

Knowledge, Attitudes and Awareness of Pre-Service Teachers on Biodiversity Conservation in Rwanda

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ABSTRACT

This research presents a case study on the knowledge of pre-service teachers of the school of lower secondary education on biodiversity conservation in Rwanda. It critically examines the implication of the level of knowledge on attitudes and behaviors towards biodiversity conservation and the potential implications of a lack of the courses focusing on biodiversity conservation in the school of lower secondary education, and presents empirical data from a survey and group discussions. Results showed that generally the level of knowledge of pre-service teachers on biodiversity conservation is high, and there is positive correlation between knowledge, awareness and attitude, which in turn may contribute to sustainable biodiversity conservation in Rwanda. Research concluded that there should be another research on the side of primary and secondary students in order to verify if the skills of teachers in biodiversity conservation are fully taught to the students.

KEYWORDS

Pre-service teachers, biodiversity conservation, knowledge, attitude, awareness

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Introduction

Biological diversity is defined as the variety and variability among the living organism from terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part (Heywood and Bates, 1995). Biodiversity includes genetic diversity, species diversity and ecosystem diversity (Suift et al., 2004). In other words, biodiversity is the variety of life on earth and includes variation at all levels of biological organization from genes, species and ecosystems (Gaston and Spicer, 2004). However, researches indicated that biodiversity encompasses more than variation in appearance and composition, and includes diversity in abundance, distribution and in behavior, and incorporates human cultural diversity (Chivian, 2002).

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Benefits from biodiversity to humans are various, and essential services provided to the society includes material goods such as food, timber, medicines, and fiber; as well as various services appreciated to underpin ecological functions such as flood control, climate regulation, nutrient cycling, maintaining hydrological cycles, cleaning water and air, soil formation and soil storage (MEA, 2005), added to the cultural, social, aesthetic and ethical values (Swift et al., 2004), pollination and pest control, carbon sequestration and storage (Hooper et al., 2005; Barton and Pretty, 2010). These functions are appreciated to secure long-term flows of benefits from nature by providing resilience to disturbance and environmental change (Hooper et al., 2005) and other economic and social contributions which are essential to human being (Gallai et al., 2009).

Increasing domination of ecosystems by humans is steadily transforming them into poor systems (Vitousek et al., 1997; Sala et al., 2000). Humans have extensively altered the global environment, changing the global biogeochemical cycles, transforming land and enhancing the mobility of biodiversity, while fossil-fuel combustion and deforestation increased the concentration of atmospheric carbon dioxide (Stuart et al., 2000). Changes in biodiversity and its links to ecosystem properties affect the cultural, intellectual, aesthetic and spiritual values that are important to society; in addition to economic impacts related to the reduction of food resources, fuel, structural materials, medicinal or genetic resources as well as abundance of other species that control ecosystem processes, leading to further changes in community composition and vulnerability to invasion (Stuart et al., 2000).

The imperative to reduce human impacts on biodiversity has wide political recognition in various countries. There is an increasing array of national, regional, and international policy mechanisms aimed at biodiversity conservation (Rands et al., 2010). Creation of protected areas, species protection and recovery measures for threatened species, ecosystem restoration, ex situ and in situ conservation services, incorporating consideration of biodiversity conservation into management practices in sectors such as agriculture, forestry and fisheries, capture of benefits by local communities, public awareness, communication and education, integration of biodiversity conservation and development are some of the action taken for biodiversity conservation (MEA, 2005) cited among others.

Rwanda, like other countries of the Albertine rift namely Uganda, Tanzania, Democratic Republic of Congo, Burundi and Zambia, has a remarkable variety of ecosystems inhabited by a variety of flora and fauna species (GoR, 2010), with many endemic species. Conservation efforts are based on the creation of protected areas, integration of communities in conservation activities, revenue sharing and establishment of various laws such as the law governing biodiversity (GoR, 2013) and the list of protected animals and plants (GoR, 2008). Biodiversity conservation education has been a priority of the government, and since 2010, Rwanda Environmental management Authority introduces the environmental education in its strategy and action plan for 2010 – 2015, where conserving, preserving and restoring ecosystems as well as protecting biodiversity and ensuring sustainable use of natural resources were given the priority (REMA, 2010).

Besides of efforts in Biodiversity conservation, there is a lack of specific subject about biodiversity conservation in the programs of students of the school of lower secondary education in Rwanda. Consequently, pre-service teachers might not be able to acquire enough skills in biodiversity conservation and may fail to understand what biodiversity conservation is and why we have to conserve. This shall in turn affect sustainable biodiversity conservation, as they shall not be well skilled to teach this subject in primary and secondary education of Rwanda. Therefore, there is a need of study of the level of understanding of pre-service teachers vis-à-vis biodiversity conservation in Rwanda. This study has the aim to measure the level of knowledge, awareness, and attitude of pre-service teachers towards biodiversity conservation. The main goal of the research was to contribute to the quality education in Rwanda, while respecting biodiversity conservation strategies.

Methods

The study took place in the School of Lower Secondary Education, in a Campus of the college of education, located in Eastern province of Rwanda. Previously, the Campus was known as Rukara College of education established by the decision of the cabinet meeting of 14 September 2007. Later in 2010, under the decision of the cabinet meeting of 16 December 2010, Rukara college of Education merged with Kavumu College of Education to form Rwanda Teachers College (RTC) and it was given a mission of training future lower secondary teachers in the domains of arts and social sciences, languages, and mathematics and sciences for a period of two years after which trained teachers are awarded Diploma in Education. In 2014, RTC was taken in the University of Rwanda, college of education, school of lower Secondary Education, Rukara Campus.

Research on knowledge, attitudes and awareness of pre-service teachers on biodiversity conservation in Rwanda was carried out in two main stages between September and October 2016, and involved the formal and informal survey methods (de Graaff, 1996). Students from the combination of MBE (Mathematics and Biology with Education) and nine students from the combination of BCE (Biology and Chemistry with Education) participated in the research. Before each stage, the purpose of research was given to participants to assure them that the information and data will be used for research only and that confidentiality will be taken into consideration. This was done to encourage them to give answers corresponding to the reality (Nsengimana et al., 2016).

The first stage involved the focus group discussion with nine students from MBE and nine students from BCE. The number of participants has been determined based on the strategy of Stewart and Shamdani (1990), and were selected randomly (Durrance and Fisher, 2005). Two group discussions have been organized on Wednesday afternoon in laboratory five (Lab 5) of the campus. General questions and photographs related to biodiversity, and ecosystem goods and services were given to participants and they were asked to assess each one and score its importance (Cottet, Piégay and Gudrun, 2013). In addition, a movie indicating the importance of biological diversity have been presented to participants for five minutes before the discussion. When the visual information was insufficient to deduce the meaning, the photograph was

classified unknown (Nsengimana et al., 2016), and the movie should be replayed by the request of participants, to facilitate the discussion.

The second stage involved the survey, where 90 students from BCE and 43 students from MBE, totaling 133 participants participated in the research. Among these students, 73 were males (49 from BCE and 24 from MBE) while 60 were female (41 from BCE and 19 from MBE). They were selected randomly by using simple random sampling without replacement, where every individual had an equal chance of being chosen for the study (Onwuegbuzie and Gollins, 2007). To validate the questionnaire guide, a pilot study was done with ten students selected randomly outside of the combination of BCE and MBE (Teddlie and Tashakkori 2008). Based on the feedback from the pilot survey, some modification were made to test the questionnaire and standardization techniques were done before conducting the full survey (Nabahungu and Visser, 2013).

The questionnaire consisted of a four point Likert – Scale. It was subdivided into three sections: knowledge, attitude and awareness. Each section had various numbers of questions and the score was based on the selected answer. Two types of questions have been developed for measuring the awareness, and were graded as follows: 1=never, 2=seldom, 3=often, and 4=very often for measuring the awareness of the influence on biodiversity, and 1=much worse, 2=worse, 3=better, 4=much better for measuring perceptions of biodiversity status. To evaluate the concern on biodiversity conservation issue, the following grades have been used: 1=not concerned at all, 2=somewhat concerned, 3=concerned and 4=very concerned. The next part focused on attitudes and four rates have been used: 1=strongly disagree, 2=disagree, 3=agree, 4=strongly agree. The last part focused on the knowledge, where the questions were answered by true (T) or false (F), where the correct answer was scored 4 while incorrect answer was scored 1.

The statistical package for social sciences (SPSS) 20 was used for the analysis of quantitative data from the questionnaire, while a thematic approach was used to analyze the focus group discussion data (Bryman and Cramer, 1997). Analysis was taken separately for every subpopulation and for every combination before it was undertaken for the overall group (Nsengimana et al., 2016). The statistical analysis which was applied includes the descriptive, frequency and Spearman's correlation coefficient.

Results

The majority of pre-service teachers (89.5%) defines biodiversity as the full range or variety and variability among and between organisms and ecological complexes in which they occur. Around 75.2% confirm that biodiversity includes processes, interactions, structure, composition and function and it encompasses genetic, species and community diversity. A small number of them (15.8%) recognizes that biodiversity encompasses a broad spectrum of scale from and within species to the biome distributions of the planet, while a considerable number of the respondents (87.2%) agreed that biodiversity conservation consist of establishing protected areas such as national parks, nature and zone reserves in order to slow the loss of biological diversity.

Concerning the knowledge on ecosystems and how they function, 92.5% of pre-service teachers define ecosystem as a natural unit consisting of all plants, animals and micro-organisms as well as the physical factors occurring in their habitats. Around 40.6% responded that ecosystem functioning refers to a variety of phenomenon, including properties, goods and services. However, a small number (32.4%) recognize ecosystem properties as the size, compartment and processes. others (57.1%) recognize ecosystem goods as those ecosystem properties that have direct market values such as food, medicines, and construction materials, while others (10.5%) recognize that ecosystem services are those properties of an ecosystem that either directly or indirectly benefit human endovers such as maintaining hydrologic cycles, climate regulation, cleaning water and air, pollination, soil formation and storage.

A considerable number of the respondents (75.7%) argued that when biodiversity is well managed, ecosystem properties, goods and services are positively affected, and biodiversity conservation might take an interest to know how the loss of biodiversity impacts ecosystem processes. In this perspective, around 12.4% replied that ecosystem sustainability refers to the capacity for a given ecosystem service to persist for a long period of time, while others (11.9%) have the point of view that also biotic factors such as climate variation, soil and temperature have an influence on the magnitude and stability of ecosystem properties. However, they pointed out that changes in biota can have greater effects on ecosystem properties than changes in abiotic factors.

Knowledge of the key factors susceptible to cause biodiversity loss are also various. A small number (12.9%) of pre-service teachers mentioned the over exploitation of species resources, environmental pollution, and increasing demand for food, fire wood, and land. Others (7.3%), mentioned the dominance of invasive species, climate change and climate variability; while others (57.6%) mentioned the habitat degradation, habitat loss and habitat destruction. Over exploitation of water resources and soil degradation have been also mentioned by some of the respondents (22.2%) as other key factors which can cause the biodiversity loss. Almost all respondents (91.1%) replied that all the above factors are related to the poverty, a big number of population depending on biodiversity resources, and lack of the knowledge on the importance of biodiversity and the reasons why biodiversity conservation is a need.

The most recognized effort for biodiversity conservation in Rwanda is the creation of national parks (61.8%), while others such as use of economic stoves and creation of home farms for domestic animals for environmental conservation have been mentioned by a relatively small number of the respondents (18.9%). Some other efforts such as engagement of local communities in community conservation and revenue sharing (5.1%), ecological restoration and protection of some ecosystems such as wetlands (4.2%), reintroduction of some species such as lions (3.3%), working with neighboring countries and in partnership with nongovernmental organizations [NGOs] (2.7%), establishment of laws policies and orders for biodiversity conservation (2.3%), establishment and creation of boards, centers and the introduction of biodiversity conservation in primary and secondary learning programs (1.7%) have been mentioned by small numbers.

For sustainable biodiversity conservation in Rwanda, the majority of pre-service teachers (73.8%) suggested that the biodiversity conservation should be incorporated into public and decision making, and integrate biodiversity conservation in the programs of local government and leadership. Others (21.6%), suggested the enhancement of the training for local people on the importance of biodiversity conservation and encourage them to look at biodiversity resources as a public good, beneficial for health and human wellbeing, so that it is worth to be maintained for the present and future generation. Others (4.6%) mentioned that it is very important to reinforce the community conservation and punish those who do not comprehend with the law. They added that, the study of biodiversity conservation should be introduced in all levels of education in Rwanda from primary up to higher learning institutions, so that whoever is learning at each level is equipped with enough skills in this domain.

Even if the level of knowledge of pre-service teachers on biodiversity conservation is generally appreciable, the majority of them (78.3%) do not at all appreciate how it is integrated and taught in their combinations. They said that biodiversity conservation as a course or module does not exist. It is only a very small component inserted in the component of ecology, in the module entitled human biology and elements of ecology. Around 68.9% explained that the skills they have is from the media such as radios, televisions and newspapers, workshops and seminars, while 5.6% have got the information about biodiversity conservation from community conservation initiatives around Nyungwe and Volcanoes national park, where they are coming from. Almost all of them (93.7%) suggest that biodiversity conservation should be integrated in the modules they are studying not only because they have to go to teach it in secondary education, but also because itself is very important for the survival of human being.

Almost all participants from the survey (93.2%) and group discussion (88.8%) accepted that their role in biodiversity conservation is needed and they replied that they are ready to be involved in conservation issues. As future teachers, they are committed to actively teach students what is biodiversity, biodiversity conservation, and importance of conserving biological diversity as well as various methods which are used for sustainable conservation. The Spearman's Bivariate Correlation Analysis between awareness, attitude and knowledge at $p \leq 0.05$, indicated a high significance of correlation between awareness and attitudes ($r=0.99$, $n=133$), and significant correlation between awareness and knowledge ($r = 0.165$, $n=133$), and between knowledge and attitudes ($r = 0.174$, $n=1333$).

Discussion

Knowledge of pre-service teachers on biodiversity conservation is generally appreciable. The definition given by the majority of them on the meaning of biodiversity and its conservation correlate with the findings of other researchers (Wilson, 1992; Gaston, 1996; Purvis and Hector, 2000; Mooney, 2002). This is the same for the understanding on ecosystem functioning specifically ecosystem properties, ecosystem goods and ecosystem services (Christensen et al., 1996; Daily, 1997), as well as the linkage between

biodiversity and ecosystem functioning (Van Cleve et al., 1991; Jones and Lawton, 1995; Smith et al., 1997; Elser et al., 1996; Schindler et al., 1997; Chapin et al., 1993, Diaz et al., 1999). It has been also indicated that both abiotic and biotic factors have an influence on the magnitude and stability of ecosystems, but changes in biota can have greater effects on ecosystem properties than changes in abiotic factors (Chapin et al., 2000).

High knowledge of pre-service teachers from the school of lower secondary education, might be an advantage for sustainable biodiversity conservation in Rwanda. The correlation between knowledge and attitude has been documented elsewhere, and results indicated that there is a relationship between knowledge and positive attitude (Zarintaj et al., 2013). Knowledge in this case is the structural property of attitudes as well as a function of the number of beliefs and experiences linked to the attitude in memory and the strength of the associative links between beliefs or experiences (Krosnick and Pretty, 1995). This is the reason why knowledge has been assessed by counting the number of attitude-relevant beliefs and experiences people can recall in open-ended listing tasks (Kallgren and Wood, 1986; Davidson et al., 1985).

Research in environmental education on the assessment of attitudes towards the environmental protection measured the relationship between knowledge and attitudes and indicated that attitudes are based on high amounts of knowledge and are more predictive of environment-related behavior than were attitudes based on little amounts of knowledge (Kallgren and Wood, 1986). When knowledge increased, positive attitude also increased for a given subject (Chen et al., 2011). On the other hand, the high relationship between awareness and attitude may appear due to some demographic variable such as age and education (Fletcher, 2000).

Other research indicated that an individual who expresses an intention to take action is more likely to engage in the action than will an individual who expresses no such intention (Hines, 1987). It appears that intention to act is merely an artifact of a number of other variables acting in a combination such as cognitive knowledge, skills and personal factors, so that before an individual can act on a particular problem, that individual must be cognizant of the existence of issue; thus knowledge of given issue appears to be a prerequisite to actions, and this is more successful once associate to the awareness and attitude (Harold and Trudi, 1990).

The above researches indicate very well that knowledge is the starting point to ownership of the problem, which in turn leads to the in-depth knowledge or understanding of the problem, which once again leads to personal engagement. In this perspective, knowledge and attitudes are linked to each other, and attitude is further connected to behavior (Flamm, 2006), and the concerned become more aware of the problem and its challenges, and thus, be more motivated to act in more responsible ways (Fahlquist, 2008). On the other hand, it has been indicated that the creation of awareness and understanding of the relationship between humans and their environments is concerned with knowledge (Hafezi et al., 2013).

Conclusion

High level of awareness and knowledge as well as positive attitude of pre-service teachers from the school of lower secondary education might contribute to the sustainable biodiversity conservation in Rwanda. However, other important research are need for the side of students who will be taught by the pre-service teachers in order to verify if the skills of teachers in biodiversity conservation are fully taught to the students. In this regard, some other factors such as age, gender, school location should be studied.

Disclosure statement

No potential conflict of interest was reported by the authors.

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