actors to adapt to the challenges and the opportunities posed by climate change.	While the use of ICT tools can facilitate access and dissemination of knowledge and information, it can also deepen existing or create new inequalities and forms of exclusion based on differential access to resources (e.g. access to climate change information through Internet-based applications could exacerbate gender-based power differentials). ICCD needs to be based on the identification and understanding of existing power differentials and inequalities in the context where they will be implemented.
Strengthen Institutional Capacities	**Weaken Capacities + Perpetuate Ineffective Institutions**
Fostering the use of ICT tools for achievement of climate change goals can help to strengthen and develop new capacities and competencies in institutions working in the field, including improved information management, networking, production and dissemination of content, mechanisms for awareness raising and education.	The absence of national and local institutional capacities to deal with ICT and climate change from an integrated perspective, could limit the implementation of ICCD policies in the field. At the same time, ICCD policies that are not based on initial assessments of needs, institutions and stakeholders, pose the risk of fostering or perpetuating ineffective institutional roles by assigning new responsibilities that weaken/exceed available human, technical and/or environmental capacities.

Table 7. Potential Benefits and Risks of ICCD Policies

Despite the complexities that characterise the junction of the three fields, the potential benefits identified above suggest that there is ample room for ICCD policy innovation and development impact. Within the emerging ICCD field, policy processes remain largely unexplored. The following section will provide a series of key entry points for policy- and decision-makers, with a focus on developing country contexts.

3.2. Key Entry Points for Developing Country Policy-Makers

(a) ICCD Policy Content

- **ICCD Awareness:** Despite the ubiquitous use of ICTs in both developed and developing countries, the linkages that exist between these tools and climate change mitigation, adaptation and monitoring are still unknown by a large number of stakeholders. The recognition of the low-level of awareness that exists on the topic constitutes an important entry point to the process of ICCD policy content, in order to include clear terminology and concepts that can be understood and appropriated by a variety of stakeholders.

- **ICCD Data, Information and Knowledge:** The development of ICCD policy content should be built upon a solid body of data, information and knowledge, including both traditional and emerging ICT and climate change sources. Identifying and assessing existing gaps and needs in terms of ICT and climate change data, information and knowledge, constitutes a crucial entry point for the design of appropriate ICCD policy content.

- **ICCD Based on ICTs' Productive AND Transformative Roles:** ICCD policy content should reflect the multiple development roles and climate-change-related capabilities that ICT tools enable. This involves making reference to the informational, productive and transformational potential of ICT tools, including their role in support of local livelihoods, content creation and income generation; all of which constitute important preconditions for the adoption of climate change mitigation and adaptation practices.

(b) ICCD Policy Structures

- **ICCD Leadership:** A key entry point for the development of ICCD structures is the availability of a well-known, trusted and credible leader who takes forward the process of inter-stakeholder and cross-sectoral coordination of policies. Ideally the ICCD process would involve leaders from both the ICT and the climate change sectors who could, in turn, be in a position to facilitate the articulation of efforts between the Ministerial and municipal levels.

- **ICCD Participation:** The active engagement from ICT, climate change and development sector stakeholders from the government, the private sector, the scientific and the civil society communities, is key in the operationalisation of representative ICCD structures. Consultative mechanisms should be put in place from the onset of the policy cycle, in order to improve the understanding of ICT and climate change needs at the local, national and global levels, maximise the access to economic and knowledge resources, and foster the scalability and sustainability of initiatives.

- **ICCD Institutional Capacities:** ICT, climate change and development institutions play a pivotal role in the implementation of ICCD policies. Thus, assessing the current role, available capacities and capacity-building needs of the institutions involved in ICT and climate change policy design and enforcement, constitutes an important entry point for decision makers.

(c) ICCD Policy Process

- **ICCD Prioritisation:** The design of a systematic mechanism to set priorities across ICT and climate change programmes and subsectors, constitutes a key entry point for policy-makers at the international, national and sub-national domains. This type of mechanism can add transparency and accountability to the policy cycle, helping to balance competing interests from the different stakeholders involved.

- **ICCD and Prevailing Gaps:** ICCD policy processes should start by identifying and assessing prevailing gaps in terms of connectivity (especially in sub-urban towns and rural areas), access and use of ICTs, as well as in the access and use of climate change information and knowledge.

- **ICCD Incentives for Early Action and Innovation:** ICCD policy processes should include mechanisms to incentivise the development of innovative ICT applications on e-mitigation and e-adaptation. Policies should also foster investment, scale-up, commercialisation, domestic market development, and reduction of the costs for implementing use of low-carbon technology, while promoting enforcement mechanisms for intellectual property rights (Roeth et. al., 2012).

The ICT sector is characterised by the constant emergence of new technologies, the growing patterns of ICT adoption, and the wide range of applications given to these tools by a wide range of stakeholders. In face of this changing context, and given the uncertainty posed by climate change impact, the success of ICCD policy will depend on its ability to remain flexible and to adapt – in terms of content, structure and process – to an ever-changing environment. It will also depend on its ability to ensure the provision of policies that tackle both long and short/medium-term challenges and opportunities at the intersection of the ICT, climate change and development fields.

Conclusions

As the frequency and intensity of climate change impacts become more manifest, and the diffusion and adoption of ICTs advances, particularly within developing country environments, the design of ICCD policies is becoming an area of increasing importance. Policy action at the intersection of the ICT, climate change and development fields is crucial to provide and mobilise the resources - both human and financial - necessary for the adoption of innovative climate change responses.

This paper presented an overall picture of the main principles, components and entry points to ICCD policies, in order to position the topic in the agenda of policy- and other strategic decision-makers, and to encourage the emergence of new actions in this field. The analysis conducted suggests that, through the design of ICCD content, structures and processes, developing country policy-makers have a historic opportunity to pioneer in an emergent field, through the provision of legal frameworks, regulations, strategies and actions that utilise ICT tools to prepare and anticipate climate change impacts, ensure the coherence of ICT, climate change and development approaches, and foster the articulation of efforts between different sectors and levels.

ICCD policies face the challenge of fostering innovation by supporting new research and funding programmes to develop, test and scale-up applications in the low-carbon/energy efficiency, e-adaptation and monitoring fields. It is crucial for ICCD policies to provide incentives and foster multidisciplinary research and technical cooperation between stakeholders from the scientific community, the private sector, civil society and the state, which will help to promote the development of relevant sectoral applications and bottom-up solutions.

As the penetration and adoption of ICTs continue to grow amidst contexts impacted by climate change, the need for ICCD policies will become more evident. But while the design of ICCD policies is gaining momentum, ICCD policy making should not be approached as a short-term political fix, but as a long-term process of continuous learning, adaptation and interaction with a changing set of actors and priorities, traditional and emerging technologies, and uncertain climatic threats and opportunities. By exploring the process, content and structures required for the development of ICCD policies, developing country policy-makers can be 'ahead of the curve' in this field, while pioneering policy approaches that support and strengthen national goals and international commitments.

Future policy action in this field should build upon the experience of countries such as Ghana, a country that has pioneered in the development of ICCD policy processes. Further research is necessary to draw lessons learned and develop policy guidelines from this and other emerging experiences, in order to ensure a solid path for policy development and implementation at the intersection of the ICT, climate change and development fields.

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