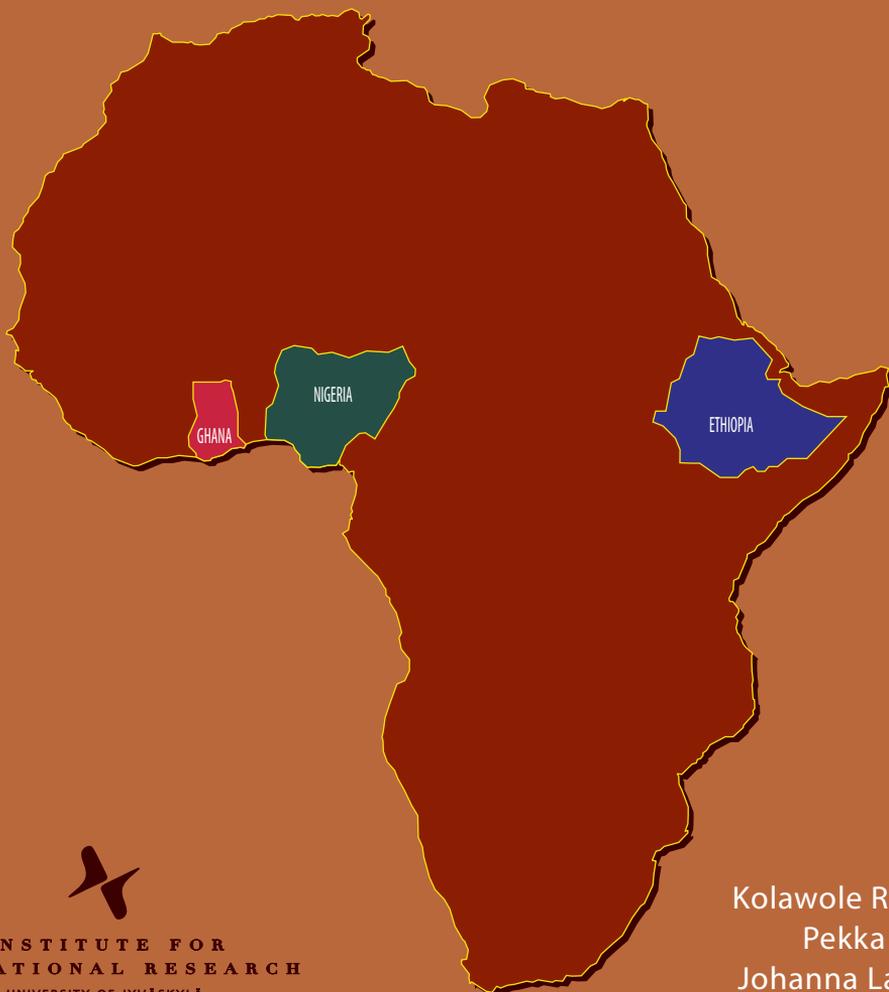




Towards Science Education for Sustainable Development in Developing Countries

A STUDY OF ETHIOPIA, GHANA AND NIGERIA



INSTITUTE FOR
EDUCATIONAL RESEARCH
UNIVERSITY OF JYVÄSKYLÄ

Kolawole Raheem
Pekka Kupari
Johanna Lasonen

Institute for Educational Research

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CAN BE OBTAINED FROM:
Institute for Educational Research
Customer services
P.O. Box 35
FI-40014 University of Jyväskylä, Finland
Phone +358 14 260 3220
Fax +358 14 260 3241
E-mail: ier-customerservices@ktl.jyu.fi
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Abstract

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Sustainable development is worldwide desired, especially for the developing countries. However, research on education and teachers' training programmes in sustainable development is not common. This pilot study was therefore carried out on the topic by applying tools such as tests and questionnaires of the Third International Mathematics and Science Study in 1999 (TIMSS 1999) and bringing together three developing countries, Ethiopia, Ghana and Nigeria, in Africa. Even though there are some differences between the countries, the idea was to 'construct an instrument' for assessing science education environment and science achievement vis-à-vis sustainable development. The knowledge from the study could be used in supporting a new type of educational policy in developing countries to achieve sustainable development. The research project concentrated on differences between curricula, national systems and national strategies for improving the quality and sustainability of education for sustainable development as they are manifested at the policy level and in teachers' and teacher educators' conceptions and students' understandings. Moving from the level of strategy to the level of specific curriculum and pedagogic initiatives were mapped. The study also included workshops that brought together stakeholders in educational development to exchange views based on the experience and findings of the study. The exchange of researchers has improved the collaboration between the North and the South in educational science and sustainable development issues. It has also encouraged active participation and contribution of some African countries to the construction of

relevant instruments used in assessing education. Students in the countries chosen for this research have benefited from the knowledge resulting from the results of the research. Three questions guided the pilot study. First, we wanted to find out the teachers' perspectives, motivation and their ideas about sustainable development and how they relate the subjects they teach to the everyday living. Second, students' achievement in science education related to sustainable development in Africa was assessed. The third question addressed the issue of possible variation and similarity in education and training policy of the three countries. The results of the study have suggested the implications for developing a measurement instrument for assessing sustainable development in science education.

The results of the study revealed that students in Ethiopia, Ghana and Nigeria are knowledgeable about the environmental problems they live with, although many of the everyday activities around them do not show sustainable use of the environment. The students, who completed the achievement test, scored really high in many science items that were closely related to the African environmental context. Especially, in many items involving Environmental Issues, Physics and Chemistry students scored even higher than the international average of the TIMSS study.

Also teachers, by the scores of the students in some science subjects, seemed to show that their teaching methods have been effective, even though it is a common knowledge that many of them are not trained for the profession. Additionally, the teachers' socio-economic status is low, and they have rated themselves low in the society. The study informed of the nature of teaching profession and teacher's everyday concern in each country and showed that teachers in Africa have impacted positively on their students. However, teachers need more support in training and enhancement of their conditions. They need to have better wages, improvement of school environment, pre- and in-service training and raising their status. The learning and teaching environment is poor. The sanitation level is very low and great attention should be paid on the school buildings and other educational infrastructures to facilitate sustainable development. Notwithstanding all the challenges, the results show that students have acquired information which is necessary for sustainable development. At the same time, these results are not sufficient for the development of science curriculum and teacher education. Further research is needed to improve, among others, the measurement tools and to enlarge the student sample. A significant result of the study is that it gives a good basis for the next phase that could be an important contribution to the improvement of development cooperation in educational issues such as sustainable development in science education. We live the UN Decade of Education for Sustainable Development (DESD) 2005 – 2015.

Keywords: sustainable development, achievement, science education, environmental education, school curriculum, learning environment, Ethiopia, Ghana, Nigeria

Tiivistelmä

Raheem, K., Kupari, P. & Lasonen, J. 2006. Kohti kestäväää kehitystä luonnontieteiden opetuksessa. Etiopian, Ghanan ja Nigerian opetussuunnitelmien kartoitusta. Jyväskylän yliopisto. Koulutuksen tutkimuslaitos. Tutkimusselesteita 32.

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Kestävän kehityksen edistäminen on yhteinen tavoite maailmanlaajuisesti. Siihen liittyvä tutkimus kasvatuksen ja opettajankoulutuksen näkökulmista on melko harvinaista. Tämän tutkimuksen tarkoituksena oli arvioida kestävään kehityksen ilmenemistä afrikkalaisessa luonnontieteiden opetuskontekstissa hyödyntämällä TIMSS 1999 -tutkimuksen luonnontieteiden osuuden arviointivälineitä. Yhtäältä arvioitiin etiopialaisten, ghanalaisten ja nigerialaisten opiskelijoiden suorituksia luonnontieteiden testissä, joka oli laadittu ja muokattu näiden maiden luonnontieteiden opetussuunnitelmien pohjalta. Toisaalta kartoitettiin opettajien mielipiteitä luonnontieteiden ja kestävään kehityksen opetuksesta muutamissa afrikkalaisissa kouluissa. Tutkimuksessa tarkasteltiin opetussuunnitelmien, koulutusjärjestelmien ja kansallisten strategioiden eroja koulutuksen laadun ja kestävyuden kehittämiseksi sen perusteella, miten niitä on ilmaistu koulutuspolitiikan tavoitteissa, opettajankouluttajien käsityksissä ja opiskelijoiden ymmärtämisenä. Tutkimuksen toteuttamisen aikana järjestettiin työseminaareja Suomessa, Ghanassa ja Nigeriassa, joihin osallistuneet tutkijat, opettajankouluttajat, opettajat ja hallintohenkilöt keskustelivat kestävään kehityksen teemoista. Näin toteutettiin tutkijavaihtoa Suomen ja osallistujamaiden välillä. Asiantuntijavaihto antoi myös rohkaisua näille maille sekä omien arviointitestiä kehittämiseen että kansainvälisiin arviointitutkimuksiin osallistumiseen. Tämän pilottitutkimuksen toteuttamista ohjasivat seuraavat tutkimustehtävät: (1) opettajien mielipiteiden kartoitus kestä-

vän kehityksen opettamisesta luonnontieteissä, (2) opiskelijoiden osaamistason arvioiminen kestävästä kehitystä peilaavassa luonnontieteiden testissä, ja (3) kolmen maan koulutuspolitiikan vertailu luonnontieteellisissä kestävästä kehityksen kysymyksissä. Tutkimus osoitti, että Etiopian, Ghanan ja Nigerian opiskelijat menestyivät hyvin sellaisissa tehtävissä, joiden aiheet koskettivat heidän jokapäiväisiä ympäristöongelmiaan. Erityisesti ympäristöä, fysiikkaa ja kemiaa koskevilla tehtävillä afrikkalaisten opiskelijoiden keskimääräiset suoritukset olivat jopa TIMSS 1999 –tutkimuksen osallistujamaiden keskiarvoa parempia. Etiopian, Ghanan ja Nigerian opettajien opetusmenetelmät näyttävät olleen tehokkaita hyvin puutteellisista opetus- ja oppimisolosuhteista huolimatta. Opettajien sosioekonominen status on näissä Afrikan maissa alhainen, minkä opettajat itsekin tuovat esille. Opettajien palkka on niin alhainen, ettei se riitä edes välttämättömään toimeentuloon. Opettajat tarvitsevatkin voimakasta tukea opetusolosuhteiden kohentamiseksi, luonnontieteiden opetuksen perus- ja täydennyskoulutuksen kehittämiseksi sekä laajemmin kestävästä kehityksen edistämiseksi koulutuksessa. Hygienian tason kohottaminen, koulurakennusten korjaaminen ja infrastruktuurin kehittäminen ovat kestävästä kehityksen toteuttamisen edellytyksiä. Kaikista puutteista ja haasteista huolimatta testitulokset osoittavat, että opiskelijat ovat omaksuneet kestävästä kehitystä tukevaa luonnontieteellistä tietoa. Kuitenkaan tämän pilottitutkimuksen tulokset eivät ole riittäviä luonnontieteiden opetussuunnitelmien ja opettajankoulutuksen muuttamiseksi. Lisätutkimusta tarvitaan esimerkiksi arviointimenetelmien kehittämiseksi ja saatujen tulosten varmentamiseksi suuremmissa opiskelijajoukoissa. Tämän tutkimuksen merkitys on siinä, että se on rakentanut perustan ja avannut suuntia uusien tutkimus- ja kehittämishankkeiden toteuttamiselle luonnontieteiden opetuksen alueella. Lisäksi tutkimuksen tulokset todentavat suuren tarpeen kehitysyhteistyöressurssien ohjaamiseksi kestävästä kehityksen edistämiseen koulutuksessa. Elämme parhaillaan YK:n julistamaa kestävästä kehitystä edistävän koulutuksen vuosikymmentä 2005 – 2015 (the Decade of Education for Sustainable Development, DESD).

Asiasanat: kestävä kehitys, oppimistulokset, luonnontieteet, ympäristökasvatus, opetussuunnitelmat, oppimisympäristö, Etiopia, Ghana, Nigeria

Preface

Education is a human right recognised worldwide as it is indicated in Article 26 of the Declaration of Human Rights (1948): “Everyone has the right to education”. It is generally believed that equal access to educational attainment promotes social justice and cohesion and indirectly eradicates poverty. However, there are still approximately 100 million children in the world who never enter primary school, 55 per cent of them girls. In addition, 771 million people aged 15 and above live without basic literacy skills (UNESCO 2005a). Women account for nearly two thirds of those excluded from education. The great majority of illiterate people live in developing countries. Poverty is one of the greatest obstacles to school attendance and to literacy.

The Education for All movement was launched at a world conference held in Jomtien, Thailand in 1990. The conference approved an Education for All Declaration and a Plan of Action with the aim to guarantee that by the turn of the millennium all people in the world would have been guaranteed access to basic education. A follow-up seminar held in spring 2000 in Dakar, Senegal discovered that progress had been slow. The EFA Dakar Framework focused on six educational goals: early childhood care and education; access to compulsory primary education by 2015; learning needs of all young people and adults; 50% improvement in adult literacy by 2015, especially for women; elimination of gender disparities in primary and secondary education by 2005 and achievement of gender equality in education by 2015; and improvement in all aspects of the quality of education and achievement of learning outcomes in literacy, numeracy and life skills. The primary objective of the action programme is to guarantee universal access to basic education by 2015.

In order to meet the EFA objectives the developing countries should achieve a yearly increase of 5 per cent in the number of school entrants over the next 10 years. In some countries the increase should be 15 per cent. It is now predictable that at least 32 countries, of which around ten are living through an armed conflict, are likely to fail to reach the goal of

all children attending school. Sub-Saharan Africa would have to triple the number of primary-school pupils from what it was in 1990–1997. What does achieving these targets require according to UNESCO (2003, 2004)?

- In Africa, student numbers must grow by 150 per cent as compared to the 1997 figures, a yearly increase of 4.9 million children. To reach this goal, Angola, the Central African Republic, Congo, Lesotho, Liberia, Nigeria and Somalia would have to raise their student numbers tenfold.
- In Southern Asia such an increase means 40 million more children. In Bhutan, a tenfold number of children should be admitted to school if the country is to guarantee school access to all children by 2015.
- In the Arab countries there must be an increase of 72 per cent, 23 million children more.
- Furthermore, 76 out of 180 countries have not reached gender parity at primary level (UNESCO 2005a).

The regions with the lowest literacy rates are sub-Saharan countries, South and West Asia and Arab States, all with literacy rates around 60 per cent, despite increases of more than 10 percentage points since 1990 (UNESCO 2005a, b).

Worldwide, basic education is not necessarily equivalent to compulsory schooling for both children and adults. The Jomtien Declaration expanded the concept of basic education including everybody, children, the youth and adults, who should be able to benefit from educational opportunities designed to meet their basic learning needs. These include both

- essential learning tools, such as literacy, oral expression, numeracy and problem solving, and
- the basic learning content (knowledge, skills, values and attitudes) required by human beings to be able to survive, to develop their full capacities, to live and work in dignity, to participate fully in development, to improve the quality of their lives, to make informed decisions, and to continue learning.

The aim of basic education is to develop human potential. Personal development foregrounds values, attitudes and skills. Knowledge and contents vary from one country and culture to another and over time (UNESCO 2000).

The Jomtien Declaration emphasises a comprehensive approach to the relationship between human beings, nature and society, which together form the background against which educational objectives can be adjusted and revised. *The focus is on integrating humans and their actions with their environment*, that is, on how human beings as persons develop

their potential and competence, make responsible decisions, improve the quality of their life and learn on a continuous basis, how they earn their livelihood in and through their work and make a valuable contribution and how they participate in the development process within the community.

According to UNDP's (United Nation's Development Programme) monitoring reports (2004, 2005) measured by the variable of Human Development Index (HDI), the four countries of this study belong to all three categories of the human development. Ethiopia is among one of the poorest countries, ranking 170 out of all 177 countries. Nigeria's rank was 151 in 2002 and 158 in 2005. Both countries belong to the low human development aggregates. Ghana, ranking 131 in 2002 and 138 in 2003, belongs to the medium human development aggregates. Finland, whose ranking number was 13 out of 177 countries in 2002, belongs to the high human development aggregates (see Appendix 1).

The Governments of Ethiopia, Finland, Ghana and Nigeria have also adopted the goal of ensuring universal access to and completion of basic education and reducing the adult illiteracy rate by 2015. Each country, considering its national context, is still challenged by the goal. The duration of primary education is six years in all these countries. However, the age of compulsory education differs between the countries (see Appendix 1). In Ethiopia and Nigeria, compulsory education refers to primary education and lasts six years whereas in Ghana and Finland, it consists of primary and lower secondary education and lasts nine years.

Adult literacy rates (% ages 15 and above) greatly vary between Ethiopia (41.5%), Finland (99%), Ghana (54.1%) and Nigeria (66.8%) (UNDP 2005; statistics in 2003). Primary education intakes, the numbers of new entrants to primary education, gender parity indexes and school life expectancy, are presented in Annex 1 (UNESCO 2005b). The average school life expectancy in Ethiopia is 5.3 years, in Finland 13.7 years, in Ghana 7.6 years and in Nigeria 9.8 years, and respective gender parity indexes are 0.68, 1.06, 0.88 and 0.81. It seems that Ethiopia, Ghana and Nigeria still face the challenge of struggling to meet the EFA and Millennium Development goals in universal primary education among males and females. In contrast to differences in primary school indicators between Finland and the three African countries, the per cents of tertiary students in science, mathematics and engineering do not vary to a great extent. Nigeria leads in this respect as 41 percent of its tertiary students major in sciences, math and engineering (Annex 1).

Finland has been committed to implementing the policy goals and strategies of sustainable development, which have been indicated in the Declaration of the United Nations Decade of Education for Sustainable Development (DESD: 2005–2014). The Finnish Ministry of Education emphasizes the promotion of sustainable development in its policy guidelines "Education and Research 2003–2008: Development Plan". Sustainable development comprises ecological, economic, social and cultural aspects.

This report focuses on sustainable development in science education. The purpose of the conducted study was to evaluate the extent to which science education implemented in Ethiopia, Ghana and Nigeria takes into account the selected indicators related to sustainable development. The study has searched for answers to the following questions:

- What are teachers' opinions about teaching conditions concerning sustainable development in Ethiopia, Ghana and Nigeria?
- What kind of science knowledge do students have in order to figure out the role of sustainable development in their living environment?

In addition, the report discusses other international means of measuring for assessing indicators of the contents of sustainable development in educational policy and teacher education programmes in the countries.

The research partners include four African universities and one Finnish research institute. The African researchers come from Ethiopia, Ghana and Nigeria:

- Professor Tirusew Teferra, MA Alemayehu Teklemariam and Dr. Belay Hagos from the *University of Addis Ababa*, Ethiopia;
- Professor Jophus Anamuah-Mensah, Professor Akwasi Asabere-Ameyaw and Dr. John Eminah from the *University of Education, Winneba*, Ghana;
- Professor Kayode Ajayi, Dr. Funmi Sotonade and Dr. Biodun Ogunyemi from *Olabisi Onabanjo University, Ago-Iwoye*, Nigeria; and
- Professor Amechi Nweze from the *University of JOS, Jos*, Nigeria.

The Finnish research team from the Institute for Educational Research at the University of Jyväskylä, Finland, consists of Drs. Kolawole Raheem, Pekka Kupari and Johanna Lasonen.

We wish to extend our warmest thanks especially to our African colleagues who have made this research possible. The Academy of Finland has funded the project in 2004-2005. We are grateful to Director, Professor Jouni Välijärvi, and to a number of people working with Jouni Sojakka, the head of the Institute for Educational Research's Publication and Information Unit, especially Kaija Mannström, for their technical support in publishing this report.

This publication, the final report of the research project titled "Measuring Indicators of Sustainable Development in School Curricula: A Study of Ethiopia, Ghana and Nigeria" (Academy of Finland No. 206667), is a continuation of the interim report 'Educational Issues for Sustainable Development in Africa'. Its intended audience is interested in sustain-

able development in curriculum design and science education at national, regional and global levels. In particular, we hope this report reaches teachers, teacher educators, administrators and researchers.

Kolawole Raheem
Jyväskylä, Finland
May 2006

Pekka Kupari

Johanna Lasonen



Introduction

The important role of education in achieving sustainable development in any human society is emphasized in the UN document called Agenda 21. Already in 1961 African leaders recognized that education would be the basic and most important factor in developing the economic, political and social sectors of their continent (ECA/UNESCO 1961: 9, 37). Recent studies have also confirmed that an adequate investment in education and a properly planned and implemented educational system that prepares young people for a changing labour market are major tools for achieving sustainable development (Azizi & Lasonen 2006).

Science subjects at school are commonly seen as the main facilitators for development and achievement. International tests evaluating student's educational achievement are mostly carried out through science subjects. Many scholars in Africa have also taken this line and called for improved and intensive teaching and learning of science subjects at school, including mathematics, for the continent to develop.

Many of the countries in sub-Saharan Africa attained their political independence in the 1960s hoping to achieve economic and political stability, which were the main development issues, through school education. However, these countries, including Ethiopia which was not colonised, have not been able to achieve their goals. African countries face serious problems concerning education, economy and health. Lack of democracy and human rights and also degradation of the environment have been surmounting factors against sustainable development in countries like Ethiopia, Ghana and Nigeria. These countries are still amongst those with over 50 percent rate of illiteracy. Nigeria, for example, is one of the educationally disadvantaged nine countries, termed E-9 by UNESCO, with the highest rate of illiteracy. Even though more schools and hospitals have been built and more literates produced, the numbers of school dropouts, communicable diseases, maternal and child mortality and unemployment have increased.

The three countries still invest less than the mandatory 26 percent of their annual budget in education. There is lack of teachers and in many cases those who take up teaching are

not qualified to do so (Ajayi, Ogunyemi & Sotonade 2006). The common ratio of teacher to student in Ethiopia, Ghana and Nigeria is 1 to 60 or 100. Nigeria, for example, is said to be in need of additional 200,000 teachers to meet the goal of the Education For All by 2015 (Minister of Education, Mrs. Chinwe Nora Obaji, <http://www.independentngonline.com>, 21st April 2006) .

African countries find it very difficult to achieve the Education For All (EFA) as recommended by UNESCO because of various reasons. Some of the important reasons for the failure in addition to those already mentioned include

- collapsing classroom buildings,
- lack of school buildings and qualified teachers,
- poor learning environment,
- ill-motivated teachers,
- poverty,
- diseases like HIV/AIDS and malaria,
- gender disparity, and
- inadequate attention given to education and health sectors by African leaders.

An interesting phenomenon in the educational sector in Ethiopia, Ghana and Nigeria is that the interest in and number of established private schools is increasing. The privatisation of the sector looks like a government policy of “filling the gaps” by the private schools. But there is no report suggesting that the increase in the overall enrolment or that the high standard of education is a consequence of such development. Rather, the private schools are seen as another means of stratification of the society and a “money-making machine”. It is the rich who can send their children to such schools, because the fees are very high. With the poor state of public primary schools, the prohibitive fees charged by private primary schools are beyond what a very large majority of the continent’s population who live on less than \$1 a day can afford. The implication of this is that too many Africans are too poor to enrol their children in private schools (Ajayi et al. 2006). The poor send their children to the public school with low standards, while the few rich people send their children to the expensive private schools.

The gender disparity has awkwardly made females the ones more affected by the system. Female child school attendance is very low compared to that of male child, which makes it possible for girls to be more extensively used as child labour. The overall consequence of this is that women remain at a very low level on the ladder of development (Sotonade and Raheem 2005). A survey report shows that about 6 million Nigerian children did not attend school in 2003. Out of this high number 3,110,033 (51 percent) are girls and 2,992,373 (49

percent) boys. The same reports states that 15 million children (7,812,756 males and 7,214,856 females) in Nigeria are labourers (Federal Office of Statistics (FOS) 2003).

Another major educational issue that is scantily addressed in the EFA is the education for children with special needs. This issue is neglected in the mainstream discussions on the provision of Education for All in Africa. The population and the problems of children with special needs are growing in Africa (Savolainen, Matero & Kokkala 2006) and this has to be considered in the EFA programmes aimed at making education accessible to all. With all these problems and the quest for solutions, Africa has recently been promised \$15bn by Britain to be used on education for next ten years so that every African child can have access to good primary school by 2015 (BBC 2006, <http://newsbb.co.uk/1.hi/world/Africa>, 10th April 2006).

However, the statistics above and the current practises and coverage of education in Africa as a whole make achieving the EFA or even a good basic education for every child on the continent by the year 2015 as envisaged by UNESCO seem unlikely.

The access to rich mineral resources in some African countries does not make them much better on the level of development than those without these kinds of riches. Nigeria, for example, is number six among the oil producing countries in the world. It is rich in natural gas, petroleum, tin, columbite, iron ore, coal, limestone, lead, zinc and arable land. Therefore it is expected to be relatively wealthy. Ghana is a country rich in gold, cocoa, timber, tuna, bauxite, aluminium, manganese ore, diamonds, which all could make it a rich country. Ethiopia is not endowed with any mineral resources as such. It has coffee, hides, oilseeds, beeswax, and sugarcane. However, their average annual incomes are not that different. They are US \$260, US \$350 and US \$100, respectively. Also the Human Development Index (HDI) ranks Ethiopia 170, Ghana 131 and Nigeria 151 (UNDP 2004; UNESCO 2003, 2004, 2005b). All these countries suffer from the same lack of adequate number of professional teachers and schools, poor standard of public schools and dropouts.

These countries suffer from soil degradation, rapid deforestation, urban air and water pollution, desertification, loss of arable land, rapid urbanization, unstable democratic political system, low level of human rights and high level of poverty. In addition to the above, Nigeria suffers from oil pollution, gas flaring and serious damage of the eco-system by oil spills. All these factors contribute strongly to the lack of sustainable development which the countries are experiencing.

The issues of sustainable development in relation to education or school curricula in Africa are just becoming a matter of concern to researchers. Even though quite a remarkable amount of work has been done with the assessment of school curricula in Africa, this has not been carried out vis-à-vis sustainable development. Therefore, there is a need to know whether the educational systems in Africa meet the goals set for sustainable development, and if not, a need to reconsider the systems or goals.

This publication includes three major parts. The first part focuses on the theories and conceptual framework for the studies. In this part some theoretical issues concerning sustainable development and education will be taken up as they are related to the education for sustainable development (ESD). The first part includes the issues related to the experiences in Ethiopia, Ghana and Nigeria. The variation and similarity in education and training policy in these countries will also be discussed, using secondary data. This part attempts to give answers to questions such as “to what extent is there variation and similarities in common education and training policy dimension concerning sustainable development between Ethiopia, Ghana and Nigeria?” This section will also take up the issues of school curricula and science education in the African context and discuss the international dimension of comparing science education by briefly explaining the Third International Mathematics and Science Study, TIMSS 1999 which provides the main measuring instruments used in this study. It addresses the question of whether the instruments applied in TIMSS 1999 are culturally applicable for measuring educational achievement in these countries.

The second part focuses on the procedures and implementation of the study. This part concerns the methods and the adaptation of the questionnaires used. A general description of the selected approach will be explained. The third part explains the empirical findings, conclusion and the implications. The results of the empirical findings are from a data collected from a focus group discussion which mainly aimed at gaining an overall understanding of the teacher’s perceptions about their role and the relevance of what they teach as related to sustainable development. The other results are from the students’ questionnaire which aimed at answering the question of the applicability of international educational achievement measurement tools in countries like Ethiopia, Ghana and Nigeria. In addition, this part describes the level of understanding of the science subjects achieved by the students and the applicability of it to their environment.



Framework Issues

The balance between socio-economic development and environment in the pursuit of human advancement is the major advocacy of sustainable development. Sustainability is one of the main concepts by which development and human welfare are defined and evaluated. It is suggested that sustainability is an innovative concept and therefore requires policy makers to promote the improvement of the betterment of human welfare that is consistent with sustainable use of the environment (World Commission on Environment and Development, 1987). To do this on a global level, the Earth Summit in 1992 came up with the Agenda 21 as a mechanism to achieve the goals of sustainable development by translating them into concrete policies and actions at the local level. The quest to promote the balance between socio-economic development and the environment in the pursuit of human advancement has resulted into the advocacy of education for sustainable development by the United Nations.

2.1 Features of Sustainable Development

The term sustainable development has been used in ways that make finding a standard and a clear definition for it difficult. It is in many cases substituted with environmental management. It is, for example, difficult to differentiate education for sustainability from environmental education. In some cases there is a mix up of "sustainable education" and "education for sustainable development". The history and beginning of sustainable development discussions at high and international levels are usually traced to the World Conservation Strategy (IUCN 1980). Since 1972 international and national fora have discussed environmental issues in sustainable development. However, it took the international discussions about 30 years (1972, Stockholm to 2002, Johannesburg) to agree that the issues of sustainable development should be given a holistic approach. This means that the issues of sustainable development are now seen in a wider perspective. The United Nations (UN) General

Assembly adopted by consensus on the 20th of December 2002 that the period of 2005 to 2015 should be declared a UN Decade of Education for Sustainable Development (DESD). It is what Raumolin in (2001) already saw as a shift from environmental education to education for sustainable development.

During the First UN Special Session on Children in New York, 8 May, 2002, Mr. Kofi Annan, the UN Secretary General stated that “children have the right to education, health, a clean environment, and to live without the shadow of war, poverty, abuse or exploitation”. An articulated education system provides a basis for sustainable development. A society that has a high rate of violent conflicts and environmental degradation, cannot build a sustainable educational system. And without a sustainable educational system that is geared towards meeting the needs of the people, the environment is likely to suffer from degradation and the people from poverty. In many of the African countries the economic activities in the form of producing and exporting raw materials to the industrialized countries are ironically detrimental to sustainable development. As a consequence it has been difficult to achieve sustainable development on the continent.

However, sustainable development is still commonly measured with economic indicators. The African economic growth which is based on exporting raw materials according to the demands in the industrialized countries is a serious impediment to sustainable development in the African countries. So also the increase in the purchasing power of the African countries, to pay for all sorts of consumer goods from the more industrially advanced countries adds more to the dilemma of sustainable development. The over-importance, so to say, given to the economic growth is probably one of the reasons why fierce competition for wealth and careless exploitation of natural resources have been so high to the detriment of peace and environmental friendly societies. In the developing countries, the urge for economic growth has continued to promote careless exploitation of natural resources, corruption, fierce and violent battle for political power that are the major factors increasing poverty and working against sustainable development. The major economic activity of the African countries for economic growth is intensification of production of raw materials for export. For example, Nigeria produces crude oil for export, Ghana is one of the main countries producing cocoa and Ethiopia has a booming production of flowers for export while at the same time the country has shortage of food crops. Ironically such activity encourages careless use of land and it is the bane of environmental degradation.

The UN and some scholars concerned with balanced economic and social growth have continued to emphasize the importance of sustainable development or “good life” through education. Chapter 36 of Agenda 21 emphasized, “Education is critical for promoting sustainable development and improving the capacity of the people to address environment and development issues...” (UNCED 1992, p. 264). The same document states that education is also critical for “achieving environmental and ethical awareness, values, and atti-

tudes, skills and behaviour consistent with sustainable development and for effective public participation in decision-making. Both formal and non-formal education is indispensable to ... sustainable development" (ibid).

It has also been suggested that the need for eco-pedagogy and eco-didactic is evident for achieving sustainable development (Åhlberg 1998a). The above suggest that schools as learning environments, teacher training and non-formal and formal education, especially in Africa, have to be reappraised. This is necessary for improving the ways knowledge is acquired, produced, diffused, stored and used for sustainable development.

It is very important to note that Chapter 36 of Agenda 21 called on all governments, international agencies, businesses and civil society groups to work for the achievement of sustainable development. Things expected of them include

- ensuring that basic education for all is achieved,
- making environmental and development education available to people of all ages,
- integrating environmental and development concepts into all educational programmes,
- including school children in studies on environmental health, including safe drinking water, sanitation food and the various impacts of resource use.

In some countries educational policies and laws are implemented to ascertain that sustainable development is part and parcel of everyday life. To strongly promote the policies, regional action programmes like the "Baltic 21" were adopted. This is to deal with cross-border environmental problems, and of course to learn from each other and cooperate in preventing and dealing with such problems. Even countries like Finland have the issues of sustainable development clearly written in their constitutions. The Finnish constitution, for example, states that "every individual is responsible for nature and its bio-diversity, environment and cultural heritage" (Loukola et al. 2001). The country has been in the forefront of those that have mainstreamed Education for Sustainable Development/Environmental Education (ESD/EE) into the school activities from pre-school level to tertiary institutions.

The unsustainable exploitation of natural resources and its consequences have raised scientific awareness that nowadays compels more and more industries and businesses in the Western countries to practise environment friendly production through the concept of industrial ecology and social responsibility. Consumers in general have also been encouraged, sometimes compelled by high taxes on consumer goods, to reduce environmentally destructive consumption and behaviours. Many countries are also promoting Environmental Education (EE) or Education for Sustainable Development (ESD) as a major part of the

curricula at schools and as educational activities in the pre-school institutions (Loukola, Isoaho & Lindsröm 2001).

In the African context sustainable development is affected by over-population, especially in the cities. The pull effect of the concentration of the few industries available in the cities has debilitating effects on the urban environment. Some of the effects of rural-urban migration listed by Asabere-Ameyaw and Anamuah-Mensah (2004) are: inadequate social amenities, poor drainage systems, living in slums and unsanitary conditions leading to outbreak of diseases and epidemics and inadequate food supply. The infrastructure available for the population in the urban areas is inadequate and makes life in the cities unsustainable.

Thus, also the push effect from the rural areas due to the lack of basic infrastructure and employment has left the areas poorer. Old people who cannot farm are left in the villages to fend for themselves. Actually, the type of education received in the schools discourages people from taking up agriculture as a profession, and at the same time the jobs in the urban areas are very limited. This has affected the production of local food crops negatively and made the prices of many food items affordable for the majority of the people.

The architectural designs of many modern buildings in Africa are not in conformity with the local weather. Many schools also have this defect. The houses are built in such a way that they consume high amounts of electricity because of the use of air conditioners and the lack to natural lights. The consumption of energy this way makes it unsustainable.

Bad leadership is also seen as a major factor causing interrelated problems of development, peace and human rights in the African countries. Ogunyemi & Raheem (2004) indicated that lack of human rights and political and economic stability is an impediment to sustainable development in countries like Nigeria. Sustainable development is closely tied to human rights and peace issues. A large majority of the Nigerians sampled for their study are favourably disposed to introducing different aspects of peace education into the school curricula. Other significant results highlighted in their study include the following: an overwhelming 92.6 per cent (52.5 strongly agree; 40.1 agree) of the respondents believed that "Nigerian youths need to be taught about tolerance to address issues like religious and ethnic conflicts", while another 84.6 per cent thought that "Human rights education is what Nigerians need to maintain peace and to achieve self-confidence", about 82 per cent of the respondents saw global citizenship education as "relevant to the development of the Nigerian youth"; with 78.8 per cent calling for education for non-violence "to help achieve Nigerians achieve a stable polity"; and 73.4 per cent stated that "Multicultural education should be made compulsory for Nigerian youths to accept the reality of cultural diversity" nationally, regionally and globally. They therefore called for the curricula review with the purpose of introducing thematic issues about human rights, peace promotion and sustainable development in Nigerian educational institutions.

Considering the above, for the purposes of this research sustainable development is conceptualised as a development that is balanced between political, cultural, social and environmental aspects. This means a development that is not lopsided, and can thus be sustained for “good life”, as propounded by Åhlberg (1998b). This may implicitly mean that there is a need for educational system that emphasizes learning, knowing and acting positively for a sustainable environment. This will be in line with what Loukola et al, (2001) put as “developing learning to learn skills”. However, some prerequisites like adequate learning and teaching environment, stable political and economic environment and robust investment in human development (education) are required for “developing learning to learn skills” that could promote sustainable development. Many of the prerequisites for sustainable development taken for granted in the Western countries are still missing in Ethiopia, Ghana and Nigeria. These factors negatively affect the possible achievement of sustainable development.

2.2 Some Factors Affecting Sustainable Development in Ethiopia, Ghana and Nigeria

At this point it is necessary to discuss some of the peculiar issues of sustainable development briefly to gain a deeper understanding of the problems facing the countries like Ethiopia, Ghana and Nigeria. Even though the problems of sustainable development are global, problems in Africa are more pronounced. This may be a result of the continent’s low socio-economic development and local factors influenced by exogenous factors such as the need for raw materials in the industrialized countries. This kind of economic activity has not been used positively to build infrastructure for basic needs. Many basic needs still remain not addressed in the African countries, because some potential is neglected in the local planning and implementation of policies that could facilitate sustainable development. The global influence on the concept of sustainable development, dominated by the Western concept of development, is somehow making the achievement of sustainable development a mirage in Africa. Ethnicity problems as such, for example, are not considered a major factor in sustainable development issues. Ethnicity in Africa is still a major challenge that has made it difficult for people of the same country to uphold the same values. The peculiar problems in Africa make it imperative to look at the issues of sustainable development in a holistic way. This is necessary, because the struggle for political and economic power by the ethnic groups is one of the major causes of armed conflicts, lawlessness and corruption, and it is ignored or not given proper attention in the discussions of sustainable development in the African context.

The non-achievement of sustainable development in Ethiopia, Ghana and Nigeria has partly been attributed to lack of good curriculum for functional literacy and education

(Ogunyemi 2005). These countries have engaged in changing and improving their curricula. A new curriculum will, for example, be introduced in Nigeria in September 2006. Ghana and Ethiopia have also continued to review their school curricula to make sure it meets their needs. In Ethiopia the development and review of curriculum seems to have generated two kinds of curricula which also seem to have focused on language – Amharic and English. Teklemariam (2006) indicates that, the “English curriculum”, as he terms it, offers a challenging program of good quality and prepares students for the literacy demands they will face as Ethiopians and members of the global community. However, the question of sufficient capacity for realising the aims of such curricula remains a problem for the countries.

In these countries vocational education has been given more emphasis for the acquisition of productive skills for sustainable development. In a recent meeting in Abuja, Nigeria the Executive Secretary, Nigerian Educational Research and Development Council (NERDC), Prof. Godswill Obioma said that there is need to replace the current curriculum because “the existing primary and secondary school curricula are structurally defective, the connection between primary and Junior Secondary School (JSS) curricula is weak, primary pupils have weak support base for learning in JSS and the JSS curriculum could not achieve functional education and the acquisition of productive skills for those who could not access senior secondary school (SSS)” (This Day, <http://thisdayonline.com>, 19th September 2005). These attempts are geared towards the achievement of education for sustainable development.

The large majority of adult population in Ethiopia, Ghana and Nigeria that are without functional education creates another peculiar problem for sustainable development in these countries. Without functional education people will continue to be unemployable or under-employed. This also affects people’s perception of the environment, survival, development and sustainability. Adult education in non-formal and formal ways is necessary and important for achieving sustainable development in Africa. It will lessen the conflict between school and home education and also take along, so to say, the adults in the process of achieving sustainable development.

Ethiopia, Ghana and Nigeria, the countries selected for this comparative research, are all multi-ethnic societies and follow various religions including Christianity, Islam and Indigenous beliefs. Ethiopia could be defined as a country of low level having natural resources, Ghana as one of the middle and Nigeria of the high level. Ethiopia has a human population of about 64 million, Ghana 20 million and Nigeria 115 million.

Even though Ethiopia, Ghana and Nigeria differ from each other due to the variation in their cultures and traditions, they share the same problems. Nigeria is supposed to be the richest of these three countries, but the rate of investment in education is almost the same in all these countries – much less than what is recommended by UNESCO.

There are several ethnic groups in the three countries. The problems this poses for the educational systems have not been extensively studied yet.

Violent Conflicts

The ethnicity problems evidently form a major cause of violent conflicts in especially Ethiopia and Nigeria. Ghana enjoys a relatively peaceful and stable environment, even though the country is populated by many different ethnic groups. Unlike Ethiopia and Nigeria, where the major ethnic groups are fighting for political and economic power, Ghana has recently been able to concentrate on developing the country. Since peace is necessary for the process of sustainable development Ghana seems to be in a good position to plan and implement education for sustainable development. Ethnic diversity that could have been a source of strength to these countries has proved to be a weakness.

Internally and externally generated violent conflicts and the use of resources of a country affect sustainable development and can also drastically affect individual poverty. Ethiopia, for example, is a land-locked country and has serious internally and externally generated violent conflicts with its neighbours. This has aggravated the drought and political instability that stand as an obstruction to sustainable development in the country.

Nigeria is rich in crude oil, but overwhelmed by internal violent conflicts that have made it impossible for political stability, economic growth and sustainable development. Ghana is politically relatively stable and has no internal or external violent conflicts. However, the country is still overwhelmed by individual poverty.

Local stakeholders in education in the selected three countries spoken to during the fieldwork for this research considered peace and food security as the first step towards sustainable development. In informal discussions with local stakeholders, even the political elite agreed that struggles for political and economic power between the different ethnic groups are detrimental to education for sustainable development. They mentioned that such struggles facilitate careless exploitation of the environment, very low commitment to halting environmental degradation, and lack of innovation for sustainable development of schools and education in general. The political and economic experiences from these countries show that curricula for education for sustainable development has to, apart from science subjects, emphasize the need to develop other subjects for human rights, democracy and vocational skills.

Language Problems

Linguists and educational psychologists have argued that the use of the mother tongue as the language of instruction in the early years of education is of great advantage, especially

where the development of cognitive faculties is concerned. It has also been demonstrated that classroom use of a language which is not the language already spoken by the child, results in cognitive and pedagogical difficulties. Quane and Glanz (2003) noted that there is a serious problem of communication between teachers and pupils in Africa because of the language of instruction. They stated that oral and written communicative exchange is reduced to "safe talk" (rote learning) and active learning does not take place.

Since the different ethnic groups in Ethiopia, Ghana and Nigeria have their own languages it was predictable that communication among them would not be easy. English was adopted as the official language in Ghana and Nigeria, because they were colonised by Britain. Amharic, the dominant language in Ethiopia, became the official language in the country. The adoption of Amharic as the language of instruction for the entire primary cycle has been criticised because it is said to have handicapped any child who has a different primary language (<http://countrystudies.us/ethiopia/70.htm>).

The problems language poses to teaching and learning in the African countries have not been deeply and widely studied. However, there are conclusive studies carried out in Nigeria to prove the case. Nigeria's national policy on mother-tongue literacy and the experimental project was carried out in 1970 in the Ife, a Yoruba-speaking region. The project tested the use of maternal languages in education during the first six years of primary school. The evaluation of the pilot schools was compared with those of other Nigerian schools. It was found that the students in the Ife project scored higher than their counterparts in the regular schools, both academically and cognitively. It was further found that students who were taught in Yoruba for the first six years of primary school were no less skilled in English than those who were taught in English throughout the last three years of primary school. The study concluded that the advantages of teaching children in their maternal language go beyond academic success to include cultural, emotional, cognitive and socio-psychological benefits (http://www.adeanet.org/newsletter/Vol8No4/en_n8v4_3.html).

This has encouraged public discussions in the country, advocating that children should be taught in their mother tongues in the first years of basic school. Educationists in the country have also suggested that for the Universal Basic Education programme to succeed, teachers must be proficient in language skills. For example, at a workshop on reading skills organised for primary school teachers Professor Olatunji Odedeyi called for the use of indigenous languages as a medium of instruction in Nigerian schools (The Punch, March 24, 2006, <http://www.punchng.com>) He is of the opinion that the use of indigenous languages would enhance teaching and learning in Nigerian schools. This, he thinks, would make students able to relate what they learnt to their environment.

The major problem however, is how/what to choose and use, for example, from about the 250 languages in Nigeria in the primary school. English is seen as a colonial language in Ghana and Nigeria while some ethnic groups in Ethiopia see Amharic as forced on them

and taken as the lingua-franca, notwithstanding those local languages like Tigrinya and Orominga which are said to be part of the major languages taught in schools. In Ghana and Nigeria a few major local languages are taught in the schools, but they are non-existent in official documentations and not used for official transactions, even though some legislatures approved them for official communication in some regions. Twi, Fante and Hausa in Ghana, and Hausa, Yoruba and Ibo in Nigeria are languages that are taught as subjects in the primary and secondary schools. More research is required for clearer picture of the effects of mother tongue on school education in Ethiopia, Ghana and Nigeria, to come up with proper recommendations.

One issue which is rarely discussed in the concept of sustainable development is the African traditional systems of sustaining the environment. These systems, even though not usually and officially recognized, are still in use for conserving the forest, rivers and for making fishing and farming sustainable. The traditional African concept of sustainable development can be understood as the equality between nature and man. Such concept makes the communities prudent and judicious in exploitation of natural resources and makes them live in harmony with every other part of the environment. Asabere-Ameyaw and Anamuah-Mensah (2003) indicated that the traditional African system ensured that there was little or no degradation of the environment, while maintaining a balance in the utilization of renewable natural resources. They also emphasized that in some traditional communities in Ghana strict traditional enforcement mechanisms were employed to manage the environment. For example, it is a taboo, according to Asabere-Ameyaw and Anamuah-Mensah (*ibid*), to use motorised canoes to fish in Lake Bosomtwe. The aim of the taboo is to protect the fish stocks in the lake from over-exploitation (*ibid*).

Even though the mechanisms employed are based on taboos, they worked perfectly well. In some of the communities in the African countries these taboos are still used to manage the environment and exploitation of natural resources.

Similar methods are used in Ethiopia and Nigeria to protect water bodies, trees and forests. For example, Lake Bishoftu and the Oda tree in Ethiopia are still sacred to many Ethiopians and taboos are used to protect them. There are also some sacred groves and rivers in Nigeria. There is, for example, a forest in Oke Eri, Ogun State dedicated to "Queen Sheba", and protected by local taboos. Some of these systems, as suggested by Asabere-Ameyaw (2005) may still serve as tools for practising and facilitating education for sustainable development in Africa.

However, many communities in Africa have been made to see the taboos as "idol worshipping" or primitive by the school education. Thus, the quest for economic growth through extensive use of land and production of raw materials for export has also made many people ignore the traditional norms in form of taboos that positively serve as mechanisms for the protection of the environment and judicious use of natural resources in Africa.

The above discussion is meant to give some clear ideas about the problems created by some peculiar factors which may not be found in the Western countries, but need to be considered in the processes of planning and implementing education for sustainable development in Ethiopia, Ghana and Nigeria. It also aims at showing that these countries are not oblivious of the problems and are looking for the ways out of the problems.

2.3 Variation and Similarity in Education and Training Policy

This section answers the question of possible variation and similarity in the educational systems and policies of the three countries under study. The information, even though from secondary data, will be useful for dealing properly with the problems of education in these countries and also for them to learn from each other. It will also give us clues as to possible educational interactions between Ethiopia, Ghana and Nigeria.

Even though the problems concerning education are similar in Ethiopia, Ghana and Nigeria, there are some variations in the common education and training policy of the countries (Ajayi et al. 2006, Anamuah-Mensah 2006, Teklemariam 2006). In Ghana and Nigeria the educational systems are the same. At present the system of education in both countries is based on 6-3-3-4. The system means 6 years in the primary school, 3 years in the junior secondary, and 3 years in the senior secondary schools and 4 years in the University. The official language in both Ghana and Nigeria is English, even though some of the indigenous languages are sparsely taught in the schools.

In Ethiopia the school system is based on 8-2-2-3 structure. Amharic is used as the medium of teaching in the schools. However, the Government's new policy may change the language of instruction to English. This, according to some officials, will give Ethiopians better access to scientific information. The teaching of English language in Ethiopia seems still to be far from what is expected (ICDR 2004). A recent study states that in "Ethiopia, it has been found the teaching of English language does not help students to learn and to read efficiently and to absorb information quickly" (Teklemariam 2006). This study suggests that the present level of English language teaching is still very low and does not help the student as such.

School buildings are very important physical environment for education. They should be comfortable, and suitable for proper teaching and learning. This means that among other things especially the climate, space and population should be considered in the process of building schools, for them to meet the local needs. This will make sustainable schools possible in countries like Ethiopia, Ghana and Nigeria.

School structures in the three countries suggest that local conditions play a major role in school buildings, hence what one might term the "seemingly structural differences"

among them. In the rural areas of Ethiopia the school buildings, especially the old ones, are structurally different from those of Ghana and Nigeria. There are simple reasons that could be attributed to the differences and similarities. Firstly, the weather in Ethiopia, a country in the Eastern Africa, is quite different from that in Ghana and Nigeria, which are on the coast of West Africa. This probably explains some of the reasons for the variations in the style of school buildings. Secondly, Ghana and Nigeria were colonised by the British. The colonial influence on school uniforms and official buildings is apparently evident, and manifests itself in the types of structures put up as schools in these countries. Of course, some of the schools in the remote rural areas are simply structures made of crude planks. In some cases school education takes place just under the trees and pupils receive instruction sitting on the bare floor.

Many schools in these countries are badly managed. Public schools in Ethiopia, Ghana and Nigeria are usually without canteens. This makes it possible for food vendors to hawk their foods in and around the schools. Many of these vendors do not handle the foods hygienically, and in many cases do not have clean water to serve the students. The issues of school building as a major learning physical environment need to be addressed in educational policies. This is because the condition of a school building and its surroundings could play a significant role in promoting good sanitation, health and environmental education in the community as a whole. According to Gorton the school '...is not an independent or isolated entity, it operates in a social context, an important element of which is the community ...' (Gorton 1983, 433). For example, poorly ventilated and dark classrooms could be detrimental to the students' and teachers' sight, and easily cause fatigue. Also schools that have badly constructed toilets, bad pit latrines or open gutters could be breeding places for mosquitoes and disease-carrying vectors. In short, a bad school building may be a major source of malaria and cholera diseases.

There are also some important similarities like individual poverty, even though of higher level in Ethiopia than in Ghana and Nigeria, a common phenomenon that badly affects access to educational services in the three countries (Raheem 2006). The problems of lack of adequate school infrastructure are the same in the three countries due to what could be termed as poor attitudes of the government towards education as a whole. The poor conditions of school buildings and inadequate educational equipment are attributed to the level of poverty, which is of course questionable. For example, UNESCO has for the past years advised and encouraged governments to develop their countries by raising their annual education budget to the minimum of 26 percent that could facilitate progress and sustainable development. It must have been assumed that these countries could make the 26 percent notwithstanding the poverty. And it is also evident that the amount allocated to military equipment in the budget is much higher than that to education.

In the quest for planning sustainable development it is important to note that Ethiopia, Ghana and Nigeria are all multi-ethnic societies and follow religions such as Christianity, Islam and Indigenous beliefs. Thus, in this study it is not out of place to mention that religion plays an important role in some of the conflicts and problems in these countries. The various religions also affect the social life of individuals and the development of the countries as a whole. Parents' attitudes towards education are affected by religion. There are schools in Nigeria, for example, that are merely meant for teaching how to read the Quran and how to understand the Sharia Law. Many of the graduates from these schools become professional Islamic clerics. Consequently, they are not skilled in a way which would make them employable in the modern job market. In Nigeria the sharp drop in the enrolment of pupils to Western-like schools in areas of the country with large population of Muslims was partly attributed to the Quranic school system, which some parents still prefer to send their children into (Statistics Branch, Federal Ministry of Education, Abuja, 1999). This scenario was detectable also in Ethiopia and Ghana.

In Ghana and Nigeria teacher training is more advanced than in Ethiopia. It is more advanced in the sense that there are more professional Colleges of Education and Universities meant for those who wish to become teachers in both the secondary and primary schools. Ghana is probably the first African country to establish a University of Education which takes care of giving university degree to professional teachers. Recently, in the quest for improving teacher education, some States in Nigeria have also up-graded their Colleges for National Certificate of Education to a full-fledged University of Education.

However, the three countries still have similar problems of inadequate teaching professionals. They all have a large proportion of people not trained in the teaching profession, yet employed as school teachers. In these countries teaching is a "transit job" for many unemployed graduates who are not interested in the profession, but who work as teachers due to lack of other suitable jobs in the labour market. They seize the opportunity caused by the lack of qualified professional teachers and get employed in the schools merely to have a temporary means living for themselves before moving to another profession. Many professional teachers in these countries are in the teaching profession because of the non-availability of better jobs. A majority of the teachers regard teaching profession as very poor and of low esteem. Policy documents in Ethiopia, Ghana and Nigeria show that the governments are not unaware of the problems and some efforts have been made to raise the standard of teaching profession and salaries.

2.4 School Curricula and Science Education in the African Context

The teaching and learning of science need to be critically examined, especially for the achievement of sustainable development. This point was strongly made by Giordan and Pellaud when they stated, "We must also take a critical look at the knowledge we handle. An analysis of science and the links between scientific knowledge, culture and society or between knowledge and values, is just as important as the knowledge itself" (Giordan & Pellaud 1999). This statement is very important for reappraising science education in the African context.

Since the early days of independence in the African countries there has always been a tendency to emphasize the important role of education, which includes science subjects, in dealing with the problems of underdevelopment. For example, African leaders at an education conference in Addis Ababa in May 1961 recognized that education was a basic factor in economic and social development. Even though education, as the statement above indicates, was recognized and expected to play a pivotal role in the alleviation of poverty and good management of the environment for sustainable development, the reality in the African countries shows that it has not succeeded. Some scholars have suggested that the problem in this context is matching words with action.

However, for the past three decades more attention has been given and importance assigned to science subjects in Africa. Attempts at restructuring the teaching of science in the secondary schools have been made in Ethiopia, Ghana and Nigeria. National policies on education have been reviewed as to how they relate to science. The secondary school curricula has employed the term integrated science. Integrated science programme is expected to be flexible so that it can be applied in all parts of the country and it must take into consideration the specific national education objectives.

In Nigeria, for example, the term 'integrated' is applied to science courses, and it means that the course is devised and presented in such a way that the children gain, (a) the concept of the fundamental unity of science, (b) the commonality of approach to problem of a scientific nature and (c) an understanding of the role and function of science in everyday life, and the world in which they live. Integrated science principles are also intended for producing a course which is relevant to the children's needs and experiences, stresses the fundamental unity of science, lays adequate foundations for subsequent special studies and adds a cultural dimension to science education (Federal Ministry of Education 1985).

Science education is also considered very important in the training of teachers. Clear objectives for training teachers of Integrated Science include, among others, enabling them to (a) gain the concept of the fundamental unity of science, (b) increasing their understanding of the role and functions of science in everyday life and in the world in which they live,

(c) enabling them to acquire and demonstrate the intellectual competence and professional skills necessary to the teaching of Integrated Science in Primary and Junior Secondary Schools, as an inquiry based subject, in conformity with the national curriculum and (d) developing in the teachers the ability to impart and encourage the spirit of inquiry into living and non-living things of the environment in their pupils (National Commission for Colleges of Education: Guidelines for Colleges of Education. Nigeria, 1998).

In Ethiopia the curriculum has been revised by developing the subject called Integrated Science in such a way that it takes care of environmental issues and HIV/AIDS as part of sustainable development programmes (Basic Integrated Science: Curriculum Guide for Grade 5, 1995). But according to Teklemariam, the inadequate number of trained teachers creates a serious obstacle to achieving the aims of such curriculum revision. He also suggests that teachers in Ethiopia lack the training which would enable them to perform well in their duties (Teklemariam 2006).

The situation has not been much different in Ghana. Many teachers in Ghana do not have professional teaching qualifications. At the pre-school, only 29% have professional teaching certificates. The percentages of professionally trained teachers at the primary, junior secondary and senior secondary levels are 78.8%, 87.2% and 54.2%, respectively (Anamuah-Mensah 2006). These figures could be linked to a recent review, which according to Anamuah-Mensah (ibid) indicated that the pupils' performance in mathematics, English language and science was weak. It was therefore suggested that "for teacher education to fulfil its role, the link between theory and practice, the needs of the school and the curriculum of the training institution, pre-service and in-service teacher education, and the balance between methodology and subject content need to be taken seriously" (Anamuah-Mensah 2006).

Trough the education authorities African governments and professionals have attempted to make science subjects more visible and to strengthen their status as a taught subject in the schools. This is probably due to the fact that science education and technology are internationally acclaimed as the major "wheels" for development. In some cases, professionals set up associations for discussing and improving the teaching of science subjects. In Nigeria, for example, there is the Science Teachers Association of Nigeria (STAN) and also an association for teachers teaching mathematics. Recently the Science Teachers Association of Nigeria decried the declining study of sciences in the nation's school system because of, among other things, insufficient number and qualification of science teachers. The National President of STAN, Dr. Mamman Wasagu noted that many teachers at the primary school level were general class teachers, rather than specialist science or mathematics teachers, and that the inadequacy of teachers who had expert knowledge on the subjects they were meant to be teaching had often made children develop a hatred for mathematics and other science subjects (The Guardian, <http://guardiannewsng.com>, April 06, 2006).

The teaching level of science education, including mathematics, is still of quite low standard in the African countries, because even though the countries have continued to develop their curricula to fit the reality of their societies, science subjects and mathematics are still poorly taught due to the lack of qualified teachers and infrastructure. However, some scholars have indicated that the problem does not lie in the curricula. Low achievements of mathematics learners, according to Director General, National Mathematical Centre (NMC) in Nigeria, Professor Sam Ale, is attributed to ineffective instructional skills and methodologies used by mathematics teachers, and it has more to do with the methods of teaching than the content of curricula of the school mathematics (This Day, <http://thisdayonline.com>, 17th May 2006). The poor level of science education in African countries could also be linked to the level of development and the fact that its connection to sustainable development is really not well-rooted in African educational systems. There are other studies which suggest that the problem is too much rhetoric from the African leaders and non-implementation of good policies (Ogunyemi 2006).

In Sotonade (2006) another important dimension is brought into the issues of curricula for sustainable development, and in particular science subjects and female students in Africa. It is the question of gender equity or inequity, and the question of encouraging female students to study science subjects. The need to involve women in decision-making directly affecting education in Africa cannot be overstated. Sotonade suggests that gender equity is therefore essential to sustainable development and school curricula and that the role of women in shaping the school curricula in Africa is crucial and should be recognized. The practises of teaching and learning in the African schools are rooted in colonial system and "masculined". Sotonade (ibid) suggests that school curricula that positively consider the female child and make it easy for her to have access to science education will be of great benefit to the society. It is therefore indeed necessary to shift from the Home Economics subjects usually taught to female students to science subjects for all. The benefits of that would include, according to Sotonade (2006); increased economic productivity, improvements in health, delayed age of marriage, lower fertility, increased political participation, and generally more effective investments in the next generation.

With all the deficiencies in the teaching and learning science subjects in Ethiopia, Ghana and Nigeria, it is useful to measure, with the available international achievement test tools, the relevance of the present teaching and learning of science subjects in these countries. This will give some information on the effects of the subjects on everyday life of the students and sustainable development. In order to assess students' knowledge and skills in science we applied the achievement test which was used in the Third International Mathematics and Science Study, TIMSS 1999. The international achievement test for students focused mainly on science subjects to compare students' achievement in different countries.

2.5 International Dimension of Comparing Science Education: Third International Mathematics and Science Study, TIMSS 1999

TIMSS 1999 was a replication of the TIMSS 1995 study at the lower-secondary or middle-school level implemented by the International Association for the Evaluation of Educational Achievement (IEA) (Martin et al. 2000). In IEA studies like TIMSS, the primary purpose is to conduct large-scale comparative studies of educational achievement to gain a deeper understanding of the effects of policies and practices within and across systems of education. This calls for, in addition to student performance data, background information about the students, teachers, and school and education environments. Thus, the aim is to improve the teaching and learning of science and mathematics for students everywhere by providing data and information about the types of curricula, instructional practices and school environments which result in higher student achievement.

The assessment framework of the TIMSS 1999 study was based on three curricular levels: 1) what society expects to be taught (*intended curriculum*), 2) what is actually taught at school (*implemented curriculum*) and 3) what students learn (*achieved curriculum*) (Robitaille & Garden 1996).

Students' science and mathematics achievements were measured by test tasks, which had been classified according to internationally defined *content domains* and *performance categories*. The leading idea in selecting the content domains was that they would suit all the participating countries' education systems and curricula as well as possible. The content domains for science included *earth science, life science, physics, chemistry, environmental and resource issues* as well as *scientific inquiry and the nature of science*. In mathematics the content domains comprised *fractions and number sense, measurement, geometry, algebra* as well as *data representation, analysis and probability*.

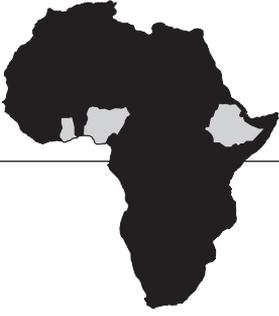
The cognitive domains, for their part, described how demanding the tasks were, i.e. what procedures and processes they required from the student. In science the main categories were 1) *understanding simple information*, 2) *understanding complex information*, 3) *theorising, analysing and problem solving*, 4) *using tools, routine procedures and science processes and* 5) *investigating the natural world*. As regards mathematics the main performance categories were *knowing, using routine procedures, using complex procedures, investigating and solving problems and communicating and reasoning*.

The study consisted of a total of 298 items, of which 143 dealt with science and 155 with mathematics. The background factors associated with school achievement were explored by means of *student, teacher, and school questionnaires*, respectively.

TIMSS 1999 involved 38 participating countries, of which 14 were OECD countries. There were only three countries from the African continent, namely Morocco, Tunisia and

the Republic of South Africa that participated in TIMSS 1999. Finland was the only Nordic country which took part in the study. All countries were to test students in the upper of the two grades with the largest proportion of 13-year-olds. For example, in Finland the study concerned 7th-graders of the comprehensive school, whereas in most other countries the student sample consisted of Grade 8 students due to the definition of the targeted age group. This meant that students in Finland and in some other countries had one year less of formal schooling and were about half a year younger, on average, than were students tested internationally. The Finnish sample comprised 159 principals from Finnish-speaking and Swedish-speaking schools as well as 3060 Grade 7 students and 600 mathematics (167) and science (433) teachers.

The science results of the TIMSS 1999 study have been published in the international report by Martin et al. (2000).



The Implementation of the Study

The conditions in Ethiopia, Ghana and Nigeria require careful plans and implementation of the study. A study that wants to test tools developed in the industrialised countries for students' educational achievement in Africa in relation to sustainable development requires wide-spread collaboration with the local experts. The items were reviewed and some reconstructed after the selection of those that were culturally and environmentally applicable to the three countries, and this was carried out by the research partners from Ethiopia, Finland, Ghana and Nigeria. In reality only few of the items of the achievement test used were reconstructed to fit the African context. That somehow implies that Western-developed educational achievement test tools could also be used for conducting comparisons between educational achievements in order to gain a deeper understanding of the effects of the policies and practices within and across systems of education in countries like Ethiopia, Ghana and Nigeria. In addition, some questions were developed for a focus group discussion by the local experts in Africa for the study.

3.1 Research Questions

Three major questions were selected for the research. First, we wanted to find out the teachers' perspectives, motivation and their ideas about sustainable development and how they relate the subjects they teach to the everyday life. The second question aimed at measuring students' achievement in science education as it relates to sustainable development in Africa. The third question addressed the issue of possible variation and similarity in education and training policy of the three countries. This question was dealt with by using secondary data (chapter 2.3).

3.2 Data Collection

The implementation of the study required a combination of different methods for gathering the data as to come up with a valid result. We think that in countries like Ethiopia, Ghana and Nigeria, a triangulation approach will be suitable for gathering data.

Studman (2002) suggests that with some data-collection methods the researchers themselves may influence the behaviours of human subjects under study. Therefore, to prevent what Cliff Studman termed the “Hawthorne effect” (Chilisa et al. 2002), it was deemed necessary to include additional methods for gathering the data. In view of this, methods such as interviews, meetings/seminars and focus group discussions were also accepted as complementary methods for data collection. The round table meetings gave the researchers possibilities for taking into consideration the culture, learning and teaching environment and also, for understanding how to interact with the subjects or target groups during their fieldwork in the African countries.

The problems of education and sustainable development in Africa are multifaceted. To get to the root of the problems the research was designed to make use of different methods, a form of triangulation, for the collection of data. Scholars have been cautioned about the positive and negative sides of triangulation in research (Guilon 2002; Marshall & Rossman 1999), however, the advantage of triangulation in collecting data in countries like Ethiopia, Ghana and Nigeria is that it strengthens the validity and reliability of research results. For our purposes as well those of using the qualitative approach we opted for triangulation methods, especially the “data triangulation”.

Triangulation was thought to give enough space for data collection on education for sustainable development, both formal and non-formal, in the African set up.

The instruments used in our study were based mainly on the TIMSS 1999 study, because it falls into our thinking domain and is relevant in this case. The TIMSS 1999 study has been briefly explained above.

Considering its cultural relevance to the target population of our study, a thorough content validation analysis of the items was made by experts from Ethiopia, Finland, Ghana and Nigeria at round-table meetings held in Finland in April 2004. The research partners from Africa and Finland worked together for a week on the issues. A complementary questionnaire adapted from the one used in the study of environmental issues in West Africa (Boadi 2004; Boadi, Kuitunen, Raheem & Hänninen 2005) was also reviewed. It was agreed that the study will focus on science subjects in the schools.

Fieldwork

A survey was carried out by collecting data from three major sources: achievement test, questionnaires and interviews and discussions. The fieldwork and data collection procedures at the planning stage were modified according to the reality on ground during the fieldwork.

The data-collection activities started in the spring of 2004 with three-day seminar organised for members of the research team for presenting papers. The papers presented served as the "foundation data" for the study on education in the three countries and efforts in achieving education for sustainable development in other regions of the world. The papers of the seminar and some other articles have been published in the report by Raheem, Kupari and Lasonen (2006).

In the summer of 2004 fieldworks were embarked upon in Ethiopia, Ghana and Nigeria by the research partners in the three countries and coordinated by Raheem. The partner universities engaged some assistants for the collection of data. The assistants facilitated preliminary visits to the selected schools.

Before the visiting these schools the research partners organised meetings with the Department Heads in the Faculty of Education, where the research issues and other related matters were discussed. The meetings were part of the necessary interaction for getting official approval and gaining access to the target groups and schools. Series of meetings were also held with the teachers and Principals to explain the study and to gain their trust. Ministries of Education and Research Institutes situated in Addis Ababa, Accra, Abuja and Lagos in Ethiopia, Ghana and Nigeria, were visited, respectively. In Ethiopia the Regional Office for Education in Awasa and the Department of Education in the University of Jos, Nigeria were also visited to collect general information about schools from the government officials.

In Ghana a seminar was organised and teachers, including those interviewed for our research, and other stakeholders were invited to participate in it. Twelve teachers and four head-teachers participated.

Partners presented lead papers on education and sustainable development in Ghana and Nigeria for discussions. Some of the facts that emerged from the discussions served as complementary sources of data. The seminar gave us the chance to catch a glimpse of educational experiments developed by the University of Education, Winneba. The proceedings of the seminar have been revised, edited and published (Anamuah-Mensah et al. 2005).

The fieldwork stretched from June to September. The rains and school holidays made the fieldwork more hectic. In Ghana and Nigeria our field work took place during the raining season, while in Ethiopia it was school holiday. The questionnaires for the students were

translated into Ahmaric, which delayed the administration of them to the students till they resumed in the autumn.

Achievement tests were administered to selected groups of students by the teachers who were assisted by the research assistants. In some schools the research assistants were present while the students completed answering the questions. A time limit of one hour was given to the students to complete the assignment. In many cases the questionnaires were left to the teachers to administer, because they did not want to use their teaching time for the students to fill in the questionnaires. For this reason many of the student questionnaires were returned after a day or two.

Teacher questionnaires were given to selected teachers, but without any time limit for the completion and return. This is because the teachers complained that filling the forms during the school hours would disturb their work. The return rate was too low for making a scientific judgement of the result.

Target Population and Samples

The pilot study targeted teachers and students in the Junior Secondary Schools (JSS) in each country – Ethiopia, Ghana and Nigeria.

The selection of schools and teachers were carried out by the research partners in Ethiopia, Ghana and Nigeria. The schools selected were in the urban or semi-urban areas. In Ethiopia three schools were selected. They were Atese Naod, Caramara and Enat Ethiopia. The four schools selected in Ghana were Don Bosco, North Campus, South Campus and Baptist Adventist. They were located in a rural town called Winneba, a University town in the Western region of the country specialised in the education of teachers.

In Nigeria the selection was a bit more wide-spread in the sense that schools were chosen in urban, semi-urban and rural areas. Apart from that, schools were also selected from the northern part of the country. Nine schools were initially chosen for the study but reduced to six because of the prevailing condition. The schools selected include Epe Grammar School, Citizen College, Ago-Iwoye Secondary School all in semi-urban towns. Ikeja Secondary School is an urban school located in Lagos. Two schools selected in the northern part (Middle Belt) of the country are Baptist High School, Jos and Government Secondary School, Jos.

Table 1. Schools selected for the study

Country	No of schools
Ethiopia	3
Ghana	4
Nigeria	6
Total	13

Most of the teachers selected for the focus group discussions teach Biology, Chemistry, Geography, Integrated Science, Computing (IT). Few others that teach religion and social studies were added to get other views on sustainable development. The choice was based on the fact that the study focused on science subjects. The age of the teachers ranged from 23 to 56 years. Ninety percent of the teachers were below the age of 50 years. Structured interviews (see Appendix 2), seminar and focus group discussions (FGD) were carried out in each country. With the exception of Ethiopia where we had only one group of teachers, we had two groups in Ghana and three in Nigeria. In addition, the local research coordinators in Ghana invited 14 teachers to participate in an open seminar which discussed the problems of sustainable development and education. The table below shows the number of teachers who participated in the focus group discussion.

Table 2. Number of teachers who participated in group discussions

Country	No of teachers	Females	Males
Ethiopia	4	0	4
Ghana	6	3	3
Nigeria	12	7	5
Total	22	10	12

The questionnaire for the teachers was also adapted from the TIMSS 1999 study. We selected seven questions that are expected to produce information about the schools. The questionnaires were also given to principals or head teachers in the schools where the student achievement tests were administered. The questionnaire for the teachers is related to their role as teachers and their influence on the curricula and subjects they teach. Eighteen teachers were selected from each country for participation, but only five returned the completed questionnaire.

The students who participated are 8th graders and their age ranged from 13 to 14 years. The sample was chosen to agree with the age of the population used for the TIMSS 1999 study, which was the main instrument used for the construction of our questionnaires. The samples and sampling frame were again discussed and revised at a round table meeting in Africa with more experts before embarking upon the fieldwork. Even though the three countries represent varying development and demographic indices, we settled for 100 students in each country. The real number of students that participated was less than envisaged. There were fewer students selected by the teachers for the test. The table below shows the number of students who participated in the achievement test.

Table 3. Number of students who took the achievement test

Country	No of students
Ethiopia	60
Ghana	81
Nigeria	40
Total	181

Achievement Test

Science education is assumed to be very important for the development of any society. We focussed on science subjects and used them to measure students’ achievement in Ethiopia, Ghana and Nigeria because of their importance for sustainable development. It is also a concrete way of knowing whether the science education is relevant to the local environment and able to promote sustainable development in practice. Therefore we applied the collection of science items from 143 items of the TIMSS 1999 study.

The science education items used were chosen for our study after ascertaining their cultural-relevance and international standard. Altogether 30 items from six different areas of science (earth science, life science, environmental and resource issues, physics and chemistry) were presented to students. In addition, some mathematics items were also included in the booklet.

As already mentioned elsewhere in this report, our rationale for using a cognitive test for the students was to know what skills and what kind of understanding the students have gained through the learning of science subjects. We also aimed at checking the international standard of the students. We did not intend to categorise the students according to their

scores even though we compare their performances, in some cases, by international standard. The main aim of the test was to gain information on the educational achievement of students in science subjects as related to sustainable development. The list of the achievement items applied in this study have been presented in the Appendix 3 and the items can be found in the TIMSS 1999 Released Item Sets, <http://isc.bc.edu/timss1999i/study.html>.

Table 4. Categorisation of test items

Content category	No of items
Earth science	5
Life science	8
Environmental issues	2
Physics	8
Chemistry	3
Mathematics	4
Total	30



Results

The study set out to use the empirical data for providing answers to two major questions: 1) What are teachers' opinions about teaching conditions concerning sustainable development in Ethiopia, Ghana and Nigeria? 2) What kind of science knowledge do students have in order to figure out the role of sustainable development in their living environment? Results based on empirical data are presented as follows: first the findings of the focus group discussions and then the results of students' performance in the science test.

4.1 Teachers' Perspectives and Teaching Conditions

The focus group discussions were mainly aimed at finding out the teachers' perspectives, motivation and their ideas about sustainable development and how they relate the subjects they teach to the everyday life. These kinds of discussions provide us with a rough idea of teacher's job satisfaction. Teacher's job satisfaction cannot be overemphasized in the issues of education for sustainable development, because there is a need to retain qualified teachers for its successful achievement (Cockburn & Haydn 2004). Teacher's job satisfaction is bound to affect the educational achievement of students. The focus group discussions were therefore meant to provide us with clues as to whether the teachers are satisfied with their jobs, committed and motivated. Sessions of "focus group discussions" held with the teachers lasted from a minimum of one hour to a maximum of two hours with each group. During the unstructured interviews the subjects were given freedom to express themselves and the proceedings were recorded on the tapes. This in a way would show the relevance of the curricula and subjects they teach to sustainable development and how much innovation they have put into it. The list of questions used for the group discussion is presented in Appendix 2.

The responses from the teachers are grouped into the following categories: 1) What is sustainable development?, 2) Subjects that could promote sustainable development, 3) How do you as a teacher promote sustainable development?, 4) Major problems of sustainable

development, 5) Teacher's self-perspective, 6) Relevance of the subjects you teach to everyday life, 7) Sanitation level in the school, 8) Attitudes of the students towards the environment, 9) Major problems of the environment, 10) How can we tackle the problems?

The answers to selected questions are summarised and presented below. Teachers are quoted when necessary to emphasize the points.

What is Sustainable Development?

Sustainable development can be perceived and understood in many ways. Some of the teachers understood sustainable development as the sustenance of education system while some understood it as good management of the environment. In Ethiopia one teacher stated that "sustainable development is sustainability of school education". His colleagues agreed with him. Many of the teachers in Ghana and Nigeria made statements that suggest that sustainable development means being a rich country without war. All the teachers in the three countries stated that their countries are far from achieving sustainable development, because they are just developing or underdeveloped and lack the infrastructure.

Subjects that Could Promote Sustainable Development

The teachers naturally mentioned the subjects they teach as very important for promoting sustainable development. Subjects like Biology, Chemistry, Mathematics, Geography, Agriculture and Computer Science were in the forefront. A Biology teacher in Ghana mentioned that "even though science subjects are important for promoting sustainable development, we do not have the necessary equipment to carry out experiments in our lab." This seems to be a general problem in the three countries, because teachers in all the countries made such a statement. The use of computer is also a problem even though it facilitates getting information. One of the teachers said that, "We do not have computers in our schools so we teach our students theories without practice. But you know, many students learn to use computer in the cyber café. But it is only to send e-mail messages and for some to gain access to adult sites."

Majority of the teachers in Ghana and Nigeria mentioned that vocational education and technical subjects are necessary for sustainable development in the countries. One teacher pointed out that "we do not produce in our countries. We import almost everything we need. And most of the locally produced goods are fakes."

Interestingly, all teachers also thought that religious studies are very important for the promotion of sustainable development. The only participant in the focus group discussion in Ghana stated that "Our students do not have morals and do not respect elders, including teachers. They watch too much television and many of the things they watch are films that

promote corruption, robbery, and other vices in the society. This is very bad for our culture and sustainable development.”

How Do You as a Teacher Promote Sustainable Development?

This issue brought up the question of poverty. Interestingly, one teacher said that “I promote sustainable development by doing small-scale farming. You know that I am poor and have to provide for my family. I keep some chicken and plant some crops to eat. My family helps on the farm and we sell part of the products to earn more money.” The teacher said that he uses his weekends for farming.

Generally the teachers do not have any specific things they do to promote sustainable development.

Teacher’s Self-Perspective

Teachers were asked how they rate their profession and themselves in the society. There was no particular system of rating the teachers other than listening to their statements during the discussions. However, under this particular item a “yes” or “no” answer was required. All the teachers in the three countries rated themselves very low. They were asked, “are you respected as a teacher in your society?” The answer from all teachers in each country was “no”. When requested for further explanation, the following statements came up.

In Ethiopia all the teachers that participated in the discussions were men and senior teachers or principals who have worked for more than ten years in the profession. They all complained that they are poorly paid and to make ends meet they engage in small-scale farming. They plant food crops and some keep poultry for family consumption. One of them said; “The officials in the Ministry treat us as inferior to them. Even though they give us so many responsibilities, we are not equipped to live up to expectation”.

A female head teacher in Ghana states that “students nowadays do not respect their teachers because they see them as poor. Teaching profession is seen as a job for women and many students would not like to become a teacher. It is good that teachers are now been encouraged to further their studies and to get a University degree. But it is very hard to get official study leave for that”. At home one has also to manage family affairs with the little salary”.

A young male teacher said, “Well as a young man I do not think I will stay as a teacher for long because there is no respect for us. People even joke that teachers are always poor people. I am trying to get admitted to the University so that I can find another job after graduating. The salary of a teacher is very small compared to other professions which are not as

demanding as ours". In the same group a female teacher who teaches religion philosophically said, "The salary is very low but we thank God that we are managing".

Two Nigerian female teachers said that they like the job even though they are poorly paid and teachers are not respected in the society. Their words; "The job is good but the pay is poor. If you want to live nicely teaching is not the job. But one can do extra things like sell some small materials after school hours".

In the Nigerian group those who graduated from the University, but without qualified teacher training said they will "definitely leave the job for a better profession". They are young, between 24 to 30 years of age. The trained teachers would like a better job, but will not leave the profession for another. One said; "the salary you get is almost nothing when you think of how expensive things are. But I work hard by giving private lessons to students who are interested in Mathematics and Chemistry. So I make little money from that".

Relevance of the Subjects You Teach to Everyday Life

The relevance of subjects taught to everyday life is worth pondering on; it is important to know whether what students learn is useful in the environment they live in or not. It is also important to know whether the teacher is able to relate his or her activities in the school to the development in his or her community.

There are no differences in the opinions of the teachers. Science teachers, especially those teaching Biology and Chemistry complained of lack of proper laboratories. All of them were of the opinion that their subjects are taught on a theoretical level. According to them the laboratories lack simple equipment for basic experiments.

The teachers were not able to pin-point the relevance of the subjects they teach to the everyday life of their local community. They said they were not in a position to really have a solid opinion on this issue. However, they all said that theoretically their subjects are relevant to everyday life.

One of the teachers humorously said that her students are interested in "practising the use of condom" whenever she was teaching sex education during the Biology class. She sees sex education as important for everyday life because of the pandemic disease called HIV/AIDS. One of the teachers in Ghana admitted that their students know many things about HIV/AIDS and sexual matters "by watching adult movies or through the porn and other sites on the web". All the teachers acknowledged the importance of Information Technology (IT) as necessary for teaching in the school and its relevance for everyday life.

However, we observed that only one school out of the 10 schools chosen for the study, which is a private school, has very limited computer classes for their students. All the teachers, except two, cannot use computer for word processing or browse the Internet.

One of the teachers said that students should be encouraged to do more religious studies because, according to her, "there is very low morality in the modern society". She thinks that religious studies will be useful for the young ones for living a good life.

Sanitation Level in the School

The discussions focused on the school environment – classroom, toilet and compound. The teachers from the private school were satisfied with the condition of their school environment. They rated their school as very clean with a good level of sanitation. One of the private school teachers said, when asked to rate the sanitation level of the school, "“Though nobody is perfect, I will score the school 95% for sanitation.” It is the only school that has functioning flush toilets, among those selected for the study. Other schools have pit latrines. Pit latrine is common system of toilets in the African schools. All the teachers would prefer to have functioning flush toilets and tap water for drinking in the school. Teachers complained that the population of students is too heavy for the toilet services available in the schools. A teacher remarked, "I do not use the school toilet because it is not clean. My house is not that far from the school, so I go to my house during the break to ease myself."

Attitude Towards the Environment

Teachers acknowledged that their students are very instrumental in keeping the school compound clean. The students do the cleaning (clearing the bush and sweeping the classroom) in most cases. The students' attitude towards the environment is rated as good by all the teachers. When pushed to give further explanations the teachers were particular about their students being "obedient in not littering the school compound with waste". All teachers agreed that they do not know what kind of attitudes students have towards the environment after the school hours.

Major Problems of the Environment

The major problems delineated from the focus group discussions include poverty and lack of government provision for waste management system. Usually teachers live in low income housing units. The houses are overcrowded and poor in sanitation. This they attribute to poverty. Because of the low-income earned by the vast majority of the people their access to electricity or use of kerosene as energy sources are very limited. Teachers see this as the major reason for people resorting to the use of woods for cooking. The use of woods, the teachers observed, has depleted the forest around the towns. Female teachers were more

vocal in complaining about the scarcity and cost of kerosene which, apart from wood, is the common source of energy for cooking.

The waste management system is rated very low by all the teachers. They are of the opinion that the government does not provide good services and that in many cases people dump waste indiscriminately. One teacher said, "People do not understand that they should keep their environment clean. They do not care at all."

One of the teachers said that "the government only makes environmental laws, but does not enforce them". She gave an example of the sanitation officers, who used to inspect houses in the late 1960s in Ghana. In her opinion such inspections made people take good care of their environment. However, the teacher thought that the government cannot do it alone and therefore individuals should strive to keep their environment clean. Other problems mentioned by teachers in the focus groups include erosion, flood, air pollution, over crowding and population.

How Can we Tackle the Problems?

The need for mass environmental education is cited by all the teachers as a must to deal with the problems. Some of the teachers said they need "a clear position on the issue from the government for them to know how to promote sustainable development in their schools". One teacher in Nigeria said that "it is impossible for us teachers to do anything about sustainable development since we live in houses that lack basic needs like water and electricity".

Teachers raised the issues of morality. All the teachers that participated in the discussions thought that civics and religious studies should be improved and taught in all the schools. There is a need, according to them, to teach students how to make the environment clean, about human rights, peace and democracy at the early ages so that they would use the knowledge to promote sustainable development. When asked whether they punish their students by assigning them to sweep or weed the school compound, all the teachers answered "yes". This is a common way of punishing students for bad manners in the school. The implication of this is that students may see keeping the environment clean as a punishment and something meant for offenders. Such thinking, if our assumption is correct, could make young people in Africa ignore the importance of environmental sanitation.

The issue of lack of improving the teachers' condition continued to re-occur during the discussions. The teachers strongly felt that teachers have to be respected and given more compensation for their work. Statements by the teachers in the three countries suggest that they are not motivated to tackle problems that obstruct sustainable development.

4.2 Students' Performance in the Achievement Test

The results of the achievement test are expected to give us clues as to whether international achievement measurement tools are relevant in the African context and also for seeing how students in African schools fare as measured by the international standard. The selected results presented were chosen based on the major problems which emerged as very important from the point of view of the teachers and African research partners. They are major issues that concern Earth Science, Environmental and Resource Issues, Physics, Chemistry and Mathematics.

In Ethiopia, Ghana and Nigeria a large majority of the population is engaged in agriculture and many practise farming for subsistence. In some places the soil has become infertile and food crop harvests have been badly affected. The importance of food security which could be linked to earth science cannot be down played in sustainable development issues.

Environmental and resource issues are major problems in the three countries. Careless exploitation of natural resources has resulted into violent conflicts and increased poverty. The depletion of forest resources by cutting down the trees and woods for export and generating energy has aggravated erosion and gorges. It has also increased the rate of desertification resulting into famine.

Basic Physics, Chemistry and Mathematics are useful to students for knowing about their environment for being able to understand and explain some simple activities of nature. Mathematics in particular is an important tool for education for sustainable development.

The samples from each participating country (Ethiopia, Ghana and Nigeria) in this pilot study were relatively very small when compared to their population. Therefore, the interpretation of the results of our empirical data should be carried out cautiously. However, the results will serve as preliminary data for mapping out a research of a larger coverage of the countries. The performance profiles of all achievement items are presented in Appendix 4.

Five selected examples of the student science performance are presented below, because of their importance and relevance to the African environment. They are examples of relating the understanding of science subjects the students are assumed to have learnt to the everyday environment they live in.

Earth Science

In example 1, students in Ethiopia, Ghana and Nigeria were asked to locate the layer in the diagram that contains the most organic material. Students in Ghana performed best (71 %) and even above the international average (68 %) of the TIMSS study. Instead, the students in Ethiopia had the lowest percentage (29 %) and the Nigerian students scored 38 %.

The item is important in the African context because the majority of the population depends on agriculture or subsistence farming to earn their income. Knowing the soil layers would be helpful for gainful farming, and perhaps for the basic treatment of soil used for farming. The picture given by the example, of course with caution, tends to indicate that Ghana may be better and more successful in producing agricultural products and food crops for its people than Nigeria and Ethiopia. It is however, important to indicate that the location of the schools and the place of residence of the students could have affected the scores. For example, the schools chosen for the study in Ghana are in a rural town where the occupation of majority of the students is farming and fishing. It is not easy to explain the reason for the score in Nigeria. Some of the schools, which are boarding schools, are located in rural towns, but probably populated by students from urban areas. This is because the towns are not far from big cities. In Nigeria many students travel far from home for education in the secondary schools with on-campus dormitories. The lowest percentage is scored by Ethiopia and the assumed reason for that could be that all the schools are situated in the city. This suggests that all students in those schools live in and around the city, and their parents are probably workers in the city.

Environmental and Resource Issues

Example 2 is an item that relates to a seasonal, but fatal disaster that is common to the three countries. Erosion is seen as one of the most serious environmental and public health problems facing human society. According to Primal (2006) humans obtain more than 99.7 % of their food (calories) from the land. This example is presented here to show how familiar a student in Ethiopia, Ghana and Nigeria is with the problems of erosion, one of the worst sources of environmental degradation in the three countries. Erosion, desertification and famine are problems that have continued to increase unemployment, diseases and poverty. Knowing the causes of erosion could be helpful in preventing it and making remedy

The performances of students in the test showed that they had pretty good knowledge of erosion. Students of Ghana had the highest percentage (76 %) again. The percentages of the Nigerian and Ethiopian students were 68 % and 57 %. Gullies caused by erosion and the washing away of topsoil which could have been useful for farming is a problem for sustainable development in the three countries. Erosion in these countries is caused by the overgrazing of fields and the clearing of forest, especially in sloping areas, for woods or charcoal being used for cooking. In the cities floods are rampant during the rainy seasons, because of the careless dumping of waste into the open sewerage or gutters. The floods are also a source of environmental degradation, diseases like cholera, dysentery and typhoid fever.

In example 3 students' performance revealed that they have a good knowledge of the causes of famine. All the countries scored very high having the percentages: 94 % in Niger-

Diagram of soil layers				H04
Content Category	Performance Expectation	Item Key	Score Points	International Average Percentage of 8th Grade Students Responding Correctly
Earth Science	Understanding Complex Information	A	1	48
				Used in 1995
				Y

Which layer in the diagram contains the most organic material?

A. Layer A
 B. Layer B
 C. Layer C
 D. Layer D

Distribution of responses

		LAYER CONTAIN MOST ORGANIC (A)			
		a	b	c	d
Ethiopia	Count	17	31	5	5
	% within *COUNTRY ID*	29,3%	53,4%	8,6%	8,6%
Ghana	Count	56	17	1	5
	% within *COUNTRY ID*	70,9%	21,5%	1,3%	6,3%
Nigeria	Count	15	18	2	5
	% within *COUNTRY ID*	37,5%	45,0%	5,0%	12,5%
Total	Count	88	66	8	15
	% within *COUNTRY ID*	49,7%	37,3%	4,5%	8,5%

Area where soil is washed away				F04
Content Category	Performance Expectation	Item Key	Score Points	International Average Percentage of 8th Grade Students Responding Correctly
Environmental and Resource Issues	Understanding Complex Information	D	1	68

Rain and running water can wash away soil. From which area is soil most likely to be washed away?

- A. A sloping area with bushes
- B. A flat area with grasses
- C. A flat area that is barren
- D. A sloping area that is barren

Distribution of responses

	AREAS SOIL WASHED AWAY (D)			
	a	b	c	d
Ethiopia	Count % within *COUNTRY ID*	5 8,3%	2 3,3%	19 31,7%
Ghana	Count % within *COUNTRY ID*	5 6,3%	1 1,3%	13 16,5%
Nigeria	Count % within *COUNTRY ID*	8 20,0%	2 5,0%	3 7,5%
Total	Count % within *COUNTRY ID*	18 10,1%	5 2,8%	35 19,6%

Two reasons for famine			P05D
Content Category	Performance Expectation	Item Key	Score Points
Environmental and Resource Issues	Understanding Complex Information	Rubric	2
			42
			N
			Used in 1995

What are two reasons why famine (a great shortage of food) occurs?

- Percentages of Students Responding Correctly**

Country	Percentage (%)
Ethiopia	86.0
Ghana	89.6
Nigeria	94.5
-

A, B: Codes for each reason

Note: Each of the two reasons must be coded separately. The same code can be used twice. However, if the reasons described are essentially the same, or an extension of the same idea, a Code 79 should be given to the second one. If only one reason is given, a Code 99 should be given for the second reason.

Code	Response	Item: S022277
Correct Response		
10	Mentions agriculturally-related factors (soil depletion, overgrazing, erosion, poor farming techniques). <i>Examples: When the soil cannot grow any food. The farmers may have tried to raise too many animals on the land.</i>	
11	Mentions natural disasters or weather-related factors (floods, earthquakes, rain distribution, drought, temperature, sun, etc). <i>Examples: Not enough rain. Too much heat/sun.</i>	
12	Mentions crop disease, insect infestation or other pests. <i>Examples: Famine occurs because of disease of the crop. Plagues.</i>	
13	Mentions overpopulation or consumption. <i>Examples: There are too many people and too little food. There may be too many people living in that area.</i>	
14	Mentions specific social/economic/political factors. <i>Examples: War. Lack of money to keep crops growing. Poor economic system.</i>	
15	Mentions pollution or other contamination. <i>Examples: Unsanitized food could not be eaten. The soil was polluted.</i>	
19	Other correct.	
Incorrect Response		
70	Mentions ONLY a lack or need of food (or other responses related to a general definition of famine). <i>Example: Famine occurs when you are hungry.</i>	
71	Response too vague. <i>Example: The government.</i>	
79	Other incorrect (including crossed out/cased, stray marks, illegible, or off task).	
Nonresponse		
99	BLANK	

ia, 90 % in Ghana and 86 % in Ethiopia. The interesting result of this example is that students in Ethiopia, Ghana and Nigeria are familiar with the problems of famine which is a major problem in their countries. It also shows that a test that is relevant to the local situation will surely give good results. The scores of the African students are much higher than that of the international average. This may be because the students in the Western countries have not experienced famine. The achievement may not be attributed to the teaching of science subjects in the schools, but to an everyday problem that students in the three African countries experience.

Physics and Chemistry

The contents of the examples 4 and 5 were Physics and Chemistry. In these examples students in Ethiopia, Ghana and Nigeria performed also well compared to the international averages of the TMSS 1999 study. In the Physics item the percentages were 83 %, 91 % and 77 % for Ethiopia, Ghana and Nigeria, respectively. In this item the international average was 84 %. In the Chemistry item the percentages were: Ethiopia 57 %, Ghana 42 % and Nigeria 49 %, while the international average was 55 %. Even though science teachers during the group discussions indicated that the teaching of Chemistry is difficult, because they do not have adequate laboratories and books, the students still performed very well when put at the average level used in the TIMSS 1999 study. This example suggests that teachers in Africa, with the harsh school and living environment, are effective in their profession. Students in the three countries could do better in science subjects if schools were equipped with necessary materials and science laboratories as requested by the teachers.

The item-based results reveal that there were many similarities, but also interesting differences between the three countries. It was especially interesting that African students' performances were at the average international level in many items and in some cases even clearly above this level. There can be many explanations for that. It seems that the context of the items is very important. For example, the item which discussed the reasons why famine occurs (P05D) was very familiar in the African context and students were able to produce many reasons for famine. There were also indications that students applied their common sense thinking for solving some items.

On the other hand, students of all three countries performed very poorly in some other items. Students seemed to have obvious misconceptions especially in the items which required understanding of science concepts.

The performance differences among the three countries did not favour just certain countries. In some items (e.g. D03 and F02) Nigerian students performed much better than their peers in Ethiopia and Ghana. On the other hand, there were items in which Ethiopian or Ghanaian students' performances were highest (e.g. Ethiopia: J07, Ghana: H04).

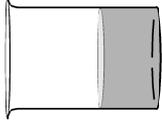
Evaporation rate by surface area					J04
Content Category	Performance Expectation	Item Key	Score Points	International Average Percentage of 8th Grade Students Responding Correctly	Used in 1995
Physics	Understanding Complex Information	C	1	84	N

A student put 100 mL of water in each of the open containers and let them stand in the sun for one day. Which container would probably lose the most water due to evaporation?

A.



B.



C.



D.



Distribution of responses

	Count	% within *COUNTRY ID*	EVAPORATION RATE - SURFACE AREA (C)			
			a	b	c	d
Ethiopia	2	3,3%	6	50	2	
Ghana	1	3,3%	10,0%	83,3%	3,3%	1
Nigeria	2	1,3%	6,3%	91,1%	1,3%	1
Total	5	5,1%	15,4%	76,9%	2,6%	4
			2,8%	85,4%	2,2%	

Burning wood absorbs/releases energy				H06
Content Category	Performance Expectation	Item Key	Score Points	International Average Percentage of 8th Grade Students Responding Correctly
Chemistry	Understanding Simple Information	A	1	55
				Y

If you are burning wood, the reaction will

- A. release energy
- B. absorb energy
- C. neither absorb nor release energy
- D. sometimes release and sometimes absorb energy, depending on the kind of wood

Distribution of responses

	REACTION OF BURNING WOOD WILL (A)			
	a	b	c	d
Ethiopia	Count 34 56,7%	2 3,3%	12 20,0%	12 20,0%
Ghana	Count 33 42,3%	10 12,8%	1 1,3%	34 43,6%
Nigeria	Count 19 48,7%	2 5,1%	4 10,3%	14 35,9%
Total	Count 86 48,6%	14 7,9%	17 9,6%	60 33,9%



Conclusion and Discussion

Educational policy and systems in Ethiopia, Ghana and Nigeria have been a subject of constant reappraisals and changes. It seems that the political instability and poor economic development in the countries have not allowed the implementation of the governments' policies which could facilitate sustainable development. None of the countries allocate up to 26 percent of their annual budget to education as advised by UNESCO. This could be a result of the political background of Western education in Africa. The countries were very much influenced by the colonial education.

However, attempts at improving school education have always been made by governments in these countries, even if the policies have been badly implemented. This seems to have been the major reason for constant changes in the development of school curricula, especially when after many years of colonization political independence was achieved. Even though Ethiopia was not colonised, the country had all the time been equally affected by colonial policies in Africa. The recent discussions on and changes in educational policies, and also the UNESCO attempts at education for sustainable development and achieving Education for All by the year 2015 in these countries show that education is seen as a strong instrument for sustainable development. The major problem is the implementation of good policies and the commitment to allocating more funds for education.

Teachers' role and perspectives are bound to give us clearer picture of the prospects and problems of education and sustainable development in Africa, hence the focus group discussions. The number of teachers that participated in the discussion group is quite small considering the population of the three countries. However, for the purposes of a pilot study the low number is sufficient. Focus Group discussions allowed the teachers involved in them to express themselves quite freely. The discussions were not limited to mere science subjects and that made it possible to include in the data the views of teachers of other subjects. The main idea for arranging the discussions was to gain a better understanding of the teachers' perspective concerning sustainable development and curriculum they practice. The discussion sessions provided us with information on the teacher's perspectives con-

cerning the school systems and their own roles as teachers. The importance of teacher education or training cannot be overemphasized in the issues of sustainable development. Teachers have to be dynamic, especially in the African countries, to improvise methods and tools that could provide possibilities for the disseminating knowledge to students and for guiding them.

The results of the discussions and the scores achieved by the students in the Chemistry and Physics tests show that teachers can do better if given proper support in the form of better wages, improvement of school environment and better training. Such support will also retain professional teachers and entice young people to take up teaching profession. There is an urgent need for more teachers to be trained to lessen the burden of the ratio of one teacher to sixty or hundred students in a classroom. Teachers are indispensable partners for a successful implementation of environmental education or what is now termed education for sustainable development (ESD).

The major problem is the lack of professional teachers in the three countries. Many of those in the teaching profession are not qualified. Teachers are not motivated because of low wages and, according to the teachers, lack of respect for teachers in the society. Teachers see themselves as people in the lower rank of the society. However, the teachers understand the relationship between their subjects and sustainable development. One of the disturbing problems that should be seriously considered is that teachers think they cannot do anything to promote sustainable development, because the government policy on the issue is not clear. Many teachers also spend much of their time on struggling for extra money that could help them and their families survive. Such struggle does not give teachers time to concentrate on their jobs.

Furthermore, the results of the group discussions inform us of the nature of teaching profession and the teachers' everyday concern in each country. The number of female teachers in the group points to gender disparity in the profession in these countries. It seems that the higher posts in teaching profession are male-dominated. Ethiopia, for example, has no female teachers among those interviewed. The case of Ethiopia could be attributed to the fact that all those interviewed are Head teachers or Principals, a position which is male-dominated. In Ghana, however, the two Head teachers or Principals are females, while in Nigeria the participants included two female and one male Head teachers.

Even though the teachers' perspectives are not that encouraging and they complained about the lack of resources, the results of the achievement test taken by their students show that they are effective in their profession and have been able to disseminate knowledge to their students.

International tools for measuring educational achievement can be applied to Ethiopia, Ghana and Nigeria. However, this pilot study suggests that it is necessary to review this kind of instrument to make it culturally and ethically relevant. The reviewed TIMSS 1999

achievement test administered during the study was suitable for the measurement of student achievement in science subjects. The results of the achievement test indicate that students in Ethiopia, Ghana and Nigeria are not significantly lagging compared to the international average standard. In many items involving Environmental Issues, Physics and Chemistry the students scored near and also above the international average. What is encouraging in the students' achievement is that they have good knowledge of the causes of some of the peculiar problems in their environment, like erosion and famine. However, it is sure that a curriculum that aptly considered the local environment and values would have made it more important for schools to teach science in the ways that are related to environmental reality.

The problems of environmental degradation, which is an obstructing factor to the achievement of sustainable development, need to be more carefully considered in the school curricula and teaching. It is important to mainstream subjects that are relevant and useful for everyday life of the students, to include them into the school curriculum. There is a need to improve the ways teachers teach their subjects, especially science subjects, and also to create a better school environment that will encourage students' and teachers' activities that could facilitate sustainable development in Ethiopia, Ghana and Nigeria.

The main result of the present pilot study is the clues it gave about the problems and prospects of school programmes and sustainable development in Ethiopia, Ghana and Nigeria. For sustainable development to take place in these countries there is urgent need for training teachers and making school subjects relevant to the local conditions. The on-going curricula re-appraisals in these countries show that they are still in the milieu of developing school curricula for education for sustainable development that could be suitable for the achievement of sustainable development.

It also shows that there is need for a holistic approach to sustainable development in Africa, and that it is not inappropriate to use international tools for achievement tests that take into consideration the cultural context, in fact they can be applied in African countries.

All in all, the results are encouraging. They show that the students have acquired information which is necessary for sustainable development. At the same time, these results are not sufficient for the development of science curriculum and teacher education. We need more research information on this question, and it can be realized by continuing this kind of study and by improving the measurement tools and enlarging the student samples. This study provides a good basis for the next phase.



Implications and Suggestions for Research and Development

The results of this pilot study are derived from a small number of samples compared to the population of the countries. We merely focused on science subjects and the teachers' perspectives on sustainable development. This is because one of our main aims was to review one of the international measurement tools for testing students' educational achievement as related to sustainable development and experiment it in Ethiopia, Ghana and Nigeria. It is therefore not possible to make generalisations on the basis of the results.

6.1 Suggestion for Further Studies

The results of the pilot study suggest that there is need for a wider application of versatile methods and instruments if we wish to go further into the study of school curricula and sustainable development in Africa. We suggest that other subjects should be added to science subjects and a holistic approach should be taken in any further studies. Science subjects alone cannot explain the problems of sustainable development or its achievement in the countries we studied. It is necessary to conduct large-scale comparative studies of educational achievement to gain a deeper understanding of the effects of policies and practices within and across systems of education in countries like Ethiopia, Ghana and Nigeria. This calls for, in addition to student performance data, background information about the students, teachers, and school and education environments. The aim should be to improve school teaching and learning relevant to the local environment while at the same time considering the global standard for sustainable development. In the process, we suggest that a serious examination of the traditional mechanisms for environmental management and judicious exploitation of natural resources should be well-considered as part of the research on education and sustainable development, because they are still in use in Ethiopia, Ghana and Nigeria.

Teachers play major roles in the achievement of sustainable development. Teacher training programmes are core parts for sustainable education both in the North and the South. It is therefore important to know how teachers perceive their profession vis-à-vis sustainable development so that they could be supported when necessary. Even though learning starts at home, the school provides the major teaching that could equip the children well for living and maintaining their environment. Åhlberg (1998b) has rightly called for a pedagogy, which includes sustainable development, good environment and good life for adequate teaching. We need much more information on teacher training programmes in sustainable development and how they teach them in Africa.

An in-depth study of school education and its cultural relevance and curricula assessment in relation to balanced development will surely be a major part of the activities for establishing education for sustainable development in Africa in this decade and would also help the development assistance for the countries.

6.2 Implications for Development Co-operation

The challenges posed by education to the development co-operation between the African countries and donors in the Western countries cannot be over-emphasized. This pilot study indicates that there are still “grey areas”, especially in the inter-continental support for Education for All in Africa. Usually the main question, and most focused on challenge is funding. However, there are equally important factors that stand as obstacles of achieving Education for All in a form that could bring forth sustainable development in Africa. There are many challenges, but four main and important ones that we think should be of great concern to donors supporting education in Africa will be mentioned here. These are; the school environment in the physical sense of it, the content of schooling (relevance of curriculum to the environment in which children are), the language in which the schooling content is transmitted to children, and the teachers’ motivation.

Most of the school buildings in Africa are dilapidated and sanitation is of very low standard. A school with bad toilets or dirty pit latrines, and also without clean water can not be expected to encourage the students, or even teachers, to practise environmental sanitation for good health and sustainable development. No matter how theoretically good the teaching might be, there is a need for good examples available in the school environment.

The content of the schooling and the language of communication in the school are too often taken for granted. In the African context they are very important and should be of great concern for sustainable development. This study also recognized the challenges posed to education in Africa by the curriculum that does not serve the needs of the environment in which the children are, and the lack of using local languages for instructions in the

school. Many African countries are now concerned with the content of schooling and the lack of using local languages for teaching and learning in the school. Their efforts should be supported to reappraise the curricula and to find a suitable local language that could facilitate teaching and learning for sustainable development.

The success of educational development in Africa will always be very limited as long as the teachers are not motivated. Apart from improving their conditions through wage increase, teachers should be involved in curriculum development and given more professional training. Development cooperation dealing with education and development in Africa has to take into consideration the above mentioned challenges for better and sustainable results.

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Appendix 1. Comparisons of Some Primary Education Indicators Between Ethiopia, Finland, Ghana and Nigeria (UNDP 2004; UNESCO 2003; 2004; 2005b)

Primary Education (PE) Indicators	Ethiopia	Finland	Ghana	Nigeria
Total population in 2002 (annual population growth rate)	69 million (2.4)	5.2 million (0.1)	20.5 million (1.9)	120.7 million (2.2)
Tertiary Students in Science, Math and Engineering (1994-1997) (% of tert. stud.)	36	37	-	41
Human Development Index (HDI) 1(2002)	0.359 (rank 170)	0.935 (rank 13)	0.568 (rank 131)	0.466 (rank 151)
Compulsory Education Age Range	7-12	7-16	6-14	6-11
Primary Education Age Duration	6	6	6	6
New Entrants	1,721,270	64,788	494,984	5,290,614
• females (%)	44	49	49	44
Gross Intake Ratio	83	100	89	144
• male	92	100	89	158
• female	74	99	89	129
• GPI2	0.80	1.00	0.99	0.82
Total Number of Repeaters	812,787	1,837	157,721	633,204
• female (%)	47	33	46	45
Percentage of Repeaters	11	-	6	3
• male	10	-	6	3
• female	12	-	6	3
Survival Rate to Last Grade of PE	53	100	60	-
• male	56	99	55	-
• female	48	100	65	-
• GPI	0.84	101	1.18	-
Gross Intake Ratio to the Last Grade of PE	36	152	67	87
• male	47	140	73	95
• female	26	166	61	80
• GPI	0.80	1.19	0.84	0.84
School Life Expectancy ISCED 1-3	5.3	13.7	7.6	9.8
• male	6.3	13.3	7.1	10.8
• female	4.3	14.1	7.1	8.7
• GPI	0.68	1.06	0.88	0.81

1 HDI is "a composite index of measuring average achievement in three basic dimensions of human development – a long and healthy life, knowledge and a decent standard of living" (UNDP 2004, p. 271).

2 GPI refers ratio of the female-to-male values to a given indicator a GPI 1.00 indicates parity between sexes.

Appendix 2. Focus Group Discussion (FGD)

Introduction

Let me thank you for the cooperation of your school so far. Kindly spare me a few minutes to exchange some ideas with you on the issues raised in the instruments you have assisted us to complete. Please note that there are no right or wrong answers to the few questions we shall be raising in the course of this discussion. Thank you.

Lead questions:

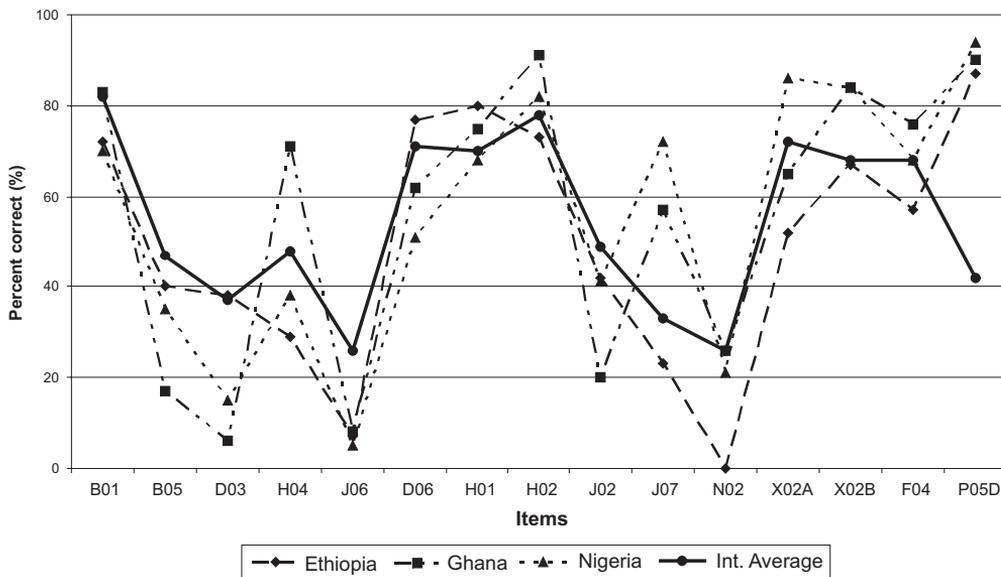
- What do you think are the major duties of a teacher?
- How and when do think your students are learning and have learnt?
- What is the essence of learning?
- How do you use your profession outside the school?
- What is the relevance of the subjects you teach your students to their everyday life? (Probe for inter-personal relationship, use of resources, etc.)
- Do you think your teachings affect the behaviours of the students?
- Would you say your students have a positive affect on their environment?
- Please rate the sanitation level of your school?
- What do you think your school lacks?
- How do you rate your subjects vis-a vis sustainable development?
- What is your idea of sustainable development?
- How can we achieve it?
- Which school subjects do you think can help in promoting sustainable development?
- Please suggest some topics you would like school curricula to address for students practising sustainable living.
- What do you think is/are the major problems of the environment in this country? (Probe for the type of environment).
- How can these problems be tackled to ensure sustainable development?

Appendix 3. List of items in the achievement test

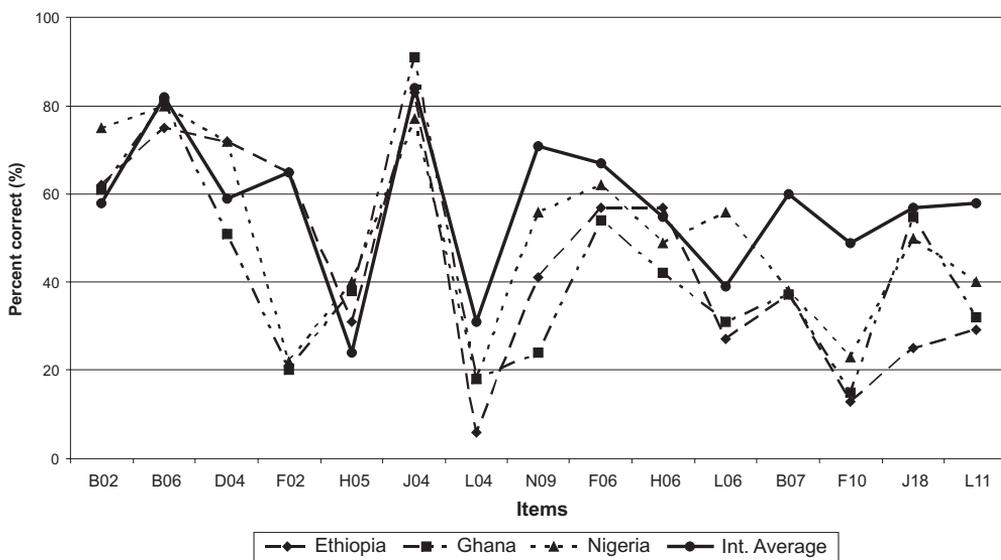
Item ID	Content area	Content
B01	Earth Science	Layers of Earth
B02	Physics	Energy released from car engine
B05	Earth Science	Elevation diagram of wind/temperature
B06	Physics	Color reflecting most light
B07	Data Representation, Analysis and Probability	Graph showing greatest increase
D03	Earth Science	Contour map showing river
D04	Physics	Sequence of energy changes
D06	Life Science	Seed development from plant part
F02	Physics	Why light-colored clothes are cooler
F04	Environmental and Resource Issues	Area where soil is washed away
F06	Chemistry	Best reason for painting iron surfaces
F10	Measurement	Measurement accuracy of ruler
H01	Life Science	NOT a function of blood
H02	Life Science	Role of vitamins
H04	Earth Science	Diagram of soil layers
H05	Physics	Energy stored in food
H06	Chemistry	Burning wood absorbs/releases energy
J02	Life Science	Feature shared by all insects
J06	Earth Science	Factor explaining seasons on Earth
J04	Physics	Evaporation rate by surface area
J07	Life Science	Reason for protein in diet
J18	Fractions and Number Sense	Distance between towns from map
L04	Physics	Efficiency of machines
L06	Chemistry	Filtration of mixtures
L11	Data Representation, Analysis and Probability	Graph of humidity in room
N02	Life Science	Food web – effect of crop failure
N09	Physics	Balancing 10 and 5 liter buckets
P05A	Environmental and Resource Issues	Two reasons for famine
P05B	Environmental and Resource Issues	Two reasons for famine
X02A	Life Science	Importance of trees/sun in rain forest
X02B	Life Science	Importance of trees/sun in rain forest

Appendix 4. Results of achievement test

Part I



Part II





ETHIOPIA • GHANA • NIGERIA

This publication is the final report of the project *Measuring Indicators of Sustainable Development in African School Curricula* funded by the Academy of Finland in 2004–2005. The purpose of the study was to assess the role of sustainable development in Ethiopian, Ghanaian and Nigerian science education by applying tests and questionnaires of the Third International Mathematics and Science Study Repeat (TIMSS 1999).

The research results show that the students of these countries have acquired relatively good science knowledge for sustainable development although many factors in their schooling and everyday surroundings contradict the principles of sustainable development. The study also illustrates the conditions of teaching and learning environment in science education.

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