



AFRICAN ECONOMIC RESEARCH CONSORTIUM

Collaborative PhD Programme in Economics for Sub-Saharan Africa

COMPREHENSIVE EXAMINATIONS IN CORE AND ELECTIVE FIELDS

FEBRUARY 11 – MARCH 2, 2015

ENVIRONMENTAL ECONOMICS

Time: 08:00 – 11:00 GMT

Date: Wednesday, February 25, 2015

INSTRUCTIONS:

Answer a total of FOUR questions: ONE question from Section A, ONE question from Section B, and TWO questions from Section C.

The sections are weighted as indicated on the paper.

SECTION A: (15%)

Answer only ONE Question from this Section

Question 1

- (a) Consider a pollution problem involving a beer factory located on a river and a community consisting of two consumers, Asan and Boti, who use the polluted water. The total damage to Asan is P^2 where P is the amount of pollution and the total damage to Boti is $3P^2$. According to an analysis by consulting engineers, the savings made by the beer factory when it causes P amount of pollution is given by $20P - P^2$.
- (i) How much will the beer factory pollute in the absence of any regulation or bargaining and why? **(2 Marks)**
- (ii) What is the society's optimal level of pollution? Explain. **(3 Marks)**
- (b) Provide a diagrammatic description of the Coasian bargaining solution to the externality problem in (a) assuming it is the society (consisting of Asan and Boti) which has the property rights to the river. Make sure you provide a statement of the Coase Theorem in your answer. **(10 Marks)**



Question 2

One convenient way to express the willingness-to-pay relationship between price and quantity is to use the inverse demand function. Suppose the inverse demand function (in shillings) of the scenic view derived from a river is:

$$P = 80 - q$$

The marginal cost (MC) in shillings is given by:

$$MC = 1q$$

- (a) Under perfectly competitive market conditions, how much would be supplied in the case of static efficiency? **(1 Mark)**
- (b) Define and compute the consumer surplus, producer surplus, and the net economic benefits if the service is to be supplied by a perfectly competitive firm. **(6 Marks)**
- (c) Define and compute the (opportunity) cost to society of preserving this scenic river. **(3 Marks)**
- (d) Compute the size of the consumer surplus if the service is to be provided by a monopoly. Compare your result with what you obtained in (b) above and comment. **(5 Marks)**

SECTION B: (25%)

Answer only ONE Question from this Section

Question 3

- (a) There are several goals that one might reasonably expect of government policy towards the use of natural resources and the environment. Achieving efficiency is often a major goal and whenever there is a departure from efficiency, the use of incentive based instruments, such as tax, is often a preferred choice. Consider the following situations.
 - (i) Open access fishery
 - (ii) Private Forestry
 - (iii) Pollution (assuming uniformly mixing pollutants)

In each of the above cases describe the basic cause of inefficiency and explain the theoretical basis for the use of tax policy to achieve efficiency in the management of the resource. **(18 Marks)**

(Note: No mathematical derivations are required but you are to apply the results from mathematical analysis to buttress your explanations).

- (b) Explain why policy makers do not exclusively use incentive based instruments to achieve resource management objectives. **(7 Marks)**



Question 4

William Beckerman, in a 1992 article in *World Development*, wrote: “there is clear evidence that although economic growth usually leads to environmental degradation in the early stages of the process, in the end the best – and probably the only – way to attain a decent environment in most countries is to become rich”.

- (a) Explain the hypothesis or reasoning upon which Beckerman’s conclusion is based. **(5 Marks)**
- (b) Provide one possible theoretical explanation for this phenomenon. **(4 Marks)**
- (c) Discuss the weaknesses (if any) in Beckerman’s argument. **(8 Marks)**
- (d) From an African perspective, briefly discuss national level policies that could help ensure that economic growth is not achieved at the expense of environmental quality. **(8 Marks)**

SECTION C: (60%)

Answer TWO Questions from this Section

Question 5

- (a) What is the hydrological cycle and what link does it have with water resources and with water contamination? **(5 Marks)**
- (b) Water quality requirements deal with water quality objectives and water quality standards. Explain what is meant by:
 - (i) Water quality objectives
 - (ii) Water quality standards **(10 Marks)**
- (c) Describe the general approach to setting standards to improve water quality and illustrate with standard setting for drinking water. **(7 Marks)**
- (d) The following statement is found in the Water Act of a (sub-Saharan African) country.

“When all or part of the cost of a state scheme or community project has been paid from moneys provided by Parliament, any person who in the opinion of the Minister has benefited by the scheme or project shall, if the Minister so determines, pay to the Government a water rate or other charge for that benefit calculated as prescribed by rules made under this Act.”

Do you agree or disagree with the view that every beneficiary from such a scheme should pay? Explain. **(8 Marks)**



Question 6

- (a) With particular reference to the latest scientific evidence on climate change, the IPCC 5th Assessment Report (AR5), discuss the IPCC's conclusions on the observed changes in the global climate system. In your response, pay attention to factors such as temperature, precipitation, sea level and GHGs. What are the IPCC's projections for the future climate with respect to temperature, precipitation, sea level? **(5 Marks)**
- (b)
- (i) State and discuss the features of the Hedonic (or Ricardian) model for estimating the effects of climate change particularly in the agricultural sector.
 - (ii) What are the strengths and limitations of this model?
 - (iii) Explain briefly how the model could be improved to yield more realistic estimates. **(10 Marks)**
- (c) Explain the cost of adaptation if:
- (i) A country wants to adapt fully to climate change, and
 - (ii) If it wants to choose an efficient level of adaptation instead. **(5 Marks)**
- (d) What would be the difference between the two policies? Describe the process by which the adaptation costs of a country in the second case could be estimated. **(10 Marks)**

Question 7

“There is a close relationship between the economics of renewable and non-renewable resources”.

- (a) By setting up dynamic continuous time models of natural resource exploitation in which harvesting costs depend on both extraction $q(t)$ and remaining stock $x(t)$ for:
- (i) A renewable resource.
 - (ii) A non-renewable resource.

Derive the appropriate results to justify the above statement **(12 Marks)**

- (b) A dynamic resource exploitation model with a stock dependent cost function allows one to capture ‘stock effects’. Illustrate, using any one of your two models and explain the importance of the ‘stock effects’ **(4 Marks)**
- (c) Furthermore, in a model with a stock dependent cost function, opportunity costs are different than they would be in a model without stock effects. Explain using any one of your two models. **(4 Marks)**



- (d) As a graduate student with specialization in Resource Economics you have been sent on attachment to the Mineral Commission of your country. Your supervisor has requested you to prepare a draft tax policy document for the mining sector. Describe the important issues that should feature in your draft policy document. **(10 Marks)**

Question 8

- (a) State and explain two theoretically appropriate measures of the depreciation of an economy's stock of a non-renewable resource. Discuss why it is difficult to implement each of these measures in practice. **(10 Marks)**
- (b) At the start of 2012, oil reserves in Country X were 504×10^9 barrels. During 2012, this country produced 8×10^9 barrels and new reserves of approximately 5×10^9 barrels were discovered by the end of the year. The world price of oil was US\$60 per barrel at the beginning of 2007 and US\$70 at the end, while the interest rate averaged 6% per annum. Total production costs in the country, including a normal return to capital employed, were US\$20 $\times 10^9$. It is estimated that the deposits will last for 30 years assuming a constant rate of extraction.

Calculate the depreciation of Country X's oil stock using:

- (i) The net price method **(4 Marks)**
- (ii) The net present value method **(5 Marks)**
- (iii) El Serafy's user cost method. **(5 Marks)**
- (c) State any assumptions underlying your calculations in (b) above. **(6 Marks)**