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Importance Of Using Renewable Sources Of Energy For Maintaining Ecological Sustainability In Case Of In Extreme Climate Vulnerable Zones : A Case Study Of Sagar Island Of Sundarban

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ABSTRACT :-

The power sector in West Bengal has achieved significant improvement over the years in the areas of electricity generation, transmission and distribution. Two percent (2%) of the total power requirement of the State is met from Renewable Energy (RE) sources. There is a need for optimally harnessing the RE potential in the state. In the implementation of National Action Plan on Climate Change (NAPCC), a share of 15% of India's total energy requirements is targeted to be met from renewable sources by 2020. To meet this ambitious target, a number of initiatives are being perused by various State Governments for enhancing the growth of renewable energy through active Public and Private participation in the sector. This paper also briefly addresses issues on the relationship between climate change and use of various kind of climate adaptation measures specially renewable energy sources for solving the power related problem of extremely climate vulnerable zone of Sundarban .

KEY WORDS :- Renewable energy, Climate vulnerable, Adaptation measure

INTRODUCTION

The precautionary approach of keeping GHG concentration within a limit of threshold or of following the optimal concentration path may lead to acceptance of some climate change to be optimal. Such a result is quite rational in view of the fact that beyond a point, mitigation of GHG emission may become more costly than that of saving damage due to climate change at the margin of variation. Further, there would remain the option of choice between the mitigation of GHG emission in order to lower its concentration level and the associated climate change on the one hand and adaptation to climate change on the other.

The latter may in fact require quite a bit of advance action to protect the economy and ecosystem from damage due to climate change as far as possible. Adaptation is in fact the only response possible for the inevitable climate change that would occur in the subsequent decades as a result of the current trend of rising GHG concentration and before the mitigation efforts adopted today or in the immediate future can have effect.

However, unlike the mitigation investment for which the impact of benefit is global , irrespective of location of the mitigation measure , the impact of adaptation investment is local , near the location of adoption of such adaptation measures. Any assessment of the challenge of this undertaking in the face of climate change would require the following :

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(i). Identification of the vulnerable sections of population (like those engaged in agriculture and living in rural or coastal areas) and the sectors of economic activities exposed to the risks of drought, cyclones or floods.

(ii). Assessing for each type of weather-related event the impact on labour engagement, use of technology and change in the cropping pattern in the affected sectors in the vulnerable regions and their impact on average income and income distribution.

(iii). Assessing for each type of weather event, the adaptive capacity of the exposed population on the basis of their knowledge base, education , and skill , availability of government finance , and the scope of any coping option of engagement of the labour population in non-agricultural sectors.

The assessment of overall vulnerability would be based on the joint assessment of all these three sets of factors . This assessment of vulnerability would enable prioritization of alternative adaptation measures , strategies , and policies.

A CASE STUDY OF SAGAR ISLAND

To understated fully the impact of adaptation measure the case study of Sagar Island , an extremely climate vulnerable zone of Sundarban , West Bengal
has been introduced in this study . Here I am trying to discuss the Power Scenario of the Island after the entrance of Conventional Electricity in 2012.

A) Analysis of Sagar Island :

i).Total households covered under this survey :-
Sagar :- 924

ii).Conventional electricity is reached at Sagar :- August , 2011.

iii).Under Sagar Block , 100% households have been covered with Solar Photovoltaic Home Lighting Systems at Ghoramara island in Sagar Block with 37 Wp Home Lighting System(HLS)(total : 5000 nos of households) under West Bengal Renewable Energy Development Agency's (WBREDA)Rural Village Electrification(RVE) Programme during 2012-2014.

iv).Augmentation / capacity addition at Sagar Power Plants in 2012 : - (use of Renewable Energy)->
Gayen Bazar :- 06 KWp (Kilo-Watt-peak)
Khasmahal :-- 06 KWp

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Uttar Haradhanpur : - 06 KWp

v). New installations : Solar Photovoltaic Pump , Solar Photovoltaic Petrol Pump .

vi). According to 2011 Census , 43,100 no of families are there at Sagar Island . 25,000 no of families are using Solar PV HLS. 17,000 no. of families are using conventional grid. Balance are using Kerosene Lanterns. (WBSEDCL , December ,2014) .

vii). Home Lighting System survey results :-→

Table 1:- Tabular Representation of HLS Data Sheet of Sagar Island

Block	**Total Households covered**	**% of SC, ST Population**	**Home lighting System (no of families)**	**Electricity (No of families)**	**Kerosene (No. of families)**	**Home lighting System Working (Nos.)**
Sagar	924	85%	562	328	34	397

(Source :- Data collected from the Power Station of Sagar and primary sample survey)

INTERPRETATION OF THE DATA

i). Interpretation of Sample survey data :-

The Sunderban forests lies in southern part of the state. It comprises of 104 island groups out of which 54 are inhabited. Sagar Island, the focus of my study, is the largest island in this area having an area of 286 km^{2}and a population of more than 1.6 lakhs. This island is situated 5 km adrift the mainland of India. Due to the presence of River Muriganga (Hooghly), this island could not be connected to the national grid. So the power requirement was fulfilled by the Diesel Generator sets run by WBSEDCL, 11 Solar Photovoltaic Plants located in the strategic areas and one Wind-Diesel Hybrid Plant run by WBREDA so that minimum power requirement could be met. On 15th August 2010, the island was connected to the conventional grid and the customers started getting the benefit of 24 hours supply of electricity from 19th October 2012. The grid connected consumers are still low with only 741 service connections were provided till 30th June 2012. Still, most of the island doesn’t have access to 24-hour grid and the people are still dependent on the SPV and Diesel, as wind diesel hybrid failed to deliver expected results.

ii). Methodology for explaining pattern of power use in the Island :-

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Sagar Island is an Ecologically fragile zone and also a vulnerable climatic sphere. In a very recent past it has experienced the devastating Aila . So, for the zone like this , beside using the Conventional power sources we have to use the ecofriendly pollution free local sources of energy so that if conventional grid based electricity supply dismantled , then supportive local and captive sources of energy can supplement those sources. For spreading the awareness for using these local level of Renewable and hybrid energy sources a mass level investment in training, capacity building and education is required. So, keeping all these things in mind, for explaining the power use scenario of Sagar the Ecological Sustainability model of Ramaprasad Senguta , is used in this analysis.

RS MODEL

Production function :-

i). $Y= F\{ A(t) , K(t), R_1 (t),R_2 (t),e(t), P(t)\} = A K^{\alpha} R^{\beta} e^{1-\alpha-\beta} P^{\Upsilon}$,

Where --→ $\alpha>0$, $\beta>0$, $\alpha+\beta < 1$, $\Upsilon <0$, A—Technology, K—Manmade Capital, R----- Natural resources, e---- emission, P--- Stock of pollutant.

ii). Accumulation of Manmade Capital :-

$\dot{K} = \bar{Y} (t) – C(t) – {}^{\delta}K(t)- Z_A (t)- Z_B (t)$,

Where, C(t)-→ Consumption spending, δ--→ the depreciation factor, Z_A (t)------→ Research and Development investment in technical change $\dot{A}$ (t),

Z_B (t) → is the R and D investment for discovery of new resources ;

iii). Technological Change :--→ $\dot{A} (t) = mZ_A^{p2} (t) = m A(t)^{p1} Z_A^{p2} (t)$,

Where → $m = \bar{m} A(t)^{p1}$, $\bar{m} >0$, $^{p1} < 1$, $0 < ^{p2} < 1$

iv). Growth of Natural Resources :-

Renewable Resource : --------→

$\dot{N}1 = Q(N1(t), P(t)) – R1(t)$,

Where N1 is the stock of renewable resources, Q is the growth or regeneration of renewable resources by nature , R1(t) is the renewable resources harvested & used in the production of Y. Q is dependent on the pre-existing stock N_1(t) & is also adversely affected by the stock of pollutant P(t).

Non- Renewable resource :-

$\dot{N}_2 = \dot{B} (t)- R_2(t)$ --------------------**(v)**

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Where N_2 is the stock of balance of non –renewable resources, B is the cumulative discovery of such resources & $\dot{B}$ (t) is the discovery of new resources in the concerned period to replenish the stock of non-renewable resources. R2(t) is the extraction of non renewable resources for use in production.

Resource discoveries :-

$\dot{B}(t)= n\, Z_B (t)^{\sigma_2} = \overline{n}\, B^{\sigma_1} (t)\, Z_B^{\sigma_2} (t)$ --------**(vi)**

Where $n= n\, \overline{B}^{\sigma_1} (t)$, $n>0$, $\sigma_1 <1$, $0 < \sigma_2 < 1$

The productivity of R and D efforts for exploration and discovery of new deposits or substitute resource would depend on the cumulative level of discovery B(t) and not on the balance of stock of N_2 . The effect of Cumulative discovery is likely to have exactly the analogous impact on productivity of the R and D effort in new discovery of resources as in the case of R&D efforts for general technology development , that is, change in A(t) for similar reason.

Growth of Stock of Pollution :-

$\dot{P}(t)= e(t)- \Theta\, P(t)$----------**(vii)**

Where Θ is the rate of degradation of pollution stock by nature per unit of time.

Initial Condition :-

$K(\tau), N_1 (\tau), N_2 (\tau), P(\tau), A(\tau),B(\tau)$ are given ------------------**(viii)**

The dynamics of various stocks, whose initial values are given, would yield an international utility profile as determined by Resource Allocation Mechanism (RAM) of the society which is defined by the institutional arrangements of production and distribution. This allocation mechanism may not be perfect from the viewpoint of either competitiveness or that of attaining the first best social optimum (Dasgupta 2001). The present value of the utility profile or the measure of social well-being over time thus generated by the RAM would , in fact, be equivalent to the aggregate value of all the initial Capital stocks, technologies and discovered resource base, using the prices which are derived from the marginal value productivities of the different types of stocks of assets including knowledge over time. The given initial configuration of $K(\tau)$, $N_1 (\tau)$, $N_2 (\tau)$, $P(\tau)$, $A(\tau)$,$B(\tau)$ and the resource allocation mechanism , say, a, would yield a time path of variables $\{ C(t),R_1(t), R_2(t),e(t),N_1(t),N_2(t), P(t) , K(t), A(t), B(t) \}_a$ and corresponding a utility time profile of $\{ u(c(t), p(t)\}_a$ and a value of $V_a (\tau)$. The shadow rentals for the use of the stock as arising from the process would yield the initial stock prices at the time τ as the discounted initial equivalent of the time profile of rental values. The aggregate value of these initial stocks of capital, natural resources, technology,

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cumulative resource discoveries as per such accounting prices would be $V_a(\tau)$. The sustainability of the development process would thus mean that the social well being overtime , or equivalently, the aggregate value of all the stocks of resources or of the wealth of the society , should be non-declining with the passage of time.

The sustainability condition would then imply :---→

$$dv^*/d(\tau) = {}^{\delta}v^*(\tau)/{}^{\delta}k(\tau).\ dk(\tau)/d\tau + {}^{\delta}v^*(\tau)/{}^{\delta}N_1(\tau).\ dN1(\tau)/d\tau + {}^{\delta}v^*(\tau)/{}^{\delta}N_2(\tau).\ dN2(\tau)/d\tau + {}^{\delta}v^*(\tau)/{}^{\delta}A(\tau).\ dA(\tau)/d\tau + {}^{\delta}v^*(\tau)/{}^{\delta}B(\tau).\ dB(\tau)/d\tau + {}^{\delta}v^*(\tau)/{}^{\delta}P(\tau).\ dP(\tau)/d\tau$$

$$= p(\tau)\ dk/d\tau + \prod_1(\tau)\ dN1/d\tau + \prod_2(\tau)\ dN_2/d\tau + \vartheta A(\tau).\ dA(\tau)/d\tau + \vartheta B(\tau).\ dB(\tau)/d\tau + \mu(\tau)dp/d\tau$$

$$= I_K(\tau) + I_{N1}(\tau) + I_{N2}(\tau) + I_A(\tau) + I_B(\tau) + I_P(\tau)$$

$$dv^*(\tau)/d(\tau) = I(\tau) \geq 0 \text{ --- } (\mathbf{ix}).$$

for all values of τ as we move along the time axis, where $v^*(\tau)$ is the attainable value of $v(\tau)$ under the RAM ;

$p(\tau)$, $\prod_1(\tau)$, $\prod_2(\tau)$, $\mu(\tau)$, $\vartheta B(\tau)$, $\vartheta A(\tau)$ are the respective stock prices & I_K, I_{N1}, I_{N2}, I_A, I_B, I_P are the respective investment values in manmade Capital (conceived as machinery and structure) , natural capital , general productivity augmenting technologies , discoveries of resources and in pollution stocks. $I(\tau)$ is the measure of the aggregate true investment. The sustainability of development , thus, requires that the true investment , which is the aggregate value of investments in all kinds of capital assets of a society including knowledge or ideas regarding technology & discovered recourses, should be non-negative for all time to come. The composition of this investment , thus needs to be examined for understanding its precise implication in respect of natural resource accounting and for analyzing the sustainability character of the development process . One important implication of the condition $I(\tau) \geq 0$ of the above model is that society's genuine or true measure of investment or accumulation of wealth , which would contribute to the progress of well- being , is not just the value of net accumulation of manmade and human capital , but the total value of net accumulation of manmade capital, natural capital of all kinds and those of stock of knowledge and ideas including discoveries of non-renewable resources , as adjusted for the net accumulation of the public bad of pollution stock. If there is (a). an over-harvesting of the renewable resources of nature exceeding the limit of nature's ability to regenerate the resources , (b). any depletion of non-renewable resources exceeding the total value of new discoveries and (c). emission of pollutants exceeding the ecosystem's ability to absorb them,
$N_1^*(\tau) < 0$, $N_2^*(\tau) < 0$, $P^*(\tau) > 0$ leading to $I_{N1} < 0$, $I_{N2} < 0$, $I_P < 0$, since $\prod_1(\tau)$, $\prod_2(\tau)$ are expected to be positive and $\mu(\tau)$ negative.

This would imply --→
$I_E = I_{N1} + I_{N2} + I_P < 0$

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I_E gives the aggregate measure of depletion of the environmental resource base of the economy, which includes the entire array of natural resources ---- fossil fuels, minerals, land and soil , water , forest and other vegetation and abiotic resources , atmosphere, ocean, lakes, rivers and so on . While the basic elementary contents of matter and energy of all these natural resources remain unchanged overtime , the time rate of their human use often tends to exceed the scale of intervention that nature can withstand., resulting in the dissipation of resources due to entropy laws. However , in case I_E is negative , the development process will be sustainable only if the absolute value of I_E is exceeded by $I_K+ I_A+I_B$, i.e, the accumulation of manmade capital, knowledge capital, and new discoveries .Such possibilities of sustainability of the development process has been admitted in spite of erosion of the value of environmental capital because of our assumption of neoclassical production function and of the use of investible surplus in manmade cum human capital , new resource discoveries and knowledge capital to offset the erosion of the adverse effects of environmental capital .

CONCLUSION

So, at the end it can be stated with the help of RS Model that for maintaining an ecological limit , optimal mix of various kind of resources are needed for maintaining sustainability. i.e. conventional as well as renewable energy sources specially in ecologically fragile and environmentally vulnerable zones.

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