CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE CARIBBEAN ADVANCED PROFICIENCY EXAMINATION

MAY/JUNE 2004

ENVIRONMENTAL SCIENCE

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INTRODUCTION

Environmental Science is a two-unit subject with each Unit consisting of three Modules. Unit 1 consists of Fundamental Ecological Principles, People and The Environment, and Sustainable Use of Natural Resources while Unit 2 consists of Sustainable Agriculture, Sustainable Energy Use, and Pollution of the Environment. For each Unit, the examination consists of three papers and a total of 300 marks. Papers 01 and 02 are examined externally by CXC, while Paper 03 is examined internally by the teacher and moderated by CXC.

Paper 01 consists of twelve short-answer questions, with four questions based on the contents in each Module. This is a compulsory paper with each Module contributing 30 marks, a total of 90 marks or 30 per cent of the total assessment.

Paper 02 consists of nine extended-response questions, three in each Module. Candidates are required to answer two questions in each Module. Each Module contributes 40 marks, a total of 120 marks for this paper or 40 per cent of the total assessment.

Paper 03, the school-based assessment, contributes 90 marks or 30 per cent of the total assessment. Unit 1 is assessed by a single project, and Unit 2 by a research paper, a journal, a laboratory exercise and a project. While the journal, research paper and laboratory exercise each focuses on a specific Module, the project is expected to encompass the three Modules.

GENERAL COMMENTS

UNIT 1 & UNIT 2

Candidates' performance in Unit 1 was better than in Unit 2. The mean score for Unit 1 was 148 with a standard deviation of 29, and for Unit 2, 132 with a standard deviation of 34. For each Unit, the performance of candidates was best on Paper 03, followed by Paper 02 and then Paper 01. It is expected that the candidates perform best on Paper 03 because this assessment is school based, and given the proper

guidance, candidates should perform significantly better on this paper than the others that are assessed under examination conditions. As in previous years, there are still too many candidates scoring less than 50 per cent of the marks available and obtaining low grades on this paper. The mean score for Paper 03 was 69 per cent and 63 per cent for Unit 1 and Unit 2 respectively.

The mean score for Paper 01 was 39 per cent and 40 per cent in Unit 1 and Unit 2 respectively. The unsatisfactory performances on Paper 01 in both units suggest a lack of comprehensive coverage of each syllabus. The mean score for Paper 02 was 42 and 38 per cent for Unit 1 and Unit 2 respectively. Some candidates demonstrated the required level of knowledge and comprehension, as well as the ability to apply and organise this knowledge in their responses to the questions on Paper 02. Unfortunately, too many candidates failed to demonstrate the higher order skills that this paper required. There were many candidates whose responses were inadequate, especially where they were required to explain importance and significance, interactions and interrelationships, or to justify or assess statements. Several candidates struggled to respond satisfactorily to questions that required application of knowledge. A greater emphasis should be placed on test items of this nature in preparing candidates to write these examinations. Candidates must be made aware of the meaning of the various instructional terms that they are likely to encounter in the examinations. A list of these terms is presented in the syllabus.

In responding to questions related to graphs or tables, many candidates only described general trends without supporting their statements with numerical information extracted from the table or graph. Candidates must be made aware that in such situations they are expected to present numerical information to support the statements that they make.

DETAILED COMMENTS

UNIT 1

The mean score in Modules 1, 2 and 3 were 45 per cent, 47 per cent, and 56 per cent respectively. Candidates performed significantly better on Module 3 that on the other two Modules. Candidates performed unsatisfactorily in Questions 5, 7 and 10 in Paper 01 and Questions 2, 3 and 5 in Paper 02. Some candidates showed some knowledge but the depth required to answer these questions satisfactorily was lacking. This suggests that some areas of the syllabus were not being covered to the depth that was required.

Paper 01

Module1: Fundamental Ecological Principles

Question 1

Parts (a), (b) and (c) of this question tested candidates' understanding of food webs, and the roles of producers and consumers in the functioning of a food web. Part (d) tested candidates' understanding of the distribution of biomass at different trophic levels and why a trophic level can only support a particular biomass.

Overall, candidates performed well on this question.

In Part (a), most candidates were able to identify a secondary consumer and the possible impacts on the ecosystem if the population of water beetles died out. This implied that the idea of feeding in a food web was well known by candidates. Part (c) was done well by candidates. However, Part (d) posed some difficulties for most candidates, as they could not explain satisfactorily why higher trophic levels cannot support a large biomass.

NOTE: Energy transfer between trophic levels is inefficient and only 10 per cent of the energy is transferred. At each level, energy is utilised by organisms to maintain their functions while some is lost as heat. Consequently, as the trophic levels increase, the available energy is reduced significantly. There would not be enough food resource or energy available to support organisms (the piranhas) at the higher trophic level. In addition, much of the preceding trophic level standing biomass is not consumed while that which is consumed is not all converted to biomass.

Question 2

Part (a) of this question assessed the candidates' understanding of natural selection and its role in the survival of species. Part (b) required candidates to identify how a resident species will react to new selective pressures. Candidates were also expected to state the conditions for each proposed alternative.

In Part (a), while most candidates recognized that natural selection eventually leads to survival of the fittest, not many of them were able to explain how this occurred. Candidates failed to explain that natural selection acts on pre-existing genetic diversity and that selective pressures favour advantageous genes. It is these individuals with favourable genetic traits that will survive and have more offsprings surviving into the next generation.

Very few candidates were able to identify correctly and outline adaptation, migration and extinction as alternatives that a resident species have when facing new selective pressures. Candidates lost marks because they stated rather than outlined the alternatives. In addition, candidates did not identify or state the conditions under which each alternative was likely to occur.

Question 3

This question assessed the candidates understanding of limiting factors and the effects of factors shifting from their optimum value to beyond the limit of tolerance.

Part (a) of this question posed a problem as candidates failed to recognize that the question asked for 'pH ranges'. Instead, candidates gave a specific pH value rather than a range.

Part (b) was generally well done. Candidates understood the concept of limiting factors and were able to state reasons why factors affecting the survival of a species are called 'limiting factors'.

In Part (c), not many candidates recognized that there is increased vulnerability to other stress factors through synergistic effects.

Question 4

This question tested the candidates understanding of species diversity and its relationship to ecosystem stability in Part (a). In Part (b), candidates were required to state one feature that was common to an agricultural farm and a natural ecosystem. This question was done fairly well.

In Part (a), candidates were able to state the meaning of the term 'species diversity' and also rank the fields in terms of stability. However, the majority of candidates had difficulty stating reasons to support their ranking. They did not understand that as the diversity of an ecosystem increases, its stability tends to increase because alternative links between different species exist. Thus, several species may also be able to carry out the same function.

Part (b) was done fairly well.

Module 2: People and the Environment

Question 5

This question was designed to test candidates' ability to:

(i) Calculate average annual growth rate

(ii) Calculate doubling time

(iii) Predict changes in population size

The responses suggest that candidates did not fully understand how to calculate average annual growth rate and doubling time. Candidates were also unaware of how to calculate and predict changes in population size.

Question 6

In Part (a), candidates were required to describe how the world population has grown since 1800 to the present and to account for this growth in Part (b).

While some candidates were good at giving the reasons for growth of the world population, they had difficulty describing the trends to show how the world population grew since 1800 to the present.

NOTE: World population was about 800 million around 1750.
Between 1800 and 1960, world population tripled from 1 billion to 3 billion.
In the 27 years between 1960 and 1987, another 2 billion were added.
Between 1987 and the present, world population grew to around 6 billion.

Question 7

This question tested candidates' knowledge and understanding of per capita GNP and the relationship between the rate of population growth and per capita GNP. This question posed difficulties to candidates.

In Part (a), candidates were unable to define correctly per capita GNP. Consequently, they were unable to explain fully its significance.

In Parts (b) and (c), many candidates failed to recognise and state correctly the relationship between the rate of population growth and per capita GNP. Candidates

found it very challenging to explain the relationship between population growth, per capita GNP and doubling time.

NOTE: The lower the per capita GNP, the lower the doubling time, which implies a faster population rate of growth.

The lower the per capita GNP, the less the ability of the population to meet its basic needs. Infant mortality rates tend to be high and life expectancy low. This is compensated by high fertility rates in an attempt to ensure that enough children survive to contribute to the family. These factors contribute to a high population growth rate.

Question 8

This question tested candidates' understanding of the role of ecological processes and the extent to which man and other organisms depended on these processes.

While most candidates gave satisfactory answers, it was evident that many did not have a clear understanding of what ecological processes were and therefore had difficulty in evaluating the extent to which man and other organisms depended on these processes. Although candidates took a position (either to agree or disagree with the statement), they failed to adequately justify their point of view. Some candidates also failed to identify and refer to specific ecological processes in their responses.

Module 3: Sustainable Use of Natural Resources

Question 9

Part (a) of this question tested candidates' understanding of the concept of Maximum Sustainable Yield (MSY) in relation to the harvesting of a natural resource. In Part (b), candidates were required to identify the MSY and corresponding harvesting effort of a natural resource from a graph that was given. Part (c) required candidates to explain the impact on a resource if harvesting occurs at a specific point as was shown on the graph.

Candidates performed satisfactorily on this question with 49 per cent of them scoring 5 or more of the maximum 8 marks.

Parts (a) and (b) were generally well done. Many candidates were able to explain that MSY was the largest amount of a resource that can be harvested and does not cause a decline in the basic stock of the resource.

In Part (b), many candidates were able to identify the MSY and corresponding harvesting effort. However, some of them lost marks because they failed to state the units correctly from the graph. In Part (c), the majority of candidates experienced difficulty explaining the impact on the resource if harvesting occurred at the given point 'A'.

NOTE: At point 'A', harvesting of the resource is too frequent and is at a level too high for the resource to recover. The minimum viable population threshold is exceeded and the population size will be too low to sustain the population biomass which eventually declines or crashes. At this point, the resource may be said to be overexploited or severely overexploited.

Question 10

This question tested the candidates' knowledge of genetic resources and their importance to the Caribbean region. Candidates were also examined on their ability to classify genetic resources as renewable or non-renewable and consumptive or non-consumptive. The majority of candidates were unable to state the meaning of the term 'genetic resources'.

In Part (b), several candidates classified genetic resources correctly as renewable. However, the majority of candidates did not give an appropriate reason for classifying genetic resources as either consumptive or non-consumptive.

Candidates need to recognize that the genetic resource of the Caribbean are represented as the sum of all genes contained in the various species of flora and fauna in the Caribbean.

Question 11

Part (a) of this question tested candidates knowledge of environmental impacts associated with mining. Part (b) tested candidates understanding of how an Environmental Impact Assessment (EIA) can mitigate environmental impacts associated with mining activities.

Part (a) of this question was well done. The majority of candidates were able to outline two environmental impacts resulting from mining activities. However, candidates simply stated the impact without an outline.

Candidates found Part (b) of this question more challenging. Some candidates demonstrated in their responses that they were aware of what an EIA was. However, they were unable to state clearly how an EIA can mitigate the impacts they identified.

NOTE: An EIA informs policy and decision makers of the feasible alternatives and the need to address, amend or enact policies, measures, laws, legislations or regulations for appropriate mitigative actions.

Question 12

This question tested candidates' understanding of how the factors of location and technology affected the exploitation of a named natural resource. Candidates performed satisfactorily on this question. While most candidates were able to state ways in which location affected the exploitation of a natural resource, not many of them were able to state ways in which technology affected the exploitation of a named resource. Also, some candidates failed to identify the named resource and to relate the stated factors to the exploitation of that named natural resource.

Paper 02

Module 1: Fundamental Ecological Principles

Question 1

In Part (a), candidates were expected to distinguish between 'habitat' and 'niche'. While most candidates recognized that a niche and a habitat were different, they were unable to state distinguishing features.

In Part (b), candidates were expected to make observations of the change in populations over time from the graph presented. Rather than stating four observations regarding the change in the population of both species over time, some candidates simply accounted for one species. Candidates generally concentrated on describing the shape of the curves rather than make observations regarding the change in population. Very few candidates made relevant statements that included numerical observations obtained from the graph.

In Part (c), the majority of candidates failed to recognize that the question dealt with the concept of carrying capacity. Consequently, they did not explain correctly or

give appropriate reasons for the observations in terms of the concept of carrying capacity. Very few candidates attempted to explain that competition was responsible but they stopped short of indicating what was the nature of the competition.

This question was attempted by 73 per cent of the candidates.

NOTE: Emphasis should be placed on the importance of good observation, which comes from practical activities, and proper inferences that come from theory.

While the habitat is defined as the physical location of the organism, the niche refers to the functional role of the organism including the eating habitat, predator – prey relations and physical location. Therefore, the niche incorporates the habitat of the organism, but the habitat is only one aspect of the niche.

Question 2

Parts (a) and (b) of this question examined the candidates' understanding of ecological succession, climate communities and stability of ecosystems. In Part (a), candidates were able to outline appropriate differences between primary and secondary succession. However, very few of the candidates recognized ecological succession as a process. In Part (b), candidates needed to show that as the process of ecological succession progressed, the diversity of the ecosystem increased until a climax community is achieved. This climax community is capable of withstanding stresses thus indicating ecosystem stability. Few candidates were able to discuss the relationship between ecological succession, climax communities and ecological stability.

Approximately 32 per cent of the candidates attempted this question.

NOTE: Ecosystem stability is the ability of an ecosystem to withstand significant changes over time and to repair any damage after any disturbance. Biotic and abiotic factors of a habitat influence the species that live there and also the process of ecological succession. As succession continues, species diversity increases and feeding relationships become more complex. Generally, complex ecosystems with high species diversity tend to be more stable because alternative links between different species exist. Eventually, a stable ecosystem develops which is in equilibrium with its environment and which undergoes little further change and is called a climax community. This stable climax community exhibits ecosystem stability, which is a measure of its sensitivity to disturbance or perturbation.

Question 3

Candidates were expected to give reasons why a food web is generally more useful than a food chain.
Part (a) was well done. Candidates satisfactorily distinguished between a food chain and a food web and also accounted for the usefulness of food webs as against food chains.

In Part (b), the majority of candidates experienced difficulty outlining reasons for assigning trophic levels to each organism in an ecosystem. Very often, candidates interchange the answer for Part (b) with the answer for Part (a). Several candidates did not recognize or indicate that trophic levels are useful in characterizing community structure in terms of energy flow and biomass.

In Part (c), candidates were unable to explain adequately why it was beneficial for humans to eat at lower trophic levels. While candidates recognized that energy was lost at each level, they failed to provide a complete explanation.

The performance on this question was unsatisfactory. The question was attempted by about 93 per cent of the candidates.

Module 2: People and the Environment

Question 4

Part (a) of this question required candidates to define 'total fertility rate' while Parts (b) and (c) tested candidates understanding of factors that influence total fertility rate and population growth rate.

Candidates performed unsatisfactorily on Part (a). They did not define total fertility rate as the average number of children born to each woman during her 'reproductive lifetime'.

Part (b) was fairly well answered by the majority of candidates. Many candidates proposed and discussed a wide range of factors that influenced total fertility rate.

For Part (c), although candidates gained marks, their responses were too general and in many cases not specific to their own country.

Candidates did not appear to grasp the differences between the demographic characteristics of human population and demographic statistics. As a result, responses to Part (c) did not address clearly the relevance of the factor and how the factor affects

population growth rate in the candidates' country.

This question was attempted by 76 per cent of the candidates.

Question 5

In Part (a), candidates were expected to define poverty and in Part (b), to compare two indices of poverty for a country. In Part (c), candidates were required to assess the validity of statements and the conclusion made in a stimulus paragraph regarding growth.

The majority of candidates recognized poverty as the lack of sufficient resources to meet one's basic needs for food, clothing and shelter. However, they were unable to provide a correct comparison of the development indices, GNP and HDI.

In Part (c), many candidates were unable to assess the validity of the statement. Candidates felt that they had to agree with the statement. Even so they did not demonstrate that they knew the trends in population growth.

This question was attempted by 22 per cent of the candidates.

NOTE: People living in acute poverty lack access to basic resources, that is, adequate diet, decent housing, basic sanitation, clean water, medical care and other essentials for human existence. While inability to access proper health care should lead to high levels of infant mortality and lower life expectancy, this does not decrease the growth rate of the populations of poor countries. There is higher population growth in poor countries as more children are produced to ensure a labour force to help on farms and take care of parents. Fertility rates are still high in poor countries. Past and current trends show that the populations of poor countries are large and continue to grow. Hence, poverty will not slow the rate of growth of world population in the future.

Question 6

This question tested candidates' understanding of the features of urbanization, the factors that contribute to urbanization and the negative environmental impacts of urbanization. The majority of candidates adequately identified the features of urbanisation and discussed factors that contributed to urbanization. A few candidates found difficulty differentiating between features of urbanization and factors causing urbanization. In Part (c), the more competent candidates adequately outlined one negative environmental impact and suggested two appropriate solutions to the problem identified.

This was the most popular question in this Module with 96 per cent of the candidates attempting it. Candidates' performance on this question was fair.

Module 3: Sustainable Use of Natural Resources

Question 7

Part (a) and Part (b) of this question focused on natural resources, the importance of natural resources to Caribbean countries and the impact of depletion of natural resources on a named Caribbean country. Part (c) (ii) required candidates to describe a suitable approach by a named country to manage the natural resource identified.

Candidates' responses suggested good knowledge and understanding of the natural resources of and the roles of these natural resources in Caribbean countries. As a result, candidates were able to assess the impact of the depletion of the natural resources. Candidates also proposed varied and appropriate approaches to manage natural resources.

This was the most popular question in this Module and candidates performed very well.

Question 8

This question was designed to allow the candidate to:

(i) Outline three categories of protected areas according to the IUCN classification.

(ii) Explain three roles of protected areas in natural resource conservation.

(iii) Assess the effectiveness of protected areas in conserving natural resources in a named Caribbean country.

Part (a) of this question was done unsatisfactorily. It was obvious that candidates were unfamiliar with the IUCN classification categories. While some candidates were able to give the functions of protected areas many could not identify the corresponding name or category of the protected areas providing the specific function.

Part (b) of this question was generally well done by the candidates who performed well in Part (a). Only a few of the candidates who did not do well in Part (a) were able to explain the roles of Protected Areas in natural resource conservation.

The question was attempted by 32 per cent of the candidates.

Question 9

Part (a) of this question examined candidates' understanding of the concept and characteristics of ecotourism and the role that ecotourism can play as a tool for natural resource conservation in a named Caribbean country.

In Part (a), the majority of candidates adequately explained the concept of ecotourism while outlining its characteristics.

In Part (b), while candidates recognized that ecotourism can be a useful conservation tool, they failed to discuss ways in which it was used effectively in a named Caribbean country. Most candidates alluded to the potential role as a conservation tool rather than show how it is actually being used and in what ways it has been effective.

This question was attempted by 55 per cent of the candidates. Most of them gave satisfactory responses.

DETAILED COMMENTS

UNIT 2

The mean score obtained in Modules 1, 2 and 3 were 51 per cent, 40 per cent and 40 per cent respectively. Candidates performed significantly better in Module 1 than in Module 2. For Paper 01, candidates performed unsatisfactorily in Questions 8, 10, 11 and 12 and in Questions 2, 5, 6 and 7 in Paper 02. Questions 5 and 6 are both from the Module on Sustainable Energy Use.

Some performances were encouraging, however, the majority of candidates struggled with Modules 2 and 3, especially in Paper 02. Candidates' performances suggested a lack of depth in certain areas of the syllabus. There is a need to improve the depth and breadth of coverage in Modules 2 and 3.

Paper 1

Module 1: Sustainable Agriculture

Question 1

This question examined the role of agriculture in the economies of the Caribbean countries. This question was well done by the majority of candidates. Few candi-

dates lost marks because they did not 'outline' but rather 'stated' the role of agriculture.

Question 2

This question assessed candidates' knowledge of the types and characteristics of agricultural systems in the Caribbean. The question was fairly well done.

The types of agricultural systems as defined by the syllabus are subsistence, peasant and commercial. However, in Part (a), some candidates identified cultural practices. Some candidates also identified different aspects of commercial agriculture, such as commercial pastoral and commercial arable as separate types of agricultural systems.

In Part (b), the majority of candidates were able to outline satisfactorily two characteristics of the system they identified in Part (a). Again, some candidates lost marks because their responses were not an outline of the characteristics.

Question 3

This question assessed candidates understanding of the environmental impacts of long term commercial farming on soil. The question was done fairly well by the majority of candidates.

In Part (a), in describing the trend observed from the graph, many candidates did not include numerical information from the graph. This is a general problem when candidates are asked to interpret information in graphical or tabular form. The expected approach in responding to Part (a) is as follows:

> Between 1970 and 2000, the yield from Princess Farms had decreased from 80 tonnes to about 10 tonnes, a decrease of 87.5 per cent.

In Part (b), the majority of candidates satisfactorily identified acidification, soil compaction, salinization and water logging as possible causes of the decrease in yield of the farm. In Part (c), however, some candidates' explanations lacked the required depth.

Question 4

This question assessed candidates' knowledge of agroforestry. The performance on this question was quite good.

In Part (a), some candidates' definition of agroforestry was deficient and did not encompass all aspects of agroforestry. An appropriate definition is as follows:

Agroforestry is a land use system where woody perennials are deliberately used on the same land management unit as agriculture, crops and/or animals.

OR

Agroforestry is a technique that uses trees as a major component of the multicrop production system and compares to a natural multi-layer ecosystem.

In Part (b), the majority of candidates satisfactorily outlined three reasons why agroforestry was an environmentally sustainable practice in Caribbean agricultural systems. However, some candidates responses were not specific to agroforestry but to forestry in general.

Module 2: Sustainable Energy Use

Question 5

This question examined candidates' understanding of the characteristics of fossil fuels, oil in particular and the meaning of the terms non-renewable and kinetic energy. This question was poorly done.

In Part (a), many candidates mentioned the renewal rate of oil in relationship to the life span of human beings as the reason why it is considered to be a non-renewable resource. However, this statement does not include two definitive characteristics of non-renewable resources, the fact that they occur in fixed quantities and they are depleted by use.

In Part (b), candidates' responses clearly indicated that they were aware of the definition of the term 'potential energy'. However, the majority were unable to relate their understanding of the term to oil.

Oil is a form of potential energy that is stored in the chemical bonds of the molecules and these bonds are released by combustion.

In Part (c), many candidates were unable to state why oil is an energy source derived from solar energy.

NOTE: Oil is the remains of prehistoric organisms, both plants and animals. The energy stored in oil was initially from the sun and was incorporated through the process of photosynthesis and feeding relationships into the bodies of these organisms.

Question 6

This question examined candidates' knowledge of nuclear fission and fusion and the appropriateness of the use of nuclear energy by Caribbean countries.

In Part (a), many candidates recognised that fission referred to the splitting while fusion referred to combining particles. However, it was incorrectly stated in many responses that the atom was split or combined in both processes. It should be emphasised to candidates that both are nuclear processes.

Nuclear fission is the splitting of an atomic nucleus into smaller fragments, while nuclear fusion is the opposite process, which is the combining of atomic nuclei to produce a larger nucleus. Both processes result in the emission of energy.

In Part (b), many candidates suggested satisfactory reasons why it was not appropriate for Caribbean countries to utilize nuclear energy. However, in many cases their responses were lacking in depth. Below are two examples of the responses expected.

> The probability of accidents occurring in nuclear plants is low. However, if they occur, the consequences are enormous and life threatening, both immediately and long after the accident. This will be devastating especially in light of the small size of many Caribbean countries.
>
> Nuclear plants produce radioactive wastes, which are extremely hazardous and must be disposed of safely. Finding safe disposal sites which will not pose a threat to ecosystems and natural resources, such as underground water resources, will be difficult.

Question 7

This question examined candidates' knowledge of cogeneration. The performance on this question was unsatisfactory.

In Part (a), the responses of candidates demonstrated inadequate knowledge since many definitions were not satisfactory. Two satisfactory definitions are stated below.

> Cogeneration is a process in which a fossil fuel is used to produce both electricity and useful heat.
>
> Cogeneration is a process in which two types of energy sources, a fossil fuel and a renewable energy source, are used to produce electricity (or other forms of energy).

In Part (b), instead of describing the process of cogeneration, many candidates re-wrote the definition. It seemed that candidates lacked the depth of knowledge required to address this section satisfactorily.

In Part (c), many candidates achieved satisfactory marks.

Question 8

This question assessed candidates understanding of the impact of geographical and technological factors on the supply of electricity in Caribbean countries, as well as alternative approaches to address these factors. This question was poorly done.

In general, candidates struggled to justify their choice of response in Part (a).

An example of an acceptable response is given below.

> "Although the technology to supply electricity is well established, many Caribbean countries have mountainous interiors making it difficult and costly to set up electricity transmission systems to access some of these areas. Therefore, the geographical factors are the more significant limiting factor in many Caribbean countries."

Note that if a candidate selected technological factors and presented arguments to adequately support that factor, the candidate would be credited.

In Part (b), few candidates suggested the use of photovoltaic modules, to solve the problem posed by geographical factors. Candidates were expected to make three statements for the three marks allocated. An example of the expected response is provided below.

> "One approach to addressing the problem posed by geographical factors is to set up photovoltaic module systems that can generate electricity to provide the basic needs of persons living in these areas. These systems convert electricity into electricity that can be stored for use. The company will not need to bear the cost associated with expanding power lines over mountainous terrain."

Module 3: Pollution of the Environment

Question 9

This question assessed candidates' understanding of the environmental pathways of pollutants. This question was well done with the majority of candidates obtaining more than 3 of the 6 marks available.

Question 10

This question examined candidates' understanding of the mechanism of formation of photochemical smog and the extent to which it poses a threat to the Caribbean region.

The majority of candidates did not even attempt Part (a) where they were required to outline the mechanism by which photochemical smog is formed.

Similarly, candidates performed poorly in Part (b). Photochemical smog forms when there is a high concentration of NO and hydrocarbon in the presence of sunlight. In large cities, where there are many motor vehicles or factories and power plants, the emissions from these sources can develop the conditions for photochemical smog to form. It is therefore likely that large cities in the Caribbean such as Kingston in Jamaica or Port-of-Spain in Trinidad will experience photochemical smog.

NOTE: Candidates may argue that photochemical smog is not a threat to the Caribbean.

Question 11

This question examined candidates' understanding of the characteristics of pollutants. Few candidates demonstrated knowledge of such properties of pollutants such as synergism, persistence, and their ability to bioaccumulate and biomagnify. Pollutants bioaccumulate in the fatty tissues of organisms. This allows the concentration to increase in the organism above the level in the environment. Organisms can therefore receive fatal doses of the pollutant as a result.

Some pollutants exhibit synergistic effects, combining or interacting with other pollutants. Although the level of each may be below the threshold, their combined effect may be greater than their individual effect, causing negative environmental impacts.

Question 12

This question examined candidates' understanding of the causes, sources and impacts of water pollution.

In Part (a), many candidates could identify at least one reason for the dramatic change in dissolved oxygen concentration beyond 20 km as indicated by the graph. The dramatic change suggests a point source of pollution and the decrease in dissolved concentration suggests that the pollutant entering the river has high BOD content, for example, sewage.

In Part (b), many candidates suggested eutrophication as the reason for the change in the dissolved oxygen in the river.

Eutrophication is nutrient enrichment of the water body. This causes excessive growth (bloom) of plants such as phytoplankton and algae. When these organisms die, oxygen is utilised for the process of decomposition resulting in low dissolved oxygen content in the water.

Many candidates did well on Part (c) of this question.

Paper 02

Module 1: Sustainable Agriculture

Question 1

This question tested candidates' understanding of the environmental impacts of pesticide use on the pest and its predator and alternative method of using biological control in agriculture. It was attempted by 52 per cent of the candidates.

Parts (a) and (c) were well done by most candidates. However, in describing the importance of pesticide use in Part (a), it was expected that candidates would have cited the economic value of crops, the potential for extensive loss and hence the need for the reliable, easy-to-use and relatively cheap means of controlling pests, offered by pesticides.

Part (b) was the most difficult for the candidates. The less competent candidates did not interpret the graph adequately. Many candidates made general statements regarding the change in the pest and predator population but did not include specific information such as time periods of population numbers. Below is an example of the approach expected.

> The population of the predator decreased from 480 to zero at day 140 or 30 days after application of the pesticide. The population of the pests decreased from 740 to 40 at day 140 or 30 days after the application of the pesticide. The pest population remained constant at this number for 20 days after which it increased over the next 60 days to 800 organisms, while the predator population was completely wiped out. As there is no natural predator to regulate the pest, its population exploded.

Some candidates attributed the growth in the pest population to the pest developing genetic resistance (in all cases described as immunity) to the pesticide. However, this could not be inferred based on the information provided by the graph.

Question 2

This question examined the socio-environmental issue related to agriculture in the Caribbean and their impact on the sustainability of agriculture in the region. The specific issues were health, threats to sustainable livelihood of communities and land availability. About 35 per cent of candidates attempted this question.

In general, candidates were aware of health and land availability issues related to agriculture. Few candidates satisfactorily demonstrated how these issues impacted on the sustainability of agriculture.

The majority of candidates struggled with linking sustainable livelihood of communities with agricultural sustainability. Some of the responses suggested that some candidates misinterpreted the question. Below is an example of the response expected.

> Many communities depend on natural resources for aspects of sustenance and subsistence. Some aspects include food, fibre, firewood and water. Agriculture, while contributing to the livelihood of communities, may reduce the availability and or value of natural resources to communities. This may occur, for example, through the pollution of water bodies such as rivers and so decrease their usefulness to communities. Therefore, agriculture poses a potential threat to the sustainable livelihood of these communities.

Question 3

This question tested candidates understanding of no tillage farming, contour farming, organic farming and crop rotation as environmentally sustainable practices in the Caribbean. This question was attempted by 76 per cent of the candidates.

The majority of candidates demonstrated adequate knowledge of these practices but did not 'evaluate' them as sustainable practices as the question required. In evaluating these practices, candidates are expected to discuss the advantages and disadvantages of each in the context of the Caribbean and offer a conclusion as to their sustainability. Many candidates simply outlined the advantages of each practice.

> In no tillage farming, the land is not ploughed and the remains of the previous crop such as the root system bind the soil together. Special machines inject seeds, fertilisers and herbicides into slits made in the soil. This method pre-

vents soil compaction, reduces erosion of sediment and nutrients and helps to maintain soil fertility. The decomposition of the previous crop adds nutrients to the soil and so enhances soil fertility. No tillage farming allows more water to be retained in the soil and more crops to be grown per season.

However, the lack of tilling can decrease soil aeration and promote pest infestation.

Module 2: Sustainable Energy Use

Question 4

This question examined candidates' understanding of the environmental impacts of using oil and the advantages and disadvantages of utilizing alternate energy sources to generate electricity. This question was attempted by 69 per cent of the candidates.

In Part (a), candidates were required to outline the trend in energy generation from Table 1. A few candidates included numerical values in their outline when describing the changes in energy generation from oil and hydroelectric generators. Those candidates were able to gain marks specifically reserved for such computations. It must be emphasised to candidates that when provided with stimulus material in graphical or tabular form to analyse, they should support their response with appropriate computations. Candidates could have calculated absolute changes, percentages or relative percentages to support their statements. Two alternate approaches are provided below.

> Between 1994 and 1999, electricity generation by oil generators increased from 1475.5MW to 2078.5 MW, an increase of 603 MW or 40.9 per cent based on 1994 figures. In the same period, electricity generation by hydroelectric generators decreased from 114.5 MW to 86.8 MW, a decrease of 27.7 MW or 24 per cent.

> In 1994, the total electricity generated was 1590 MW, of which 7.2 per cent was provided by hydroelectric generators and 92.8 per cent by oil generators. By 1999, the energy generation capacity had increased to 2164.9 MW, an increase of 36.2 per cent. The contribution of oil generators during the period had increased to 96 per cent, with the hydroelectric generators supplying only 4 per cent, a decrease of 3.2 per cent.

Part (b) was well done by most candidates. It is important to note that the mark scheme made allowances for alternate views of the candidates which were supported by adequate reasons.

In Part (c) (i), many candidates were able to identify one way that the country could diversify its source of energy. A few candidates seemed to lack an understanding of the concept of diversification and in Part (c) (ii), some candidates were unable to identify three advantages and one disadvantage of the approach identified in (c) (i).

Question 5

This question tested candidates' knowledge of the non-renewable fossil fuel, liquid natural gas LNG. This question was attempted by 33 per cent of candidates. The responses by the majority of candidates suggested that the depth of knowledge required for satisfactory performance was lacking.

In Part (a), the majority of candidates failed to give an appropriate definition of LNG. In Part (b), candidates struggled with assessing the use of LNG as a source of energy based on the criteria of production, transportation and use. Part (c), which required candidates to comment on the appropriateness of Caribbean countries utilising LNG in order to decrease their dependency on oil, was satisfactorily done by a few.

Question 6

This question examined candidates understanding of the concepts of energy efficiency, energy conservation and demand management or 'control of demand patterns'. This question was attempted by 72 per cent of the candidates.

In Part (a), only a few candidates satisfactorily distinguished between 'energy efficiency' and 'energy conservation' and gave appropriate examples. In Part (b), many candidates struggled to explain the concept of demand management and the ways that this could be achieved.

Demand management refers to the actions taken by electricity generating companies to limit the quantity of electricity required by their customers. Some approaches to achieve demand management include the following:

Provision of incentives to consumers for using energy efficient appliances
Dissemination of information regarding energy efficient and energy conservation practices
Funding of research to develop energy efficient measures or devices
Provision of incentives for decreased consumption

In Part (c), only a few candidates satisfactorily discussed the advantages and disadvantages of demand management.

Successful implementation of a demand management programme will effectively result in a decrease in the quantity of electricity demanded by the population. The present generating capacity may then be able to satisfy the needs of the population. If this is the case, there will be no need to expand generation capacity. The country will save foreign exchange that would have been spent to purchase capital machinery and the money saved can be allocated to other important social programmes.

Additionally, the excess capacity may be adequate to satisfy any increase in demand as a result of population increase or development in the future.

The decrease in demand may warrant a decrease in the quantity of electricity generated. This would require the use of less fossil fuel and result in savings. As a result of the decrease in fuel consumption, there will be a corresponding decrease in air pollution emissions such as carbon dioxide, sulphur oxides and particulates. Effective demand management will result in environmental benefits.

However, if the decrease in demand is such that the company has to run at its generation capacity, the production of the excess electricity represents wasted energy. Similarly, the resulting emissions represent environmental pollution from wasted production.

Effective demand management may also decrease the profit of the power company. This is possible if the decrease in demand is such that the company will still have to operate all its generators to satisfy existing demand. Hence, the savings that would have accrued from shutting down a generator does not materialise.

Module 3: Pollution of the Environment

Question 7

This question tested candidates' knowledge of the importance of water quality parameters, sources, impacts and methods of mitigating water pollution. This question was attempted by 15 per cent of the candidates.

In explaining the importance of the parameters BOD, TSS and TN in Part (a), candidates were expected to define the parameter and then state their relevance as evidence of water pollution. Only a few candidates satisfactorily achieved this and the responses of many candidates suggested an awareness of the parametres but the depth of knowledge was lacking.

In Part (b), candidates appeared to be confused as to the difference between a cause and a source of pollution that could influence the water parameters BOD, TSS and TN. As a result, the distinction was not apparent in their responses.

> The cause of high BOD of water bodies is the presence of high concentration of organic matter such as that resulting from sewage pollution. The source could be point source of pollution such as outfall pipes from primary treatment sewage plants.

In Part (c), many candidates satisfactorily described two environmental impacts associated with water pollution. However, some candidates experienced difficulty in suggesting appropriate methods of mitigating the impact they identified.

It should be emphasised to candidates that eutrophication means nutrient enrichment of water bodies. Eutrophication however causes excessive growth of algae and phytoplankton. When they die, the decomposition process removes oxygen from the water resulting in dissolved oxygen deficiency.

Question 8

This question examined candidates' understanding of the greenhouse effect, the factors that contribute to global warming and the possible effect of global warming on Caribbean countries. Eighty-nine percent of the candidates attempted this question.

In Part (a), some candidates were unable to describe the 'greenhouse effect' and its importance in atmospheric temperature regulation. In Part (b), the majority of candidates were able to discuss clearly two factors contributing to global warming. However, some candidates struggled when discussing the extent to which Caribbean countries have contributed to this phenomenon. The examiners accepted candidates' opinion that Caribbean countries have contributed to global warming, when the supporting argument was valid.

Question 9

This question examined candidates understanding of the problems associated with solid waste and methods of disposal. This question was attempted by 93 per cent of the candidates.

Parts (a) and (b) were done fairly well by the majority of candidates. In Part (c), some candidates suggested burning as an appropriate alternative method of disposing of solid waste. This suggestion was unacceptable. Burning and incineration are not considered to be synonymous.

THE INTERNAL ASSESSMENT

Overall, most of the Internal Assessments submitted were of a satisfactory standard. However, there were still some poor pieces. In most instances, the assessment criteria appeared to be clearly understood. Generally, the topics chosen were appropriate and were given adequate treatment. Candidates demonstrated initiative and good judgment with the variety of tasks undertaken.

DETAILED COMMENTS

UNIT 1

Candidates were required to complete a single project that would encompass all three Modules in the Unit. Some candidates did some excellent projects. These projects had components of each of the three Modules of the syllabus. However, there were some projects which did not conform to the recommended format specified in the syllabus and presented little or no evidence of field investigation.

Some areas in which projects in Unit 1 may be improved are:

- Candidates should be more concise and focused in the formulation of research topic.

- Topics selected should allow candidates to include all three Modules and aspects of ecology, human population and resources utilization and development.

- Candidates should demonstrate skills pertaining to laboratory and/or field work, for example, testing, measurement, observation.

- Candidates should use effectively the graphs, charts, tables and statistics with the text/analysis.

- Discussion of findings, conclusion and recommendations should be based only on what was presented in the literature review, and the data collected and analysed.

UNIT 2

For Unit 2, candidates were required to submit a research paper, a journal, a set of laboratory exercises and a project. The overall quality of assignments submitted for Unit 2 was fairly good.

In general, the journals, written papers and projects showed evidence of fieldwork and individual student involvement. The literature review was satisfactory, however, improvement is needed in the referencing of textual material. In most instances, laboratory reports and journals were done satisfactorily. In a few cases, it was apparent that candidates and teachers had difficulty in finding appropriate tasks for the laboratory exercise.

The majority of candidates exhibited weaknesses in analysing and interpreting the results. A few candidates did not submit the required minimum number of pieces for the laboratory exercises and also less than the minimum entries for the journal.

The Project

Generally, the projects submitted were satisfactory. In many instances, the titles were vague and too wide. This resulted in candidates having difficulties with data collection and the presentation of data to address the wide range of issues that the titles indicated. Consequently, some projects failed to justify their titles.

Candidates are reminded that there is a word limit of about 2 500 – 3 000 words. This should guide candidates as to how much information to present in the report.

The purpose of the project must be stated clearly and the variables identified. It is recommended that a section be titled, Purpose of Project or Statement of Task.

While a few candidates clearly described their data collection procedures, this was not true for the majority of candidates. A greater emphasis is needed in the planning and design, so that more appropriate data collection procedures can be employed.

Literature review was attempted but in most cases, it was neither appropriate nor comprehensive. This aspect needs special attention early in the course if any significant improvement is to be seen. Very few candidates referenced material correctly in the text and in the Bibliography. Candidates ought to be cautioned about the importance of referencing and acknowledging another author's work and the dangers of plagiarism.

Another area of major concern was the language and communication of information. Although, there was a reduction in the use of colloquial expressions by most candidates, this was not accompanied by an improvement in the use of standard English

for effective communication of information.

In some instances, candidates included data, which they were unable to analyse and discuss adequately. As a result, the conclusions drawn were either flawed or not based on the data presented. In a few cases, conclusions were not in line with stated objectives of the project. Candidates are advised to pay attention to the statement of purpose and objectives when analysing their data and drawing conclusions. Candidates are reminded to state all findings and present facts to support findings. This would improve the interpretability, reliability and usefulness of findings.

Candidates are reminded that

- conclusions must be clear, based on findings, valid and related to the purpose of the project

- recommendations must be based on findings and must be **fully** derived from findings.

Laboratory Exercises

The syllabus facilitates laboratory exercises in all Modules. For assessment purposes, laboratory exercises submitted were expected to focus on Module 3 in the case of Unit 2. For Unit 1, it is expected that laboratory techniques and investigation be demonstrated in the planning and design, and data collection sections of the project.

In general, most candidates submitted an adequate number of laboratory exercises with satisfactory coverage of the criteria to be assessed. There was an improvement in the measurement and reporting of basic parameters. Only a few candidates submitted less than the minimum number of pieces. While there was an overall improvement in the general quality of the laboratory exercises submitted, there is still room for improvement in the analysis and interpretation of results.

Research Paper

This component was generally satisfactory. However, there was not much evidence of planning and design by some candidates or of effort to obtain data based on field work to supplement secondary data. This reliance on secondary data only reduced the quality of the candidates' analysis and comparison of data. Wherever candidates undertook fieldwork to collect data, they relied solely on questionnaires. This did not allow a variety of data sets to be collected.

Candidates are encouraged to devote more attention to the plan and design of the research paper. This will direct the design for the types of data to be collected while

at the same time allowing for the type of analysis that will be used. Effective planning and design will also lead to effective interpretation and discussion since the scope and purpose of the research paper would have been identified.

Journal

There was an overall improvement in the journals submitted. Most candidates followed the criteria outlined and were able to make relevant entries, observations and interpretative comments. Only in a few cases were follow-up activities not included.

The interpretative comments were generally weak. In some instances, these comments did not correspond to the entries or the observations recorded. Greater attention is needed in the formatting and organization of space. An introduction to the journal would be helpful as this would indicate the scope and purpose of the journal entries to the reader.