Informational Governance of Climate Change Organisations

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Executive Summary

Climate change has emerged as a key global issue, and increasing numbers of organisations are seeking to address this issue in various ways. These "climate change organisations" are found at different levels, from the international organisations of the UN system through national ministries and down to local government and community organisations.

There is recent and growing recognition that information and communication technologies (ICTs) play an important role in climate change monitoring, mitigation and adaptation. This presents a strategic challenge to climate change organisations; the more so since – to date – there has been little analysis of how these organisations should build ICTs into their strategic thinking.

This paper therefore provides guidance for local, national and international organisations responding to climate change on how to build "informational governance": the effective response that both incorporates ICTs into a strategy for external climate change action, and which utilises ICTs as a tool for the internal planning and implementation of organisational climate change strategy.

It does this by identifying the key factors required for effective informational governance, i.e. for effective strategic use of ICTs by climate change organisations. Those factors are categorised as arrangements (organisational presence and structure, and climate-ICT initiatives); frameworks (focus, strategy and resources); coordination (horizontally/vertically, internationally, and with other stakeholders); and accountability. These are presented in the form of questions that climate change organisations can ask themselves in order to identify current challenges and opportunities, to build a firmer foundation for effective informational governance, and to thus enable a better climate change response.

1. Introduction

Damage to the environment has crossed national borders and generations at the same time that the world becomes interconnected because of globalisation[1]. Climate change is among those problems whose effects know no boundaries. It affects developed and developing countries alike. However, the ability to adapt to these changes is not uniform across countries. While London may be able to construct sophisticated mechanisms to save the city from a projected sea level rise, more vulnerable Dhaka could apparently not given its current level of development. Human settlement patterns are seen to be potentially disrupted by climate and weather pressures with the poorest communities likely to be the most vulnerable since they are the most directly dependent on natural resource systems and have the least resources to adjust to change[2]. Climate change is indeed one of the defining development issues of our time.

An unprecedented transformation of economic and social development is required for effective response to the global climate challenge. Climate change is a problem that is tied to a wide array of policy areas – transportation, energy, water, technology, etc. It is an issue that requires integrated action – monitoring, mitigation, and adaptation – at multiple levels of governance (local to national and international) within the spheres of politics, economics, and society. This suggests the paramount importance of understanding climate change governance from the perspective of organisations and their roles at different levels of governance.

In this paper, we refer to these organisations as "climate change organisations" to mean the entities whose activities are in one way or another aimed at monitoring climate data (such as the work of the World Meteorological Organisation (WMO) and national meteorology agencies), mitigating the effects of climate change (such as electricity suppliers investing in renewable energy technology and smart grid distribution), and adapting to the effects of the changing climate (such as disaster management agencies). In practice, organisations may combine these activities, e.g. the National Board on Climate Change which acts as a collegial body for climate monitoring, mitigation and adaptation in Indonesia. The Indonesian Board, like other country committees and ministries, operates at the national, macro level. At the supra-macro – regional and international – level, are bodies like WMO and other agencies of the UN. At the micro level are community-based organisations (often focused on adaptation) such as Barotseland.com in Western Zambia, which operates the Lyambai Vulnerability and Adaptation Project.

Regardless of governance location and climate action, the struggle to keep up with the complex, diffuse impacts of modern technologies[3], especially information and communication technologies (ICTs)[4] has always confronted climate change

[1] Mason, 2008; Esty, 2008; Haas, 1999.
[2] Meadowcroft, 2009.
[3] Mason, 2008:8.
[4] ICT, in this paper, primarily refers to digital computer technology, the protocols used to connect these together and the software which enables human interaction with these tools. It encompasses the familiar desktop and laptop computer, mobile telephony, digital photography, and wired and wireless networks, including the Internet (Kennedy, 2010; FAO, 2010:39; Kalas & Finlay, 2009). In the particular context of climate change institutional governance, ICT also spans radio, television and other traditional media, as well as new media and satellite-based technologies, remote sensors connected to a central monitoring service, and mobile sensing devices.

organisations. The role ICT plays in the wide gamut of the climate change agenda has been apparent. ICTs can function as an efficient means of knowledge collection and sharing. These new technologies provide a dynamic way for knowledge development and instant sharing of various perspectives[5]. Use of ICTs is rapidly spreading thereby creating new spaces, opportunities and challenges for developing countries that are most vulnerable to climate change impacts. Institutions[6] and organisations, as expected, play an important role in mediating climate action. Yet, a review of available literature in the field of ICTs, climate change and development[7] suggests that governance of climate change organisations and their usage of ICTs in practice is still one of the least explored areas for analysis.

With the emergence of climate change as a key policy issue and the implied significance of ICTs in climate change action, climate change organisations at different levels of governance need to adjust in order to incorporate the potential of ICTs into their strategies to meet climate-related goals and objectives. These organisations possess distinct and complementary roles in developing strategies for climate action[8]. Yet, given the diffusion of environmental governance practice in various organisations, limited analysis has taken place to date on how these organisations implement policy processes to address climate change and recognise the major potential and role of ICTs.

Despite the world becoming increasingly interconnected by flows of information, trade and technology, many perceive organisation-building to be fragmented, poorly coordinated, and inapt in dealing with the escalating speed of informational and climatic changes. Governance for climate change is increasingly non-optional as adopting appropriate responses to climate change increasingly becomes a norm for 'good governance' at all levels[9]. Yet those responses must now also include an understanding of ICTs.

Recognising the close links that exist between governance in climate change organisations and the achievement of development outcomes, alongside the increasing use of ICTs within climate and development contexts, this paper seeks to review existing literature on environmental governance across developing countries and international organisations focusing on the use of ICTs in climate change action within and outside their organisations. Particularly, focus will be on understanding the roles, procedures and mechanisms of these organisations. ICTs will be introduced as strategic tools that have the potential and role of contributing towards effective governance and therefore, helping to enable strategies for climate change action. Specifically, this paper aims to take stock of existing knowledge and practical applications on the potential and role of ICTs in climate change action by climate change organisations; identify the elements necessary for effective governance for climate change action at different levels; identify challenges; and recommend policy actions to advance the emerging notion of "informational governance".

[5] FAO, 2009; Kalas & Finlay, 2009.
[6] Institutions include both the legal entities and informal organisations for climate change monitoring, mitigation, and adaptation including the rules and processes within which they operate. Although 'organisations' are theoretically different from 'institutions', most international relations writers treat both terms as synonyms (Haas & Haas, 2002). They are used interchangeably in this paper.
[7] Ospina and Heeks, 2010a.
[8] Schreurs, 2010.
[9] Meadowcroft,2009.

2. Review of Literature and Model for Analysis

In this section, we take a quick look at our understanding of organisations and governance in general. Then, we try to associate these concepts with the potential and role of ICTs on climate change action and identify elements that make up the notion of informational governance.

Recognising that organisations have a key role in both the selection and implementation of policy for climate change action, it is also appropriate to understand the process of their formation including the frameworks that define their arrangements[10]. Institutions[11] are organised by both informal organisations (such as family groupings and power relations) and formal organisations (such as those of the government, private and NGO sectors) [12]. The process of organisation often required complex and long term sub-processes of institutional evolution, cross national imitation and learning, and iterative lesson drawing and design[13]. Today, governance institutions are identified with their well known legislative mechanisms, representative organisations, federal structures, functional differentiation of ministries, professional bureaucracies, policy frameworks and so on[14].

Through the decades, attention on the focus of governance, especially in developing countries, has been about 'accelerating' development – a multi dimensional process involving economic, social, and political advance. Modern organisations came into being across the developed world, spreading later to developing countries since the late 1960s[15]. At the multilateral level, international environmental governance has been evolving for more than thirty five years as the international community attempted to address ecological externalities brought about by economic globalisation[16].

Nevertheless, environmental governance institutions (including obviously those involved with climate change action) are perceived as weak compared to more established areas of government competence[17]. Thus, a further phase of better governance practices in these organisations is apparently required on the basis of its importance, development imperative, and immediate necessity for action. This further extends to the use of ICTs in creating, harnessing and delivering effective climate change governance. The next section attempts to merge these elements and conceptualise the notion of informational governance of climate change organisations.

2.1. Conceptualising and Modelling Informational Governance of Climate Change Organisations

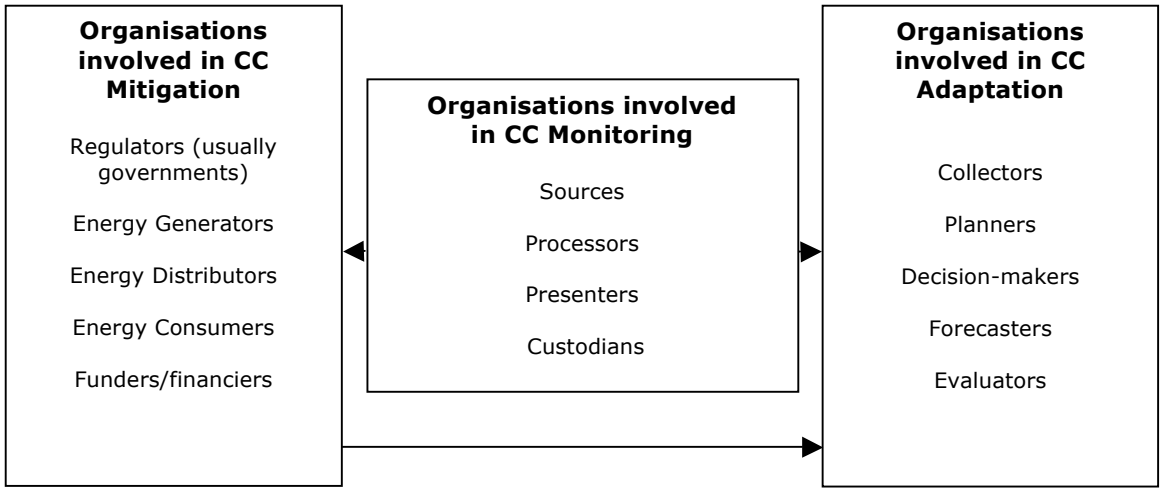
This paper is developed based on the recognition of a seemingly complex set of relationships existing between organisations, environmental governance, climate

[10] The concept of "arrangements" and "frameworks" are described in the latter part of the paper.
[11] In this paper, we focus on established formal organisations.
[12] Lowndes,1996 in Ospina & Heeks, 2010a.
[13] Meadowcroft,2009.
[14] Ibid.
[15] Ibid.
[16] Haas, 1999:103; Pelletier, 2010.
[17] Esty, 2008.

change and tools without removing development goals from the picture. We put a premium on the use of ICTs as strategic tools for meeting these goals. The linkages that exist between these concepts will be illustrated in Figures 1 to 6, building an overall picture of informational governance[18].

Climate change organisations are currently typified as having three distinct "personalities" based on their functions in climate change action – monitoring, mitigation and adaptation. The chain affecting the various dimensions of these actions relative to the utilisation of ICTs is reflected in Figure 1.

Figure 1: Linkages between Climate Change Organisations, their Functions in different Climate Change Actions, and the their Functional Relations to ICT Tools



Source: Kalas & Finlay 2009, Ospina & Heeks 2010

It follows from Figure 1 that although the three areas for climate action are distinct from each other, they are intertwined such that the activities in one sphere affect those of the others. This may affect individual organisations, some of which work in more than one field of climate change action. It may also affect multiple organisations. For instance, organisations involved in monitoring activities are expected to share their data to organisations involved in mitigation and adaptation to ensure that relevant actions are carried out, and vice versa.

Porosity across these organisations not only exists in terms of varied actions but also in relation to their locations in the various jurisdictional scales and different levels of governance. Since the pathways of actual and potential harm that climate change brings have provoked responses at these levels, a multi-sectoral and multi-level approach is imperative.

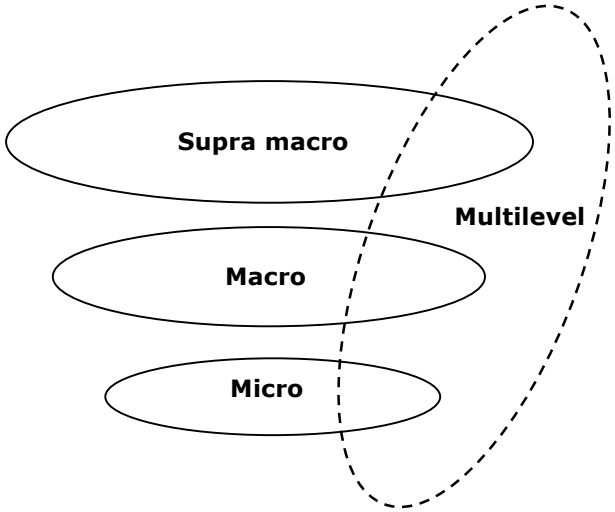
This approach has been succinctly described by neoinstitutionalism as a movement involving coordination among networks and actors from different types and level of organisations. Multi-level governance emerges as a conceptual approach that steps away from the assumptions that national government at the

[18] Aside from this author, Kennedy (2010) has also recently provided a general description of this notion albeit in the context of law.

macro level is the dominant policy making unit towards policy making that involves actors within a 'nested hierarchical set of government levels'[19]. Actors of multilevel governance may come from community organisations, NGOs, and people's organisations, private organisations, local governments, national governments, and international organisations.

Recognising this approach to climate change action, climate change governance must thus be seen as multi-level, spanning three principal units of analysis: the micro (community or local level), macro (national level), and supra macro (international level).

Figure 2: Location of Climate Change Organisations at the Three Levels of Governance



Source: Author

Regardless of their locations and actions, however, the functions of climate change organisations are related with how, when and where they use ICT tools. The following sections describe this; albeit briefly since these roles have been described in greater detail elsewhere, and the intention here is just to illustrate the ways in which ICTs can participate in climate change action. The focus of these sections is on this "external" role of ICTs, but we also note and will incorporate their more "internal" role as a tool that can generically assist organisations in the planning and implementation of their organisational strategies.

2.1.1. Climate Change Monitoring Organisations: Activities and ICT Tools

Generally, this type of organisation gathers and distributes key data. With this information, organisations stress the potential and use of accurate indicators to increase the possibilities of mitigating climate change and of helping developing countries in particular to adapt to weather events. Access to high quality, timely data is central to facing the challenges of climate change and ICT has been considered as key to achieving this. At the moment, ICTs are used in monitoring

[19] Marsden & Rye, 2010

systems for forecasting weather, predicting climate changes, and mitigating the effects of natural disasters[20].

Figure 3 shows how ICTs could be specifically utilised by organisations in climate data monitoring. It breaks this down by stages in the information system process; identifying that climate change monitoring organisations basically function as data sources, processors, presenters and storekeepers. Across these four activities, specific tasks are involved and ICT tools are utilised.

Figure 3: Organisations for Climate Change Monitoring: Activities and ICT Tools

	Sourcing	**Processing**	**Presenting**	**Storing**
Organisations use ICTs to	…collect data from all available sources	…convert raw data into useful information (either for adaptation or mitigation)	…provide appropriate information to all stakeholders at the right time	…store information for future retrieval and sharing with networks
Examples of ICT tools	Remote sensing techniques; sensor-based networks	Software-based systems	Media, including internet, SMS and broadcast (especially radio); telecentres	Digital databases and repositories
Examples of organisations	Supra macro (World Meteorological Organisation through the Global Climate Observing System (GCOS))	Supra macro (World Meteorological Organisation; World Bank Group[21]) Macro (national government agencies)	Supra macro (World Meteorological Organisation; World Bank Group) Macro (national government agencies)	Supra macro (World Meteorological Organisation; World Bank Group) Macro (national government agencies)

Source: Author's compilation from Kalas & Finlay 2009:16 and Ospina & Heeks 2010:16-17

2.1.2. Climate Change Mitigation Organisations: Activities and ICT Tools

Climate change organisations involved in mitigation activities need to understand emission sources, cost-effective abatement procedures, and policy approaches allowing ICTs to be used in identifying 'no regrets' policies which can encourage

[20] ITU, 2009

[21] The World Bank Group assembles and shares data to help set baselines for climate change, to identify effective public and private actions in adaptation and mitigation, to monitor progress on goals and targets, and to evaluate impacts. It provides and conducts research and shares findings which are mostly available online to help developing countries understand and address the impact of climate change (World Bank, n.d.)

mitigation at little or negative economic cost[22]. Exploring environmentally-sustainable business practices and models to transition towards a less carbon-intensive society is particularly relevant for developing countries[23]. Among these practices is the promising use of ICTs especially in energy efficiency. Within this strand, the potential of ICTs includes a variety of highly innovative applications aimed at improving energy efficiency in building, transport, communication and other sectors. Figure 4 shows how mitigation organisations could employ ICTs in their activities.

Figure 4: Organisations for Climate Change Mitigation: Activities and ICT Tools

	Consumption and Production	Energy Generation and Distribution	Energy Consumption
Organisations use ICTs to	…dematerialise goods and services	…ensure monitoring and minimum to zero losses	…advance energy efficiency at homes, offices, buildings, transport systems and industries
Examples of ICT tools	Journey substituting through online collaboration (VOIP, social networking); web-based applications; interactive media; satellite imagery	'Smart' grids; web-based applications	Green ICT, smart building design, green buildings, smart transport systems
Examples of organisations	All levels (organisational mitigation efforts))	Macro to micro (electricity companies - generators and distributors alike)	All levels (organisational mitigation efforts)

Source: Author's compilation from Kalas & Finlay 2009:16-17 and Ospina & Heeks 2010:15-16, 24-25

The activities of climate change organisations involved in mitigation range from reducing emissions in material consumption and production to energy generation, distribution and consumption. Within the organisation itself, standards and procedures may be checked against energy efficiency (see, for example, the activities of the International Telecommunication Union (ITU) [24]). Carbon audits within the premises of organisations may also be undertaken to intensify the use of ICT tools in carbon footprint reduction. Several dematerialisation activities utilising ICT tools may be employed including virtual meetings and other online collaboration. The use of ICT in smart building design is also emerging in the construction and building sectors. These among others are bright prospects for many developing countries.

[22] Meadowcroft, 2009.
[23] Ospina & Heeks, 2010:13.
[24] Johnson, 2010.

2.1.3. Climate Change Adaptation Organisations: Activities and ICT Tools

In developing countries, most organisational and programmatic focus has shifted from mitigation towards adaptation within the context of increasing international awareness over the magnitude of climate change and the impacts of extreme natural events to society and the economy. The organisational role of ICTs in the process of adaptation is presented in Figure 5.

Figure 5: Organisations for Climate Change Adaptation: Activities and ICT Tools

	Data collection	Analysis & Planning	Decision-making	Implementation & Management	Monitoring & Evaluation
Organisations use ICTs to	…collect, store and share data and information for developing appropriate adaptation strategies	…predict events (risk and early warning) and design appropriate adaptation strategies	…get the right information to the right people at the right time	…forecast, warn, and disseminate information and cope with short and long-term disaster	…provide an effective way to analyse, store and communicate the impact of adaptation strategies
Examples of ICT tools	Remote sensing techniques; sensor-based networks	Software-based modelling systems for scenario analysis	Media, including internet, SMS and broadcast (especially community radio); telecentres	Early warning systems and devices; emergency response systems	Software-based systems, digital databases, and repositories
Examples of organisations	Supra macro (World Meteorological Organisation through the Global Climate Observing System (GCOS); UN ESCAP[25]) Macro (national government agencies) Micro (local governments)	Supra macro (UN ESCAP[26]) Macro (national government agencies) Micro (local governments)	Macro (national government agencies) Micro (local governments)	Macro (national government agencies) Micro (local governments; community organisations, civil society)	Macro (national government agencies) Micro (local governments; community organisations, civil society)

Source: Author's compilation from Kalas & Finlay 2009:16, 18 and Ospina & Heeks 2010:17-20, 25.

[25] ESCAP (2010) has recognised ICT as a major player in this field learning from the frequency and severity of disasters in the Asia Pacific region as exampled by the 2004 Indian Ocean tsunami and 2008 Cyclone Nargis in Myanmar.

[26] ESCAP launched in September 2010 the Drought Monitoring and Early Warning Cooperative Mechanism which provides satellite products for general drought monitoring and higher resolution products for identified high drought areas and assists members in developing localised products and services for relevant decision-making.

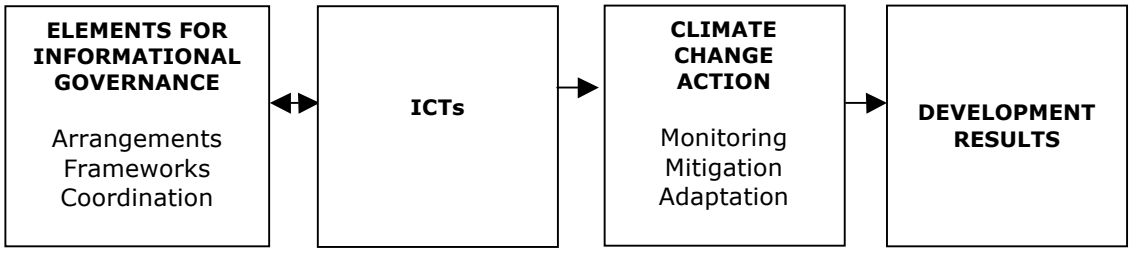
The international community – realising that extreme weather conditions and natural disasters result from climate change – adopted the Hyogo Framework for Action in 2005 to strengthen disaster preparedness, enhance early warning systems, and identify, assess and monitor disaster risks[27]. The potential and use of ICTs in climate organisations with activities focused on adaptation have started to emerge in the literature with examples such as the use of mobile phones in adaptation strategies[28]. Others include improving farmers' market information, raising agricultural production, and providing early warning during hydro-meteorological fluctuations to enable farmers to change cropping patterns[29]. In Figure 5, five adaptation activities are listed that – as for climate change monitoring – approximate to the stages of information systems operation: data collection, analysis and planning, decision making, implementation and management, and monitoring and evaluation. This series of activities could be taken as the procedural path of action for risk management. There are, of course, obvious activities that cross both adaptation and monitoring (as in 2.1.1).

2.2. Model for Informational Governance of Climate Change Organisations

The added value ICTs contribute as strategic tools for climate change action is well-known from other literature, and has only been briefly reprised here. As shown in Figures 3 to 5, the potential for ICTs in climate change activities is mostly accomplished through awareness raising, knowledge sharing and capacity development when viewed from an information systems perspective. The potential to use them as technologies for mitigation is also important. To dig deeper into this vast potential, we turn to the concept of "informational governance".

"Information governance" is the term we can apply to the use of ICTs as strategic tools in climate change governance. This concept integrates the key factors that help determine the role of ICTs in effective organisational governance for climate change action. This in turn, is intended to achieve development results amidst an uncertain climatic future. The concept could be best defined by using a model in which ICTs interact with a group of organisational properties that would enable organisations to monitor, mitigate, and adapt to climate change (see Figure 6).

Figure 6: Model for Informational Governance



Source: Author

[27] ESCAP, 2009. Although "disaster risk reduction" and "climate change adaptation" have different origins, they overlap a great deal through common factor of weather and climate and the similar tools used. It makes sense therefore to consider them and implement them in a systematic and integrated manner (ISDR, 2009).
[28] Ospina and Heeks, 2010a.
[29] UNDG, n.d.

The model allows us to analyse the dynamic interactions between organisational processes that play a role in the achievement of mitigation, adaptation and development at the three levels of analysis: supra macro, macro, and micro. The use of ICTs as strategic tools across these three levels implies that the tools must be an "integrated component of a development programme"[30]. The integration of ICT tools to development programmes is, therefore, contributory to the effectiveness of climate programmes in particular and climate organisations in general. The hypothesis and working assumption for this paper could then be stated as follows: good informational governance determines the effectiveness of ICT utilisation and development policy implementation in climate change organisations in order to achieve development results. One fundamental organisational virtue that is required to respond to climate change and development is "effectiveness." Unless there is a promise that a policy mechanism will produce net benefits, there is little reason to invest in governance[31]. We posit the same argument for climate-ICT policy. Effectiveness, being the sine qua non of organisational design, could be realised in climate change organisations through informational governance.

Informational governance of climate change organisations covers the use of political authority, organisations, and resources (with special focus on ICTs as strategic tools) at all levels. This elucidates the number of spatial dimensions and issues that crosses the concept which generally include: structures[32], resources (people and ICTs, oftentimes finance), human capacity (including training), strategies[33] (such as direction-setting), climate policy development processes (including integrating organisational activities and interventions with related development programmes), funding mechanisms, the use and role of monitoring (standards, evaluation, and indicators)[34], compliance and enforcement to ensure accountability, research and innovation (for strategy delivery, review and organisational evolution), and interventions (including projects and programmes).

The scope of informational governance is indeed broad. At the same time, it is a relatively complex concept and not much has been written about it even in developed countries. This paper therefore seeks to provide a modest contribution in this emerging field by drawing upon experiences across countries and international organisations to better understand its key elements. As a caveat however, this approach should be seen as illustrative rather than comprehensive.

3. Informational Governance of Climate Change Organisations

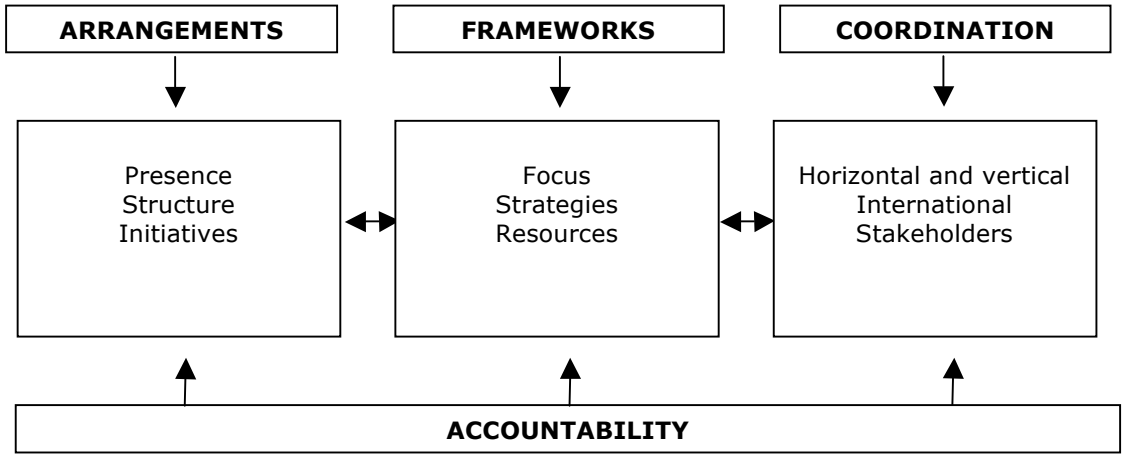
To grasp the concept of informational governance, it is essential to start by identifying essential elements in organisations favourable in achieving optimal performance. We can identify four elements of informational governance: arrangements, frameworks, coordination, and accountability. These elements could be understood as the "means" for achieving an "end." We can posit that the "end" is best understood as something that defines an "effective organisation." Each of the first three elements, in turn, has underlying identifiers (see Figure 7)

[30] Kalas & Finlay, 2009:14.
[31] Esty, 2008.
[32] Meadowcroft, 2009.
[33] Schreurs, 2010.
[34] FAO, 2009; FAO, 2010.

which are described in detail in 3.1, 3.2, and 3.3 respectively. Accountability, the fourth element for organisational effectiveness, is shown encompassing the first three elements. In order to provide a corresponding framework for these extended concepts, the model in Figure 6 is now supplemented by Figure 7 which lists the elements for ensuring effectiveness of informational governance.

To check whether these elements are present, at work, and responsive to climate change action, this paper suggests an assessment that could be done internally by organisations. A series of questions were identified at various levels of governance that need to be asked. As a caveat, it should be noted that this approach is by no means exhaustive, but does capture a substantial amount of practical information that would define effective informational governance at the micro, macro and supra macro level. Overall, this chain provides the support to our assumption that effective ICT utilisation in climate change organisations enables the achievement of development results.

Figure 7: Elements for Effective Informational Governance for Climate Change Organisations



Source: Author

3.1. Arrangements of Climate Change Organisations

The first leg of effective informational governance involves organisational arrangements, which include the typologies and broad range of organisations involved in climate-ICT policy as well as their structures and initiatives. Overall, the typologies and structures of climate change organisations should be appropriate and congruent to the level of ICT resources allocated in order to produce and sustain climate change action. Their design and structure should be reflective of their desired results. Although a number of organisational designs exist such as those for energy efficiency institutions[35], it should be noted that there is no single universal model that fits all. With regards to organisational initiatives for climate action, any approach, strategy and procedure adopted to support ICT tools in climate action should, in general terms, be easily understood, written in simple terms, and well-communicated to stakeholders[36].

[35] World Bank, 2008.
[36] Kalas & Finlay, 2009:44.

3.1.1. Presence

Organisational arrangements for climate-ICT policy exist variably across the three levels of governance. At the supra macro level, these arrangements take the form of international agencies (mostly attached to the United Nations), international NGOs, multilateral development banks, and private enterprises. At the macro level, these are usually in the form of ministries (oftentimes environment and energy ministries), specialist technical agencies (such as weather bureaus), energy generators and distributors, NGOs and private enterprises. At the micro level, climate change organisations may be seen as a division or a department of local governments, a community-based or civil society organisation. Their presence at each level is an important element in ensuring that appropriate climate change policies and actions are made, developed and implemented.

At the supra macro level, transboundary environmental issues through international regimes are a key issue[37]. At the macro and micro level, however, specific governance measures are required[38]. Above all, though, there is a need for nation states to put up organisations capable of undertaking climate change governance.

Thus, it is important that at the national level, governments are able to respond to questions such as:

- Are there organisations at the level of the nation state that are primarily tasked to deal with climate change?
- If there are, what are these organisations?
- How do they exist? Is it at the level of a ministry, a specialised technical body, or as a committee consisting of multiple agencies?
- What are the constraints for establishing a primary climate change organisation in developing countries? How could these challenges be overcome?
- Does the nation state participate in the international climate change regime? How and in what capacity?

The responses to these questions signal whether at a baseline point, appropriate organisations have been put up to address climate change and involve themselves in a larger process at the supra macro level. A negative response to any of these questions provides the opportunity to create a primary organisation. Building an appropriate organisation at the macro level may be easy for some countries but may be difficult and take time especially in developing countries. Low-income countries should at least aim to develop a competent basic climate administration[39]. In summary, presence of a particular organisation established especially for climate change issues is a first signal of effective informational governance.

[37] See for example, Bulkeley, 2005; Siebenhuner, 2008; Ivanova, 2010.
[38] Meadowcroft, 2008.
[39] Ibid.

Local governments, especially in the most vulnerable developing countries have an important role in local adaptation and response, generally because they have the primary responsibility for a wide range of infrastructure and service provision, for implementation of regulatory frameworks, and because of their spatial proximity to the consequences of climate change. ETekwinin Municipality (previously a part of Durban Municipality in South Africa), for instance, through its own Environment Management Department developed the 'Headline Climate Change Adaptation Strategy' highlighting how key sectors should respond to climate change[40].

However, good local governance and management depends on the active engagement of other local stakeholders and a supportive national government[41]. The former is oftentimes represented by civil society groups facilitating effective climate change action, especially in evacuation and distribution of emergency supplies in the case of extreme events. National governments, on the other hand, have the key role in providing the legislative, financial and institutional basis within which micro-level organisations respond to climate change. It is therefore necessary that at the micro level of governance, the following questions are answered:

- Does the local government have a lead division to identify and spearhead local initiatives on climate change issues especially in most vulnerable places in developing countries? How does this exist? Is this through some form of legislation or as an initiative of the local government?

- What kind of support does this division get from other levels of governance (such as national government, international organisations, and community stakeholders)?

- What types of non-governmental climate change organisations typically work at the micro level? How do they exist?

- How can local governments tap the capacity of civil society groups in climate change action?

3.1.2. Structures

An administrative structure is required to implement any kind of climate-ICT policy. While climate change organisations can perform any type of climate-ICT activity, there are situations when some of these functions could only be performed by governmental organisations, by the private sector, or through collaboration among organisations[42]. Whatever the case is, an appropriate structure is needed.

At the supra-macro setting, structures of international organisations are often defined by multilateral agreements involving different governments such as the case of many agencies of the United Nations[43]. However, there is widespread

[40] Dodman & Satterhwaite, 2008.
[41] Dodman & Satterhwaite, 2008.
[42] Meadowcroft, 2009.
[43] Pelletier, 2010.

agreement that the international environmental regime suffers from significant design flaws and does not provide a functioning institutional structure[44]. This, in itself, is a big challenge especially since structure has direct implications for organisational effectiveness and legitimacy. At the macro level, governments are primarily responsible for designing the structures of climate organisations, whereas structures at the micro level may be defined by both the government and civil society.

Appropriate response can only be defined through appropriate organisational structuring, which in turn determines organisational needs and their set up at appropriate levels. Given these realities, it is important that structural frameworks for monitoring, addressing, and adapting to climate change are laid out by answering:

- What are the existing structural designs of climate change organisations at the supra macro, macro and micro level?

- How does the current organisational structure facilitate the need for effective climate-ICT policy?

- Does the current structure impede the organisation in programme delivery? What are these structural challenges?

Responses to climate-related emergencies also take a multilevel approach which involves collaboration among various organisations across the three levels. Nevertheless, the placement of local communities existing at the micro level is an important consideration for organisational structuring. Their role in climate change action is understandably critical due to their familiarity with local circumstances that macro and supra macro organisations often do not have[45]. Citizen engagement through the use of ICT tools offers an opportunity given the scale of climate impacts[46]. This has important implications especially for adaptation activities.

3.1.3. Initiatives

Climate-ICT initiatives are programmes and activities involving ICT deployment for climate change actions. They represent another organisational condition for effective informational governance. There are a number of sound examples of initiatives across the three levels of governance in the form of symposia, seminars, development of e-toolkits, community-enabled models resulting from GIS, mobile applications, and others.

The scope of such initiatives was outlined above in Figures 3 to 5, and there and in the broader literature, examples are provided. One example of a climate-ICT initiative at the supra macro level is the ITU-developed e-Environment Toolkit and Readiness Index which responds to the need for a strategic planning framework to enhance the capacity of countries to use ICTs for environmental management.

[44] Esty, 2008; Young, 2008
[45] Schreurs, 2010
[46] Ospina & Heeks, 2010:13

The Index is a practical tool for rapid assessment of a country's potential for using ICTs to help mitigate and adapt to environmental and climate change[47].

Awareness raising and knowledge sharing could be accomplished through symposia such as the ITU-sponsored international symposium on climate change in 2009[48]. UNESCO had also held a seminar in 2009 to identify learning materials and good practices on climate change education, and how to enhance their dissemination via suitable ICT tools[49]. UN ESCAP is also involved with training on the use of ICTs in adapting to climate change[50]. A final supra macro example is the use of the online Climate and Tourism Information Exchange Service in the activities of the World Tourism Organisation which have direct relevance for many highly vulnerable developing island states where tourism is a principal economic resource[51].

At the macro to the micro level, a number of climate-ICT initiatives could be listed. One is the agricultural clinics in India and online advisory service in Chile where rural communities, mostly farmers, get access to relevant information[52]. In addition to improving the links between micro systems and macro-level organisations in providing enabling conditions for climate adaptation, these kinds of initiatives have increased the information assets available and the capacity of human capital at the micro level, which obviously can be tapped during climate-related events[53].

Both traditional and emerging technologies have the potential for awareness raising and knowledge sharing[54]. Recognising this, climate change organisations in developing countries may exploit the potential of community radio, for instance, to help in informing and involving communities in local climate actions[55]. In the Caribbean, for example, collaboration among various organisations resulted to the launching of *My Island – My Community,* a regional drama serial aimed at building public awareness on climate change adaptation[56]. Evidence on other uses of ICT tools in climate action in developing countries is present in the literature[57].

However, informational governance does not end at simply having climate-ICT initiatives but in reflecting on the effectiveness of such initiatives, and in learning which performed well and which did not[58]. Thus it is important to ask:

- What are the good and bad practices in planning, implementing and monitoring climate-ICT initiatives that are similar to the initiative of the focal organisation, especially in developing countries?

- Where could the organisation find resources on climate-ICT initiatives? Are their repositories of good practices available?

[47] ITU, 2009
[48] ITU, n.d.b
[49] UNESCO, n.d.
[50] ESCAP, 2009
[51] World Tourism Organisation, n.d.
[52] Stienen, Bruinsma & Neuman, 2007.
[53] ESCAP, 2009.
[54] ESCAP, 2009:3.
[55] Ospina & Heeks, 2010:25; Kalas & Finlay, 2009:22-24.
[56] PCI-Media Impact, 2010.
[57] See Ospina and Heeks, 2010:25-26; Kalas & Finlay, 2009:22-45 for examples.
[58] Ospina & Heeks, 2010:14; Kalas & Finlay, 2009:20.

- Upon identification of climate-ICT initiatives, how could macro and micro climate organisations in developing countries adopt and replicate the good ones while trying to avoid the bad ones?

- Where could ICT tools be best positioned to make these lessons available for other climate change organisations?

Responses to these questions allow climate change organisations to learn from each other and to replicate or adapt climate-ICT initiatives in their own situation. It also allows them to classify initiatives, procedures and actions which are working and which are not.

3.2. Frameworks of Climate Change Organisations

This organisational element confers authority, attracts attention and provides resources for the utilisation of ICTs in climate change and development policy implementation. The organisation must possess focus, establish strategies, and allocate (or be allocated with) funds, which in most cases could be enabled by an appropriate piece of legislation. At the macro level, such legislative frameworks oftentimes include: an articulation of government policy's purpose and intent, and the justification for government intervention. Across all levels, frameworks usually involve the inclusion of specific, quantitative, time-bound goals or targets, and provision of funding and other necessary resources.

Focus is inevitable to ensure organisational effectiveness and could be realised only if strategies for ICT mobilisation and utilisation are made available. The functions of ICTs as part of climate change action are incorporated into longer term development planning and practice in the organisation. Targets and goals often provide the solid basis for organising successful initiatives. In many cases, funding mechanisms to enable ICT use in informational governance are a serious challenge, especially in developing countries.

3.2.1. Focus

Organisational focus is an important indicator for the frameworks of climate change organisations to achieve effective informational governance since it provides the statement about how the organisation utilised (and will utilise) ICT tools and where it is headed. Organisational focus manifests in the context of responses that are made appropriate to the scope of the problem[59]. At each level, it is therefore helpful to ask:

- What is the primary focus of the organisation in the utilisation of ICT tools in climate change action? Is it specific to monitoring, mitigation or adaptation? Or does it cross these three?

- How has the focus evolved? What processes were involved in arriving at this statement?

[59] See Schreurs, 2010 for examples.

- How is the focus conveyed? Is this written as a part of an important document such as the organisational mission?

- Does the organisational focus manifest itself in the current climate-ICT initiatives and future directions of the organisation?

- How does the organisation communicate its focus internally and externally?

- How are ICT tools placed in achieving organisational focus, and which ICT tools are included? Are they also utilised in the process of communicating the organisational focus?

Different problems warrant different responses. Whatever the case, the kind of organisational focusing should generally respond to the problem at hand. The potential and role of ICT tools in determining the problem is therefore significant in defining the primary focus of the organisation, the mode of conveying this focus to relevant stakeholders, and role of the tools in the process.

3.2.2. Strategies

In order to materialise organisational focus on the use of ICTs in climate action, strategies and plans are made to effectively implement climate initiatives[60]. Targeting and goal setting – from organising programmes to justifying funding, and obtaining resources – are necessary elements for strategy formulation since targets and goals provide the basis for initiatives. A common tool for measuring policy implementation is to compare actual data against targets. This measure determines whether strategies are effective or not. Whether the initiative is for monitoring, mitigation or adaptation, it is important that organisations lay out their targets at the beginning of their intervention and continually check their progress against these baselines. Throughout this process, ICT tools play important role.

- How does the organisation lay down its targets and goals in the effective utilisation of ICT tools in climate action? What are its strategies? Are these clearly worded and communicated to stakeholders?

- How does the organisation utilise ICT tools in the process of strategic implementation? Do ICTs also play a role in checking actual data against targets?

- How does the organisation utilise this information to strengthen climate-ICT initiatives?

- What are the barriers and challenges that developing countries face regarding access and capacity in adopting ICT tools in climate change action?

[60] Ibid.

3.2.3. Resources

At different levels of governance, climate-ICT initiatives need to be assigned with adequate resources available to maximise the potential and role of ICTs. At this point however, no one has yet attempted to estimate the overall ICT requirements at any level. Incorporating ICTs into the functions of climate change organisations must take into account numerous resource issues – personnel, technical and financial especially. Funding provisions are critical when determining the framework of the organisation. The level of funding usually determines the scale of governance (as in the case of governance of energy efficiency institutions[61]). Nevertheless, funding should not always be seen as an external intervention rather it should also be considered as potentially emerging from within. It is important then that organisations are ready to respond to questions such as:

- What are the necessary ICT tools to be procured in the short and the long term? Does the organisation conduct an appropriate inventory to identify these?

- What skill sets are required and where do they currently exist? How should the organisation prepare its people to the influx of new technology in climate monitoring, mitigation and adaptation?

- What actions should the climate change organisation take to ensure it has appropriate tools?

- What are the available mechanisms for ensuring that developing countries have access to these tools?

- Where should funding come from? How could the organisation design its framework to be more independent of external funding, if possible?

The responses to these questions are related to choices about resources which need to be reflected in designing appropriate strategies. Although capacity building can take a long time, especially in developing countries where other development objectives are the priority, there are options available for countries to upgrade their equipment[62]. Possibilities range from applying for grants to approaching multilateral funders to collaborating with neighbouring countries at the sub regional level.

3.3. Coordination among Climate Change Organisations

The creation of coordination mechanisms both within and across the three levels of governance directly impacts the effectiveness of climate change policy, action and development results. The necessity for coordination is directly related to ensuring mobilisation of the complex network of organisations required for successful and effective informational governance. FAO further reports the necessity for alliances stressing that effective social change on any development issue emerges from alliances of social interests rather than from one specific

[61] See Jollands, Gasc & Pasquier, 2009:35-36.
[62] ESCAP, 2009:4.

programme[63]. Similarly, work on neoinstitutionalism trace the shift of governance away from the conventional process of public administration to a process involving actors from within and outside the aegis of public office[64].

In the neoinstitutionalism sense, capacity building, balancing structures, and maintaining flexibility are necessary for effective coordination[65]. These can lead to more comprehensive policies, improvements in climate-ICT implementation, efficiency in the utilisation of resources, and improved stakeholder participation. Although organisations may exhibit coordination either horizontally or vertically or both directions at the same time, coordination mechanisms always vary according to the inherent complexity of their arrangements. In sum, coordination is the mesh that ties the many elements of informational governance altogether.

3.3.1. Horizontal and Vertical Coordination

Coordination within and among climate organisations happens either horizontally or vertically where state and non-state actors play a variety of roles[66]. Horizontal coordination is especially recognised in the form of intra-agency cooperation at the macro level to address overlaps and duplication. This type of coordination allows for informed discussions among organisations at the same level of governance to ensure effective decision-making and good policy implementation. In informational governance, coordination provides opportunities for new ideas and allows efforts and ICT tools that are proven effective to be replicated at other levels. Moreover, coordination improves implementation, and helps identify and resolve policy gaps between micro, macro and supra macro strategies and policies. Examples of coordination abound across the three level of governance. In China, for example, there is growing awareness that climate mitigation must involve a multilevel governance approach[67]. These approaches usually involve energy conservation and improved energy efficiency in action plans[68]. Climate change policies are coordinated vertically from China's 27 central government ministries and agencies all the way down through provinces and autonomous regions to individual cities. The same set-up could be observed in many developing countries.

Many of the governance structures necessary to assure effective vertical and horizontal collaboration among organisations, however, remain underdeveloped[69]; thus presenting a number of opportunities. In ensuring that organisations get optimal results out of coordination, it is important to ask these questions:

- What are the mechanisms adopted by governments to facilitate effective coordination in the horizontal (across agencies) and vertical (addressing porosity of the three levels of governance) directions?
- What are the existing coordination mechanisms at the level of the organisation? How about with other levels?

[63] FAO, 2009:7, 23-25.
[64] Paavola, 2007.
[65] Ibid.
[66] Bulkeley, 2005.
[67] Koehn, 2008 in Schreurs, 2010.
[68] Qi et al., 2008 in Schreurs, 2010.
[69] Corfee-Morlot et al., 2009 in Schreurs, 2010.

- How are the current coordination arrangements affecting the delivery of climate-ICT initiatives? What are the pros and cons?

- How should the organisation maximise the potential of coordination in the horizontal and vertical directions?

- What are the necessary and critical factors for ensuring effective coordination?

- What are the lessons learned from coordination that worked, is working, and did not work?

- How could the climate change organisation utilise the potential of ICTs for effective coordination and in building strategic and operational partnerships? What are the examples of mutual support in the field?

- Where are the gaps and what are the challenges for coordination and forging new alliances?

3.3.2. International Cooperation

The importance of international cooperation in approaching transboundary environmental problems has long been acknowledged through multilateral environmental treaties and regimes[70]. Over time, informational governance of climate change organisations especially at the supra macro level would be commonplace. The literature is rich in emphasising the potential of ICT tools in international cooperation driven by the need to scale-up the utilisation of ICTs in response to climate change and development concerns where international support and cooperation are instrumental in the establishment of a number of programmes around the world[71].

At the supra-macro level, the World Meteorological Organisation promotes cooperation in the establishment of networks for making weather observations, as well as the exchange, processing and standardisation of related data, and assisting in technology transfer, training and research[72]. One of its initiatives, the WMO Information System is built upon the global telecommunication system of the WMO World Weather Watch encompassing three types of centres: global information system centres (for regional and global connectivity), data collection or production centres (for data generation, processing and archiving), and national centres (for collecting and distributing data on a national basis)[73].

The Global Climate Observing System (GCOS) jointly undertaken by WMO, the Intergovernmental Oceanographic Commission of UNESCO, UNEP, and the International Council for Science is another example of a coordinated system of methods and facilities for making environmental observations on a global scale[74]. These facilities provide observations of the atmosphere and ocean surface for the

[70] Haas, 1999.
[71] FAO, 2009:11-12
[72] WMO, n.d.
[73] WMO, n.d.c
[74] WMO, n.d.b

preparation not only of weather forecasts and warnings, but also for national and international climate-related observations[75].

Regional examples include the UN ESCAP Regional Cooperative Mechanism on Drought Monitoring and Early Warning created to help its member states across the Asia-Pacific Gateway on Disaster Risk Reduction and Development in the context of climate change adaptation. This Gateway consists of a one-stop information portal where member states exchange knowledge, and obtain ESCAP expertise in areas such as the development of policies, and post-disaster assessments of damage and losses[76].

At the micro level, the growth of awareness and concern with climate change has initiated networking among cities[77]. Activities in these networks range from sharing information about best practices for energy efficiency improvements, air and water pollution control, and GHG mitigation where the use of ICTs in information sharing has been proven valuable.

Given these examples, it is helpful for climate change organisations to explore possibilities for cooperation at the supra macro level especially at times when micro and macro organisations do not have the necessary resources to monitor, mitigate and adapt to climate change on their own. The challenge for developing countries, however, relates to the inaccessibility of appropriate and timely information in those vulnerable environments which need this information most, due to the lack of infrastructure and skilled human resources[78]. But this could be addressed by collaborating with other nation states at the supra macro level such as via the above-mentioned WMO information system.

At the country level, macro and micro organisations could utilise these data to design an appropriate action, either in mitigation or adaptation. Important questions such as the following could help organisations at these levels in accessing the rich resources available at the supra macro level:

- Which existing cooperation mechanisms at the international level do macro and micro organisations involve themselves in, especially on the utilisation of ICT tools in climate action?

- What mechanisms and arrangements at the supra macro level allow micro and macro organisations to cooperate? How could micro and macro organisations participate in these cooperation mechanisms?

- What are the preconditions for joining these international cooperation mechanisms? How could micro and macro organisations prepare themselves to meet these preconditions?

[75] WMO, n.d.
[76] ESCAP, 2010
[77] Schreurs, 2010 lists a handful of local government networks that adopted climate change action in their activities.
[78] Ospina & Heeks, 2010:12.

3.3.3. Stakeholder Engagement

Stakeholder engagement in policy initiatives has been increasingly utilised across different levels. This has been a trend in development programmes where active participation in decision-making is a norm. Designing a climate change and development policy is a complex process; thus making it a challenging task. This complexity requires consideration of different perspectives, and this consideration applies equally to climate-ICT initiatives[79]. Here, stakeholder engagement is seen as a way to capture this diversity in order to develop more effective ICT-based solutions.

Multistakeholder mechanisms are important to make relevant information accessible to end users[80]. For example, intermediary organisations have to connect rural communities to available knowledge. Users will increasingly want tailor-made, quality answers to their questions. Examples where communities engage themselves range from mobile Q&A services in India to the extensive use of mobile telephones in rural South-East Asia and Africa.

In ensuring that stakeholders are engaged in climate change actions and that they participate actively, the following questions would be helpful to organisations:

- What are the existing practices at the micro, macro and supra macro level in ensuring that stakeholders are engaged in the important processes of climate change action?

- What are the challenges encountered so far?

- How could organisations utilise ICT tools to ensure effective stakeholder engagement for climate action?

- What are the challenges for realising this? How could these barriers be hurdled?

3.4. Accountability

Accountability arrangements, such as oversight and evaluation in strategy implementation of ICT-based climate change action are an important element for ensuring effectiveness in informational governance. Accountability is at the core of any organisation and this could be ensured with proper evaluation procedures and techniques[81]. As in other case, there is a dual role for ICT here. It is a component of climate action strategy for which organisations must be held accountable. But ICT can also serve as a strategic tool for increasing accountability by providing better access to information[82]. Evaluation and monitoring have critical roles to play in ensuring that climate change organisations are developing and implementing climate-ICT initiatives and that these actions are accomplished as originally planned. It makes them accountable for results, and this can be improved by addressing the following questions:

[79] Santos et al., 2006.
[80] Ospina & Heeks, 2010:14.
[81] Backstrand, 2008.
[82] Kalas & Finlay, 2009.

- In the current arrangements, who is providing oversight? In case there is none, who may be able to provide it?

- What are the evaluation mechanisms available for organisations to assess their performance?

- What is the frequency of evaluation? Where it is situated? Is it during or after the process? Or both?

- Who conducts the evaluation? Who is involved in the evaluation process?

- What are the mechanisms adopted by organisations to ensure that the evaluation yields credible results?

- How does the organisation utilise the results of the evaluation?

- Does the presence of ICT within strategic plans present any specific accountability issues?

- How does the organisation position and use ICT tools during the evaluation process of climate-related activities?

- What challenges do organisations face during the evaluation process?

Whether the climate change organisation is created by an international agreement, a national institution, an NGO, or a private entity, evaluation results provide the measure of outcomes against targets consequently providing an overall barometer for organisational performance.

4. Conclusions and Recommendations

Effective governance is the key to effective action for climate change organisations, and it demands strategic planning and implementation. The increasing insertion of ICTs as both a component of external strategic action, and a tool for internal planning and implementation presents both challenges and opportunities for these organisations. This paper has sought to identify the factors which underpin the "informational governance" that is necessary to make the most of ICTs for climate change. However, this only starts the debate on the emerging notion of informational governance signalling a larger opportunity to conduct research on the topic.

After listing some illustrative climate-ICT initiatives and asking organisations important informational governance questions in the preceding sections, this section wraps up the paper by determining the challenges and opportunities to enhance informational governance.

Acknowledging the fact that much remains to be explored in terms of the role and potential of ICTs within the climate change field, the analysis in this paper sheds light on key concepts and practical experience that help better understand the complex linkages that exist within the context of informational governance of climate change organisations. As with other branches of the emerging literature

on the nexus of ICTs, development and climate change, emerging evidence is often anecdotal with regards to climate change organisations and the ways they employ ICTs as a tool for climate change action[83]. Overall, the analysis undertaken above of the potential contribution and role of ICTs in climate change organisational governance is not easy. However, international and national experience as shown in this paper demonstrates the existing and varying challenges to coordinate, communicate, and share vital climate change information for monitoring, mitigation and adaptation among various actors and stakeholders.

The impact of ICT on the governance of climate change organisations could be far and wide. This could be done through creating new possibilities for linking regimes and creating networks that bypass blockages in existing organisational arrangements. ICTs in organisations are expected to enable small-scale climate change actions to be effective, facilitate more responsive and appropriate national and local governance, and help climate change organisations to exist and connect more easily. Although ICT provides the necessary tools and implements to better understand, manage and adapt to the varying effects of climate change and extreme weather events, it also has important limitations that need to be considered. We then turn now to discussing some of these challenges, and their possible solutions.

Before looking at these specific components though, mention must be made of the cross-cutting issues that face informational governance in developing countries, and of the need to take into account the broader development picture within which developing country governments, institutions and agencies operate. These may further challenge climate change organisations in those countries and/or may limit their ability to take up some of the recommendations provided here. Space prevents a full consideration of these challenges but the most obvious would be resource constraints: the limitations of ICT infrastructure, human resources and finance that were seen as important to various parts of informational governance. These knock-on into constraints on organisational capacity including governance deficits and hindrances to strategic planning. And yet, simultaneously, we have noted that developing countries are most in need of climate change action; most in need of the support to climate change response that ICTs can provide. It is thus to be hoped that priority is given to overcoming and/or working around the specific informational governance challenges that developing countries face in order to make effective use of ICTs for climate change action.

4.1. Arrangements

Ultimately, all countries will require systems to govern climate change monitoring, adaptation, and mitigation. At the macro level, the extent of national socio-economic development and the effectiveness of existing climate change organisational arrangements have direct relevance for informational governance as well as for the priorities that governments are adopting in relation to climate change. Developing countries should therefore aim to create or identify and sustain a competent climate change organisation at the macro level. This is basic.

[83] Ospina & Heeks, 2010: 25-26.

The strengthening of informational governance for climate change organisations at all levels should be a national agenda in the long run. At the national level involving macro and micro governance, this could be accomplished by creating and passing policy and legislation on the role of ICTs in climate change action. ICT tools should also be included into national development plans and successfully integrated into local plans. The important factor for strengthening human and organisational capacity however does not end with legislation and policy but with their sustainability. To achieve this, the development of ICT and its integration in climate change action should receive continued support.

Organisations should avoid complexity, overlaps and duplication by simplifying procedures as much as possible. Developing and implementing effective procedures and programmes is not an easy task but ICTs could in their internal role provide a means to do this.

A fully-developed system for mobilising ICT resources in support of climate change actions and goals means moving a number of parts that need to be interconnected. Developing such organisational arrangements and structures could take years and incur significant resource costs, especially for developing countries. However, it is important to take into account existing organisational resources and capacity in apportioning organisational responsibilities which in some cases may mean creating an entirely new organisation.

4.2. Frameworks

In order to effectively implement ICT applications for climate change action, an enabling environment that fosters ICT infrastructure development along with strengthened human and organisational capacity is required. Although awareness on the use of ICTs in climate change action has increased in parallel with the increasing affordability and reach of ICT tools, the current situation in many developing countries renders it unrealistic to put everything in place soon. The lack of skilled staff to analyse and interpret data gathered by ICT tools for decision making is another organisational challenge in many developing countries which comes mostly along with the absence of effective organisational frameworks for data handling.

Effective informational governance depends on strong human resources, ICT tools that work, and well-developed organisations. Gaps and deficiencies in staffing and equipment of technical agencies responsible for climate change action should be addressed. Developing countries whose personnel and organisational faculties are weak may join cooperative mechanisms available at the regional and international level such as those mentioned in 3.3.2.

4.3. Coordination

Considering the impact of lower transaction costs and higher speed of iteration, it becomes clear that ICT allows the easy creation of cross-border organisations and collaborations[84]. This extends across the three level of governance to demonstrate the role of digital technology in supporting general climate governance. For supra macro organisations, whose basic mission is to encourage collaborative work

[84] Kennedy, 2010.

among its global members, remote collaboration is a bright prospect. This may include audio and video conferencing, instant messaging and chat, etc. Workshops held online can also address a wider audience, notably reaching participants from developing countries. Organisations need to identify the opportunities for cooperation through networking. Organisational mechanisms need to be in place to ensure learning and information sharing. At the supra macro level for instance, "commitment to robust programs of data collection, problem identification, risk assessment, trend tracking, comparative metrics on policy performance, and other elements of cross country benchmarking" is critical for international institutions[85]. Regional and international organisations should therefore establish cooperation across specific clusters of countries to achieve greater possibilities for collaboration and data sharing.

In many cases too, climate change policy at the national level falls within the purview of the Environment ministry while ICT policy is the responsibility of a different ministry such as Information or Telecommunications. This division demands increased coordination among organisations by establishing inter-agency coordination mechanisms. Organisations also need to identify and engage stakeholders to create a community of interest. Stakeholders include those who are affected by climate change and extreme weather events and those who are doing something about it; thus their involvement in policy development can improve quality and help build consensus. Again, there is a dual role here: stakeholder engagement is a necessity for effective strategic use of ICTs in climate change, but also ICTs can enable the stakeholder engagement that underpins effective climate change strategy planning and implementation.

4.4. Accountability

Across countries and regions, perspectives on the role of evaluation vary but its importance is recognised everywhere. The data gained from a good evaluation are vital for improving organisational policy, initiatives and climate-related actions, and for communicating results to stakeholders. The process of evaluation, therefore, fosters innovation, increases credibility, and helps build consensus for future undertakings.

The process of designing evaluation materials starts with identifying the objectives. It is therefore necessary that at the beginning of the programme development process, evaluation needs are taken care for[86]. If applicable, the evaluation plan should involve programme designers, implementers and other stakeholders. What is actually needed is an evaluation process that yields credible information, objective analysis, and transparency of programme results.

4.5. Future Research

This paper provides only a preliminary attempt to elucidate some of the concepts that could be built upon the notion of "informational governance" for climate change organisations especially in developing countries. Owing to the novelty of this notion, a number of opportunities arise for further investigation. These could include:

[85] Esty, 2008
[86] FAO, 2009; FAO, 2010

- A larger study across climate change organisations hinged on the informational governance framework presented in Section 2 that would enrich the elements discussed in Section 3. This would not only provide the necessary evidence on the obvious importance of ICT tools in climate change governance but also allow for the determination of gaps, barriers and challenges.

- A study on the successful (and less successful) application of ICT tools in general environmental and climate change governance in different contexts in the developing world would provide specific and important guidance.

- The development of toolkits, guidelines, or similar instruments for climate change organisations would outline the elements and factors for effective informational governance based on the results of these studies.

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