

# Education for Sustainable Development: Enhancing Climate Change Adaptation Expertise in Developing Countries

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## Abstract

This article presents the results of an innovative education capacity assessment and delivery project to promote sustainable development in large ocean states in the Western Indian Ocean (WIO) region. Science education can help prepare the present and coming generations for stability in an uncertain future. Limited financial, geographical and knowledge-based resources make large ocean states particularly vulnerable to future uncertainties, such as those associated with climate change. With island populations already feeling the impacts of a changing climate, improved adaptive capacity and disaster risk reduction have become increasingly essential. Thus, climate change adaptation forms the basis for a stakeholder-designed curriculum to meet the capacity-building needs of stakeholders. Partnerships between external experts and local stakeholders were formed to build upon human resource capacity and maximize delivery through a programme of ‘train-the-trainer’ activities. In this way, the mentoring of local stakeholders to undertake their own training can advance sustainable development goals beyond traditional non-collaborative educational approaches. This article shows how this aim can be accomplished through the design and delivery of a phased, coherent professional development programme.

**Keywords:** Small island developing states, large ocean states, stakeholder participation, framework for education needs assessment, climate change adaptation

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## INTRODUCTION

**E**ducation builds human capacity to contribute to and enhance economic development (see, e.g., Bailey & Eicher, 2000; Cooray, 2009; International Institute for Applied Systems Analysis [IIASA], 2008; Stevens & Weale, 2003). Economic evaluations in the United States and United Kingdom have demonstrated that between 50 and 85 per cent of growth in gross domestic product (GDP) can be ascribed to innovation in science and engineering. Discoveries and innovations in science, engineering and technology generate more than 50 per cent of the growth in America's GDP (Augustine et al., 2010). However, to maintain current standards of living, sustainable development and ecological resilience, thousands more people need increased knowledge and awareness of science and engineering (Augustine et al., 2010; Confederation of British Industry and Education Development International [CBI], 2013).

Science education that prepares the coming generations for a future that includes sustainable, stable and successful social and economic development will require multi-disciplinary skills (Duobliene, 2013). The skills include relevant science content, futures thinking and problem solving for issues we do not yet know are problems and those that already exist (Fahey, 2012). An issue we do know, that societies now and in the future will need to cope with, is the changing climate (McMichael et al., 2006; National Aeronautics and Space Administration [NASA], 2012, 2014; National Oceanic and Atmospheric Administration [NOAA], 2012, 2013; Oreskes, 2004; Ramaswamy, 2006; Ritter, 2009; United Nations [UN], 1992; United Nations Education, Scientific and Cultural Organization [UNESCO], 2011, 2012; Whetton, 2007; Wigley, 1999).

Science education, and the subsequent socioecological benefits, is most urgently needed by populations with limited resources, knowledge and time to prepare or cope with the changing climate (Intergovernment Panel on Climate Change [IPCC], 2001; Mertz, Halsnaes, Olesen & Rasmussen, 2009). As these populations are already experiencing the effects of climate change, training on how to adapt to and reduce disaster risk is the need of the hour (Crossley & Sprague, 2014). Additionally, practitioners from all sectors in these countries are required to contextualize the knowledge of climate change adaptation to local conditions. Partnerships are required between external experts and local stakeholders to foster sustainable development by building human resource capacity (UN, 2013; United Nations Environment Programme [UNEP], 2005). This can be accomplished through coherent professional development programmes.

### **Sustainable Development in Developing Countries through Climate Change Adaptation**

The Intergovernmental Panel on Climate Change (IPCC) first noted in its Fourth Assessment Report (AR4) (2007) that most of the anticipated climate change effects would be felt across Africa's least developed countries (LDCs):

Africa is one of the most vulnerable continents to climate change and climate variability—a situation aggravated by the interaction of multiple stresses occurring at various levels, and including low adaptive capacities. (IPCC, 2007)

These countries are extremely vulnerable to the effects of climate change given their lack of necessary resources to adapt. The IPCC's Third Assessment Report (AR3) (2001) lists the requirements for a high adaptive capacity as:

- A stable and prosperous economy;
- A high degree of access to technology at all levels;
- Well-delineated roles and responsibilities for implementation of adaptation strategies;
- Systems for the national, regional and local dissemination of climate change and adaptation information; and
- An equitable distribution of access to resources (IPCC, 2001).

Although LDCs and Small Island Developing States (SIDS), now widely referred to as large ocean states (LOSs) (see, e.g., Fahey, Verstraten & Meyers, 2014a, 2014b), vary in particular in their geography, climate, culture and stage of economic development, they have many common characteristics that highlight their vulnerability. This is particularly true in relation to sustainable development and climatic change. These characteristics include:

- Extreme openness of small economies and high sensitivity to external market shocks, over which they exert little or no control (low economic resilience);
- Limited physical size, which effectively reduces some adaptation options to climate change and sea-level rise (e.g., retreat; in some cases, entire islands could be eliminated, so abandonment would be the only option);
- Generally limited natural resources, which are, in many cases, already heavily stressed from unsustainable human activities;
- High susceptibility to natural hazards such as tropical cyclones (hurricanes) and associated storm surge, droughts, tsunamis and volcanic eruptions;
- Relatively thin water lenses that are highly sensitive to sea-level changes; in some cases, relative isolation and great distance to major markets;
- Generally high population densities, and in some cases, high population growth rates; and
- Frequently, poorly developed infrastructure (except for major foreign exchange earning sectors such as tourism) (IPCC, 2001).

The IPCC's Fifth Assessment Report (AR5) reiterates the findings of the previous reports with regard to vulnerability to climate change impacts (IPCC, 2014).

Rising sea levels, and climate variability, including changing rainfall patterns that affect food production, are major issues for SIDS given the lack of coping mechanisms. These issues were some of the drivers for convening the first global conference on the sustainable development of SIDS, the Barbados Conference in 1994 (UNEP, 1994). The ensuing Barbados Plan of Action (BPA) for SIDS, in recognition of their vulnerability to environmental degradation, climate change and natural disasters, underscored the need for building capacity to implement sustainable development policies.

The United Nations Educational, Scientific and Cultural Organization (UNESCO) expert meeting in the Bahamas (2001) focused on the role of education to help SIDS cope with the challenges of climate change. Capacity building was highlighted, with the principal recommendations including programmes for teacher education and train-the-trainers programmes.

Following the Barbados Conference and subsequent development of the BPA and the UNESCO documents, the Mauritius Strategy (MS, 2005) was adopted. The aims included further implementation of the BPA. In particular, the MS set out specific actions and measures at national, regional and international levels (see, e.g., MS Section I: climate change and sea level rise). Recognizing the vulnerability of LDCs and SIDS to climate change, the MS targets adaptation to climate change as an essential component of the strategy.

### Western Indian Ocean Context

Efforts in the Western Indian Ocean (WIO) region to achieve sustainable development and to adapt to climate change commenced prior to the MS. In 1982, the World Bank funded an intergovernmental organization in the region, the Indian Ocean Commission (IOC), to support international collaboration for sustainable development. A primary reason for this collaborative effort was that some of the most vulnerable populations to impacts of climate change are found in the region. The UNESCO (2012) referred to the islands in this region as SIDS and LDCs.

The IOC's (2011) intention to support the implementation of the MS in the WIO region includes priority activities undertaken through their projects: 'Comprehensive Integrated Capacity Building Strategy' (CICBS) and ISLANDS 'Implementation of the Small Island Developing States' Mauritius Strategy' (ISIDSMS) and the Western Indian Ocean Coastal Challenge (WIOCC, 2009). The activities include:

- Effective engagement of, and ownership by stakeholders;
- Strengthening collaboration and broader experience sharing, using science-based decision support and adequate knowledge management systems;
- Promoting integrated management and ecosystem-based approaches;
- Addressing information needs and gaps through focused research; and
- Improving capacity at multiple levels.

The purpose of this article is to present the results of an innovative education needs assessment project in the WIO region. The project focus is on building human resource capacity to adapt to climate change.

### METHODS

We focused on a design that would build capacity by enabling stakeholders to first learn and then train others in the skills and knowledge needed to enhance adaptation to climate change. This we deduced would potentially enable sustainable development

through continued economic growth in these and other developing countries. We designed a series of steps to achieve, through education, the priorities of human capacity building and thriving economic development by adapting to future climate change impacts.

Our assessment project involved a process to evaluate local capacity for delivering education across a range of cultures and contexts. We based the process upon a framework and methodology designed to specifically evaluate climate change adaptation education. In short, we wished to test a strategy that would ultimately lead to enhancing sustainable development through professional-level education—building human resource capacity to adapt to climate change.

Stakeholder assessment, education design and application were conducted in five countries in the WIO region: Seychelles, Madagascar, Mauritius, Comoros and Zanzibar (see Fahey et al., 2014a, 2014b). These countries represent a range of socially, culturally and economically diverse backgrounds. Involvement of the diverse group of stakeholders in the process from the outset was a key feature of the framework. We desired that this involvement would enhance the facilitation and inclusion of the professional needs of stakeholders into the design and selection of training methods for the climate change adaptation courses.

The framework and the detailed methodology used to assess the educational needs in each of the countries are described in Fahey et al. (2014a, 2014b). These papers also present the profiles of the countries involved.

## **Surveys and Focus Groups**

The intention at the outset of the project, and subsequently for the overall curriculum design, was that the process to build the professional development capacity of the local people should be cumulative in effect. So, for example, we sequenced the activities and introduction of information to achieve learning outcomes which were identified by local stakeholders. The primary approaches we employed to do this were via the use of individual surveys and collaborative focus groups guided by open-ended questions during workshops to facilitate discussion.

The survey questions were designed to establish the professionally required, existing and desired knowledge and skills in climate change adaptation in each of the five participating countries.

Focus groups comprised participants from three sectors: academia, government and non-government or civil society.

As such, participants were professionally affiliated with government departments, education institutions and non-government organizations (NGOs) involved in environmental or climate change capacity building in the Indian Ocean region. Countries of residence included Madagascar, Comoros, Zanzibar, Mauritius and Seychelles. The countries were equally represented, except for an additional two participants from the host country Seychelles. Gender was also evenly distributed.

All participants were either involved with or had previously received education or training, and were currently professionally engaged with environmental or climate change issues. Previous education was predominantly at the university graduate or postgraduate level.

Gibson-Graham (1994) suggested key reasons to utilize focus groups:

...focus groups serve not just to 'mine', 'uncover', and 'extract' existing knowledge; they can also contribute to the development and construction of new knowledge and understandings for both researcher and 'researched'. (Gibson-Graham, 1994 in Cameron, 2005)

Thus, for our project:

- The educational needs of the stakeholders would be identified in a way that could be assessed qualitatively as well as quantitatively.
- We wished to encourage interaction among stakeholders who are not normally able to meet face-to-face. The format would also allow the participants and facilitators to gain insights from stakeholders' shared perspectives.

Our approach incorporates Biggs' (2002, 2003) model of learning and teaching and the work of Meyers and Nulty (2009). These authors highlight that a curriculum aligned with learners' needs and desires results in high levels of achieved intended learning outcomes. As such, we structured our work to commence with seeking the learners' educational needs and desires.

Focus group workshop activities included a series of open-ended questions for completion in stakeholder sector groups. The workshops were scheduled for no less than six hours duration. The schedules considered holidays, weekends and competing national, religious, community and stakeholder priorities.

At the completion of each participant-based activity during the workshop, a different participant each day was asked to present the findings of their group to the workshop. By regularly asking different participants to present the findings of their group to the general workshop, the constructive participation of workshop attendees in the group activities was ensured. It also gave participants the opportunity to become actively involved in expressing their opinions to the whole group.

## Course Structure

The first climate change adaptation course, selected from participants' stated priorities, focused on climate change adaptation, the barriers and solutions. Through analysis of surveys and focus group participant feedback, a range of training methods was selected to maximize the learning experience of the participants, who were the designated regional trainers from each of the participating countries.

Methods incorporated during the five-day course included the use of paraphrasing, parallel personal comments, question-and-answer sessions, leading query on learner-selected topics, group-based practical activities, participant presentations, brainstorming and case studies. These methods allowed participants to be engaged with a sequence of lecture-based content delivery and practical participant-based activities.

## RESULTS

### Surveys and Focus Groups

Responses to the survey and open-ended questionnaires were ample to substantiate the why, what and who dimensions of environmental and climate change training that was important to the participants. The participants indicated a definite need for capacity building, including training, to adequately address environmental or climate change issues on the national level as professionals, individuals or organizations.

Responses identified numerous potential topics, formats and strategies for national training and capacity building to guide future efforts in meeting environmental or climate change education needs. National, regional and international institutions, organizations and individuals that participants considered relevant to developing or receiving training were established.

The results from the surveys (and open-ended workshop questions) provide an evaluative overview of environmental and climate change research, activities, programmes and projects that participants are or have been involved in. This included positive/negative aspects and suggestions for achieving the desired outcomes.

### Curriculum Design

One result of interacting with the focus groups during the project was to achieve strong concurrence among the stakeholders for the subsequent curriculum design. That is, the participants' preference for a curriculum that focuses on training for the local trainers was clearly articulated.

Stakeholders identified specific needs and desires for climate change education. On a general level, they requested an integrated curriculum that offered 'stand-alone' courses for professional development. This sort of system of professional development could address the needs of immediacy for action in SIDS and LDCs.

They also concurred that the design should incorporate ongoing, small-scale projects, wherein participants would implement and practice the skills and knowledge that they learned through short courses delivered in their country. This design using problem-based learning has long been found to be effective for several decades since Tyler first noted that

learning takes place through the active behaviour of the student: it is what he does that he learns, not what the teacher does. (Tyler, 1949, p. 1)

The participants expressed a preference for face-to-face, local training. They highlighted the critical roles that they hold within the government, non-government and academic sectors. The small population in these countries and the resulting limited human resource capacity to fill these roles prohibits stakeholder participation in external courses.

The stakeholders from the participating countries agreed on a set of courses (a curriculum<sup>1</sup>) that they determined would address their need for climate change knowledge and skills to fulfil their job roles. Accepting that topic prioritization was required, they

consistently identified, through questionnaires completed at stakeholder workshops, three top priority areas. These were:

- Climate change adaptation, barriers and solutions;
- Governance engagement and capacity building; and
- Integrated environmental management

After these three priority topics, stakeholders identified the priority subject of Environmental and Resources Economics.

Responses from workshop evaluations indicate that participants were confident that they would form partnerships among the WIO regional countries to achieve climate change adaptation outcomes.

All participants responded that, as a result of the training, they were also now confident of communicating their new climate change adaptation knowledge and/or training methods to their colleagues and community. Similarly, participants were also asked about the types of activities they planned to implement upon completion of the workshop. How these activities correlate with the training methods recommended during the workshop provides an indication of their suitability and relevance to the needs of IOC member countries. Participants responded that they would disseminate the knowledge they had learnt through a range of methods, from training events, school education, media, conferences, meetings with colleagues and awareness campaigns.

### **Course Delivery**

Some participants noted that had they greater background knowledge on certain adaptation topics, such as vulnerability and resilience, mitigation and adaptation, and scientific details on climate change, it would have enhanced their learning results. Course evaluations indicated that expectations of what the course would deliver were almost universally satisfied. All participants noted that their knowledge of climate change adaptation had increased suitably.

The capacity to communicate the barriers and possible solutions to climate change was improved among all participants. The following selected response describes how this individual's capacity to communicate improved. 'A lot of the issues I deal with daily in a more ad hoc manner, the course has enabled me to unify the issues and so increased my ability to communicate the issues to others both colleagues and community level'.

### **Participants' Course Evaluation**

The primary motivation for participating in the course was to build professional capacity on climate change adaptation through increased knowledge of the subject. There was universal interest in continuing to be professionally engaged in climate change and environmental fields and to continue education, training and research in the future to further build their professional capacity. Knowledge and skills identified to aid achievement of professional aspirations included communication skills, management skills, knowledge on coastal zones, climate change adaptation



and development of policies and action plans. This knowledge and skills were to be acquired through university degrees, short-term courses and professional development.

All participants felt that the course increased their confidence in their capacity to meet professional expectations. The ability to transfer this knowledge to colleagues or into new work responsibilities was also universally acknowledged by participants. Dissemination of knowledge gained from the course to colleagues and/or the community was an immediate action to be undertaken by most participants upon return to professional duties. The knowledge gained in the course will be used to facilitate the current and future research of the participants.

## **DISCUSSION**

The methods selected for this project required some modification on a country-by-country basis. The methods include distribution of an individual online survey, and distribution of the same survey (hard copy) at a following stakeholder, in-country workshop. The use of focus group questionnaires to guide discussion is also effective for gathering qualitative data for the assessment which includes self-assessed knowledge, skills and gaps in existing versus desired knowledge and skills.

### **Surveys and Focus Groups**

Distributing an online survey worked only in some cases. Feedback from some participants indicated that they were unable to submit the form electronically using the instructions provided. In some cases, participants indicated that they did not receive the survey prior to attending the workshop. This was due to some late selections or last-minute changes to the list of invitees. Thus, distribution of the survey form at the commencement of the working group meetings enabled the investigating team to increase the response rate. Survey response was one of the primary purposes of convening focus groups.

Difficulties arose when trying to interpret handwritten surveys and during data analysis, as some handwritings were difficult to decipher. This was especially difficult for the Anglophile investigators when trying to decipher the French-written questionnaires. Some feedback received during the working group session indicated that the survey questions were not entirely clear.

The use of open-ended general questions combined with more topic-guided questions at the workshops achieved several purposes. These included gaining insight into group dynamics and stakeholders' shared perspectives and encouraging interaction. Using dialogue-requiring questionnaires in an online format during focus group activities encouraged interaction. Completing these together seems to be a valuable method to encourage interaction and exchange of perspectives. Facilitator observation of group dynamics indicated that more participants shared and contributed to the questionnaires when in the smaller groups, than when seated with the larger working group that comprised all sectors together.

The results from the open-ended questionnaire indicated that the storytelling nature of the questions proved challenging to participants who were new to their role. This format required extensive time to decipher and record for analysis.

The physical arrangement of the focus groups was an important factor in achieving collaboration and participation. The facilitator ensured that the smaller focus groups were seated next to each other. It appeared to encourage communication and enjoyment as in all cases, the groups were very engaged, laughing and seemed to be quite involved in discussing the questions and their responses. The feedback received from the working group session using poster paper and sticker notes indicates that participants enjoyed the sharing of ideas in a collaborative environment with people of diverse backgrounds.

People learn in different ways. Capturing a range of learning types and styles through the selection of varied teaching methods can reduce barriers inherent in the workshop. For example, the workshop was offered in English, which caused difficulties—a barrier—for some participants, as none were native English speakers. The use of slow English, interpreters and targeted teaching methods all contributed to overcoming the educational barriers encountered during the workshop.

## **Curriculum Design**

Our results indicate that when input from stakeholders is solicited and incorporated at the outset of the curriculum design (priority courses and content delivery), the process contributes to achieving a coherent, academically aligned set of courses. This supports Fahey's (2012) findings that for an accredited curriculum at the postgraduate level, input from the stakeholders (programme teachers) was the critical factor to achieve the desired outcomes. As such, our chosen methods would achieve the overarching purpose of sustainable development by building human capacity.

## **Course Delivery**

Through problem-based learning activities, participants examined the barriers to climate change adaptation from ecological, societal and industry perspectives. Key information and concepts of barriers were delivered through a range of widely recognized training methods and techniques, including content-based and practical participant-based delivery styles. Participants often learn in different ways.

Commonly, people learn best if given the opportunity to listen to new content, to read about it, to discuss and to put it into practice (Fyrenius, Bergdahl & Silen, 2005; Hodges, 2005). Enhanced knowledge retention often results when participants discuss the meaning of the lecture material with each other in small or large groups. In many instances, these methods or combinations of methods enable the instructor to take on the role of a facilitator to guide group discussion and to answer questions as required by participants. This was the instructors' experience during this workshop.

The results from our educational needs assessment conducted across five independent SIDS (Zanzibar, Comoros, Seychelles, Mauritius and Madagascar) indicate that in the context of climate change adaptation, there is similar knowledge and skills needed by the tertiary education, government and non-government organization professionals in all countries.

Further, while the stakeholders in the present study are professionals across sectors from diverse cultural, political, social and economic backgrounds, the educational needs can be met with a similar curriculum or programme design. Our results showed that participants from IOC countries share the same needs and priorities regarding knowledge and skills, desired topics to inform their professional roles and similar concerns with regard to environment, economics and sustainable development.

In the present study, no teachers are yet trained in the participating countries to deliver the courses that the stakeholders identified as required to achieve their desired outcomes. Thus, the initial set of courses was designed to (i) provide the technical knowledge and skills needed locally and (ii) also to train the stakeholders on how to deliver the knowledge and skills in their country. This aspect of the design addresses the necessity for capacity building of human resources—to develop and mentor those who will continue the training and provide professional development after the completion of the present activity. The partnership between the external experts and local practitioners to build human resource capacity through coherent professional development programmes will continue, with a focus on mentoring.

Overcoming barriers to climate change adaptation through the formation of inter-country partnerships provides aspirational targets in achieving key sustainable development initiatives of the project. Train-the-trainer elements implicit in the course design empower workshop participants to engage colleagues and the community and continue to build local capacity in ISLANDS project beneficiary countries, post-workshop.

## CONCLUSIONS

Sustainable development goals can be advanced through education. Science education that prepares the coming generations for a future that includes sustainable, stable and thriving social and economic development, will require multidisciplinary skills. The skills that can be passed from one generation to the next include relevant science content, futures thinking and problem solving for issues we do not yet know are problems. We know that societies now and in the future will need to cope with the changing climate, and that the timelines to adapt to climate change are short. Experts are needed now to cope with immediate effects. In the long term, future expertise will be built through school reform. What is required in the short term is a coherent professional development programme that strategically and systematically builds human resource capacity among local practitioners. Local practitioners know what immediate knowledge and skills are needed. Partnerships between external experts and local practitioners are required to contextualize knowledge of climate change adaptation to local conditions.

One example of courses and a curriculum designed from stakeholder input received during country-specific, focused, educational needs assessments has been presented here. The curriculum design consists of short, one-week duration courses, with targeted content as requested by professionals from four sectors: tertiary

education institutions, government and non-government organizations and the private sector. International professionals, who are academics and practitioners themselves, deliver the courses to local sector stakeholders. The international trainers mentor the participants after the course completion, through the process of training them as future teachers at the local level. Participants of the courses have developed a regional network of trained individuals to support their efforts at the country and regional levels.

This system of professional development could address the needs of immediacy of action to address climate change adaptation options at the local level in small island developing countries and LDCs.

**Acknowledgements:** We appreciate the financial support of the European Union and the infrastructure support of the Indian Ocean Commission's ISLANDS project that enabled this work to proceed. The University of the Seychelles kindly provided the infrastructure and administrative resources to enable the first stakeholder-identified priority course to proceed—Climate Change Adaptation: Barriers and Solutions.

## Note

1. The definition of curriculum that we apply in the context of the project is: 'a set of courses constituting an area of specialization' (*Merriam-Webster* dictionary, <http://www.merriam-webster.com/dictionary/curriculum>, 2013).

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