The University of Hull

DEVELOPMENT OF ENVIRONMENTAL EDUCATION GUIDELINES FOR SECONDARY SCIENCE TEACHER EDUCATION PROGRAMMES IN THE SUDAN'S UNIVERSITIES

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By

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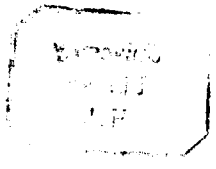

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Environmental Education Guidelines For Secondary Science Teacher Education Programmes in the Sudan's Universities

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List of Abbreviations

EE	Environmental Education
SEs	Science Teacher Educators
STs	Science Teachers
PTs	Prospective Science Teachers
SSs	Secondary School Students
HEIs	Higher Education Institutions
NCHE	National Council of Higher Education
NRC	National Research Council
SSTEPs	Secondary Science Teacher Education Programmes
PTTIPs	Primary Teacher Training Institute Programmes
ITTIPs	Intermediate Teacher Training Institute Programmes
INSETPs	In-service Education and Training Institute Programmes
IES	Institute of Environmental Studies
Q1	Science Teacher Educators' Questionnaire
Q2	Science Teachers' Questionnaire
Q3	Prospective Science Teachers' Questionnaire
Q4	Secondary School Students' Questionnaire

TTIPs Teacher Training Institutes Programmes.

ABSTRACT

The study is an attempt to ascertain the status of environmental education in secondary science teacher education programmes in the Sudan's universities and the science programmes of the secondary school curriculum. In addition, it explores how the shortcomings of these programmes could be rectified in accordance with the emerging philosophy of environmental education.

Four instruments were used to collect the research data. Science teacher educators' and science teachers' questionnaires used previously in Malaysia, were modified and adapted for this study. Students' questionnaires were developed by the researcher. The research instruments were pilot tested in the Sudan in December 1991, and used in the main study in February/March 1992.

The research respondents comprised 20 science teacher educators, 88 science teachers, 107 prospective science teachers and 240 secondary school students. They were selected from colleges and faculties of education in the Sudan's universities and Khartoum state academic secondary schools, in the academic year 1991/1992.

It was found that Environmental Education perspectives were poorly incorporated into both secondary science teacher education programmes and the science programmes of the Sudan's secondary school curriculum. Need exists for the shortcomings of these programmes to be rectified and the constraints hindering their environmentalisation addressed. Both prospective science teachers and secondary school students are well aware of the Sudan's environmental concerns. They perceived themselves competent to investigate, evaluate and take action in issues related to their environment. They also expressed positive attitudes towards the environment and the incorporation of environmental education perspectives into the science programmes of the Sudan's secondary schools.

A set of Environmental Education guidelines was finally developed. They are based on the findings of this study survey, experts' opinions obtained from the literature, as well as the author's own conception of what Environmental

Education for science teachers should be. They are presented in three domains: (1) knowledge of basic environmental concerns; (2) skills for teaching environmental issues and values; and (3) attitudes favourable to Environmental Education.

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CHAPTER ONE
INTRODUCTION AND PROBLEM

1.0 Introduction

The Tbilisi Declaration adopted and issued by the UNESCO conference on environmental education (EE) assessed the urgency of the possibility of eco-catastrophe and set forth guidelines for creating public awareness of the environment. The UNESCO-UNEP experts (UNESCO, 1977a, p.70) stated that:

> "In the long run nothing significant will happened to reduce local and international threats to the environment unless widespread public awareness is aroused concerning the link between the environmental quality and continued satisfaction of human needs"

Environmental education in the Sudan had its beginnings in the growing world-wide concerns about the environmental crisis in the last few decades. The country's urgent needs for sustainable development, international and regional EE efforts and the EE activists' pressure are the main factors that urge the government to adopt the current EE policies (Elkhalifa and Mohammed, 1991; Mohammed, 1984, 1983).

The Sudan has current education reform policies for the incorporation of EE perspectives in the general and higher education curricula including the following: (Min. Educ., 1992; the Sudan's Environmental Strategy, 1992; NCHE Act, 1990).

1- Adoption of an interdisciplinary approach in the basic education curriculum (grade 1 to 8) involving content, teaching and learning approaches and assessment procedures;

2- Amalgamation of the traditional academic and vocational secondary school curriculum into a comprehensive secondary school curriculum. The new curriculum emphasises the following:

A- More time for vocational education than at present, by the year 2002, it should constitute 60% of the curriculum at this level;

B- Decentralisation of the curriculum, introduction of a new streaming system and new fields of specialisation. This should be subject to the social and natural environment of the school;

C- Introduction of environmental studies as an examinable subject in the Sudan School Certificate Examinations starting from the academic year 1992/1993;

3- Introduction of EE, population education and nutrition and health education in the general education (basic and secondary) as cross curriculum themes;

4- National and state university programmes and plans of action should be orientated to the county's natural and social environment. In addition, environmental studies should be introduced as a field of specialisation in all universities.

Environmental educators have unanimously indicated that the key to the environmentalisation of the education system is the classroom teacher (Poch, 1993; Gayford, 1991; Selim, 1990, 1986; Wilke, et al., 1987; Stapp, 1983). Wilke (1985, p.1) stated that:

> "The key to the successful EE is the classroom teacher, if teachers do not have knowledge, skills and commitment to environmentalise their curriculum, it is unlikely that environmentally-literate students will be produced in our K- 12 schools".

The education and training of teachers has been recognised by successive UNESCO-UNEP conferences and reported as "priority of priorities" for research and action in promoting EE (UNESCO-UNEP, 1990, 1988, 1987; UNESCO, 1986a and b, 1980, 1977b).

In the Sudan, an inter-institutional programme (IP) was organised by the Institute of Environmental Studies (IES), the University of Khartoum, Bakht Elruda Institute of Education and the Sudanese Commission for UNESCO. In its four successive workshops for planning EE in the Sudan the urgent need for education and training of teachers for EE was recognised (Mohammed and Ahmed, 1991; Mohammed, 1985, 1984, 1983).

During the 1980's the IP successfully introduced EE into primary and intermediate school teacher training institute programmes. It also carried out considerable work for the environmentalisation of the teaching and learning resources at all levels of education (Elkhalifa and Mohammed, 1991, 1986).

Empirical research has revealed that little progress was made in the environmentalisation of the secondary school curriculum. Critical need exists for education and training of teachers for EE in all secondary subjects (Ali, 1987; Androga, 1986; Salih, 1983).

Therefore, this study is mainly to examine whether traditional SSTEPs in the Sudan's universities are capable of producing environmental educators who can implement the policies of the current education reform, in addition, what are the shortcomings, if any, in these programmes and how effectively they can be rectified in accordance with the emerging philosophy of EE.

1.1 Overview of the study

The present study is presented in eight chapters. Chapter 1 provides an account of international aspects of EE, the research problem, its purposes, significance and limitations.

Chapters 2 and 3 present the theoretical background of the study. Chapter 2 highlights the Sudan's environmental issues and the response of the country's education system to the EE movement. Chapter 3 presents the review of the literature in STs' education and training for EE.

The development of the research instruments is described in chapter 4 and 5. In addition, these chapters provide an account of the population and sampling procedure, detailed information on the research field work, as well as the validation procedures for the research instruments.

The research results are presented in chapter 6 and discussed in chapter 7. The discussion is based on research findings in chapters 2 and 3 of this study as well as the relevant literature in the field.

The final chapter presents the proposed EE guidelines. These guidelines it is hoped will rectify the shortcomings of SSTEPs in the Sudan's universities regarding the EE question.

1.2 The international aspects of EE

It was during the UN Conference on the Human Environment, Stockholm, Sweden, 1972, that for the first time governments at the highest level came together to take stock of what mankind had done to the environment of which they were an integral part. Industrialised countries expressed their shock at what had happened to them in the process of industrialisation and rapid development while developing countries identified poverty and under-development as the major factors of their environmental degradation (Ghaznawi, 1990).

Thus, in the light of this global concern about the environment, a number of measures were considered to correct this state of affairs. One of these measures was the international EE programme. Recommendation 96 of the Stockholm conference stated that:

> "The Secretary General, the Organisation of the UN System, especially the UNESCO and other international agencies concerned should after consultation and agreement, take the necessary steps to establish an international programme in EE" (UN, 1972, p.9).

The major influential international documents (UN, 1972; UNESCO, 1980, 1977b, UNESCO-UNEP, 1978a and b, 1976) and The UN International EE Programme (IEEP) organised by UNESCO-UNEP focused on the needs and formulated the word-wide adopted EE goals, objectives, and main guiding principles. These foundations as stated in the Belgrade Charter (UNESCO-UNEP, 1976) are the following:

1- The goals of EE are:

- to foster clear awareness of, and concern about, economic, social, political and ecological interdependence in rural and urban areas;

- to provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment;
- to create new patterns of behaviour of individual, groups and society as a whole towards the environment.

2- The main categories of EE objectives are:

- Awareness: to help social groups and individuals acquire an awareness and sensitivity to the total environment and its allied problems.
- Knowledge: to help social groups and individuals gain a variety of experience in, and acquire a basic understanding of, the environment and its associated problems.
- Attitudes: to help social groups and individuals acquire a set of values and feelings of concern for the environment and the motivation for actively participating in environmental improvement and protection.
- Skills: to help social groups and individuals acquire the skills for identifying and solving environmental problems.
- Evaluation abilities: to help individuals and social groups to evaluate environmental measures and educational programmes in terms of ecological, political, economical, sociological and educational factors;
- Participation: to provide social groups and individuals with an opportunity to be actively involved at all levels in working towards resolution of environmental problems;

3- The guiding principles for EE are that it should:

- consider the environment in its totality;
- be a continuous life long process;
- be interdisciplinary in its approach;
- emphasise the process of learning;
- be concerned with refinement of problem solving skills;
- use the community as a learning resource;

- utilise diverse learning environments and a broad array of educational approaches to learning/teaching with due stress on practical activities and first hand experience;
- promote the values, ethical and moral aspects of the environment.

International, regional and national attempts to lay the educational foundations that incorporate EE perspectives in the educational curricula during the early stage of its formulation, include the following: (UNESCO, 1980)

1- National polices and mechanisms to cater for EE;

2- Sound educational theories in the design, development and implementation of EE curricula;

3- Empirical research to elaborate the Tbilisi Conference Objectives and translate them into applicable and manageable programmes.

The need for the training of personnel was documented at the Tbilisi Conference, specifically recommendations 10, 11, 17 and 18. These Conference Recommendations emphasised the need for teachers to understand the importance of EE in their teaching and called for steps to be taken in order to provide appropriate training for teachers in EE (UNESCO-UNEP, 1978b).

On the basis of the above recommendations, the UNESCO-UNEP experts developed a series of experimental EE modules for training of primary and secondary school teachers and supervisors. These modules were prepared and adopted on a national and regional basis world-wide (UNESCO-UNEP, 1984, 1981)

Ten years after Tbilisi, UNESCO-UNEP organised the International Congress on EE and Training, in Moscow. The congress was attended by 300 experts from 85 UN Member States. It took stock of EE development since 1977 and established EE strategies for the 1990's. The two concrete recommendations addressed to the UNESCO and the UNEP by this congress were to announce the 1990's as the Decade of EE and to organise the next international congress in 1995. The proposed congress is mainly to identify the priorities and spearhead the

development of EE towards the first decade of the 21st century (Ghaznawi, 1990; UNESCO-UNEP, 1987).

Environmental education today has achieved a recognised status world-wide, reflected in numerous declarations stating the urgent need for its incorporation into education curricula at all levels, as well as the development of a body of pedagogical expertise relating to its concepts, methods and teaching materials. This expertise has grown out of much thought and debate, pilot projects, research results etc., and the critical contribution of UNESCO-UNEP as a driving force in all that, through the creation and operation of its EE programmes world-wide.

In curriculum terms, the gaps between theory and practice in the life of any education innovation is a long journey. Chapters 2 and 3 of this study will present empirical research findings that show EE status and trends in SSTEPs at the university level, as well as the planning and implementation barriers that need to be dealt with if EE perspectives are to be realised.

1.3 Statement of the research problem

Educating STs for their dual role as science and environmental educators requires SEs to review the traditional SSTEPs in the light of the emerging philosophy of EE, to explore how effectively they can be organised to cater for EE, as well as how the support for EE within and outside teacher education institutions can be established (UNESCO, 1986a and b, 1980, 1977b) Selim (1977b, p.134) stated that:

> "Competent teachers do not emerge by good luck, they must acquire and practice the attributes of competency and skills during their education. Thus teacher training colleges and universities must review their teacher education programmes in the light of the emerging philosophy of EE. This also must be planned to use as effectively as possible, the time spent on studying EE and relevant courses".

In the Sudan, to date, little if any thing, is known about the response of SSTEPs to the environmental question, and how STs are being prepared as environmental educators or whether they are being prepared at all.

Research has revealed that Khartoum state's secondary school chemistry teachers were not approaching their subject environmentally (Ali, 1987). Whether this is the case with biology and physics teachers is questionable. In addition, if this is the case with the three groups' members, or some of them, the question arises whether this problem derives from what was taught in teacher education institutions or from the science programmes taught in secondary schools. Considering all that, also, how can the shortcomings, if any, of these programmes regarding EE question be rectified?

Moreover, researchers in science education in the Sudan have pointed out that most of the current science programmes in secondary schools have been imported from the Arab or western countries. They were not planned in accordance with the Sudanese students' knowledge and attitudes and they do not encourage the active participation of the learner in teaching and learning processes (Ali, 1987, Androga, 1986; Lutfi, 1984). The scope of EE involves knowledge, beliefs, values and attitudes in relation to individuals, other people and the environment (Poch, 1993; Gayford, 1993, UNESCO, 1980, 1977a and b). In addition, the learners' knowledge and attitudes are the central factors in the success of any educational innovation (Fish, 1989; Bishop, 1986). Therefore, in conjunction with the above issues, this study investigated how PTs and SSs as consumers of the programmes above, perceived their environmental knowledge, attitudes and sources of information.

1.4 Purposes of the study

In the light of the research problem outlined above (section 1.3), the main purposes of this study are the following:

1- To ascertain EE status in SSTEPs in the Sudan' universities, and science programmes of the Sudan's secondary school curriculum;

2- To assess the need for the incorporation of EE perspectives into these programmes;

3- To investigate PTs' and SSs' perceived environmental knowledge, attitudes and sources of information;

4- To develop a set of EE guidelines to rectify the shortcomings of SSTEPs, if any exist, in accordance with the emerging philosophy of EE.

1.5 Significance of the study

The Sudan is characterised as a country endowed with vast natural resources, as well as all the potential to be the world's basket of food. Currently educating its population at large to preserve these resources and to utilise them rationally for their own benefit and the entire world population are very much debated topics. Politically this issue is seen as the major factor for the country's stability and its future. In addition, it is recognised by policy makers as the factor that should be given priority in all development plans.(The Sudan's Environmental Strategy, 1992; Mohammed, 1985, 1984, 1983). Therefore, the data collected by this study might be useful for all government agencies to formulate environmental policies that would help in educating environmentally literate citizens.

In the Sudan, research in teacher education and training is relatively rare. This study might be the first of its kind to address the environmentalisation of SSTEPs in the Sudan's universities, as well as investigating the university and secondary school students' environmental knowledge, attitudes and information sources. As a result, the data collected and the guidelines proposed by this study might be useful for educators to formulate policies for "greening" the Sudan's education. They might also help in identifying how future teachers be educated to implement these policies. In addition, they might also form a frame of reference for other researchers in the area of teacher education and training.

The current education reform in the Sudan targeted teacher education and training as the key issue for its success. Ten new secondary teacher education institutions are planned and fifty primary and intermediate teacher training

institutes will be upgraded to university level by the year 2002 (Min., Educ., 1992). Consequently the findings of this study would be a baseline for those who will shoulder the responsibility of establishing curricula with a green vision in these institutions.

Many curriculum developers (Gough, 1989; Grieg et al., 1989; Hicks, 1988; Reardan, 1988), as well as environmental educators (Poch, 1993; Selim; 1990, 1986; Elkhalifa and Mohammed, 1991, 1986) are in favour of "greening" future education policies. They urge teacher education institutions to formulate programmes for the 21st century to address the future demand of the world. Therefore, the findings of this study might be useful to educators word-wide and specifically for the Sudan's neighbouring African and Arab countries to incorporate EE perspectives into their education systems.

1.6 Limitation of the study

This study is limited to the following:

1- Variables specified by the research instruments (chap. 5, section, 5.5);

2- Secondary science teacher education programmes taught in the academic year 1991/1992 in Omdurman Faculty of Education, University of Khartoum, Juba College of Education, University of Juba and Atbra Faculty of Education, University of Wadi Elnil.

3- Science programmes of the Sudan's secondary school curriculum in the academic year 1991/1992;

4- As with all studies based on the use of self-reported instruments, this research relied on the willingness of the respondents to give full and honest answers to the questionnaires' items.

1.7 Definition of terms

Environmental education: is the process of recognising and clarifying the values, attitudes, and concepts necessary to understand and appreciate the interrelatedness among man, his culture, and his biophysical environment. It also emphasises the individual's practice in decision-making about issues concerning environmental quality (ALECSO, 1978, 1977).

Secondary science teacher education programmes: A 4 or 5 year pre-service concurrent degree course when educational and professional disciplines are incorporated into a basic science degree programme.

Environmental knowledge: According to Good (1973, p. 325) knowledge is figuratively defined as the "accumulated facts, truth, principles and information that the human mind has access to or the product of the operation of man's intellect, either within or apart from human experience". Moreover, the widely used classification scheme for the cognitive variables, presented in Bloom's Taxonomy of Educational Objectives (Bloom, 1956) classified knowledge into three main categories: (1) knowledge of specifics (facts and terminology), (2) knowledge of ways and means of dealing with the specifics (action strategies) and (3) knowledge of the universal and abstractions in a field (principles, generalisations, theories and structure). Thus on the basis of this definition, in this study students' perceived environmental knowledge is defined as their perceived knowledge of environmental concerns (issues, problems and solutions), their knowledge of how to take actions in issues related to their environment, as well as their perceived ability to use EE teaching methods and approaches.

Environmental attitudes: Many technical definitions of the term 'attitudes' have features in common. According to Fred (1986, p. 130) "An attitude is an organised predisposition to think, feel, perceive and behave towards a referent or cognitive objective (a referent is a category, class or set of phenomenon)". Hawes and Hawes (1982, p. 19) define attitude as "a general predisposition or mental set

with regard to any persons, beliefs or other entities". Good (1973, p. 49) defined 'attitudes' as:

> "Predispositions or tendencies to react specifically towards an object, situation, or value, usually accompanied by feeling and emotion. Thus they can be classified as verbal attitudes (what the reacting person says) and behavioural attitudes (what he actually does when he is confronted with the affect-producing stimuli). Attitudes cannot be directly observed but must be inferred from overt behaviour, both verbal and non-verbal".

Therefore, on the basis of these definitions in this study students' environmental attitudes were defined as their expressed opinions, feelings, values and perceptions towards the environment, about the incorporation of EE perspectives into science programmes, as well as their perceptions of the value of different sources of environmental information.

CHAPTER TWO
ENVIRONMENTAL EDUCATION IN THE SUDAN

2.0 Introduction

The main purpose of this chapter is to highlight the Sudan's environmental issues and the main features of the country's current education reform. In addition, it describes the response of the country's education system to the EE movements. The latter will be discussed by examining the status of EE in science programmes in the general education curriculum, teacher education and training institutions, National Research Centres (NRCs) and higher education institution programmes.

2.1 Sudanese environmental issues

The Sudan is the largest country in Africa, with an area of one million square miles, stretching across nearly 18 degrees of latitude, from rainless desert in the north to tropical woodland and swamps in the south. This vast area of land includes contrasting terrain, but the Nile and its tributaries provide a unifying feature. The Sudan also has a range of continental climates with a marked gradient from south to north and various ecological zones Fig. 2.1 (Appendix O). In the south the rainy season lasts up to eight months providing over 1000 mm of precipitation, while in the area around Khartoum and to the north, there is a one month rainy season with 50 mm of rainfall.

Agriculture and pastoralism provides a livelihood to over 80% of the population. As most of the country lies in arid or semiarid zones, irrigated agriculture plays a very important role in the country's economy. Crops for commercial production are grown in large irrigated schemes like the Gezera, the Rahad and Nile pumps schemes. Mechanised rainfed agriculture plays a major role in provision of subsistence food crops. Most of the country's population lives outside the influence of the Nile in the plain areas of Kordofan, Darfour and Kassala where they practise traditional agriculture and animal rearing.

According to the 1983 census, since the 1960's the country has experienced rapid population growth. The rate of annual growth is approximately 2.8%. The

total population is 21 millions. Abusin (1991) indicated that the urban population in the 1983 census was 28%, of whom 90% were in ten large towns. Greater Khartoum alone houses about 34% of the urban population and with Port-Sudan as the second largest city, it may account for 50% of the urban population. At an average rate of annual growth of 4% the urban population is expected to reach 50% of the total population by the year 2003.

The Sudan is described as a country having a wide range of natural resources and with a high potential to become the main source of world food. However, the country faces many environmental problems that effectively contribute to the poverty that exists in both urban and rural areas. Despite impressive achievements in the field of irrigated agriculture and mechanised rainfed farming, the environmental impact of these developments are also considerable.

According to Mohammed (1985, 1983) the Sudan's major environmental problems can be summarised as following:

1- Desertification;

2- Impacts of irrigation and water provision projects;

3- Urban and rural migration;

4- Excessive use of pesticides;

5- Wildlife depletion;

6- Environmental health problems;

7- Industrial pollution and waste disposal.

Desertification is the most important problem and poses a severe threat to agricultural lands, the backbone of the country's economy, in both the irrigated schemes and in the traditional sector. It has been estimated that the desert boundaries in 1975 were 200 km to the south of their 1958 positions (Tolba, 1985; Meine, 1984; Fouad, 1978).

According to Meine (1984) the Sudan's desertification problem is believed to be the result of man's destructive activities in the form of misuse of land

resources, overcultivation, overgrazing, overexploitation of ground water and deforestation. As a result of the relative population growth in some rural areas and under the influence of the market economy, the traditional farmers responded by increasing the areas under cultivation and shortening fallow periods. This resulted in loss of soil fertility, soil erosion and the spread of desert-like conditions.

Meine (1984) further indicated that another major cause of desertification is overgrazing due to large increase in the number of livestock. Veterinary services and the development of rural water supplies in some areas encourage nomadic populations to keep large herds of animals leading to the depletion of pasture resources.

Deforestation, whether as a result of expansion of mechanised rainfed agriculture or from cutting down of trees and other vegetation to provide fuel, building materials, food and foreign earnings, effectively contributes to the process of desertification, drought, climate change and wildlife depletion in the Sudan (Abdel Nour, 1991; Mabutt, 1978).

Another environmental health problem is associated with the development of irrigation projects. They have created favourable conditions for the increase and transmission of water-borne and water-related diseases, such as malaria and schistosomiasis (bilharzia). Surveys made in the Gezera scheme showed bilharzia infection rates of over 70%. The prevalence of malaria also increased by almost 20% in the years between 1974 and 1976 (Min. Health, 1978).

According to Beshir (1989) in all irrigated agriculture farms, pesticides are used for crop protection and public health purposes. They are used to combat pests like the cotton white fly and against the spread of mosquitoes. The Gezera project surveys showed that pesticide residues have been detected in drinking water, plants, soil and milk, and present severe threats to human and animal lives.

In recent years, with the preliminary work on the hydrological estimate of the effects of the Jongoli canal, the country began to face another serious environmental problem connected with irrigation and water development. Aquatic

weeds became a very serious problem in the White Nile and in irrigated canals. In the White Nile, water hyacinth hinders irrigation and adversely affects aquatic life, while the weeds in the irrigation canals result in water loss and encourage snails (NRC, 1990; Sutclitte and Park, 1982).

Desertification, drought, poverty, civil war and other environmental problems have resulted in a large scale migration to urban centres, leading to the growth of shanty towns and severe degradation of urban life. As a result of urbanisation in recent years, the country now faces problems of housing, urban sanitation, transport and environmental health problems and congestion. (Abusin, 1991; Elsmani and Abusin, 1987). Further, Abusin (1991) indicated that, in terms of human resources urban centres have failed completely to employ population in a sustainable production system. The planning authorities lack the means and even plans to ensure conservation management and the development of natural resources in most of the country's urban centres.

In connection with the above discussion, Sudan's major environmental issues as in most developing countries, as Bowonder (1987) pointed out, are associated with socio-economic development processes. They either arise out of the newer activities aimed to promote development or are caused by the lack of development projects. Table 2.1 summarises the Sudan's environmental problems based on Bowonder's (1987) classification.

Environmental problems in the Sudan, as indicated by environmental scientists (Abusin, 1991; Beshir, 1989; Elkhalifa and Mohammed, 1991, 1986; Meine, 1984) are difficult to control for the following reasons:

1- Basic information about the Sudan environment is not available after the 1980's destructive desertification, drought, flood and impact of civil war;

2- Literacy in the country is low, 28% in the whole population and less than 10% among the adult in the traditional sectors of the economy;

3- Culturally, the population do not initiate social control action groups, there are very few persons who are knowledgeable and concerned about intricate links between man and his environment and the irreversible changes in ecosystems;

4- Political leadership sometimes is more concerned about economic achievements and short term gains. They consider environmental conservation as wasteful expenditure;

5- An effective mechanism to enforce and co-ordinate environmental regulations and laws has not been developed;

6- Environmental issues are discounted by the mass media.

Table 2.1
The Sudan's Major Environmental Problems

Typical problems arising out of lack of development and poverty	Typical problems arising out of economic development projects
- desertification;	- Malaria, bilharzia and cholera;
- Malaria, bilharzia and cholera;	- Increased pesticides residues;
- Over-grazing and over-cultivation;	- Water and air pollution;
- Poor drinking water supply facilities;	- Toxic wastes;
- Slums settlements in urban areas;	- Loss of plant germ plasma;
- Wild-life depletion;	- Water logging and salinity;
- Illegal or over extraction of fuel woods;	- Deforestation;
- Soil erosion.	- Aquatic weeds, e.g., water-hyacinth.

2.2 The main features of the current education reform in the Sudan

Concurrent with the writing of this research, the Third Sudan Educational Reform, since the country's independence in 1956, is in its initial stages. The reform is mainly to prepare people for constructing an Islamic State. It includes, a ten year curriculum reform plan for general education and a revolutionary programme to expand higher education institutions (HEIs) to all states and to orientate their programmes to local community needs and the country's environmental conditions (Min. Educ., 1992; NCHE Act, 1990).

The basic features of the general education reform plan include:

1- Change in the organisation of schooling from a 6 - 3 - 3 or 4 plan (Fig. 2.2) to an 8 - 3 plan (Fig. 2.3);

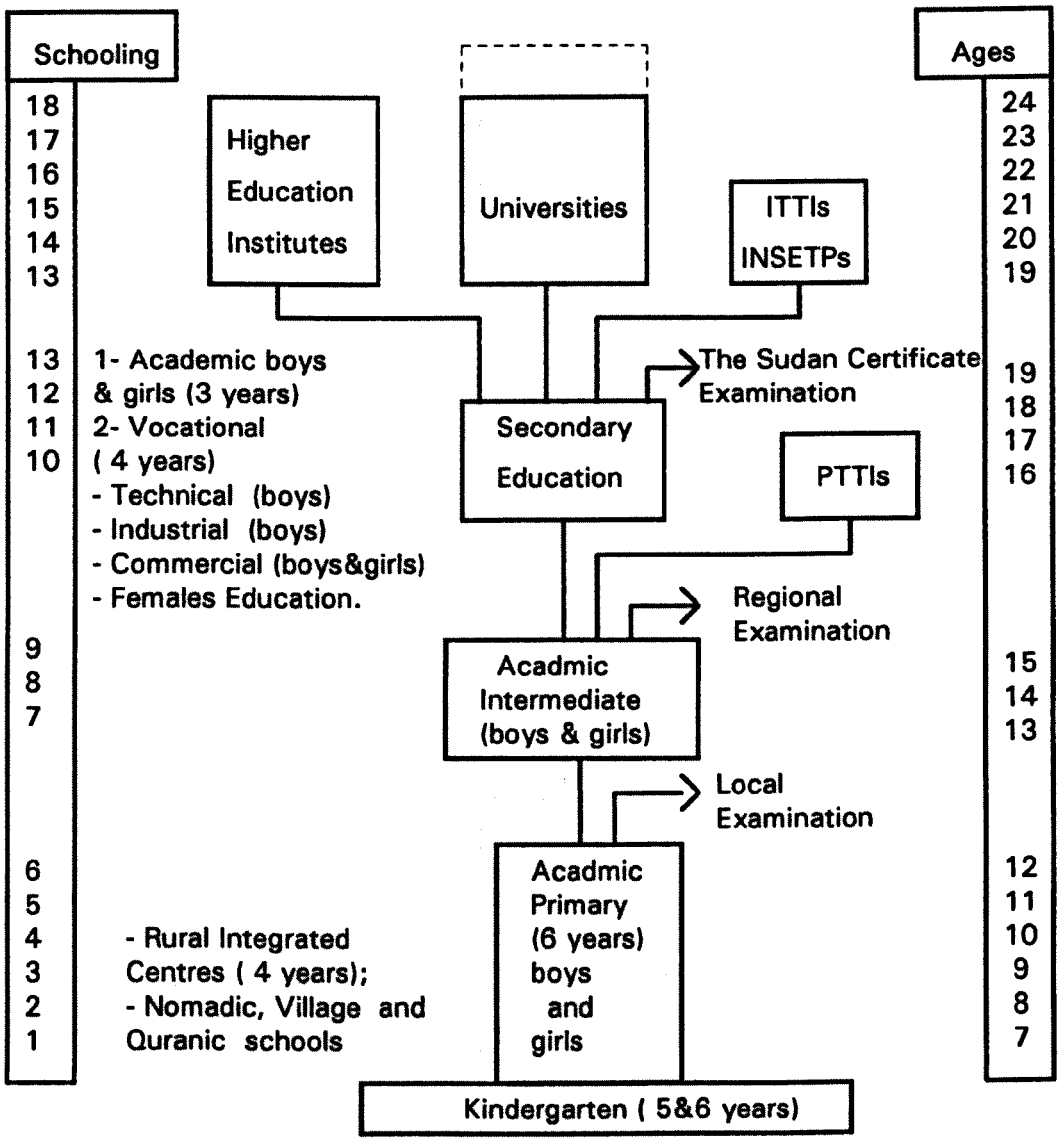
2- Diversification of lower education level pools to include rural integrated centres, village schools, Quranic schools, nomadic schools and kindergartens.

3- Universalisation of basic education by the year 2002.

The main purposes of the new schooling organisation plan are to provide a longer period of basic schooling, to give more room for Islamisation of curriculum context and to introduce more vocational education in the lower educational system levels (Min. Educ., 1992).

In all Sudan's Educational Reforms, since the beginning of the so called Sudan National Education, in the early decades of this century, a policy has occurred of relating schooling to local community needs, to the agriculture sector and to rural environmental conditions. This policy is based on the fact that 72% of the country's population is in the rural areas and agriculture is the backbone of the Sudan's economy (Min. Educ., 1992, 1977; Abdulwhab, 1975; Griffiths, 1975, 1953; Beshir, 1970).

Approaching all curriculum subjects environmentally, to educate an environmental literate citizenry and to reduce environmental problems is the new aim advocated in EE literature (Selim, 1990; Volk et al., 1984; UNESCO, 1980). In the Sudan, this trend emerged in the education system in the late 1970's and early in the 1980's. The current education reform policy for the environmentalisation of the general and higher education curricular was stated earlier (chap. 1 section, 1.0). The remainder of this chapter examines the level of incorporation of EE perspectives in the education system in the last two decades.



ITTIs Intermediate Teacher Training Institutes;
INSETPs In-service Education & Training Institutes;
PTTIs Primary Teacher Training Institutes.

Fig 2.2 The Sudan Education System 1970-1991

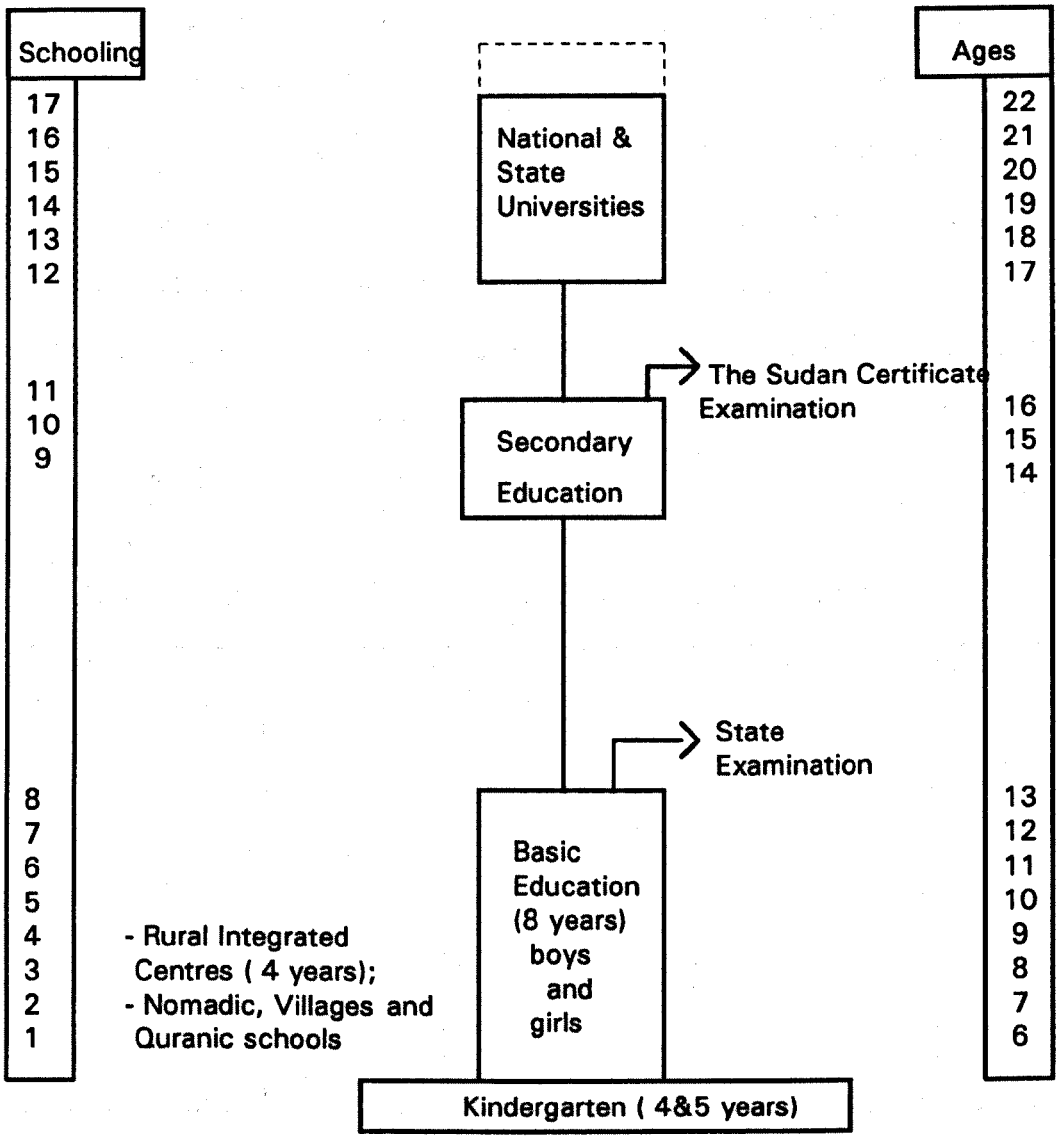


Fig 2.3 The Sudan Education System 1992

2.3 Status of EE in science programmes in the general education curriculum

Science education in the general education curriculum is compulsory for all students, except for arts students in the third grade of the secondary level, since the country's 1970's educational reform. It starts in the primary level, in the second grade, as science and health education courses. In the intermediate level science is taught as integrated science courses. In the secondary level science is taught as biology, chemistry and physics. Table 2.2 shows the science provision in the general education curriculum in the Sudan.

Table 2.2
Science Provision in the Sudan General Education Curriculum

Education level	Grade	Total periods a week	Science periods a week	Percentages
Primary	1	24	-	-
	2	26	2	8
	3	28	2	7
	4	29	3	10
	5	31	4	13
	6	31	4	13
Intermediate	1	36	4	11
	2	36	4	11
	3	36	4	11
Secondary	1	42	6	14
	2	42	6	14
	3	42	12	29

*1 The Sudan academic year = 210 days =35 weeks/ 6 working days a week;
*2 Streaming into (science and arts) starts in 3rd grade in secondary level. Science groups are divided into biological science group and mathematical group.

The potential for the incorporation of EE perspectives into science programmes in all general education levels has been thoroughly studied. Based on criteria stated by UNESCO-UNEP (1980) for developing environmentally-orientated educational programmes, Mutuli (1986) carried out a study in Khartoum state primary schools to survey the contribution that science programmes were making to EE perspectives. Textbooks, teachers' manuals and instructional processes were analysed by a panel of curriculum planners and environmental educators. Questionnaires were distributed to 150 primary school teachers in Khartoum state analysing the extent of the incorporation of EE perspectives into science programmes in the primary school curriculum. The study

revealed that most of the EE objectives were not achieved by the primary science programmes. Environmental concepts were scattered in science programme contents without any connections among them. The teaching methods adopted by most of the science teachers were whole class instruction, mainly lectures, demonstrations and discussion. Progressive teaching and learning approaches advocated in EE literature such as role-play, games, problem solving and individual and group projects were neglected by most of the primary teachers. The teachers generally perceived the instructional activities suggested in the manuals positively, they indicated that most of the activities were related to the Sudan's environment, orientated to rural and agriculture community needs, and they encouraged first hand experiences by pupils. The major problems encountered by the respondents in incorporating EE in Khartoum state schools were (1) inadequate teacher training for EE; (2) large class size; (3) inadequate time and funds and (4) having a science programme based on set disciplines while EE advocates interdisciplinary approaches. The researcher concluded that an environmentally-orientated science programme was possible. Existing programme topics could be enriched with EE perspectives but if EE was to permeate the whole of the school curriculum as advocated in EE literature, there must be an extensive programme for education and training of teachers in EE.

Eltaib, Elkarim and Hassan (1985) conducted a study to evaluate the contribution of the primary school curriculum to EE based on the criteria recommended by UNESCO (1980) for developing environmentally-orientated curricula. They surveyed all subjects taught in the Sudan's primary schools' textbooks, teachers' manuals and instructional processes. The study revealed that scattered environmental topics were found in geography, general science and health education programmes. In grade three mention was made of water resources, water-borne diseases, malaria and soil preservation. In grades five and six, environmental topics included alluvial plains, climate, food production, natural vegetation, industrial resources, irrigation schemes, population and human

activities to prevent illness in relation to environmental hazards. Instructional activities included a few simple science experiments and out-door activities in geography. The researchers concluded that although environmental topics were included in the curriculum content a clearly defined EE programme as a separate or integrated identity in the curriculum was not found. The emphasis was found to be placed on teaching environmental topics rather than learning skills or developing attitudes towards the environment.

Mekki (1987) conducted a study to assess the utilisation of national parks and game resources as instructional sites for EE in intermediate school science programmes. The parks considered in the study were described from an ecological point of view and their facilities were reviewed. The environmentally related topics in the intermediate curriculum were scanned. The study revealed that environmental issues were incorporated into the various disciplines such as geography, science and rural education, but they were dispersed. Both teachers and students emphasised the importance of environmental information. The national parks have been established for recreational purposes. They are unsuitable at present for EE. The teachers' skills in EE were quite poor. The role of EE was considered critical for the creation of environmental awareness and positive attitudes towards the environment. The utilisation of the national parks and reservoirs could contribute significantly to promote EE.

Lutfi (1983) surveyed science textbooks and teachers' manuals at intermediate level in the Sudan for environmental concepts and other EE components. He found that a large number of environmental topics were included in the first and second grade textbooks but the environment was not considered from a holistic perspective. In the third grade, the science textbook was divided into two sections. The first section dealt with the physical environment. The second section dealt with living organisms, their environment and the conservation of the natural resources in the Sudan. Lutfi concluded that the usefulness of the conservation section in the intermediate science programme was

limited. The time allocated to it was too short. In addition, it lacked the proper teaching methodologies to develop concern and attitudes towards the environment.

Based on the criteria stated by ALECSO (1977), for developing environmentally-orientated science curriculum in the Arab States, Ali (1987) investigated the relevance of the Sudan's Secondary School Chemistry Programme to EE perspectives and the extent to which secondary school chemistry teachers incorporated environmental dimensions in their teaching. The chemistry programme was analysed by a panel of curriculum planners and environmental educators. Questionnaires were distributed to chemistry teachers in Khartoum state. Ali's findings revealed that the panel members thought that a considerable relationship existed between the chemistry programme items and EE concepts from the perspectives of aims, contents, teaching and learning approaches and evaluation. Most of the environmental concepts that matter to the Sudan can be incorporated into the existing chemistry programme. The topics which have environmental dimensions in the chemistry programme are (1) thermodynamics; (2) oxidation reduction reactions; (3) energy resources and pollution (4) organic and inorganic fertilisers, insecticides and pesticides and their role in food chains; and (5) essential elements cycles and ecosystems.

The secondary school chemistry teachers' responses indicated that they were not approaching the chemistry programme on an environmental basis. They perceived their instructional approaches and activities as having little influence on modifying students' attitudes, values and behaviour towards environmental concerns in the Sudan. Progressive teaching methods and approaches that involve the active participation of students and using the environment as a learning resource, i.e. case study, field projects, simulation games, role play, and value clarification were poorly adopted by most chemistry teachers, despite the fact that more than 60% of respondents reported that they were confident in using them. Major constraints for the incorporation of EE perspectives into chemistry

education in the Sudan secondary schools as perceived by both panel members and chemistry teachers included (1) inadequate teacher education and training for EE; (2) chemistry textbooks, and teaching resources were not environmentally-orientated; (3) examinations mainly tested factual knowledge rather than comprehension, evaluation and other higher levels of thinking; (4) the science inspectors had no concern about the incorporation of environmental dimensions in chemistry teaching and (5) students did not tend to perceive school knowledge as having any relevance to their every day lives or relation to their local environment.

Androga (1986) investigated the effects of the secondary school biology programme on the students' awareness of environmental concerns in the Sudan and evaluated the relevance of the programme items to EE perspectives. Questionnaires were distributed to secondary schools biology teachers and students in Khartoum state schools. Androga's study revealed that both biology teachers and students were of the opinion that the biology programme contributed positively to students' awareness of environmental issues in the Sudan. The biology teachers perceived the programme as environmentally-orientated. They indicated that textbooks for all secondary school grades were rich with environmental concepts and all the biology topics in the programme could be approached environmentally. The biology students' perceptions of the contribution of the biology programme to their abilities and skills to identify and implement environmental action were relatively poor. The researcher concluded that the poor contribution the programme made to environmental action skills may be attributed to the fact that the environmental concepts in the programme were mainly ecological, dealing mainly with interrelationships of organisms and their environment rather than with humans in the ecosystem and an emphasis on mankind as a part of nature.

2.3.1 Teacher preparation for EE

Teacher education and training has been reported continuously as the major factor related to low implementation of educational plans in the Sudan (Hammod, 1990; Lynch and Omer, 1989; Min. Educ., 1989, 1977; Elhassan, 1987; Beshir, 1970). Hammod indicated that:

> "Based on Ministry of Education Statistical Report 1990, 48% of the secondary school teaching force have no education qualification. Some of them have been teaching for more than 20 years, and by now they are holding administrative posts in schools and ministries of education on national and states levels. More than that, some of these group members, are subject inspectors. and there is a negative concept widely spread among the secondary teachers that teaching in this level does not need an education qualification" (Hammod, 1990, p. 13).

In this connection, secondary school chemistry teachers in Khartoum state were not prepared to approach their subject environmentally. They had received no refreshing or retraining courses in EE at all (Ali, 1987). Primary school teachers in Khartoum state, perceived themselves as ill prepared to approach science programmes environmentally and only 20% reported that they have had EE in their previous education and training courses (Mutuli, 1986).

According to Mohammed (1985) 55% of the participants of a Teacher Trainers Workshop for Planning EE in the Sudan indicated that their previous training and experiences did not prepare them for EE.

In general although all the above studies were carried in Khartoum state their findings may indicate that teacher preparation for EE in the country as a whole was unsatisfactory at general education level and in teacher education and training institutions.

2.3.2 Students

Students have been considered in EE literature both as future citizens of the earth and as the EE programme's consumers in the schools. Work has been carried out to relate school programmes and teaching/learning approaches to

students' environmental behaviour, attitudes, values and sources of information. According to Iozzi (1989a and b) no clear cut relationship was found between the above variables and, in general, the introduction of an environmental philosophy or of some environmental issues in the school curriculum does not necessarily mean that EE objectives will be achieved.

In the Sudan, a few studies indirectly touch on the above variables. Findings of these studies revealed that intermediate school students in Khartoum and Central states indicated that science programmes are the main sources of their environmental information (Salih, 1984).

Eltaib and his colleagues (1985) in an experimental study in Khartoum state primary schools found that pupils' scholastic achievement and behaviour changes were significantly improved after introduction of an environmental resource unit module for seven and half hours per week for four weeks into the school science programme. Students who participated in the EE programme activities showed increased understanding and enthusiasm for topics related to environmental concerns in the Sudan desertification, drought, pollution, diseases control, the abuses of natural resources and unsatisfactory living conditions.

2.4 Environmental education status in teacher education programmes

The two principal types of institutions in the Sudan for teacher education and training are teacher training institutes (TTIs), and university colleges and faculties of education. These institutions run pre-service and/or in-service teacher training programmes for the general education sector.

Research in teacher training and education in the Sudan is relatively rare. In the author's knowledge no work has been carried out to evaluate the incorporation of EE perspectives in teacher education and training programmes. Consequently, the status of EE has to be inferred from institution prospectuses, reports and official documents.

2.4.1 Environmental education in teacher training institute programmes

Concurrent with the writing of this research a plan is underway to reform teacher training institute programmes (TTIPs) in the Sudan. Primary and intermediate TTIs will be upgraded to university level. Comprehensive retraining and in-service courses will be organised all over the country as the first phase of teacher education and training for the reform. (Min. Educ., 1992).

The current educational reform is in its initial stages. The existing TTIPs can be classified into three types: (Hammod, 1990; Min. Educ., 1989)

1- Primary teacher training institute programmes (PTTIPs);

2- Intermediate teacher training institute programmes (ITTIPs);

3- In-service education and training institute programmes (INSETPs)

Primary teacher training institute programmes (PTTIPs) involve a 4 year pre-service course to prepare separately males and females who have passed the Intermediate School Final Examinations. It was introduced first as a 2 year course in 1934, and after the so-called education revolution in 1970 upgraded to a 4 year programme. Teachers in these programmes normally cover all primary school subjects, educational and professional courses and subsidiary primary subjects, e.g. rural education, physical education, drama, gardening, health and nutrition education.

Intermediate teacher training institute programmes (ITTPs) are 2 year in-service training programmes for teachers trained in single sex institutes with Sudan Secondary Schools Certificate (pass), who have had at least two years experience in intermediate level teaching. The programme was first started in 1938 in Bakht Elruda Education Institute as an integrated part of the primary training programme. It had been known traditionally as the Two Year Diploma Training Course. It is a subject specialisation course. The graduates teach two main subjects plus one subsidiary subject, in the case of science and mathematics teachers, they take gardening, rural education or physical education.

In-service education and training institute programmes (INSETPs) are 2 year co-education training programmes, introduced in the Sudan in 1972 to cater for the chronic shortage of qualified primary teachers needed for the 1970's educational reform. The programmes were first adopted by UNESCO Training Institutes for Palestinian refugees in Beirut. The main advantages of these programmes were that they enable teachers to be trained while they are working, they emphasise general teaching methods, continuing teaching practice, life long learning based on multi-training resource stages and advocate a direct training style. Hammod (1990, p. 10) indicated that "INSETPs proved their efficiency and effectiveness in the Sudan's environment and expanded in the last 15 years to cover the training needs for all general education administrative and teaching force sectors".

Despite the newness of the term EE, concern about environmental quality and relating school to local community needs advocated in EE literature have been found in teacher training programmes in the Sudan. Abdulwhab (1975, p.62) reported that "most of the TTIs in the Sudan type 1 and 2 above were established in rural areas. They adopted the Bakht Elruda Teacher Training Programme Model (BTTPM). The programme's instructional activities were orientated towards the agriculture sector and rural environment in the Sudan".

Atchia (1978) argued that the Sudan's experience in ruralisation of TTIPs was a unique trend in African education. It advocates turning inwards to one's own natural environment rather than outwards to the ideas and fruits of western technology.

Atchia's argument was based on Griffiths's approach to TTIPs in the Sudan (Griffiths, 1975; 1953). Historically Griffiths's philosophy was the corner stone of TTIPs in the Sudan. It showed a considerable attention to environmental quality and relating schooling to local community needs. In addition, it advocated most of the guiding principles of today's EE movement, mainly progressive approaches to

learning and teaching, action training, and first hand experience. Griffiths describing the efforts of his final year students said:

> "They put a lot of study, planning and labour into building a hen-house, starting a fruit-garden, digging a fish and a crocodile pond and planting 6000 mosquito seedlings on a sandhill. It is true that the fruit-trees died in the summer drought, that the fish refused to live in the pond, the crocodile escaped and out of the 6000 trees, hardly one survived a particularly rainy season" but
> "The need of the project was the experience of getting knowledge at first hand, and not at second hand from books, the revelation that local matters could be rewarding subjects of study and the stimulus of taking action based on intelligent study" (in Atchia, 1978, p.61).

Studies which show the incorporation of Griffiths's philosophy in current TTIPs in the Sudan and how it was related to EE movements are not available to the author's knowledge. However, as a general observation in TTIPs' prospectuses in the Sudan, courses in out door education, gardening, farm and conservation and field trips still constitute essential parts in TTIPs.

Salih (1983) pointed out that TTIPs in the Sudan 1970's education reform, were enriched with community education programmes, to improve the quality of general education curriculum contents. He further indicated that these programmes in general have had an EE flavour in their content and approaches. They include (1) population education; (2) health and nutrition education; (3) nomadic education; (4) rural integrated centres project and (5) adult education project.

According to Mohammed (1985) EE was introduced as a formal course in Bakht Elruda Institute of Education TTP in 1980. The incorporation of EE in other TTIPs in the Sudan varied in intent, scope and directions. The Inter-institutional arrangement formed by the Institute of Environmental Studies (IES), University of Khartoum, Bakht Elruda Institute of Education, Sudanese National Commission for UNESCO and the United States Agency for International

Development targeted TTIPs as a starting point for the environmentalisation of education in the Sudan.

With the eve of the current education reform in the Sudan, according to the Ministry of Education (1992) in an attempt to make general education productive, relevant to the Sudan's environment and to meet the country's needs in the 21st century, EE and vocational education will be given priority in teacher education and training programmes. The in-service and comprehensive retraining programmes organised by the Ministry of Education will be the starting point.

2.4.2 Environmental education status in SSTEPs in the Sudan's universities

Colleges and faculties of education in the Sudan's universities offer two kinds of secondary science initial teacher education programmes:

1- Bachelor of Science with Education B.Sc.(Ed) or Bachelor of Education (Science) B.Ed.(Sc.). Both are 4 year concurrent degree courses, when educational and professional disciplines are incorporated in a basic science degree programme. The programmes are mainly pre-service, with the exception of Atbara and Gezera faculties of education, which run in-service programmes for primary and intermediate level teachers.

2- Diploma in Science Education: This is a one year postgraduate course which follows the basic degree in science from the faculty of science, with at least two years experience in science teaching in secondary schools or teacher training institutes.

Teachers taking the above programmes are mainly prepared to teach in secondary schools and teacher training and education institutes. Table 2.3 shows the basic information about colleges and faculties of education in the Sudan's universities that offer SSTEPs. Excluded from the table are the new colleges, established by the Higher Education Reform Act (1990), as no students have yet graduated from them, and no data is available about their courses. These colleges

are Kordofan, Kassala, Darfour (Elfathi University) and Africa Islamic University College of Education and Daua.

Table 2.3
Basic Information About Colleges and Faculties of Education in the Sudan's Universities with SSTEPs

Variables	Omdurman	Juba	Atbra	Gezera	Omdurman
University	Khartoum	Juba	Wadi Elnil	Gezera	Omdurman Islamic
Foundation year	1961	1977	1985	1985	1972
Degrees	B. Sc. (Ed.) & Diploma	B. Ed. (Sc.)	B. Ed. (Sc.)	B. Ed. (Sc.)	B. Ed. (Sc.) & Diploma
Degree period	4 or 5 years & 1 year	4 years	4 years	4 years	4 or 1 year
Field (s) of specialisation	one subject	two subjects	two subjects	two subjects	two subjects
Study system	course unit	course unit	course unit	course unit	full year
Teaching practice duration	15 weeks in 4th year and the same period for the diploma students	6 weeks in 3rd year and 8 in 4th year	15 weeks in 4th year	15 weeks in 4th year	15 weeks in 4th year and the same period for the diploma students

The author's (1991) analysis and evaluation of SSTEPs prospectuses revealed that EE was not taught as part of the core curriculum or as an elective course. A clear policy does not exist for its incorporation in SSTEPs in all universities. Environmental science is not offered in colleges and faculties of education programmes as a major or minor field of study.

Natural sciences, i.e. biology, chemistry and physics, generally, cover environmental issues. They are highly influenced by the gain in knowledge and new insights of environmental issues (Berry and Lydford, 1990). Environmental dimensions of each course in SSTEPs in the Sudan's universities cannot easily be deduced from course titles or general description. However, there are some courses which have a direct bearing on the Sudan's environmental concerns (issues, problems and solutions). These courses are presented in tables 2.4 and 2.5. Physics courses in these institutions' programmes were excluded, as they are not in the author's field of specialisation.

Table 2.4
Omdurman Faculty of Education Courses that have Direct Environmental Concerns

Course code	Department	Course title
1- B 3054	Biology	Ecology;
2- B 3073	Biology	Entomology, insecticides and vector control;
3- B 4043	Biology	Parasitology;
4- B 4083	Biology	Microbiology;
5- B 5044	Biology	Advanced ecology
6- C 3083	Chemistry	Special topic 1 (Environmental chemistry);
7- C 4022	Chemistry	Special topic 2 (Environmental pollution);
8- Hs 2063	Home science	Family life and population education;
9- Hs 2082*	Home science	Introduction to sociology and anthropology;
10- Hs 4092*	Home science	Environmental aspects of energy;
11- G 1012*	Geography	Man and the environment;
12- G 4102*	Geography	Natural resources management and land use

* Offered as supporting or elective courses to both biology and chemistry students.

Table 2.5
Juba College of Education Courses that have Direct Environmental Concerns

Course code	Department	Course title
1- NRG 101	Biology	Syne-ecology;
2- NRG 213	Biology	Insecticides and vector control;
3- EDB 303	Biology	Ecology and soil;
4- EDB 401	Biology	Microbiology;
5- EDB 403	Biology	Ecology and conservation;
6- EDC 302	Chemistry	Industrial chemistry;
7- EDC 401	Chemistry	Environmental chemistry

* NRG = Natural resources common course

Juba University has a policy of introducing three Sudan foundation courses as core curriculum for all first and second year students. This policy is in line with EE perspectives. Included in such courses is an introduction to the Sudan's economy, politics, sociology, population and man power, natural resources management and environment and development in the Sudan. Additionally, students in the natural sciences and environmental studies including prospective science teachers follow common courses before they specialise in the third year (table 2.5). These common courses have an environmental emphasis.

Atbara Faculty of Education, Wadi Elnil University, and Gezera Faculty of Education, Gezera University are running in-service science teacher education programmes. The colleges were established in 1985 mainly to solve the chronic shortage of mathematics and physics teachers in teacher training institutes and secondary schools. Biology and chemistry courses are offered only in the first year. A plan is underway to introduce them as fields of specialisation. Direct environmental concerns were not found in current prospectuses of these college courses.

2.5 Environmental education in national research centres and higher education institutions.

Concern for environmental issues emerged in HEI in the Sudan, since its early beginnings, in The Gordon Memorial College, (later University of Khartoum in 1950). The University of Khartoum, as the first HEI, has continuously addressed itself to Sudan's environment and development issues (Hassan, 1991).

The need to adopt ecological development policies, rational use of environmental resources and environmental protection were represented in the Sudan's Government 5 year and 10 year plans in the 1970's. The plans targeted the Sudan as an agricultural country, endowed with numerous natural resources to be one of the main sources of world food.

Two national bodies were formed to back the government's plans. The National Research Council (NRC) was established in 1970 and The National

Council for Higher Education (NCHE) in 1972. The councils' programmes and plans of actions targeted an increase in scientific/technical manpower and exploitation of the country's natural resources as the main factors for their success. Consequently, EE and environmental science programmes were launched in the councils' specialised institutions.

According to the NRC Act (1970), the main purposes of the council are to encourage and co-ordinate research work in the state and private sector and to carry out urgent research to resolve problems posed for the environment by development plans in agriculture and various fields. The National Environmental Committee (NEC) was formed in the NRC to co-ordinate EE programmes. They are basically of two kinds:

1- International programmes, UNESCO National Commission, UNEP National Commission and IUCN commission on Education, and on a regional basis, ALECSO EE programmes.

2- Specialised environmental research institute programmes, which include the Hydrobiology Research Unit, Marine biology and Oceanography Institute, Medical Institute for Tropical Areas, Institute for Study of Medical Plants, Institute for Savannah Research and Population Research Unit.

The National Council for Higher Education Institutions which have EE programmes can be classified, based on their programme levels, into three categories:

1- Postgraduate programmes in EE;

2- Graduate programmes in EE;

3- Postsecondary EE programmes.

2.5.1 Postgraduate programmes in EE

According to Elkhalifa and Mohammed (1986) postgraduate environmental studies programmes are taught in Sudan's universities in various departments. The Institute for Environmental Studies (IES), Khartoum University was established in

1976 to co-ordinate and encourage national, regional and international environmental research and training in environmental studies. The IES objectives are mainly to provide specialists, whether in natural or social sciences, with new approaches to the awareness of the interaction of man with his environment and to encourage and promote multi-disciplinary research projects with teams working either independently or with other university departments or government agencies.

Elkhalifa and his colleague further indicated that the IES targeted the training of HEI tutors as the means for environmentalisation of HEI programmes in the Sudan. The training programme of the Institute includes a 2 year M.Sc. (environmental science) pre-service programme for the younger HEI tutors and researchers in environmental fields in other government sectors and an in-service programme for senior HEI tutors. The in-service programme is mainly based on workshops, seminars and research publications. The research field of the institute covers matters of environmental concern to the Sudan and its neighbour African and Arab states.

Mohammed and Ahmed (1991) pointed out that the IES considered the roots of Sudan's environmental problems mainly to be due to human behaviour. Hence, efforts to combat them must have very strong education components. The IES in the 1980's launched the inter-institutional programme with Bakht Elruda Institute of Education for planning EE in the Sudan. The programme organised four workshops: for teacher educators in Sudan's universities (1983); for Middle education administrators (1983); for Institute of education teacher trainers (1984, 1985). The IES has been involved in the last ten years in in-service training of general education teachers and in the development of EE teaching materials resources for all education stages in the Sudan.

2.5.2 Graduate programmes in EE

Despite the fact that Sudan's environmental issues were addressed in various Khartoum university departments, Beshir (1989) pointed out that NCHE Act (1975) gave special consideration to environmental concerns. For instance,

Juba and Gezera universities were established in 1977 and 1978 respectively to concentrate on environment and development issues and to provide graduates who would lead development projects in rural areas.

According to the Juba University Act, 1975, environmental training should be present in all forms of education in the university's programmes by acquisition of a general professional background, specialisation and in-depth study of a particular field within the chosen specialisation.

Juba University's Six Year Plan 1975 - 1981 shows that 50% of its budget is directed to the College of Natural Resources and Environmental Studies. The college offers a 5 year honours course in environmental studies. Environmental assessment and management and natural resources conservation are offered as core curriculum courses. Areas of specialisation include fishery, forestry, wildlife, animal sciences and crop sciences. The College of Medicine offers courses orientated to tropical diseases and community medicine.

Beshir (1989) indicated that the faculties in Gezera University with significant environmental science courses are (1) The Faculty of Economics and Rural Development (2) The Faculty of Science and Technology and (3) The Faculty of Agriculture (Environmental Science and Natural Resources Section).

The Faculty of Science and Technology, Gezera University prospectus (1989, p. 2) indicated that "All the faculty departments considered that environment protection and the rational utilisation of the Sudan's vast natural resources, through the application of science and technology is the vital means of achieving social and economic development". Hence, the departments are actively involved in research in areas that have environmental concerns related to the Sudan's urgent needs. They include, (1) efficient conservation of energy resources in the Sudan; (2) thermal solar system; (3) renewable energy resources; (4) environment and polymer chemistry and (6) food technology and quality control.

The Sudan experiences in EE in Juba and Gezera universities show new trends in Africa and developing countries in relating higher education programmes

to local community needs and directing real efforts to conserving the natural resources of the country. Delany (1979, p. 9) regarding the Juba University experience said:

> "Contrast the Nigerian situation with the proposed developments at the new University of Juba in the Southern Sudan. Here, all sciences education is contained within the college of Natural Resources and Environmental Studies. The degree courses will have a foundation in science, with particular reference to the local environment, and they lead to specialisation in the fields such as fishery, wildlife-life management, animal production, crop protection and forestry. It is also the intention to include a sizeable element of vocational training within the courses. This is the refreshingly new and ambitious programme which breaks with traditional approaches and which should ultimately be of considerable value to the people of the Southern Sudan".

2.5.3 Postsecondary EE programmes.

Environmental science programmes in postsecondary level started as two year diploma programmes to train para-professional and middle cadre manpower in various environmental fields. They include (1) Shambat Institute of Forestry; (2) Suba Institute of Fishery; (3) Abu Namma College of Agriculture and Natural Resources and (4) Khartoum School of Hygiene. According to Hassan (1991) the institutes were first established under the Ministry of Agriculture and Ministry of Health respectively. The NCHE Act, 1975 upgraded them to three year diploma courses and included them under the NCHE umbrella as independent institutes. In the NCHE Act, 1990 these institutes were annexed to suitable universities, Forestry and Fishery to The Sudan University of Science and Technology, the Hygiene School to Khartoum University and Abu Namma upgraded to Blue Nile University.

Environmental sciences are given ample coverage in the on-going Higher Education Reform Programme. The NCHE Act 1990 stated as policy that all new state universities were to establish colleges and sections for natural resources and

environmental studies. According to 1992 universities intake figures Kordofan, Elshargi (East) and Wadi Elnil universities have started such colleges.

2.6 Conclusion

Chapter two presented a synthesis of literature on the response of the Sudanese educational system to the EE movement. The major points drawn from this synthesis are summarised below.

The Sudan's major destructive environmental problems are associated with human behaviour and the socio-economic development processes. They either arise out of activities aimed towards development or are caused by the lack of development. Hence, the efforts to combat them must address both the causes and effects, and in all cases these efforts need a very strong educational component to support them.

Science programmes in the general education curriculum in the Sudan have been reviewed for the incorporation of the EE perspectives at all levels, except physics courses in secondary level. Scattered environmental topics were found in science programmes. No holistic approaches or clearly-defined EE programme, either separate or integrated were found in the existing curriculum. Textbooks and other instructional materials were not environmentally orientated. Emphasis was found on teaching environmental topics rather than developing environmental attitudes and skills (Mohammed and Ahmed, 1991; Ali, 1987; Mutuli, 1986; Eltaib, et al., 1985).

An urgent need for teacher education and training for EE was reported in all studies in general education levels in the Sudan (Mohammed and Ahmed, 1991; Ali, 1987; Mutuli, 1986). Secondary science teachers were not prepared to approach their subjects environmentally. They have no in-service, retraining or refreshing courses in EE (Ali, 1987; Androga, 1986).

In TTIPs, EE as a formal course was introduced in Bakht Elruda Institute of Education in 1980. Comprehensive work was carried out through inter-institutional programme organised jointly by IES and Bakht Elruda to introduce

EE in all TTIPs in the Sudan. The new education policy considered EE incorporation in in-service and comprehensive retraining programmes organised by the Ministry of Education as a green light for more environmentalisation of TTIPs in the Sudan.

In SSTEPs in the Sudan's universities EE is not taught as a core curriculum course or as an elective course and no clear policy exists for promoting it. Environmental science is not offered as a field of specialisation. Natural science courses of colleges and faculties of education, in general, have some direct relevance to Sudan's environmental concerns. Juba University's policy of introducing Sudan Foundation Courses as a core curriculum is in line with the incorporation of EE perspectives.

Concern for environmental issues emerged in HEIs in the Sudan since its beginning in the early decades of the 20th century. NRC and NCHE were established to support the development plans in the 1970's. Their programmes and plans of action were directed to provide scientific and technical manpower to facilitate ecological development policies, to lead the rational exploitation of the country's vast natural resources and to protect the environment. The Sudan experience in IES, Juba and Gezera universities can be considered as a new trend in applying science and technology in rational utilisation of the country's natural resources, environmental protection, orientation of HEI programmes to local communities needs and considerable contribution to the country's socio-economic development.

The NCHE Act's (1990) policy of establishing colleges and departments for natural resources and environmental studies in all new states' universities indicates the urgent need for EE and environmental studies in the country's future development plans.

CHAPTER THREE
SCIENCE TEACHER PREPARATION FOR ENVIRONMENTAL EDUCATION

3.0 Introduction

The main purpose of this chapter is to review literature relevant to STs' education and training for EE. The literature reviewed is presented in four sections. Section one presents research findings that investigated EE status in SSTEPs. Section two presents studies that assessed SSTEPs needs for the incorporation of EE perspectives. Section three provides an account of research findings concerning PTs' and SSs' environmental knowledge and attitudes. The final section presents environmental educators' and EE researchers' recommendations and efforts to incorporate EE perspectives in SSTEPs at the university level.

3.1 Status of EE in SSTEPs

In the UK, in accordance with government policy (Department of Education and Science, 1989) and the criteria stated by the Council for Accreditation of Teachers Education (CATE), on completion of their courses, students should be aware of links and common ground between subjects and be able to incorporate in their teaching cross-curricula dimensions, themes and skills, EE included. Oulton (1991) surveyed UK Institutions that train STs through the Post Graduate Certificate in Education (PGCE). Questionnaires were distributed to members of the Association of Science Education Tutors (ASET) to gain an initial impression of the degree to which courses were currently designed to introduce student to issues in relation to EE. Oulton found that six of the seven institutions surveyed claimed EE was integrated into the course as a whole. The degree of integration varied markedly from the incorporation of EE into the methodology course to optional short courses for students who wished to consider EE further. Institutions described the types of activity undertaken by students that they considered to be related to students' preparation to teach about, in and for the

environment. These activities included (1) a focus week compulsory for all science and technology students; (2) several written assignments; (3) projects on alternative technology and (4) field work. Oulton found it difficult to assess the extent to which STs were prepared to teach for the environment, although he found that at least two institutions which introduced students to methodological issues in relation to role-play and simulation work and implications of teaching about controversial issues. Oulton concluded that provision for science teacher students in relation to EE is patchy across the country. While some institutions are clearly tackling the issue directly, others have yet to do so. It is worth mentioning that from his small sample, only one institution had a tutor who took specific responsibilities for EE and two other institutions indicated that all science tutors were interested.

Disinger and Schoenfeld (1987) carried out a case study in 44 higher education institutions across the US. The purpose of their study was to learn from practitioners and programme directors what changes, adaptations and mutations had occurred in a specific set of programmes over a ten year period (1978 - 1987). In colleges and schools of education involved in SSTEPs, clear administrative rules for training in EE had been implemented during this time. They included teacher certification in seven specified EE competencies and the introduction of a core curriculum course in environmental studies and EE teaching methodology that supported the EE programme in schools. The Wisconsin and Michigan universities programmes are examples. Academic preparation of STs which was reported in some college programmes reflected infusion of EE philosophy into courses. Numerous courses of natural sciences have been influenced by the gains in knowledge and new insights on environmental issues. Environmental science as a field of specialisation was found in many school and college programmes. In addition, new courses which specifically focus on the environment via an interdisciplinary approach were indicated, e.g. 'Man and Environment', 'Environment, Science and Society' 'Environment Ethics and Values'

'Environmental Health Science' and 'Field Studies in EE'. Professional preparation of STs includes courses in EE teaching methods as options in some institutions and as core curriculum in colleges that have EE centres. At Murry State University for example, every secondary education student who graduates with a teaching certificate receives training in EE. A considerable number of tutors were reported to be involved in developing, implementing and evaluating EE curricula in secondary schools and other education related organisations. Many institutions reported having EE centre staff to co-ordinate students' training in EE and to provide advice and consultation to the state's regional task force groups and schools.

Lee (1987) surveyed the colleges and schools of education of the five universities in Malaysia involved in pre-service SSTEPs. Questionnaires were distributed to SEs to find out the perceived status of EE in their institutions. Lee (1987) found that the emphasis given to EE in SSTEPs was rather diffused and superficial, there was no clear-cut or explicit policy for promoting or even including it in such programmes. EE of PTs very much depend on what the individual science teacher educator make of its importance in the context of science teaching methods courses and what students are able to extract or extrapolate from these courses or the various science subject matter courses. Few science teacher educators had degrees in EE. Two of them (9%) were involved in funded projects in EE for their institutions, and three (13.5%) others were involved in developing EE curricula for schools.

Williams (1985) with the support of the World Wildlife Fund, comprehensively reviewed EE in teacher education and compared systems of EE in teacher training within Europe. He found that there were usually three forms of higher education establishment, each with slightly different approaches to EE teaching and learning, namely universities, polytechnics and teacher training colleges. Students taking a degree in biological or geographical sciences or specialising to become teachers in these subjects encounter more environmental

issues than students specialising in foreign languages or mathematics. The EE content of courses is determined by the course syllabus. However, there is an increasing trend in all subjects to have some part of the course that looks outwards across the curriculum. This often includes environmental issues and in many cases environmental perspectives were taught in tutorials rather than lectures. In many teacher training colleges and university departments of education, EE is a significant part of the core curriculum. A student who is not specialising in subjects of a particular environmental studies' nature might spend 90 hours on environmental studies out of the three-year undergraduate teacher-training programme. Specialist teachers would spend much more. In-service training of teachers is also an important route for cultivating environmental awareness in European countries who start late in EE.

On the basis of information collected from environmental educators in Europe and North America, Stapp and his colleagues (1980/1981) found that emphasis in pre-service EE of teachers varied from traditional, discipline-based, passive learning to direct experience, interdisciplinary strategies. A categorical review of the findings from the literature dealing with pre-service EE for teachers in the countries under study revealed different emphasis in different areas. Regarding methodology in EE, varying degrees of integration of environmental studies with other subjects was found. There were similar variations in interdisciplinary methodological approaches and specific courses in EE methodologies. This is the case in most teacher education institutions in UK, Norway, Denmark, Czechoslovakia and The Federal Republic of Germany. The survey also revealed some of the inadequacies of pre-service teacher preparation programmes for EE. These included lack of experience and training for teachers in (1) using the community and its resources; (2) helping students to examine their values; (3) developing and using problem solving skills; (4) actively involving students in relevant learning experiences and (5) working and solving problems as members of a group or team.

A study was conducted in 13 teacher education institutions in African countries (UNESCO, 1981). The results indicated that only four countries had teacher education programmes with EE training, the majority of which were in East Africa. There was general agreement that there was not an adequate number of trained teachers for the region. There was no formal EE in teacher training colleges, but in the West and the East especially there is an environmental component in such subject fields as food, water, air, land conservation, population growth and an attempt at integrating courses in general with the environment as one of the integrating themes. In South Africa, EE is conducted mostly through parents' meetings at schools and through school children themselves. Respondents indicated that the problems encountered in incorporating EE into the curricula of teacher training colleges were largely lack of (1) an appreciation of importance of EE; (2) adequately trained teacher educators; (3) scheduled time in crowded programmes; (4) EE materials for teacher use; (5) opportunities for field studies and (6) funds. Solutions proposed, in addition to meeting the above shortages, involved national policies for the inclusion of environmental themes in existing curricula, development of new syllabi with environmental components, orientation toward community education on local environmental problems and organisation of seminars and workshops particularly for in-service EE teacher training.

A survey of Canadian pre-service teacher education for EE by Towler (1980/81) revealed that few institutions offered methodology courses to prospective teachers and few students were enrolled in them. More institutions and students were involved in courses dealing with environmental concerns than with methodologies of how to teach their content. Towler also found that a very small number of tutors were involved in teaching EE. Relatively few had degrees in EE, only 8% of the tutors were involved in funded research in EE and fewer than 30% were involved in the design of curriculum materials for schools. Towler expressed concern as to where leadership for further development in the field of

EE would be cultivated in the absence of graduate programmes and the lack of attention that the subject was receiving in teacher education institutions.

Trent (1976) compiled data on trends in curriculum development of EE in both colleges and state departments of education in US. Questionnaires were sent to a random sample of colleges of education and 50 state departments for each of the years 1970-1975 except 1971. Trent used a chi-square analysis against the base year 1970 to determine if there were significant changes over time. He found that by 1973 there was a significant increase (0.05 level) in the number of colleges offering methodology courses in EE, this trend continued and by 1975, 42% of all sampled colleges of education were offering methodology courses as opposed to 18% in 1970. By 1974 there were significant differences in those colleges in which tutors were involved in Federal, State and/or local projects in EE, similar differences were noted for offering a major or minor and for offering in-service in the field. By 1975 there was a very significant increase (0.01 level) compared to 1970 in the number of colleges incorporating environmental science as a major or a minor subject. Trent concluded that there was a trend towards wide spread offerings of courses in environmental sciences, EE method courses and overall, a peaking and levelling off in development of EE programmes.

3.2 Environmental education curriculum need assessment studies

Hart and Robottom (1990a) in a summary of research papers addressing the question of how to conduct professional development in EE, pointed out that there was a need for teacher education and training curricula to address this issue. They suggested that professional development in EE should be participatory and practice-based, research or inquiry-based, critical, community-based and collaborative.

Lee (1987) conducted a questionnaire study to assess the perceived needs in pre-service SSTEPs in Malaysian universities. His sample included SEs and STs who graduated from colleges and schools of education in Malaysian universities. He found that most of the respondents were of the opinion that the

student teachers' academic preparation in terms of science subject matter was not adequate for teaching EE in schools. The specialist orientation of these science teacher education programmes was perceived as narrow, lacking the broad perspective required for understanding environmental problems and issues. Many respondents also felt that additional courses in such non-traditional non-science areas as sociology and economics would be helpful to prospective science teachers. Most of the respondents were of the opinion that the current science teaching methods' courses offered by universities in Malaysia were not adequate for training science teachers to function as environmental educators in schools. The respondents also felt that team-taught, multi-disciplinary, and interdisciplinary methods and approaches should be provided to prospective teachers to familiarise them with the teaching of real-life interdisciplinary environmental problems and issues.

Volk, Hungerford and Tomera (1984) conducted a study to assess perceived EE curriculum needs in the US. They developed the EE Curriculum Need Assessment Questionnaire (EECNAQ) and mailed it to 169 randomly selected professional environmental educators. The EECNEQ elicited perceptions about the desired status and the current status of EE curriculum, the need for curriculum development, the anticipated use of new curricula by teachers and the need for teacher education. Five major questions were posed relative to fifteen goals which reflected the Tbilisi objectives and four levels of environmental literacy advocated by Hungerford and his colleagues (1980). The findings revealed that a consensus existed among the professional participants that the goals were important ones, that they were not being met to a large extent in existing curricula, that intensive needs existed for both goal-oriented curricula and teacher education . The results of this study, as Volk and his colleagues (1984) indicated, provide a clear mandate for increasing teacher education for EE. Such teacher education should focus on EE goals and curricula which address these goals.

In the US Peyton (1984) analysed relevant studies in research in EE related to teacher education and training. His findings revealed that few principles for designing EE experiences come forth from research that could be used to provide guidance in preparing courses or workshops. The questions he posed were: What key components should be included in training experiences to produce the most effective changes in participants? How much involvement and time are required to produce maximum effects and efficient use of training resources? He concluded with two main issues, that an organised approach to the question of how to improve teachers' ability and willingness to achieve environmental goals is greatly needed and that attention should be given to curriculum design and research reporting in teacher education and training.

UNESCO (1977c) published the result of an international survey of needs and priorities in EE. The aims of the study were to furnish specialists and decision makers in EE with a valid and valuable base of information on which future actions could be based. The questionnaire that served as the principal source of information of the study was completed and returned by 111 of 136 UNESCO Member States. Among the many findings of the study was a general deficiency in all countries of personnel capable of promotion of EE. Teachers' needs for knowledge and skills in achieving the citizenship action goal level were indicated. It appears appropriate that educators receive training in knowledge and skills relative to citizenship action skills as stated in the UNESCO study:

> "in order to assure an adequate training of educators, it would seem most important to encourage their participation along with other socio-professional groups, in concrete actions aimed at preservation and improvement of the environment, educators are, in effect, called upon to play a decisive role in preservation and solution of environmental problems, not only through their educational activities, but also their participation, as citizens and professionals in elaboration and carrying out of environmental literacy policies" (p. 16).

Schwabb (1976) carried out a survey with public school teachers and professors of education in Illinois, US. The purpose of his study was to provide educators with information that could be used in evaluating current methods courses and modifying or developing method courses to provide EE pre-service training for all teachers. In his survey findings, respondents indicated the need for pre-service training of all teachers, to include an environmental method course, an experience in preparing an EE resource unit, experience in conducting a field trip and studying environmental problems, skills in using simulation games and experiences in conducting educational activities at resident centres. The most important recommendation of Schwabb's study was that those university departments of education should look at their programmes to see if they are adequately training their students to meet the requirements of EE often legislated by the states.

3.3 Studies related to students' environmental knowledge and attitudes

Edralin (1989) investigated the attitudes and teaching perceptions related to environmental concerns (issues, problems or solutions) in a population of 347 pre-service teachers in 16 selected colleges and universities of East Tennessee, US. A questionnaire was used for data collection. The findings of the study indicated that a majority of pre-service teachers had strong opinions, feelings and support for environmental quality. Attitudes and familiarity with specific environmental concerns were varied among disparate groups but the overall results indicate the following:

1-There was a high degree of awareness, interest and worry over problems concerning 'water quality' and 'air quality';

2- There was an unawareness of 'resource management' concerns;

3- The teaching of 'over population' and 'waste management' topics was unpopular;

4- There was a positive correlation between 'perceived seriousness of problems' and 'perceived readiness to teach problems';

5- The prospective teachers perceived themselves to be knowledgeable to teach a broad range of environmental topics.

Gayford (1987) carried out a survey to determine the effectiveness of EE programmes in the UK in the development of values, attitudes and behaviour related to the environment. In addition, it provides basic information on attitudes shown to general and specific environmental issues by selected samples of the population of the UK. His samples included secondary school students, colleges and university students, general education teachers and youth leaders. The main findings of Gayford's research are the following:

1- From among those respondents who had received no formal EE there were more people than in other groups who expressed little direct personal concerns or responsibility for the environment.

2- The perception of many people seemed to be that there was a good deal of muddled thinking about environmental issues, which probably reflects the complexity of the problem involved and that different viewpoints are expressed;

3- Where the attitudes to specific environmental issues were investigated it was apparent that those who had received some EE more frequently expressed views which may be described as "environmentally acceptable" viewpoints of a panel of experienced environmental educators but this was not so clearly the case with nuclear energy, deforestation and recycling;

4- Comparisons between males and females (university and secondary students only) in relation to general and specific attitudes to environmental issues revealed few significant differences. These differences were more often apparent among those who had received EE. Boys were more often inclined to object to conservation practice on the ground of economy and likely influences on employment.

Hines and his colleagues (1987) carried out a meta-analysis of 128 studies in the US. The main purpose of their work was to clarify the relationships that might exist between knowledge, attitudes, biographic factors and behaviour. They found that the individuals with greater knowledge of environmental issues and/or knowledge of how to take environmental actions on those issues were more likely to have reported engaging in responsible environmental behaviour than were those who did not possess this knowledge. Individuals with more positive attitudes were more likely to have reported engaging in responsible environmental behaviour than were those with less positive attitudes towards the environment. Classroom strategies that involve active participation by the learner, that generated an expressed intention to take actions were both factors that were strongly associated with responsible environmental behaviour. The authors finally recommended studies to explore the interrelationships between these variables.

In the UK, Market Opinion Research International (1987) carried out research on behalf of the World Wildlife Fund. The study was to assess the students' awareness and attitudes to the environment. In addition, it assessed how they obtain their information and the role of the school in this process. The evidence obtained showed that schools were the most common source of information to the students with television as second. A good deal of what went on the schools as EE was based on traditional methods of teaching. The most common environment related activities outside the classroom that students were involved in were visits to farms and nature reserves. Protection of the environment was considered by the respondents to be an important matter. Pollution, crime and nuclear power were considered to be the most serious environmental problems.

Kinsey and Wheatly (1984) conducted a study in two US universities (University of Maryland and State University College at Buffalo). The main purpose of their study was to assess whether the completion of an environmental studies course affects the defensibility (i.e. stability) of environmental attitudes. The question they asked was do students utilise information learned in an

environmental studies course to support their stated attitudes towards environmental issues? Results indicated that environmental studies do not significantly affect students' attitudes on environmental issues but knowledge obtained by such courses does provide informational support for pre-existing attitudes. The researcher hypothesised that, because the students were in college, their age may have affected the result.

Peyton and Hungerford (1980) furnished information on the need for pre-service and in-service education to enable teachers to become active citizens and involved in environmental decision making. They attempted to assess teachers' abilities to identify, teach and implement environmental action. Their sample included 225 pre-service (59%) and in-service(41%) teachers from Kentucky, Missouri and Illinois, US. They reported that the teachers involved in their study were limited in their abilities to provide examples of various modes of action persuasion, consumerism, political action, legal action and ecomanagement. Fewer than 20% of the sample provided examples of all five action modes. The participants exhibited a similar lack of ability to identify criteria useful in the selection of environmental actions. The teachers further reported a limited involvement in environmental actions. 56% of the participants indicated that they had not taken any form of positive environmental action. Only 3% felt competent to take action in all five categories. 38% did not feel they could effectively take action in any of the categories. The researchers sought additional information from participants who expressed no intention to take future action. 95% of this subgroup indicated a lack of environmental action skills and 86% reported that they would take action if they had the appropriate skills. The result of the Peyton and Hungerford study indicated that the teachers surveyed were poorly prepared in the environmental action skills measured in their study. The researchers concluded that most of the population of (pre-service and in-service teachers) has had limited experiences in environmental action taking, perceive they posses little competency

in the necessary skills and have incomplete plans or none at all for future involvement as environmental activists.

The body of literature relative to teacher education appears to suggest strong needs in that area and in general teachers perceive themselves as ill-prepared to teach EE. The need for teacher education relative to EE goal levels advocated by Hungerford and his colleague (1980) is reflected in their concluding statement that:

> "Without some form of future intervention there is little reason to expect the assessed sample or similar sample to effectively prepare environmentally literate students in their classrooms" (p. 165).

Noibi (1981) carried out a survey to assess Lagos pre and in-service teachers' actual knowledge of environmental action skills and to ascertain Lagos teachers' use of certain criteria in selecting and implementing environmental action skills in order to provide baseline data for future curriculum development in Nigeria. He adapted Peyton and Hungerford's (1980) instruments to the Nigerian environment. Noibi's findings are similar to those of Peyton and his colleague. But he further indicated that PTs actual knowledge of environmental skills was not better than that of social sciences prospective teachers. This finding according to Noibi was quite surprising since The Science Teachers' Association of Nigeria has designed revolutionary curricular to embrace consideration of social changes and environmental issues. Noibi also found that in-service teachers were more aware of environmental skills than pre-service teachers. He also argues that this finding is surprising in that it is generally expected that pre-service teachers are more knowledgeable about contemporary and environmental issues and are more prepared to take action than in-service teachers. This finding seems to indicate that teacher preparation programmes in Lagos State have not promoted environmental action in their students.

In the US, Bohl (1976) and Perkes (1973) surveyed the environmental knowledge and attitudes of tenth and twelfth grade students in 33 states. The

instrument used in the study was developed by the staff of the ERIC Clearinghouse for Science, Mathematics and EE at the Ohio State University in association with selected consultants. It consisted of three inventories, each of 40 items, dealing with environmental facts, concepts, beliefs and perceptions. The response patterns and outcomes of the two studies were very similar and some common generalisations can be made regarding their findings. For the most part students did not display a high level of factual knowledge on environmental matters but responded with considerably more success on conceptual knowledge items. Students' attitudes tended to be favourable toward the environment, especially when they involved little personal commitment or sacrifice. Some significant differences were noted with respect to sex, grade level and size of the community. Males scored significantly higher than females on factual knowledge items, while on many conceptual items females exhibited more knowledge than the males. Twelfth grade pupils performed better than the tenth grade on conceptual items but did not display a clear superiority of factual knowledge. Slight attitudinal differences were evident regarding sex and grade levels. State residence was also found to be a significant factor in the identification of environmental problems.

Richmond (1976) adapted the ERIC's instrument used above to the British environment. He used this instrument to assess fifth year students' environmental knowledge and attitudes. His findings were strikingly similar to the response patterns observed by Bohl (1976) and Perkes (1973) in the US. He further reported relationships between the respondents' scores in environmental knowledge and attitudes' sub-tests. Fewer than 40% of his respondents felt that they had gained most of their environmental knowledge from their formal schooling.

Hounshell and Ligget (1973) developed an Environmental Knowledge and Opinion Survey (EKOS) which consisted of 35 knowledge items and 30 items for measuring attitudes. After field testing, the instrument was administered to 2500

students in North Carolina, US. An analysis of the results indicated that girls scored significantly higher than boys in the attitude sub-test, but there were no significant differences between sexes on the knowledge sub-test. In addition, a correlation coefficient of 0.60 was found between all participants' scores on the knowledge and the attitude sub-tests.

3.4 Efforts and strategies to develop EE guidelines for SSTEPs

Attempts to prepare classroom teachers to be environmental educators range from theoretical and philosophical considerations, through educational research experiences to highly practical, on the ground, "how to do it" or "this is how I/we do it" models (Hart and Robottom, 1990).

Teacher education and training in EE needs specified by professionals and researchers in the field (section 2.2.2) indicated the need to highlight efforts and strategies reported by researchers in developing EE curriculum guidelines for SSTEPs. These strategies can be classified into three main areas: (1) studies to develop whole curriculum guidelines (2) studies to develop curriculum guidelines for SSTEPs and (3) strategies to implement EE perspectives within existing science teacher education and training programmes. These will be discussed separately.

3.4.1 Studies to develop whole curriculum guidelines

Knapp (1983) provided some suggestions for developing an environmental values curriculum. Fourteen valuing skills were listed which can be used to build a curriculum that (1) incorporates a wide range of issues and problems; (2) helps the learner to form value judgements on issues and defend them; (3) develops an informed concern for environmental quality and ethics and (4) stimulates individuals' involvement in local environmental issues.

According to Hart (1981) a major problem in curriculum development has been the lack of principles of selection that could operate to validate the curriculum. The purposes of his study were to help improve the conceptualisation

of EE by the identification of key elements that have come to characterise EE programmes and materials in the literature. EE documents examined were those published by the Educational Resources Information Centre (ERIC) between 1966 - 1978, the period when EE was in its formative stages. It was assumed that elements or components in the form of characteristic concepts and generalisations of EE could be identified from the literature. A set of criteria was developed to govern the identification of major EE characteristics. In all, 25 such elements were identified. Hart further identified EE characteristics according to their high frequencies of occurrence in the EE literature. He found that interdisciplinary, global views, understanding of science and science concepts, problem solving, value clarifying, active participation and new productive student-teacher relationships are the most acceptable key EE characteristics. He concluded that it seems reasonable that a list of key EE characteristics identified by a fairly systematic objective procedure could facilitate more detailed guides on operationalisation and implementation of future EE programmes. Until there was a conceptual framework between general purposes and operating components of the new field there would be no clear guidelines for the selection of learning experiences.

Hungerford and his colleagues (1980) identified and developed Goals for Curriculum Development in EE. These goals were grouped into four levels:

Level (1) - Ecological Foundation;

Level (2) - Conceptual Awareness- issues and values;

Level (3) - Investigation and Evaluation;

Level (4) - Environmental Action Skill- training and application.

This work has been subjected to rigorous validation by a jury of nationally recognised environmental educators. The authors point out that although their work was developed independently of the Tbilisi conference, it bears a marked correspondence to general categories of objectives endorsed at the Tbilisi conference. Sack (1984) indicated that the North America Association for EE

accepts these goals as a base for classification of EE studies and advocates that future EE curriculum development should consider them for further curriculum processes in the field.

Hammerman (1979) carried out a study to formulate a comprehensive set of major objectives for EE to serve as a structural framework for curriculum development and evaluation. A Delhi survey was started with 28 professional environmental educators as panel members. A list of 70 EE objectives were found in current research and literature. These objectives were finally reduced to the following ten:

1- To treat EE in an interdisciplinary manner, that involves social, political, economic, etc. aspects in addition to science.

2- To develop a citizenry that is: (a) knowledgeable about the bio-physical and socio-cultural environments of which humans are part; (b) aware of environmental problems and management strategies of use in solving those problems; and (c) motivated to act responsibly to develop diverse environments that are optimum for living.

3- To develop an awareness of man's/woman's place within the total environment;

4- To develop a clear understanding of human beings as an inseparable part of the functioning system that has the ability to alter the interrelationships of the system;

5- To provide experience in working with environmental problems, issues and concerns and thereby gain experience in personal valuing process, decision making and political and governmental systems and how to effect change in them.

6- To foster a change in attitude and value through a commitment to lifestyles conducive to maintaining a quality environment;

7- To help individuals and social groups gain a variety of experiences within the total environment;

8- To develop awareness of historical, cultural and the natural environment of the community;

9- To develop a holistic view of the environment that enables one to evaluate the impact of changes on the environment;

10- To develop an awareness of the need for individual responsibility to maintain or improve the environment.

Hammerman and Voelker (1987) argue that objectives resulting from Hammerman's study have contributed to the advancement of EE by consolidating the results of a decade of effort to give direction to EE. They claimed that these objectives have given credence to much of what has been accomplished and they have produced order out of what was, for a time, a chaotic endeavour. They have the power of consensus and research behind them and, as such, may be one of the land mark studies that gives direction to the second generation of development of EE.

Environmental education curriculum development during its initial stages undergoes the search for concepts to be incorporated in traditional curricula world-wide. Table 3.1 shows some of the research work that considers conceptualisation of EE perspectives in schools curricula.

The common ground of the research work in table 3.1 is that most of the concepts developed have been subjected to validation by environmental educators, translated or recommended to be translated into instructional programmes, tested for attitudinal and/or behavioural effects on the learners, suggested to be included or infused into curriculum contexts and pre-service and in-service teacher education should incorporate these concepts in the curricula as a matter of urgency. The main broad concepts common to these studies, despite the fact that they were developed for different education levels and settings are (1) ecology (interdependence of living things); (2) culture (interactions with environmental consideration); (3) natural resources (management and rational use); (4) population (interaction with environmental conservation) and (5) global issues.

Table 3.1
Research Work that Considered Conceptualisation of EE Perspectives in School Curricula

Author name	Year	Research title	University
Townsend, R.	1982	An Investigation into the Underlying Structure of the Domain of EE Concepts	Ohio State University
Atchia, M.	1978	Concept and Dynamics of EE with Particular Reference to Britain, Africa and Mauritius	Salford
Conception, M	1974	A Conceptual Framework for EE adapted to the Philippine Environment	Michigan University
Lucas, A.	1972	Environment and EE Conceptual Issues and Curriculum Implications	Ohio State University
Allmans, S.	1972	Identification of EE Concepts for Inclusion in Elementary School Curriculum	Nebraska

3.4.2 Studies to develop EE guidelines for SSTEPs

Champeau (1990) pointed out that beginning in 1985, the Wisconsin legislature mandated for all state universities that all education candidates, including science, must receive course work in EE. Different approaches have been taken to meet this mandate in the state's universities and colleges. At the University of Wisconsin-Steven Point, the mandate is incorporated into a three-credit, semester-long environmental studies/education course. Champeau (1990) reported the results of a survey questioning the perspectives of pre-service teachers on their experience with mandated EE course work. The survey was administered to 105 junior and senior elementary and secondary education majors who had recently completed the course. Results indicated that students perceived a need for pre-service training in EE. They perceived their EE course as being instrumental in motivating them to include environmental concerns in their teaching. They believed that environmental science content should be taught simultaneously with appropriate subject teaching methods in pre-service training. Further, they believed that EE should be a priority in the elementary and secondary school system and its introduction would best be accomplished by infusion. Champeau concluded that requirements of EE in training courses are effective at putting bodies in desirable places. Without that in Wisconsin, very

little opportunity would have been provided to expose potential educators to important roles they could play in determining a quality environment.

Edralin (1989) formulated some suggestions for teacher preparation in EE based on his research findings. These suggestions include the following:

1- Colleges and schools of education should design curricula which allow prospective teachers to take environmentally related courses in their respective academic programmes;
2- More efforts should be made to encourage and/or motivate teacher trainees to take content and methodologies courses dealing with environmental topics;
3- Environmental content offered by other departments/colleges of institutions involved in teacher education should be identified and considered as course options for teacher trainees;
4- Environmental courses must include more topics on waste management, resource management and over population, since these are the areas with which pre-service teachers appear not so familiar and not ready to teach.

Cheong (1983) expounded that the training of teachers is very much limited to certain disciplines and consequently the training cannot provide the wide range of knowledge, skills and values from diverse disciplines that are required for development of interdisciplinary approaches. With regard to the specific skills relevant to the field of EE which teachers ought to have, she suggested that the answer can perhaps be found in the characteristics of EE itself. EE has been described as pragmatic, problem solving and to develop commitment to issues including following them through to action. According to her, the implication of this to teacher education is that teachers must be helped to manage learning environments so that these objectives and achievements come about. They will need a range of skills that include (1) management of human resources; (2) management of material resources; and (3) management of learning situations. Cheong (1983) further, recognised that teachers are not expected to know everything about environmental problems. However, it will be an asset for

teachers to know how to utilise expertise and resources in and out side the school. The kinds of skills involved in this task would include, identifying the kind of resource people available, assessing the motivation, skills, attitudes, and values of resource persons and arranging appropriate learning situations in collaboration with other people. Therefore one of the goals of teacher training must include the development of teachers' ability to recognise and understand the contribution that people trained in particular disciplines or specialising in environmental issues can make to environmental teaching.

Pettus (1982) suggested that some innovative curriculum changes are needed in teacher training programmes to prepare teachers to provide effective EE for students. He pointed out that it is difficult for teachers or for those preparing to be teachers to acquire what they need to be effective environmental educators by encountering separate aspects of their EE training in a few separate courses. Ultimately, EE experiences should be an integral part of every aspect of a teacher training programme. However, until such is the case, special EE courses that treat all aspects of environmental problems and their interrelationships and which develop skills for teaching EE may be needed to prepare teachers to provide effective EE. Pettus (1982) suggested that teacher preparation programmes should include the following elements as a minimum requirement for those completing the programmes:

1- A comprehensive course or set of experiences designed to develop understanding and skills related to environmental concerns and to promote attitudes and behaviour for maintaining environmental quality;
2- A comprehensive set of practical experiences designed to develop competencies in planning appropriate learning experiences in EE for students and in effectively guiding students through those experiences.

Chelliah (1981) designed and developed an EE course to meet basic needs of science and humanities' teachers based on the following objectives:

1- To create awareness among teachers on the need for and importance of EE;

2- To help teachers develop a sensitivity to environmental related topics and to help them identify topics in their respective areas of academic specialisation through which they can teach EE;

3- To expose them to a variety of methods and techniques that could help to teach EE, so that they could develop related skills once they are on their own;

4- To help them to develop their own resource collection for teaching and give them skills to maximise the use of available resources;

5- To help them develop techniques to carry out field and laboratory work with their pupils on related topics.

The course which Chelliah (1981) designed in Malaysia included the following topics:

1- The organism and its environment;

2- Development and the environment;

3- The nature and scope of EE;

4- The beginning of environmental awareness in Malaysia;

5- Identification of relevant topics in various school subjects;

6- Discussion of environmental problems that could be included in the teaching of EE;

7- The integration technique for teaching of EE;

8- Methodologies and techniques for teaching EE;

9- Resources for teaching EE;

10- Laboratory work and out-door activities related to EE.

Interesting information for conceptualisation of a curriculum model for this purpose has been obtained from the responses of teacher trainees who have taken the EE course in the University of Malaya (Chelliah, 1981). All the respondents were positive about their ability to introduce environmental concepts through their various disciplines. Certain specific skills that they considered to be necessary include:

1- Skills such as collection of relevant information;

2- Identification of topics in their subjects through which they could teach EE;

3- Methods by which they could incorporate EE perspectives in their subjects.

The European Information Centre of Charles University (1981) organised a sub-regional workshop on the training of teachers for EE. The workshop proposed a model of pre-graduate training of teachers in higher education institution. The model prescribed as part of its compulsory education, areas common for all students of all specialisations. These include the following:

1- Fundamental ecological interrelations in nature;

2- Multiform linkage between man as a bio-social unit and environment;

3- Survey of principal current environmental problems;

4- Comprehensive concepts of environmental problem areas and the approach of states to the solution of environmental problems.

The rationale for inclusion of this content area was the acknowledgement that environmental education should be one of the requirements of the State Diploma examination of higher education for those training for the teaching profession.

On the basis of information collected from environmental educators in Europe and North America, Stapp and his colleagues (1980/81) developed an instructional model for furthering EE for pre-service teachers by identifying what they thought were major components that should be included in pre-service teacher education. These competencies are summarised and presented in table 3.2 below. The researchers further recommended that pre-service teacher education programmes for EE should include activities, experiences and skills in the affective domain, cognitive domain, skills and problem solving domain as well as in the evaluation of EE programmes.

Table 3.2
Components of an Instructional Model for Pre-service EE for Teachers

Competence in the bio-logical, physical, social and behavioural sciences	Competence in understanding the interrelationship of human ecosystem	Competence in education
- Biological and ecological foundation; - Economics foundation; - Policy foundation; - Psychological and sociological foundation	- Human ecosystem foundation - Community field study foundation	- Education theory foundation - Education skills foundation - EE group teaching foundation

3.4.3 Strategies to implement EE perspectives in existing SSTEPs

Numerous strategies have been employed to develop the cognitive and affective competencies needed by pre-service teachers to incorporate environmental dimensions into educational programmes. According to Wilke, Peyton and Hungerford (1987) these strategies include but are not limited to the following:

1- Required courses in EE for pre-service teachers;

2- Infusion of competencies in pre-service teaching method courses;

3- Workshops, graduate courses and degrees, conferences and development of specialised teacher centres.

Realising that strategies to incorporate EE perspectives in teacher education and training programmes have taken different forms, this section will consider the curriculum efforts reported in the EE literature that were field-tested in most cases and whose implementation served mainly to facilitate competencies needed for professional development of science teachers as environmental educators.

Wilke (1980) investigated the effects of three different treatments on teacher use of, knowledge of and attitudes towards resources use in teaching. He used the following design:

1- Treatment A: 60 hours training sessions in ecology and EE and involvement in the development of a resource manual;

2- Treatment B: two hours training sessions in ecology and EE and acquisition of the developed resource manual;

3- Treatment C: acquisition of the developed manual only.

Wilke found that teachers receiving treatment A had significantly higher use of concepts in their teaching and more positive attitudes towards the use of resource materials than teachers receiving treatments B or C. He further stated that the teachers experiencing treatment B had higher use of manual resources than the teachers in treatment C. Based on the results of his study, Wilke concluded that involvement in developing guides, coupled with sessions in the use of resource materials, appeared to yield better teaching practices than simply distributing guides to teachers.

Jaus (1978) in a science method course found that the experimental group of teachers who were asked to develop problem-solving activities and perform experiments relating to environmental problems possessed significantly more positive attitudes towards teaching EE than the non-environmental control groups.

Brogden and Rowsey (1977) reported that prospective teachers in science and social studies showed improved attitudes towards their teaching activities when taught through an interdisciplinary method of teaching EE.

Mayer and Mackenize (1974) reported on a summer institute in environmental science offered by Ohio State University with the support of the National Science Foundation. Since the summer of 1971, the programme has been intended to teach environmental concepts and designed according to three major themes. These themes are (1) the interdisciplinary nature of environmental problems; (2) development of attitudes favourable to environmental action; and (3) utilisation of alternative forms of learning. An alternative teaching model was employed which focused on individual and small group research, utilising field, laboratory, library and staff resources. Favourable evaluation by participants and high attendance at follow-up sessions indicated a high degree of acceptance of the programme by participants.

3.5 Conclusion

Chapter three presented a synthesis of literature pertaining to a number of important variables associated with the development of EE guidelines for SSTEPs at the university level. Major points drawn from this synthesis are summarised below.

The incorporation of EE into teachers' academic and professional education and training courses has occurred with varying degrees of success (Oulton, 1991; Disinger and Schoenfeld, 1987; Lee, 1987; Williams, 1985).

International studies conducted by UNESCO experts (Stapp et al., 1980/81; UNESCO, 1981, 1977c), although they considered teacher education and training for EE from a wide scope and from different teacher education establishments, have produced findings that were used as baseline information for international teacher education programmes in EE (UNESCO-UNEP, 1984). Comparing the findings of these studies with the current research results above we can say that a considerable incorporation of EE perspectives has occurred in teacher education programmes in the last two decades.

An assessment of needs is a prerequisite for curriculum development and implementation. The curriculum need assessment reported in the literature is mainly of two types. The first is the discrepancy model, in which the ideal condition is defined, the existing status of the curricula determined and the discrepancies between the two observed and communicated (Lee, 1987; Volk, et al., 1984). The findings of these studies show a considerable gap between the desired status and the current status of EE in science teacher education programmes. Studies of the second type consider identification of curriculum needs related to development and implementation in schools (Peyton, 1984; Schwabb, 1976).

Studies relating to students' environmental knowledge and attitudes showed that PTs' and SSs' attitudes tended to be favourable towards the environment (Edralin, 1989; Gayford, 1987; Bohl, 1976; Richmond, 1976; Perkes,

1973). Prospective teachers did not display a high level of knowledge of environmental action skills (Noibi, 1981; Peyton and Hungerford, 1980). Secondary school students showed a greater knowledge of environmental concepts than facts (Bohl, 1976; Richmond, 1976; Perkes, 1973). Only one study attempted to compare the attitudes of those who have EE experiences at university and secondary school levels with those who have no such experiences (Gayford, 1987). None of the studies reviewed in this research attempted to assess students' attitudes towards the incorporation of EE perspectives into university or secondary school subjects. Therefore, this study might be the first of its kind to do that.

Efforts to incorporate EE in SSTEPs vary from theoretical to practical attempts. They generally include suggestions, recommendations and formulation of curriculum guidelines by researchers and environmental educators. The more practical aspects reported by institutions include (1) providing environmental science as major or minor fields of specialisation; (2) enriching traditional science courses with EE perspectives; (3) introduction of new courses in environmental sciences; (4) mandating EE cognitive and affective teacher competencies; (5) introduction of environmental science and EE as core curriculum courses and (6) introduction of EE teaching method as optional course.

Several strategies were adopted for the incorporation of EE in teacher education programmes. Some of these studies reported in the literature as having been tried out in practice have resulted in increasing the competencies of STs to carry out EE.

CHAPTER FOUR
RESEARCH PROCEDURE AND SAMPLES

4.0 Introduction

The purpose of this chapter and the subsequent one is to give a description of the procedures that were followed in this research in order to collect the baseline data to help develop EE guidelines for SSTEPs in the Sudan's universities.

Chapter four describes the approach of the study, the research questions, the development of the research instruments and the research population and sampling procedures

4.1 Approach of the study

The approach of the study was twofold:

1- To review literature and research materials that pertain to teacher professional and academic preparation for EE.

2- To conduct a survey to ascertain the current status of EE and to assess the needs for its implementation in SSTEPs in the Sudan's universities and science programmes in the secondary school curriculum. In addition, the survey examines PTs' and SSs' perceived environmental knowledge and attitudes.

The main purpose of the survey part of the study was to collect information in the following research areas:

1- The academic background of the SEs, their involvement in the promotion of EE and the extent to which they prepared their students to incorporate EE perspectives in their teaching;

2- The perceived needs for the incorporation of EE perspectives in SSTEPs in the Sudan's universities as seen by SEs and the graduates of these institutions who are currently teaching science in Khartoum state government secondary schools;

3- The perceptions of STs of the degree of the incorporation of EE perspectives into science programmes of the secondary school curriculum and the

supportive needs for inclusion of environmental dimensions in these programmes;

4- The perceptions of PTs and SSs of their environmental knowledge and attitudes.

All the information gathered thus was one of the inputs for developing EE guidelines. It is the researcher's opinion that these guidelines cannot be developed solely on the basis of this particular study or on an analysis of the current situation in the universities. Therefore, in an attempt to develop these guidelines, the researcher has to draw heavily on his knowledge of curriculum studies, innovation, learning theories and EE (its philosophy, content, and teaching and learning approaches), current research findings in EE and science education, as well as his experiences in curriculum development in the Sudan.

4.2 Research questions

In the light of the research problem stated earlier (chap. 1, section 1.4), and the literature review in the previous chapters of this study, the survey of this research was conducted to collect data that might provide answers to the following questions:

1- To what extent do SSTEPs in the Sudan's universities prepare STs to incorporate EE perspectives into science programmes of the secondary school curriculum?

Specifically:

1:1 Do SSTEPs include specific courses in EE instructional methodologies?

1:2 If not, do science teaching method courses incorporate EE methodologies and approaches? What is their major emphasis pertaining to EE?

1:3 Do the SSTEPs include courses involving content pertaining to ecology or environmental concerns? To what extent is the content specifically orientated to local environmental issues and problems?

1:4 What is the academic background of the SEs in colleges and faculties of education in the Sudan's universities? To what extent are they involved in EE research and the development of EE teaching and learning materials?

1:5 What are the major problems concerning the incorporation of EE perspectives in SSTEPs in the Sudan's universities?

2- What are the needs of SSTEPs as perceived by STs who had gone through these programmes and the SEs who are conducting these programmes?

Specifically:

2:1 To what extent are the objectives of EE perceived as being important and to what extent are they incorporated in SSTEPs in the Sudan's universities?

2:2 Are there any discrepancies between the desired and the actual status of EE in STs' professional preparation courses in the Sudan's universities?

2:3 Are the current science teaching method courses adequate for preparing PTs to incorporate EE perspectives in secondary school curriculum? Can environmental educators be prepared in the framework of traditional science teaching method courses?

2:4 Should the universities develop team-taught, multidisciplinary method experiences?

2:5 Is the student teachers' academic preparation adequate to prepare them as environmental educators? Is the usual structure of natural sciences, as biological and physical sciences courses appropriate to prepare students as environmental educators?

2:6 Would additional courses in such non-traditional areas for PTs preparation as sociology, economics and EE competencies' courses be helpful to prepare future environmental educators?

2:7 If STs are expected to function in multidisciplinary programmes in the schools, can they do so without having that experience in teacher education programmes?

2:8 Do experiences provided during teacher education typically engender genuine concerns about environmental problems and issues in the Sudan?

3- What is the current status and curriculum needs of EE in the Sudan secondary schools?

Specifically:

3:1 In the perceptions of the STs, to what extent are environmental concepts, action skills and EE teaching and learning methodologies incorporated into the present science programmes of the Sudan's secondary schools curriculum?

3:2 Are there any significant differences between the perceptions of the STs for the incorporation of EE perspectives into science programmes of the Sudan's secondary school curriculum based on their major fields of specialisation or years of teaching experience or gender?

3:3 To what extent are supportive and communicative needs for the incorporation of EE perspectives into science programmes of the Sudan secondary schools perceived by STs?

3:4 Are there any significant differences between the perceived abilities of STs to teach environmental issues based on their fields of specialisation or years of teaching experiences or gender?

3:5 In the perception of the STs, what are the major problems concerning the incorporation of EE perspectives into science programmes of the Sudan's secondary schools? What do they suggest to overcome these problems?

4- To what extent do PTs and SSs perceive their environmental knowledge and attitudes as allowing them to get involved with EE in the Sudan?

Specifically:

4:1 Are PTs and SSs aware of the Sudan's environmental concerns (issues, problems and solutions)? Are there any significant differences between the sub-groups of the two populations regarding their awareness of the above issues?

4:2 Do PTs and SSs feel competent to investigate, evaluate and take actions in issues related to the Sudan's environment? Are there any significant differences between the sub-groups of the two populations in their perceived abilities and skills to take environmental actions?

4:3 What is the general attitude of PTs and SSs towards the environment and to the incorporation of EE perspectives into science programmes in secondary schools in the Sudan? Are there any significant differences between the sub-groups of the two populations in these issues?

4:4 To what extent do PTs and SSs in the Sudan perceive the contribution which science subjects, general education curriculum, and mass media make to their environmental awareness?

4:5 In the perception of PTs and SSs, what are the most serious environmental problems facing the Sudan today?

4:6 Are there any relationships between perceptions of PTs and SSs of their environmental knowledge and attitudes?

4:7 What factors are the best predictors of PTs' and SSs' abilities and skills to identify, evaluate and take actions in issues related to the Sudan's environment?

4.3 Development of the research instruments

A review of EE literature revealed that there were no instruments that could be used in the present study without modification. Thus the suggestion was followed that new instruments had to be developed and existing ones modified to suit the situation (Keeves, 1988; Youngman, 1979; Selltiz et al., 1976). The instruments had to be shown to be sound by establishing their reliability and validity (Youngman, 1979). Four questionnaires were developed and used to collect the information needed in this research. They are:

1- Science teacher educators' questionnaire (Q1);

2- Science teachers' questionnaire (Q2);

3- Prospective science teachers' questionnaire (Q3);

4- Secondary school students' questionnaire (Q4).

The first two questionnaires were developed originally by Lee (1987) to survey the status and the curriculum needs for SSTEPs in Malaysian universities. They were modified for use in the Sudan and adopted for this study. Q3 and Q4 were developed by the researcher to survey PTs' and SSs' perceived environmental knowledge and attitudes.

According to Borg and Gall (1989) questionnaires show wide applicability in educational research, despite the serious criticism of questionnaire studies that they are often shallow, i.e. they may not dig deeply enough to provide a true picture of respondents' opinions and feelings. There are also the problems of non-return and the possibility of the misinterpretation of the questions.

The questionnaires, despite their limitations, were chosen for data collection for this research for their following advantages, which are widely mentioned in educational research literature (Keeves, 1988; Cohen and Manion, 1986; Johnson; 1977):

1-They permit wide coverage at minimum expense both in money, time and efforts;

2- They permit more valid answers, as they give open ground for the respondent to consult his sources of information;

3- They allow greater uniformity in the manner in which the questions are posed and ensure comparability.

The incorporation of EE perspectives into science programmes in the Sudan's education system is a matter of interest to the programme executors and consumers at all education levels. In attempting to develop EE guidelines for SSTEPs in the Sudan's universities views, opinions and attitudes of different groups of population were needed (Lin, 1976).

4.3.1 Description of the research questionnaires

Each of the research questionnaires was accompanied by a covering letter. It explained the purposes of the study, the importance of the respondents' participation in the research and gave a brief definition of the term EE. Moreover,

the respondents were assured in the letter that their responses would be confidential and they would be used only for the research purposes, in addition, they were requested not to write their names in the instruments.

The SEs' questionnaire is mainly to survey the status and curriculum needs for EE in the Sudan's universities. There are two main sections in this questionnaire. The first section consists of questions that aim to gather general information pertaining to biographical data about the respondents, and their involvement in EE in their institutions. The second section comprises items for determining the respondents' perception of the curriculum needs for EE in SSTEPs in the Sudan's universities (Appendix A).

The STs' questionnaire is mainly to survey curriculum needs for EE in the Sudan's universities and secondary schools and to assess the extent of the incorporation of EE perspectives into science programmes of the secondary school curriculum. It consists of three sections. Section one gathers biographic information about the respondents. Section two attempts to identify the respondents' perceived curriculum needs for the EE of SSTEPs in the Sudan's universities. Section three aims to find out the opinions of the respondents on various issues related to the incorporation of EE perspectives in the secondary school science programmes (Appendix B).

The main purpose of students' questionnaires Q3 and Q4 is to assess their perceived environmental knowledge and attitudes. Each of the two questionnaires consists of two sections. Section one attempts to assess the respondents' perceived environmental knowledge, mainly their knowledge of basic environmental concepts related to the Sudan's environment, and the essential abilities and action skills needed to be developed by an environmentally-literate citizenry. Section two, assesses the respondents' perceived environmental attitudes. It includes students' perceptions of their environmental beliefs and values, their attitudes towards the incorporation of EE perspectives into science programmes, their

major sources of environmental information and what they think are the three most serious problems facing the Sudan (Appendices C and D).

4.3.2 Modification of the research questionnaires

The SEs' questionnaire and the STs' questionnaire were modified to suit the Sudan's environment.

The modifications in Q1 included the addition of six items in section two involving curriculum needs assessment. These items were intended to gather information about the importance of and the degree of the incorporation of EE objectives in SSTEPs in the Sudan's universities.

The modification of Q2 included the addition of some new items and rewording of others. Twelve items were added to the questionnaire. In section two, curriculum needs assessment, 6 items were added to assess the incorporation and the importance of EE objectives in teacher education programmes. In section three, items 3, 4 and 5 were added to assess the degree of incorporation of EE perspectives into science programmes in secondary school curriculum. Question 7 in the same section was added to assess the STs' perceived abilities to teach environmental topics in science subjects. Items 12 and 14 were added to solicit the opinions of respondents about the possibility of introducing environmental science as a subject in secondary schools and their suggestions for the incorporation of EE perspectives into science programmes in secondary school curriculum.

The rewording of the items in Q2 included in section two questions 8 to 15 and in section three questions 5 to 11. In the original version of the questionnaire (Lee, 1987), the items were stated in closed question form to be answered by "yes", "no" or "not sure". In this research these items were formulated in a form to be answered by "agree" "disagree" and "not sure". The rewording of these items was done to facilitate the answering of the questionnaire. Question 4 in section two of the original version was reworded from a closed to open format and replaced at the end of section three of Q3.

4.3.3 Construction of the new research questionnaires

The PTs' and SSs' questionnaires were developed by the researcher. The main purpose of these questionnaires was to assess respondents' perceived environmental knowledge and attitudes.

Environmental education literature was reviewed to establish the theoretical framework of the questionnaires (chap. 2, section, 2.3). The model on responsible environmental behaviour (shown in Fig. 4.1) was utilised in establishing the questionnaires' dimensions. The model was based on meta-analysis of empirical research on responsible environmental behaviour (Hines et al., 1987).

The literature related to questionnaire design was reviewed to identify key issues in the area (Sudman and Bradburn, 1983; Youngman; 1979; Oppenheim, 1966). Youngman's (1979) following suggested steps in research instrument construction were used whenever possible as guidelines in the questionnaires' design:

1- Compile a pool of relevant items;

2- Assemble these items into the form of an instrument;

3- Apply the instrument to one or more samples;

4- Perform items analysis of the responses obtained;

5- Remove any unsuitable items;

6- Assess reliability and validity;

7- Repeat steps 5 and 6 if necessary.

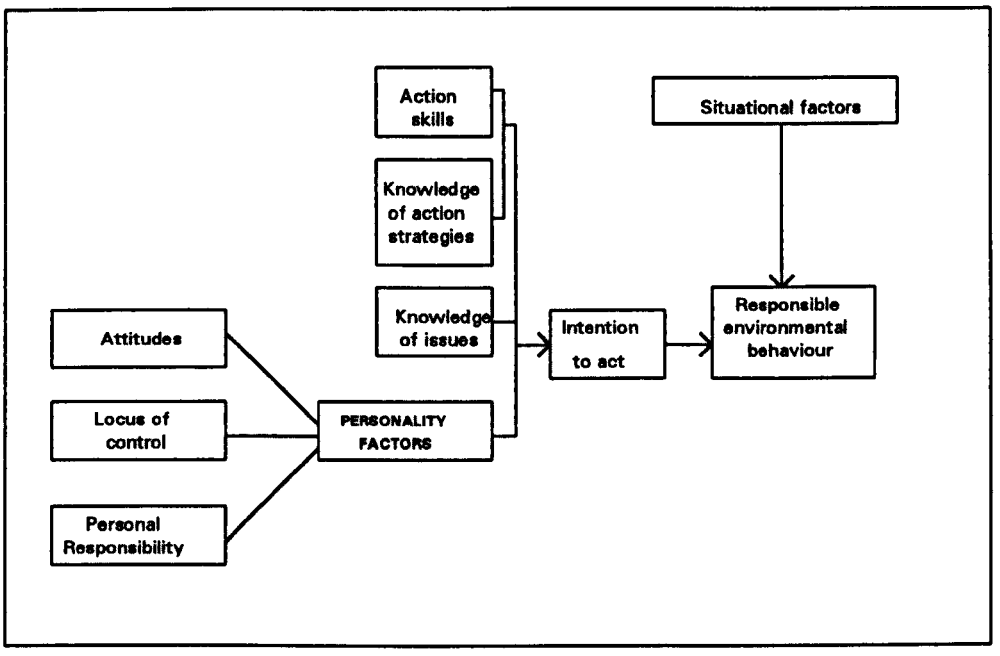


Fig. 4.1 The Proposed Model Of Responsible Environmental Behaviour Source: Hines et al.,(1987)

The questionnaire items were pooled from a number of published scales which have been used in assessing environmental knowledge and attitudes in the UK (Gayford, 1987; Richmond, 1976), in the US (Edralin, 1989; McClaren and Hart, 1978; Steniner, 1973; Perkes, 1973) and in Jordan (Subbarini, 1991). The concepts related to the Sudan's environmental concerns were based on the literature review (chap. 2, section, 2.1) of this study and the recommendations of the four successive workshops on EE which have taken place in the Khartoum, Sudan (Mohammed, 1985, 1984, 1983). The attitude items regarding the incorporation of EE perspectives into science programmes were guided by the objectives suggested by the UK National Curriculum Council (NCC) Documents (NCC, 1990a and b).

In writing questionnaire items, consideration was given to the wording of the items. Technical terms were simplified whenever possible to match respondents' levels of understanding. Items were restricted to conveying only one idea to avoid double-barrelled items (Borg and Gall, 1989). Complex concepts such as pollution were considered as one idea.

A Likert-type scale technique was used for establishing the dimensions of the questionnaires. The technique is widely used in educational and social research and is considered to provide an accurate measure of a respondent's position (Ebel and Frisbie, 1986; Fishbein and Ajzen, 1975).

To ensure the content validity of the questionnaires, care was taken to provide both positive and negative items in the attitudinal sections (Shaw and Wright, 1967). Eight items were stated positively and 5 items were stated negatively (table 4.1).

Table 4.1
Positive and Negative Attitudes Items in Q3 and Q4

Positive items	Negative items
1. Mankind has the right to modify the environment to satisfy his basic needs;	1. Mankind is created to rule over nature, so people should consume natural resources as they want;
2. Wise utilisation of natural resources depends on personal values;	2. Environmental preservation in the Sudan can be maintained only by law;
3. Sudanese should be encouraged to give priorities to environmental protection to improve their health conditions;	3. Studying environmental issues in science is not interesting;
4. Sudanese have social responsibilities to participate in preserving their environment;	4. Studying local environmental issues in science will limit students' participation in social activities;
5. I prefer an environmental approach to science learning;	5. Students' involvement in environmental preservation programmes in science is a waste of time;
6. Studying environmental issues in science helps me to think critically by looking at problems from different points of views;	
7. Group work on environmental protection in science helps me in respecting others' views;	
8. Science-based activities on the environment promote tolerance towards solving our environmental problems.	

Information gathered by Q3 and Q4 was related to the third purpose of this study (chap. 1, section, 1.4). They were mainly to assess the following research aspects:

1- The respondents' degree of awareness of the Sudan's environmental concerns (issues, problems and solutions);

2- The respondents' perceived abilities to investigate, evaluate and to take action in issues related to their environment;

3- The respondents' attitudes toward the environment and the incorporation of EE perspectives into science programmes in the secondary school curriculum;

4- The respondents' perceived sources of environmental information;

5- The respondents' perceptions of the most serious environmental problems facing the Sudan today.

The final version of Q3 contained 42 items, while Q4 contained 35 items (Appendix, D and C). Table 4.2 summarises the questionnaires' scales and dimensions.

Table 4.2
Scale Names, and Scale-ranges of Q3 and Q4

	Scale-range					
Scale (name)	**NI**	**MS**	**MXS**	**SMP**	**Q3 SNI**	**Q4 SNI**
1. Knowledge of environmental concepts (Cog1);	13	13	65	39	1 - 13	1 - 13
2. EE competencies (abilities & skills) (Cog2);	6	6	30	18	14 - 19	14 - 19
3. Ability to use EE teaching methods and approaches (Cog3);	7	7	35	21	20 - 26	-
3. Attitudes towards the environment (At1);	6	6	30	18	29, 32, 35, 37, 38, 39	22, 25, 28, 30, 31, 32,
4. Attitudes towards the incorporation of EE perspectives into science programmes (At2);	7	7	35	21	27, 28, 30, 31, 33, 34 36	20, 21,23 24, 26, 27 29
5. Sources of environmental information;	-	-	-	-	40 - 41	33 - 34
6. Serious environmental problems.	-	-	-	-	42	35

NI = number of items, MS = minimum scores, MXS = maximum score, SMP = scale mid-point, SNI = serial number of items.
Note: The abbreviations between the parentheses are used as names for the scales in Q3 and Q4 as well as in Q2 section three scales.

4.4 Populations involved in the study.

Four populations were sampled in this study. The first population was the SEs in the colleges and faculties of education, who in the academic year

1991/1992 were involved in science teacher education as science teaching methods and curriculum studies tutors or academic subject tutors who had education qualifications. Table 4.3 shows the number and distribution of members of this population according to their institutions.

Table 4.3
Distribution of SEs by Institution

Faculty of Education	University	Number of tutors	Percentages
Omdurman	Khartoum	15	68
Juba	Juba	4	18
Atbra	Wadi Elnil	3	14
Total		22	100

The second population surveyed was the STs who in the year 1991/1992 were teaching biology, chemistry, and physics in the Sudan government academic secondary schools. They had graduated from colleges and faculties of education in the Sudan's universities with B.Ed. (science) or B.Sc. (Ed.). According to the Ministry of Education's Statistical Report (1992) the size of this population, in all the Sudan's academic secondary schools is 728.

The third population of the study was the PTs studying biology, chemistry and physics, during this research period, in the Sudan's universities. The ages of members of this population were between 19 and 24 years. The majority of them were pre-service students. According to the Ministry of Higher Education and Scientific Research Report (1992) the number of this population in all the Sudan's universities including the new ones is 748 students.

The fourth population of the study was the government academic secondary school science students in Khartoum State. Their age is 19 years. They studied in single sex schools, 30 boys' schools and 24 girls' schools. According to the State's Education Office Report (1992) the size of this population is 4352 students.

4.4.1 Sample design and size

Nachmias and Nachmias (1992) pointed out that prior to the selection of a sample, the sampling frame has to be evaluated for potential problems. The

sampling frame of the population under study was taken from lists and secondary data sources obtained from potential respondents' institutions. Evaluation of the sampling frame shows that some of the colleges and faculties of education lists do not include all tutors' qualifications, e.g., in the College of Education, University of Juba, academic courses are taught by Natural Resources and Environmental Studies College tutors. Similarly the Ministry of Education's classification of STs does not indicate their education qualifications and the institutions from which they were graduated. However, this information did indicate that a representative sample could be drawn from these populations. Moreover, the researcher's constraints of time and resources, the country's size and the distribution of the four populations have to be considered as limiting factors in conducting the research.

The essential requirement of any sample is that it has to be as representative as possible of the population from which it is drawn (Gronlund and Linn, 1990). Stratified and convenience sampling designs were adopted in the present research as precision-increasing techniques to ensure adequate representation for all populations and to reduce the cost of the research execution (Keeves, 1988; Borg and Gall, 1989).

Colleges and faculties of education in the Sudan's universities that were chosen for the survey are the ones from which at least two batches of STs graduated in the academic year 1991/1992. Khartoum State government academic secondary schools were chosen to represent the Sudan schools. They were chosen for the following reasons:

1- The country has adopted a unified national curriculum in all states;

2- The state generally has a good social representation from all states of the country;

3- The state schools were more accessible to the researcher, as the majority of them were established in cities and towns;

4- The researcher's personal relationship with schools' directors, STs and training tutors during his work as a teacher trainer in this state would help in the research execution.

The sample for SEs included all science teaching methods and curriculum studies tutors and the academic staff members who held education qualifications in Omdurman Faculty of Education, University of Khartoum, College of Education, University of Juba and Atbra Faculty of Education, University of Wadi Elnil.

The STs sample included graduates of colleges and faculties of education surveyed in this study, who taught biology, chemistry or physics in Khartoum state schools in the academic year 1991/1992. The size of this sample was 152 teachers, including those who had graduated from foreign universities. They represented 21% of all secondary STs in the Sudan (Min. Educ., 1992).

Prospective science teachers were chosen from those institutions whose programmes are under study in this research. The final year students constituted this sample. They represented 19% of all science teachers in training.

Secondary school students were chosen from 12 schools in Khartoum state (six boys and six girls). The schools were chosen by their convenience, the number of boys' schools slightly out number girls' schools in Khartoum state, and schools differ in their size. Twenty third-grade science students were chosen from each school (table 6.3, Appendix P). They were chosen on a stratified design based on the first odd numbers from the science stream list. The size of this sample was 240, comprising 120 boys and 120 girls and represented 6% of all SSs. Table 4.4 summarises the research respondents' populations and the samples' size.

Table 4.4
Summary of Respondent Populations and Sample sizes

Respondents	Population	Sample	Percentages
1. Science teacher educators;	22	22	100
2. Science teachers;	728	152	21
3. Prospective science teachers;	748	139	19
4. Secondary school students.	4352	240	6

4.5 Basic research assumptions

The literature reviewed in the previous chapters provides support for the following operational assumptions underlying the execution of the present research:

1- The SSTEPs in colleges and faculties of education in the Sudan's universities include some aspects of EE perspectives with some varying degrees in their intentions, scope and directions;

2- Environmental education competencies (knowledge and attitudes) included in the research instruments, are basic competencies needed to train environmentally literate citizens, who can cater for the Sudan's environmental concerns (issues, problems and solutions). They are urgently needed to be incorporated into science programmes in all levels of the Sudan's education system;

3- Science programmes of the Sudan secondary school curriculum, to some extent incorporate EE perspectives and contribute to developing positive attitudes towards the environment;

4- Science teacher educators' perceptions and experiences are considered to be valid and reliable in evaluating EE status and curriculum needs in their institutions;

5- The perceptions and experiences of STs in Khartoum state, government academic secondary schools are valid and reliable in evaluating EE curriculum need in colleges and faculties of education in the Sudan's universities and the incorporation of EE perspectives into science programmes in secondary school

curriculum. They represent adequately the graduates of the institutions under study who work currently in the Sudan's secondary schools. They are honest in their responses to the questionnaire;

6- The samples of PTs and SSs adequately represent their populations from which they are drawn. They are honest in their responses to the questionnaires. They have the ability to evaluate their environmental knowledge and attitudes;

7- The questionnaires used in collecting the base-line information in this study are valid and reliable.

CHAPTER FIVE
FIELD WORK OF THE STUDY

5.0 Introduction

Chapter five is mainly concerned with the implementation of the study. It includes details of the establishment of the validity and reliability of the research instruments, pilot study, administration of the main research instruments and data collection, the nature of the research variables and the statistical analysis procedures conducted on the research data.

5.1 Validity of the research questionnaires

The criteria for evaluating research instruments are wide. They are traditionally classified under two headings, validity and reliability. The validity indicates how far an instrument actually measures what it was intended to measure. On the other hand, the reliability is an indication of the degree to which it performs consistently, both for the subjects being assessed and in differing situations under which the measurement is made (Keeves, 1988; Ebel and Frisbie, 1986; Youngman, 1979).

A synthesis of educational literature shows that the validity of the research instrument can be estimated by one or more methods: experts' opinions, actual performance and the result of another instrument of known and accepted validity (Nachmias and Nachmias, 1992; Gronlund and Linn, 1990; Borg and Gall, 1989).

The validity of the questionnaires used in the present study was ascertained first by the use of a panel of experts and independent judges in the University of Hull and then in the Sudan. In July 1991, the initial drafts of the questionnaires were submitted to two computer experts and five Ph.D. science education students in the University of Hull. They were requested to scrutinise the questionnaires based on the research objectives, to give advice and recommendations on the appearances of the questionnaires, as well as to judge their suitability for computer analysis.

From the suggestions and discussion with these group members, open questions were added to Q1 and Q2. These included item 23 in Q1 section two, and item 14 in Q2 section three. Four items in students' Questionnaires, Q3 and Q4 were reworded. These included items 27, 28 and 32 in Q3 section two and items 20, 21 and 25 in Q4. Moreover, some changes in the appearances of the questionnaires were made.

In October 1991, sets of the revised versions of the questionnaires were submitted to two groups of Sudanese experts. The first group included three SEs and two environmental science professors. The second group included two science curriculum planners, three science inspectors and three science head teachers.

The Sudanese experts were chosen based on their long experience in science teacher education in the Sudan's universities and for their familiarity with science and EE programmes development in the Sudan. In addition, they were currently involved in science teaching and in the development of science and EE programmes in the Sudan.

The Sudanese experts were requested to scrutinise the research questionnaires in the light of the following:

1- To analyse and evaluate the content of each questionnaire based on the research objectives;

2- To revise or reword any vague items, to eliminate items they felt to be inappropriate and to add items they believed would be relevant to the study;

3- To give suggestions about the appearances of the questionnaires;

4- To give advice about the Sudan's environmental concerns (See letter to experts in appendix H).

Scrutiny of the experts' validation results revealed a high face validity for the content and construct dimensions of the research questionnaires. On the experts' advice, two questions from Q2 section three were eliminated and two items in students' questionnaires Q3 and Q4 were reworded. The latter items

included items 28 and 33 in Q3 section two and items 21 and 26 in Q4 in the same section.

Empirical validation of the research instruments was based on the fact that the Q1 and Q2 had been previously applied on a national basis, in universities and secondary schools in Malaysia (Lee, 1987) and in Canada (Towler, 1980). The validity of the instruments in the two educational settings was established through expert opinions. Moreover, the questionnaires developed for this study (Q3 and Q4) incorporated items generally drawn from questionnaires that had been used on a national and state basis in the UK, US and Jordan (chap. 4, section, 4.3.3).

The STs' questionnaire (Q2) and students' questionnaires Q3 and Q4 were translated from English to Arabic. The accuracy of the translation was checked by two Arabic language professors, both of whom had previously been involved in translating educational materials from English to Arabic or the reverse. The final versions of the questionnaires were then prepared for the pilot study (appendices, E, F and G).

5.2 Pilot Study

The main purposes of a pilot study are:

1- To help in estimating the length of the research instruments;

2- To predict and hence offset problems that may affect the implementation of the main study.

3- To confirm the validity of the research questionnaires;

For the purpose of the pilot study, the research questionnaires were pilot tested in the Sudan in December 1991. The piloting of the research instruments was conducted with samples of individuals from populations similar to the research subjects. Individuals participating in the pilot study were excluded from the main study (Miller, 1991).

The SEs' questionnaire (Q1) was administered to only two persons, as the size of the population addressed by it is limited and no major modifications had been carried out in its initial validation stages.

The STs' questionnaire (Q2) was administered to 30 STs, working in training schools attached to Omdurman Faculty of Education, University of Khartoum. 10 teachers were chosen from each science subject, biology, chemistry and physics.

The PTs' questionnaire (Q3) was administered to 30 final year students, from Omdurman Faculty of Education. 10 students were chosen on a stratified design from each science subject department list.

The SSs' questionnaire (Q4) was administered to 40 students, from Ahleia (boys) and Bulk (girls) secondary schools. Twenty students were chosen, on a stratified design, from the third grade science stream list of each school, based on the first 20 odd numbers.

During the administration of the questionnaires for the pilot study, respondents were requested to comment on the scope, content and the length in writing as described in the covering letters of each pilot study version questionnaires (Appendix I). At the same time discussion about the questionnaires was conducted with PTs and SSs who participated in the pilot study, as some of them may not have been able to express their opinions about the questionnaires in writing.

Scrutiny of the pilot study respondents' opinions revealed that the validity of the research questionnaires was confirmed. The questionnaires were appropriate and suitable for the respondents. The lengths of questionnaires were reasonable. SEs completed their form within an average time of 20 minutes, STs 25 minutes, PTs and SSs 18 minutes.

5.3 Administration of research questionnaires and data collection

A letter was sent to the Academic Secretary of Omdurman Islamic University in July 1991, requesting that the researcher be provided with airline tickets and other financial support for the field work study in the Sudan. This was accompanied by a supporting letter from the research supervisor (Appendices J1 and 2).

Two follow up letters about the airline tickets were sent to the researcher's university. In November 1991, the researcher received a letter indicating the approval of his field work by the Omdurman Islamic Vice Chancellor's Office but the Ministry of Higher Education Financial Regulations applicable at that time would not allow the Academic Secretary to issue him tickets for field work (Appendices K1 and K2).

In the light of these constraints it was decided to mail the questionnaires to the Sudan, to enable the researcher to catch the final term of the academic year 1991/1992.

Two of the researcher's colleagues were contacted to supervise the pilot and the main study on his behalf in the Sudan. A letter was sent to the researcher's university to facilitate all possible means for them of carrying out the research work (Appendix L).

Letters were sent also through the researcher's institute to the deans of colleges and faculties of education in the Sudan's universities under study and the director of secondary education, Khartoum state, asking permission for the researcher to conduct the pilot and the main study in their institutions. (Appendix M).

The director of secondary education requested the school directors in Khartoum state to co-operate with the researcher (Appendix N).

Research questionnaires were prepared in booklet form to be mailed to the Sudan. The pilot study questionnaires were mailed in December 1991. The main study questionnaires were mailed to the researcher's correspondents in January 1992. The main study was conducted in February/March 1992.

The SEs' questionnaire and STs' questionnaires were distributed by hand. The PTs' questionnaire was distributed to the science teaching method tutors as the students were involved in teaching practice in their secondary schools. The SSs' questionnaire was administered by science headteachers. They were informed by the researcher's correspondents on how to select students and requested to

explain to them how to answer the questionnaires and to remind them to read the covering letter and all the instructions. The questionnaires were collected from the respondents, three weeks after distribution.

The questionnaires were mailed to the researcher in March 1992. Table 5.1 shows the distribution and return inputs of the questionnaires. 15 copies of STs' questionnaire were disregarded, as the respondents had graduated from foreign universities, mainly Egyptian ones.

Table 5.1
Distribution and Returning Inputs of the Questionnaires

Questionnaire	No. of copies distributed	No. of copies returned	Percentages returned
Q1	20	20	100
Q2	122	103	84
Q3	109	107	98
Q4	240	240	100
Total	491	480	98

5.4 The reliability of the research instruments

The reliability of a research instrument basically places emphasis on two sets of questions. The first involves the degree of consistency of the measurement scores, such as what is the relationship between scores obtained under varying testing conditions and how much does the individual's score change on retesting? The second set of questions emphasises the causes of discrepancies between the instruments' scores, such as what factors produced inconsistent scores and what is the magnitude of their effects? Such factors include, among others, the length of the research instrument, spread of the scores and the difficulty of the instrument items and their objectivity.

The reliability of a research instrument can be established by one or more of the following methods (Gronlund and Linn, 1990; Borg and Gall, 1989; Cohen and Manion, 1986; Ferguson, 1981; Guilford and Fruchter, 1978):

1- Test-retest method;

2- Parallel-form technique;

3- Spilt-half method;

4- Internal consistency methods.

The internal consistency method was adopted in this research to estimate the reliability of the research questionnaires. It was used to reduce the cost of the research and to make effective use of the time, since each instrument had to be administered on one occasion. Moreover, the method is widely used in current educational and social research (Nachmias and Nachmias, 1992; Ebel and Frisbie, 1986). Borg and Gall (1989, p. 261) indicated that "K-R20 is considered by many specialists in educational and psychological measurement to be the most satisfactory method of determining reliability".

Cronbach's Coefficient Alpha is a general form of the K-R20 formula. It was used to determine this research questionnaires' scales reliability. The formula as pointed out by Cronbach (1951) provides a reliability estimate for measures composed of items scored with values other than zero and one. Such is the case with these research instruments that provide responses on Likert-type scales from five to one or in the form of three to one.

Cronbach's formula can be expressed as:

$$rxx = \frac{k}{k-1}\frac{[1-\sum si]}{sx}$$

Where:

k = the number of items of the instrument;

$\sum si$ = the sum of variances of the item scores;

sx = the variance of the scores on all k items.

Table 5.2 shows the reliability coefficients of the research questionnaires' scales as estimated from the main study. The values range from 0.51 to 0.94, with most values being more than 0.65 (i.e., 14 out of 20). These values are considered to be satisfactory for scales containing relatively few items. They suggest that the research instruments have a satisfactory internal-consistency reliability.

Table 5.2
The Reliability of the Research Questionnaires' Scales as Estimated from the Main Study

Scales	Coefficient alpha Q1	Q2	Q3	Q4
1. The degree of importance and the extent of the incorporation of EE objectives in SSTEPs;	0.68	0.71	-	-
2. SEs' and STs' views about the adequacy of SSTEPs for PTs preparation for EE;	0.67	0.65	-	-
3. Cog1;	-	0.94	0.79	0.78
4. Cog2;	-	0.93	0.76	0.84
5. Cog3;	-	0.88	0.87	-
6. At1;	-	-	0.55	0.51
7. At2;	-	-	0.58	0.55
8. Supportive and communicative secondary curriculum needs for EE;	-	0.68		
9. Students' sources of environmental information.	-	-	0.61	0.53

5.5 The nature of the research variables

There are two types of variables in this research independent and dependent. The independent variables include the biographic variables of the different populations under study. The dependent variables are the main areas addressed by the research instruments. These variables are presented in tables 5.3 and 5.4.

Table 5.3
Independent Variables in the Research

Respondents	Independent variables	questionnaire's section & items
1- SEs;	qualifications, teaching experience, fields of specialisation and institution;	one, items, 1, 2, 9 and 10;
2- STs;	sex, fields of specialisation, teaching experience and institution;	one, all items;
3- PTs;	sex, fields of specialisation and institution;	covering letter;
4- SSs.	Sex;	covering letter.

Table 5.4
Dependent Variables in the Research

Variables	Questionnaire section	Items
1. EE status in SSTEPs;	Q1, section one;	all;
2. SSTEPs' needs;	Q1 and Q2 section two;	all;
3. EE status in science programmes in secondary school curriculum;	Q2 section three	1 - 5
4. EE supportive and communicative needs in secondary schools;	Q2 section three	6 - 13
5. PTs' and SSs' perceived environmental knowledge;	Q3 section one	14 - 26
	Q4 section one	14 - 19
6. PTs' and SSs' perceived environmental attitudes	Q3 section two	27 - 39
	Q4 section two	20 - 32
6. PTs' and SSs' perceived environmental information sources	Q3 section two	40 - 41
	Q4 section two	33 - 34
7. PTs' and SSs' perceived serious environmental problems.	Q 3 section two	42
	Q4 section two	35

5.6 Data analysis procedures

The responses to all study questionnaires were translated to data processing tabulation sheets, coded and analysed at the University of Hull Computer Centre, using the SPSS (Statistical Package for Social Sciences).

The kind of questions asked and the nature of the information gained by the research instruments were the two prime factors which influenced the choice of statistical procedures employed. The questions asked in the survey were mainly descriptive statements. Consequently, descriptive and inferential statistics were used for the research data analysis. The descriptive statistics include: frequencies, percentages, weighted means, Pearson correlation coefficient (r) and multiple regression. The inferential statistics involved a t-test only.

5.6.1 The weighted mean

The weighted means were used to examine the incorporation of EE perspectives into science programmes in the secondary school curriculum (information gathered by Q2 section 3) and PTs' and SSs' perceived environmental knowledge and attitudes (Information gathered by Q3 and Q4).

According to Porkess (1982) the weighted mean is the result produced by a technique designed to indicate the importance of certain factors when compiling the average of a group value. In this research, responses reported in Likert-type

techniques were given values of five to one in environmental knowledge scales (Cog1, Cog2 and Cog3) and in the attitudinal scales (At1 and At2) the same values were given to the positive responses and the reverse in the negative ones. The weighted means in the two cases were calculated for each item by dividing the sum of all responses by total sample number.

5.6.2 Pearson correlation coefficient (r)

The Pearson coefficient (r) or product-moment correlation coefficient was used to estimate the relationship between the PTs' and SSs' perceived environmental knowledge and attitudes (Information gathered by Q3 and Q4).

According to Borg and Gall (1989) the purpose of the correlation coefficient is to express, in mathematical terms, the relationship between any two variables. If the relationship is perfectly positive, the correlation coefficient will be 1.00, if the relationship is perfectly negative, it will be -1.00. If, there is no relationship, the coefficient will be zero. If the two variables are somewhat related, the coefficient will have a value between zero and one (if the relationship is positive), or between zero and minus one (if its negative). Thus the correlation coefficient is a precise way of stating the extent to which one variable is related to another and the greater the relationship, the greater the measure's magnitude (absolute value), but the measure equals zero if there is no relationship.

5.6.3 Multiple regression

Multiple regression was used in this study to evaluate the magnitude of the relationship between the dependent variables derived from the PTs' and SSs' scores in environmental abilities and action skills scale in Q3 and Q4 and the independent variables derived from the two groups' scores in (1) knowledge of environmental concepts scale (Cog1); (2) ability to use environmental teaching methods and approaches (Cog3); (3) attitudes towards the environment scale (At1); (4) attitudes towards the incorporation of EE perspectives into science programmes scale (At2).

Youngman (1979) pointed out that multiple regression analysis will offer a more appropriate analytical approach to researchers who specifically identify their independent variables. Environmental abilities and skills were chosen for this statistical analysis for the growing concern they have in current EE literature as ultimate goals for EE (Hungerford et al., 1987, Volk, et al., 1984; Stapp, 1969), or as competencies badly needed for an environmentally-literate citizenry (Ramsey and Hungerford, 1989, 1981; Stokes and Grawshow, 1986). Moreover, in science education literature, similar abilities and skills were widely reported as science processes (UNESCO, 1986a, Shaw, 1983; Diuashow, 1980).

Technically, the well-known equation for a straight line

$$y = a + bx$$

represents a simple linear regression (Edwards, 1979), where y is the dependent variable and x is the independent variable, a is the intercept constant, and b the regression coefficient. Therefore, y values are predicted from x values. If the values for y and x are plotted, and a line made as close to the points as possible, then that line "Should express the relationship between the x and y, the regression of y on x" (Ferguson, 1981). The slope of that line would be b, and would indicate the change in y with the change of one unit of x. Generally, b describes how y changes as x changes. The intercept constant a is the point where the regression line intercepts the y axis. The line that expresses the regression of y on x is the line for which the average deviation of y values from the line is minimum.

In any regression analysis, values labelled R, R^2 and B are known. B is the standard score coefficient, and indicates the proportion of total variation in y that can be accounted for by variation in x. Therefore, in a simple regression B coefficient is identical with the Pearson product-moment correlation coefficient, r. For example, if the correlation between the IQ and the academic attainment explainable by IQ is equal to $0.40 = 0.16$ this means that IQ can explain 16% of the total variance in the academic attainment of the cases used.

The relationship between the y and x in a multiple regression is expressed by the multiple correlation, R, and the proportion of variance is accounted for by the predictors together is equal to R^2, (Ferguson, 1981). R is always positive, the direction of the relationship between y and x being inferred from the signs of the b coefficients. The equation here is as in the simple regression except that there are, as the name suggests, multiple independent variables, x_1, x_2, x_3.....x_n as in

$$y = a_1 + b_1x_1 + b_2x_2 + b_3x_3.....b_nx_n.$$

In the above equation a_1 is the y_1 intercept, and b_1, b_2, b_3, b_n are the regression coefficients. The significance of the values of R^2 and B is usually found by comparing the F-values of the analysis with the F-values given in distribution tables.

According to Kerlinger and Pedhazur (1973) there are three possible regression analysis methods available to identify the minimum number of variables necessary to be accounted for by the combined effects of the independent variables. These are:-

1- The forward solution;

2- The backward solution;

3- The stepwise solution.

The stepwise solution incorporates the advantages of both the forward and the backward solutions. In the stepwise solution, tests are performed at each step to determine the contribution of each variable already in the equation as if it was entered last. Thus, variables are entered in to the regression equation one at a time, the first independent variable included in the equation being the one that has the highest zero-order correlation with the dependent variable. The second variable chosen will be the one that produces the greatest increment to R^2, having taken into account the variable already in the equation. The stepwise addition continues until all independent variables are added or until no other independent variable makes a significant contribution to the value of R^2.

5.6.4 T-test statistics

The t-test was used in this study to assess the differences if any between the subgroups of STs, PTs and SSs. It was used mainly to examine the following:

1- The difference between STs' subgroups perceptions of the incorporation of EE perspectives into science programmes of the Sudan secondary school curriculum. (Information gathered by Q2 section three);

2- The differences between PTs' and SSs' subgroups' perceptions of their environmental knowledge and attitudes (information gathered by Q3 and Q4).

According to Borg and Gall (1989) the t-test is a parametric inferential statistical test widely used in educational and psychological research to determine whether two means, proportion or correlation coefficients differ significantly from each other. It enables the researcher to decide whether some factors other than chance account for the apparent relationships. It also shows how reliably the researcher can infer that the phenomena observed in a limited group will also occur in an unobserved larger population from which the sample is drawn.

There are several formulae for the compution of the t-test, each of which is limited to serve different purposes. In this study, the t-test for independent groups (males and females, biological and physical scientists) was used for the test of significance between the two groups using the following standard formula of the t-test:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^s}{n_1} + \frac{S_2^s}{n_2}}}$$

where:

t = the value by which the statistical significance of the main difference will be judge;

$\bar{X}_1$ = the mean of group one;

$\bar{X}_2$ = the mean of group two;

S_1^s = the variance of group one;

s_2^2 = the variance of group two;

n_1 = the number of subjects in group one;

n_2 = the number of subjects in group two.

CHAPTER SIX
PRESENTATION OF THE RESULTS

6.0 Introduction

The purpose of this chapter is to present and analyse the survey data that was gathered from the four study questionnaires addressed to SEs, STs, PTs and SSs, in colleges and faculties of education in the Sudan universities and Khartoum state academic secondary schools in the academic year 1991/1992. It is presented to answer systematically the questions asked in chapter four of this study, section 4.2.

On the basis of the main questions of the study, the results are presented in five sections. Biographic information of the research respondents was analysed and is presented in section one. SEs' replies regarding EE status in SSTEPs in their various institutions are presented in section two.

Section three is devoted to analysing the SEs' and STs' replies regarding their institutions' curriculum needs in integrating EE perspectives into SSTEPs.

Section four presents STs' perception of the extent to which EE perspectives were incorporated into science programmes of the Sudan's secondary school curriculum. The respondents' perceptions of their abilities to teach environmental topics were assessed. Moreover, the perceptions of the respondents on the above issues were examined by their gender, fields of specialisation and years of teaching experience.

Section five addresses PTs' and SSs' data. The respondents' replies were subjected to various methods of statistical analysis in order to find out their awareness of the Sudan's environmental concerns, their abilities to take environmental actions, their attitudes towards the environment and their attitudes towards the incorporation of EE perspectives into science programmes of the Sudan's secondary school curriculum. Further analysis of the subjects' replies was carried out to assess the relationship between the subjects groups' scores in environmental knowledge and attitudinal scales, to find out factors that could be

the best predictors of their abilities to investigate, evaluate and take environmental actions and to examine the differences between the subjects' groups and sub-groups in the above issues.

6.1 Respondents' biographic information.

Information about the respondents is presented in tables 6.1 to 6.3. Secondary students' distribution in Khartoum state schools by gender is presented in table 6.3 (Appendix P).

Table 6.1
Respondents' Biographic Information

Biographic variables	Science educators		Science teachers		Prospective teachers	
	F	%	F	%	F	%
1. Sex						
. Males;	-	-	58	66	69	65
Females;			30	34	38	35
2. Fields of specialisation						
Biology;	8	40	25	28	22	21
Chemistry;	6	30	32	36	33	31
Physics;	5	25	27	31	24	22
Biology/chemistry;	-	-	4	5	17	16
Physics/math;	-	-	-	-	11	10
Environmental education;	1	5	-	-	-	-
3. Years of teaching experience						
1 - 05	5	25	53	60		
6 - 10	6	30	18	21		
10 - 15	3	15	8	9		
16 and more	6	30	9	10		
4. Institutions						
Khartoum;	15	75	77	88	79	74
Juba;	2	10	8	9	22	21
Wadi Elnil	3	15	3	3	6	5
5. Qualifications						
Ph.D. Ed;	6	30	-	-		
M. Ed;	7	35	4	5		
B. Ed;	9	45	75	85		
Diploma;	11	55	9	10		
6. EE courses						
None;	-	-	86	92		
One or more.	-	-	2	2		

F = frequencies.

The academic background of SEs and STs (tables 6.1 and 6.2) shows that only 5% of SEs (one person) was qualified in EE and only 2% of STs (two persons) had attended one or more courses in EE. These findings may indicate that the incorporation of EE perspectives, if any, in both the Sudan's universities and secondary schools depends mainly on what individuals make of its importance in the context of their programmes. Towler (1980, p. 15) indicated that, "Teachers who are not prepared or trained to teach EE can not help in its integration into their programmes, but have neutral if not negative attitudes towards the subject and its importance"

Table 6.2
Characteristics of Secondary SEs According to their Training and Fields of Specialisation

Disciplines	Bachelor		Diploma		Master		Ph.D.	
	F	%	F	%	F	%	F	%
1. Biology;	8	40	-	-	5	25	4	20
2. Chemistry;	4	20	-	-	4	20	4	20
3. Physics;	3	15	-	-	1	5	-	-
4. Education;	5	25	11	55	1	5	-	-
5. Science education;	-	-	3	15	7	25	6	30
6. EE	-	-	-	-	1	5	1	5
7. Environmental science or studies.		-	-	-	1	5	-	-

F = frequencies.

For the purposes of the data analysis, STs and PTs were divided, based on their fields of specialisation, into two groups, a biological science group which includes biology and biology/chemistry teachers and a physical science group, which includes chemistry, physics, chemistry/physics and physics/math teachers. STs were also divided, based on their years of teaching experience, into two groups, junior teachers with less than five years and senior teachers with more than five years teaching experience.

6.2 Status of EE in SSTEPs

This section presents the data collected by the SEs' questionnaire (Q1) section one. Frequencies and percentage distributions of the respondents' replies to all questions in this section are tabulated in appendix Q. The data presented in this section address the following main research question:

To what extent do teacher education programmes in the Sudan's universities prepare students to incorporate EE perspectives in secondary schools?

The extent to which SSTEPs prepared students to incorporate EE perspectives in their teaching can be summarised in the following points.

Environmental education teaching methods and approaches were poorly incorporated in science teaching method courses in colleges and faculties of education in the Sudan's universities, 65% of the respondents were incorporating them to "a little extent", only 20% indicated that they incorporated them "a lot" and 15% of the respondents indicated that they "didn't incorporate them at all". Three of those who incorporated them a lot in their science teaching method courses were biology teaching method tutors from Omdurman Faculty of Education and the other one was a chemistry teaching method tutor from the same institution. The three who indicated that they did not incorporate them at all were physics teaching method tutors from various institutions.

The major emphasis of EE teaching methods and approaches when integrated into science teaching method courses were reported to be mainly ecological by 50% of the respondents, conservation by 25%, biological by 15% and sociological by 10%.

In examining whether the institutions offered academic courses dealing with environmental concerns and whether they required that for PTs academic preparation, 70% of the respondents indicated that their institution's academic courses dealt with environmental concerns, 15% replied negatively to the statement and 15% indicated they "don't know". Moreover, 75% of the respondents indicated that their institutions required these courses for their

students' academic preparation, 20% said they "don't know", and only one person said "no". When the tutors were requested to list courses they taught which included environmental concerns, only the Biology Department of Omdurman Faculty of Education listed its ecology courses. The 20% of the tutors who replied with "don't know" were science teaching method tutors. Their responses could be justified by the fact that they were not directly involved in the academic teaching in some of the institutions under study.

Examining the extent to which the contents of the courses with environmental concerns were orientated to the local environmental issues and problems, 30% of the respondents said to "a great extent", another 30% said to "a small extent" and 40% stated "don't know". With 60% of respondents indicating that their academic courses with environmental concerns were orientated to "a great/a small" extent we could say with caution that these courses were to some extent orientated to local environmental issues.

The SEs' replies to the question about their involvement in research projects and curriculum materials development in their institutions and secondary schools in the Sudan revealed that of the twenty respondents only one was involved in a funded research project in EE and concerned with developing EE curriculum materials for his institution. 20% of the respondents were involved in developing EE curriculum materials for use in secondary schools. All those who were involved in developing EE curriculum materials for secondary education were from Khartoum University. When asked whether they favoured certification in EE in their institutions (i.e. introduction of EE as major or minor fields of specialisation), 85% of the respondents were in favour of that certification.

Respondents were asked about the three major problems hindering the incorporation of EE perspectives into SSTEPs in the Sudan's universities. The response frequencies and percentages are shown in table 6.4. From this table the three major problems as perceived by the SEs are:

1- Shortage of qualified staff;

2- Shortage of teaching materials and equipment;

3- Lack of textbooks.

Table 6.4
Frequency and Rank Order of the Problems Hindering the Incorporation of EE Perspectives into SSTEPs in the Sudan's Universities

Problems	F	%	Rank
1. Shortage of qualified staff;	13	65	1
2. Shortage of teaching materials and equipment;	13	65	1
3. Lack of textbooks;	8	40	3
4. Limited funding for research;	7	35	4
5. Lack of communication;	7	35	4
6. In accessibility of up to-date information;	7	35	4
7. Lack of research.	4	20	7

F = frequencies.

6.3 Curriculum needs assessment

This section presents the information gathered from Q1 section two and Q2 section two, addressing the following main research question:

What are the curriculum needs for the incorporation of EE perspectives into SSTEPs as perceived by SEs who are conducting these programmes (Q1, section two) and STs who have gone through them? (Q2, section two).

6.3.1 The degree of importance and extent of the incorporation of EE objectives in SSTEPs

The respondents were asked to rate the degree of importance of each of the six EE objectives and to indicate to what extent they felt these objectives were incorporated in the existing SSTEPs in the Sudan's universities (Q1 and Q2, section two, items 1 to 6). The response frequencies and percentages of the two groups are presented in table 6.5. The response means of the two groups are shown in figures 6.1 and 6.2.

Table 6.5 shows that all EE objectives were considered "very important/important" by the overwhelming majority of the respondents, with percentages ranging from 90% to 95% in the case of SEs and 92% to 100% in the case of STs.

Only two of the EE objectives were considered to be "moderately/satisfactorily" incorporated by SEs ("knowledge" by 65% of them and "awareness" with 50%). Three of the EE objectives were considered to be "moderately/satisfactorily" incorporated by STs ("knowledge" by 57%, "skills" by 52% and "attitudes" by 50% of them). Evaluation and participation objectives were considered to be poorly incorporated by the overwhelming majority of SEs and the majority of STs.

Overall, the results indicate that there is a clear discrepancy between the degree of importance that the respondents attached to the EE objectives and the extent to which they perceived their incorporation occurred into SSTEPs. This

suggests the need for the programmes to address the EE objectives more thoroughly.

Table 6.5.
The Degree of Importance and Extent of the Incorporation of the EE Objectives into SSTEPs as Perceived by SEs and STs

Environmental education objectives	R	F & %	Importance N. im	Im	V. im	Incorporation P	M	Sa
1. Awareness: to help acquire an awareness and sensitivity to the total environment and its problems;	SE	F	01	04	15	10	08	02
		%	05	20	75	50	40	10
	ST	F	0.0	09	79	41	33	14
		%	0.0	10	90	47	37	16
2. Knowledge: To help acquire basic understanding of the total environmental concerns and human role in it;	SE	F	02	04	14	07	13	0.0
		%	10	20	70	35	65	0.0
	ST	F	0.0	12	76	38	38	12
		%	0.0	14	86	43	43	14
3. Attitudes: To help acquire social values, strong feelings of concern for the environment and motivation for active participation in its protection;	SE	F	02	02	16	13	05	02
		%	10	10	80	65	25	10
	ST	F	01	31	56	44	34	10
		%	01	35	64	50	39	11
4. Skills: To help acquire the skills for solving environmental problems;	SE	F	01	03	16	13	05	02
		%	05	15	80	65	25	10
	ST	F	0.0	35	53	42	37	09
		%	0.0	40	60	48	42	10
5. Evaluation abilities: To help in the evaluation of environmental measures and programmes;	SE	F	01	06	13	17	02	01
		%	05	30	65	85	10	05
	ST	F	02	31	55	52	30	06
		%	02	35	65	59	34	07
6. Participation: To develop sense of responsibility that ensure appropriate action for environmental problems.	SE	F	02	03	15	19	01	0.0
		%	10	15	75	95	05	0.0
	ST	F	02	28	58	52	27	09
		%	02.3	32	66	59	31	10

F = frequencies, R = respondents, SE = science teacher educators (N = 20), ST = science teachers (N = 88), N. im, not important, Im, important, V. im, very important, P, poor, M, moderate, Sa, satisfactory;

* The responses in this table were scored for the computer analysis as N. im = 1; Im = 2; V. im = 3; P = 1; M = 2 and Sa. = 3.

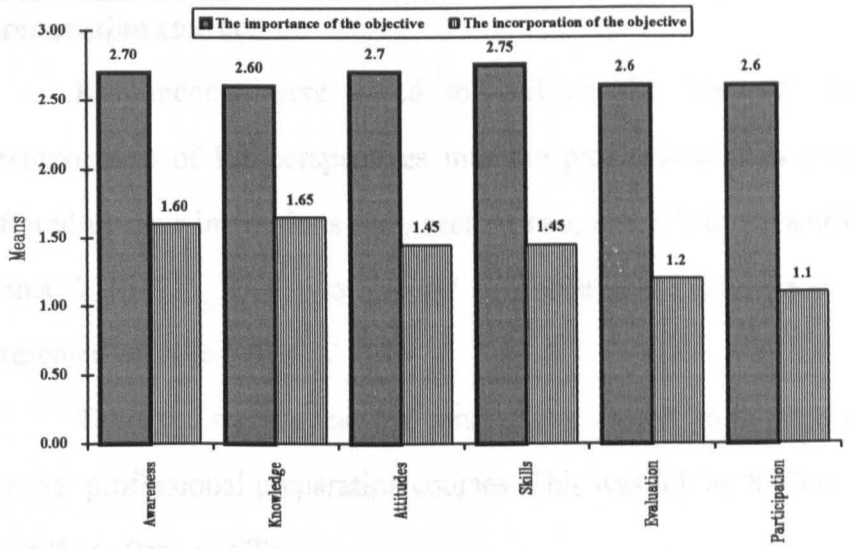


Fig. 1 SEs' Perceptions the Importance and the Incorporation of EE Objectives into SSTEPS in the Sudan's Universities

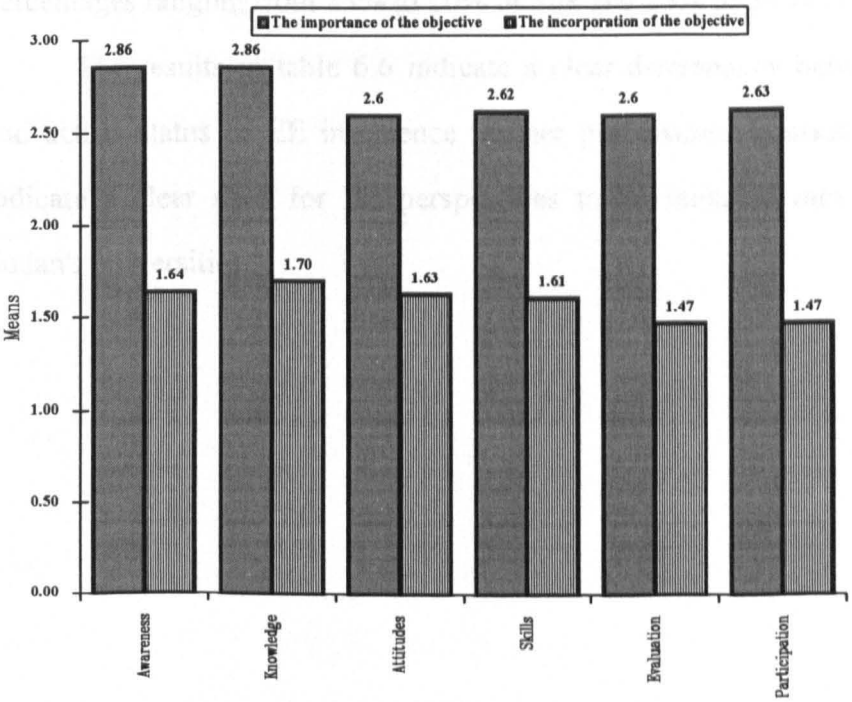


Fig. 2 SEs' Perceptions the Importance and the Incorporation of EE Objectives into SSTEPS in the Sudan's Universities

6.3.2 The desired and actual status of EE in science teacher professional preparation courses

Respondents were asked to indicate the "desired" and the "actual" incorporation of EE perspectives into the professional PTs preparation courses offered in their institutions (Q1, section two, items 7 to 12 and Q2, section two, items 7 to 11). The two groups' response frequencies and percentages are presented in table 6.6.

Table 6.6 reveals that EE perspectives should be incorporated into science teacher professional preparation courses. This was felt by 85% to 95% of SEs and by 83% to 95% of STs.

The current status of EE in science teacher professional training was perceived as being very low by the respondents in all training aspects with percentages ranging from 15% to 20% of SEs and 23% to 34 % of STs.

The results in table 6.6 indicate a clear discrepancy between the desired and actual status of EE in science teacher professional courses and they also indicate a clear need for EE perspectives to be included into SSTEPs in the Sudan's universities.

Table 6.6
The Desired and Current Status of EE in Science Teacher Professional Preparation Courses as Perceived by SEs And STs

Statements	Desired status		Current status	
	SE F (%)	ST F (%)	SE F (%)	ST F (%)
1. Environmental education is part and parcel of STs professional preparation courses;	19 (95)	77 (88)	3 (15)	30 (34)
2. Environmental education teaching methods are incorporated into all science teaching method courses;	17 (85)	73 (83)	3 (15)	21 (24)
3. Science teacher education programmes include courses pertaining to research methodology for designing and developing methods and instruments which enable teachers to effectively fulfil the objectives of EE;	19 (95)	83 (93)	2 (10)	27 (31)
4. Science teachers in training are given an understanding of as wide range as possible of EE materials, aids and resources with special reference to low cost material and opportunity for adaptation in local circumstances;	18 (90)	84 (96)	4 (20)	22 (25)
5. Science teacher education institutions undertake research to develop low-cost EE teaching materials for the science educators training;	18 (90)	-	3 (15)	-
6. Science teacher education institutions include appropriate aspects of EE curricula that meet interdisciplinary approaches and methods.	17 (85)	82 (93)	3 (15)	20 (23)

F = frequencies, SE = Science teacher educators (N = 20), ST = science teachers (N = 88).
* the responses in this table were scored for the computer analysis as desired = 2; actual = 1.

6.3.3 Science teacher educators' and STs' views about their colleges' curricular needs for implementation of EE perspectives in secondary schools

Respondents were asked to give their views about their institutions' curricular needs for the preparation of PTs to incorporate EE perspectives into the secondary school curriculum (Q1, section two, items 13 to 22 and Q2, section two, items 11 to 20). The two groups' response frequencies and percentages are presented in table 6.7.

Table 6.7 shows the respondents' view about the curriculum needs in three areas, general curriculum needs, professional course needs and academic courses needs. The items that solicit the respondents' opinions about the general curriculum needs are items 1, 8 and 9. The subjects' replies in these items suggested that SEs unanimously and 98% of STs were of the opinion that there is

a need for curriculum development in teacher education institutions to ensure that EE is taken into consideration. 65% of SEs and 67% of STs felt that science teachers cannot function in a multidisciplinary approach without having experienced it in teacher education programmes. Only 37% of SEs and 17% of STs felt that the experiences provided in their college programmes engender genuine concern about environmental issues. It could be inferred from the respondents' replies to these items that there was a need for EE and a multidisciplinary approach to be introduced into SSTEPs and more efforts to enhance environmental concerns in them are needed.

The opinions about needs relating to the professional science teacher courses were solicited by the respondents' replies to items 2, 3 and 4 in table 6.7. The subjects' replies to these items revealed that 60% of SEs and 65% of STs felt that the current science teaching methods are inadequate for training STs to integrate EE perspectives into secondary school curriculum. 55% of SEs and 52% of STs "agree" with the possibility of environmental educators being trained within the traditional framework of science teaching method courses in their colleges. Only 45% of SEs but 78% of STs felt that education institutions should develop team-taught multidisciplinary approaches for EE. It could be inferred from the respondents' views in this teacher preparation area that the current science teaching method courses are inadequate for STs preparation for EE but STs can be trained for EE in them. Moreover, SEs were not in favour of multidisciplinary and team-taught methods for EE while the majority of STs favour that. However, the overall result revealed that the respondents showed agreement on the needs for professional teacher preparation for EE but disagreement on the means. The results suggest that there is a need for science teacher education institutions to up-date their teaching methods' courses to prepare STs to be environmental educators in secondary schools.

Table 6.7

Science Teacher Educators' and STs' Views About the Adequacy of Existing College Courses for Equipping PTs to Handle EE Perspectives in Secondary Schools

Statements	R	Not sure F (%)	Disagree F (%)	Agree F (%)
1. There is a dire need for curriculum development in teacher education institutions to ensure that EE is taken into consideration;	SE	0.0	0.0	20 (100)
	ST	0.0	2 (2)	86 (98)
2. The current science teaching method courses offered in your college are adequate for training prospective science teachers to incorporate EE perspectives in secondary schools curriculum;	SE	4 (20)	12 (60)	4 (20)
	ST	16 (18)	57 (65)	15 (17)
3. It is possible to train environmental educators in the framework of our traditional science teaching method courses;	SE	3 (15)	6 (30)	11 (55)
	ST	18 (21)	24 (27)	46 (52)
4. Science teacher education institutions should develop team-taught multi-disciplinary method experiences for EE;	SE	9 (45)	2 (10)	9 (45)
	ST	14 (16)	5 (06)	79 (78)
5. The PTs academic preparation in terms of science subject matter is adequate for integrating EE perspectives in the Sudan's secondary schools;	SE	5 (25)	11 (55)	4 (20)
	ST	8 (09)	54 (62)	26 (29)
6. The usual distribution of subjects such as biology, chemistry and physics required of students is adequate for preparing them as environmental educators;	SE	2 (10)	14 (70)	4 (20)
	ST	16 (18)	19 (22)	53 (60)
7. Additional courses in such non-traditional areas as sociology and economics would be helpful to PTs to integrate environmental concepts into secondary school science programmes;	SE	4 (20)	4 (20)	12 (60)
	ST	10 (11)	13 (15)	65 (74)
8. STs can function in multidisciplinary programmes in the schools without having experience it in their education programmes;	SE	3 (15)	13 (65)	4 (20)
	ST	11 (13)	59 (67)	18 (20)
9. The experiences provided by science teacher education programmes engender concern about environmental issues.	SE	4 (20)	9 (45)	7 (35)
	ST	22 (25)	51 (58)	15 (17)

F = frequencies, SE = science teacher educators (N = 20), ST = science teachers (N = 88).

* The responses in this table were scored as not sure = 1; disagree = 2; agree = 3.

With regard to the academic courses needs for science teacher preparation for EE, the respondents' replies to items 5, 6 and 7, in table 6.7 reveal that 55% of SEs and 62% of STs were of the opinion that PTs academic preparation in terms of science subject matter is inadequate for the incorporation of EE perspectives into the Sudan's secondary school curriculum. Only 20% of SEs but 60% of STs were of the opinion that the usual distribution of science subjects such as biology, chemistry and physics required of PTs is adequate for preparing them as environmental educators. 60% of SEs and 74% of STs express the view that additional courses in untraditional science subject areas such as sociology and economics would be helpful to PTs to integrate environmental concepts into secondary schools' science programmes.

The respondents' replies about the academic courses of their colleges (table 6.7) suggested the need for them to be up-dated and new ones to be added to them to help PTs to integrate EE perspectives into science programmes of the Sudan's secondary school curriculum. Moreover, the respondents also showed disagreement about the approach, SEs showed support for an interdisciplinary one while STs preferred to retain an approach through established disciplines.

Science teacher educators' and STs' responses were similar for most items in table 6.7, with the exception of items 4, 6 and 9 where a clear disagreement between the two groups' views was shown.

Science teacher educators' views were obtained about proposed additional courses needed for STs preparation as environmental educators (Q1, section two, item 15). Frequencies and rank order of the respondents' replies are shown in table 6.8. From this table, the subjects generally agree that there is a need for additional courses in their colleges' programmes for prospective teachers to integrate EE perspectives into their teaching.

Table 6.8

Science Educators' Views by Rank Order About the Additional Courses Needed in the Preparation of STs as Environmental Educators

Courses	Not sure F (%)	Disagree F (%)	Agree F (%)
1. Environmental education teaching methods;	1(5)	1 (5)	18 (90)
2. Curriculum design and evaluation for EE;	1 (5)	1 (5)	18 (90)
3. Biological foundation;	4 (20)	-	16 (80)
4. Sociological foundation;	2 (10)	2 (10)	16 (80)
5. Ecological foundation;	5 (25)	-	15 (75)
6. Philosophy and theory of EE;	2 (10)	3 (15)	15 (75)
7. Economical foundation;	4 (20)	1 (5)	14 (70)
8. Community field study;	6 (30)	-	14 (70)
9. Development of instructional materials for EE;	3 (15)	3 (15)	14 (70)
0. Policy foundation;	5 (25)	2 (10)	13 (65)
1. Psychological foundation;	6 (30)	1 (5)	13 (65)
2. Human ecosystem foundation.	6 (30)	2 (10)	12 (60)

* The responses in this table were scored for the computer analysis as not sure = 1; disagree = 2 and agree = 3.

6.4 The incorporation of EE perspectives into science programmes of the Sudan's secondary school curriculum

This section is devoted to analysis of data collected by the STs' questionnaire (Q2) section three. The data address the following main research questions:

What is the current status of EE in science programmes of the Sudan's secondary schools? How could deficiencies in implementation of EE perspectives in the curriculum be rectified?

6.4.1 The incorporation of environmental concepts into science programmes of the Sudan's secondary school curriculum

Environmental concepts provide the foundation upon which curriculum developers construct EE programmes (Lucko et al., 1982). STs were provided with 13 key environmental concepts and asked to rate their incorporation in the science subject they taught in the Sudan's secondary schools on a five-point Likert-type scale ranging from "not at all" to "very much" (Q2, section three, item 3). Frequencies, means standard deviations and rank order of subjects' responses are presented in table 6.9.

Table 6.9 indicates that a score above the mid-point was achieved by STs on item 1 only "*desertification*" and the subjects' scores mean falls well below the expected scale mid-point ($33.50 < 39$). When the STs' score means were ranked the result indicates that the concepts most incorporated into the existing science programmes are items 1, 9 and 2 and the least incorporated ones are items 8, 12 and 13.

The results above indicate that STs perceived the key environmental concepts as poorly incorporated into the existing science programmes of the Sudan's secondary school curriculum. The socio-cultural aspects of the environmental concerns were the least incorporated concepts.

Table 6.9

Science Teachers' Views of the Extent to Which Environmental Concepts Were Incorporated into Science Programmes of the Sudan's Secondary School Curriculum

The Sudan's key environmental concepts	Value labels and frequencies							
	No	L	Fa	At	V. m	Mean	SD	Rank
1. Desertification;	20	13	19	17	19	3.02	14.6	01
2. Natural resources conservation;	17	25	13	17	16	2.88	1.41	03
3. Population growth and environmental health;	30	18	15	13	12	2.53	1.43	09
4. Energy source conservation;	28	17	19	12	12	2.58	1.41	07
5. Food production, starvation and malnutrition;	28	14	20	13	13	2.64	1.44	05
6. Land use and environmental protection;	29	19	16	11	13	2.55	1.44	08
7. Pollution;	28	15	21	11	13	2.61	1.42	06
8. Environmental problems and social values;	37	15	14	09	13	2.38	1.48	11
9. Irrigation schemes role in diseases transmission;	19	17	15	20	17	2.98	1.44	02
10. Degradation of urban life;	34	12	09	12	21	2.70	1.64	04
11. Natural disasters impacts on rural areas;	39	11	13	11	14	2.43	1.53	10
12. Politics and environmental problems;	43	17	11	10	07	2.10	1.33	13
13. Global environmental issues and national policies.	45	14	13	06	10	2.11	1.40	12

Scale mid-point = 39, item mid-point = 3,
Scores mean = 33.55, score SD = 15.37,
No = not at all, Li = little, Fa = fairbit, Al = a lot, V. m = very much;
* The responses in this table were scored for the computer analysis as No = 1; Li = 2; Fa = 3; Al = 4 and V. m = 5.

6.4.2 The incorporation of EE Competencies (abilities and skills) into science programmes of the Sudan's secondary school curriculum

Respondents were asked to rate the extent to which they thought EE competencies (abilities and skills) were incorporated into the science programme they taught in the Sudan secondary schools (Q2 section three, item 4). Frequencies, means and standard deviations of the subjects' responses are presented in table 6.10.

Table 6.10 indicates that above mid-point scores were achieved by STs on items 1 and 4 on the scale Cog2. The scores mean falls slightly below the expected mid-point of the scale (17.82 < 18).

The results above indicate that STs perceived items 1 and 4 as incorporated "a lot/very much", but the overall result could be interpreted that EE competencies to investigate, evaluate and take environmental action were incorporated to "a moderate" extent in science programmes of the Sudan's secondary school curriculum.

Table 6.10
Science teachers' Views of the Extent to Which EE Competencies (Abilities And Skills) Were Incorporated into Science Programmes of the Sudan's Secondary School Curriculum

Environmental education competencies (abilities and skills)	Value labels and frequencies No	Li	Fa	Al	V. M	mean	SD
1. Identification of environmental issues;	13	12	22	16	25	3.31	1.40
2. Analysis of environmental issues based on social values;	23	18	17	19	11	2.74	1.38
3. Identification of different solutions to envir-onmental problems;	14	19	24	18	13	2.96	1.29
4. Change individuals' concepts based on gained environmental information;	19	15	15	24	15	3.01	1.41
5. Design environmental work plan;	25	16	09	18	20	2.90	1.56
6. Decision-making on environmental issues.	21	19	13	18	17	2.92	1.47

Scale mid-point = 18, Item mid-point = 3,
Scores mean = 17.84, Sores SD = 7.42.
No = not at all, Li = little, Fa = fairbit, Al = a lot, V. m = very much;
* The responses in this table were scored for the computer analysis as No = 1; Li = 2; Fa = 3; Al = 4 and V. m = 5.

6.4.3 Science teachers use of EE teaching methods and approaches

Progressive teaching methods are required if key perspectives of EE are to be implemented in the school curriculum (UNESCO-UNEP, 1990; Wilke et al, 1987). STs were asked to indicate, in accordance with a five-point Likert-type scale ranging from "always used" to "never used" the frequencies with which he/she used each of the listed methods and approaches (Q2, section three, item 5).

Frequencies, means and standard deviations of the respondents' responses are presented in table 6.11.

Table 6.11 shows that above mid-point score were achieved by STs on items 1 and 7 of the scale Cog3. The respondents' scores mean falls below the expected mid-point of the scale (19.86 < 21).

The results above indicate that STs "Always/frequently" used "discussion" and "affective teaching approaches", but the overall result indicates that majority of them "never/rarely" used most of the EE teaching methods and approaches advocated in EE literature.

Table 6.11
Science Teachers' Use of EE Teaching Methods and Approaches

Environmental education teaching methods and approaches	Value labels and frequencies Ne	Ra	Oc	Fe	Al	Mean	SD
1. Affective teaching approaches (value clarification);	13	16	26	20	13	3.4	1.27
2. Problem solving and role play;	26	20	24	11	07	2.46	1.26
3. Case study;	19	25	27	09	08	2.57	1.20
4. Field work;	20	18	22	13	15	2.83	1.39
5. Using community as teaching and learning resources;	15	21	24	18	10	2.85	1.26
6. Action training and group work;	20	22	18	14	14	2.77	1.39
7. Discussion.	12	18	12	20	26	3.34	1.44

Scale mid-point = 21, item mid-point = 3;
Score mean = 19.86, score SD. = 7.07;
Ne = never, Ra = rarely, Oc = occasionally, Fe = frequently, Al = always;
* The responses in this table were scored for the computer analysis as Ne = 1; Ra = 2; Oc = 3; Fe = 4; Al = 5.

6.4.4 The communicative and supportive needs for the implementation of EE perspectives into science programmes of the secondary schools curriculum

Respondents were asked to give their views about the communicative and supportive measures needed for the implementation of EE perspectives into science programmes of the Sudan's secondary school curriculum (Q2, section three, items 6 to 11). Frequencies and percentages of the subjects' views are presented in table 6.12.

Table 6.12 shows that 56% of the respondents thought that information about local environmental issues in the Sudan was not accessible to the teachers in schools. 73% of the respondents indicated that secondary schools have problems getting access to environmental information. 96% of them agreed that environmental resource centres are necessary to disseminate information to teachers.

Table 6.12
Science Teachers' Views About the Communicative and Supportive Needs for Implementation of EE Perspectives into Science Programmes of the Sudan's Secondary School Curriculum

Statements	Not sure F (%)	Disagree F (%)	Agree F (%)
1. Information pertaining to local environmental issues in the Sudan are accessible to science teachers in secondary schools;	21 (24)	49 (56)	18 (20)
2. Secondary schools have problems getting access to environmental information;	08 (09)	16 (18)	64 (73)
3. Environmental resource centres are necessarily to disseminate information to STs;	01 (01)	02 (02)	85 (97)
4. It is important to introduce environmental science as subject in secondary school curriculum;	02 (02)	05 (06)	81 (92)
5. My learning experiences in the faculty of education prepare me to incorporate EE perspectives in secondary schools;	12 (14)	36 (41)	40 (45)
6. Workshops should be organised to up-date STs knowledge on the following areas:			
a - Sudan's environmental issues;	01 (01)	0.0	87 (99)
b - Global environmental issues;	05 (06)	04 (04)	79 (90)
c - EE methodologies and approaches.	04 (05)	04 (04)	80 (91)

* The responses in this table were scored for the computer analysis as not sure = 1; disagree = 2; agree = 3.

Clear support was shown for workshops to be organised to up-date STs' knowledge and skills about the Sudan's environmental issues, global environmental issues and EE teaching methods and approaches. Since only 46% of the respondents agreed that their experiences in teacher education institutions prepared them to incorporate EE perspectives in secondary schools, this finding suggests other types of in-service training are necessary apart from the workshops indicated above. This is particularly relevant since 92% were of the opinion that

environmental science as a subject should be introduced into the secondary school curriculum.

6.4.5 Discrepancies between the actual and possible incorporation of EE perspectives into science programmes of the Sudan's secondary school curriculum

Teachers were asked to indicate to what extent they thought EE perspectives were incorporated or could be incorporated into the science subjects they taught in secondary schools (Q2, section three, items 1 and 2). Frequencies and percentages of the subjects' replies are presented in table 6.13.

Table 6.13 reveals that a clear discrepancy was found between the actual and possible incorporation of EE perspectives into the existing science programmes in the secondary school curriculum as perceived by STs. 49% of the subjects felt that EE perspectives were not incorporated at all or incorporated to a little extent in their teaching. On the other hand, the majority (66%) of them indicated that they could be incorporated "very much/a lot".

Table 6.13
Science Teachers' Views of the Actual and Possible Incorporation of EE Perspectives into Science Programmes

Statements	not at all F (%)	little F (%)	fairbit F (%)	a lot F (%)	V. much F (%)
1. The actual incorporation of EE perspectives;	11 (12)	32 (36)	25 (28)	15 (17)	05 (06)
2. The possible incorporation of EE perspectives.	04 (04)	05 (06)	21 (24)	36 (41)	22 (25)

F = frequencies.

6.4.6 Science teachers' perceptions of their abilities to teach environmental topics

Teachers' abilities and willingness to teach environmental issues were considered to be the key factors in the implementation of EE perspectives in pre-university curricula (Peyton, 1984). STs were asked to rate their abilities to teach

environmental topics (Q2, section three, item 12). 49% of them rated their abilities as "good", 17% as "very good" and substantial number (34%) as poor.

6.4.7 Obstacles and solutions

Science teachers were asked to identify obstacles to the incorporation of EE perspectives into science programmes and to recommend ways and means of overcoming them (Q2, section 3 items 13 and 14). The frequencies and percentages of subjects' opinions are presented in tables 6.14 and 6.15. These responses suggest that teachers' education and training in EE is the key issue to the problem. This finding is in line with the recommendations of the four workshops organised in the 1980's for planning EE in the Sudan (Mohammed and Ahmed, 1991) and the successive UNESCO-UNEP conferences recommendations (UNESCO-UNEP, 1990). Moreover, the other problems and solutions suggested by the respondents could be considered of critical importance for implementation of EE perspectives into science programmes despite their lower percentages.

Table 6.14
Obstacles Hindering the Incorporation of EE Perspectives into Science Programmes of the Sudan's Secondary School Curriculum

Obstacles	F	%
1. Science teachers were not adequately prepared to incorporate EE Perspectives into science subjects;	48	55
2. Lack of appropriate EE instructional materials;	35	40
3. Lack of time in school day;	26	27
4. Lack of consensus about the scope and content of EE among the curriculum developers, educational planners and school administrators;	20	23
5. Lack of funding;	17	19
6. The Sudan Certificate Examination Questions mainly based on students' memorisation of facts.	14	16

F = frequencies

Table 6.15
How to Overcome Problems Hindering the Incorporation of EE Perspectives into Science Programmes of the Sudan's Secondary School Curriculum

Recommendations	F	%
1. Organisation of comprehensive EE in-service courses for science teachers, curriculum developers, education planners and school administrators;	47	53
2. A clear national policy should be laid down to facilitate the incorporation of EE perspectives into SSTEPs and general education curriculum;	36	41
3. Development of new science syllabi and instructional materials with EE components;	28	32
4. School libraries should be supplemented with books, audio-visual journals and so on with EE components;	26	30
5. School timetables should be made more flexible to allow outdoors activities;	24	27
6. Schools should be provided with more funds and transports means;	13	15
7. Efforts should be made to link school programmes with community sectors which work in environmental protection.	10	11

F = frequencies

6.4.8 The effects of STs' characteristics on their performance in Q2 section three scales

The differences between STs' subgroups' performance in Q2 section three scales and items were examined by t-test. The statistical summaries of the test results are presented in tables 16a, b and c. The results from these tables reveal the following:

1- Sex was not a discriminating factor (table, 16a);

2- Teachers of biological science felt that EE perspectives were incorporated into their subject to a greater extent than their physical science counterparts and they rated their abilities to teach environmental issues higher than them (table, 16b);

3- Junior STs felt that EE action skills were incorporated into their subjects to a greater extent than their senior counterparts and they frequently used EE teaching methods and approaches more than them (table, 16c).

Table 16

Statistical Summary of the STs' Sub-groups Differences in their Performance in Q2 Section Three Scales and Items

a) Science Teachers' sex differences

Scales and items	Males N = 58		Females N = 30		
	Mean	SD	Mean	SD	t- value
1. Environmental concepts (Cog1);	33.30	15.91	33.66	14.55	0.05
2. EE action skills (Cog2);	17.43	7.37	18.80	7.54	0.86
3. EE teaching methods (Cog3);	19.05	7.27	21.46	6.49	1.59
4. Supportive and communicative needs;	21.41	1.82	21.60	1.56	0.50
5. Possible incorporation of EE perspectives;	03.79	0.96	03.70	1.78	0.37
6. Actual incorporation of EE perspectives;	02.90	1.11	2.70	1.05	0.84
7. Ability to teach environmental topics	01.79	1.79	1.90	0.76	0.65

** $p < 0.01$; * $p < 0.05$.

b) Science Teachers' Specialisation Differences

Scales and items	Biology N = 29		Physical sciences N = 59		
	Mean	SD	Mean	SD	t- value
1. Environmental concepts (Cog1);	34.82	16.88	32.94	14.68	0.50
2. EE action skills (Cog2);	20.31	6.49	16.62	7.59	2.36*
3. EE teaching methods (Cog3);	20.89	6.67	19.37	7.13	0.96
4. Supportive and communicative needs;	22.06	1.85	21.18	1.61	2.19*
5. Possible incorporation of EE perspectives;	3.96	0.98	3.34	1.04	2.67**
6. Actual incorporation of EE perspectives;	2.58	0.86	2.71	1.17	0.57
7. Ability to teach environmental topics	2.03	0.56	1.72	0.74	2.15*

** $p < 0.01$, * $p < 0.05$.

(C) Science Teachers' Experience Differences

Scales and items	Junior N = 53		Senior N = 35		
	Mean	SD	Mean	SD	t- value
1. Environmental concepts (Cog1);	33.49	14.50	33.65	16.83	0.05
2. EE action skills (Cog2);	19.39	06.71	15.48	07.91	2.41**
3. EE teaching methods (Cog3);	21.18	06.10	17.88	08.02	2.07*
4. Supportive and communicative needs;	21.52	01.81	21.40	01.63	0.35
5. Possible incorporation of EE perspectives;	03.71	01.01	03.82	01.10	0.48
6. Actual incorporation of EE perspectives;	02.75	01.01	02.54	01.17	0.87
7. Ability to teach environmental topics	01.84	0.69	01.80	0.71	0.32

** $p < 0.01$, * $p < 0.05$.

6.5 Environmental knowledge and attitudes

This section is devoted to analysis of the data collected by the PTs' questionnaire (Q3) and SSs' questionnaire (Q4). The data address the following main research question:

How do PTs and SSs perceive their environmental knowledge and attitudes?

6.5.1 Knowledge of environmental concepts

Respondents were asked to rate their perceived knowledge of 13 key environmental concepts in accordance with a five-point Likert-type scale ranging from "very weak" to "very good" (Q3 and 4 section one, items 1 to 13). Frequencies, means, standard deviations and rank orders of the subjects' replies are presented in table 6.17.

Table 6.17 reveals that above mid-point scores were achieved on 11 items of the scale Cog1 by PTs and on 12 items by SSs. However, PTs achieved on 8 items a higher item-mean than SSs and they show slightly greater scores mean (46.31 > 45.81). When the subjects' response means were ranked in descending order, the results indicate that both PTs and SSs perceived themselves most aware of items 10, 9 and 1, and least aware of items 8, 12 and 13.

The results above indicate that the respondents perceived their knowledge of the Sudan's key environmental concepts as "very good/good" and these results could be interpreted as indicating that they are well aware of the country's environmental concerns (issues, problems and solutions). The ranking orders also show that the respondents are well and least aware of the concepts perceived by STs as most and least incorporated into the existing science programmes (tables, 6.9 and 6.17), the implications of this finding will be discussed in chapter 7.

Table 6.17

Frequencies, Means, Standard Deviations and Rank Order of PTs' and SSs' Perceived Knowledge of Key Environmental Concepts

The Sudan's key environmental concepts and problems	Value labels and frequencies R	V. w	W	M	G	V. g	Mean	SD	Ra
1. Desertification;	PT	05	05	19	35	43	3.98	1.12	03
	SS	05	17	54	84	80	3.90	1.01	03
2. Natural resources	PT	05	07	30	36	29	3.72	1.08	04
conservation;	SS	09	26	71	71	63	3.63	1.09	06
3. Population growth and	PT	07	20	28	28	24	3.39	1.21	10
environmental health;	SS	18	33	74	68	47	3.38	1.16	09
4. Energy sources	PT	06	16	33	33	19	3.40	1.11	09
conservation;	SS	26	37	86	60	31	3.13	1.15	11
5. Food production, starva-	PT	02	18	26	28	33	3.67	1.14	05
tion and malnutrition;	SS	12	26	61	68	73	3.68	1.18	05
6. Land use and environmen-	PT	06	11	34	30	26	3.55	1.14	07
tal protection;	SS	17	42	63	60	58	3.41	1.22	08
7. Pollution;	PT	07	11	24	43	22	3.58	1.13	06
	SS	12	20	48	67	93	3.81	1.16	04
8. Environmental problems	PT	05	22	35	27	18	3.29	1.12	11
and social values;	SS	24	41	84	54	37	3.16	1.18	10
9. Irrigation schemes role in	PT	03	09	14	25	56	4.14	1.12	02
disease transmission;	SS	15	16	41	54	114	3.98	1.21	02
10. Degradation of urban	PT	02	03	20	32	50	4.17	0.96	01
life;	SS	12	15	36	65	112	4.04	1.14	01
11 Natural disasters impacts	PT	10	11	29	36	21	3.43	1.20	08
on rural areas;	SS	15	27	69	65	64	3.57	1.17	07
12. Politics and environmen-	PT	21	16	31	28	11	2.92	1.27	12
tal problems;	SS	35	41	72	56	36	3.07	1.26	12
13. Global environmental	PT	18	19	36	22	12	2.92	1.23	13
issues and national policies;	SS	50	42	62	41	45	2.95	1.39	13

Scale mid-point = 39, item mid-point = 3;
Scores mean PTs = 46.31, SSs = 45.81,
Scores SD PTs = 8.51, SSs = 7.72,
R = respondents, V. w = very weak, W = weak, M = medium, G = good, V. g = very good, Ra = Rank order.
* The responses in this table, tables 6.18 and 6.19 were scored for the computer analysis as V. w = 1; W = 2; M = 3; G = 4; V. g = 5.

6.5.2 Environmental competencies (abilities and skills)

Subjects were asked to rate their abilities and skills to take environmental actions, in accordance with a five-point Likert-type scale ranging from "very weak" to "very good" (Q3 and 4, section two, items 14 to 19). Frequencies, means and standard deviations of the responses are presented in table 6.18.

Table 6.18 shows that above mid-point scores were achieved on all items of scale Cog2 by both PTs and SSs. For 5 items SSs achieved slightly higher than PTs, but the two groups had approximately equal score means ($20.79 \cong 21.22$)

The results above indicate that the respondents perceived their abilities to investigate, evaluate and take environmental actions as "very good/good". They also suggested that they possess competencies badly needed for an environmentally literate citizenry, a matter widely reported in the literature as an ultimate goal of EE (Posch, 1993; Ramsey et al, 1989; Wilke, 1985).

Table 6.18
Frequencies, Means and Standard Deviations of PTs' and SSs' Perceived Abilities to Investigate, Evaluate and Take Action in Issues Related to the Sudan's Environment

Environmental education competencies (abilities and skills)	R	Value labels and frequencies V. w	W	M	G	V. g	Mean	SD
1. Identification of environmental issues;	PT	02	13	24	40	28	3.73	1.04
	SS	06	21	66	79	68	3.75	1.03
2. Analysis of environmental issues based on social values;	PT	04	19	38	29	17	3.34	1.06
	SS	22	47	89	54	28	3.07	1.12
3. Identification of different solutions to environmental problems;	PT	04	10	44	32	17	3.45	0.99
	SS	13	32	70	66	59	3.52	1.16
4. Change individuals' concepts based on gained environmental information;	PT	07	14	35	34	17	3.37	1.10
	SS	13	32	81	71	43	3.41	1.09
5. Design environmental work plan;	PT	09	22	23	33	20	3.31	1.23
	SS	21	26	65	64	64	3.52	1.24
6. Decision making on environmental issues.	PT	08	13	22	36	28	3.59	1.23
	SS	13	18	41	65	103	3.95	1.17

Scale mid-point = 18, item mid-point = 3,
Scores mean PTs = 20.79, SSs = 21.22,
Scores SD PTs = 4.43, SSs = 4.48,
R = Respondents, V. w = very weak, M = medium, W = weak, G = good, V. g = very good.

6.5.3 Environmental education teaching methods and approaches

Respondents were asked to rate their abilities to use EE teaching methods in accordance with a five-point Likert-type scale ranging from "very weak" to "very good" (Q3, section two, items 21 to 27). Frequencies, means and standard deviations of the subjects' responses are presented in table 6.19.

Table 6.19 reveals that above mid-point scores were achieved on all items of the scale Cog3 by PTs. The respondents achieved in this scale higher scores mean than the expected scale mid-point (27.05 > 21). The results indicate that the respondents perceived their competencies to use EE teaching methods and approaches as "very good/good". This result could be interpreted as indicating that the respondents perceived themselves competent to used progressive teaching methods and approaches advocated in literature for teaching EE (Wilke et al., 1987; Stapp, 1983).

Table 6.19
Frequencies, Means and Standard Deviations of PTs' Perceived Competencies to Use EE Teaching Methods and Approaches

Environmental education teaching methods and approaches	Value labels and frequencies V. w	W	M	G	V. g	Mean	SD
1. Affective teaching approaches (value clarification);	1	04	17	40	45	4.10	0.89
2. Problem solving and role play;	5	14	32	42	14	3.41	1.02
3. Case study;	5	11	26	47	18	3.58	1.03
4. Field work;	4	07	18	26	52	4.07	1.12
5. Using community as teaching and learning resource;	2	01	18	39	47	4.02	0.88
6. Action training and group work;	4	10	27	39	27	3.70	1.06
7. Discussion.	5	06	12	42	42	4.02	1.07

Scale mid-point = 21, item mid-point = 3,
Scores mean = 27.08,
scores SD = 4.
V. w = very weak, M = medium, W = weak, G = good, V. g = very good.

6.5.4 Attitudes towards the environment

Respondents were asked to indicate their attitudes towards the environment in accordance with a five-point Likert-type scale ranging from "strongly disagree" to "strongly agree" (Q3 and 4 section three). Frequencies, means and standard deviations of the responses are presented in table 6.20.

Table 6.20
Frequencies, Means and Standard Deviations of PTs' and SSs' Attitudes Towards the Environment

Statements		Value labels and frequencies						
	R	S. DA	DA	N. S	A	S. A	Mean	SD
1. Mankind has the right to modify the environment to satisfy his basic needs;	PT	12	30	20	24	21	3.11	1.32
	SS	40	45	51	51	53	3.13	1.39
2. Mankind is created to rule over nature, so people should consume natural resources as they want (N);	PT	24	38	15	19	11	3.42	1.29
	SS	59	70	36	28	47	3.27	1.45
3. Environmental preservation in the Sudan can be maintained only by law (N);	PT	12	19	15	38	23	2.61	1.31
	SS	32	54	47	36	71	2.75	1.42
4. Wise utilisation of natural resources depends on personal values;	PT	04	02	10	38	53	4.25	0.97
	SS	05	06	16	68	145	4.42	0.88
5. Sudanese should be encouraged to give priorities to environmental protection to improve their health conditions;	PT	01	02	04	35	65	4.50	0.74
	SS	05	04	05	67	159	4.54	0.81
6. Sudanese have social responsibilities to participate in preserving their environment.	PT	0.0	02	04	57	44	4.33	0.64
	SS	03	04	09	72	152	4.53	0.81

Scale mid-point =18, item mid-point = 3,
Scores mean PTs = 22.24, SSs = 22.65,
Scores SD PTs = 2.56, SSs = 2.96,
R = respondents, PT = prospective science teachers, SS = secondary school students, S. DA = strongly disagree, DA = disagree, N. S = not sure, A = agree, S. A = strongly agree, N = negative statements.
* The responses in this table and table 6.21 were scored for the computer analysis as S. DA = 1; DA = 2; N. S = 3; A = 4; S. A = 5 and by the reverse when the item is stated negatively.

Table 6.20 reveals that above mid-point scores were achieved on 5 items of the scale At1 by PTs and SSs. For 5 items SSs achieved a slightly higher item mid-point than PTs. They also show higher scores mean than them.

The results above indicate that the two groups' response positions generally show positive attitudes towards the environment, with both of them achieving a higher mean score than the expected scale mid-point (22.65 and 22.24 > 18), despite their agreement with item 3 "*Environmental preservation in the Sudan can be maintained only by law*".

6.5.5 Attitudes towards the incorporation of EE perspectives into science programmes

Respondents were asked to indicate their attitudes towards the incorporation of EE perspectives into science programmes of the Sudan's secondary school curriculum in accordance with a five-point Likert-type scale (Q3 and 4 section three). Frequencies, means and standard deviations of the respondents' replies are presented in table 6.21.

Table 6.21 reveals that above mid-point scores were achieved on all items of the scale At2 by the two groups. For 5 items SSs achieved slightly higher item-means than PTs but the two groups achieved approximately equal score means.

The results above indicate that respondents' response positions generally show positive attitude towards the incorporation of EE perspectives into science programmes with the two groups achieving remarkably higher score means than the expected scale mid-point (28.19 and 28.36 > 21).

Table 6.21

Frequencies, Means and Standard Deviations of PTs' and SSs' Attitudes Towards the Incorporation of EE Perspectives into Science Programmes of the Sudan's Secondary School Curriculum

Statements		Value labels and frequencies						
	R	S. DA	DA	N. S	A	S. A	Mean	SD
1. I prefer an environmental approach to science learning;	PT	0.0	03	08	43	53	4.36	0.74
	SS	04	13	34	71	118	4.19	0.98
2. Studying environmental issues in science helps me to think critically by looking at problems from different points of views;	PT	0.0	0.0	01	35	71	4.65	0.49
	SS	4	4	13	55	165	4.55	0.79
3. Studying environmental issues in science is not interesting (N);	PT	27	49	14	13	04	3.76	1.07
	SS	61	107	28	19	20	3.66	1.23
4. Science-based activities on the environment promote tolerance towards solving our environmental problems;	PT	05	07	15	55	25	3.82	1.01
	SS	06	05	55	87	87	4.01	0.95
5. Studying local environmental issues in science will limit students' participation in social activities (N);	PT	19	37	24	18	09	3.36	1.10
	SS	45	71	54	35	35	3.23	1.23
6. Group work on environmental protection in science helps in respecting others' views;	PT	02	06	11	44	44	4.14	0.94
	SS	07	05	20	61	147	4.40	0.94
7. Students' involvement in environmental preservation programmes in science is a waste of time (N).	PT	46	42	09	04	06	4.10	1.03
	SS	140	69	10	04	17	4.29	1.11

Scale mid-point = 21, item mid-point = 3,
Scores mean PTs = 28.19, SSs = 28.36,
Scores SD PTs = 3.44, SSs = 3.50,
R = respondents, S. DA = Strongly disagree, DA = disagree, N. S = not sure, A = agree, SA = strongly agree, N = negative statements.

6.5.6 Sources of environmental information

Respondents were asked about the contribution which science subjects made to their awareness about environmental problems in the Sudan and the extent to which other sources of environmental information were perceived to make a contribution (Q3 section three, items 42 and 43, and Q4, section three, items 35 and 36). The results are shown in tables 6.22 and 6.23. From these tables the following observations can be made:

Biology was seen to make the greatest contribution followed by chemistry and physics, with biology and chemistry means higher than the expected item mid-point (table 6.22).

Table 6.22
Frequencies, Means And Standard Deviations of PTs' and SSs' Perceived Contribution of Science Subjects to their Environmental Awareness

Subject		Value labels and frequencies						
	R	NO	Li	Fa	Al	V. m	Mean	SD
1. Biology;	PT	01	02	14	18	072	4.47	0.86
	SS	03	03	13	31	190	4.67	0.74
2. Chemistry;	PT	14	09	37	38	009	3.18	1.13
	SS	35	19	80	86	020	3.15	1.15
3. Physics.	PT	11	08	41	28	018	2.64	1.15
	SS	76	44	77	30	013	2.41	1.20

Item mid-point = 3,
R = respondents, No = Nothing, Li = little, Fa = fairbit, Al = a lot, V. m = very much.
* The responses in this table and table 6.23 were scored for the computer analysis as No = 1; Li = 2; Fa = 3; Al = 4 and V. m = 5.

Prospective science teachers perceived private reading as the most important source of their environmental information (mean 3.70) followed by mass media, general education and academic courses. Youth and students' organisations and educational and professional courses were seen as least important. On the other hand, SSs perceived general education as their most important sources of environmental information followed by mass media and private reading (means' 3.82, 3.66 and 3.46 respectively). Parents and friends and youth and students' organisations were perceived as least important sources by this group (table 6.23).

Table 6.23
Frequencies, Means, Standard Deviations and Rank Order of PTs' and SSs' Perceived Sources of Environmental Information

Environmental information sources		Value labels and frequencies							
	R	No	Li	Fa	Al	V. m	Mean	SD	Ra
. General education;	PT	11	08	41	28	18	3.32	1.15	03
	SS	11	19	68	46	96	3.82	1.17	01
. Mass media;	PT	07	12	32	38	18	3.45	1.10	02
	SS	08	25	66	81	60	3.66	1.06	02
. Private reading;	PT	02	12	36	23	34	3.70	1.09	01
	SS	18	25	75	72	50	3.46	1.15	03
. Parents and friends;	PT	-	-	-	-	-	-	-	-
	SS	65	52	61	35	27	2.61	1.32	05
. Youth & students'	PT	38	21	18	24	06	2.43	1.32	07
organisations;	SS	72	36	66	37	29	2.65	1.36	04
. General university	PT	17	15	36	26	13	3.03	1.23	05
courses;	SS	-	-	-	-	-	-	-	-
. Academic courses;	PT	12	16	29	25	25	3.32	1.29	03
	SS	-	-	-	-	-	-	-	-
. Educational and									
professional courses.	PT	23	18	35	20	11	2.79	1.26	06
	SS	-	-	-	-	-	-	-	-

Item mid-point = 3,
R = respondents, No = nothing, Li = little, Fa = fairbit, Al = a lot, V. m = very much.

6.5.7 Environmental Problems

Respondents were asked in free response to indicate the three most serious environmental problems facing the Sudan today (Q3, section three, item 44 and Q4, section three, item 37). Frequencies, weights and rank order of the six problems indicated by the respondents are presented in table 6.24.

Table 6.24 shows that the three most serious problems are desertification, pollution and abuse of natural resources. Desertification was perceived as the most serious problem facing the country by 60% of PTs and 50% of SSs. These results will be linked later with the respondents' perceptions of knowledge of these areas in chapter 7.

Table 6.24
Rank Order of Seriousness Attributed to Various Environmental Problems Facing the Sudan Today as Perceived by PTs and SSs

Environmental problems	R	First problem	Second problem	Third problem	Weight	Rank
. Desertification;	PT	76	10	2	250	1
	SS	133	34	13	480	1
. Population dynamic;	PT	5	7	11	40	5
	SS	17	28	15	122	4
. Environment and	PT	4	13	5	43	4
public health;	SS	8	32	16	104	5
. Pollution;	PT	9	39	7	112	2
	SS	44	55	24	266	2
. Natural disasters;	PT	00	3	6	15	6
	SS	1	8	6	33	6
. Abuse of natural	PT	10	23	18	94	3
resources.	SS	30	59	23	231	3

The problem weight was calculated by multiplying the number of respondents who perceived the problem by three when cited as first problem, by two as second problem and by one as third problem;
R = respondents;
PT = prospective science teachers;
SS = secondary students.

6.5.8 The relationships between the subjects' environmental knowledge and attitudes

In order to find out the relationships between the PTs' and SSs' scores in the environmental knowledge and attitude scales of their questionnaires Q3 and Q4, the means and standard deviations of each group's scores in these scales were calculated (tables, 6.17 to 6.21), and the relationships between the groups' scores were analysed using the product moment correlation coefficient (r). Results are presented in tables 6.25a and b.

From tables 6.25a and b, the inter-correlation of respondents' environmental knowledge scores (Cog1, Cog2 and Cog3) tended to be mostly high and significant, in the case of PTs ($r = 0.42$, and 0.45, $p < 0.01$), in the case of SSs ($r = 0.44$, $p < 0.01$). The correlation between respondents' scores in environmental attitudes' scales (At1 and At2), tended to be fairly low ($r = 0.15$ and 0.16) in the case of the two groups respectively. Moreover, despite the significant correlation between the respondents' scores in the knowledge of environmental concepts (Cog1) and their attitudes towards the incorporation of EE perspectives

into science programmes of the Sudan's secondary school curriculum (At2) (r = 0.35 and 0.21, $p < 0.01$) the inter-correlation between the respondents' scores in environmental knowledge and attitudes sub-sets in both groups tended to be very low.

Table 6.25
Inter-correlation of Respondents' Score Means in Environmental Knowledge and Attitude Scales

a) Prospective Science Teachers N = 107

Variables	Cog1	Cog2	Cog3	At1
1. Cog1;				
2. Cog2;	0.42**			
3. Cog3;	0.17	0.45**		
4. At1;	0.11	0.07	0.06	
5. At2.	0.35**	0.16	0.19	0.15

b) Secondary School Students N = 240

Variables	Cog1	Cog2	At1
1. Cog1;			
2. Cog2;	0.44**		
3. At1;	0.04	0.05	
4. At2.	0.21**	0.05	0.16**

** $p < 0.01$, * $p < 0.05$
Cog1 = Knowledge of environmental concepts;
Cog2 = EE Competencies (abilities and skills);
Cog3 = Ability to use EE teaching methods and approaches;
At1 = Attitudes towards the environment;
At2 = Attitudes towards the incorporation of EE perspectives into science programmes.

6.5.9 The relative contributions of respondents' perceived environmental knowledge and attitudes to their perceived abilities to investigate, evaluate and take environmental actions

A stepwise multiple regression analysis procedure of the SPSS computer programme at the University of Hull Computer Centre was used in the analysis of PTs' and SSs' scores (see chap. 5 for the procedure) on environmental knowledge and attitude scales of their questionnaires. The subjects' perceived abilities to investigate, evaluate and take environmental action was taken as the dependent variable. The independent variables entered into the regression equation were the following:

1- Knowledge of environmental concepts (Cog1);

2- Abilities to use EE teaching methods and approaches (Cog3);

3- Attitudes towards the environment (At1);

4- Attitudes towards the incorporation of EE perspectives into science programmes of the Sudan's secondary school curriculum (At2).

The results are shown in tables 6.26a and b. Table 6.26a shows that only environmental knowledge variables contributed to the respondents' perceived abilities to investigate, evaluate and take environmental actions in issues related to the Sudan's environment. The first independent variable entered into the regression equation was the respondents' scores in their perceived abilities to use EE teaching methods and approaches (Cog3). This variable explained 20% of the variance in respondents' scores in their abilities to take environmental actions. The second variable that entered the regression equation was the respondents' scores in their perceived knowledge of environmental concepts (Cog1). This variable explained 10% of the variance in the respondents' perceived abilities to take environmental actions. No further significant contributions were made by any other variables. Thus, overall, 30% of the variance was explained by the respondents' scores in environmental knowledge scales, leaving the rest of the variance to be attributed to other factors not included in the present study.

Table 6.26b shows that SSs' scores in perceived environmental knowledge variables contributed to their perceived abilities to investigate, evaluate and take environmental actions. Only respondents' scores in their perceived knowledge of environmental concepts (Cog1) entered the regression equation. This variable explained 20% of the variance in the respondents' abilities to take environmental actions, leaving the rest of the variance to be attributed to other factors not included in the present study.

Table 6.26
Statistical Summary of Multiple Stepwise Regression Analysis Procedure Indicating the Independent Variables that Contributed to Respondents' Perceived Abilities to Investigate, Evaluate and Take Environmental Actions

a) Prospective Science Teachers

Independent variables	R	R^2	R^2 changes
1. Cog3;	0.45	0.20	0.20
2. Cog1.	0.55	0.31	0.10

b) Secondary Students

Independent variable	R	R^2	R^2 changes
1. Cog1	0.44	0.19	0.20

The results above show that the respondents' scores in EE attitudinal scales (At1 & At2) make no contributions to their perceived abilities to investigate, evaluate and take environmental actions (tables 6.26a and b) The reason for that is the low correlation between the said variables and the criterion variable (Cog2), as shown in tables 6.25a and b, in the case of PTs ($r = 0.06$ and 0.16) and in the case of SSs ($r = 0.05$)

6.5.10 The differences between PTs' and SSs' groups' and sub-groups' perceived environmental knowledge and attitudes

The differences between the respondents' groups' and sub-groups' perceived environmental knowledge and attitudes were assessed by t-test. The statistical summaries of the test results are presented in tables 27a, b, c and d. The results from these tables reveal the following:

1- Educational level was not a discriminating factor (table 27a);

2- Male PTs expressed more positive attitudes towards the environment than their female counterparts (table 27b);

3- Physical sciences PTs expressed more positive attitudes towards the environment than their biological counterparts (table 27c);

4- Female SSs showed a greater awareness of the Sudan's environmental concerns, and expressed more positive attitudes towards the environment than their male counterparts (table 27d).

Table 6.27
Statistical Summary of the Differences Between PTs' and SSs' Groups' and Sub-groups' Perceived Environmental Knowledge and Attitudes

a) Differences Between PTs and SSs Based on their Education Levels

Scales	University N = 107		Secondary N = 240		
	Mean	SD	Mean	SD	t- value
1. Environmental concepts (Cog1);	46.31	8.51	45.81	7.72	0.38
2. EE action skills (Cog2);	20.79	4.43	21.23	4.48	0.83
3. Attitudes towards the environment (At1);	22.24	2.56	22.65	2.96	1.31
4. Attitude towards the incorporation of EE perspectives into science programmes (At2).	28.19	3.44	28.36	3.53	0.32

** P < 0.01; * p < 0.05

b) Differences Between PTs Based on their Sex

Scales	Males N = 68		Females N = 39		
	Mean	SD	Mean	SD	t-value
1. Environmental concepts (Cog1);	45.80	8.80	46.82	8.04	0.66
2. EE action skills (Cog2);	20.60	4.46	21.13	4.38	0.53
3. EE teaching methods (Cog3);	27.01	4.04	27.41	4.54	0.45
4. Attitudes towards the environment (At1);	22.60	2.61	21.64	2.42	1.92*
5. Attitude towards the incorporation of EE perspectives into science programmes (At2).	28.16	3.50	28.13	3.38	0.10

** P < 0.01; * p < 0.05

c) Differences Between PTs Based on their Fields of Specialisation

Scales	Biological science N = 39		Physical science N = 68		
	Mean	SD	Mean	SD	t-value
1. Environmental concepts (Cog1);	44.18	7.92	46.82	6.82	1.75
2. EE action skills (Cog2);	20.35	4.42	21.01	4.43	0.74
3. EE teaching methods (Cog3);	27.41	3.53	27.01	4.60	0.50
4. Attitudes towards the environment (At1);	21.23	2.65	22.83	2.35	3.14*
5. Attitudes towards the incorporation of EE perspectives into science programmes (At2).	27.92	3.75	28.33	3.27	0.58

** P < 0.01; * p < 0.05

d) Differences Between SSs Based on their Sex

Scales	Males N = 120		Females N = 120		
	Mean	SD	Mean	SD	t- value
1. Environmental concepts (Cog1);	44.88	7.39	46.75	7.95	2.19*
2. EE action skills (Cog2);	20.88	4.27	21.59	4.68	1.22
3. Attitudes towards the environment (At1);	22.23	3.15	23.07	2.70	2.22*
4. Attitudes towards the incorporation of EE perspectives into science programmes (At2).	28.41	3.60	28.30	3.48	0.24

** P < 0.01; * p < 0.05

6.6 Summary of research findings

The analysis and interpretation of the data from this study (chapter 6) have led to the following conclusions:

Status of EE in science teacher education programmes

Science teacher educators' replies, regarding the status of EE in their institutions' programmes, revealed that EE teaching methods and approaches were poorly incorporated into science teaching method courses. Colleges and faculties of education in the Sudan's universities offer academic courses with environmental concerns. These courses were to some extent orientated to local environmental issues and required for PTs preparation. Few (5%) science tutors were involved in funded EE research projects. Only 20% of science tutors were involved in developing EE teaching materials for use in their institutions and secondary schools. Certification in EE was favoured by 85% of science tutors. The three major problems hindering the incorporation of EE perspectives into science teacher education programmes were (1) shortage of qualified staff, (2) shortage of teaching materials and equipment and (3) lack of appropriate textbooks.

Curriculum needs assessment

Science teacher educators' and STs' replies regarding what was needed to incorporate EE perspectives into SSTEPs revealed that EE objectives are important and they should be addressed by programme executors. It was also necessary to integrate EE perspectives into prospective science teacher professional preparation courses. In the opinions of the respondents, in order to prepare PTs as environmental educators in the Sudan's secondary schools, the following should be considered:

1- Environmental education perspectives should be integrated into science teaching methods and academic courses required for teacher preparation;

2- Team-taught and multidisciplinary experiences should be introduced into the existing SSTEPs to familiarise student teachers with teaching environmental issues and problems;

3- Environmental education and new untraditional science subject courses should be added to the SSTEPs in the Sudan' universities.

The incorporation of EE perspectives into science programmes of the Sudan's secondary school curriculum

In the perceptions of STs, environmental concepts related to the Sudan's environment were poorly incorporated into school science programmes and the socio-cultural aspects of environmental concerns were the least incorporated concepts. EE competencies (abilities and skills) to investigate, evaluate and take environmental actions were moderately incorporated in these programmes. Most of the EE teaching methods and approaches were "rarely/never" used by STs. Clear discrepancies were found in the STs' views about the actual and possible incorporation of EE perspectives into the science subjects they teach. However, 65.9% of them rated their abilities to teach environmental topics as "very good/good". Teacher education and training in EE are a key issue in the incorporation of EE perspectives into science programmes in the Sudan's secondary schools. Differences between PTs' perceptions were found on the above issues based on their fields of specialisation and years of teaching experience (tables 16b and c).

Environmental knowledge and attitudes

Prospective science teachers and SSs perceived themselves well aware of the Sudan's environmental concerns. They felt competent to take environmental actions. They expressed positive attitudes towards the environment and the incorporation of EE perspectives into science programmes. They perceived science subjects (biology and chemistry) as contributing a lot to their awareness of the Sudan's environmental concerns. PTs perceived private reading and mass

media as their main sources of environmental information. SSs perceived general education and mass media as their main sources of environmental information.

The correlations between respondents' scores in environmental knowledge scales tended to be higher than the correlations between their scores in environmental knowledge and attitudinal scales.

The regression analysis of respondents' scores in environmental knowledge and attitudinal scales showed that only environmental knowledge variables, in the case of the two groups, explained the variance in the subjects perceived abilities to take environmental actions. The said variables explained 30% of the variance in the case of PTs and 20% of the variance in the case of SSs.

Minor differences were found between PTs and SSs perceived environmental knowledge and attitudes based on their sex. Physical sciences PTs expressed more positive attitudes towards the environment than their biological counterparts (tables 27b, c and d).

CHAPTER SEVEN
DISCUSSION OF THE RESULTS

7.0 Introduction

This chapter is devoted to the discussion of the results of the study presented in chapter 6. The discussion is divided into four sections. The first two sections are concerned with the status of EE in secondary science teacher education programmes (SSTEPs) in the Sudan's universities and the assessment of the curriculum needs for the incorporation of EE perspectives into these programmes.

The current status of EE in science programmes of the Sudan's secondary school curriculum, the differences between the STs' sub-groups responses in this issue, and how to rectify the shortcomings of these programmes with regard to questions raised by these results are discussed in section three.

The final section of this chapter is devoted to the discussion of PTs' and SSs' perceived environmental knowledge and attitudes, the relationships between each group's scores in its questionnaire scales, the contribution these variables made to the subjects' perceived abilities to take environmental action, and the differences between the subjects' groups' and sub-groups' perceived environmental knowledge and attitudes results.

7.1 Status of EE in secondary science teacher education programmes

The evidence from this study reveals that SEs' backgrounds with regard to EE is relatively weak. Few of them were involved in developing instructional materials for their institutions and secondary schools. EE teaching methods and approaches were poorly incorporated into the existing science teaching methods courses. Colleges and faculties of education in the Sudan's universities offered academic courses with environmental concerns orientated to local environmental issues (chap. 6, section 6.1 and 2).

Science teacher educators biographic information reveals that only 5% (one person) hold a Ph.D. in EE (table, 6.2). The implications of this are that the

incorporation of EE perspectives into SSTEPs in the Sudan's universities, if any, is restricted to what SEs make of its importance in the context of their teaching methods courses or subjects and what students are able to extract or extrapolate from these courses. The effects of this state of affairs on the incorporation of EE perspectives in SSTEPs will be shown later in this chapter.

The data about the SEs involvement in funded EE projects or in developing EE curriculum materials for their institutions or secondary schools revealed that only a small number of SEs are involved in these areas (table 7.1) Arrayed (1980) indicated that staff participation is of significance in effecting educational innovation in the following ways:

1- Participation leads to higher staff morale, and high staff morale is necessary for successful implementation;
2- Participation leads to greater commitment and a high degree of commitment is required for effecting change;
3- Participation leads to greater clarity about the innovation and clarity is necessary for successful implementation;
4- Participation will reduce initial resistance and thereby facilitate successful implementation.

Therefore SEs poor involvement in developing EE curriculum materials for their institutions may be a disadvantage for the environmentalisation of these programmes. But their relatively low involvement in EE projects and in the development of the EE curriculum for secondary schools is explained by the fact that these projects are mainly executed by the National Ministry of Education Centres, i.e., Bakht Elruda National Educational Research Centre or the National Curriculum Research Centre. The relatively low involvement of SEs in these projects indicates a critical need for greater co-ordination between the higher and general education institutions in order to produce more effective teacher preparation in this area.

Table 7.1
Tutors' Qualification and Involvement in EE in the Sudan, Malaysia and Canada

Statements	The current research	Lee, (1987) Malaysia	Towler, (1980) Canada
	N (%)	N (%)	N (%)
. Tutors with Ph.D.'s in EE;	1 (5)	2 (9)	5 (8)
. Tutors involved in funded EE projects;	1 (5)	2 (9)	5 (8)
. Tutors involved in developing EE curriculum materials for their institutions;	1 (5)	2 (9)	--
. Tutors involved in developing EE curriculum materials for secondary schools.	4 (20)	3 (13.5)	20 (32)

Comparing the current research findings in the areas of SEs' qualifications and involvement in EE projects with research findings in Malaysia (Lee, 1987) and Canada (Towler, 1980), the results so far suggest the three countries show weak SEs-backgrounds in EE and low rates of involvement in this area. Despite the time factor between the three studies, the situation in the Sudan seems to be not too far behind the other countries (table 7.1), but it is a disappointing result after nearly two decades of the environmentalisation movement world-wide.

The fact that EE teaching methods and approaches were poorly incorporated in the science teaching methods courses, yet colleges and faculties of education in the Sudan's universities offer academic courses with environmental concerns orientated to the local environmental issues, indicates the absence of a holistic approach to EE in SSTEPs. Environmentalists have generally stressed that EE experiences should be an integral part of every aspect of teacher education and training programmes (Selim, 1990; Wilke et al., 1987; Wilke, 1983; Pettus, 1982; UNESCO, 1980). However, these results also raise the question as to whether such approaches will prepare environmentally educated teachers competent to handle complex, multifaceted and controversial environmental issues in secondary schools and whether such approaches will improve teachers' abilities and willingness to integrate EE perspectives into their teaching.

The evidence from this study shows that the major problems hindering the environmentalisation of SSTEPs in the Sudan's universities are (1) shortage of qualified staff, (2) shortage of teaching materials and equipment and (3) lack of textbooks (table 6.4). According to Stapp and his colleagues (1980/81) without well trained and motivated teachers, the best designed physical facilities, instructional materials and curricula programmes will not lead to successful EE. Therefore, the problem in the Sudan's universities appears to be the shortage and lack of all the ingredients in the equation above. Consequently, without precise measures to correct this state of affairs the future of EE in these programmes does not look bright.

The conclusion in this section is that the SEs' background and SSTEPs content and approaches are not matching the current philosophy of EE. Major problems are facing the incorporation of EE perspectives in the institutions under study. Consequently, their chances of preparing environmentally educated science teachers are questionable.

7.2 Curriculum need assessment

Data collected from this research survey (Q1 section (2), and Q2 section (2)) indicate that:

1-There is a clear need for curriculum development in teacher education institutions to ensure that EE is taken into consideration;

2- Although it is generally felt that environmental educators can be prepared within the framework of traditional science teaching methods courses, these courses, as they exist, are perceived by SEs and STs as being inadequate for this purpose. There is a need for SEs to make concerted efforts to incorporate EE teaching methods and approaches into the science teaching method courses;

3- There is a need to make EE part and parcel of science teachers' professional preparation courses in the Sudan's universities;

4- There is a need for SSTEPs to include courses pertaining to research methodologies for designing and developing methods and instruments which enable teachers to effectively fulfil the objectives of EE;

5- Science teachers in training need to be given an understanding of as wide a range as possible of EE instructional materials, aids and resources, with special reference to low cost materials and opportunities for adaptation in local circumstances;

6- Teacher training institutions need to include aspects of EE that meet the requirement of an interdisciplinary approach and methodology;

7- There is a need for teacher education institutions to undertake research to develop low cost EE methods and materials to enable educators to train or retrain themselves on their own;

8- There is a need to develop team-taught multidisciplinary method experiences in SSTEPs so that PTs can transfer and translate this practice into reality of the teaching and learning situation in schools;

9- Science teacher trainees' academic preparation is perceived as inadequate for preparing them to integrate EE perspectives into science programmes in the Sudan's secondary schools curriculum. This is attributed to the fact that the usual structure of natural science courses as separate subjects biology, chemistry and physics is not adequate to meet the demands of a science curriculum that includes problems and issues related to the environment. In the light of this, there is a need to include elements of untraditional science subjects areas such as economics, sociology and EE in the curriculum;

10- Overall, teacher education programmes need to provide experiences that typically engender genuine concerns about environmental problems and issues.

7.2.1 The gap between theory and practice

The evidence from this study is that clear discrepancies existed between SEs' and STs' stated views and what actually takes place in colleges and faculties of education in the Sudan's universities. The subjects felt that EE objectives are

important, but most of them are not being met to a satisfactory extent by the existing SSTEPs (table 6.5). They also expressed the view that EE perspectives are desired but currently they are not met in the existing PTs' professional preparation courses (table 6.6)

The research findings above are consistent with research findings in the US (Volk et al., 1984) and in Malaysia (Lee, 1987). They also suggested that there is an urgent need for the correction of this state of affairs in these programmes to prepare PTs for their dual role as science and environmental educators, the role advocated by UNESCO-UNEP experts.

> "Educators have in fact a decisive part to play in preventing and solving environmental problems, not only by virtue of their teaching activities, but also through their participation in farming and implementation of environmental policies. This dual function of educators confers on them a great social importance, but also great responsibilities" (UNESCO, 1980, p. 48).

The mismatch between theory and practice shown above by the subjects' responses can be attributed to a number of factors noted in chapters 4 and 6 of this study. These factors may hint at some of the measures that may help in correcting this state of affairs. These include the following:

1- No clear policies existed for promoting EE or even for including it in the existing SSTEPs in the institutions under study by this research (chap. 2, section, 2.4.2). The guidelines advocated by the UNESCO-UNEP experts (UNESCO, 1986a and b, Wilke et al., 1987) and the experience from the US (Champeau, 1990; Wilke, 1985) and in the UK (Oulton, 1991) showed that the key issue for implementation of EE perspectives into teacher education programmes are the institutional policies and the mechanisms which translate them into manageable programmes;

2- The SEs-backgrounds are relatively weak with regard to EE (table 6.2). Ham and Sewing (1988, p.18) stated that "Teachers with a poor background in the

discipline may lack the personal interest or commitment to provide adequate instruction in that subject area";

3- The traditional content, teaching methods and approaches, assessment procedures, and experiences provided by the existing SSTEPs are not orientated for preparing PTs for their dual role as science and environmental educators (chap. 6, section, 6.2 and table 7.2).

4- There is a lack of consensus about the role, scope and content of EE among the administrators, educational planners, the curriculum developers and programme designers and executors. This state of affairs was identified by 45% of the respondents who attempted Q1, section two, item 23. This can best be summarised by quoting respondent three:

> "As you may know, EE is underestimated in a culture like ours i.e. in the Sudan. I was astonished when I first learnt that this study is about EE. Probably the best start is to convince the decision makers and the curriculum planners that such an education is important and even crucial in a society undergoing drastic environmental change towards the worst. I recall for example, the recent problem of drought and desertification. The steps to follow, I think, will be easy. Best wishes".

7.2.2 Environmental education approaches

Evidence from this study shows that teacher education institutions need to include appropriate aspects of EE curricula that meet interdisciplinary methods and approaches (table 6.6, item 6; and table 6.7 items 4 and 8).

Advocates of EE stress that since EE should be directed to the practical solutions of human environmental problems (often these are complex and multifaceted) an interdisciplinary approach should be adopted in SSTEPs (Fien, 1991; Selim, 1990; Wilke et al., 1987). Innovative changes are needed in these programmes to provide PTs with basic knowledge, skills, experiences and values so that they can effectively function in team-taught and multidisciplinary approaches in schools (Nicholas and Scott, 1993; UNESCO, 1986a and b, 1980).

A synthesis of literature in chapter 3 of this study and the guidelines advocated by UNESCO-UNEP experts regarding the incorporation of EE perspectives into SSTEPs (UNESCO, 1986a and b; 1980) showed that the innovative changes needed in the existing SSTEPs to introduce team-taught and multidisciplinary approaches can be implemented through two routes (1) the incorporation of EE perspectives in the whole programme and (2) the introduction of a new team-taught and multidisciplinary method and/or academic course(s).

The first of these possibilities involves a break down of the traditional boundaries between disciplines to make EE a subject of study that should facilitate the team-taught and multidisciplinary training of non-specialist teachers and also produce a capability of introducing environmental issues and problems into their teaching. The aim here, as expounded by UNESCO-UNEP experts is "not to train EE specialists, but rather to provide educators with the necessary skills to approach environmental questions" (UNESCO, 1980, P.45).

On the other hand, team-taught and multidisciplinary methods and/or academic course(s), focus on approaches to teaching about controversial environmental issues, and provide teachers with the minimum requirements needed to handle these issues. Cheong (1983) pointed out that teachers are not expected to know everything about environmental problems. However, it will be an asset for them to know how to utilise expertise and resources in and out of school to tackle environmental questions.

Each of the two routes outlined above has its own limitations. For the environmentalisation of the whole programme, these include as indicated in the literature (Wilke, et al., 1987; Gayford, 1986) the following:

1- Tutors' experience and commitments;

2- It requires considerable planning, management and organisation across the curriculum;

3- The availability of environmentalised teaching and learning facilities;

4- Time;

5- Training and retraining of the personnel;

6- The negative attitudes of tutors who perceive their role as to prepare subject specialists only.

Moreover, introduction of new course(s) in the programmes, is also considered to be a short term solution, if the overall nature of the issue is that EE experiences are to be an integral part of every aspects of SSTEPs, as pointed out by Pettus (1982). In addition, there is a fear that this approach may lead other tutors who teach the other courses to think that what is given in this new course(s) is all that is needed for the programme's environmentalisation.

The conclusion here is that, given the critical need and justification for team-taught and multidisciplinary approaches noted by both SEs and STs and confirmed by curriculum developers and EE theorists and considering the fact that, the existing SSTEPs faced most if not all of the constraints stated above (Chap. 6, section 6.2 and section 7.2.1 above), the way ahead for environmentalisation of these programmes, could be the adoption of the two routes, the second one as a short term solution and the first one for the longer term.

7.2.3 Teaching method courses

Evidence from this study shows that 60% of SEs and 65% of STs felt that the current science teaching method courses offered in colleges and faculties of education in the Sudan's universities under study by this research are inadequate for preparing STs to incorporate EE perspectives into science programmes of the secondary school curriculum. However, 55% of SEs and 52% of STs were of the opinion that environmental educators can be prepared within the framework of these courses (table 6.7).

Further analysis of STs replies to item 2 (table 6.7) indicate that the magnitude of this problem differs across the teaching method courses in the three subjects. 45%, 75% and 74% of teachers of biology, chemistry and physics

respectively indicated that their subject teaching method course are inadequate for STs preparation for EE (table 7.2).

Table 7.2

The Adequacy of Science Teaching Method Courses to Prepare STs for EE

Statement	Respondents	Agree N (%)	Disagree N (%)	Not sure N (%)
The current science teaching method courses offered in your college are adequate for training PTs to incorporate EE in secondary school curriculum	Biology teachers	11 (38)	13 (45)	05 (17)
	Chemistry teachers	03 (09)	24 (75)	05 (16)
	Physics teachers	01 (04)	20 (74)	06 (22)
	Total	15 (17)	57 (65)	16 (18)

The inadequacy of teaching method courses noted above and the differences across the three science subjects could be attributed to the following factors:

1- The poor incorporation of EE teaching method and approaches in these courses (Q1, section one);

2- Science teacher educators' weak backgrounds with regard to EE (table 6.2). In the UK Her Majesty's Inspectorate (Department of Education and Science, 1987, p.111) pointed out that "the teaching methods employed by tutors should be regarded as models for students' own future teaching". Therefore, the SEs' backgrounds noted in this research suggest that they may not be able to employ teaching methods and approaches that could be good models for student teachers to incorporate EE perspectives in their future teaching. This might be a reason for them to consider existing science teaching method courses as inadequate for their preparation as environmental educators;

3- The inadequacy of STs' academic preparation in terms of science subject matters (table 6.7 items 5, 6 and 7). This factor will be explained later (section 7.2.4).

Given the conviction shown by a substantial number of both SEs and STs that environmental educators can be prepared within the framework of existing science teaching method courses and considering the fact that the aim is to prepare STs to handle environmental questions in their teaching, rather than preparing EE

specialists, the shortcomings of these courses could be rectified if the following measures were considered:

1- Training and retraining of SEs for EE;

2- Restructuring the existing science teaching method courses to integrate EE teaching methods and approaches;

3- Introduction of EE method courses as elective course for STs who want to develop further their competencies in this area.

7.2.4 Academic course needs

The results of this study indicate that SEs and STs felt that the specialist orientation of SSTEPs was narrow, lacking the broad perspectives required for understanding environmental problems and issues. Additional courses were needed for them to prepare PTs to handle environmental issues in their teaching (tables 6.7 and 6.5). The respondents felt that additional courses in non-traditional science areas such as EE, sociology and economics would be helpful to PTs to integrate EE perspectives into science programmes in the Sudan's secondary schools (tables 6.7 and 6.8).

Advocates of EE pointed to two main issues that needed to be addressed in the academic preparation of PTs, to enable them to integrate EE perspectives into their teaching. These issues are:

1- To combat environmental problems through education, environmental concerns (problems, issues and solutions) should be seen as an interlinked array of political, social, economic and biophysical environmental factors. Therefore, if science teaching is to address these issues, the academic preparation of science teachers should not be contingent solely on traditional requirements of scientific disciplines per se (UNESCO, 1986a and b; Zoller, 1984).

2- Environmental education involves essentially teaching through action. Knowledge, attitudes and skills assume their full significance in contact with the problems of the environment. (UNESCO, 1980).Therefore :

a- teacher education and training for EE should go beyond environmental awareness to environmental action and decision making (Wilke et al., 1987; Hungerford and Volk, 1984; Noibi, 1981; Peyton and Hungerford, 1980);

b- it should prepare PTs to play their dual role as environmental educators and activists in their communities (Posch, 1993; Robottom, 1987; UNESCO, 1980);

c- it should equip them with problem solving skills, in order to facilitate their development into environmentally-orientated competent decision-making agents, capable of creating a bridge between the "model" world of the school and the "actual" complex reality of their communities (Hart and Robottom, 1990a and b; Zoller, 1984; Knapp, 1983); and

d- it should equip them to educate scientifically and environmentally literate citizens who can explore, discover, discuss, synthesise and assess problems and issues associated with their physical and social environment (Pettus, 1982; Chelliah, 1981; UNESCO, 1980; Hungerford, et al., 1980; Hammerman, 1979).

To overcome the academic shortcomings of SSTEPs shown by the SEs' and STs' views on the basis of the guidelines mentioned above, two possible solutions could be adopted. First, the current SSTEPs could be restructured to shift the emphasis from a science specialist orientation to more broad-based, interdisciplinary programmes with a generalist orientation. The fact that most of the science departments in colleges and faculties of education in the Sudan's universities have a flexible course structure, which is based on basic, supportive and elective courses may be in favour of this solution, especially since, most of the additional courses suggested by the SEs' views (table 6.8) are offered by science departments or the other departments in their institutions.

Secondly, since the academic courses take more than 65% of PTs' degree time, e.g. 67% in Omdurman Faculty of Education, University of Khartoum (Omdurman Faculty of Education Prospectus, 1987), and 70% in Juba College of

Education, University of Juba (University of Juba Calendar, 1986), they should play a considerable role in PTs preparation for their role as science and environmental educators. The new trends advocated by the EE theorists of community-participation, decision-making, citizenship education, problem solving and teaching controversial issues in science should be integrated into these courses. However, it also seems indispensable in this connection to increase the numbers of seminars, workshops and practical activities in this field, involving joint participation by tutors in different disciplines to give PTs practical examples which will equip them for their future role as science and environmental educators in schools.

7.3 The status of environmental education in science programmes of the Sudan's secondary school curriculum

The perception of STs was that the key environmental concepts were poorly incorporated into science programmes of the Sudan's secondary school curriculum and the socio-cultural aspects of environmental concerns were the least incorporated concepts in these programmes (table 6.9). EE action skills were moderately incorporated into these programmes (table 6.10). 65% of STs rated their abilities to teach environmental topics as "very good/good".

The results above confirm the research findings in the Sudan's secondary schools (Ali, 1987), and in lower education levels (Mutuli, 1986; Eltaib et al., 1985; Lutfi, 1983). The main conclusion from all these studies is that STs perceived most of the existing science programmes in the general education curriculum as not environmentally-orientated in their content and approaches.

The poor incorporation of EE perspectives into science programmes of the Sudan's secondary school curriculum could be attributed to the following:

1- These programmes were designed in the 1970's Sudan Educational Reform. Since that time, their content, approaches and methodologies have not been revitalised or modernised. Consequently, the coverage in these programmes of the current environmental concerns in the Sudan is not satisfactory and

relevant, if we consider the current drastic natural and social environmental changes that occurred recently due to the desertification, drought and the impact of the ongoing civil war.

2- Given the fact that the country has adopted a centralised national curriculum, with unified textbooks for all schools, the existing secondary science textbooks have a lot of shortcomings with regard to environmental questions. These include the following:

a- The biology textbooks, whose editors claimed that they adopted an environmental approach to biology teaching in their content (Abdulwhab et al., 1982), have been criticised as not covering the different ecological zones in the Sudan, which range from desert in the North to deciduous forests in the South (Lutfi, 1984). Moreover, the ecology sections in these textbooks lack practical activities and mainly deal with interrelationships of organisms and their environments, rather than with human ecosystems that emphasise man kind as a part of nature (Androga, 1986);

b- In Ali's (1987) study, respondents stated that one of the constraints on the environmentalisation of the existing chemistry programmes was that chemistry textbooks and teaching resources were not environmentally-orientated;

c- Science textbooks generally present science as factual information to be memorised rather than processes to be learned and applied by students in their real life (Tairab, 1992; Salih, 1983).

Socio-cultural issues were perceived by STs as being the concepts least well incorporated into existing science programmes (items, 8 , 12 and 13, table 6.9), and also, PTs and SSs perceived themselves least aware of these concepts, (items, 8, 12 and 13, table 6.17). These issues include:

1- Environmental problems and social values;

2- Politics and environmental problems;

3- Global environmental issues and national policies.

The literature relative to these concepts raises issues of concern to both science and environmental educators. These issues arise because of the aims to enable students to become active citizens, involved in environmental decision-making, as well as having global perspectives towards the environmental concerns (Hammerman and Volker, 1987; Byee, 1987; UNESCO, 1986b; Hungerford and Volk, 1984). For example, Their (1981, p.103) stressed that:

> "Scientific and environmental awareness, knowledge and understanding are cultural imperative in all countries. The citizens in a free society must understand the advantages and limitations of scientific and environmental changes in order to participate effectively in public policy making. For this reason science and EE should be related to the local environment, culture and experience of citizens. Therefore, our concern with the development of science and EE to meet this societal need requires emphasis on science for the citizen".

On the basis of the issues above, the shortcomings of the existing science programmes in addressing the concepts stated earlier, could be considered as other indicators of the irrelevant and out of date approaches of these programmes for both science and EE.

Therefore, the implications of these findings are that the current science programmes' content, approaches and teaching/learning materials should be environmentalised. The new trends advocated in science and EE should be considered in their reappraisal to enable STs and those who prepare to be STs to incorporate EE perspectives into their teaching.

7.3.1 Teaching methods and approaches

The results of this study reveal that STs "never/rarely" used most of the teaching methods and approaches advocated for teaching EE in the literature (table 6.11). This finding confirms the previous research results in the Sudan. Ali (1987) found that Khartoum state's secondary chemistry teachers rarely used progressive teaching styles advocated for teaching EE in schools. Both Eltaib and his colleagues (1985) and Lutfi (1983) reported that pedagogical styles used in the

Sudan's primary and intermediate school science classrooms emphasised teaching environmental topics rather than developing skills, concerns and attitudes towards the environment.

Environmental education theorists generally stress that if we intend to achieve EE objectives, it is necessary to adopt problem-orientated and action-orientated methodologies which involve students in active participation in using the environment as a teaching/learning resource (Posch, 1993; Wilke et al., 1987; UNESCO-UNEP, 1992; UNESCO, 1986a, 1986b; Hungerford and Volk, 1984; Pettus, 1982; Chelliah, 1981). Greis (1988, p.21) stated that:

> "In both development and EE as in the related field of world studies ..., there is also a growing emphasis on the importance of process in teaching and learning. A classroom characterised by individual competition, compartmentalisation of knowledge into rigid subject areas, an emphasis on learning through abstract concepts rather than direct experience and devaluing of personal feeling is unlikely to foster concern, understanding and skills necessary for active participation and involvement in rapidly changing, interdependent world in which we live. An education which involves integration across subject boundaries and which emphasises active, experiential student-centred approaches is felt to be more appropriate for such a world, that is, an education both for the whole world and the whole person".

Empirical research findings support the environmentalists' viewpoints mentioned above. Researchers in science education in the Sudan found that students who participated in the EE programmes activities showed increased understanding and enthusiasm for topics related to the environmental concerns in the country (Eltaib et al., 1985). Science educators in the US reported that teaching strategies which involved the learner in active participation in science classrooms promoted responsible environmental behaviour among 7th and 8th grade students. Subjects who participated in this instruction tended to use remediative environmental behaviours more frequently than students who did not receive this training. (Ramsey and Hungerford, 1989; Ramsey et al., 1981).

In addition, progressive teaching styles have a theoretical psychological and educational backing (Gagne, 1985). They have been widely advocated in recent years with the emergence of teaching science as a process to help students to face real life challenges - environmental concerns included - (Finley, 1983; Shaw, 1983; Diuashow, 1980), and the teaching of science from STS/ environment perspectives (Bybee, 1987; Disinger, 1987). Therefore, STs' relatively low use of these teaching styles and approaches in the Sudan secondary schools may have negative impacts on environmentalisation of science programmes in particular and science teaching in the Sudan in general. This indicates a critical need for urgent measures to be taken to correct this state of affairs. These measures were reflected in STs' views (tables 6.11 and 6.16) and can be summarised in two main points:

1- Comprehensive in-service teacher education and training programmes are needed to enable STs to master the new teaching styles and approaches and to encourage them to use these styles in their science classes. Since only 3.7% of physics teachers (one person) and 9.4% (3 persons) of chemistry teachers felt that their subject teaching methods course are adequate for STs preparation for EE (table, 7.2), this matter should be given priority in any attempt to environmentalise existing science programmes of the Sudan's secondary school curriculum;

2- Considerable measures are needed to develop environmentalised teaching and learning materials in secondary schools so that teachers might apply these methods and approaches.

7.3.2 The influence of STs' characteristics on their perceptions of the incorporation of EE perspectives into science programmes of the Sudan's secondary school curriculum

Any possible sex difference between STs' views on the incorporation of EE perspectives into the current science programmes in the Sudan secondary school curriculum will be discussed later (section 7.6). 38% of teachers of biological

science felt that their subject teaching methods courses in colleges and faculties of education prepared them to incorporate EE perspectives into science programmes in secondary schools curriculum (table 7.2). Both PTs and SSs felt that biology contributed a lot to their awareness of the Sudan's environmental concerns. We can say with caution that this programme to some extent could be considered environmentally-orientated compared with the physical science courses. This conclusion is consistent with Androga's (1986) finding that biology teachers in Khartoum state secondary schools perceived biology programmes as environmentally-orientated, textbooks for all grades were rich with environmental topics and it contributed positively to students' awareness of the Sudan's environmental concerns.

The fact that biological programmes are more environmentally-orientated than physical science programmes could be attributed to the fact that this programme was adopted from the ALECSO Biology Teaching Development at Upper-secondary Level Project (Androga, 1986). This project's teaching materials according to Selim (1990) were empirically tested for their environmental-orientation in Egypt and Jordan. On the other hand, physical science programmes were adopted from the US's 1960's science programmes (Ali, 1987). The content of these programmes were criticised in their home land as discipline-centred and tightly-defined in terms of subject matter and language (UNESCO; 1986b). However, these programmes existed before the world-wide EE movement. Therefore, their shortcomings regarding the incorporation of EE perspectives is obvious.

The different views of junior and senior STs (table 16c) could be attributed to the fact that, some of the senior STs graduated from universities before the environmentalisation movement and the lack of in-service education and training for EE in the Sudan (table 6.1). Therefore, if we considered the fact that the majority of this group are science headteachers or inspectors, then, it is possible

that this may have negative impacts on the environmentalisation of science programmes. A similar point was made by Ali's (1987) respondents.

Finally differences in the views of these sub-groups and their implications may provide helpful pointers to educational planners, curriculum developers and science programme designers for identifying priorities in the environmentalisation of existing science programmes, and the in-service education and training of teachers for EE. In addition, such programmes should be developed from within the Sudan rather than imported.

7.4 Environmental knowledge and attitudes

7.4.1 Knowledge of environmental concepts

Awareness of the Sudan's students of environmental concerns (table 6.17) could be attributed to the exposure to environmental issues they received in their science classes (table 6.22), and from other environmental information sources (table 6.23). However, after the country's drastic desertification, drought and civil war in the 1980's, students have been more exposed to such terms as desertification, urbanisation, food, energy and oil crisis. Moreover, some of these issues have become parts of their day to day life. The media, politicians, international community (aid agencies), environmentalists and teachers have all expressed concerns over the deteriorating quality of the environment and the critical need for measures to combat these issues. The observations worth noting at this juncture, from the subjects' responses are:

1- The concepts which PTs and SSs perceived themselves as most and least aware of are mostly the same concepts that STs perceived as most and least well incorporated into the existing science programmes in the Sudan's secondary schools curriculum (tables 6.17 and 6.9);

2- While STs perceived desertification as the only concept incorporated "a lot" into the existing science programmes (table 6.9), PTs and SSs perceived this concept as one of the three concepts they were most aware of (table 6.17), and

60% of PTs and 50% of SSs considered this issue as the most serious environmental problem facing the country today (table 6.24);

3- While STs perceived that environmental concepts were poorly incorporated into the existing science programmes (table 6.9), both PTs and SSs perceived that science subjects (biology and chemistry) contributed "a lot" to their awareness of the Sudan's environmental concerns (table 6.22), with biology being rated first of all student's environmental information sources (tables 6.22 and 6.23).

The results above and the observations drawn from them show clear features of PTs' and SSs' "conceptual maps" with regard to their awareness of the Sudan's environmental concerns. They also indicate from students' viewpoints that the existing science programmes have considerable environmental awareness messages. Currently in science education students' concept maps are considered to be essential for successful teaching and learning processes (Trowbridge and Mintzes, 1989; Shayer and Adey, 1980). Moreover, EE theorists are considering students' knowledge of environmental concepts as the key factor in the environmentalisation of the curriculum (Hungerford, et al., 1980; Hammerman, 1979). The results above should be considered in any attempt to environmentalise the existing science programmes in the Sudan's teacher education institutions and secondary schools.

7.4.2 Environmental competencies (abilities and skills)

The results from this study reveal that PTs and SSs perceived themselves competent to investigate, evaluate and take environmental actions in issues related to the Sudan's environment (table 6.18).

This result suggests that the subjects possessed competencies badly needed for environmentally literate citizens (Poch, 1993; Curriculum Council for Wales, 1992; Wilke, 1985). These features have been cited in the literature as the ultimate goal of EE (Ramsey and Hungerford, 1989). Sia and his colleagues (1985/6,

p.391) stressed the need for students and teachers to be trained in these competencies. They stated that :

> "Students need to be equipped with knowledge of environmental action strategies which they can choose to use in problem/ issue remediation. Furthermore, they need to be given training in order to develop skills and expertise in use of these strategies in remediating the specific environmental issues facing them in their daily lives. If teachers are to use citizenship participation curricula effectively, they would need to be trained how to use them".

The results above should be interpreted with caution, if we considered that researchers in the US (Peyton and Hungerford, 1980) and in Nigeria (Noibi, 1981) reported clear discrepancies between pre- and in-service teachers' "perceived" and "actual" abilities to identify, implement and take environmental actions. Even, if we considered that the subjects "actually" have these competencies, it seems based on the findings of this study, the contribution the existing SSTEPs and secondary science programmes made to the promotion of these competencies is questionable. These finding are that:

1- Almost 85% of SEs and 59% of STs felt that EE objectives (evaluation and participation) were poorly incorporated into the existing SSTEPs in the Sudan's universities (table 6.5);

2- Relatively little attention was usually given to the aspects of methodologies and approaches which promote students' competencies to take environmental action in both SSTEPs (chap. 6, section, 6.2 and table 7.2) and in secondary science programmes (table 6.11);

3- Science teachers perceived the said competencies as incorporated to "a moderate" extent in their subjects (table 6.10).

Finally, the results above and their implications seem to suggest the following:

1- Further research efforts in this area seem warranted to examine the subjects' or similar populations' "actual" environmental competencies as a prerequisite for curriculum environmentalisation in the Sudan.

2- A broad range of methodologies and approaches which promote the environmental action competencies are needed in teacher education institutions and secondary schools in the Sudan.

7.4.3 Attitudes towards the environment

The results of this study indicate that PTs and SSs expressed positive attitudes towards the environment and the incorporation of EE perspectives into science programmes of the Sudan's secondary school curriculum (tables 6.20 and 6.21).

The results above confirm research findings in the US (Edralin, 1989; Bohl, 1976; Perkes, 1973) and in the UK (Gayford, 1987; Richmond, 1976), with regard to subjects' expressed positive attitudes towards the environment (attitude sub-sets, beliefs and values). However, this point should be interpreted with caution, bearing in mind the different cultural factors involved and the rapid change and regional nature of environmental concerns.

Hines and his colleagues (1987) hypothesised that environmental knowledge and attitudes are interrelated and they can generate, with other personality factors, expressed intention to take action. They are also factors strongly associated with responsible environmental behaviour (chap. 4, Fig. 4.1). Therefore, the positive attitudes expressed in the present research by respondents may be considered as good support for their awareness of the Sudan's environmental concerns and their perceived abilities and skills to take environmental actions. In addition, they may be also an indicator of their future environmental behaviour. The results above may also indicate students' desire to learn more about environmental concerns in the future. Yager and Tamir (1993, p.643) stated that:

"It is generally accepted that learning is enhanced when students have positive attitudes about the subject. They are more motivated, more involved with meeting the course objectives, and more likely to realise instructional goals".

Environmental educators generally advocate that one of the major goals of EE is to develop a sense of responsibility that ensures appropriate action for environmental issues and problems (UNESCO, 1980, 1977b). However, some of the observations that can be made from the subjects' response patterns reflect their willingness to materialise this goal, together with their sympathetic view of the environmentalisation of science programmes. These observations include the following:

1- The subjects' environmental attitudes tended to be strongly positive when the item was concerned their participation in environmental actions (e.g. item, 6, table 6.20, and items, 6 and 7, table 6.21).

2- The subjects' environmental attitudes tended to be strongly positive when the item was concerned with their preference for or the utilitarian function of environmentalisation of science programmes, (e.g. items, 1 and 2, table 6.21).

The only negative response revealed by the subjects' response patterns was shown by their agreement with item, 3 (table 6.20) "*environmental preservation in the Sudan can be maintained only by law*". This response may be because the majority of the subjects were not aware of the complex and multifaceted nature of the issue, apart from the legal aspects. These measures include environmental ethics, EE, sustainable development and environmental data collection and dissemination (Ghaznawi, 1990). Therefore, it seems warranted that this issue should be considered in the environmentalisation of the curriculum in the Sudan.

Currently both science and environmental educators emphasise that future programmes should address the learner's affective domain, so that he/she be motivated and participate willingly to overcome real life challenges, environmental concerns included (Yager and Tamir, 1993, Iozzi, 1989a and b; Hodson, 1988a and b). Therefore, the results above and their implications may be

good pointers for curriculum developers and programme designers to "green" SSTEPs in the Sudan's universities and science programmes of the secondary school curriculum.

7.4.4 The relationships between the respondent's perceived environmental knowledge and attitudes

The evidence from this study shows that the inter-correlation of respondents' perceived environmental knowledge scores tended to be in most cases relatively high and significant. The correlation between their scores in attitudinal scales tended to be fairly low. The overall correlation between subjects' scores in environmental knowledge and attitudes sub-sets tended to be very low (Tables 6.25a and b).

The results above support research findings in the US (Hines et al., 1987; Hounshell and Ligget, 1973) and in the UK (Richmond, 1976). Significant correlation between the respondents' scores in environmental knowledge and attitudes sub-sets has been reported in all these studies. However, these relationships have not been well established in EE literature (Hines et al., 1987). They could not be seen as cause-effects relationship (Borg and Gall, 1989). But researchers (Hounshell and Liggett, 1973, p.30) who found relatively strong relationships ($r = 0.60$), between these variables postulate that:

> "One viable approach to creating constructive environmental attitudes appears to be through providing knowledge about man's environment and his role in the environment to the students. This would lead one to believe that a well structured and well-planned approach to EE will yield positive attitudinal changes".

Moreover, Richmond (1976, p.186) reported a strong relationship between conceptual knowledge and attitudes ($r = 0.48$) and slightly weaker relationship between factual environmental knowledge and attitudes ($r = 0.38$). He concluded that:

> "Without diminishing the value of factual environmental knowledge (which was mentioned earlier as prerequisite for responsible decision-making), these results appear to underline the importance of conceptual knowledge in the development of positive environmental attitudes. Although no causative relationship has been demonstrated the relative correlation between conceptual and belief sections suggests that the development of sound concepts might be productive means of leading to the establishment of positive attitudes... Therefore, conceptual understanding should be a prime objective of EE".

The results of this study appear to be in line with Richmond's (1976) conclusion above. The respondents' scores in conceptual knowledge appear to be a central factor correlating significantly with their perceived abilities to take environmental actions ($r = 0.42$ and 0.44) for PTs and SS's respectively, and with their attitudes towards the incorporation of EE perspectives into science programmes of the Sudan's secondary school curriculum, ($r = 0.35$ and 0.21, $p<0.01$ for the two groups respectively). Therefore, with the research findings above in mind, one may postulate that conceptual understanding should be given priority in the environmentalisation of SSTEPs and science programmes of the secondary school curriculum. Such an approach would help the learners to address and remediate environmental problems effectively and to establish proactive attitudes towards the incorporation of EE perspectives in science programmes. This might also lead to the development of positive attitudes to the environment.

On the other hand, the overall correlation between the subjects' scores in environmental knowledge and attitudinal sub-sets in this study (Tables 6.26a and b) are lower, suggesting that these construct are different (Cronbach and Meehl, 1955). Therefore, the results in this case could be interpreted as construct validity of the research instruments Q3 and Q4. Brown and Njabili (1989, p. 62) in testing the construct validity of practical biology in East African Public Examinations stated that: "High correlation occurs between tests which measure the same construct, i.e. tests show 'convergent' validity and low correlation are expected to

occur between tests measuring different constructs, i.e. showing 'divergent' or 'discriminant' validity".

7.4.5 The relative contributions of the respondents' perceived environmental knowledge and attitudes variables to their perceived abilities to take environmental action

The regression analysis of PTs' and SSs' scores in environmental knowledge and attitudes sub-sets showed that only perceived environmental knowledge variables in the case of the two groups, explained the variance in the subjects' perceived abilities to take environmental actions (Cog2). These variables explained 30% of the variance in the case of PTs and 20% of the variance in the case of SSs (tables 6.26 a and b).

The previous studies in the US (Peyton and Hungerford, 1980) and in Nigeria (Noibi, 1981) which tested their respondents' abilities to take environmental actions did not explore the factors which contributed to this issue. The earlier studies in the US (Bohl, 1976; Perkes, 1973) and in the UK (Richmond, 1976) examined the contributions made by students' demographic factors to their environmental knowledge and attitudes (schools' sex, type and location). Moreover, the recent studies in the US showed that EE instructional methodologies in science classrooms contributed to the seventh grade students' perceived abilities to take environmental actions (Ramsey et al., 1989). Adults' perceived skills in and knowledge of environmental action strategies are the best predictors of their responsible environmental behaviour (Sia et al., 1986). This study took the issue from a different angle from all these studies, by examining the contributions made by some students' personality factors to their perceived abilities to take environmental actions.

With the critical need for emphasis in EE to be directed from awareness and analysis of environmental problems towards citizen participation and the development of learners' abilities and skills to take environmental actions to be considered as the ultimate goal of EE (Sia et al., 1986; Volk et al., 1984), the

results above provide a clear mandate for EE curriculum developers, and programme designers, to address environmental knowledge variables in the environmentalisation of SSTEPs in the Sudan's universities and science programmes of the secondary school curriculum. This statement is made, in part, because of the variables under consideration in this study, only environmental knowledge variables accounted for an appreciable amount of the variance.

Twenty per cent of the variation of the PTs perceived abilities to take environmental actions (Cog2) was explained by their perceived abilities to use EE teaching methods and approaches (Cog3). These variables were significantly correlated ($r = 0.45$, $p < 0.01$, table 6.25a). It may be inferred that the more PTs are prepared to use EE teaching methods and approaches, the more they become capable of addressing and remediating environmental problems effectively in the science classrooms and in their localities. Hence, they might also transfer that to their students. Therefore, without diminishing the value of other factors needed for PTs preparation to take environmental actions, this issue should be given due consideration in the environmentalisation of SSTEPs in the Sudan's universities.

Finally, although these results offer some valuable information about the factors which contributed to the subjects' perceived abilities to take environmental actions, they also establish the need to identify what variable or set of variables account for the unexplained 70% and 80% of the variability in PTs' and SSs' scores respectively. Further research among the two groups or of similar populations in other education institutions in the Sudan seems warranted in order to further identify the factors that more fully predict subjects' "perceived" or "actual" abilities to take environmental actions.

7.4.6 The difference between PTs' and SSs' groups' and sub-groups' perceived environmental knowledge and attitudes

The similarity between PTs and SSs in their perceived environmental knowledge and attitudes based on their education levels (table 6.27a) could be attributed to the fact that most of the issues in the two groups' questionnaires (Q3

and Q4) are more related to the secondary level. In addition, shared views seem to indicate areas of genuine concern.

The fact that physical sciences PTs expressed more positive attitudes towards the environment than their biological counterparts (table 6.27c) is hard to explain if we consider the other results of this study that EE perspectives were perceived to be incorporated to a greater extent into biological programmes than physical sciences in both SSTEPs and science programmes of the Sudan's secondary school curriculum (chap. 6, section 6.2, tables 6.15b and 7.2). The explanation for this may be that perhaps, at the university level, acquiring environmental knowledge does not alter one's attitudes towards the environment or environmental issues, as pointed out by Kinsey and Wheatley (1984, p.682). "Environmental studies doesn't significantly affect student's attitudes on environmental issues, ... but knowledge acquired by such courses does provide information support for pre-existing attitudes".

The sex differences on environmental knowledge and attitudes were examined in most of the research work reviewed in chapter 3 of this study. Relatively few studies have attempted to explore the possible influence of sex as a variable factor. In Nigeria Noibi (1981) found that pre-and in-service male secondary teachers perceived their attitudes to take environmental actions significantly higher than their female counterparts. He attributed that to cultural factors. Noibi (1981, p.74) stated that:

> "The male population at large in Nigeria is more diverse and knowledgeable of contemporary issues than the female population, because of the Nigerian cultural milieu. Nigerian cultural values dictate that a woman's role is domestic and men are expected to transmit contemporary and political issues to their women as they see fit".

The early EE research findings in the UK, Richmond (1976) and in the US Bohl (1976) and Perkes (1973) reported that male secondary students performed significantly better than females on factual environmental knowledge. The

researchers in the two countries attributed that to psychological factors, i.e., that males generally show interest and select science and environmental studies more than females.

The overall result of this study regarding the effect of sex on perception of environmental knowledge and attitudes reveals that sex is not a discriminating factor on STs performance on Q2 section three scales and items (table 16a). Minor significant differences were found between STs' and SSs' perceived environmental knowledge and attitudes based on their sex (tables 27b and d). The interesting issues in the last two groups' differences on this issue are that:

1- The females in secondary schools expressed a greater awareness of the Sudan's environmental concerns than their male counterparts;
2- Male PTs expressed more positive attitudes towards the environment than their female counterparts. This perception was reversed among SSs.

A look at the literature makes it apparent that environmental knowledge and attitudes are a complex function of many factors. These include personal, cultural, psychological, educational and biological ones (Robottom, 1988; Kinsey and Wheatly, 1984; Noibi, 1981; Richmond, 1976). It is also difficult to explain why people have the environmental attitudes that they do express (Gayford, 1987). Therefore, any attempt to attribute the sex differences in these issues to one or a set of factor(s) might be a part of but not the whole truth. The differences above might be attributed to cultural, psychological and educational factors, if we assumed the other factors are constant.

Sudanese cultural values dictate that males at secondary level have more freedom to move about, to join the work force and to socialise with many organisations outside the family, while their female counterparts usually stay at homes under their parents' control. Therefore, this state of affairs gives the females more access to the media and to private reading, the main sources of students' environmental information (table 6.23). As a result, they may become more aware of contemporary and environmental issues than their male

counterparts. Perhaps this could be the factor causing them to express more positive attitudes towards the environment.

On the other hand, the sex effect at secondary level could be attributed to the females' interest in biology. Students at this level rate this subject as their first source of environmental information (tables 6.22 and 6.23). Females in the Sudan generally have more interest in this subject and recent studies have reported higher achievement in it than by their male counterparts (Tairab, 1992, The Sudan Examination Council Report, 1991).

The fact that males at university level express more positive attitudes towards the environment than their female counterparts could be attributed to the fact that, at this level, the Sudanese cultural values give females more freedom to move about, to join co-education institutions and to become more independent. Consequently, they will start to establish a new world for themselves in an environment different from their homes and dominated by males where, for example, they have to cover their bodies from head to toe all the time. This factor might affect their knowledge, attitudes and behaviour towards many things. It also may allow the males who have been given this freedom by virtue of being males since the early days of their maturity period, to express more positive attitudes towards the environment. In addition, biologically speaking, the fact that at this level, females learn more about the socio-biological environmental factors which directly affect them as females compared with their male counterparts, for example, their role in birth control, may contribute to their less favourable attitudes towards the environment than males.

To the author's knowledge, this research may be the first of its kind to examine any effects of sex on perceptions of STs, PTs and SSs environmental knowledge and attitudes. These results suggest a need for more research in this area to examine sex differences among different age groups to highlight further whether we actually need to consider this issue in the environmentalisation of our curriculum in the Sudan.

7.5 Conclusion

The research results reveal that EE perspectives were poorly incorporated into both SSTEPs in the Sudan's universities and science programmes of the secondary school curriculum. Need exists for the shortcomings of these programmes to be rectified and the constraints hindering their environmentalisation to be addressed. Both PTs and SSs are well aware of the Sudan's environmental concerns. They expressed positive attitudes towards the environment and the environmentalisation of science programmes. Therefore, measures, approaches and areas for further research on the environmentalisation of these programmes have been highlighted.

CHAPTER EIGHT
ENVIRONMENTAL EDUCATION GUIDELINES FOR SSTEPs IN THE SUDAN'S UNIVERSITIES

8.0 Rationale

The main theme of this chapter is to propose EE guidelines for SSTEPs in the Sudan's universities and to highlight the possible procedures for the implementation of these guidelines.

The proposed EE guidelines are conceptualised and their development is based on the information gathered from the survey part of this study, the experts' opinions obtained from the literature review, as well as the author's own conception of what EE for STs should be. The ideas of many educators have been adopted and where appropriate their work has been incorporated into the guidelines (see chap. 2 and 3 for the sources of the work cited).

The major constraints for the incorporation of EE perspectives into the Sudanese education system are considered in developing the proposed EE guidelines. These include the following:

1- At the university and secondary levels, education materials and course structure are generally organised around disciplines, and little emphasis is place on an interdisciplinary approach;

2- There is a lack of consensus about the role, scope and content of EE among the administrators, education planners, curriculum developers and programme designers at all levels;

3- Science teacher educators' and STs' backgrounds with regard to EE is relatively weak;

4- Environmental education cannot avoid values, ethical and moral questions, since one of its core perspectives is that the learner should be involved in decision-making in environmental concerns and participate in remediating environmental problems in the community. In addition, the learner's community and its environment should be used as a teaching and learning

resource. The author's scrutiny of the prospectuses of the institutions under study by this research revealed that there is little provision for PTs to receive formal training in the above areas (see also tables 6.5 and 6.17). Therefore, this issue is a constraint from the environmentalists' viewpoint. It indicates that these programmes are not in line with the new trend that advocates the socialisation of science education.

The proposed guidelines are conceptualised around the following broad guiding principles:

1- The learner is the key entity of an instructional system: a curriculum is meaningful only if it meets the needs and matches the knowledge, skills and attitudes of the learner. Therefore, the proposed EE guidelines have to be designed around and in response to STs' perceived needs for the environmentalisation of SSTEPs (chap. 7, section 7.2), and PTs' perceived environmental knowledge and attitudes (chap. 6, section 6.5).

2- Integration rather than re-education: the preparation of PTs for their dual role as science and environmental educators should be viewed in the light that the emphasis is to prepare PTs to address environmental questions in their teaching rather than preparing them as EE specialists. Therefore, the guidelines should work towards the goal of enabling student teachers to internalise and to integrate what they learn from different disciplines into a more holistic understanding and awareness of EE, within the constraints of minimal restructuring and reorganisation of the existing SSTEPs. As a result, the guidelines, should make provision for the two routes advocated for the environmentalisation of SSTEPs (chap. 7, section, 7.2.2). These include (1) integration of EE perspectives into all relevant science and education courses and (2) the introduction of a course(s) that is(are) truly team-taught and multidisciplinary. In this way students need not abandon all the traditional science and educational disciplines or be educated in entirely new ones (EE/environmental science) to function as environmental educators.

3- Science and EE: use of science as vehicle for EE should be reviewed from the perspectives that:

A- Natural sciences, i.e. biology, chemistry and physics generally cover environmental concerns. They are highly influenced by the gain in knowledge and new insight of environmental issues (see chap. 2, section 2.4.2). Therefore, the incorporation of EE perspectives into these subjects, at tertiary and secondary levels is attainable if those who teach these subjects have the willingness and commitment to do so;

B- Science education and EE have a lot of common ground in their perspectives (Disinger, 1987; Volk, 1984). Therefore, the precise utilisation of this ground may provide the impetus for EE to be incorporated into university and secondary school disciplines, rather than environmental science being offered for a limited number of students in already over-crowded curricula;

C- The introduction of EE is consistent with the recent trends in science education that advocate teaching science as a process rather than abstract facts to help the learner to face real life challenges (UNESCO, 1986a). It is also in line with the move for STs to include science, technology, society and environment in their teaching. The UNESCO-UNEP experts' (UNESCO, 1986b) viewpoint on this issue is that STs are concerned about the interface between scientific knowledge and society, but the characteristics of EE might add an important dimension to this limited interface, which had not been included in the socialisation of traditional science subjects with their emphasis on description and analysis.

4- People should be educated to act locally and to think globally: environmental problems are known often to have escalated into global problems and to attempt to solve them at national and/or regional levels would be both impractical and myopic. In the light of that human beings should be educated to act and to think globally. Teachers themselves have to be global in their

perspectives and SSTEPs should also place corresponding emphasis on this issue.

5- Education and the environment: education related to the environment may take three forms which have been summarised as follows (NCC, 1990a and b; Lucas, 1980; Schools Council Project Environment, 1974):

A- Education about the environment in which knowledge is obtained in connection with the environment;

B- Education through or in the environment in which environment is used as a resource for teaching and learning a broad range of educational skills;

C- Education for the environment in which an appreciation and caring attitudes is encouraged towards the environment and its use.

Therefore, the three forms above should be adopted in the environmentalisation of SSTEPs. But the ultimate purposes of EE are to be seen as education for the environment. Education of this kind is as much concerned with developing knowledge and skills as with attitudes and behaviour which are consistent with conservation.

The proposed EE guidelines that have been developed based on the above rationale, present a structural framework for programme improvement in teacher education institutions in the Sudan's universities. It is hoped that they will address the perceived needs of all concerned and above all incorporate what is believed to be an effective way to prepare PTs for their dual role as science and environmental educators. In addition, they will provide the curriculum developers and programme designers with a conceptual frame of reference within which they can improve, formulate and plan programmes that incorporate EE perspectives to achieve the following objectives:

1- To alert PTs to the urgency of environmental crisis, nationally, regionally and world-wide;

2- To develop PTs' understanding of EE within the framework of the existing SSTEPs in the Sudan's universities;

3- To develop PTs' professional capabilities in devising instructional and learning arrangements that equip them to educate scientifically and environmentally literate citizens;

4- To provide opportunities for PTs to participate actively in the development of EE initiatives in schools and at the university;

5- To provide problem solving, learner-active participation, using the community as teaching and learning resource, citizenship education and teaching controversial issues as central features of EE in science teaching;

6- To provide a rationale for and a sense of urgency for EE in science teaching as well as teaching other subjects.

8.1 Environmental education guidelines

The EE guidelines presented below represent an organised description of content in three identified domains: environmental knowledge, skills and attitudes within which potential science teachers need to attain competence during their four or five year course.

1- Knowledge

The basic environmental knowledge needed for PTs to handle environmental issues in secondary school is presented in table 8.1.

In teaching each of the environmental concepts, problems and issues presented in table 8.1 above, the following should be emphasised:

- a global perspective to environmental problems and issues;
- the ecological and cultural implications of these problems and issues;
- the viable alternative solutions available for remediating these issues and the ecological and cultural implications of these alternative solutions;
- the need for responsible citizenship action (e.g., persuasion, consumerism, legal action, political action) in addressing these environmental issues;
- the need for various transitions and policy changes in the building of a sustainable society;

Table 8.1
Environmental Knowledge

Basic environmental concepts	Environmental problems and issues
I. Ecological and physical science concepts	a. Desertification: the dramatic deterioration of the world' terrestrial resources by desert;
- Structure and function of the ecosystem;	- the Sudan's desert diffusion causes, effect and control;
- Energy flow in the ecosystem	- the ecological imbalance in area affected by drought and desert in the Sudan and the appropriate effort for their rehabilitation;
- Biochemical cycles;	b. Land use planning and priorities;
- Population dynamics;	- large scale settlements and housing schemes;
- Earth resources, their abundance, use and abuse;	- range, wildlife and national parks development
- Agriculture: the science, possi-bilities and limitations	c. Population;
- Global dynamics: changes, interdep-endence and the dynamics of feed back;	- population dynamics and environmental health;
	- rural urban migration, community health and rural population demography;
II. Social and behavioural sciences concepts related to the philosophy and theory of EE;	d. Urbanisation
- Human beings, fundamental aspects of their origin, nature and the social and cultural foundations of their behaviour;	- housing and health;
- Basic economic principles and the effect of economic conditions of people and their environment;	- traffic and transportation;
- The characteristics of human socio-cultural units and the governing dynamics within and among these unit;	- urban planing and environmental health;
- The concept of sustainable development.	e. Environmental pollution control and management;
	- air, water and noise;
	f. Management and conservation of resources;
	- basics principles of resource management and conservation;
	- energy, forest, wildlife, timber, land and minerals;
	g. Energy consumption and waste;
	- inefficiency due to old machinery and equipment;
	- lack of conservation;
	- utilisation of non-conventional energy sources for environmental protection;
	h. Waste disposal;
	- municipal waste disposal;
	- industrial;
	- agricultural;
	i. Use of chemicals in agriculture;
	- pesticides and herbicides;
	- fertilisers;
	j. Global environmental issues;
	- global warming and the destruction of the ozone layer;
	- world peace and stability;
	- green education;
	- protection of endangered species;
	- acid rain.

- the need for people to appreciate the wonder, delight and sheer pleasure that can be gained from the environment rather than the total preoccupation with environmental problems in relation to EE.

2- Skills

A number of skills are needed by PTs to create a learning environment where learners are encouraged to investigate their natural and social surroundings as well as to use them as teaching and learning resources. These include the skills in methods and approaches in how to deal with controversial and complex environmental issues in the classroom that include:

I. Methods for teaching environmental concerns (issues, problems and solutions). These include educational theories and teaching skills to:

a- infuse environmental content into the science programme by:

- setting student learning objectives which are compatible with both EE perspectives and the existing science programme content;
- selecting and developing useful contexts that embody relevant environmental principles, concepts and factual data;
- designing and developing methods and materials to highlight or emphasise the environmental relevance of appropriate topics in science programmes;

b- select appropriate instructional and learning arrangements for teaching the environmental content such as:

- discovery learning strategies;
- different modes of inquiry;
- managing a wide range of learning activities, e.g., case studies, field trips, interviews, demonstrations, role play and simulations

c- utilise a wide range of EE materials, aids and resources, with especial references to low cost materials and opportunities for adaptation in local circumstances

d- utilise appropriate resources for conveying EE perspectives, e.g. forum, case studies in the community, field trips, etc.

e- utilise problem-solving and decision-making processes as a focus for explaining environmental curriculum content in classroom discussion, work assignment and participation exercises.

II. Approaches for environmental values, ethical and moral education: Teachers must possess knowledge of learning, moral theories and the ability to assist their students in:

- acquiring positive environmental attitudes and commitment toward the total environment;
- recognising, analysing and clarifying personal values concerning the environment;
- identifying value transitions necessary for the evolution of a sustainable society;

These approaches include:

a- Value inculcation: developing sound social environmental values of the Sudanese society that are grounded in our religious and cultural history;

b- Values analysis: helping students to better understand their own social and environmental values and how these affect their behaviour as well as assisting students in comparing their personal values with those most beneficial to social and environmental welfare;

c- Cognitive moral development: building upon the identification of the universal and sequential stage development of values, designed to lead students to progressively more complex and higher levels of moral reasoning;

d- Action learning through involvement in educational and community projects or issues. It should provide opportunities for individuals and groups to act on personal values in the context of real issues and problems.

3- Attitude

a- an appreciation of the complex, holistic and interdisciplinary nature of environmental systems, problems and issues which are produced by and affect humanity-environment relationships

b- an appreciation of global interdependence and a commitment to the maintenance of a sustainable society;

c- a willingness to develop this same appreciation and commitment in students by encouraging active interest and participation in environmental decision-making at both the individual and social levels;

d- utilisation of current theories of knowledge, attitudes and behaviour relationships in selecting, developing and implementing a balanced curriculum that maximises the probability of desired environmental behavioural changes in the learners.

8.2 Implementation

It is apparent from the previous chapter that an acceptable implementation approach seems to be that of integrating the perspectives presented in the guidelines through the appropriate courses offered in SSTEPs and the introduction of new multidisciplinary and team-taught course(s) to compensate for the lack of environmental dimensions in them. This section is mainly to propose how to incorporate the proposed EE guidelines in SSTEPS in the Sudan's universities, as well as to recommend some basic guiding principles that might be followed for the implementation of these guidelines. Table 8.2 presents suggestions for the implementation of the perspectives presented in the EE guidelines in SSTEPs.

On the basis of the proposed implementation procedure as well as the discussion in chapter 7 of this study, clearly educating STs for their dual role as science and environmental educators should be a function of all SSTEPs component, i.e. education foundation, professional and academic courses. Therefore, if SEs recognise the critical need for their students to be educated in this area as shown in chapter 6, tables 6.5 to 6.7 of this study, a number of basic

guiding principles should be considered in the implementation of the proposed EE guidelines. These include the following:

Table 8.2
Proposal for the Incorporation of EE Guidelines in SSTEPs

Content	Courses
I. Knowledge	
A. Basic environmental concepts	
a. Ecological and physical science concepts;	biology, chemistry, physics & environmental sciences
b. Social and behavioural sciences areas related to EE philosophy;	Environmental education, philosophy of education & the humanities
B. Environmental problem & issues	
a. Desertification	environmental science, biology/ecology
b. Land-use & planning priorities	economics, ecology & earth science
c. Population	biology/ecology & EE
d. Urbanisation	health education, economics & sociology
e. Environmental pollution	biology/ecology, chemistry & physics
f. Management & conservation of resources	biology/ecology, environmental science, chemistry and physics
g. Energy consumption & waste	biology, chemistry, physics & environmental science
h. Waste disposal	health education, biology, chemistry & physics
i. Use of chemical in agriculture	biology, chemistry, earth science & ecology
j. Global environmental issues	biology/ecology, environmental science, chemistry, physics & social sciences
II. Skills	
A. Methods for teaching environmental knowledge, educational theories & teaching skills to:	
a. infuse environmental dimensions into the science programmes	science teaching methods courses & curriculum studies courses
b. select appropriate instructional and learning arrangements for incorporating EE perspectives;	science teaching methods courses & curriculum study courses
c. Utilise appropriate resources for the environmentalisation of the curriculum;	Environmental education & curriculum studies courses
B. Approaches for environmental values, ethical and moral education;	education psychology, education philosophy & EE
III. Attitude	
a. an appreciation of the complex, holistic & interdisciplinary nature of environmental problems and issues;	environmental science, EE, biology/ecology, chemistry & physics
b. an appreciation of global interdependence and commitment to the maintenance of sustainable society	environmental science, EE, biology/ecology, chemistry, social sciences
c. utilisation of current theories of knowledge, attitude & behaviour relationships in selecting educational materials and maximising the probabilities of desired environmental behavioural	environmental education, education psychology, education philosophy & curriculum studies courses

1- A clear policy and mechanism for the incorporation of these guidelines in all SSTEPs should be established. In addition, a responsible body for co-ordinating these issues across the programme dimension should be identified. This body should oversee whom is doing what, for what purposes, at which level of students' four or five year course, as well as plan future development in this vital teacher education area;

2- Science teacher educators' weak backgrounds regarding EE should be addressed as a priority for the implementation of the proposed EE guidelines in this study. Pre- and in-service training of tutors in this area should be planned, financed and encouraged. This training might be through the following routes:

A- Postgraduate studies in colleges and faculties of education in the Sudan's universities;

B- The IES, Khartoum University Programme for training HEI tutors for EE (see chap. 2, section 2.5.1);

C- The UNESCO-UNEP International EE Programme.

3- The teaching and learning in teacher education institutions should be regarded as a model for PTs' future teaching. The basic EE knowledge, skills and attitudes needed for PTs' professional development in this area cannot be achieved by any one or any one group of course(s) in SSTEPs. It is widely accepted by those who are involved in teacher education and training that PTs always tend to teach in the way in which they were taught. Therefore, a view held especially by some of the academic tutors that teaching methods as well as other aspects of teacher professional development are the sole responsibilities of science teaching methods tutors or teaching practice supervisors in secondary schools should be corrected. They should all function as role models.

4- Given the current status of EE in science programmes of the Sudan's secondary school curriculum as well as the weak background of STs regarding EE, it is

the duty of SEs to educate PTs to include environmental dimension in their teaching as well as to help schools established and implement their EE policies.

5- Prospective science teachers' teaching practice experience should be planned with two main points in mind. First, training PTs for their dual role should consider the necessary departures from traditional training procedures. It should consider the crucial demand of EE on both teacher and students. This demand is best expressed in Poch's (1993, p. 45) words that: "Both teacher and students should leave the 'stable state' of systematic knowledge transmission and acquisition and involve themselves in school-based initiatives in EE. They have to cope with open-ended, uncertain, unpredictable and sometimes contradictory situations which entail risks". Secondly, PTs should be encouraged to be creative and to take the risk of challenging the traditional teaching methods employed by STs in secondary schools. It is the researcher's view that this can only be realised if the existing teaching practice regulations and assessment procedures be altered, as well as changing the negative view held by some of the training supervisors and PTs that teaching practice is a time for the 'final' demonstration of previously learned instructional skills. Professional development in teaching must continue beyond the pre-service stage.

Finally, after nearly two decades of the world-wide EE movement educating secondary school teachers for EE seems to be an international problem. In the author's knowledge few, if any, pre-service SSTEPs are evaluated on the extent to which they promote EE perspectives despite claims they sometimes make to be so doing. Most of the experiences in EE come from in-service teacher education programmes. Therefore, implementing the proposed EE guidelines in SSTEPs in the Sudan's universities might be an exemplar for the international community in this respect and for the developing world in particular. Thus the hope is expressed that this issue be realised in a country severely affected by environmental problems.

BIBLIOGRAPHY

Abdel Nour, H. O. (1991) "Forestry in the Sudan current problems and future prospects" In University of Durham, ed. Second International Sudan Studies Conference Papers Vol. I, Sudan: Environment and People.

Abdulwhab, O. A. M. (1975) A Curriculum Development in Biology in the Sudan with Special Reference to the Higher Secondary Level, Unpublished Ph.D. thesis, University of Sheffield, UK.

Abdulwhab, O. Abogedere, M. and Hassan, S (1983) Secondary School Third Grade Biology Textbook, 3rd ed., Khartoum: Education Publication Bureau.

Abusin. M. E. (1991) "Urban process and resource conservation in Sudan" In University of Durham, ed. Second International Sudan Studies Conference Papers, Vol. I, Sudan: Environment and People.

Abusin. M. E. and El Sammani, M. O. (1987) "Population and environment in the Sudan" In Atif, A. S. ed., Population and Development in the Sudan, Proceedings of the Third National Population Conference, Khartoum: KUP (Khartoum University Press).

ALECSO (1977) A Source Book of Environmental Education for Pre-university Level, Cairo: Eltamdon (Arabic).

ALECSO (1978) Man and the Environment: A Source Book of Environmental Education for Higher Education Institutions, Cairo: Eltamdon (Arabic).

Ali, F. M. (1987) The Development of EE Modules for Sudan's Secondary School Chemistry Programme, Unpublished M. Ed thesis, University of Khartoum (Arabic).

Allman, S. A. (1972) Identification of EE Concepts for Inclusion in Elementary School Curriculum, Unpublished Ph.D. thesis, University of Nebraska.

Andrews, D. M. (1979) Effect of a Values-Oriented EE Unit on the Attitudes of Pre-service Teachers and their Students, Ph.D. Boston University, Dissertation Abstracts International 40 (1979): 3216A. 4M1 7923845.

Androga, R. (1986) The Effect of Secondary School Biology Programme on Students Awareness of the Environmental Problems in the Sudan, Unpublished M. Ed. thesis, University of Khartoum.

Arrayed, J. E. (1980) School Science Teaching in Arab Countries, London: Longman Group Ltd.

Atchia, M. (1978) Concepts and Dynamics of EE with Particular Reference to Britain, Africa and Mauritius, Unpublished Ph.D. thesis, Salford University, UK.

Bahrain National Commission for Education, Science and Culture (1986) "Workshop on teacher training in EE for the Arab states" Connect, 11 (4): 3 - 4.

Berry, P. S. and Lydford, C. (1990) Guide to Resources in Environmental Education, 11th ed, London: Library Association Publishing.

Beshir, M. O. (1970) Educational Development in the Sudan 1898 to 1956, Oxford: Clarendon Press.

Beshir, M. O. (1989) "Environmental issues in higher education institutions in the Sudan, Paper presented to the workshop on EE in the Sudan, (29 - 31 October), Organised by the Gezera University and The Central State Ministry of Education.

Bishop, G. D. (1986) Innovation in Education, London: Macmillan.

Bloom, B. S. (1956) Taxonomy of Educational Objectives: Book 1, Cognitive Domain, London: Longmans.

Bohl, W. B. (1976) A Survey of Cognitive and Affective Components of Selected Environmentally Related Attitudes of Tenth and Twelfth Grade Students in Sex Midwestern, Four Southwestern and twelve Plains and Mountain States, Ph.D. dissertation, the Ohio State University, Dissertation Abstracts International, 37 (8): 471 - A UMI 77 - 2352.

Borg, W. R. and Gall, M. D. (1989) Educational Research: An Introduction, 5th ed., New York: Longman.

Borgdon, R. and Rowsery, H. (1977) "Some effects of interdisciplinary EE" The Journal of Environmental Education, 8 (3): 26 - 31.

Bowonder, B. (1987) "Management of the environment in developing countries" The Environmentalist, 7 (2): 111 - 122.

Brown, C. R. and Njabili, A. F. (1989) "The construct validity of an examination designed to test practical ability in biology" Research in Science and Technological Education, 7 (1): 61 - 73.

Bybee, R. W. (1987) "Science education and science, technology and society (S/T/S) theme" Science Education, 71 (5): 667 - 683.

Bybee, R. W. (1985) "The restoration of confidence in science and technology education" School Science and Mathematics, 85 (2): 95 -108.

Champeau, R. (1990) "Perspectives of pre-service education students on EE coursework" In D. C. Engleson and J. F. Disinger, eds., Preparing Classroom Teachers to be Environmental Educators: A Report of A Symposium, Monographs in EE and Environmental Studies, Tory, OH: North American Association for EE.

Chelliah, T. (1981). "Training of teachers with science or humanities background for EE: A Malaysian case study" Environmental Education and Information 1 (2): 95 -107.

Cheong, S. Y. (1983) "Environmental problems and orientations a Malaysian case study" In Proceeding of the Eight Biennial Conference of AABE, Quezon City: Secretariat University of Philippines.

Cohen, L. and Manion, L. (1986) Research Methods in Education, 2nd. ed., London: Routledge.

Conception, M. P. (1974) A Conceptual Framework for EE, Adapted to the Philippine Environment, Unpublished Ph.D. dissertation, Michigan State University.

Cronbach, L. J. (1951) "Coefficient alpha and the internal structure of tests" Psychometrika, 16: 297 - 334.

Cronbach, L. J. and Meehl, P. E. (1955) "Construct validity in psychological tests" Psychological Bulletin, 52 (...) 281 - 302.

Curriculum Council for Wales (1992) Environmental Education: A framework for the Development of Cross-curricular Theme in Wales. Cardiff: CCW.

Delany, M. J. (1979) Environmental Education and the Developing World Problems, University of Bradford, UK.

Department of Education and Science (1987) Quality in Schools: the Initial Training of Teachers, London: HMSO.

Department of Education and Science (1989) Initial Teacher Education: Approval of Courses (Circular 24 1989), London: HMSO.

Dillashaw, F. G. and Okey, J. R. (1980) "Test of the integrated science processes skills for secondary science students" Science Education, 64 (5): 601 - 608.

Disinger, J. and Schoenfeld, C. (1987) "Prologue: Case studies in college and university environmental studies programmes today: A decade later" The Environmental Professional, Vol. 9 (3): 185 - 187.

Disinger, J. F. (1987) "Environmental education research news" The Environmentalist, 17 (2): 85 - 89.

Ebel, R. L. and Frisbie, D (1986) Essentials of Educational Measurement, 4th ed., Englewood Cliffs: Prentice-Hall.

Edralin, N. M. (1989) Attitudes and Teacher Perceptions Related to Environmental Concerns of Prospective Middle/High School Teachers In Colleges and Universities of E. Tennessee, Unpublished Ph.D. thesis, University of Tennessee.

Edwards, A. L (1979) Multiple Regression and the Analysis of Variance and Co-variance, San Francisco: W. H. Freeman and Co.

El Khalifa, M. and Mohammed, Y. A. (1991) "Training of personal to work in drought stricken areas of Sudan" Sudan Environment, 2 (2): 5 - 19.

El Khalifa, M. D. and Mohammed, Y. A. (1986) "Environmental education in training of higher education teachers in the Sudan" In J. H. Perkins ed. International Aspects of EE. Monograph in EE and Environmental Studies Vol. (3), Tory, OH: North American Association for EE.

Elhassan, A. H. (1987) "General education teachers education and training" In Ministry of Education,. The Proceedings of the National Conference: General Education, Issues and Problems, (22 - 27 February 1987) Khartoum: Min. Educ., The Documentation Unit. (Arabic).

Eltaib. Z. E, (1983) Introduction of EE Programmes into Primary Level of Education in Sudan, Unpublished M. Sc. thesis, IES, University of Khartoum.

Eltaib. Z. E, Elkarim, A. and Hassan. A. H. (1985). "Status of EE programmes into primary level of education in the Sudan" The International Journal of Environmental Education and Information 4 (1): 180 - 190.

Eltaib. Z. E, (1983) Introduction of EE Programmes into Primary Level of Education in Sudan, Unpublished M. Sc. thesis, University of Khartoum.

European Information Centre of the Charles University for Further Education of Teachers (1981) Sub regional Workshop on Training of Teachers for EE Final Report Prague-Huboka: CSSR, October 13 - 17, 1980). ERIC ED 202 731.

Faculty of Science and Technology (1989) Prospectus, Madani: The Gazera University Press.

Ferguson, G. A. (1981) Statistical Analysis in Psychology and Education, 5th ed., London: McGraw-Hill Books Co.

Fien, J. (1991) "Accepting the dual challenge for professional development in EE" The International Journal of EE and Information, 10 (1): 1 - 18.

Finley, F. N. (1983), "Science Processes" Journal of Research in Science Teaching, 20(1): 47 - 54.

Fish, D. (1989) Learning Through Practice in Initial Teacher Training: A challenge for the Partners, London: Kogan.

Fishbein, M. and Ajzen, I. (1975) Belief, Attitude, Intention and Behaviour: An Introduction to Theory and Research, Reading, MA: Addison-Wesley.

Fouad, N. I. (1978) The Problem of Desertification in the Republic of the Sudan, with Special Reference to North Darfur province, Khartoum: KUP.

Fred, N. K. (1986) Foundation of Behavioural Research, 3rd. ed. New York: Holt, Rinehart and Winston.

Gagne, R. M. (1985) The Conditions of Learning and Theory of Instruction, 4th ed. New York: Holt, Rinehart and Winston.

Gayford, C. G., (1993) "Support for science teachers in environmental education" Education in Science, 154 (...): 18 - 19.

Gayford, C. G., (1991) "Environmental education: A question of emphasis in school curriculum" Cambridge Journal of Education, 21 (1): 73 - 79.

Gayford, C. G. (1986). "Environmental education and the secondary school curriculum" Journal of Curriculum Studies, 18(2): 147 - 157.

Gayford, C. G. (1987) Environmental Education: Experiences and Attitudes, Reading: Council for EE.

Ghaznawi, A. G. (1990) "Environmental education: A measure for fostering compatibility of environment, population and development" In Arab Bureau of Education for the Gulf States, Proceedings of the Regional EE Seminar, (17 - 20 December, Muscat, Oman).

Good, C. V. (1973) Dictionary of Education, 3rd. ed. New York: McGraw-Hill Book Company.

Gough, N. (1989). "From epistemology to ecopolitics renewing a paradigm for curriculum" Journal of Curriculum Studies, 21 (3): 225 - 242.

Grieg, S, Dike, G. and Selby, S. (1989) Green Prints for Changing Schools, London: The World Wide Fund for Nature and Kogan Page.

Griffiths, V. L. (1953) An Experiment in Education: An Account of the Attempt to Improve the Lower Stages of Boys Education in the Moslem Anglo-Egyptian Sudan 1930 - 1950, London: Longmans, Green and Co.

Griffiths, V. L. (1975) Teacher-Centred Quality in Sudan Primary Education 1930 - 1970, London: Longman Ltd.

Gronlund, N. E. and Linn, R. L. (1990) Measurement and Evaluation in Teaching, 6th. ed., New York: Macmillan Publishing Company.

Guilford, J. P. and Fruchter, B. (1978) Fundamental Statistics in Psychology and Education, 6th ed., New York: MacGrow-Hill.

Ham, S. H. and Sewing, D. R. (1988) "Barriers to EE". Journal of Environmental Education 19 (2): 17 - 24.

Hammerman, E. L. (1979) "A Delphi formulation of EE objectives" In E. L. Hammerman and M. A. Voelker (1987) "Research based objectives for EE: Consensus on the past, a base for the future" Science Education, 71 (1): 529 - 40.

Hammod, A. H (1990). "Teacher preparation and training in the Sudan" Unpublished paper, Faculty of Education, Gezira University, Sudan. "Arabic"

Hart, E. P. (1981) "Identification of key characteristics of EE" Journal of Environmental Education, 13 (1): 12 - 16.

Hart, E. P. and Robottom, I. M (1990b) "The Science-Technology-Society Movement in science education: A critique of the reform process" Journal of Research in Science Teaching 27 (6): 275 - 588.

Hart, E. P., and Robottom, I. M. (1990a). "Professional development in EE: A summary of research papers" In D. C. Engleson and J. F. Disinger, eds., Preparing Classroom Teachers to be Environmental Educators: A Report of Symposium. Monographs in EE and Environmental Studies, Tory, OH: North American Association for EE.

Hart, E. P (1990) "Rethinking teacher education environmentally" In D. C. Engleson and J. F. Disinger, eds. Preparing Classroom Teachers to be Environmental Educators: A Report of Symposium. Monographs in EE and Environmental Studies, Tory, OH: North American Association for EE.

Hart, P. and McClaren, M. (1978) "Attitudes of high school students towards environmentally oriented issues" Science Education, 62 (4): 497 - 508.

Hassan, Y. F. (1991) "Some aspects of the development of the university system in the Sudan, with special reference to the University of Khartoum" In University of Durham, ed. Second International Sudan Studies Conference Papers Vol. 1 I: Sudan: Environment and People.

Hawes, G. R. and Hawes, L. S. (1982) The Concise Dictionary of Education, New York: Van Nostrand Reinhold Company Inc.

Hicks, R. ed. (1988) Education For Peace: Issues, Principles and Practice in Classroom., London: Routledge.

Hines, J. M. Hungerford, H. and Tomera, A. N. (1987) "Analysis and synthesis of research on responsible environmental behaviour: A meta-analysis" Journal of Environmental Education, 18 (2): 1 - 8.

Hodson, D. and Reid, D. (1988) "Changing priorities in science education Part 1" School Science Review, 70 (250): 101 - 108.

Hodson, D. and Reid, D. (1988) "Changing priorities in science education Part 2" School Science Review, 70 (251): 159 - 165.

Hounshell, P. B. and Liggett, E. (1973) "Assessing the effectiveness of environmental education" Journal of Environmental Education, 5 (2): 28 -30.

Hungerford, H. Peyton, R. B. and Wilke, R. J. (1980) "Goals for curriculum development in EE" The Journal of Environmental Education, 59 (3): 413 - 22.

Hungerford, H. R. and Volk, T. L. (1984) "The challenges of K - 12 environmental education" In A. B. Sack, Monographs in EE and Environmental Studies Vol (1), Columbus, Ohio: Clearing House for Science, Mathematics and EE.

Iozzi, L. (1989a) "What research says to the educator, part 1: EE and affective domain" Journal of Environmental Education, 20 (3): 3 - 9.

Iozzi, L. (1989b) "What research says to the educator, part 2: EE and affective domain" Journal of Environmental Education 20 (4): 6 - 13.

Jaus, H. H. (1978). "The effect of environmental instruction on teachers attitudes towards teaching EE" Science Education, 62 (1): 79 - 84.

Johnson, M. C. (1977) A Review of Research Methods in Education, Chicago: Rand McNally College Publishing Company.

Keeves, J. P. (1988) Educational Research Methodology and Measurement: An International Handbook, Oxford: Pergamon Press.

Kerlinger, F. N. and Pedhazur, E. J. (1973) Multiple Regression in Behavioural Research, New York: Hott, Rinehapt and Winston, Inc.

Khartoum State Education Office (1992) Secondary Education in Khartoum State, Khartoum: Education Planning Unit (Arabic).

Kinsey, T. G. and Wheatley, J. H. (1984) "The effects of an environmental studies course on the defensibility of environmental attitudes" Journal of Research in Science Teaching, 21(7): 675 - 683.

Knapp, C. (1983) "A curriculum model for environmental values education". Journal of Environmental Education, 14 (13): 22 - 26.

Lee, G. S., (1987) Environmental Education in Malaysia: Curriculum Guidelines For Pre-service Science Teacher Education Programmes, Unpublished Ph.D. thesis, University of Hawaii.

Lin, N (1976) Foundations of Social Research, New York: McGraw-Hill.

Lucas, A. M. (1972) Environment and Environmental Education: Conceptual Issues and Curriculum Implications, Unpublished Ph.D. dissertation, The Ohio State University.

Lucas, A. M. (1980) "Science and EE: Pious, hopes, self praise and disciplinary chauvinism" Studies in Science Education, 7 (...):1 - 26.

Lucko, B. J., Disinger, J. and Roth, C. (1982) "Evaluation of environmental education programmes at the elementary and secondary school levels" Journal of Environmental Education, 13 (4): 7 - 12).

Lutfi, A. D. (1983) "Contribution of Biology Syllabus to EE" In Y. A. Mohammed ed., Proceeding of the workshop: Planning for EE in the Sudan, (22 October to 3rd of November, IES, University of Khartoum).

Lynch, P. D. and Omer, S. (1989) "The implementation of the new educational policy in the Sudan, 1970-1985: Promise and reality" Educational Review, 41 (3): 257 - 261.

Mabutt, J. A. ed., (1979) Proceedings of the Khartoum Workshop on Arid Land Management, Tokyo: United Nations University.

Makki, A. A. (1987) The utilisation of National Parks as Educational Sites in Sudan, the Case Study of Khartoum Sunt Forest, Dinder Park and Umbarona, Unpublished M. Sc. thesis, University of Khartoum.

Market Opinion Research International (MORI) (1987) Children Attitudes to the Environment (Survey undertaken by MORI on behalf of World Wildlife Fund).

Mayer, V. J. and McKenzie, G. D. (1974). "Preparing teachers in environmental science". The Journal of Environmental Education, 5 (3): 37 - 41.

Meine, V. (1984) Ecology Textbook for the Sudan, Khartoum: KUP.

Miller, R. C (1991) Handbook of Research Design, 5th ed., Newbury Park: Sage Publication.

Ministry of Education (1977) Sudanese Education: An appraisal and Strategy for Action, Khartoum: Education Publication Bureau.

Ministry of Education (1992) "The general education strategy" In The Republic of The Sudan The Comprehensive Development Plan 1992 - 2002, Khartoum: Government Press.

Ministry of Education (1992) The Annual Statistical Report, Khartoum: Education Publication Bureau (Arabic).

Ministry of Education. (1989) Evaluation of In-service Training Programmes for Primary and Intermediate School Teachers in the Sudan, Khartoum: Min. Educ., The Documentation Unit (Arabic).

Ministry of Health, (1978) Flies, Mosquitoes and Disease in the Sudan, Khartoum: KUP.

Ministry of Higher Education and Scientific Research (1992) Higher Education Statistical Report for the Academic Year 1991/1992, Khartoum: KUP.

Mohammed, Y. A. and Ahmed, A. J. (1991). "Environmental education: A needed change in the Sudan's education" in University of Durham, ed. Second International Sudan Studies Conference Papers Vol. II Sudan: Environment and People

Mohammed. Y. A. ed. (1984) Report of the Workshop on EE for Trainers of Teachers in the Sudan, Khartoum: (27 October - 8 November, IES, University of Khartoum).

Mohammed. Y. A. ed. (1983) Proceedings of the Workshop: Planning for EE in the Sudan, Khartoum: (22 October - 3 November, IES, University of Khartoum).

Mohammed. Y. A. ed. (1985) Report of the Workshop on Development of Instructional Materials for Bakht Elruda, Sudan, Khartoum: (8 - 21 Aug., IES, University of Khartoum)

Mutuli, E. B., (1986) The Sudan's Primary School Science Programme Contribution to the EE perspectives, Unpublished M. Ed. thesis, Khartoum University (Arabic).

Nachmias, D. and Nachmias, C. (1992) Research Methods in Social Sciences, 4th ed., London: Edward Arnold.

National Curriculum Council 'NCC' (1990a) Curriculum Guidance 3: The Whole Curriculum, York: NCC.

National Curriculum Council (1990b) Curriculum Guidance 7: Environmental Education York: NCC.

National Research Council (1990) The Jongoli Environmental Aspects, Khartoum: KUP.

NCHE (1990) National Council for Higher Education Act, 1990, Khartoum: KUP. {Arabic: Qanun Tanzim al-Ta'lim al' Ali Li-Sanat 1990}.

Nicholas, J. and Scott. W. (1993) "Teacher education for the environment: A comparative view from Australia and the UK" International Journal of Science Education, 15 (5): 567 - 574.

Noibi, A. S., (1981) Relationship Between Moral Reasoning Levels and Selected Environmental Variables Among Teachers in Nigeria, Unpublished Ph.D. thesis, University of Lowa, US.

NRC, (1970) National Research Council Act, 1970, Khartoum: KUP.

Omdurman Faculty of Education (1987) Prospectus. Khartoum: KUP.

Oppenheim, A. N. (1966) Questionnaire Design and Attitude Measurement, London: Heinmann.

Oulton, C. (1991). "Environmental education and initial teacher education" Annual Review of Environmental Education, (4): 17 - 19.

Perkes, A. C. (1973) A Survey of Environmental Knowledge and Attitudes of Tenth and Twelfth Grade Students from Five Great Lakes States and Six Far Western states, Unpublished Ph.D. dissertation, The Ohio State University, Dissertation Abstracts International, (1974) 34 (3613A - 5379A).

Pettus, A. L. (1982). "Preparing teachers in environmental science". College Student Journal, 16 (2): 181 - 86.

Peyton, R. B. (1984). "Environmental education research related to teacher training: Summary of research in EE 1971 - 1982". In L. A. Iozzi, ed. Monographs in EE and Environmental Studies, Vol. II, 1984. Columbus: (ERIC) Clearinghouse for Science, Mathematics. and EE; Troy: North American Association for EE. ERIC ED 259 879.

Peyton, R. B. and Hungerford, H. R, (1980) "An assessment of teachers' abilities to identify, teach and implement environmental action skills" In A. B. Sacks, L. L. Burrus-Bammel, C. B. Davis and L. A. Iozzi, eds. Current Issues VI: The Year Book of EE and Environmental Studies Columbus, Ohio: ERIC/ SMEAC Information Centre.

Porkess, R. (1982) Mathematics: A Complete Course for First Examinations, Glasgow: Collins.

Posch, P. (1993) "Research issues in environmental education" Studies in Science Education, 21(...): 21 - 48.

Ramsey, J. M. and Hungerford, H. (1989) "The effects of issue investigation and action training on environmental behaviour in the 7th grade students" Journal of Environmental Education, 20 (4): 29 - 34.

Ramsey, J. H, Hungerford, H. R and Tomera, A. V. (1981) "Effects of environmental action and environmental case study instruction on the overt environmental

behaviour of eighth grade students" The Journal of Environmental Education, 13 (1): 24 - 29.

Reardon, B. A. ed., (1988) Educating for Global Responsibility: Teacher-Designed Curricula for Peace Education K-12, New York: Teacher College Press.

Richmond, J. M. (1976) A Survey on Environmental Knowledge and Attitudes of Fifth Years Students in England, Unpublished Ph.D. thesis, Ohio State University.

Robottom, I. M. (1989) "Social critique or social control: Some problems for evaluation in EE" Journal of Research in Science Teaching, 26 (5): 435 - 443.

Robottom, I. M. (1987) "Two Paradigms of professional development in EE" The Environmentalist 7 (4): 291 - 298.

Robottom. I. M. ed., (1988), Environmental Education Practice and Possibility, Victoria: Deakin University Press.

Salih, T. M. (1983) "The status of environmental studies at secondary school level" in Mohammed Y. A. Proceeding of the Workshops: Planning for EE in the Sudan, Khartoum: (22 October - 3 November, IES, University of Khartoum).

Salih, T. M. (1984) The Effect of Intermediate School Geography Programme on the Students Awareness of the Environmental Problems, Unpublished M. Ed . thesis, University of Khartoum.

Schools Council Project Environment (1974) Education for the Environment, London: Longman Group Limited.

Schwaab, K. E. (1976). A Survey of the Effectiveness of EE Teaching Methods as Rated by Public School Teachers and Professors of Education in Illinois. Ph.D. thesis, Southern Illinois University, Dissertation Abstracts International 36 (1976): 7752A. UMI 76-13, 286.

Selim, M. S.(1990) "EE in teachers' preparation programmes in higher education institutes" In the Arab bureau of Education for the Gulf States. Proceedings of the Regional EE Seminar (17 - 20 December, Muscat, Oman).

Selim, M. S. (1986) "Environmental education in the Arab states" in J. H. Perkins, et al., eds. International Aspects of EE. Monograph in EE and Environmental Studies Volume (3), Tory, OH: North American Association for EE.

Selim, M. S., (1977b) "Environmental education at the tertiary level for teachers" In UNESCO Trends in Environmental Education, Gembloux, Belgium: J. Duculot.

Selltiz, C., Wrightsman, L. S. and Cook, S. W (1976) Research Methods in Social Relations, NY: Holt, Rinehart & Winston.

Shaw, T. J. (1983) "The effects of a process-oriented science curriculum upon problem-solving ability" Science Education, 67 (5): 615 - 23.

Shaw, M. E. and Wright, J. M (1967) Scales for the Measurement of Attitudes, New York: McGraw-Hill.

Sia, A. P., Hungerford, H. and Tomera, A. N. (1985/1986) "Selected predictors of responsible environmental behaviour: An analysis" Journal of Environmental Education, 17 (2): 31 - 40.

Stapp, W. R., Caduto, M. J., Mann, L. D. and Nowak, P. F. (1980/1981) "An analysis of pre-service EE of teachers in Europe and an instructional model for furthering this education" The Journal of Environmental Education, 12 (2): 3 - 10.

Stapp, W. B. (1969) "The concept of EE" Journal of Environmental Education, 1 (3): 31 - 36.

Stapp, W. B. (1983) "Environmental education: goals, objectives and strategies" in Mohammed Y. A. Proceeding of the Workshops: Planning for EE in the Sudan, Khartoum: (22 October - 3 November, IES, University of Khartoum).

Steiner, R. L. (1973) "Attitudes of Oregon high school seniors towards some of environmentally oriented science related social issues" Science Education, 56 (3): 427 - 437.

Stokes, D. and Crawshow, B. (1986) "Teaching strategies for EE" The Environmentalist, 6 (1): 35 - 47.

Subbarini, M. S. (1991) "Environmental knowledge of in-service classroom teachers enrolled in the certification programme at Yarmouk University" The International

Journal of Environmental Education and Environmental Information, 10 (3): 129 - 142.

Sudmand, S. and Bradburn, N. M. (1983) Asking Question: A practical Guide to Questionnaire Design, San Francisco: Jossey Bass Publishers.

Sutclitte, J. V. and Park, Y. P. (1982). A Hydrological Estimate of the Effect of the Jongoli Canal on Areas of Flooding, Report to the FAO, Rome: FAO.

Tairab, H. H (1992) Perceptions of Biology Teachers' Classroom Teaching Behaviours and Student Achievement in Sudanese Secondary Schools, Unpublished Ph.D. thesis, The University of Hull.

The Sudan Examinations Council Report (1991) Report of the 1991 Sudan Secondary School Certificate Examinations, Min. Educ., Khartoum.

The Sudan's Environmental Strategy (1992) In The Republic of The Sudan, The comprehensive Development Plan 1992 - 2002, Khartoum: Government Press.

Their, H. D. (1981). "Global impact: A progress report" World Studies Journal, 7 (1): 21 - 24.

Tolba, M. K. (1985) "Desertification: A threat to world stability" The Environmental Professional, 7 (4): 116 - 120.

Towler, J. (1980/1981) "A survey of Canadian pre-service training in EE" The Journal of Environmental Education, 12 (2): 11-17.

Townsend, R. D. 1982. An Investigation into the Underlying Structure Domain of EE Concepts, Unpublished Ph.D. dissertation, The Ohio State University. US.

Trent, J. H. (1976). "Changes and trends in EE" The Journal of Environmental Education, 7 (3): 51 - 60.

Trowbridge, J. E. and Mintzes J, J, (1989), "Alternative conceptions in animal classification: A cross-age Study" Journal of Research in Science Teaching, 25 (7): 547 - 571.

UNESCO (1977a) "Tbilisi Conference Declaration on Environmental Education" Convergence, 10 (4): 70 - 71.

UNESCO (1977c) Needs and Priorities in EE: An International Study, Paris: (UNESCO/ ENVED6).

UNESCO (1978b) Final Report: Intergovernmental Conference on Environmental Education, Tbilisi, USSR, (14 - 26 October 1977), UNESCO ED/MD/49, Paris, 1978.

UNESCO (1980) Environmental Education in the Light of the Tbilisi Conference, Paris: Presses Universities de France, Vendome.

UNESCO (1981) "Report on the status of teacher training in EE in Africa" Connect. 6 (4): 2.

UNESCO (1986a) Environmental Education: Module for In-service Training of Science Teachers and Supervisors for Secondary Schools, (EE series 8), Paris: UNESCO, Division of Science, Technical and Vocational Education.

UNESCO (1986b) Environmental Education: Module for Pre-service Training of Science Teachers and Supervisors for Secondary Schools, Paris: UNESCO-Division of Science, Technical and Vocational Education.

UNESCO-UNEP (1976) "The Belgrade Charter: A global framework for environmental education" Connect, 1 (1): 1 - 8.

UNESCO-UNEP (1978a) "The Tbilisi Declaration" Connect, 3 (1) 1 - 5.

UNESCO-UNEP (1981) "Teacher training in EE" Connect. 6 (4): 1 - 5.

UNESCO-UNEP (1984) "Publications of the International EE Programme" Connect, 9 (1): 1 - 3.

UNESCO-UNEP (1987) "UNESCO-UNEP International Congress on EE and Training" Connect 12 (3): 1 - 3.

UNESCO-UNEP (1988) International Strategy for Action in the Field of EE and Training for the 1990s Paris: UNESCO.

UNESCO-UNEP (1990) "Environmentally educated teachers the priority of priorities" Connect 15 (1): 1 - 3.

University of Juba (1975) The University of Juba Six Year Plan, Khartoum: KUP.

University of Juba (1975) The University of Juba Six Year Plan, Khartoum: KUP.

University of Juba (1986) The University of Juba Calendar 1984-1986, Juba: The Catholic Press Institute.

Volk, T. L, Hungerford, R. and Tomera. A. N, (1984). "A national survey of curriculum needs as perceived by professional environmental educators" The Journal of Environmental Education, 16 (1): 10 - 19.

Volk, T. L. (1984) " Project synthesis and EE" Science Education, 68 (1): 23 - 33.

Volk, T. L. (1984) "Project Synthesis and environmental education" Science Education, 68 (1): 23 - 33.

Wilke, R. J., Peyton, R. B. and Hungerford, H. (1987) Strategies for Training of Teachers in EE: A Discussion Guide for UNESCO Training Seminars on EE. Paris: UNESCO.

Wilke, R. J. (1983) "Conclusions and generalisations drawn from research in EE 1971-1980 regarding training pre-service, teacher training in-service, community resource use and field trips" In A. B. Sacks, ed., Current Issues in EE and Environmental Studies Vol. VIII: 199 - 207 Columbus: ERIC/ SMEAC.

Wilke, R. J. (1980) An analysis of Three strategies Designed for Influence Teacher Use of, Knowledge of and Attitudes Towards Educational Resources Use in EE, Ph.D. thesis, Southern Illinois University at Carbondale. Dissertation Abstracts International. 1980, 41 (2) 636 UMI 8017434: 305.

Wilke, R, J. (1985) "Mandating pre-service EE teacher training: The Wisconsin Experience" Journal of Environmental Education, 17 (1): 1 - 8.

Wilke, R. J. Peyton, R. B. and Hungerford, H. R. (1987) Strategies for the Training of Teachers in EE UNESCO-UNEP International EE Programme, (EE series No. 25), Paris: UNESCO Division of Science, Technical and EE.

Williams, R. (1985) Teacher Education and the Global Environment University of Sussex, U. K.

Yager, R. E. and Tamir, P (1993) "STS approach: Reasons, intentions, accomlishments and outcomes" Science Education, 77 (6): 637 - 658.

Youngman, M. B. (1979) Analysing Social and Educational Research Data, London: McGraw-Hill Book Company (UK) Ltd.

Zoller, U. (1984). "Strategies for EE within contemporary science education" European Journal of Science Education, 6 (4): 361 - 368.

Appendix A
Science Teacher Educators' Questionnaire

School of Education,
Hull University,
Hull, HU6, 7RX,
UK

Dear colleague,

I am a Ph.D. student, carrying out a research study to formulate curriculum guidelines for environmental education in The Sudan's universities.

I will appreciate it if you would give your frank opinions and respond to the questionnaire as promptly as possible. Information supplied will be treated in strictest confidence and will be used only for research purposes.

Thanks
Yours Sincerely
Abd-Elrahim Ahmed Salim

Instructions:

(1) Please indicate your answers by a tick (✓) in the appropriate box or column unless otherwise requested;

(2) Please answer all questions by reference to the definition given below of environmental education;

"Environmental education is the process of recognising and clarifying the values, attitudes and concepts necessary to understand and appreciate the interrelatedness among man, his culture, and his biophysical environment. It also emphasises the individual's practice in decision-making about issues concerning environmental quality"

Section One: General Information

1. Your academic background:

Please write the code numbers in the boxes provided.

Code No.

1. Environmental Science/ Studies.
2. Biology.
3. Chemistry.
4. Physics.
5. Education.
6. Science Education.
7. Environmental Education.
8. Others (please specify)_____

Diploma [ ] Bachelor [ ]

.Master [ ] Ph.D.[ ]

2. Which of the following science teaching methods courses have you had most teaching experience with?

a. Environmental Education. [ ]
b. Biology. [ ]
c. Chemistry. [ ]
d. Physics. [ ]
e. Integrated Science. [ ]
f. Others (please indicate)._____.

3. If you do not teach an environmental education teaching methods course, do you incorporate environmental education teaching methods in your science teaching methods course?

A lot [ ] Little [ ] None at all [ ].

4. If you do incorporate environmental education teaching methods, what is your major emphasis (please check one only):

Ecological [ ] Biological [ ]

Sociological [ ] Conservation [ ]

5.(a) To your knowledge, does your institution offer courses involving content pertaining to environmental concerns?

Yes [ ] No [ ] Don't know [ ]

(Please list the courses if any):_____

_____.

(b) Are prospective science teachers required to take one or more of such courses?.

Yes[ ] No [ ] Don't know [ ]

(c) To what extent is the content of these courses orientated to local environmental issues and problems?

A lot [ ] Little [ ] Don't know [ ].

6. Are you in any way involved in:

(a) funded research project in environmental education? Yes [ ] No [ ].

(b) developing curriculum materials in environmental education for the use in your institution? Yes [ ] No [ ].

(c) developing environmental curriculum for the use in the schools? Yes [ ] No [ ].

7. Do you favour teacher certification in the area of environmental education? Yes [ ] No [ ].

8. What do you perceive to be the major problems concerning the development and teaching of environmental education in your faculty/department? (Please select three major problems from the list given below and write the code number in the boxes provided):

Code number

1. lack of textbooks;
2. shortage of teaching material and equipment;
3. shortage of qualified academic staff;
4. lack of research;
5. limited funding for research;
6. Lack of communication
among environmental educators;
7. inaccessibility of up_to_date information;
8. Others(please specify).....
.....

The three major problems;

(a) [ ]
(b)[ ]
(c) [ ]

9. Your institution_____
10. Your teaching experience:_____ years.

Section two: Need assessment

Instruction (A): the following are the objectives of environmental education. Please tick the appropriate category (1, 2 or 3) to show:

(a) to what extent is the objective important?

(b) to what extent does the science programme in your college incorporate the objective?

Please note that: THREE = THE OBJECTIVE IS VERY IMPORTANT AND INCORPORATED TO A SATISFACTORY EXTENT; TWO = THE OBJECTIVE IS IMPORTANT AND INCORPORATED TO A MODERATE EXTENT; ONE = THE OBJECTIVE IS NOT IMPORTANT AND INCORPORATED TO A POOR EXTENT.

Environmental education objectives	Importance of the objective			Incorporation of the objective		
1. Awareness: to help individuals and social groups to acquire an awareness of and sensitivity to the total environment and its problems;	3	2	1	3	2	1
2. Knowledge: To help individuals and social groups acquire basic understanding of the total environmental concerns and human role in it;	3	2	1	3	2	1
3. Attitudes: To help individuals and social groups acquire social values, strong feelings of concern for the environment and motivation for active participation in its protection;	3	2	1	3	2	1
4. Skills: To help individuals and social groups acquire the skills for solving environmental problems;	3	2	1	3	2	1
5. Evaluation abilities: To help individuals and social groups to evaluate environmental measures and educational programmes in terms of ecological, political, economical, sociological and educational factors;	3	2	1	3	2	1
6. Participation: To help individuals and social groups develop a sense of responsibility and urgency regarding environmental problems so as to ensure appropriate action to solve those problems.	3	2	1	3	2	1

INSTRUCTION (B): please tick (✓) each of the following statements, if you think that it describes the desired status or current status of environmental education in your institution [*YOU MAY TICK ONE OR BOTH CATEGORIES*].

Statements	Desired status	Current status
7. Environmental education is part and parcel of science teacher professional preparation courses;		
8. Environmental education teaching methods are incorporated into all science teaching method courses;		
9. Science teacher education programmes include courses pertaining to research methodology for designing and developing methods and instruments which enable teachers to effectively fulfil the objectives of environmental education;		
10. Science teachers in training are given an understanding of as wide range as possible of environmental education materials, aids and resources with special reference to low cost material and opportunity for adaptation in local circumstances;		
11. Science teacher education institutions undertake research to develop low-cost environmental education teaching materials for the science educators training;		
12. Science teacher education institutions include appropriate aspects of environmental education curricula that meet the training requirement of interdisciplinary approaches and methods.		

INSTRUCTION (C): Please tick (✓) the appropriate category to indicate your response towards the following statements;

Statements	Not sure	Dis-agree	Agree
13. There is a need for curriculum development in teacher education institutions to ensure that environmental education is taken into consideration;			
14. Secondary science teacher education programme should include the following: (A) Biological, sociological and behavioural sciences: a. biological foundation; b. ecological foundation; c. policy foundation; d. psychological foundation; e. economic foundation; f. sociological foundation; (B) Courses for understanding the interrelationship of human ecosystem: a. human ecosystem foundation; b. community field study; (C) Courses for competencies in environmental education: a. philosophy and theory for understanding environmental education; b. the teaching methods for environmental education; c. curriculum design, adaptation and evaluation for environmental education; d. development of instructional materials for environmental education.			
15. The current science teaching method courses offered in your college are adequate for training prospective science teachers to incorporate environmental education perspectives in secondary schools curriculum;			
16. It is possible to train environmental educators in the framework of our traditional science teaching method courses;			
17. Science teacher education institutions should develop team-taught multi-disciplinary method experiences for environmental education;			
18. The prospective science teachers' academic preparation in terms of science subject matter is adequate for integrating environmental education perspectives in the Sudan's secondary schools;			

19. The usual distribution of subjects such as biology, chemistry and physics required of students is adequate for preparing them as environmental educators;			
20. Additional courses in such non-traditional areas as sociology and economics would be helpful to prospective science teachers to integrate environmental concepts into secondary school science programmes;			
21. Science teachers can function in multi-disciplinary programmes in the schools without having experience it in their education programmes;			
22. The experiences provided by science teacher education programmes engender concern about environmental issues.			

23. Are there any other comments you would like to make about environmental education in the Sudan's universities?

THANK YOU

APPENDIX B
Science Teachers' Questionnaire

School of Education,
Hull University,
Hull, HU6, 7RX,
UK

Dear colleague,

I am a Ph.D. student, carrying out a research study to formulate curriculum guidelines for environmental education in The Sudan's universities.

I will appreciate it if you would give your frank opinions and respond to the questionnaire as promptly as possible. Information supplied will be treated in strictest confidence and will be used only for research purposes.

Thanks
Yours Sincerely
Abd-Elrahim Ahmed Salim

Instructions:

(1) Please indicate your answers by a tick (✓) in the appropriate box or column unless otherwise requested.

(2) Please answer all questions by reference to the definition given below of environmental education.

"Environmental education is the process of recognising and clarifying the values, attitudes and concepts necessary to understand and appreciate the interrelatedness among man, his culture, and his biophysical environment. It also emphasises the individual's practice in decision-making about issues concerning environmental quality"

Section one: Please provide the following information about yourself:

1. Sex (male/female).....
2. Qualification: a.....
   b.....
   c.....
3. Teacher education institution attended:

a. University.....
b. Faculty.....

4. Major and minor field of specialisation.....
5. Years of teaching experience.....
6. Number of in-sevice training courses that you have in environmental education.....

Section two: Need assessment

Instruction (A): the following are the objectives of environmental education. Please tick the appropriate category (1, 2 or 3) to show:

(a) to what extent is the objective important?

(b) to what extent does the science programme in your college incorporate the objective?

Please note that: THREE = THE OBJECTIVE IS VERY IMPORTANT AND INCORPORATED TO A SATISFACTORY EXTENT; TWO = THE OBJECTIVE IS IMPORTANT AND INCORPORATED TO A MODERATE EXTENT; ONE = THE OBJECTIVE IS NOT IMPORTANT AND INCORPORATED TO A POOR EXTENT.

Environmental education objectives	Importance of the objective			Incorporation of the objective		
1. Awareness: to help individuals and social groups to acquire an awareness of and sensitivity to the total environment and its problems;	3	2	1	3	2	1
2. Knowledge: To help individuals and social groups acquire basic understanding of the total environmental concerns and human role in it;	3	2	1	3	2	1
3. Attitudes: To help individuals and social groups acquire social values, strong feelings of concern for the environment and motivation for active participation in its protection;	3	2	1	3	2	1
4. Skills: To help individuals and social groups acquire the skills for solving environmental problems;	3	2	1	3	2	1
5. Evaluation abilities: To help individuals and social groups to evaluate environmental measures and educational programmes in terms of ecological, political, economical, sociological and educational factors;	3	2	1	3	2	1
6. Participation: To help individuals and social groups develop a sense of responsibility and urgency regarding environmental problems so as to ensure appropriate action to solve those problems.	3	2	1	3	2	1

INSTRUCTION (B): please tick (✓) each of the following statements, if you think that it describes the desired status or current status of environmental education in your institution [*YOU MAY TICK ONE OR BOTH CATEGORIES*].

Statements	Desired status	Current status
7. Environmental education is part and parcel of science teacher professional preparation courses;		
8. Environmental education teaching methods are incorporated into all science teaching method courses;		
9. Science teacher education programmes include courses pertaining to research methodology for designing and developing methods and instruments which enable teachers to effectively fulfil the objectives of environmental education;		
10. Science teachers in training are given an understanding of as wide range as possible of environmental education materials, aids and resources with special reference to low cost material and opportunity for adaptation in local circumstances;		
11. Science teacher education institutions include appropriate aspects of environmental education curricula that meet the training requirement of interdisciplinary approaches and methods.		

INSTRUCTION (C): Please tick (✓) the appropriate category to indicate your response towards the following statements;

Statements	Not sure	Dis-agree	Agree
12. There is a need for curriculum development in teacher education institutions to ensure that environmental education is taken into consideration;			
13. The current science teaching method courses offered in your college are adequate for training prospective science teachers to incorporate perspectives in secondary schools curriculum;			
14. It is possible to train environmental educators in the framework of our traditional science teaching method courses;			
15. Science teacher education institutions should develop team-taught multi-disciplinary method experiences for environmental education;			
16. The prospective science teachers' academic preparation in terms of science subject matter is adequate for integrating environmental education perspectives in the Sudan's secondary schools;			
17. The usual distribution of subjects such as biology, chemistry and physics required of students is adequate for preparing them as environmental educators;			
18. Additional courses in such non-traditional areas as sociology and economics would be helpful to prospective science teachers to integrate environmental concepts into secondary school science programmes;			
19. Science teachers can function in multi- disciplinary programmes in the schools without having experience it in their education programmes;			
20. The experiences provided by science teacher education programmes engender concern about environmental issues.			

Section three

Environmental education in the science programmes of the Sudan's secondary school

INSTRUCTION (A): please answer items 1, 2, 3 and 4 by entering the appropriate code numbers in boxes and columns provided:

code number	response
5	very much;
4	a lot;
3	fairbit;
2	little;
1	not at all.

1. To what extent do you think environmental education perspectives have been incorporated into the science subject that you are teaching? [ ]
2. To what extent do you think environmental education perspectives could be incorporated into the science subject that you are teaching? [ ]
3. To what extent do you think the following environmental concepts have been incorporated into the science programme that you are teaching in secondary school?

Environmental concepts	**Very much**	**A lot**	**Fair-bit**	**Little**	**Not at all**
a. Desertification;					
b. Natural resources conservation;					
c. Population growth and environmental health;					
d. Energy source conservation;					
e. Food production, starvation and malnutrition;					
f. Land use and environmental protection;					
g. Pollution;					
h. Environmental problems and social values;					
i. Irrigation schemes role in diseases transmission;					
j. Degradation of urban life;					
k. Natural disasters impacts on rural areas;					
l. Politics and environmental problems;					
m. Global environmental issues and national policies.					

4. To what extent do you think the science subject that you teach helps students to acquire the following environmental competencies (skills and abilities)

Environmental education competencies (abilities and skills)	**Very much**	**A lot**	**Fair-bit**	**Little**	**Not at all**
a. Identification of environmental issues;					
b. Analysis of environmental issues based on social values;					
c. Identification of different solutions to environmental problems;					
d. Change individuals' concepts based on gained environmental information;					
e. Design environmental work plan;					
f. Decision-making on environmental issues.					

5. Below is the list of environmental education instructional methodologies and approaches, please indicate how often you used them by putting a tick (✓) in appropriate column?

Environmental education teaching methods & approaches	**Always**	**Frequ-ently**	**Occas-ionally**	**Rarely**	**Never**
. Affective teaching approaches (value clarification);					
. Problem solving and role play;					
. Case study;					
. Field work;					
. Using community as teaching and learning resources;					
. Action training and group work;					
. Discussion.					

INSTRUCTION (B): Please tick (✓) the appropriate categories to indicate your response towards the following statements:

Statements	Not sure	Dis-agree	Agree
6. Information pertaining to local environmental issues in the Sudan are accessible to science teachers in secondary schools;			
7. Secondary schools have problems getting access to environmental information;			
8. Environmental resource centres are necessary to disseminate information to science teachers;			
9. It is important to introduce environmental science as subject in secondary school curriculum;			
10. My learning experiences in the faculty of education prepare me to incorporate environmental education perspectives in secondary schools;			
11. Workshops should be organised to up-date science teachers knowledge on the following areas: a- Sudan's environmental issues; b- Global environmental issues; c- Environmental education methodologies and approaches.			

12. How do you grade your ability to teach the Sudan's environmental issues? very good [ ] moderate [ ] poor [ ].

13. What do you perceive to be the major problem concerning the incorporation of environmental education perspectives into the science programmes of the Sudan's secondary school curriculum?

14. Are there any comments or suggestions you would like to make about the incorporation of environmental education perspectives into science programmes of the Sudan's secondary school curriculum?

THANK YOU

Appendix C

Prospective Science Teachers' Questionnaire

School of Education,
Hull University,
Hull, HU6, 7RX,
UK

Dear student,

I am a Ph.D. student, carrying out a research study to formulate curriculum guidelines for environmental education in The Sudan's universities.

I will appreciate it if you would give your frank opinions and respond to the questionnaire as promptly as possible. Information supplied will be treated in strictest confidence and will be used only for research purposes.

Thanks
Yours Sincerely
Abd-Elrahim Ahmed Salim

Instructions:

(1) Please indicate your answers by a tick (✓) in the appropriate box or column unless otherwise requested;

(2) Please answer all questions by reference to the definition given below of environmental education.

"Environmental education is the process of recognising and clarifying the values, attitudes and concepts necessary to understand and appreciate the interrelatedness among man, his culture, and his biophysical environment. It also emphasises the individual's practice in decision-making about issues concerning environmental quality"

(3) Please provide the following information about yourself:

a. Sex (male/female).....

b. Teacher education institution attended:

I. university.....

II. Faculty.....

c. Major and minor field of specialisation.....

Section one

INSTRUCTION (A): How much do you feel you know about the following environmental concepts and issues related to the Sudan's environment? *-Please indicate your answer by putting a tick (✓) in the appropriate column below-*

Environmental concepts	Very good	Good	Med-ium	Weak	Very weak
1. Desertification;					
2. Natural resources conservation;					
3. Population growth and environmental health;					
4. Energy source conservation;					
5. Food production, starvation and malnutrition;					
6. Land use and environmental protection;					
7. Pollution;					
8. Environmental problems and social values;					
9. Irrigation schemes role in diseases transmission;					
10. Degradation of urban life;					
11. Natural disasters impacts on rural areas;					
12. Politics and environmental problems;					
13. Global environmental issues and national policies.					

INSTRUCTION (B): How do you grade your environmental competencies (abilities and skills) to investigate, evaluate and take action in issues related to the Sudan's environment? - *Please indicate your answer by putting a tick (✓) in the appropriate column below-*

Environmental education competencies (abilities and skills)	**Very good**	**Good**	**Med-ium**	**Weak**	**Very weak**
14. Identification of environmental issues;					
15. Analysis of environmental issues based on social values;					
16. Identification of different solutions to environmental problems;					
17. Change individuals' concepts based on gained environmental information;					
18. Design environmental work plan;					
19. Decision-making on environmental issues.					

INSTRUCTION (C): How do you grade your ability to select and use the following environmental education teaching methods and approaches?
-Please indicate your answer by putting a tick (✓) in the appropriate column below-

Environmental education teaching methods & approaches	**Very good**	**Good**	**Med-ium**	**Weak**	**Very weak**
0. Affective teaching approaches (value clarification);					
1. Problem solving and role play;					
2. Case study;					
3. Field work;					
4. Using community as teaching and learning resources;					
5. Action training and group work;					
6. Discussion.					

Section two

INSTRUCTION: Please indicate by a tick (✓) the response that best expresses your opinion about each of the following statements.

Note: SA = strongly agree; A = agree; N = neutral; DA = disagree; S. DA = strongly disagree.

Statements	SA	A	N	DA	S. DA
27. I prefer an environmental approach to science learning;					
28. Studying environmental issues in science helps me to think critically by looking at problems from different points of views;					
29. Mankind has the right to modify the environment to satisfy his basic needs;					
30. Studying environmental issues in science is not interesting;					
31. Science-based activities on the environment promote tolerance towards solving our environmental problems;					
32. Mankind is created to rule over nature, so people should consume natural resources as they want;					
33. Studying local environmental issues in science will limit students' participation in social activities;					
34. Group work on environmental protection in science helps in respecting others' views;					
35. Environmental preservation in the Sudan can be maintained only by law;					
36. Students' involvement in environmental preservation programmes in science is a waste of time;					
37. Wise utilisation of natural resources depends on personal values;					
38. Sudanese have social responsibilities to participate in preserving their environment;					
39. Sudanese should be encouraged to give priorities to environmental protection to improve their health conditions.					

40. While studying in secondary school, to what extent do you think you have learned about the environment from the subjects listed below?

Subject	Very much	A lot	Fairbit	Little	Nothing
a. Biology;					
b. Chemistry;					
c. Physics.					

41. To what extent do you think each of the following sources contributed to your environmental information?

Environmental information sources	Very much	A lot	Fairbit	Little	Nothing
a. General education;					
b. Mass media;					
c. Private reading;					
d. Youth and students' organisa-tions;					
e. General university courses;					
f. Academic courses;					
g. Educational and professional courses.					

42. What do you think are the three most serious environmental problems in the Sudan today?

a.....

b.....

c.....

THANK YOU

Appendix D
Secondary Students' Questionnaire

School of Education,
Hull University,
Hull, HU6, 7RX,
UK

Dear student,

I am a Ph.D. student, carrying out a research study to formulate curriculum guidelines for environmental education in The Sudan's universities.

I will appreciate it if you would give your frank opinions and respond to the questionnaire as promptly as possible. Information supplied will be treated in strictest confidence and will be used only for research purposes.

Thanks
Yours Sincerely
Abd-Elrahim Ahmed Salim

Instructions:

(1) Please indicate your answers by a tick (✓) in the appropriate box or column unless otherwise requested;

(2) Please answer all questions by reference to the definition given below of environmental education;

"Environmental education is the process of recognising and clarifying the values, attitudes and concepts necessary to understand and appreciate the interrelatedness among man, his culture, and his biophysical environment. It also emphasises the individual's practice in decision-making about issues concerning environmental quality"

(3) Please provide the following information about yourself:

a. Sex (male/female).....

b. School.....

Section one

INSTRUCTION (A): How much do you feel you know about the following environmental concepts and issues related to the Sudan's environment? - *Please indicate your answer by putting a tick (✓) in the appropriate column below-*

Environmental concepts	**Very good**	**Good**	**Med-ium**	**Weak**	**Very weak**
1. Desertification;					
2. Natural resources conservation;					
3. Population growth and environmental health;					
4. Energy source conservation;					
5. Food production, starvation and malnutrition;					
6. Land use and environmental protection;					
7. Pollution;					
8. Environmental problems and social values;					
9. Irrigation schemes role in diseases transmission;					
10. Degradation of urban life;					
11. Natural disasters impacts on rural areas;					
12. Politics and environmental problems;					
13. Global environmental issues and national policies.					

INSTRUCTION (B): How do you grade your environmental competencies (abilities and skills) to investigate, evaluate and take action in issues related to the Sudan's environment? -*Please indicate your answer by putting a tick (✓) in the appropriate column below-*

Environmental education competencies (abilities and skills)	**Very good**	**Good**	**Med-ium**	**Weak**	**Very weak**
14. Identification of environmental issues;					
15. Analysis of environmental issues based on social values;					
16. Identification of different solutions to environmental problems;					
17. Change individuals' concepts based on gained environmental information;					
18. Design environmental work plan;					
19. Decision-making on environmental issues.					

Section two

INSTRUCTION: Please indicate by a tick (✓) the response that best expresses your opinion about each of the following statements.

Note: ***SA = strongly agree; A = agree; N = neutral; DA = disagree; S. DA = strongly disagree.***

Statements	SA	A	N	DA	S. DA
20. I prefer an environmental approach to science learning;					
21. Studying environmental issues in science helps me to think critically by looking at problems from different points of views;					
22. Mankind has the right to modify the environment to satisfy his basic needs;					
23. Studying environmental issues in science is not interesting;					
24. Science-based activities on the environment promote tolerance towards solving our environmental problems;					
25. Mankind is created to rule over nature, so people should consume natural resources as they want;					
26. Studying local environmental issues in science will limit students' participation in social activities;					
27. Group work on environmental protection in science helps in respecting others' views;					
28. Environmental preservation in the Sudan can be maintained only by law;					
29. Students' involvement in environmental preservation programmes in science is a waste of time;					
30. Wise utilisation of natural resources depends on personal values;					
31. Sudanese have social responsibilities to participate in preserving their environment;					
32. Sudanese should be encouraged to give priorities to environmental protection to improve their health conditions.					

33. While studying in secondary school, to what extent do you think you have learned about the environment from the subjects listed below?

Subject	Very much	A lot	Fairbit	Little	Nothing
a. Biology;					
b. Chemistry;					
c. Physics.					

34. To what extent do you think each of the following sources contributed to your environmental information?

Environmental information sources	Very much	A lot	Fairbit	Little	Nothing
a. General education;					
b. Mass media;					
c. Private reading;					
d. Parents and friends;					
e. Youth and students' organis-ations;					

35. What do you think are the three most serious environmental problems in the Sudan today?

a.....

b.....

c.....

THANK YOU

Appendix E
Science Teachers' Questionnaire (Arabic Version)

بسم الله الرحمن الرحيم

المملكة المتحدة
جامعة (هل) مدرسة العلوم التربوية

استبيان لمعلمى العلوم بالمرحلة الثانوية لمعرفة ارائهم فى امكانية ادخال التربية البيئية ضمن برامج كليات التربية بالجامعات السودانية

زميلى المعلم.....
زميلتى المعلمة....

تحية طيبة

اقوم بدراسة لامكانية ادخال التربية البيئية ضمن برامج كليات التربية فى الجامعات السودانية ولمعرفة اراء الاساتذة الاجلاء دور اساسى فى ذلك علية ارجو التكرم مشكورا بالاجابة عن اسئلة الاستبيان ادناة علما بان المعلومات لغرض البحث العلمى وسوف تعالج بسرية تامة باذن الله تعالى.

مع التقدير سلفا لمساهمتكم وبالله التوفيق
عبد الرحيم احمد سالم- طالب دكتوراة

ملاحظات هامة :-

ا- ارجو الاجابة عن الاسئلة بوضع علامة (✓) ما لم يطلب غير ذلك.
ب- ارجو الاجابة عن كل الاسئلة واضعا فى الاعتبار التعريف ادناة للتربية البيئية.

تعريف " التربية البيئية هى عملية تكوين القيم والاتجاهات والمهارات والمدركات الازمة لفهم وتقدير العلاقات المعقدة التى تربط الانسان وحضارتة بمحيطة الحيوى الفيزيقى (الكونى) وتوضيح حتمية المحافظة على مصادر البيئة وحسن استغلالها لصالح الانسان"

القسم الاول:- الرجاء التكرم بملئ البيانات الاتية :-

١/ الجنس:-(ذكر/انثى)_____
٢/ المؤهلات:-ا- _____
ب- _____
ج- _____
٣/ الجامعة التى تخرجت منها والكلية: ا- الجامعة _____
ب- الكلية _____
٤/ التخصص الاساسى والفرعى ان وجد:- _____
٥/ سنوات العمل بالتدريس: _____
٦/ الوظيفة (معلم/رئيس شعبة/ موجة) _____
٧/ عدد الدورات التدريبية التى نلتها فى تدريس التربية البيئية _____

القسم الثاني:-

تقدير الاحتياجات المبدئية لامكانية ادخال التربية البيئية ضمن برامج كليات التربية بالجامعات السودانية:-

P/الجدول ادناة يوضح الاهداف العامة للتربية البيئية ارجو التكرم بوضع علامة (✓) في المكان المحدد لتوضيح الاتي:-

أ - اهمية الهدف.

ب - مدى شمول برامج اعداد معلم العلوم بكليات التربية للهدف.

	الاهداف العامة للتربية البيئية	اهمية الهدف			مدى شمولة في برامج كليات التربية		
		مهم جدا	مهم	غير مهم	لدرجة كبيرة	لدرجة وسط	لدرجة لاتذكر
١/	تكوين الوعي الفردي والجماعي بمشاكل البيئة .						
٢/	المساعدة في فهم مشاكل البيئة ودور الانسان في حمايتها .						
٣/	تكوين المفاهيم والاتجاهات والقيم الخاصة بحماية وتحسين البيئة.						
٤/	المساعدة في اكتساب المهارات الخاصة بتشخيص وحل مشاكل البيئة.						
٥/	اكتساب المهارات الخاصة بتقويم الوضع البيئي والبرامج التربوية الازمة له.						
٦/	المساعدة في تكوين روح المشاركة الفعالة والمسئولية تجاة مشاكل البيئة.						

ج/ العبارات (٧ الى ١١) توضح الوضع المرغوب او الوضع الحالي للتربية البيئية في كلية التربية التي تخرجت منها ، علية ارجو توضيح وجهة نظرك بوضع علامة (✓) حسب ما تراة .

" يمكن ان تاشر في الخانتين اذا كنت ترى ذلك"

		وضع مرغوب	واقع تربوي
٧/	التربية البيئية جزء اساسي في منهج وطرق تدريس العلوم.	( )	( )
٨/	طرق تدريس التربية البيئية متضمنة في طرق تدريس العلوم.	( )	( )
٩/	البرامج التربوية لمعلمي العلوم تشمل التدريب على اعداد المواد وتصميم وتطوير الادوات والوسائل الخاصة بتحقيق اهداف التربية البيئية.	( )	( )
١٠/	معلمي العلوم يجدون في التدريب فرصة كافية لاعداد المواد والوسائل الخاصة لتدريب على تدريس التربية البيئية مع مراعاة التكلفة والارتباط بالبيئة.	( )	( )
١١/	مؤسسات اعداد معلم العلوم بالمرحلة الثانوية تعطي اعتبار التدريب على مفاهيم واسس التربية البيئية.	( )	( )

ج/ العبارات (١٢ــ٢٠) ارجو الاجابه عليها بوضع علامة (✓) لتوضح موقفك من كل عباره؟ (موافق، لا اوافق، غير متاكد).

العبـــــــــارات	اوافق	لا اوافق	غير متاكد
١٢/ تطوير منهج خاص بالتربيه البيئيه في مؤسسات اعداد المعلم العلوم يعتبر شئ اساسي.			
١٣/ طرق تدريس العلوم في كليات التربيه تؤهل لتدريس التربيه البيئيه بالمدارس الثانويه.			
١٤/ يمكن تدريب المعلمين على تدريس التربيه البيئيه في اطار طرق تدريس العلوم الحالي.			
١٥/ يمكن لكليات التربيه تطبيق نظام الورش التدريبيه لتدريب الطلاب على العمل الجماعي وحل المشكلات.			
١٦/ المقررات الاكاديميه بكليات التربيه كافيه لاعداد الطلاب لادخال مفاهيم التربيه البيئيه بالمدارس الثانويه.			
١٧/ يمكن تدريب معلم التربيه البيئيه في اطار تقسيم العلوم الحالي (احياء، كيمياء، فيزياء)			
١٨/ اضافة علوم ثقافيه مثل الاقتصاد والاجتماع لمتطلبات تاهيل معلمي العلوم يفيد في ادخال مفاهيم التربيه البيئيه.			
١٩/ يمكن لمعلمي العلوم ادخال مفاهيم التربيه البيئيه دون التدريب عليها بكليات التربيه.			
٢٠/ الخبرات التي تقدمها برامج كليات التربيه لمعلمي العلوم كافيه لادخال مفاهيم التربيه البيئيه بالمدارس الثانويه.			

القسم الثالث:-

- التربية البيئية بالمدارس الثانوية السودانية:-

١) ارجو الاجابة عن الاسئلة (١، ٢، ٣، ٤) الاتية بكتابة الرقم المسلسل الذى يحدد اجابتك؟ في المكان المحدد لذلك.....

الرقم المسلسل

١- لدرجة كبيرة جدا .
٢- لدرجة كبيرة
٣- لدرجة متوسطة
٤- لدرجة صغيرة
٥- لدرجة لاتذكر

١/ الى اى مدى ترى ان عناصر التربية البيئية يمكن ان تدرس ضمن مادة العلوم التى تدرسها بالمرحلة الثانوية؟ . ( )

٢/ الى اى مدى ترى ان عناصر التربية البيئية متضمنة فى مادة العلوم التى تدرسها بالمرحلة الثانوية ؟ ( )

٣/ الى اى مدى تعتقد ان مادة العلوم التى تدرسها تشمل المفاهيم والمشاكل ذات العلاقة بالبيئة السودانية الاتية ؟ ( )

مفاهيم ومشاكل البيئة السودانية	لدرجة كبيرة جدا	لدرجة كبيرة	لدرجة وسط	لدرجة صغيرة	لدرجة لاتذكر
ا - الزحف الصحراوى اسبابة اثارة وعلاجة					
ب - استغلال الموارد الطبيعية بوعى والمحافظة عليها .					
ج - العلاقة بين النمو السكانى وصحة البيئة .					
د - اعتبار حماية البيئة عند التخطيط لاستغلال الاراضى لاغراض التنمية .					
هـ - الطاقة ومصادرها المتجددة وغير المتجددة والمحافظة عليها .					
و - علاقة الانتاج الغذائى بالمجاعات وسوء التغذية .					
ز - التلوث اسبابة اثارة وعلاجة .					
ح - علاقة مشاكل البيئة بالقيم الاجتماعية والسياسية .					
م - اثر مصاريع الرزفى نقل الامراض المسمى (الملاريا والبلهارسيا					
ع - اثار النزوح والهجرة على التخطيط والخدمات والمرافق العامة بالمدن الكبرى .					
غ - اثار الكوارث الطبيعية على الحياة فى الريف السودانى .					
ر - دور الجهات السياسية فى حماية البيئة .					
ز - توافق السياسات القومية مع الاتجاهات العلمية لحماية البيئة					

٤/ الى اى مدى يساعد تدريس العلوم الطلاب فى اكتساب الكفايات البيئية (المقدرات والمهارات) الازمة لتشخيص وتقويم مشاكل البيئة واتخاذ القرار فى حلها ؟

الكفايات البيئية (المقدرات والمهارات).	لدرجة كبيرة جدا	لدرجة كبيرة	لدرجة وسط	لدرجة صغيرة	لدرجة لاتذكر
ا ـ التعرف على مشاكل البيئة من مصادرها الاولية والثانوية.					
ب ـ تحليل مشاكل البيئة فى ضوء القيم السياسية والاجتماعية.					
ج ـ توضيح مشاكل البيئة وما يترتب عليها من ناحية اجتماعية اقتصادية وثقافية.					
د ـ تغيير القيم والمفاهيم فى ضوء المعلومات الجديدة التى يكتسبها الفرد.					
هـ ـ تصميم خطة عمل بيئية وتطبيقها.					
و ـ اتخاذ القرار المناسب لحماية البيئة.					

٥/ ما مدى تقديرك لاستعمالك لطرق واساليب التربية البيئية الاتية فى تدريس العلوم ؟

ـــــ ارجو وضع علامة (✓) فى المكان المناسب الذى يحدد تقديرك وتحت الفئة المناسبة ـــــ .

طرق واساليب تدريس التربية البيئية	تستعمل غالبا	تستعمل	تستعمل احيانا	تستعمل نادرا	لا تستعمل ابدا
ا ـ تطوير الاتجاهات والميول العلمية (توضيح القيم والمبادئ).					
ب ـ حل المشكلات المحاكاة وتمثيل الادوار.					
ج ـ دراسة الحالة.					
د ـ الرحلات الميدانية.					
هـ ـ استغلال البيئة الحلية كوسط تربوى.					
و ـ التدريب على اتخاذ القرار فى ضوء العمل الجماعى والفردى.					
ح ـ المناقشة.					

ب) العبارات(٦ــ١٢)ارجو الاجابة عليها بوضع علامة(✓) لتوضيح رايك فى كل منها ..

	العبـــــارات	اوافق	لااوافق	غيرمتاكد
٦/	اعتقد ان تاهيلى بكلية التربية ساعدنى فى ادخال مفاهيم التربية لبيئية فى المادة التى ادرسها .			
٧/	ارى ضرورة ادخال مادة علم البيئة فى منهج المرحلة الثانوية فى السودان.			
٨/	المعلومات عن البيئة السودانية متوفرة لمعلمى العلوم بالمرحلة الثانوية.			
٩/	الدارس الثانوية تواجة مشاكل فى الحصول على المعلومات عن البيئة السودانية.			
١٠/	ارى ضرورة ايجاد مراكز تعليمية لتوفير المعلومات عن البيئة السودانية.			
١١/	ارى ضرورة اقامة كورسات لتحديث تدريب معلمى العلوم فى المجالات الاتية:ـ ا ـ مشاكل البيئة السودانية. ب ـ مشاكل البيئة العالمية. ج ـ طرق تدريس التربية البيئية.			

١٢/ ما مدى تقديرك لمقدرتك على التدريس مفاهيم التربية البيئية ضمن مادة العلوم التى تدرسها بالمرحلة الثانوية؟

جيد جدا ( ) جيد ( ) دون الوسط ( ).

١٣/ماهى اهم المشاكل التى تعتقد انها تعيق ادخال مفاهيم التربية البيئية ضمن مناهج العلوم بالمرحلة الثانوية؟

_____

_____

_____

_____

١٤/ماهى مقترحاتك وتوصياتك لادخال التربية البيئية ضمن مناهج العلوم بالمرحلة الثانوية؟

_____

_____

_____

_____

شكرا على مساهمتكم وبالله التوفيق..

Appendix F
Prospective Science Teachers' Questionnaire (Arabic Version)

بسم الله الرحمن الرحيم

المملكة المتحدة
جامعة (هل) مدرسة العلوم التربوية

استبيان لتحديد المقدرات والاتجاهات البيئية
لطلاب كليات التربية بالجامعات السودانية

اخى الطالب ... اختى الطالبة ،
بعد التحية
اقوم بدراسة لامكانية ادخال التربية البيئية ضمن برامج كليات التربية بالجامعات السودانية ، ولمعرفة المقدرات والمهارات والاتجاهات البيئية لطلاب كليات التربية دور اساسى فى ذلك ، علية ارجو شاكرا التكرم بالاجابة عن اسئلة الاستبيان المرفق علما بان المعلومات التى تدلى بها لغرض البحث العلمى وتحفظ بسرية تامة باذن الله تعالى.

وشكرا مقدما على مساهمتكم وبالله التوفيق
عبد الرحيم احمد سالم - طالب دكتوراة

ملاحظات هامة :-
ا - ارجو الاجابة بوضع علامة (✓) مالم يطلب غير ذلك.
ب - ارجو الاجابة عن كل الاسئلة واضعا فيى الاعتبار التعريف ادناة للتربية البيئية .

تعريف :" التربية البيئية هى عملية تكوين القيم والاتجاهات والمهارات والمدركات اللازمة لفهم وتقدير العلاقات المعقدة التى تربط الانسان وحضارتة بمحيطة الحيوى الفيزيقى (الكوني) وتوضيح حتمية المحافظة على مصادر البيئة وضرورة استغلالها لصالح الانسان ."

ج - لاتكتب اسمك فقط ارجو توضيح الاتى :-
اسم الكلية _____
الجنس (ذكر / انثى) _____
التخصص _____

القسم الاول: المفاهيم والمقدرات.

المفاهيم: ما مدى تفهمك امثاكل ومفاهيم البيئة السودانية الاتية؟
ارجو الاجابة بوضع علامة (✓) امام رقم كل عبارة بورقة الاجابة

رقم العبارة	مشاكل ومفاهيم البيئة السودانية	جيد جدا	جيد	وسط	ضعيف	ضعيف جدا
١-	الزحف الصحراوى اسبابة اثارة وعلاجة .					
٢.	استقلال الموارد الطبيعية بوعى والمحافظة عليها .					
٣.	العلاقة بين النمو السكانى وصحة البيئة .					
٤-	الطاقة مصادرها المتجددة وغير المتجددة والمحافظة عليها					
٥.	علاقة الانتاج الغذائى بالمجاعات وسوء التغذية .					
٦-	اعتبار حماية البيئة عند التخطيط لاستقلال الاراضى لاغراض التنمية .					
٧-	التلوث اسبابة اثارة وعلاجة .					
٨-	علاقة مشاكل البيئة بالقيم الاجتماعية والسياسية .					
٩.	اثر مشاريع الرى فى نقل الامراض المستوطنة (كالملاريا والبلهارسيا).					
١٠-	اثار النزوح والهجرة على التخطيط والخدمات والمرافق العامة بالمدن الكبرى .					
١١-	اثا الكوارث الطبيعية على الحياة فى الريف .					
١٢-	دور الجهات السياسية فى حماية البيئة .					
١٣-	توافق السياسات القومية مع الاتجاهات العالمية لحماية البيئة .					

ب- المقدرات والمهارات: ما مدى تقديرك لكفاياتك البيئية (المقدرات والمهارات) الازمة لتشخيص وتقويم واتخاذ القرار فى مواضيع ومشاكل البيئة ؟
ارجو الاجابة بوضع علامة (✓) امام رقم كل عبارة بورقة الاجابة

رقم العبارة	الكفايات البيئية (المقدرات والمهارات)	اجيد جدا	جيد	وسط	ضعيف	ضعيف جدا
١٤-	التعرف على مشاكل البيئة من مصادرها الاولية والثانوية					
١٥.	تحليل مشاكل البيئة فى ضوء القيم الاجتماعية والسياسية .					
١٦-	توضيح مشاكل البيئة وما يترتب عليها من الناحية الاجتماعية السياسية والاقتصادية .					
١٧-	تغيير القيم والمفاهيم فى ضوء المعلومات الجديدة التى يكتسبها الفرد .					
١٨-	تصميم خطة عمل بيئى وتطبيقها .					
١٩-	اتخاذ القرار المناسب لحماية البيئة .					

ج ـ ما مدى تقديرك لكفايا تك للتدريس بطرق واساليب التربية البيئية الاتية؟

	طرق واساليب تدريس التربية البيئية	جيد جدا	جيد	وسط	ضعيف	ضعيف جدا
٢٠	تطوير الاتجاهات والميول العلمية (توضيح القيم والمبادئ).					
٢١	حل المشكلات المحاكاة وتمثيل الادوار.					
٢٢	دراسة الحالة.					
٢٣	الرحلات الميدانية.					
٢٤	استغلال البيئة المحلية كوسيط تربوى.					
٢٥	التدريب على اتخاذ القرار فى ضوء العمل الجماعى والفردى.					
٢٦	المناقشة .					

القسم الثانى:ـ" الاتجاهات البيئية"

العبارات(٢٧ـ٤١)ارجو الاجابة عليها بوضع علامة(✓) امام كل عبارة لتوضيح رايك بمدى الموفقة على كل منها.

(موافق تماما ، موافق، غير متاكد، لا وافق،لا وافق تماما).

	العبارات	اوافق تماما	اوافق	غير متاكد	لا وافق	لا وافق تماما
٢٧-	افضل المدخل البيئى لدراسة العلوم.					
٢٨-	دراسة مواضيع البيئة فى مادة العلوم يفيد فى تنمية الشعور بمشاكل البيئة.					
٢٩-	للانسان الحق فى تغيير البيئة لسد حاجاته.					
٣٠-	دراسة مشاكل البيئة فى العلوم غير ممتعة.					
٣١-	نشاطات العلوم المرتبطة ببيئة الفرد تعود على الصبر لحل مشاكل البيئة.					
٣٢-	استغلال الموارد الطبيعية حسب متطلبات الفرد حق مطلقة بحكم سيادة الفرد على الطبيعة.					
٣٣-	دراسة مشاكل المجتمع المحلى فى العلوم تحد من مشاركة الطلبة فى النشاطات الاجتماعية					
٣٤-	العمل الجماعى لتحسين البيئة يساعد على احترام راى الاخرين.					
٣٥-	حماية البيئة فى السودان لا تتم الا بالقانون.					
٣٦-	مشاركة المنظمات الطلابية والشبابية فى برامج تحسين البيئة منيعة للزمن.					

٣٧	ترشيد استغلال الموارد الطبيعية يتوقف على مبادئ واخلاق الافراد.
٣٨	الطلاب لهم مسئولية اجتماعية فى المطالبة بالمشاركة فى تحسين الوضع البيئى.
٣٩	لتحسين الوضع البيئى الصحى فى السودان يجب ان يشغل الناس لاعطاء اولوية لحماية البيئة.

٤٠/ فى اثناء دراستك بالمرحلة الثانوية الى اى مدى تعتقد ان كل من المواد الاتية ساعدتك فى دراسة مشاكل ومفاهيم البيئة السودانية والمحافظة عليها؟

المادة	لدرجة كبيرة جدا	لدرجة كبيرة	لدرجة وسط	لدرجة صغيرة	لدرجة لاتذكر
ا ـ الاحياء.					
ب ـ الكيمياء.					
ج ـ الفيزياء.					

٤١ الى اى مدى تعتقد ان كل من المصادر الاتية ساعدك على تفهم مشاكل ومفاهيم البيئة فى السودان؟

المصادر	كبيرة جدا	لدرجة كبيرة	لدرجة وسط	لدرجة صغيرة	لدرجة لاتذكر
ا ـ التعليم العام بالمدارس.					
ب ـ مواد الثقافة العامة بالجامعة.					
ج ـ مواد التخصص الاكاديمى.					
د ـ العلوم التربوية والمهنية.					
هـ وسائل الاعلام.					
و ـ الاطلاع الخاص.					
ز ـ المنظمات الطلابية والشبابية.					

٤٢/ فى رايك ما هى اكبر ثلاث مشاكل بيئية يعانى منها السودان؟

ا ـ _____

ب ـ _____

ج ـ _____

شكرا على مساهمتكم وبالله التوفيق.

Appendix G
Secondary Students' Questionnaire (Arabic Version)

بسم الله الرحمن الرحيم

المملكة المتحدة
جامعة (هل)مدرسة العلوم التربوية

إستبيان لتحديد المقدرات والإتجاهات البيئية لطلاب المرحلة الثانوية السودانية

اخى الطالب...اختى الطالبة...

بعد التحية

اقوم بدراسة لامكانية ادخال التربية البيئية ضمن برامج كليات التربية فى السودان و ولمعرفة المقدرات والاتجاهات البيئية لطلاب المرحلة الثانوية دور اساسى فى ذلك ، علية ارجو التكرم مشكورا بالاجابة عن اسئلة الاستبيان المرفق علما بان المعلومات التى تدلى بها لغرض البحث العلمى وسوف تحفظ بسرية تامة باذن الله تعالى.

مع التقدير سلفا لمساهمتكم وشكرا

عبد الرحيم احمد سالم-طالب دكتوراه

ملاحظات هامة :-

ا- ارجو التكرم بالاجابة بوضع علامة (✓) امام الرقم المسلسل لكل عبارة بورقة الاجابة مالم يطلب غير ذلك.

ب- ارجو التكرم بالاجابة عن كل الاسئلة واضعا فى الاعتبار التعريف ادناة للتربية البيئية .

تعريف " التربية البيئية هى دراسة علاقة الانسان بالكائنات الاخرى والوسط الذى يعيش فية واثر النمو السكانى على صحة البيئة والموارد الطبيعية، ودور الانسان فى استغلال مواردة الطبيعية بوعى والمحافظة عليها "

ج - لا تكتب اسمك على ورقة الاجابة ارجو فقط كتابة اسم المدرسة والفرقة التى تدرس بها .

القسم الاول: المفاهيم والمقدرات.

المفاهيم: ما مدى تفهمك لمشاكل ومفاهيم البيئة السودانية الاتية؟

ارجو الاجابة بوضع علامة (✓) امام كل عبارة وتحت الفئة التى تناسب تقديرك.

رقم العبارة	مشاكل ومفاهيم البيئة السودانية	جيد جدا	جيد	وسط	ضعيف	ضعيف جدا
١-	الزحف الصحراوى أسبابه آثاره وعلاجه .					
٢.	إستغلال الموارد الطبيعية بوعى والمحافظة عليها .					
٣.	العلاقة بين النمو السكانى وصحة البيئة .					
٤-	الطاقة مصادرها المتجددة وغير المتجددة والمحافظة عليها					
٥.	علاقة الإنتاج الغذائى بالمجاعات وسوء التغذية .					
٦-	إعتبار حماية البيئة عند التخطيط لاستغلال الأراضى لأغراض التنمية .					
٧-	التلوث أسبابه آثاره وعلاجه .					
٨-	علاقة مشاكل البيئة بالقيم الإجتماعية والسياسية .					
٩-	اثر مشاريع الرى فى نقل الأمراض المستوطنة (كالملاريا والبلهارسيا).					
١٠-	آثار النزوح والهجرة على التخطيط والخدمات والمرافق العامة بالمدن الكبرى .					
١١-	آثار الكوارث الطبيعية على الحياة فى الريف .					
١٢-	دور الجهات السياسية فى حماية البيئة .					
١٣-	توافق السياسات القومية مع الاتجاهات العالمية لحماية البيئة .					

ب- المقدرات والمهارات: ما مدى تقديرك لكفاياتك البيئية (المقدرات والمهارات) الازمة لتشخيص وتقويم وإتخاذ القرار فى مواضيع ومشاكل البيئة ؟

ارجو الاجابة بوضع علامة (✓) امام كل عبارة وتحت الفئة التى تناسب تقديرك.

رقم العبارة	الكفايات البيئية (المقدرات والمهارات)	جيد جدا	جيد	وسط	ضعيف	ضعيف جدا
١٤-	التعرف على مشاكل البيئة من مصادرها الأولية والثانوية					
١٥.	تحليل مشاكل البيئة فى ضوء القيم الإجتماعية والسياسية .					
١٦-	توضيح مشاكل البيئة وما يترتب عليها من الناحية الإجتماعية السياسية والاقتصادية .					
١٧-	تغيير القيم والمفاهيم فى ضوء المعلومات الجديدة التى يكتسبها الفرد .					
١٨-	تصميم خطة عمل بيئى وتطبيقها .					
١٩-	إتخاذ القرار المناسب لحماية البيئة .					

القسم الثاني:- "الاتجاهات البيئية "

العبارات (٢٠ــ٣٤) ارجو الاجابة عليها بوضع علامة (✓) امام رقم كل عبارة على ورقة الاجابة لتوضيح رايك بمدى الموافقة على كل منها.

(موافق تماما ، موافق ،غير متاكد ،لا وافق، لا وافق تماما .)

رقم العبارة	العبارات	أوافق تماما	أوافق	غير متاكد	لا وافق	لا أوافق تماما
٢٠-	افضل المدخل البيئى لدراسة العلوم .					
٢١-	دراسة مواضيع البيئة فى مادة العلوم يفيد فى تنمية الشعور بمشاكل البيئة.					
٢٢-	للانسان الحق فى تغيير البيئة لسد حاجاته.					
٢٣-	دراسة مشاكل البيئة فى العلوم غير ممتع .					
٢٠-	نشاطات العلوم المرتبطة ببيئة الفرد تعود الصبرعلى حل مشاكل البيئة.					
٢٥-	استغلال الموارد الطبيعية حسب متطلبا الفرد حق مطلق له بحكم سيادة الانسان على الطبيعة.					
٢٦-	دراسة مشاكل المجتمع المحلى فى للعلوم تحد من مشاركة الطلاب فى النشاطات الاجتماعية					
٢٧-	العمل الجماعى لتحسين البيئة يساعد على احترام راى الاخرين .					
٢٨-	حماية البيئة فى السودان لاتتم الا بالقانون.					
٢٩-	مشاركة المنظمات الطلابية والشبابية فى برامج تحسين البيئة مضيعة للزمن .					
٣٥-	ترشيد استغلال الموارد الطبيعية يتوقف على مبادئ وأخلاق الأفراد.					
٣٢-	الطلاب لهم مسئولية إجتماعية بالمطالبة فى المشاركة فى تحسين الوضع البيئى .					
٣٣-	لتحسين البيئة الصحية فى السودان يجب ان يشجع الناس لاعطاء أولوية لحماية البيئة .					

٣٣/ فى اثناء دراستك بالمرحلة الثانوية الى اى مدى تعتقد ان كل من المواد الآتية ساعدك فى دراسة مشاكل ومفاهيم البيئة السودانية والمحافظة عليها ؟
ـــ وضح اجابتك بوضع علامة (✓) امام رقم كل مادة على ورقة الاجابة ـــ

المادة	الدرجة كبيرة جدا	الدرجة كبيرة	الدرجة وسط	الدرجة صغيرة	الدرجة لاتذكر
ا ـ الاحياء .					
ب ـ الكيمياء .					
ج ـ الفيزياء .					

٣٤/ الى اى مدى تعتقد ان كلا من المصادر الآتية ساعدك على تفهم مشاكل ومفاهيم البيئة فى السودان ؟
ـــ " ارجو الاجابة بوضع علامة (✓) امام رقم كل مصدر بورقة الاجابة " ـــ

المصادر	الدرجة كبيرة جدا	الدرجة كبيرة	الدرجة وسط	الدرجة صغيرة	الدرجة لاتذكر
ا ـ التعليم العام فى المدارس .					
ب ـ وسائل الاعلام .					
ج ـ الاطلاع الخاص .					
د ـ الاباء والاصدقاء .					
هـ ـ منظمات الشباب والطلاب .					

٣٥/ فى رايك ما هى اكبر ثلاث مشاكل بيئية يعانى منها السودان ؟
ا ـ _____
ب ـ _____
ج ـ _____

بالتوفيق وشكرا على مساهمتكم .

Appendix H
Letter to the Sudanese Experts (Arabic)

التـــاريـــخ 7 /12 / 1991م

الأستاذ الفاضل المحـــــــــترم

السلام عليكـم ورحمة الله و بركـا تـه و بعـد:

أ كتب لكم هذا الخطـا ب إ فـادةً بـأ نـني أ حـد الطـلاب البـا حثين لـد رجـة الدكتـو راة في مدرسـة العلـوم الت بوية- جـا معة هـل -إ لجلـت ا و أ قـوم بـد را سـة لا د خـا ل الـت بيـة البيئيـة ضمـن بـر ا مـج إ عـد ا د معلمي العلو م با لمر حلـة الثـا نـو يـة بـا لجـا معـا ت السـو د ا نيـة و الأ غـر ا ض الأساسية للدراسة كما يلي:

1- تحد يد مد ى شمو ل بر ا مج إ عـد ا د معلمي العلـو م بـا لمر حلـة الثـا نـو يـة بـا لجـا معـا ت السـو د ا نيـة و بر ا مج العلو م با لمر حلة الثـا نـو يـة علـى أ سـا سيـا ت الـت بيـة البيئيـة.

2- تحد يد إ حتياجـا ت البـر ا مـج السـا لفـة الذكـر لا د خـا ل الـت بيـة البيئيـة.

3- إ سـتطلاع المقـد رات و الإ تجـا هـا ت البيئيـة لطـلا ب كليـا ت الـت بيـة قسـم العلـو م و طـلا ب المرحله االثا نـو يـة.

آ مـل شـا كـراً التكـرم بفحـص محتـوى الإسـتبانات المرفقـة بطيـة هـذا الخطـاب علـى ضـؤ أهـداف الدراسـة الموضحـة أ عـلا ه موضحـاً مـاتر اه فيمـا يتعلـق بمـدى و ضـوح لغـة الإ سـتبا نـا ت ، مظهرهـا العـا م ، والى أي مدى تغطي هـذ ه الإ ستبا نـا ت الـوا قـع البيئي في السـودان وأي إ قـتراح تـراه منـا سـباً لغـر ض هـذه الدراسة.

شاكر اً لكم تعا ونكـم مـع خـا لـص شـكري و تقـد يـر ي

والسـلام عليكـم و رحمـة الله و بـر ا كـا تـه

عبدالرحيم أ حمد سا لم

با حث لد ر جة الد كتو را ة

مدرسة العلوم الت بوية- جـا معة هل -إ لجلـت ا

Appendix I
Covering Letter Accompanying the Pilot Study Questionnaires

التـــاريـــخ 7 /12 / 1991م

الأ خ الكريـم

السلام عليكـم ورحمـة الله و بركـا تـه و بعـد:

أكتب لكم هـذا الخطـاب إ فـادةً بـأنني أ حـد الطـلاب البـا حثين لـد رجـة الدكتـو راة في مدرسـة العلـوم التـر بويـة- جـا معـة هـل -إ لجلـتـر ا و أ قـوم بـد را سـة لإ د خـا ل التـر بيـة البيتيـة ضمـــن بـــر ا مـــج إ عـــد ا د معلمي العلو م بـا لمـر حلـة الثـا نـو يـة بـا لجـا معـا ت السـو د ا نيـة ا لإ ستبا نـة المـر فقـة في مـر حلـة الـد را سـة الأوليـة

أ رجـو شـا كـر اً التكـرم بـا لإ جـا بـة علـى جميـع الأ سـئلة آمـلاً تـد ويـن ملحوظـاتكم فيمـا يتعلـق بوضـــوح اللغة و كـم مـن الزمـن بـالتحد يـد أ ستغرقته في الإجابـة.

شـاكراً لكـم تعـاونكم الدائـم .

والسلام عليكم ورحمة الله و بركا ته.

عبدالرحيم أ حمد سا لم

با حث لد ر جة الد كتو را ة

مدرسة العلوم التر بوية- جا معة هل -إ لجلتر ا

Appendix J1
letter to the Academic Secretary of Omdurman Islamic University

التـا ريـــخ 9 /7 / 1991م

الموضوع:تذا كـر سفر للعمـل الميـد انـي بـا لسـو د ان

السيد \ الـد كتـور أمـين الشـئون العلميـه جامعـة أم درمـــان الأ ســلامية المحـتـر م

بواسـطة المستشـار الثقـا في – بريطـا نيـا – لنـد ن

السلام عليكـم ورحمـة الله و بركـا تـه و بعـد:

أبعـث لكـم هـذا الخطـا ب إ فـا دة بـأ نـني قـد أ كملـت ولله الحمـد الجـزء الأول مـن دراسـة الدكتـوراة بجـا معـة هل بالمملكة المتحدة والمتعلق يا د خـا ل الـتر بيـة البيئيـة ضمـن منـا هـج كليـات الـتر بيـة بـا لجـا معـات السو دا نية و المدارس الثا نو ية و قـد و ا فـق المشـر ف اأ لأ كـا ديمي علـى الـدرا سـة بـا لقيـا م بـا لـدرا سـة الميـد ا نيـة بـا لسـو دا ن خـلا ل شـهري أ كتوبـر و ديســمبر 1991 م عليـه أ رجـو شـــا كـر اً التكـرم بإرســال تذاكـر لي و لأ سـر تـي حتـى أ تمكـن مـن إ نجـا ز العمـل الميـد ا نـي في وقتـه المحـدد علمـاً بـأ ن د راسـتي مـر تبطـة بـا لعـا م الـد ر ا سـي بـا لجـا معـا ت السـود ا نيـة والمرحلـة الثـا نـو يـة و فـتـر ة تـد ر يـب المعلمـين في المراحـل النهـا ئيـة.

شـا كـر اً لكـم تعـا و نكـم الـد ا ئـم .

والســلام عليكـم ورحمـة الله و بركـا تـه.

عبدالرحيم أ حمد سـا لم

كلية أ صول الد ين و الـتر بية

Appendix J2
Letter From the Research Supervisor

THE UNIVERSITY OF HULL

SCHOOL OF EDUCATION
DEPARTMENT OF EDUCATIONAL STUDIES AND INSTITUTE OF EDUCATION

Tel: 0482 465406
Fax: 0482 466205
Telex: 592592 KHMAIL G HULIB375

Cottingham Road, Hull, HU6 7RX

Dean: Professor V. A. McClelland M.A., Ph.D.(Tel. 465988)
Secretary to Education: I. D. Marriott, C.Biol., M.Biol.(Tel. 465989)
Administrative Assistant: Mrs M. E. Cordeaux, B.A.(Tel. 465031)

CRB/JL

10 July 1991

TO WHOM IT MAY CONCERN

Mr A A SALIM

Mr A A Salim is undertaking research for a PhD at this institution. His topic involves an area of considerable interest for the development of aspects of environmental education in Sudan. It is necessary for him to return to the Sudan to conduct pilot work and field work relevant to his study. We would be grateful if every possible consideration could be given to providing him with the airline ticket and the other financial support which he has detailed in his application and which is necessary for the successful completion of his work.

C.R. Brown. M.A (Cantab). M.Ed.

C R BROWN
Lecturer in Education & Supervisor

Appendix K1
The Academic Secretary's Reply

جمهورية السودان
جامعة أم درمان الإسلامية

وزارة الخارجية
٩١/١٢/٢

النمرة: أس/أشع/ب/ ٤٥
التاريخ: ١٩٩١/١١/٢٨

مكتب
الشئون
العلمية

السيد / المستشار الثقافى لسفارة السودان ـ بريطانيا ـ لندن
بواسطة السيد / وكيل وزارة الخارجية ـ الخرطوم

الموضوع/ الرحلة الميدانية للمبعوث / عبد الرحيم احمد سالم

بالاشارة الى خطابكم رقم ٦٠/ ٥٤ بتاريخ ١٩٩١/٧/٢٥ بخصوص الرحلة الميدانية للمبعوث عبد الرحيم احمد سالم الى السودان لمدة شهرين نفيدكم بأن الدكتور مدير الجامعة قد وافق على الرحلة الميدانية المطلوبة هذا وقد اخطرنا السيد وكيل الجامعة لارسال تذاكر للمبعوث واسرته

ارجو اخطار المبعوث بذلك " "

ولكم فائق شكرى وتقديرى

الشيخ / ..

د . مدنى عبد الرحمن تاج الدين
امين الشئون العلمية

Appendix K2
A Cable From The Sudan Embassy to Omdurman Islamic University

بسم الله الرحمن الرحيم

EMBASSY
OF
THE REPUBLIC OF THE SUDAN
3, CLEVELAND ROW, ST. JAMES'S
LONDON SW1A 1DD
TEL: 071-839 8080 FAX: 071-839 7560

سفارة
جمهورية السودان
لندن

Our Ref. 60/54

18/2/92

CABLE

KHARIJIA KHARTOUM

FOR OMDURMAN ISLAMIC UNIVERSITY

CUL/492

REFERENCE YOUR LETTER DATED 28/11/91
REGARDING FIELD WORK APPROVAL FOR
ABDEL RAHIM AHMED SALIM (STOP) KINDLY
EXPEDITE SENDING AIR TICKETS (STOP)
REGARDS

SUDANCUL LONDON

Appendix L
Second Letter to the Academic Secretary

التا ريخ 7 /12 /1991م

الموضوع: دراسة ميدا نية

السيد / الد كتور أمين الشئون العلميه جامعة أم درمان الأ سلامية

بواسطة المستاشا ر الثقا في – بريطا نيا – لند ن

السلام عليكم ورحمة الله و بركا ته و بعد:

با لإ شا رة إ لى خطا بكم بتا ريخ 18 /3/ 1991 م الخا ص بموا فقة مكتب السيد / مدير جا معة أ م درما ن على قيا مي بالدراسة الميدانية آمل شاكراً أ ن تبعثوا لي التذ ا كر باسرع فر صة ممكنة علماً با ن د ا ر ستي كما أوضحت لكم سا بقاً مرتبطة با لعا م الد را سي با لجا معا ت و المد ا رس الثا نو ية. كما أ ر جو من سيا د تكم إستخر ا ج خطابات للد كتور عبد الرحمن الشيخ الطا هر –– جامعة أم درمان الأ سلامية– و ا لسيد / الفا تح ادم حامد – كلية التر بية جا معة الخر طو م حتى يقوما ن با لد را سة الأولية نيا بة عني. آ ملاً أ ن يو فر لهم مكتبكم العامر ما يعينهم على القيا م بما يلز م .

شا كراً لكم تعا و نكم الد ائم.

والسلام عليكم ورحمة الله و بركاته.

عبدالرحيم أ حمد سا لم

جا معة هل

Appendix M

Letter to the Deans of the Faculties of Education and the Director of the Secondary Education, Khartoum State

بسم الله الرحمن الرحيم

جمهورية السودان

جامعة ام درمان الاسلامية

مكتب

الشئون

العلمية

النمرة: ا س/ا ع/٥١

التاريخ: ١٥/١٢/١٩٩١م

الموضوع: دراسة ميدانية

السيد/ .....

تهدى جامعة ام درمان الاسلامية ان الاستاذ/ عبد الرحيم احمد سالم طالب دكتوراه بجامعة هذه انجلترا وموضوع بحثه ادخال التربية البيئية فى مناهج كليات التربية بالجامعات السودانية.

ارجو تقديم المساعدة الممكنة له فيما يتعلق بجمع المعلومات التى تخص بحثه.

ولكم فائق شكرى وتقديرى

الشيخ/..

د. مدنى عبد الرحمن تاج الدين

امين الشئون العلمية

Appendix N

letter From the Director of Secondary Education to the Academic Secondary Schools (Khartoum State)

بسم الله الرحمن الرحيم
ولاية الخرطوم
وزارة الرعاية الاجتماعية
ادارة التعليم الثانوي

التاريخ: ١٩٩١/١٢/١٢م النمرة: م ا ت/ع/٥٠/٥٥/٠١

السيد/ مدير مدرسة .....

الموضوع: دراسة ميدانيه

الاستاذ/ عبد الرحيم احمد سالم مبعوث جامعة ام درمان الاسلامية يحضر دكتوراه في التربيه بانجلترا، جامعة هل.

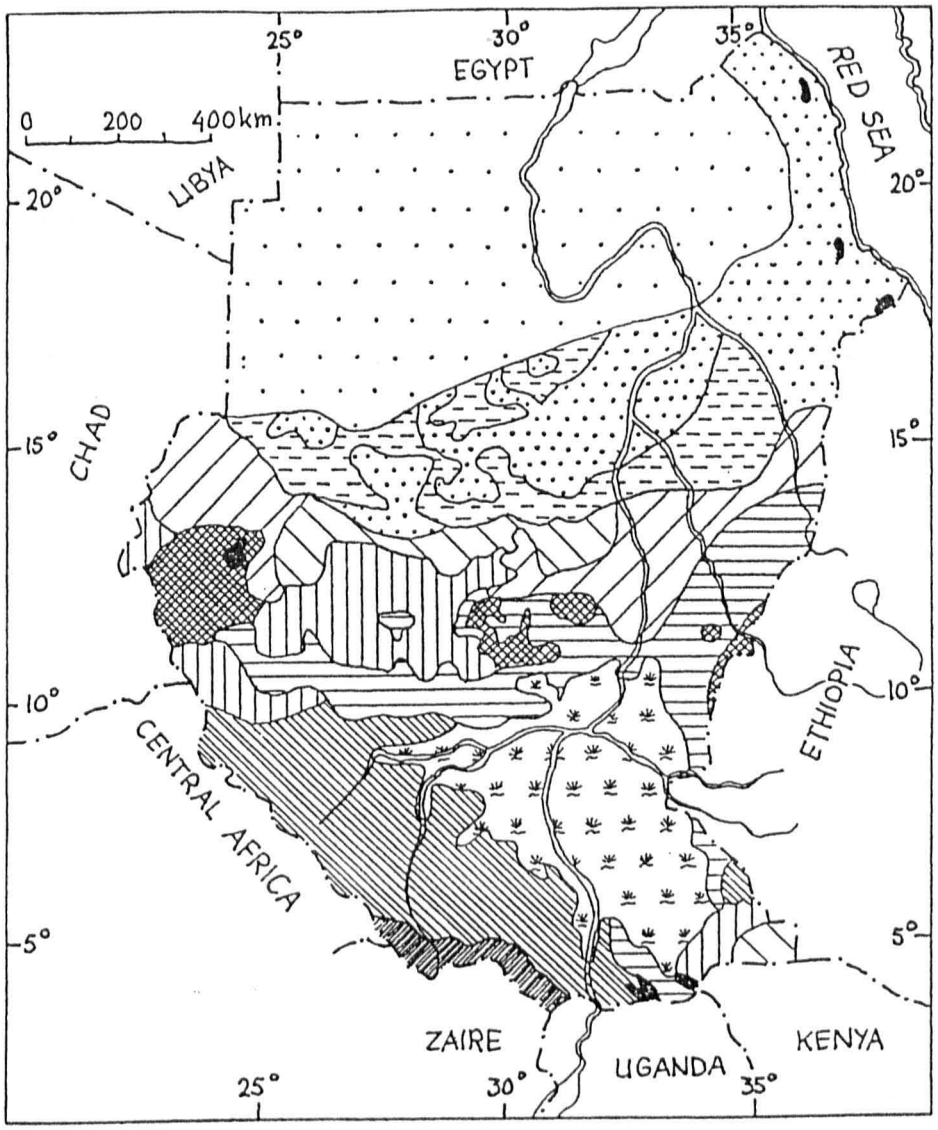
ارجو تعاونكم معه فيما يتعلق بجمع المعلومات التي تخص موضوع بحثه.

وشكرا

صديق السيد الصديق
مدير المرحله الثانويه

صوره للسيد:
مدير مكتب وزير التعليم

Appendix O
Fig.2.1
The Sudan's Ecological Zones



- desert
- semi-desert (shrub)
- semi-desert (grassland)
- sahel savanna on clay
- sahel savanna on sand
- sudan savanna on clay
- sudan savanna on sand
- hill areas
- flood region
- high rain woodland (guinea savanna)
- woodland recently derived from rainforest (greenbelt)
- montane vegetation

Appendix P

Table 6.3
Distribution Of Secondary Students By School's Sex

Boys' secondary schools	Number of students surveyed	Girls' secondary schools	Number of students surveyed
1. Wadi Sidna;	20	1. Omdurman East;	20
2. Elmatamer;	20	2. Omdurman West;	20
3. Khartoum Gadema	20	3. Khartoum Gadema	20
4. Shammbat;	20	4.Mohieldeen Wahbi	20
5. Trait Elbeja;	20	5. Shammbat;	20
6. Bahri Elgadema;	20	6. Trait Elbeja.	20
Total	120	Total	120

Appendix Q
Frequency and Percentage Distributions of SEs' Responses

2. Which of the following science teaching methods courses have you have had most teaching experience?

a. Environmental education. 1 (05)
b. Biology. 8 (40)
c. Chemistry. 6 (30)
d. Physics. 5 (25)
e. Integrated Science. 0 (0).

3. If you do not teach an environmental education teaching methods course, do you incorporate environmental education teaching methods in your science teaching methods course?

A lot 3 (15) Little 13 (65) None at all 3 (15).

4. If you do incorporate environmental education teaching methods course, what is your major emphasis (please check one only):

Ecological 10 (50) Biological 3 (15)
Sociological 2 (10) Conservation 5 (15).

5.(a) To your knowledge, does your institution offer courses involving content pertaining to environmental concerns?

Yes 14 (70) No 3 (15) Don't know 3 (15).

(b) Are prospective science teachers required to take one or more of such courses?

Yes 15 (75) No 1 (5) Don't know 4 (20).

(c) To what extent is the content of these courses orientated to local environmental issues and problems?

Great extent 6 (30) Little 6 (30) Don't know 8 (40).

6. Are you in any involved in:

	Yes	No
(a) funded research project in environmental education?	1 (5)	19 (95).
(b) developing curriculum materials in environmental education for the use in your institution?	1 (5)	19 (95).
(c) developing environmental curriculum for the use in the schools?	4 (20)	16 (80).
7. Do you favour teacher certification in the area of environmental education?	17 (85)	3 (15).

Note: Percentage of SEs' responses appears in parentheses.