Tertiary Education Knowledge and Standards in Sustainable Development: A Crisis for the Democratic Republic of the Congo

Eva A. McNamara, Melaine Kermarc, Joseph Zambo Mandea and Glenn Bush

Abstract This paper presents a case study to stimulate debate and action concerning the lack of capacity to plan and manage development sustainably in the Équateur province of the Democratic Republic of the Congo (DRC). The case study examines environmental literacy of higher education students enrolled in programs focused on rural sustainable development in the context of human resource needs to effectively implement complex sustainable development programs financed through international climate change initiatives. Written surveys of students and teachers and semi structured interviews with key informants in a higher institute of education's administration revealed low comprehension of key environmental issues in the region (climate change, deforestation impacts), low French literacy, and limited access to teaching and learning materials as well as the Internet. Overall, this case study illustrates those immediate interventions which are needed to avert a current crisis in the ability of the DRC to scale up planned sustainable development programs. Curriculum revisions and improved access to current information and training methods are especially needed in order to create a foundation for sustainable development within the country.

Keywords Democratic Republic of Congo · Sustainable development Higher education · Tertiary education · Environmental literacy Institutional capacity building · REDD+ · Deforestation · Decentralization Climate change · Knowledge transfer · Internet access

E. A. McNamara (✉)
Graduate Institute of International Development and Applied Economics, University of Reading, Reading RG6 6UA, UK
e-mail: emcnamara@whrc.org

E. A. McNamara · M. Kermarc · G. Bush
Woods Hole Research Center, Falmouth, MA 02540, USA

J. Z. Mandea
Coordination Nationale REDD: Ministre de L'Environnement et Développement Durable, Mbandaka, Democratic Republic of the Congo

U. M. Azeiteiro et al. (eds.), *Climate Literacy and Innovations in Climate Change Education*, Climate Change Management, https://doi.org/10.1007/978-3-319-70199-8_6

Introduction

> Development does not start with goods; it starts with people and their education, organization, and discipline. Without these three, all resources remain latent, untapped, potential.
>
> Schumacher (1973, p. 117)

This case study focuses on students in the province of Équateur in the Democratic Republic of the Congo (DRC) enrolled in tertiary education programs focused on sustainable development and the environment.

The quality of their work supporting rural development projects while maintaining natural resource stocks, and especially forests, is inextricably linked to national and international sustainable development initiatives, as well as large investment programs such as REDD+ (Reduction of Emissions from Deforestation and Forest Degradation in developing countries plus the sustainable management of forests, conservation of forest carbon stocks and enhancement of forest carbon stocks). This program aims to compensate actors providing a conservation service of forest resources, whether they be state actors, civil society or private entities. This compensation can be in the form of direct financial payment or in the form of sustainable development activities such as agricultural extension or social infrastructures. Regardless of the benefit-sharing program put in place in the context of REDD+, development practitioners implementing these projects are required to master both best practices in the development realm as well as have a comprehensive understanding of natural resource management. There is currently no academic literature exploring the environmental literacy of these students, the quality and subject matter of the national environmental and sustainable development tertiary programs within the DRC, the institutional capacity of tertiary institutes in Équateur, their ability to access information, or their ability to stay up to date with new and important research happening at institutes and universities around the world.

In order to inform projects and programs looking to build capacity and increase environmental literacy as it pertains to sustainable development and climate change mitigation and adaptation, this study was undertaken to better understand (1) If higher education students in the sustainable development field are equipped with the basic knowledge of fundamental environmental concepts that will allow them to contribute to environmental programs like REDD+ and sustainability-based development initiatives and (2) What are the barriers to obtaining a relevant and current education in this field, and how can these barriers best be alleviated?

While this case study is small, the results of the survey were used by a pilot REDD+ project to design sustainable development activities that would best suit the needs of the staff and students at the surveyed university. The discussion includes information about how this was done, and highlights the complexity of facilitating information transfer in the context of the DRC. We focus our conclusions on the importance of these programs being improved in a participatory manner and how capacity building and knowledge transfer for sustainable development can only be supported and sustained if projects and programs set up to improve sustainable

development education are flexible enough to adapt to provide individualized and targeted resources when needed.

Literature Review

Tertiary Education (TE) and Sustainable Development

There is no, "one size fits all" when it comes to how a community can achieve sustainable development (Khelghat-Doost et al. 2011). However, universities can play an important role in building human capital by helping develop capable community leaders, managers, and educators (Ketlhoilwe and Maila 2008; Khelghat-Doost et al. 2011). Since the early 1990s several international agreements have been put in place, which

> *…acknowledge that the role of [*Institutes of Higher Education*] can be categorized into three groups. The first is that higher education has a role to play in helping students gain awareness of the world in which they live. The second, an understanding of the way in which multifaceted economic, social and environmental processes interact with each other (including the contribution individuals make to these processes) and lastly, familiarity with the perspectives of other societies and cultures on these issues.*
>
> Khelghat-Doost et al. (2011, p. 111)

Higher education institutions have been identified as necessary leaders in the sustainable development movement. Knowledgeable experts, research facilities, modern infrastructure, and students from diverse populations with diverse interests make universities a unique place for sustainable development initiatives to grow and flourish (Khelghat-Doost et al. 2011). Additionally, "Institutes of Higher Education appear to be appropriate candidates for assuming the sustainable development leadership and becoming center points of coordination between different actors and members of society (NGOs, individuals, private sector, etc.) in achieving sustainable development goals," (Khelghat-Doost et al. 2011, p. 115). This does not come as a surprise, as a 1994 report form the World Bank noted:

> Higher education is of paramount importance for social and economic development. Institutions of higher education have the main responsibility for equipping individuals with advanced knowledge and skills required for positions of responsibility… estimated social rates of return of ten percent or more in many developing countries also indicates that investments in higher education contributed to increase in labor productivity and to higher long term economic growth essential for poverty alleviation.
>
> World Bank (1994, p. 1)

However, while sentiments about the value of tertiary education seem not to have shifted dramatically since the 1990s, funding from the Inter-American Development Bank and African Development bank dropped from 129.7 million and 520.8 million respectively between 1990 and 1999 to 8.8 million and 52.5 million USDs between

2000 and 2005. And this decrease in funding has not gone unnoticed. In the World Bank Group Education Strategy 2020 it is acknowledged that since 2000 "the share of education funding for tertiary education and vocational education has declined, while the share of "general education" funding—which benefits several education levels—increased" (World Bank 2011, p. 48). This decrease in funding for TE is presented as a positive, and it is clear from the rhetoric of the report that basic education (pre-primary, primary, and low secondary levels) is considered to be a more valuable societal investment than tertiary education.

This situation is paradoxical, as it is estimated that, "if Africa could increase the tertiary education stock of its population by one additional year (averaged over the whole population) the GDP per capita growth rate in Africa would rise by 0.24 percentage points in the first year" (Bloom et al. 2006, p. 7). Coupled with the fact that increased rates of tertiary education promote a faster adoption of modern technologies, "this higher rate of technological growth […] may boost incomes by roughly 3 percent after five years and by 12 percent eventually" (Bloom et al. 2006; p.7).

In addition to these cuts, conflicting interests abound regarding how these funds are distributed—much development aid money earmarked for TE is actually channeled through universities in developed countries, as "technical assistance" has historically been more valued than in-country capacity building at the tertiary level. This is illustrated not only by the substantial aid funding many American universities receive to train developing country nationals but also by the Department of International Development's (DFID) funding of research for developing countries in UK universities (Kapur and Crowley 2008), as well as their scholarship offerings to developing country nationals. However, 2003 study showed that only about 40% African nationals who went to the USA to pursue PhDs returned to their country of origin (Gupta et al. 2015), suggesting that encouraging studying abroad may not greatly contribute to capacity deficits within developing countries.

Donors are not unaware of the benefits of TE—a rigorous literature review funded by DFID in 2014 concluded that although more studies about TE's impacts on development are needed, there is

> …evidence to suggest that TE may provide greater impact on economic growth than lower levels of education…TE provides a range of broader, measurable benefits to graduates, relating to health, gender equality and democracy, among other areas. In addition, it contributes to the strengthening of institutions, and the forming of professionals in key areas, such as education and healthcare. The diverse functions of the university, in addition to its direct impact on economic growth, should be acknowledged and supported.
>
> Oketch et al. (2014)

Contrarily to this report, DFID's research and development website advertises their current research (being done within UK universities) which focuses on reducing corruption and improving governance (DFID 2015)—which could possibly be improved by funding higher education facilities abroad and not at home. According to Bloom et al. (2007) there are significant positive correlations between corruption, rule of law, and quality of bureaucratic institutions (general governance indicators) and a country's higher education enrolment rates. Despite this, facilities

in developing countries, especially in Sub-Saharan Africa, remain largely neglected (Kapur and Crowley 2008), while governance focused programs carried out by development organizations abound.

Despite the ever-growing span of research initiatives being undertaken in higher education facilities around the world, much needed research that is specific to the needs of developing countries is not being sufficiently undertaken. Agricultural research, for example, is often more helpful for industrial farmers, and not particularly advantageous for small-scale farmers living in poverty. Even in the cases where research is specific, the transfer and application of this knowledge is often done poorly, inappropriately, or not at all. The most practical remedy to this situation is the investment in higher education facilities within developing countries in order to build capacity to not only help students develop hard skills, but also to provide an environment where innovative research is encouraged, supported, and highly applied (Kapur and Crowley 2008).

Tertiary Education as a Vector for Sustainable Development in DRC

In the DRC there is a great need for workers who are highly and specially trained, as well as critical and creative in their approaches to problem solving, as sustainable development needs to be highly contextualized and specific depending on resources, population and needs. The university has often championed as a promoter of middle class growth, which has been seen to have a positive impact on the organization of institutions (Kapur and Crowley 2008). Income inequality is high in the DRC, and the development of a middle class, perhaps aided by better access to quality degrees, could be a catalyst for sustainable development.

In the most recent Growth and Poverty Reduction Strategy Paper (GPRSP) for the DRC, Pillar 1 of the report, entitled 'Strengthening Governance and Peace', it is emphasized that there is a great need for capacity building among leaders in order to address poor governance issues and corruption (IMF 2013). Tertiary education does just this—it educates future leaders about the needs of their countries and gives them the skills to tackle these problems.

While there is no available data available about the returns of higher education in the DRC, a recent study done in the neighboring Republic of Congo found convex returns to education, highlighting significantly higher returns in income levels from tertiary and secondary education than primary education (Kuepié and Nordman 2015). In the DRC, a context of "extremely limited capacity" (Aquino and Guay 2013, p. 74) of the government to implement projects and programs at national and local levels, capable professionals are in high demand. However, in 2012 it was estimated that out of the 9000 young people who exit Congolese universities each year, less than 100 find a job for which they are not overqualified. This is most likely due to the inconsistent quality of educational facilities in the country, and the fact that foreign qualifications are more highly considered by employers (OECD et al. 2012).

Currently in the agricultural sector, which in Équateur will need to be involved in sustainable development initiatives as agriculture is both a cause of deforestation in the province but also a high potential economic sector given its perfect climate for crops like palm oil (Woods Hole Research Center 2007), qualifications are generally low and most junior staff hold only bachelor degrees or lower while senior staff approaches retirement age (Ragasa et al. 2014).

Tertiary Education in Equateur

Équateur is the poorest province in the DRC and suffers from high political instability (IMF 2013). Équateur's graduates will be vital to the future of a province whose economy is, and most likely will continue to be, based heavily on the exploitation of its natural resources. Therefore, it is pertinent that graduates have adequate levels of environmental literacy (EL)—specifically an understanding of environmental degradation and sustainable resource management in order to foster an economic development that is environmentally sustainable for future generations.

While research has exposed the necessary corruption of teachers within the DRC education system (Brandt 2014), there is no literature about the actual content of the national curriculums nor about the TE sector in Équateur. While universities in more developed cities such as Kinshasa and Kisangani are able to benefit from partnerships with international universities and NGOs, more remote provincial universities in the DRC have been largely ignored.

Additionally, travelling to the provincial capital of Mbandaka is arduous and expensive, making Équateur province generally an undesirable place to be, as many goods and services as well as basic utilities such as electricity and running water are not widely available. While there is no available literature on the TE sector in the province, the findings of a study from Brandt (2014) on primary education can be extrapolated to the university level to highlight the unwillingness of teachers to travel to remote provinces and the difficulties that institutions have in finding qualified staff.

Study Context

The DRC, Equateur Province, and Its Forest

The DRC covers over 2.4 million square kilometers of land of which about 63% is forested (FAO.org 2017). Conflict and political mismanagement over the past decades have severely hindered development, and the DRC currently ranks 186 out of 187 on the human development index (UNDP 2015). Located in the northwest of the DRC and with a population of roughly 9 million, Équateur is the poorest

province in the country, and about 93.6% of the population is estimated to be living in extreme poverty (UNDP 2009). It is important to note that this paper refers to the statistics available for the old province of Équateur, however it has been divided into five smaller provinces as of 2015. The province sits in the heart of the Congo Basin, and contains about 25% of the country's forested land. Several years of relative stability and a booming population are beginning to put more pressure on these forests, and low access to electricity (estimated around 1%) (UNDP 2009) and limited economic opportunities—the informal economy accounts for about 95% of family incomes within the province (UNDP 2009)—mean that the growing population, especially in rural, isolated areas, must increasingly turn to the forest for their livelihoods (Milburn 2014). Already in Équateur an estimated 90% of the population depends directly on the forest and its resources for food, fuel and medicinal plants, and often sell excess or high value goods to garner a monetary income (CPP-CAD 2009). It is estimated that between 2001 and 2013, 1.2 million hectares of land were deforested in the province alone (Walker 2015).[1]

Équateur province has a young population, with over 57% of its inhabitants below the age of 20 and an average age of 21 (UNDP 2009). While population growth has slowed in the DRC in recent years, it is still comparably high even for sub-Saharan Africa, averaging about 3.1% growth in 2015 (World Bank 2016). Deforestation in the DRC is caused primarily by shifting agricultural practices (Russell et al. 2011; Potapov et al. 2012; Woods Hole Research Center 2007), as well as by charcoal production driven by the needs of growing urban populations (Potapov et al. 2012). Deforestation alone is estimated to cause a rise in temperature of around 0.7 °C, with some spots reaching 1.258 °C warming by the middle of the century (Akkermans et al. 2014). Additional warming caused by other factors, coupled with an average rainfall decrease of 5–10% (Akkermans et al. 2014) will further challenge the livelihoods of the people of Équateur.

The DRC government has adopted an integrated REDD+ program framework that acknowledges that the protection and conservation of forest resources is a complex issue that needs multi-sectorial and ministerial communication, participation, and collaboration to be successful and sustainable. These integrated programs will be based in areas identified as "high risk" areas for REDD+, such as Équateur, and the framework recognizes that REDD+ must include efforts to support and stimulate sustainable development as well as address direct and indirect drivers of deforestation (Fond National REDD+ 2015). In 2006, the DRC government adopted the idea of decentralization in their national constitution to help the country develop by allowing more localized governance structures to focus on regional needs and potential, and giving them "administrative freedom and managerial autonomy with regard to their economic, human, financial and technical resources" (Cabinet of the President of the Democratic Republic of Congo 2006). A similar route has been taken with the development of the national REDD+ framework policy—although the general

[1]This estimation is based on data extracted from Baccini et al. (2012)'s global carbon data set in order to look more closely at deforestation rates within the province

framework and investment plan has been developed at a national level, REDD+ provinces will be required to develop their own strategies depending on contextual issues, institutions and available resources, as illustrated by the Mai Ndombe Emission Reduction Program (Ministry of Environment, Conservation of Nature and Tourism 2014). Équateur's vast forest resources, hotspots of deforestation, and high poverty rates mean that the national REDD framework considers it a "high risk" area for increased deforestation. Both the country's GPRSP for 2011–2015 and the province's own most recent development plan from 2010–2015 cite REDD+ as a key monetary investment in their hopes of achieving a sustainable development as well as conserving their forest resources (CCP-CAD 2009; IMF 2013).

For Équateur, given its year-round growing season and a large potential local and regional market, this process could focus on rehabilitating degraded lands to be used for agriculture, as well as encouraging REDD+ friendly practices like crop rotation and agroforestry. However, the success of REDD+ projects depends on more than developing a logical framework. The DRC REDD+ Investment Plan for 2015–2020 has identified that their first window of funding must address the need for capacity building, as capacity deficits are a risk to a decentralized REDD+ structure. The plan notes that "capacity building of local and national institutions to better manage space and natural resources" are a key to laying "the foundations for a harmonious and sustainable development of the country" (Fond National REDD+ 2015).

While there are a number of capacity building initiatives going on within the DRC, there are few that are directly involved with agricultural training institutes and/or tertiary education institutions (Ragasa et al. 2014). The DRC's tertiary education framework has not seen thorough reform since 1971, although several reports have been produced identifying problems as wells as possible interventions (Table Ronde de l'Education en République Démocratique du Congo «Vers une stratégie pour une Education de qualité pour Tous»—Rapport General 2004; Cellule Technique pour les Statistique de l'Education (CTSE) 2009). New programs addressing environmental issues and sustainable development have been put in place in the last decade, however there is little information available that explores what exactly students in these programs are learning about the environmental state of their country, the threats and causes of climate change, and sustainable development theory. Given that institutional capacity building has been recognized as essential to the success of REDD+ within the country, it is important that the role of the university in building human capacity, producing relevant and sound research, and training citizens be considered as a valuable investment in encouraging sustainable development in the DRC.

Study Site: L'Institut Supérieur de Développement Rurale Mbandaka (ISDR-MDK)

L'Institut Supérieur de Développement Rurale Mbandaka (ISDR-MBK), or the Higher Institute of Rural Development in Mbandaka, is a higher education institute located in Mbandaka, the capital of Équateur province. The institute offers both *graduat* and *licence* courses (modeled after the old Belgian system), of three and two years respectively. The first year of *graduat* is a general year, after which students can choose their course of study from five options; social organization (OS), rural enterprise development and management (GDER), rural planning (PR), rural administration (AR), and Environment and Sustainable Development (EDD).

At the time of the study, ISDR-MBK had a total of 30 educators, 2 of whom were professors. The remaining 28 make up the 'scientific body'—some of who are assistant teachers and others who are 'chefs de travaux', teachers who supervise practical work. The professors are mainly responsible for teaching the *licence* students while the remaining teachers teach the *graduat* level courses.

In the 2014–2015 school year, ISDR-MDK had a total of 1,253 students, 1,074 *graduat* and 179 *licence*. While female students account for about 40% of *graduat* students (higher than both the national and provincial averages), they only make up about 28% of the *licence* course. As of 2014, according to their own records, ISDR-MDK had awarded degrees to 2781 students. Numbers of students receiving diplomas decreased severely during the period between 1993 and 2007, with the number of graduates falling to a low of 7 in 2001, most likely due to conflict within the country.

The ISDR-MDK campus is made up of several buildings; offices for administration, living quarters for students, and classrooms containing only desks and chalkboards. During an interview with the Director General of the institute he noted that theft is rampant, and the few valuable teaching resources (including computers) they receive are usually stolen, as security resources are insufficient. The library is a single room and contains primarily theses written by previous students. Most of the few books date back to the Belgian colonial era, including agricultural volumes written in the 1950s. During an informal conversation the librarian remarked that until the conflict in 2000 many students did come to use the library, but after that interest and quality of the work declined. The campus does not have Internet access.

ISDR-MDK's main missions, according to the 'Guide to Discovering ISDR Mbandaka' (Institut Supérieur de Développement Rural de Mbandaka 2015), are:

1. To provide formative training to create professionals able to work in the most diverse areas of national life. As such, ISDR-MDK provides teaching for those enrolled in its programs designed to foster the emergence of new ideas and skills development.
2. To organize basic scientific research oriented towards the specific problems of the Democratic Republic of Congo, taking into account new techniques and technology in the world.

In order to achieve these two objectives, they must:

- Train Rural Development Technicians (TDR), specifically men and women capable of arousing, accompanying, planning, supporting and encouraging human, economic, and social development of rural communities;
- Collaborate in the study of human, economic and social-organization faced in rural areas;
- Establish a varied and complete documentation about all aspects of rural life.

Additionally, the guide goes on to note that all students will graduate well versed in five topics: agriculture, fisheries management, agro-pastoralism, biotechnology/appropriate technology, and environmental/biodiversity ecosystems. All students are to attend weekly field trips to organizations and businesses during their first year, cultivate their own small agricultural plot each year, spend at least ten days working and observing life in rural villages during their second year, and do a two or three-month internship with a local public or private non-governmental organization (NGO) during their final year to gain work experience.

While there were several higher education institutes in Mbandaka very willing to participate in this research, the decision was made to work with ISDR-MBK exclusively due to time and cost constraints. Only two institutions in the city offer environmental courses (ISDR-MBK and the University of Mbandaka). ISDR has the best reputation locally in terms of academics, is the older of the two, and is primarily focused on training rural development technicians.

Method

Evaluating Environmental Literacy

In order to evaluate the student's current environmental literacy (EL) levels, the EL Evaluation Instrument (ELEI), designed to help higher education institutes to "better understand [their] current impact before investing heavily in change" (Shephard et al. 2013, p. 477) in terms of education for sustainability was used as a model for the written survey done at ISDR. The ELEI was designed to help "academic departments to better understand the degree to which they are fostering this attribute in their undergraduate teaching and the degree to which our undergraduate cohorts possess it" (Shephard et al. 2013, p. 478).

Given that the students at ISDR are being trained in rural development issues, which in the case of Équateur overlap significantly with environmental issues, an environmental literacy survey was a logical starting point for understanding larger capacity deficits within the institution. The example ELEI developed by Shephard et al. (2013) was used as a basis for the EL survey, but multiple-choice questions that more specifically addressed environmental problems in Équateur were also

added. Shephard's ELEI was designed in collaboration with the North American Association for Environmental Education (NAAEE), a recognized institution that has been working over many years to design instruments to assess the level of student's EL. It is important to note here that their ELEI was designed to be efficient to distribute, meaning that tests were graded by machine and students were asked to respond to the multiple-choice questions and also give their 'confidence level'. This was impossible to replicate in Mbandaka—there are no grading machines available. Additionally, based on the tryout of the survey the format was also considered foreign to students, so additional questions about confidence in their answers were deemed unsuitable for the context and may have hindered response rates. All surveys were filled out anonymously.

Nine multiple-choice (MC) questions were included on the student surveys. Two questions were included as "test" questions, which focused on very recent government information and research addressing local deforestation and agricultural issues. The purpose of including these questions was to see whether or not this relatively new data, which is of direct concern to sustainable development actors in the region, was being effectively communicated to these university students within the environmental and development sector. The performance on these questions was hypothesized to be low in comparison to the more general knowledge questions. The general knowledge questions included several taken from Shephard's ELEI, however given that those questions were designed for university students in New Zealand and Australian in 2012, it was necessary that additional questions be developed that would be more appropriate in a rural, rainforest context (i.e. replacing questions about fracking with questions about forest resources).

All questions were developed, selected, and/or modified in partnership with the National REDD Coordination's Provincial Focal Point for Équateur, as well as the Project Manager of Projet Équateur, a pilot REDD+ project based in Mbandaka, in order to ensure that questions and vocabulary were appropriate for students, as well as correctly reflected environmental knowledge relevant to the sustainable development of the province. Administration officials at ISDR were also given the questions in advance for review, and offered advice for modifications and the mode of distribution to ensure that the structure of the survey would not hinder the students' ability to perform in a way that accurately reflected their level of knowledge. A pre-test was also run with local environment and sustainable development professionals to ensure the difficulty level reflected professional standards. According to the ISDR brochure, graduating students should not only understand basic ecological systems, but also be able to bridge gaps between social and environmental issues. Thus, the survey, although not considered to have a high level of difficulty, touched on a number of basic ideas and concepts related to these issues within the province and country.

Data Collection

Students surveyed in July of 2015 were in their final years of their course at ISDR-MBK, hereafter referred to as L2 (*Licence* year 2) and G3 (*Graduat* year 3). A disproportionate stratified random sampling method was used to select 40 students from official class lists. The G3 students were chosen exclusively from the EDD option, and the L2 students, as there were only 13 students enrolled in the EDD option total, chosen from all five course options. A total of 32 surveys were collected from 12 female and 20 male students (a response rate of 80%) over a period of two days.[2] All 20 teachers and professors at ISDR-MDK were invited to fill out the survey. A total of 12 surveys were completed, 11 by teachers and 1 by a professor, for a response rate of 60%. All surveys were completed anonymously.

Student surveys included demographic questions, the modified ELEI, as well as questions about future goals, their opinions of the quality of their education, Internet use, and changes they might like to see at ISDR. Educator surveys included background questions, questions about internet use and teaching materials as well as the portion of the ELEI used to measure environmental sentiments, not knowledge (including the environmental knowledge component could have been potentially insulting to the educators). Semi-structured interviews were also carried out with administration. ISDR-MBK shared their official course lists as determined by the Ministry of Education Superieur et Universite (MESU) as well as their enrollment and graduation statistics and information brochure. Government documents from the MESU website and partner NGOs concerning tertiary institutions were also consulted, however reports were not current and the website has since gone offline.

Surveys and interviews were conducted in French, as French is the national teaching language in DRC. ISDR-MBK is a public institution and classes, administrative information, and library materials are in French although regional dialects are widely spoken throughout the country.

Results

Descriptive Results

In order to gain a more general demographic understanding about those surveyed, student participants were asked to answer questions about their age, gender, and grade level. These results are displayed in Table 1. Educators surveyed were asked

[2]While the survey was initially to be given on one day, an additional day was added as many selected students, especially females in the *licence* course were unable to attend (they normally attended evening classes at the institute as they worked during the day). Other students selected could not attend as they had already finished their classes and coursework and had returned home to other cities.

Table 1 Descriptive results for students surveyed

Total surveys collected	Age range (years)	# of male students	# of female students	Number of L2 students	Number of G3 students	L2 average age	G3 average age
32	22–58	20	12	13	19	28	27

Source Own data

Table 2 Descriptive results for educators surveyed

# of educators surveyed	Age range (years)	Average age	Number of years teaching (range)	Average number of years teaching	Male	Female	Teachers	Professors
12	43–60	53	4–32	15	12	0	11	1

Source Own data

similar questions, as well as how long they had been teaching and if they were considered teachers or professors. These results are illustrated in Table 2.

Test Item Analysis

Before looking into scores further, all numerically scored questions were looked at through quantitative analysis in order to determine if any of the questions were inappropriate for the audience. Results of this analysis are shown in Table 3. For this analysis Difficulty Index (Df) and Discrimination Index (Dc) were used. The Df reports the difficulty of a question on a scale of 0.0-1.0, and the ideal item difficulty for a four alternative multiple choice test is considered by Thompson and Levitov (1985) to be halfway between a pure guess (0.25) and all answering correctly (1.0), or 0.625. The Dc is a measure of a question's ability to differentiate between students who average higher scores overall and students who average lower scores (Colbert 2001). It is measured on a scale of −1.0 to 1.0. Negative scores indicate that more students who scored lower overall answered the question correctly, while scores above 0 indicate that more students who scored higher overall answered the question correctly. Negative scores would indicate that higher scoring students struggled with a question, signifying that its wording or format may be flawed.

Difficulty Levels

Difficulty level was appropriate (<0.7 and >0.3) for all questions except MC1(0.72), MC3(0.84), MC4(0.03) and MC5(0.25).

Table 3 Test item analysis

Question	Ns or Σc	Df	Dc
Multiple choice 1 (MC1)	**23**	**0.72**	**0.33**
Multiple choice 2 (MC2)	17	0.53	0.44
Multiple choice 3 (MC3)	27	0.84	0.33
Multiple choice 4 (MC4)	1	0.03	0.11
Multiple choice 5 (MC5)	**8**	**0.25**	**0.22**
Multiple choice 6 (MC6)	**13**	**0.41**	**0.67**
Multiple choice 7 (MC7)	**13**	**0.41**	**0.56**
Multiple choice 8 (MC8)	18	0.56	0.44
Multiple choice 9 (MC9)	15	0.47	0.11

Source Own data
N_s = Number of successful students
Σ_c = Sum of total credits
D_f = Difficulty Index
D_c = Discrimination Index

Discrimination Index

All questions scored positively on the discrimination index, indicating that students in the top 27% of overall scores did answer more questions correctly than those students who scored in the bottom 27%, signifying that questions were appropriately structured and used accessible language.

Multiple Choice Environmental Literacy Questions

The average score on this section of the test was 47%, including all nine questions. Without the two "test" questions, the average score overall rose slightly to 53%. All score frequencies are illustrated in Fig. 1.

When not including the "test questions", which most students performed poorly on, significant differences were seen between average multiple-choice questions section response rates of those of different genders as well as students in different grade levels. Score frequencies by gender and grade level are illustrated in Fig. 2. Two-sample t-test revealed that *graduat* students (median score 41.1%) scored significantly lower than higher level *licence* students (median score 66%); ($t = -3.21$, $df = 22$, $p < 0.01$). Another two-sample t-test also showed that male students (median score 59%) scored significantly higher than female students (median score 42%); ($t = 2.51$, $df = 30$, $p < 0.05$).

A one-way anova analysis of variance showed that age range had no significant impact on overall multiple-choice scores ($F(2, 27) = 0.84$, $p > 0.05$).

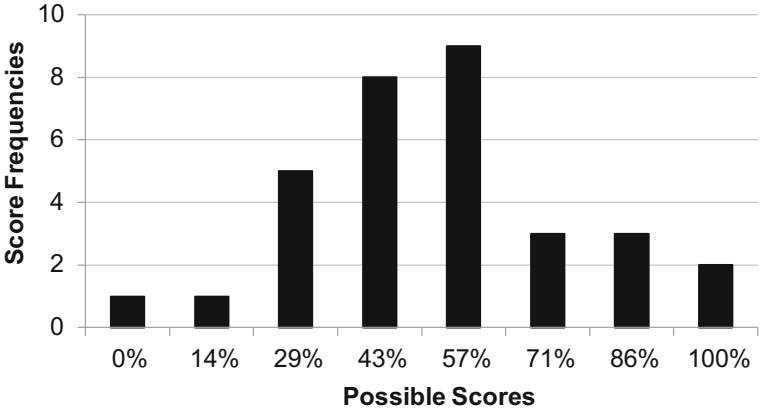

Fig. 1 Score frequencies (not including "test" questions) for student multiple choice section

Opinion and Behavioral Questions

Out of all the students, most expressed satisfaction with the quality of their education. When asked if they thought ISDR-MDK was preparing them successfully for a career as a rural development worker only two students responded no, while 28 (88%) responded yes (2 did not respond).

However, when asked if there were classes not offered at ISDR-MDK that they would like to take, 22 students (69%) responded yes. Of the responses, the following classes were most mentioned.

1. Ecology (6 mentions)
2. Sociology (3 mentions)
3. Project Management (3 mentions)
4. English (3 mentions)

Students were also asked if they used the Internet, and 23 students (72%) reported that they did, most commonly from their smartphones or at the cyber café. Several students indicated that Internet credit was expensive.

All students except one reported having heard about climate change somewhere, most commonly in class at ISDR (15 mentions), at the conference hosted on World Environment Day at ISDR hosted by the provincial REDD+ focal point and Projet Équateur (11 mentions), on the radio (11 mentions), on television (6 mentions), or on the internet (5 mentions).

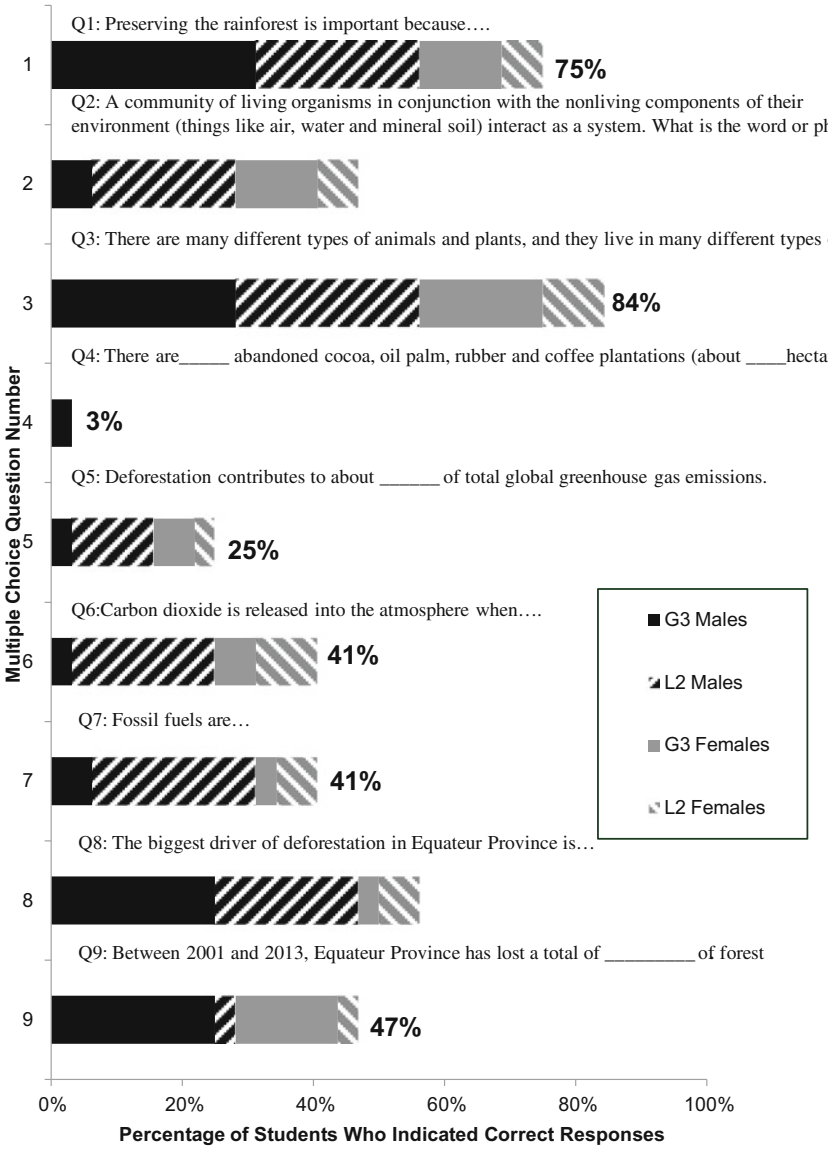

Fig. 2 Correct answers rates to "environmental knowledge" multiple choice question based on grade level and gender

Open Response Educator Surveys

Educators were asked a number of questions about their experiences at ISDR-MDK, their own education, and their views on the development of the province. When asked what they thought the biggest challenges to sustainable development in Équateur were, the overwhelming response was that poor management of natural resources and environmentally degrading practices would be the hardest to overcome. Also mentioned were poor governance, the mentalities of the population, and poverty.

The educators responded that they viewed ISDR-MDK as an institution for training development technicians to be able to work doing outreach and capacity building in the DRC. The majority of educators indicated that their students were being trained so that they would be able to help educate rural populations about environmental issues, as well as help them develop and learn alternative, less ecologically harmful practices, especially in regards to agriculture.

Educators surveyed taught between 1 and 5 courses. While most of the courses they listed were in the official curriculum, several were not. These classes included one on HIV/AIDS (currently being taught by two of the educators), a class called "Sanitation, Hygiene and Environment" and a final entitled "Appropriate Technologies".

When asked how they develop the lessons for their classes, most educators simply listed the challenges they face when doing so. These challenges were

1. Lack of Library/Teaching Resources (6 mentions)
2. Low salary (3 mentions)
3. Limited Teaching Hours (these are determined by the state and inflexible) (3 mentions)
4. Lack of Further Training (2 mentions)

When asked where they get material for teaching, the most common responses were:

1. Library (both personal and otherwise) (8 mentions)
2. Internet (5 mentions)

Educators were also asked to list any challenges that they have when teaching their students, these challenges were:

1. Ability to do practical/field work with students (limiting factors included lack of transport and funds) (5 mentions)
2. Students unable to communicate adequately in French (4 mentions)
3. Inadequate teaching materials/internet access (4 mentions)
4. Low level of students due to poor primary and secondary schooling (3 mentions)

Many of these complaints were echoed throughout answers to other questions, and when asked how they evaluated their students, three educators indicated that because the level of their students is so low, and because students have little or no

access to reading materials, exams and assignments are "modified" so that they can be "achievable". Two educators also indicated that corruption at the primary and secondary levels leads to students receiving passing marks despite not having the necessary skills and knowledge to do so.

Although several educators responded that their access was limited due to high costs, 8 educators reported using the Internet two or more times per week, with the remaining 4 indicating that they did not or rarely used the Internet.

All but one educator reported speaking about climate change in their courses.

Discussion

Environmental Knowledge

Based on results from open-response and multiple-choice questions, it is clear from response rates that most students surveyed have generally low levels of environmental literacy, but a few have managed to master basic environmental concepts despite limited access to resources.

The differences in score between grade levels could be due to work experience, as administration noted that *licence* students are required to have several years of experience in the development and/or agricultural sector before they are admitted to the program. Regardless, it is concerning that there is such a difference in knowledge between the two classes concerning basic concepts, especially as *graduat* students were in their final year and about to start their working careers.

Gender inequality is a much-discussed issue in the DRC, however the significant differences in score between females and males attending the same courses suggest that even when women are given access to higher education, they are not receiving the same benefits. This could be due to a number of factors, including more time spent taking care of household necessities (childcare, cooking, cleaning, etc.) instead of focusing on schoolwork, or perhaps may have something to do with the fact that ISDR's teaching staff is all male. Further research is needed to understand this issue, however interventions at the university level must be aware of educational issues surrounding gender even within educational institutions.

Educational Barriers

Overall the survey offered much insight into the workings of ISDR and the challenges that educators, students, and administrators face. Poor language skills and low general knowledge levels seem to hinder students in their performance as well as pose a great challenge to educators. Administrative financial barriers as well as state-designed courses and curriculums mean that educators are limited in how

much time and funds they can invest into their teaching, as well as how much practical training they can provide to students. When asked for a list of the courses offered, ISDR-MDK provided the national curriculum, a list of classes that should be taught every year by each rural development institute (there are currently four other ISDRs in Goma, Bukavu, Mbeo Bandundu, and Uvira, in addition to Mbandaka). It also includes the hours that should be allocated to theoretical and practical teaching. Classes that students had expressed a desire to take (specifically English and project management) were listed in the national curriculum, which reflects that ISDR-MDK does not have the means and/or educators necessary to uphold national curriculum standards. Staff ranged in age from 43 to 60, and had been teaching from 4 to 32 years. Several teachers noted that they have not had access to continued training, which means that their teaching materials and personal knowledge of environmental issues may not be current. Incidentally, the Director General also acknowledged that they have had a difficult time recruiting educators because they cannot guarantee that their salaries will be paid.

While there is little literature on the subject, recent research done in the DRC suggests that educators who do not receive adequate pay often depend on "motivation fees" from students. Although a teacher may not formally ask students for money, students will often give money to their teachers and expect rewards (i.e. higher/passing grades) in return (Brandt 2014). This would account for some students at ISDR-MBK being unable to read, write and speak fluently in French despite having received marks high enough to be accepted into the institute.

Putting Information Transfer into Context

While the results of this survey highlight important gaps in information access, addressing these issues on the ground is still a challenge, despite the large amount of open access information and courses available on the Internet. This survey was given in July of 2015, and the following summer a digital library, complete with Internet access and a large database of open access information, was installed on ISDR's campus. While this may address some of the lack of available resources, it does little to address French literacy levels, and there were many other challenges that came to light during the installation. Most notably:

1. **How to Acquire, Use, and Service Computers and the Internet**

Given the isolated nature of ISDR, all Congolese contractors capable of installing a solar system at the university were not locally based. This led to delays in installation and servicing. Lack of local technicians and the complexity of procurement procedures from international donors are a hindrance to projects like these, especially if the project intends on hiring and engaging local businesses.

2. **Securing Expensive Equipment**

During the first month of the library's installation there were two attempted break-ins reported by ISDR staff. ISDR does not have the monetary means to hire security guards, and so the building had to be reinforced to ensure the materials could be stored safely.

3. **Computer Literacy of Staff and Students**

This survey highlighted that most of the staff and students access the Internet from their mobile phones. When the library staff was introduced to the laptop database of learning materials, many of them struggled to use the computers. Training can address these issues, but most preferred to use the tablets.

4. **Unreliable Internet Connections and Limited Bandwidth**

ISDR now has access to the Internet via a satellite system, but Internet is often unreliable due to overhead clouds. The decision was made to also provide an offline database of materials that could provide some information even without Internet access. Additionally, a limited number of providers means that bandwidth is costly and limited, so sites that use video or similar interactive features may not work in this context. While there are many sites that provide free interactive courses, they do not work well in this environment. To address bandwidth limitations, ISDR staff and students are not supposed to download items without permission from the head librarian, as downloads slow Internet access for the whole library.

5. **Internet Literacy and Trusted Information**

While not solely an issue in this context, the ability to scrutinize information on the Internet is a valuable life skill that is not often attained without training. Additionally, advertisements based on IP addresses near ISDR often contain viruses and malware, or are adult themed in nature. Therefore, aside from restricting access to inappropriate and unsafe content, it is paramount to train students and staff to identify secure and reliable online content.

Conclusion

Present approaches to vocationally orientated capacity building through programs such as REDD+ focus on offering key workers limited "on the job training" to develop novel skills and experiences, such as participatory forest management, land use planning, and carbon monitoring training. Wide-scale sustainable development practices will not become best practice unless there is a serious overhaul of the broader tertiary education system. This is in terms of both theory, e.g. curriculum

design, and practice, e.g. tertiary education management, access to information resources and networks. Tertiary and technical schools are responsible for training future leaders and workers in all sectors, and graduates are essential to the success of decentralized REDD+ programs and other sustainable development initiatives, especially in remote and highly impoverished provinces like Équateur. The university structure offers an excellent opportunity for formal capacity building through already existing institutions managed and attended by DRC citizens, but the specific challenges of students and staff will need to be carefully considered and addressed.

This study utilizes a case study of a single tertiary education establishment in an inaccessible province, perhaps the poorest and least developed of all regions in the DRC. As such, the conditions experienced perhaps represent a worst-case scenario. As noted earlier, in universities in Kinshasa and Kisangani there have been some efforts to support improvement in teaching and training. However, the range of issues described in this case study are relevant in a general sense to the DRC and there remains a systematic underinvestment in training and education in all sectors in the DRC.

The survey results show clearly that at present ISDR is not preparing students to be effective rural development practitioners. Teaching staff face numerous challenges in rectifying knowledge gaps and capacity deficits, including their own, due to lack of financial, material, and information resources. Sustainable development at scale in Équateur will not be possible without serious and sustained financial and technical support to reform and recapitalize the national tertiary education infrastructure. Based on the size of Équateur province alone (which has an estimated population of about 9 million people), hundreds, if not thousands, of environmental and development professionals will be needed to scale up sustainable development programs at the provincal level, let alone nationally. This represents an immediate crisis in terms of realizing ambitious policy objectives such as the national REDD+ investment program. The levels of funding for rural development that are presently being committed are laudable, however there are presently insufficient adequately trained individuals to manage those funds productively. In the DRC, zero net deforestation by 2030 will not be attainable without systematically and rapidly addressing the educational needs and capacity deficits of tertiary institutions and their sustainable development and environmental experts in training.

Acknowledgements This study was carried out with funding from the Congo Basin Forest Fund and the University of Reading's Stanley Howard Hodgkin graduate scholarship program. The Woods Hole Research Center's Projet Équateur provided invaluable logistical and technical support while in the DRC. Thank you also to Amanda Poston, Emmanuel Kabemba, Raymond Achu Samndong, and all the staff and students at ISDR.

References

Akkermans, T., Thiery, W., & Van Lipzig, N. (2014). The regional climate impact of a realistic future deforestation scenario in the Congo Basin. *Journal of Climate, 27*(7), 2714–2734.

Aquino, A., & Guay, B. (2013). Implementing REDD+ in the Democratic Republic of Congo: An analysis of the emerging national REDD+ governance structure. *Forest Policy and Economics, 36,* 71–79.

Baccini, A., Goetz, S., Walker, W., Laporte, N., Sun, M., Sulla-Menashe, D., et al. (2012). Estimated carbon dioxide emissions from tropical deforestation improved by carbon-density maps. *Nature Climate Change, 2*(3), 182–185.

Bloom, D., Channing, D., & Chan, K. (2006). Higher Education and Poverty in Sub-Saharan Africa. *International Higher Education, 45,* 7.

Bloom, D. E., Hartley, M., & Rosovsky, H. (2007). Beyond Private Gain: The Public Benefits of Higher Education. In: J. J. F. Forest & P.G. Altbach (Eds.), *International Handbook of Higher Education* (Vol. 18). Dordrecht: Springer. Springer International Handbooks of Education.

Brandt, C. (2014). *Teacher's struggle for income in the Congo (DRC) between education and remuneration*. Research M.Sc. International Development Studies. University of Amsterdam.

Cabinet of the President of the Democratic Republic of Congo. (2006). *Constitution de la République Démocratique du Congo* (p. 11). Kinshasa: Journal Officiel de la République Démocratique du Congo.

Cellule Technique pour les Statistique de l'Education (CTSE). (2009). *Annuaire Statistique de l'Enseignement Supérieur et Universitaire - Année Académique 2008-2009U*. Projet d'Appui au Secteur de l'Education (PASE) Composante II: Système D'Information pour la Gestion de l'Education (SIGE). [online] Kinshasa. Available at: https://repositories.lib.utexas.edu/bitstream/handle/2152/4665/3753.pdf?sequence=1. Accessed July 10, 2015.

Colbert, M. (2001). *Statistical analysis of multiple choice testing*. Maxwell Air Force Base, Alabama: Air University.

Comité Provincial de Planification et de Coordination des Actions de Développement (CCP-CAD). (2009). *Plan Quinquennal de Développement de la Province de L'Equateur 2010-2014*. Ministere du Budget, du Plan, et des Finances.

Coordination Nationale REDD+. Plan D'investissement REDD+ (2015–2020). Kinshasa, DRC: Government of the Democratic Republic of the Congo, 2015 (Print).

DFID. (2015). *Research at DFID—Department for International Development—GOV.UK*. Gov.uk. Available at: https://www.gov.uk/government/organisations/department-for-international-development/about/research#who-we-work-with-on-research-projects. Accessed July 4, 2015.

Fao.org. (2017). *FAOSTAT*. Available at: http://www.fao.org/faostat/en/#country/250. Accessed July 8, 2017.

Fond National REDD+ (2015). *Plan d'investissement REDD+* (2015–2020). Kinshasa.

Gupta, D., Nerad, M., & Cerny, J. (2015). The road home: Exploring the choice to stay or return of international Ph.D's. *International Higher Education, 31,* 15–16.

IMF. (2013). *Democratic Republic of the Congo: Poverty reduction strategy paper 2011–2015*. IMF Country Report No. 13/226. Washington: International Monetary Fund.

Institut Supérieur de Développement Rural de Mbandaka. (2015). *Guide et Découverte de l'ISDR/Mbandaka*. Mbandaka: Institut Supérieur de Développement Rural de Mbandaka.

Kapur, D., & Crowley, M. (2008). Beyond the ABCs: Higher education and developing countries. *SSRN Electronic Journal*.

Ketlhoilwe, M., & Koketso, J. (2013). Developing capability and agency through a poverty-reduction approach to community education and sustainability in Botswana. *Southern African Journal of Environmental Education*, *29*(2012/2013).

Ketlhoilwe, M., & Maila, M. (2008). Exploring issues of relevance and quality in the context of a university programme. *Southern African Journal of Environmental Education, 25*(2008), 132–148.

Khelghat-Doost, H., Abidin Sanusi, Z., Firdaus Dato' Tunku Fariddudin, T., & Jegatesen, G. (2011). Institutions of higher education and partnerships in education for sustainable development: Case study of the Regional Center of Expertise (RCE) Penang, Malaysia. *Journal of Sustainable Development, 4*(3), 108–117. Available at: http://www.ccsenet.org/jsd. Accessed April 12, 2016.

Kuepié, M., & Nordman, C. (2015). Where does education pay off in Sub-Saharan Africa? Evidence from two cities of the Republic of Congo. *Oxford Development Studies, 44*(1), 1–27.

La Cellule Technique Pour les Statistiques de l'Education (CTSE). (2009). *Annuaire Statistique de L'Enseignement Superieur et Universitaire: Annee Academique 2008–2009*. Kinshasa.

Milburn, R. (2014). The roots to peace in the Democratic Republic of Congo: Conservation as a platform for green development. *International Affairs, 90*(4), 871–887.

Ministry of Environment, Conservation of Nature and Tourism. (2014). *Summary: Maï Ndombe Emission Reduction Program, DRC*. Kinshasa. Available at: https://www.forestcarbonpartnership.org/sites/fcp/files/2014/MArch/DRC%20Summary%20English.pdf. Accessed July 4, 2017.

OECD, UNDP, UNECA. (2012). *African economic outlook, Congo, Dem Rep* (p. 2). African Development Bank. Available at: http://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/Congo%20Democratic%20Republic%20Full%20PDF%20Country%20Note.pdf. Accessed April 27, 2016.

Oketch, M., McCowan, T., Schendel, R. (2014). *The impact of tertiary education on development. Education rigorous literature review* (123 pp.). London, UK: Department for International Development (DFID).

Potapov, P., Turubanova, S., Hansen, M., Adusei, B., Broich, M., Altstatt, A., et al. (2012). Quantifying forest cover loss in Democratic Republic of the Congo, 2000–2010, with Landsat ETM+ data. *Remote Sensing of Environment, 122,* 106–116.

Ragasa, C., Babu, S., & Ulimwengu, J. (2014). Institutional reforms and agricultural policy process: Lessons from Democratic Republic of Congo. *Agricultural and Food Economics*, *2*(1).

Russell, D., Mbile, P., & Tchamou, N. (2011). Farm and forest in Central Africa: Toward an integrated rural development strategy. *Journal of Sustainable Forestry, 30*(1–2), 111–132.

Schumacher, E. F. (1973). *Small is beautiful: Economics as if people mattered* (p. 117). Harper & Row Inc.

Shephard, K., Harraway, J., Lovelock, B., Skeaff, S., Slooten, L., Strack, M., et al. (2013). Is the environmental literacy of university students measurable? *Environmental Education Research, 20*(4), 476–495.

Summary: Maï Ndombe Emission Reduction Program, DRC. Forest Carbon Partnership Facility. N.p. 2016. Web, April 20, 2017.

Table Ronde de l'Education en République Démocratique du Congo «Vers une stratégie pour une Education de qualité pour Tous»—Rapport General. (2004). In *Table Ronde de l'Education en République Démocratique du Congo*. Kinshasa. Available at: https://repositories.lib.utexas.edu/bitstream/handle/2152/4665/3753.pdf?sequence=1. Accessed May 10, 2015.

Thompson, B., & Levitov, J. E. (1985). Using microcomputers to score and evaluate test items. *Collegiate Microcomputer, 3,* 163–168.

UNDP, (2009). *Pauvreté et Conditions de Vie des Ménagés. Province de l'Equateur: Profil Resume*. Kinshasa: UNDP. Available at: http://www.cd.undp.org/content/dam/dem_rep_congo/docs/povred/UNDP-CD-Profil-PROVINCE-Equateur.pdf. Accessed July 4, 2016.

UNDP. (2015). *Human development reports, DRC*. Hdr.undp.org. Available at: http://hdr.undp.org/en/countries/profiles/COD. Accessed July 6, 2016.

Walker, W. (2015). Biomass losses in the Democratic Republic of the Congo.

Woods Hole Research Center. (2007). *Reducing CO_2 emissions from deforestation and degradation in the Democratic Republic of Congo: A first look*. Bali, Indonesia: Woods Hole Research Center. Available at: http://whrc.org/wp-content/uploads/2015/09/WHRC_REDD_Congo.pdf. Accessed March 6, 2017.

World Bank, (1994). *Higher education: The lessons of experience*. Development in practice. Washington DC: The International Bank for Reconstruction and Development. Available at: http://siteresources.worldbank.org/EDUCATION/Resources/278200-1099079877269/547664-1099079956815/HigherEd_lessons_En.pdf. Accessed July 3, 2015.

World Bank. (2011). *Learning for all investing in people's knowledge and skills to promote development: World Bank group education strategy 2020*. Washington D.C.: The International Bank for Reconstruction and Development/The World Bank. Available at: http://siteresources.worldbank.org/EDUCATION/Resources/ESSU/Education_Strategy_4_12_2011.pdf. Accessed July 24, 2015.

World Bank. (2016). *Congo, Dem. Rep.|Data*. Available at: http://data.worldbank.org/country/congo-dem-rep. Accessed July 11, 2016.