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A MODEL FOR THE APPRAISAL OF THE ENVIRONMENTAL IMPACTS OF THE PROJECTS

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INTRODUCTION

Environmental impacts of the projects arise from the market failure performances of the actual economies, due to externalities of the individual projects implementation. Externalities could be positive (benefits) or negative (costs), however they are not considered through the regular market mechanism. These externalities refer to the utilization of the public goods, where not all economic agents act as price takers and not all economic agents have complete information. Market failure is, also, due to that there are not well-defined private property rights in all inputs to and outputs from production and consumption activities. Once, the prices emerging in markets cannot generally, be taken to express the relative social valuations, required for efficiency in allocation. Then, there is a role for social appraisal of the projects. For example, establishment a factory definitely generates income to its enterpriser, but he or she does not compensate the society for the probable premature death due to pollution of air with smoke, or water with disposal residues of the plant operations. Replacement of conventional fuel for solar energy to operate a certain processing plant creates external benefits as providing clean energy that will protect people from the probable premature death, due to the combustion of the conventional fuel. Inclusion of the environmental impacts in the project evaluation refers to the social appraisal of projects. The cost benefit analysis, in its appropriate term is the procedure to treat such problem. This does not assume that project appraisal can never proceeds based on valuation and aggregation at market prices. The point is that under the theme of the sustainable development, with its four dimensions (economic, technological, environmental, and human development) even conceivable project requires to be subjected to a cost benefit analysis by some governmental agency. However, for projects, where none of its consequences is in the nature of public goods, there are no external costs or benefits arising. Thereof, the markets in which the prices emerge are dominated by price taker behavior based on complete information, will be appropriate to proceed its economic evaluation and aggregation of all their consequences at actual market prices. Where market prices are regarded as inappropriate, the agency doing the cost benefit analysis has necessarily to determine the appropriate social prices.

The study generates a case study model for social project appraisal that simulates the economic treatment of a depletable resource, environment protection from pollution effects and public goods damage. The project is a high dam project that generates a an "environmental friendly technology" for energy creation "Hydroelectric" that saves a depleted fuel and reduces the premature death probability and it preserves water for irrigating additional newly reclaimed land for agricultural production. Although, this model simulates the comparable one in Egypt, its volume and figures were simplified here for several reasons. The study is interest in building up a model to test its validity for further applications, rather than to restrict it to access the feasibility or validity of the High Dam, as the protection of Egypt from drought several times within the last three decades was enough evidence to judge how valid was the decision to establish it. The externalities of the actual "Aswan" high dam are much more beyond what presented here.

Methodology

1. Direct Costs:

1.1. Construction, operating and removal costs:

It should be noted that in such large civil engineering works, there might be an observed tendency to underestimate the inputs quantities, at the planning stage; however, this will not affect the theme or the concepts of the model as an empirical one. The quantities of inputs, which are required during construction, at all stages, are aggregated using market prices for the purposes of this paper. It is assumed that in terms of inputs for construction, maintenance, and shutdown, market prices are appropriate for social valuation. This assumption would not necessarily be appropriate in all conceivable circumstances. The engineering specifications for the project give construction input requirements, the estimates of the running, costs, maintenance costs, price of inputs, and the removal costs of the dam and its associated facilities (the cost of the shutdown and removal). They also provide the scheduling over the project life, which is valued at market prices.

1.2. Land Reclamation Costs:

The costs of area which is going to be reclaimed, in order to utilize the water reserved behind the dam have been identified and estimated as investment costs. The volume of this cost is estimated on per Hectare basis and aggregated for the total area over the investment period of the project. The study presents such cost as a sum figure. However, it composes of several sub-categories. These categories are, the infrastructure, attributable to the land cultivation, i.e. irrigation canals network, roads and water main pump stations and power stations. They include, also, the on-farm established utilities, and investments, i.e. irrigation system, field canals and housing. The operating costs of cultivation, associated with production is included with the net income of agricultural production, which is presented under * direct benefits of the project.

2. Direct Benefits:

2.1. Electricity Output:

Establishment of the dam generates electricity by establishing a hydroelectric plant. The electrical output is valued per unit in terms of the value of the resource input savings it realizes for the electricity supply system. By building a hydroelectric plant the electricity supply system reduces its fuel costs for meeting any^ given demand for electricity to the extent that output from the" hydroelectric plant, fuel cost zero, displaces output from conventional energy plant (coal, oil or gas fired) with nonzero fuel cost. The valuation of the hydroelectric plant is output. Therefore, depends on the fuel(s), which would have been used in the absence of the plant. In practice, determining the quantities of savings of various fuels attributable to the hydroelectric, plant is an exercise, which involves modeling the entire electricity supply system. To focus on the essential issues in this study, it is assumed that the electricity supply system in which, in the absence of the projected hydroelectric scheme, the fuel is coal.

Then the output from the proposed plant displaces coal, and is to be valued in terms of such resource input savings. The quantity of coal input saved depends on the thermal efficiency of co_2 percentage, burning power stations. A widely used ready reckoned a conversion factor is used.

The market price of coal is not the appropriate social valuation per ton of coal input saved in every year of the project's life. There are *two* reasons for this assumption: (1) Coal is a non-renewable resource, (2) Burning coal to generate electricity, gives rise to external costs. Natural resources economic concepts, imply that efficiency in inter-temporal allocation requires that the price of a non-renewable resource rises over time at a proportional rate equal to the interest rate, assuming constant marginal' extraction costs. Since the cost benefit analysis is concerned with efficiency in allocation, the value of coal saving in each year of the project's life should be at the price corresponding to efficient inter-temporal allocation. Although, during the most probable outcome of this project, the price of coal rises at a proportional rate equal to the interest rate, in further detail studies, the change in interest rate, extraction costs and/or vast new coal deposits that may discovered should be considered.

2.2. Agricultural Output;

The cultivation of new land could be under several optional cropping pattern with also variation in yields and farming practice. However, for the purpose of this study, and its limited scope, to focus upon the appraisal of external benefits and external costs, as environmental impacts, the average of the cropping pattern that generates the most profitable net income per Hectare, under appropriate technology (drip and sprinkle irrigation), is considered. It was derived from the most recent national professional studies; to avoid the inefficient utilization *followed* along the experience plans.

3. External Benefits:

3.1. Saved Depleted fuel Resource:

The external costs avoided by substitution of non-polluting hydroelectricity for fuel-fired electricity are benefits to be attributed to the project, as are the depleted fuel resource savings.

3.2. Avoidance of pollution Externalities:

It is well known that burning conventional fuel to generate electricity gives rise to pollution problems especially atmospheric pollution. Qualification of the project benefits so arising is difficult. The atmospheric pollution from coal combustion has adverse effects on material structures giving rise to corrosion and to cleaning costs; it has adverse effects on plants and animals including man. In quantitative terms, most research attention has focused on the effects on human health. This is not to be taken to imply that the other effects of atmospheric pollution due to coal combustion are trivial. In terms of their physical dimensions, they clearly are not though there is much uncertainty involved. The acid-rain problem is clear evidence.

Event though just considering human health effects estimating the costs attributable to the burning of coal to produce electricity is two-stage process.

3.2.1. Health Effect:

To quantify the health effect, there is much uncertainty and it requires a great deal of research effort. The health effects express increasing morbidity (disease incidence) and mortality due to fuel combustion. Relatively little is known about the former. The study regards only here the probability of increased mortality as the only estimate that has significant published research output.

3.2.2. Social valuation of Reduction in Mortality:

Putting a value on human life is a difficult area for discussion the basic principle here is as elsewhere that social valuation should reflect willingness to pay. Now clearly, if an individual is asked what he would be willing to pay to prevent his owns certain death on the narrow, his answer will be the largest sum of money on which he can lay his hands. Conversely, if an individual were asked how much he would require compensating him for the certain prospect of death tomorrow, the answer would be, in most cases, an entirely large sum of money. However, projects do not give rise to the prospects of certain life or death for specific individuals. Rather they give rise of decrease or increase in mortality rates or whole populations, and hence to changes in the probability of death for individual members of that population. Individuals can and do make choices which involve changes in the probability of death, as for example, when they travel by car rather than walk in urban areas, demonstrating that they value time saved more than the increased probability of death. In principle, then, one can infer willingness to pay for changes in the probability of death from observed behavior. The implementation of this principle is difficult. One approach, which has been adopted, is to look at wage rate differentials across occupations of varying degrees of riskiness. Other things equal, it is an observable fact that wage rates are higher for riskier jobs. Although few studies about this subject have been done, the range of variation in the values they produce for a human life is rather large. Although it is a difficult and contentious problem, Appraisal of environmental impacts of projects is impossible to avoid it. If a project appraisal does not involve changes in the probability of premature death for members of the population of the beneficiaries, then it is implicitly valuing human life. The net benefit of such project does not consider premature death as social costs. It is in fact reflects the society willing to accept such net benefits as a trade off against the expected premature deaths of a certain numbers of its population. If the argument is that premature deaths cannot be traded off against benefits to society under any circumstances, it means that this project should be rejected however large the net benefit is. As positive way of thinking to pay an amount of funds to protect population from premature death attributed to the project implementation, is accepted by the society, once such amount of funds is less than the projects net benefits (without including premature deaths value).

4. External Costs:

The environmental impacts assess to consider the expected loss of the tourism activity to the recreation, historical' -and monumental area that suppose to disappear, and the use of these facilities and services have not bean subject of market transactions, there is no market price or quantity data to quantify and value this consequence. To estimate the value of loss due to vanishing of this economic activity, the widely used available empirical procedure is *"Clawson Method"*. It considers the costs. Incurred by visitors to the valley to infer their willingness to pay for the recreation facilities and culture services it offers. The first step is to identify the exporting zones by distance from where the visitors come. To ascertain the number of visitors is done by counting and by interviewing a sample of them over a certain period. The population size of each zone is used to get figures for visitors per thousand of population from each zone. The cost of a visit is assumed to be directly related to distance. The data of costs and visits are used to estimate a demand curve function. To ascertain willingness to pay by tourists, it is possible to simulate the effect of charging at different levels. By this means, a demand schedule is derived and the market revenue is estimated, from the derived. *"Surrogate Demand Curve" for* the monuments, recreation and culture facilities, and services, which will become unavailable if the project is implement. Valuation of the annual cost to be assigned to the project on this count is the total willingness to pay for the availability of the services and facilities, because it will be entirely lost of the project goes ahead. The market revenue 'The area under the demand curve", is such cost estimate.

However, if the visitors to the area which is to be flooded were the only people whose utility were affected by the distraction of this historical, monumental and recreation facilities, "such distraction would not be an additional cost to charge against the project. This is because in counting their willingness "to pay for these facilities, services, etc, the loss they suffer from not being able to see has been counted. However, it is not reasonable to suppose that visitors to the area are the only people who derive satisfaction from the existence of this natural museum historical for monuments affected. This area was the only known place for such monuments. It appears that many people derive satisfaction from the knowledge that rare things exist is quite independent of their own prospects of ever visiting such area. In addition, the extinction of these monuments means the loss of material for scientific study. The problem involved in including these considerations in a cost benefit analysis is apparent.

Thereby, willingness to pay for preservation of these things is not directly observable from market behavior, even by using the indirect approach of *"Clawson method.* What can be fairly and empirically, be done is to proceed with the cost benefit analysis, leaving out the destruction cost. Two possible alternatives of the social value judgments are investigated. First, if the project does not then pass the positive net present value test, the destruction cost of the area is irrelevant to the decision on the project.

Second, If the project have a positive net present value, its size tells what the society' willingness to pay for preservation of the area would have to be in order for it not be socially desirable to proceed with the project. !t is then possible to consider whether. Willingness to pay for the area preservation is sufficiently large to stop the project. Such a procedure can inform public debate on the project and stimulate efforts to infer the size of willingness to pay for monuments preservation.

5. The Net Present Value:

In terms of the most probable outcome, the project involves the following assumptions; (a) the first five years inclusive for construction and land reclamation, (b) The shut-down occurs in $^{Le;}$ the year 50. (c) The production starts in the year 6 and expands until the year 50. (d) Although the loss of the monumental sites and x-recreation facilities takes effect in the year 1, it is not apparent that there is a unique correct date at which it would be appropriate to assume the cessation of this annual loss. Clearly, the loss continues beyond year 50, as removing date the dam, does not immediately restore the area to its former state. It might H be argued that, say, 50 years after the removal of the dam intensive processes will have reinstated the area facilities and cultural locations and monumen[1] Strictly spewing the area will never revert to exactly its former state. Accordingly, the study evaluates the project on two broad assumptions. First, the culture, monumental and recreation area is lest for 100 years, and Second, it is lost forever, i.e. the distraction is permanent, insofar, as shown earlier, under section (3),the external cost, the society decision value judgment against the project's NPV is how much is the willingness TO scarify in order to save area. As a social project appraisal, although the date of the project lifetime is a matter of uncertainty, the project lifetime is not f fixed by the date at which the project ceases to generate its direct output. In this case, the electricity is fixed by the date at which it is true that all of the consequences attributable to the project have ceased to exist.

The project appraisal model concerns the relative prices, rather than the absolute prices. If the general price level is constant, absolute and relative prices are the same. In cost benefit analysis, any anticipated movements in the general price level, but not in relative price, should be ignored.

6. Sensitivity Analysis:

The sensitivity analysis is a crucial part of any properly conducted project appraisal due to there is inherent uncertainly attached to the project. It indicates the areas where the decision en the project is crucially dependent on the data input to the cost benefit analysis. This section examines the sensitivity of the outcome of the cost benefit analysis to such uncertainty.

RESULTS AND DISCUSSION

1. Direct Costs:

1.1. Estimates of The construction, operating and removal costs:

Estimates of the construction costs are \$200 million for each of the five years of the construction phase. The running and maintenance costs at market price reach \$0.5 million a year for years 6 to 50. The shutdown and removal operation of the dam and its associated facilities will cost the project about \$100 million, at the year 50.

1.2. Land Reclamation Costs:

The costs of reclamation of land for agriculture production using the water reserved behind the dam are estimated per Hectare as \$1200 dollar for 40,000 Hectares per year over the first five years. It counts \$48 million as aggregate costs of reclamation per year.

2. Direct Benefits:

2.1. Electricity Output:

The average electricity output will be 6,570 GW//h. GW/h stands for gaga watt/hour. A watt is a unit of power, equal to 0.293 Btu "British Thermal Unit" per hour, which is the amount of energy required to raise the temperature of one pound of water one degree from 3 to 4^{U}C. Giga stands for 10 watts. The planning assumption is to create such volume of electricity a year for 45 years. The "Ready Reckoner' conversion factor used is 500 tons of coal to generate 1 GW/h of electricity. The operating rate a year is 75%. It means that the hydroelectric plant reduces (ssves) 3.285,000 tons per year. The market price of coal is \$30 per ton in the year in which work on the project is commence. The Coal price is assumed to rise annually at a proportional rate equal to 5 percent interest rate. The following equation is used to generate the annual coal price in the successive future years: $P_t = P_0 (1^{+}r)^{T}$.

Where, P_t = Coal price in the target year t and P_0 = the price in the onset year and T is the number of years between P_0 and P_t

2.2. Estimate of Agricultural Output:

The net farm income from agriculture production on new land reclaimed is estimated as $600 per Hectare, which is the most probable outcome of the selected option of cropping pattern that fits the new desert land, as cited by the recent studies. The output starts from the year 6 of the project with 50% of its potential output reach 75% of its potential output in the year 7 and its full output in the year 8. Then it continues at such level until the year 50. The full potential agricultural net income a year is estimated as $120 million.

3. Estimation of External benefits:

3.2. Estimate of Pollution Externalities:

3.2.1. Estimate of Health Effects:

It is based upon the most probable outcome of the project performance, for the mortality effects estimate of the various pollutants emitted in fuel (coal) combustion and considering the emissions from a typical one GW/h plant operating at 75% load-factor, which means that the plant is running 75% of the year. The estimate is 80 extra deaths per year attributable to plant operation. However, the range of estimates for the excess mortality, attributable to such a plant, which is found in the literature, is from 10 to one CO persons a year. Since there are 365 days in the year and *24* hours in a day, one GW/h plant operating at 75% load-factor sends out 6570 GWT per year. This is the estimated average yearly output of the hydro plant. This is the most probable outcome of the project, which would mean SO fewer premature deaths per year.

3.2.2. Estimate of the Benefit due to Reduction in Mortality:

The study will use an average .across countries and across occupations, of the increase in annual wage due to the probability of premature death, although the range of variation in the values is rather large. The study estimate, adjusted for skill requirements and unpleasant working conditions, is that an increase in the risk of premature death of 0.001 in the probability of premature death is associated with an increase in the annual wage of $100. It is assumed that this $100 is the compensation required by a typical individual for an increase of 0.001 in the probability of premature death. Therefore, the total willingness of 1,000 people to pay for a 0.001 reduction in the probability of death would be $100.000. Consequently, it means one fewer premature death. Then 100.000 would be taken as the social valuation of the saving of one life. The literature estimates ranged from $28 to $5,000. Accordingly, for 80 expected premature death attributed to the project implementation, means $8 million dollars a year at the steady state of the project output.

4. Estimate of External Costs:

The following equation is estimated from data of the interviewed sample of the tourists: V =10.5-0.003 C.

Where, V = represents visits per 10,000 of population, and C represents travel costs per visit. By using this equation, it is possible to simulate the effect of charging at different levels, i.e. a demand curve function. As shown from Table (1), the aggregate derived number of visitors from the five regions was estimated by raising the postulated charge above the travel costs by $500 dollars each time. This generates five different quantity levels (number of visitors) at extra charge of zero, $500 $1,000, $1,500, $2,000 per visit, associated with 153,000, 78,000, 36,750 18,000, and 3,000 total visitors, respectively. The graph number 1 shows the driven demand curve. Calculation of the area the curve provides about $164 million market revenue a year It will be entirely lost if the project is implemented. !t is concluded from Table (1) shows that the tourists are not willing to travel to the area if the costs have been more than $3000 per visit.

Table 1:
Simulation the demand Schedule for recreation different Travel and Charge costs:

Zone	1	2	3	4	5	Total
Population (Million)	20	80	25	150	226.66	501.66
1. Charge/visit ($)	0	0	0	0	0	
Cost/Visit, $	1000	1500	2000	2500	3000	
Visits (000)	15	48	36	24	12	153.25
2. Charge/visit ($)	500	500	500	500	500	
Cost/Visit, $	1500	2000	2500	3000	3500	
Visits (000)	12	36	7.5	22.5	0	78.00
3. Charge/visit ($)	1000	1000	1000	1000	1000	
Cost/Visit, $	2000	2500	3000	3500	4500	
Visits (000)	9	24	3.75	0	0	36.75
4. Charge/visit ($)	1500	1500	1500	1500	1500	
Cost/Visit, $	2500	3000	3500	4000	4500	
Visits (000)	6	12	0	0	0	18.00
5. Charge/visit ($)	2000	2000	2000	2000	2000	
Cost/Visit, $	3000	3500	4000	4500	5000	
Visits (000)	3	0	0	0	0	3.00

5. Calculation of the Net Present Value:

The able two sets out the cash flow chart of costs and benefits assorted with the project, leaving aside the loss of the historical places and monuments, over 100 years. The cost and benefit streams were discounted over the project life at a rate 5%, to get the present value. Table four, presents the technical coefficients and basic parameters of the model. It should be mentioned that the discounted benefit stream arising from coal savings is constant from the year 6 to the year 50, because the price of coal is increasing at a proportional rate equal to the rate of interest. NPV at 5% discount rate was calculated for the net benefits of the project without considering the environmental impacts (external benefits and external costs), as $3,874.2 million, dropped to about $730.6 million with consideration of the mentioned environmental externalities. The " social (rather than internal) rate of return", i.e. SRR, rather than IRR, was also calculated , it accounted 6-57% if environmental impacts were considered in comparison with 15.1% without considering such impacts. The main reason behind the drop in the return to investment of the project, when the environmental impacts were taken into consideration was mainly due to the negative externalities (external costs) of the cultural monumental and recreation area loss. The estimate of the net present value of its costs was approximately \$3,255 million. This is on the assumption that the area losses cease to be effective after 100 years. On this assumption, and at market interest rate of 5%, the project offers an excess of discounted net benefit over cost and so according to the efficiency criterion it should be implemented. On the other hand, the judgment that the loss of the area is forever is because of the project, should be investigated by the following equation;

P.V. = $(1+r)\, x/r$, where: PV is the present value of the losses forever of the concerned area, and X is the annual current value and r is the interest rate of loss.

Application of this equation where $r = 0.05$ and $X \sim \$164$ million, then PV = 3,443, which is not far from \$3255 million calculated on base of project's life of 100 years. This because, the increase in the present value beyond the year 100 gets smaller and smaller (it is multiplied by a very small discount factor at discount rate 5%), In the year 100 the PV of \$164 million will be only \$1.3 million. Thereby, the effect of this proposed change from 100 years to be forever, on the NPV figure is negligible.

Table 2:

Present Value of Benefits and Costs of the project, in million dollars.

Present Value	
Benefits :	
Coal savings	3.379
Mortality Reduction	111
Agricultural net income	1.585
Total benefits	5.075
Costs :	
Construction, Operational and removal	882
Land reclamation	208
Culture and recreation	3.255
Total Costs	4.344
Net Present Value :	
With Environmental impacts	731
With out Environmental impacts	3.874

Table 3:

Basic Parameters and Technical coefficients of the Cost Benefit analysis Model:

Technical Coefficient	Value	Unit
Construction costs/year	200	Million $
Running costs/year	0.5	Million $
Removal costs	100	Million $
Area reclaimed/year	40	(000) ha
Costs of reclamation/hectare/year	1.200	$
Costs of reclamation /year	48	Million $
Reckoner conversion factor	500	Tons
Electricity out put/year	6.570	GWTH
Reduction in coal burn/year	2.628	(000) tons
Price/ton of coal	30	$
Interest rate	5%	%
Net income/hectare/year	600	$
Total reclaimed area	200	(0000) ha
Agricultural net income per year, at steady state	120	Million $
Load factor of electrical plant	75%	%
Plant operating capacity/hour	1	GWTH
Premature deaths per year*	80	Person
An increase in the annual wage @	100	$
The social valuation of the saving of one life	100.000	$
Recreation and tourism cost**	164	Million $

However, the costs attributable to the loss of monumental sites consequent upon implementation of the project were ignored. Ignoring such costs made the project to have a NPV around $731 million. Therefore, such costs (losses) would have to have a present value in excess of $731 million in order for their inclusion to lead to a decision against the project. By using the equation above, it was possible to convert this present value figure to an annual, current, cost stream since the monumental sites loss would be permanent. Substituting PV= $731 million and at r^ 5%, in the above-mentioned equation, results in $ 34.79 million. Therefore, if the society was prepared to believe that people collectively were willing to pay around $35 million per year to preserve the monumental sites, they have two optional decisions. The negative one is to vote against the implementation of the project. The positive one is to provide donations of about $35 million annually to move up the monuments to a different save similar location, away from the dam stream.

6. Implementation of Sensitivity Analysis:

The cost and benefit streams of the project are dominant by the construction, running and removal costs, as well as, the fuel savings benefits, while the other costs and benefits play a relatively minor role.

6.1. The coal savings benefits: Under the most probable outcome:

It is assumed that the price of fuel increases at the same rate as the rate of interest and the relationship of the annual quantity of coal saved would be constant over the life of the project. These would not be the proper assumptions over time. There might be a reduction in the rate of increase in the price of fuel and the thermal efficiency coal-fired power stations were to improve over time. In this case, the annual fuel savings attributable to the hydro plant would fall over the plant's lifetime. Reduction in the rate of price increase has the same effect as reduction in the quantity of fuel saved. From Table (4), the changes of just 1 % in the value of the coal saved, arising either due to a different price appreciation of fuel and/or different quantity saved of fuel, exerts a large effect on the NPV outcome.

6.2. The constriction, running, and shutdown costs of the project:

At the planning stage the construction of large civil engineering, projects are frequently under-estimated. If the construction costs has increased to 300 million dollars per year for five years and both the running, and removal costs have also increases from 925.7 to 1380 million dollars, the project's NPV would be reduced to $234 millions.

Considering a tenfold increase in the shutdown costs, to $1000 millions, increases the present value for construction, running and removal costs to $1008 millions, which in turn, reduces the NPV to $678 million. The larger increase in the shutdown costs has less effect on the NPV because the shutdown costs arise at the year 50 and are heavily discounted in the NPV calculation {for the year 50 the discount factor at a rate 5% is 0.0916).

6.3. Changes in Environmental benefits:

These are attributable to the avoided external costs associated with fuel burning. In estimating the size of the mortality effect and putting a unit value on it, there is scope for legitimate disagreement about the appropriate numbers and value. The most probable outcome assumed 80 persons per year, however, it ranged from 10 to 100 as cited in the literature. **If** the lower of these figures is **used,** the present value for the mortality reduction benefits drops to $15 millions, which reduces the NPV to $655 million. If the figure for mortality reduction was increased to 100 and the value of an avoided premature death would be doubled to $200, the NPV would be increased by about 16.2% and 26.1% respectively; Table (4).

Table 4:
Sensitivity analysis indicators

Source of Change in Project Components	(%)Change in Net Present Value of the Project
(1) Change in projects costs :	
(1-1) % 50 increase in construction costs	-58.33
(1-2) Tenfold increase in the shutdown costs	-10.65
(2) Change in projects environmental benefits :	
(2-1) % increase in fuel price and/or quantity saved	
4	-42.18
3	-73.5
2	-96.98
(2-2) 10 mortality, rather than 80, saved per year	-81.57
(2-3) 100 mortality, rather than 80, saved per year	+16.2%
(2-4) Double the value of opportunity cost of premature death saved	+26.1%

REFERENCES

Abelson, P., (1979) "Cost Benefit analysis and Environmental Problems" Saxon House Press, UK

Ashley, H. Rudman, R., and Whipple, C. (1976) "Energy and Environment: a risk-thought" Longman press. Sydney, Australia

Collard, D. Pearce, D. W. and Alpha, D "Economics Growth and Sustainable Environments" Macmillan Inc, New York

Common, M., (1988) "Environmental and Resource Economics: An Introduction, Longmann Inc., New York

Ferine, J. and Pitkethly, A. S., (1985) "Resources, Environment and Policy" Harper and Row Press, New York

Ministry of Agriculture and Land Reclamation of Egypt (1994) "New Land Development Study" Conducted by Social Studies Consulting Institute and Sponsored by US AID of Cairo

Ministry of Irrigation and Public Work, Egypt (1994) "Unpublished Reports and Studies"