CASE STUDY
Category: ICTs and Climate Change Monitoring

Climate Change, Innovation & ICTs Project

Centre for Development Informatics (CDI), University of Manchester, UK
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Learning from Egypt's Environmental Monitoring and Reporting Systems

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Initiative Overview

Egypt is facing increasing soil salinity and erosion of its agricultural lands in the Delta due to water level rises in the Mediterranean and decreasing flow of Nile waters. Coupled with meteorological changes impacting agriculture and rising demand for both water and food due to population growth, the country's climate change challenges are focused on adaptation in integrated coastal zone management, agriculture, and water resource management.

In its efforts to deal with climate change, Egypt ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1994, and was a signatory of the Kyoto Protocol in 1999, the latter having been ratified in 2005. Due to the Egyptian government's ratification of the UNFCCC it is obliged to provide periodic country reports that include data on climate, climate change and climate change effects, and also details of the adaptive and mitigative initiatives the country is implementing or is planning to implement. In order to produce such reports – and, more generally, in order to develop climate change policies and plans – a country needs an effective monitoring and reporting (M&R) system to gather all the different types of data from a wide variety of stakeholders.

What follows is therefore a case study of a developing country trying to set up its M&R system, particularly with a view to meeting its UNFCCC obligations. The Egyptian experience shows that it is relatively easy to set up the technical side of the system – the ICTs – but that this is not sufficient to ensure an efficient, integrated and sustainable tool for collecting, analysing and tracking climate change-related data and indicators that support decision making. The difficulties faced by Egypt in setting up its general climate change M&R system are contrasted with the relative success of two much more specific environmental information systems which have some climate change relevance: one monitoring water quality, one monitoring air quality.

Application Description

Egypt has a number of individual information systems of some relevance to climate change monitoring. Some – such as those of the National Authority for Remote Sensing and Space Sciences (see: http://www.narss.sci.eg/Projects.aspx) – directly relate to climate change. However, these are more for scientific purposes rather than national reporting. This study will therefore focus on the two M&R systems that have been used by major stakeholders and have contributed to decision making: the Marine Water Quality System and the Greater Cairo Air Quality Project. While not solely concerned with climate change – these are more general environmental monitoring systems – each does have some climate change relevance, and each can provide lessons for climate change information systems.

Egypt does not have a national, integrated climate change monitoring and reporting system. Even line ministries do not have M&R structures for climate change in their sectors. In the absence of a national climate change monitoring and reporting system, the UNDP Global Environment Facility has been facilitating the SMRES project: Strengthening the Monitoring and Reporting Systems of the MEAs

(multilateral environmental agreements). Its goal has been to aggregate data across multiple sectors in Egypt to report to national decision makers and, internationally, to the Rio Conventions (http://www.cbd.int/rio/ - which include UNFCCC). But SMRES has been struggling to fulfil its mandate due to a number of obstacles that will be discussed further below, and contrasted with the experiences of the water and air systems. At the time of writing, SMRES appeared to be in abeyance, undergoing a period of re-assessment to improve its output.

In the three examples above – water quality, air quality, and SMRES – ICTs provide the technical underpinnings of the monitoring and reporting systems. ICTs are used in the scientific equipment that tests and analyse (e.g. air, water) samples, and then aggregates the data and passes it on to the central information system. That central system is ICT-based and stores, processes and communicates the environmental data. More specifically, geographic information systems (GIS) are used within the systems to display the data. (This case study focuses on monitoring and reporting, and therefore does not include other uses of ICT, including modelling of climate change, and disaster early warnings systems.)

Drivers and Purposes

The Egyptian Environmental Affairs Agency (EEAA) has identified five key areas of vulnerability in the country that are likely to be exacerbated by climate change: coastal zones, agriculture, water resources, human health, and coral reefs.

For example, Egypt is a country that has been, and is projected to be, highly vulnerable to rising sea water levels; those sea levels in turn occurring due to climate change (Agrawala *et al.* 2004); see also Figure 1. The Nile Delta already has a salt wedge reaching 30 kilometres inland and there is not enough water in the northern part of the Delta to wash out the sewage, fertilisers and industrial waste that accumulate in the soil. If the projections of the Intergovernmental Panel on Climate Change (IPCC) are right the Nile Delta will lose one third of its lands by 2050, resulting in massive displacement of people and loss of valuable agricultural land (Hassanin 2010). The government has been implementing adaptive measures and is monitoring changes in sea levels both on its northern borders with the Mediterranean and along the Red Sea.

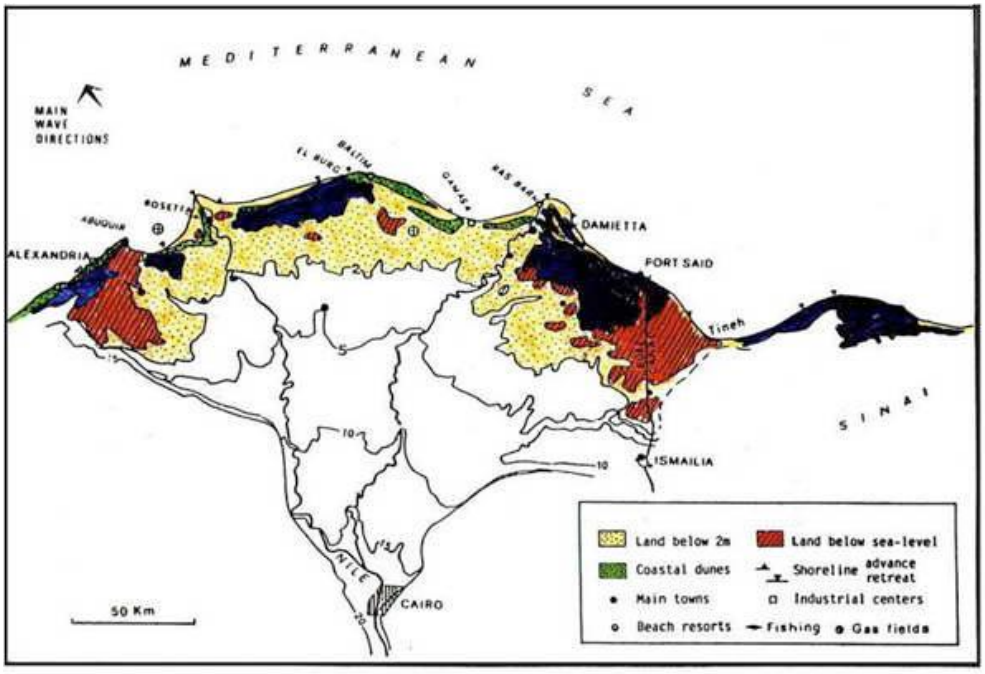

Figure 1: Nile Delta Topography Showing Areas in Danger due to Climate Change (source: El Raey 2007)

More generally, agricultural production and food supply are being threatened by climate change. There are also strong concerns about sustainability of fresh water supply. Many of the causes of water quality and availability problems are non-climate change related – e.g. the rising population, industrial output and agricultural run-off – but growing salinity and changes in rainfall patterns due to climate change are making matters worse. Likewise with air pollution, a major problem in Egypt's main urban areas. This has traditionally be handled separately from climate change, but the two are interconnected: air pollutants contribute significantly to climate change, and it is also possible that climate change may exacerbate some aspects of air pollution (SEI 2008).

In the face of these exacerbated vulnerabilities, the government needed to gather data on the current status of these issues, in order to make well-informed and effective decisions. It therefore facilitated the creation of the three monitoring and reporting systems identified earlier:

- The Marine Water Quality System which (see Figure 2) gathers data and reports on water quality in coastal areas, covering both quality of sea water (e.g. including pollution around coral reefs in the Red Sea) and also the impact of saline water on coastal agriculture.
- The Greater Cairo Air Quality Project which (see Figure 3) gathers data and reports on air quality in the Greater Cairo area, focusing on levels of lead, hydrocarbon particulates, NO_x gases, and black carbon among others.
- SMRES which aims to be cross-sectoral, and integrate various sources in order to support global reporting on climate change.

As noted above, all three of these systems are completely dependent on ICTs for all aspects of their functioning: data capture, storage, processing, and output.

Figure 2: Coastal Water Monitoring Stations (courtesy EEAA)

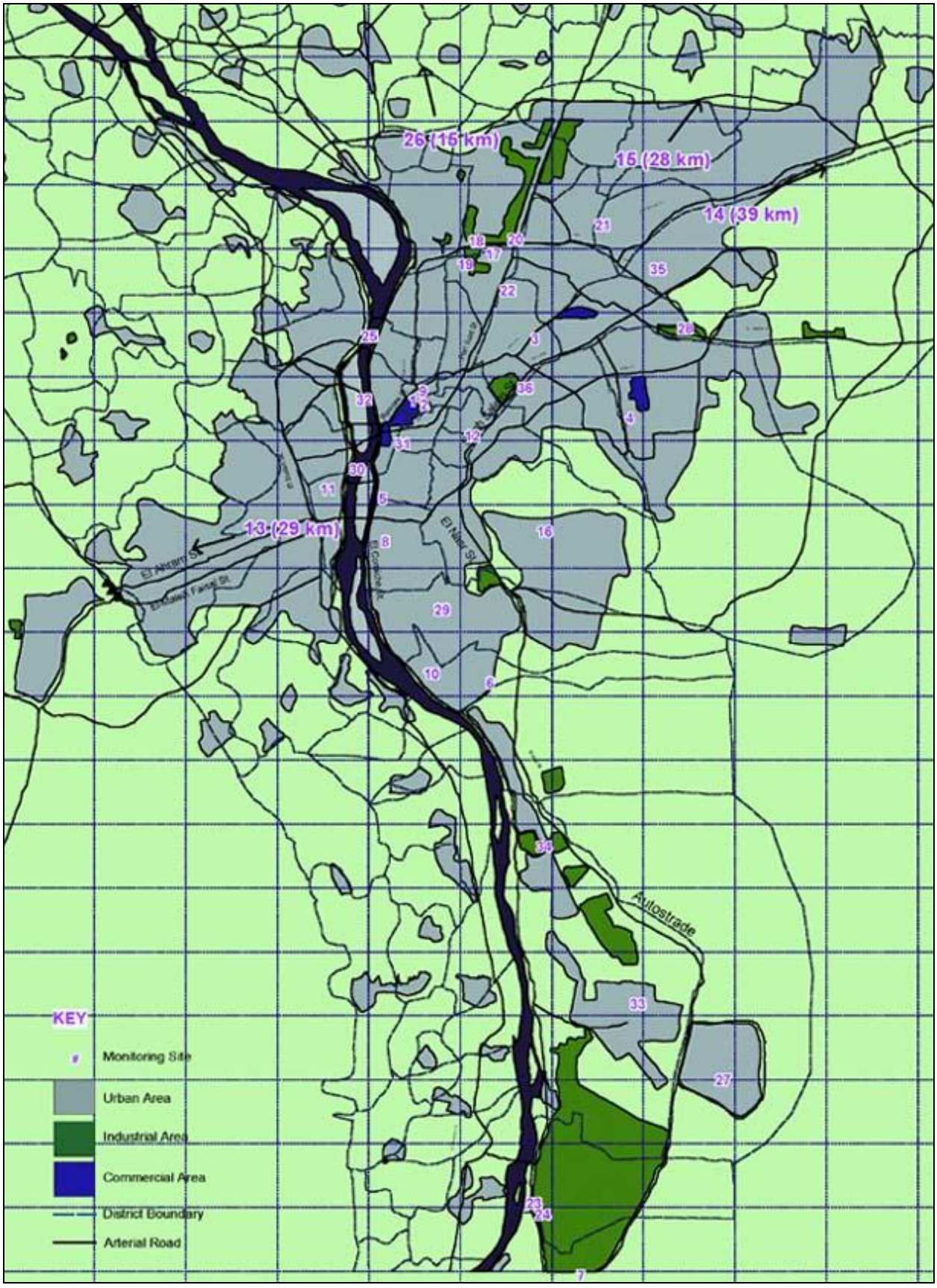

Figure 3: Cairo Air Monitoring Stations for the Greater Cairo Air Quality Project (courtesy EEAA)

Stakeholders

The air and water quality systems have specific, and relatively limited, stakeholders. The Marine Water Quality System is an EEAA project in collaboration with the coastal governorates (Egypt's equivalent of states or provinces) and water-related research bodies. The Greater Cairo Air Quality Project is a more multilateral initiative including USAID and its contractor (Chemonics), the Ministry of Health, World Health Organisation, EEAA, and local authorities and organisations within the Cairo area.

SMRES – and climate change monitoring more generally – has an even wider remit and wider set of stakeholders (see Figure 4). Egypt does not have specific climate change policies or legislation. However – through the Environmental Protection Law (4/1994) and its amendment (9/2009) – the Ministry of State for Environmental Affairs (MSEA) and the Egyptian Environmental Affairs Agency are responsible for all environmental laws and policies and are the country's focal point for environmental monitoring and reporting. Their remit therefore covers climate change, and they can be seen as the nodal agencies for this application.

Line ministries like the Ministry of Agriculture and Land Reclamation, Ministry of Water Resources and Irrigation, Ministry of Health, Ministry of Transportation, the National Agency of Energy and local authorities like the governorates would be important generators of climate change data for central aggregation by the climate change unit (CCU) within the environmental agency. But they would also be important users of that data as well. In addition, various university departments have been co-opted to provide data inputs.

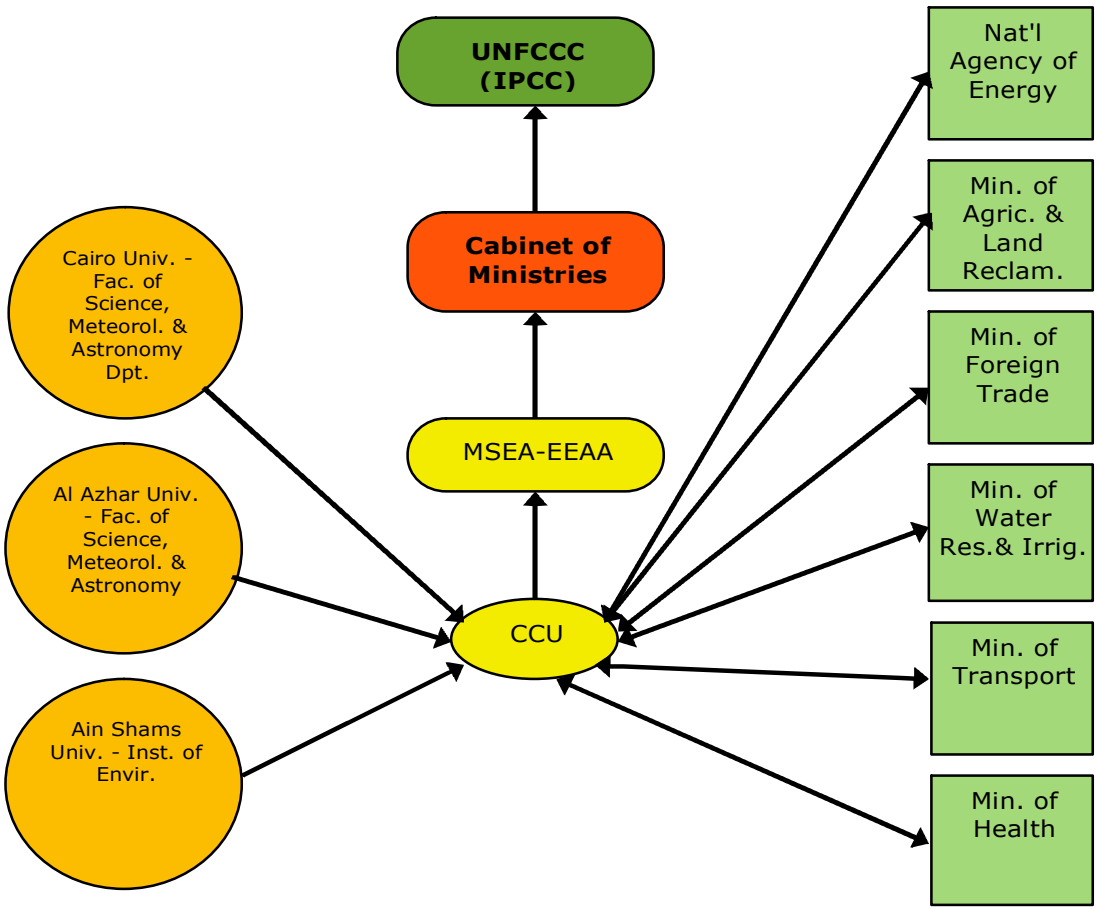

Figure 4: Stakeholders and Data Flows for National Climate Change Monitoring and Reporting System

Beyond the specifics of SMRES – and in order to implement its UNFCCC obligations – Egypt established a National Committee on Climate Change in 1997, developed a Climate Change National Strategy and Action Plan, among other initiatives; and built capacity that translated into the Initial National Communication (EEAA 1999) and the Second National Communication (EEAA 2010a) sent to UNFCCC.

Impact and Evaluation

The financial and in-kind costs of the systems described here often involve several parties with differing contributions. The Greater Cairo Air Quality project, for example, was partly funded by USAID and managed by an American contractor, Chemonics. The Ministry of Health was for a while an independent contributor, responsible for monitoring sulphur dioxide, total suspended particulate matter, and smoke. WHO contributed by helping to set monitoring standards (Nasralla 2001). Since the early 2000s, EEAA has added its own air monitoring programme to the project, measuring small (PM10) particulates, carbon monoxide, nitrogen dioxide and ozone. EEAA is also involved through another separate programme that temporarily measured lead levels.

Combining different stakeholders and thus collectively using their resources such as monitoring equipment, ICT systems, laboratories, staff, etc, helps to save overall costs. However, overall, very large amounts have been invested. USAID has invested up to US$50 million per year in the project to improve air quality in Cairo. The total amount invested in the five-year, Danida-supported programme to improve monitoring of coastal water and air quality was US$17 million. The costs for a planned virtual network centre for climate research are around US$50 million (EEAA 2010b). It is not possible to distinguish within these overall budgets what the exact figure is for the ICT component.

In assessing what has been achieved from these investments, one can distinguish between the relative success of the narrowly-focused water and air quality systems, and the relative failure of the broader climate change M&R system. The former two have been able to create a means by which data is gathered on a regular basis – twice monthly for water quality, monthly for air quality. This has relied on work done to standardise data inputs from different sources, enabling it to be aggregated.

This initially proved difficult for the air quality project: its sub-components had different objectives, different data profiles, poor quality equipment, and different types of equipment (Nasralla 2001). But this was then addressed through additional USAID funding which paid for staff capacity building, new equipment, and a unification of data collection, data handling, and data analysis procedures among stakeholders.

Both the air and water information systems therefore work effectively as monitoring and reporting systems. They have also had some successes in seeing the information they produce turned into decisions and actions. For example, the number of air pollution episodes in Cairo fell from 31 to 4, lead levels have been reduced, and buses converted to natural gas (Chemonics 2004).

By contrast, inter-sectoral initiatives for climate change monitoring and reporting, like SMRES, have been much more problematic. Even the foundations of standardising the data that is to be used, aggregating that data, and managing it, have proven very hard to achieve (interview data from EEAA project manager). The current suspended state of the SMRES project is one clear example. The central unit within EEAA has not been able to obtain the necessary data from stakeholders as per the intentions shown in Figure 4: they have treated the data as personal property that is not to be divulged or shared. The data that has been released uses different and incommensurate forms and indicators. So, while the ICT technical base for the system has been put in place, it is not functioning as intended. Lacking core funding from EEAA, the system has proven unsustainable.

Enablers/Critical Success Factors

Comparing the success and failure differentials, the following enablers can be identified:

Where stakeholders share **common objectives**, then monitoring systems seem to have performed relatively well. For example, with the water quality system, the coastal governorates want to address water quality issues – they lose tourist and agricultural revenue if there are problems with water quality and problems with salinity, and have to deal with health problems. Their interests and objectives therefore align well with those of the Environmental Information and Monitoring Programme

within EEAA that has overall responsibility for coastal water monitoring. It has helped that EEAA has branch offices in each governorate, which can assist with data collection and with local discussions. It has also helped that donor funding could be used as a "carrot" to encourage cooperation and to ensure delivery of a working M&R system.

Adequate initial and recurrent financing. Donors like Danida and USAID have provided the significant sums necessary to get the air and water monitoring systems up and running. The recurrent operational costs for the systems have been lower, and the EEAA has to some degree been able to sustain these from its core budget.

Focused staff capacity development. Although knowledge and skills were lacking initially for the air and water systems, it was relatively easy for donor funds to help create the absent capacity. There was a clear and relatively narrow expertise-set required – for example linked to particular hardware, software or data techniques – which intensive training was able to address on a fairly short time-scale. (By contrast, SMRES' many stakeholders and broad remit have made capacity building much more difficult.)

Being results-led not technology-led. The focus for the water and, especially, the air quality monitoring systems has been the results that were to be achieved: cleaning up Cairo's terrible pollution in the case of the latter. ICTs were therefore relegated to their proper place: as tools to be used to achieve those results, rather than being placed centre-stage. (With more complex integrated climate change projects like SMRES, so much needs to be done that the focus can fall back to being the ICT platform, with the result that the technology is put in place, but without the means or planning to work out how to use it. The ICT can therefore become the end not the means for the project.)

Constraints/Challenges

Absence of carrots and sticks. If an individual organisation receives funding to pay for resources for its own purposes, it has a direct motivation to participate. But inter-sectoral climate change systems often pay significant sums for resources that sit between, rather than within, organisations; and that – more importantly – support activities those organisations regard as peripheral. Such initiatives will struggle to succeed. All the more so if the lack of carrot is matched by a lack of stick. In the case of EEAA, it is relying on much more powerful line ministries to "make nice" and cooperate. EEAA does not have the political clout or the enforcement capacity to obtain compliance from those ministries.

Proprietary data motivations. Line ministries and local authorities tend to regard the data gathered from their sector or geographic region as their sovereign property, which they are not eager to share with others. In some ways this is a basic issue of motivation: the problem with carrots and sticks was just noted, and sharing data also tends to be an additional workload placed onto individual officers with no assistance or incentive provided for them. It is often cited as a cultural matter: in many developing countries, there is a culture of secrecy and an absence of transparency norms. But this, also, may in part relate to motivations (interview with EEAA project manager). If stakeholders are not sure how the data they provide is going to be used or, worse, if they fear it may be used in some way adverse to their interests – for example to criticise them for failing to reach targets, or by having funds diverted to other purposes – then it is not surprising that they are reluctant to share. Such perceptions may, of course, have no basis in reality but merely arise from unsubstantiated fears.

Inadequate stakeholder participation. Motivation also partly derives from feelings of ownership and involvement. The failure of SMRES to get the participation of stakeholders from early in the design phase, meant a failure to develop those positive feelings. It thus felt like a system imposed from outside, rather than something in which those organisations did, indeed, perceive they had a stake.

Unsustainable funding. Many climate change information systems are developed through project-based donor funding. The problem with such funding is that projects have a definite end point. Unless government organisations have the means to cover the recurrent financing from within their core budget – particularly to cover staff costs and costs of ICT maintenance and upgrade – the systems will

be at risk. This becomes even more challenging where the system relies on many different government agencies, each of which needs to provide core budget support.

Absence of hybrid perspectives and capacities. Effective implementation of climate change information systems requires a "hybrid" perspective that combines both the technical and the organisational. It requires socio-technical expertise that understands data, technology, people and context. But this has sometimes been missing. For example, with SMRES, the Ministry of Communication and Information Technology (MCIT) was commissioned to set up the climate change and other environmental databases that the system would require. But MCIT sees itself purely as a technical provider, rather than taking a hybrid perspective that would involve it in thinking about how to ensure data flows, or how to develop the institutional capacity to make the databases useful. As a result, once it has laid the hardware, software and telecommunications infrastructure, MCIT regards its role as completed because the technology works even though the monitoring system it is supposed to support, does not.

Recommendations/Lessons Learned

The main lesson coming out of the Egyptian experience in setting up various national and subnational climate change-related monitoring and reporting systems is that stakeholders should **put human and organisational design ahead of ICT design**: they should refrain from setting up the ICT platform before having worked out the more complex institutional, financial and scientific technicalities of their initiative. Taking SMRES as an example, it would have made more sense to secure a sustainable funding source at the design stage, to have stakeholders work together to set the system up, and to have a clear understanding of why certain data are collected and how they will be used. If training and equipment needs would have been assessed from the start and indicators and methodological standardisation agreed upon in the design and planning stages, that also would have helped.

For decision makers it is tempting to first build the ICT platform as it is quick and relatively straightforward to set up, and it provides a tangible deliverable. But climate change monitoring and reporting is in many instances reflective of the **political will** towards climate change. Often the ratification of a Convention leads directly to production of a shopping list for funds and loans, rather than being reflective of a serious interest in climate change. As long as this game is convenient to both the developed and the developing nations it is questionable that one can stop this scenario from repeatedly happening. As long as stakeholders lack the incentive to produce reliable data for the benefit of a common goal then weak, failing and fragmented climate change monitoring and reporting systems are the natural outcome.

In addition:

Aim low and hit, rather than aiming high and missing or **"KISS: keep it simple, straightforward"**. A central difference between the systems that have worked relatively well, and the system that did not is scope and complexity. Successful climate change information systems are those that keep the technology fairly simple, have quite focused objectives, require more limited funding and involve relatively few stakeholders. Rather than aiming for the best possible ICT systems, it is better to form a realistic assessment of what can actually be achieved given the allocated funds and timescale, and to keep things simpler rather than not.

Have an answer for the "golden question". The golden question – the one that everybody involved with a climate change information system asks – is "what's in it for me?". SMRES has had problems largely because it has been unable to provide a convincing answer to that question for most of the stakeholders. Successful projects address this motivational issue. They may provide financial carrots or regulatory sticks. And they provide reassurance about how data is going to be used; ensuring that those who share their data will not be disadvantaged by so doing.

Data Sources & Further Information

The research is based on first- and second-hand data derived from personal experience and from interviews, observation, document analysis and knowledge mining. The author – Leila Hassanin, Independent Environmental Consultant, lhassanin@gmail.com – has been involved in environmental monitoring and reporting systems, and in ICT and environmental sustainability research in Egypt and internationally. Her interest in climate change M&R systems grew out of first-hand experience with the need for data quality and consistency for implementation, based partly on her association with EEAA since the mid-1990s.

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Further information about the project and related resources can be found at: http://www.niccd.org

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