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Planned Retreat and Ecosystem Regeneration as Adaptation to Climate Change

This issue brief on adaptation, developed in the context of the global adaptation debate is intended to inform the global WWF network and the public on an ecological economic valuation framework developed to ascertain whether planned retreat and ecosystem regeneration should be the preferred mode of adaptation, particularly for places with high development deficit and high vulnerability to impacts of climate change. The target audience for this Issue Brief include policy makers, think tanks and climate/sustainable development stakeholders.

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Summary

WHAT IS AT STAKE?
ADAPTING TO CLIMATE CHANGE IN INDIAN SUNDARBANS DELTA

4.5 MILLION PEOPLE
PRIMARILY DEPENDENT ON AGRICULTURE AND FISHING

1 MILLION
OF THESE PEOPLE INHABIT HIGHLY VULNERABLE AREAS

100 TIGERS
INHABIT THE MANGROVE FOREST

ADAPTATION COST IS HIGH BUT BENEFITS ARE MANY INCLUDING AVOIDED LOSS OF LIFE AND WELLBEING AS WELL AS INCREASED HABITAT FOR TIGERS

Planned retreat and ecosystem regeneration have lately been thought of as an adaptation strategy in the regions vulnerable to the vagaries of global warming and climate change.

Such an adaptation strategy has replaced the traditional modes of adaptation that often entail structuralist thinking or accommodating infrastructures especially in high-risk or impossible situations. Here we create an ecological economic argument on how planned retreat and ecosystem regeneration as envisaged in a vision document for Indian Sundarbans proves to be a better solution than the business-as-usual scenario which includes elements of IGNORE (do nothing), RESIST (protect), and ACCOMMODATE (enhance resilience) modes or approaches. This entails a detailed cost-benefit analysis based on ecological economic valuation over two scenarios in the context of vulnerable regions of the Indian Sundarbans Delta that also have high development deficit. As per the vision of adaptation, the population will relocate to safer regions, and the mangrove forests will be allowed to regenerate in that region by 2050. The regenerated ecosystem is unlikely to be the same as the one that was removed when settlement was encouraged. Nevertheless, it has been found that the net benefits (benefits minus the costs) accruing to the community between 2050 and 2100, once this scenario of adaptation is implemented, is 12.8 times of that of sticking to business-as-usual. When the rates of premium were varied, it was found that the ratio of the net benefits of adaptation to business-as-usual varied from 8.25 to 20.25, thereby proving the former's superiority under all cases.

The West Bengal government's intent to create a new Sundarban district provides an opportunity to put to practice the valuation framework developed here.

Background

Globally, there have been many responses to combat the effects of global warming and climate change. While there have been various adaptation and mitigation mechanisms that have been in vogue, lately, planned retreat of the population from a vulnerable region (where in situ adaptation is no longer possible or is exorbitantly expensive), and subsequent regeneration of the ecosystem in that region, have been thought of as a major breakthrough in the domain of adaptation practice. Planners and managers in the past have focused on defending development in vulnerable regions, by shielding these from damage caused by climate risks (RESIST mode). These are essentially reactive mechanisms, such as building structures to protect shorelines. Over time, this was found to be unsustainable, in the face of the ferocity and increasing frequency of extreme events. Similar was the fate of mechanisms like accommodating infrastructures, which include techniques such as redesigning, rebuilding, or elevating the existing developments and infrastructure (ACCOMMODATE mode). [1] The choice of adaptation mode is situation specific and will depend on the level of risk.

Here, we present an ecological economic argument in favour of the changing face of adaptation by combining the dual phenomena of planned retreat and ecosystem regeneration in one of the most vulnerable mangrove forest regions of the developing world, the Indian Sundarbans Delta (ISD). This is also one of the poorest regions of the world, apart from having low rank in most of the human development indicators.

In this backdrop, it is believed that phased movement as a component of planned retreat combined with ecosystem regeneration will bring about an improvement in human development, prevention of avoidable loss of life and livelihood, partial reversal of ecosystem degradation, and improvement in ecosystem services. These will unfold themselves in the form of enhanced livelihood opportunities, and increased provisioning and regulating

1 Niven, R. J. and D. K. Bardsley (2013): "Planned retreat as a management response to coastal risk: a case study from the Fleurieu Peninsula, South Australia", *Regional Environmental Change*, 13, 193-209.

services. However, while there are benefits involved for the society through the ecosystem-society interactive processes, there are certain costs that are also involved. Given the natures of the costs and the benefits, the extent of feasibility of such a scheme needs to be examined. This is the core of this paper. The questions that arise here are the following: if planned retreat with eco-regeneration is implemented, what are the streams of benefits and costs? How are the net benefits (benefits minus costs) altered, as compared to the business-as-usual (BAU) scenario? This paper attempts to answer these concerns, considering the economic valuation of the regenerated ecosystem services. This has been exhibited in the context of the Indian Sundarbans Delta. The ecological economic valuation framework could be applied to other ecologically important but vulnerable areas but will entail capturing of relevant ecosystem services.

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Indian Sundarbans Delta

The Indian Sundarbans Delta (ISD) is one of the most vulnerable delta regions in the world, being prone to extreme events, growing population pressures, and depleting ecosystem services. Part of a critical ecosystem in the Ganga-Brahmaputra-Meghna (GBM) basin in South Asia, this densely forested wetland (Ramsar Site number 560; Sundarbans Reserved Forest in Bangladesh) is dominated by mangrove forests (one of the three largest single tracts of mangrove forests in the world).

WHAT'S UP?

26% RISE
IN HIGH TO VERY HIGH INTENSITY STORMS

FALLING PRODUCTIVITY OF LAND & DISCONTINUED AGRICULTURE

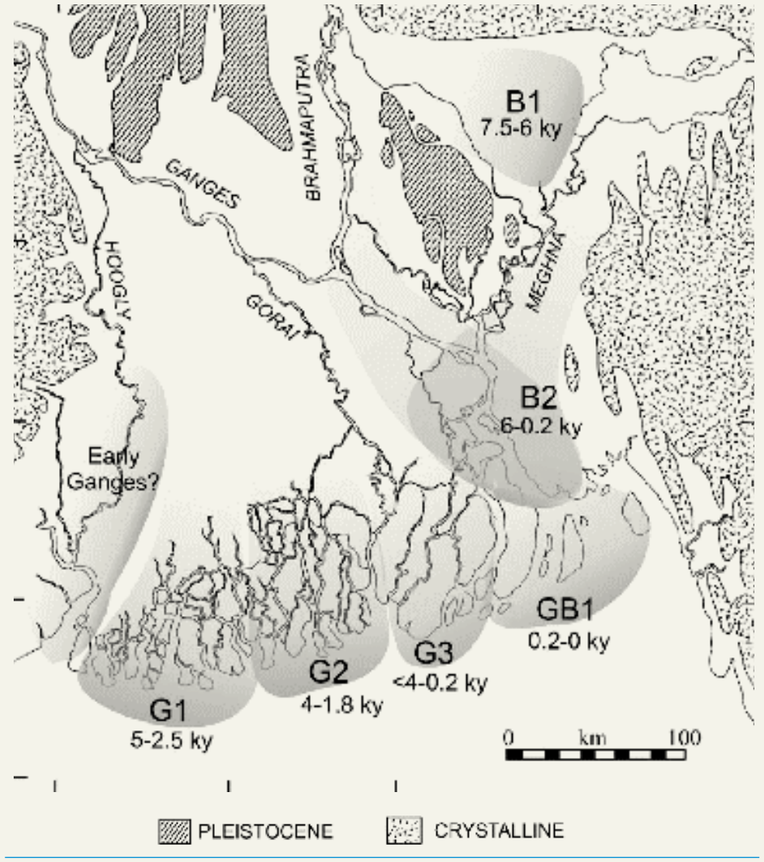
PHYSICAL AND OCCUPATIONAL DISPLACEMENT

25100 ha
OF LAND LOST DURING 1970-2015 AT AN INCREASING RATE

The ISD spreads over an area of about 9630 sq. km in the state of West Bengal in India, bordering Bangladesh. The landscape is characterised by a web of tidal channels and islands.

The Sundarbans consists of exceptionally rich diversity of aquatic and terrestrial flora and fauna, and is the only mangrove tiger habitat in the world. The forested parts of Sundarbans were declared as reserved forest in 1878 by the British colonial administration. In 1973, a part of the forest spread over 2585 sq. km was construed as the Sundarban Tiger Reserve (STR). Within the Tiger Reserve, an area of 1330.12 sq. km was declared as Sundarban National Park in 1984. While in 1987, the Sundarban National Park became a UNESCO World Heritage Site. The whole of ISD comprising the forested and inhabited parts (19 sub-districts spread across two districts in West Bengal) was declared as Biosphere Reserve in 1989.

G1 represents Indian Sundarbans Delta



Source: Allison et at (2003)[2]

2 Allison, M. A., Khan, S. R., Goodbred, S. L., Jr., & Kuehl, S. A. (2003). Stratigraphic evolution of the late Holocene Ganges–Brahmaputra lower delta plain. *Sedimentary Geology*, 155 (3-4) pp. 317-342.

ECOSYSTEMS-LIVELIHOODS LINKAGES IN ISD

The Sundarbans presents an example of an endangered ecosystem, both fragile and economically valuable, that is subject to growing population pressures due to deep-rooted linkages of livelihoods with ecosystem services. While half of the over 4.5 million population are landless, they are almost entirely dependent on agriculture. This is in light of the fact that other livelihood options barring fishing and fishery are practically non-existent in the Sundarbans.

Rain-fed agriculture forms the mainstay of the economy in the ISD. Erection of earthen embankments, to keep brackish tidal water at bay, is regarded as a prerequisite for sustaining the rain-fed freshwater based agro-ecosystem. Despite receiving substantial average rainfall of about 1800 mm during the monsoon months (June through September), agricultural productivity of the delta region is low due to (a) saline water intrusion, and (b) no more than 20% of agricultural land of about 2,91,682 hectare produces a second crop in the absence of irrigation facilities. With natural calamities like storm surges destroying livelihoods and property there has been a propensity among the population, especially the landless, to exploit the ecological resource base rather indiscriminately.

IMPACTS OF GLOBAL WARMING & CLIMATE CHANGE IN ISD

Bio-physical changes in the form of increase in sea surface temperature, sea level rise, changes in the precipitation patterns, and increasing frequency of cyclone events are prevalent in the ISD. During 2002-2009, Relative Mean Sea Level (RMSL) increased at the rate of 12 mm/year. Considering the record of past 25 years, the rate of relative sea level rise comes close to 8 mm/year, which is significantly higher than the rate of 3.14mm/year observed during the previous decade.[3,4] Analyses of cyclonic events over a period of 120 years indicate a 26 percent rise in the frequency of high to very high intensity cyclones over this time period.[5]

3 Hazra, S. (2010): *Temporal change detection (2001-2008) of the Sundarban*. Unpublished report, WWF-India.
4 Hazra, S., T. Ghosh, R. Das Gupta, and G. Sen (2002): “Sea level and associated changes in the Sundarbans”, *Science and Culture*, 68(9-12) 309-321.
5 Singh, O.P. (2007). “Long-term trends in the frequency of severe cyclones of Bay of Bengal: Observations and simulations”. *Mausam*, 58(1) pp. 59-66.

VISION 2050

Planned Retreat & Ecosystem Regeneration

WHO WILL RELOCATE AND WHEN?

HOUSEHOLDS IN THE HIGH VULNERABILITY ZONE DECIDE TO RELOCATE WHEN THEY DEEM APPROPRIATE UP TO 2050. SUCH DECISION IS LIKELY TO BE BASED ON THE INABILITY TO MAKE A LIVING IN THE CURRENT LOCATION AND LOSS OF MARKET VALUE OF LAND THAT THE HOUSEHOLD POSSESSES

In view of the prevailing challenging situation, an alternative scenario – a vision for 2050 – has been envisaged.[6] This vision is about an adaptive management system to not only cope with the onslaught of devastating predicted changes, but also to convert adversity to an opportunity for improving the quality of life of the people and to rehabilitate the ecological health of the ISD to the extent possible in the changed environment.

The main points of this vision are: encouragement of phased and systematic outmigration from the vulnerable zone (planned retreat), and regeneration of mangrove forests in the vulnerable zone. It is believed that only when a safer habitat is provided to the people of the region along with proper source of livelihood will it be possible to regenerate mangrove forests in the vulnerable zone and thereby bring about partial ecological rehabilitation of the region.

6 Danda, A. A, G. Sriskanthan, A. Ghosh, J. Bandyopadhyay and S. Hazra (2011): *Indian Sundarbans Delta: A Vision* (New Delhi: World Wide Fund for Nature-India).

WHO PAYS FOR RELOCATION?

THE STATE PAYS FOR RELOCATION OF THE POPULATION OF THE IDENTIFIED HIGH VULNERABILITY ZONE, PROPORTIONATE TO LAND HOLDING/ACCESS TO LAND AS SHARE CROPPER OR TENANT FARMER. THIS EXPENDITURE TO BE DEEMED AS ADAPTATION COST TO BE SOURCED NATIONALLY AND INTERNATIONALLY FROM ADAPTATION FINANCE MECHANISMS BEING PUT IN PLACE

PHASE I of the Vision involves a clear-cut identification and demarcation of the area of the ISD as a single administrative unit with restrictions on outsiders from acquiring land and thereby obtaining permanent residence in the area.

PHASE II focuses on the development of adequate physical infrastructure in the stable zone, away from the high vulnerability zone. It is expected that population from within the vulnerable zone would gradually immigrate to the nearby stable zone. Thus, adequate infrastructure is necessary to absorb these people in the stable zone.

PHASE III envisages preparing the residents for this change in order to minimise their psychological barrier towards the movement from the vulnerable to the less vulnerable zone. However, the people of the region should have the choice to decide whether they want to relocate or live in their current location. The movement is envisaged as voluntary and "organic".

PHASE IV visualises relocation of the population from the high vulnerability zone to the newly developed areas in nearby stable zone. The unused lands are allowed to regenerate as mangrove forests. It is estimated that by 2050, the total regenerated area should be around 1190 sq. km. However, land ownership over vacated land remains with the people who have relocated and will be entitled to benefit flows.

The question that arises is whether pursuing such a vision can prove beneficial over the current or the business-as-usual scenario. This is where we bring in the economic argument through arriving at the various costs and benefits, and eventually net benefits that are associated with either of the scenarios, described as business-as-usual (BAU) and Vision scenarios.

Description of the Scenarios

Business-As-Usual (BAU) Scenario: This is a scenario where the community does not relocate and stays back in the vulnerable region. While assuming that the economic condition of the vulnerable zone remains as prevalent, we present the figures of the stream of benefits that may be accrued from 2050 to 2100. We assume that the BAU scenario is affected by natural disasters, and estimate what might happen if a moderate disaster affects the zone during this period. Of course, the limitation of this analysis is that the intensity of an event has been evened out by considering an "average" position between a "high intensity" and a "low intensity" event. (See Appendix A1 for exposition).

Vision 2050 scenario: Vision 2050 unfolds itself as a state that prevails in the year 2050 with the population from vulnerable zone having moved to the stable zone, and the mangrove forests have been allowed to regenerate in the former. In the process, all the costs to be incurred are not going to be incurred at the same time, but will be incurred over a period of time. The same is the case for the various benefits. It needs to be borne in mind that it is not the same generation that may eventually obtain the benefits. It is possible that over the interim period, only certain proportions of a population might choose to move to the newly developed area. To get into details of such a phenomenon, a cohort analysis will be needed, taking into consideration the demographic structures, occupational patterns, changing linkages between the ecosystems and the livelihoods, choices and preferences, and many other issues. This has not been undertaken in the present paper.

Therefore, in this scenario, we land up with a host of costs that arise from building infrastructure, reskilling, mangrove regeneration, corpus creation, etc. The benefits will entail the incomes from the alternate employment, incomes from eco-tourism, incomes from ecosystem services of mangrove, possible incomes from access to the regenerated mangrove forest thus created, etc.

DOES THE VISION ENTAIL AN IMPROVEMENT OVER THE BUSINESS AS USUAL?

As stated earlier, the benefits entail various economic opportunities in the stable zone, as also the ecosystem services that will be obtained in the vulnerable zone. So what would happen if the community does not relocate and what is the benefit flow they obtain?

Costs and Benefits associated with Vision 2050

For the implementation of the Vision 2050, the community will have to relocate, and proper infrastructure will have to be constructed in the zone of relocation. Reskilling of those willing to relocate has to happen so that they may find alternative employments. While most of those in the vulnerable zones are engaged in agricultural activities, we assume that there will be two members of each household who would be working in the stable zone: one in the service sector, and the other finding skilled employment. While mangrove regeneration gets implemented in the vulnerable zone, there are various associated costs with the process. Mangrove forest, by itself, has its associated ecosystem benefits. At the same time, the income from the BAU scenario also emerges as the opportunity cost, as that benefit will no more be obtained.

Therefore, we have considered ecosystem services from the regenerated mangroves as carbon sequestration (regulating service), fishery production (provisioning service), storm surge protection (regulating service), tourism (recreational service), honey (provisioning service), prawn larva (provisioning service), and crab (provisioning service). Standard valuation methods in the form of surrogate pricing, indirect values, and benefit transfer have been to used obtain the values.

On the other hand, there will be incomes generated through employment in service sector, and skilled employment. With field data and necessary WPI adjustments, we have arrived at certain figures.

Under the net benefit flows, we consider the total value of the flow of the economic and the ecosystem benefits generated from 2050 to 2100, the total value of the flow of incomes from employment in the services sector, the total value of the flow of incomes from skilled employment in the benefit stream (see Appendix for further details).

The comparative figures across the two scenarios

Scenario	Current Value of Net benefits (Rs 000 billion)
Business-as-usual	172.31
Vision 2050	2202.76

Source: Estimated by authors

NET BENEFIT FLOWS WITH CHANGES IN THE PREMIUM RATES

Here, we present a comparative picture on how the flows of current value of (net) benefits change with perturbations in the premium rates. Our base rate throughout the analysis has been 10%, where we find that the net benefit flows in case of Vision 2050 is almost 12.8 times of the total benefit flows of the BAU scenario. We have caused perturbations in it by increasing and diminishing the rates. Table below presents the comparative picture under the various premium rates.

It is clear that the ratio between the current values of net benefits of Vision 2050 and BAU diminishes with increases in the premium rates. This is because the elasticity is lower for Vision 2050 scenario, as compared to the BAU scenario, due to the nature of the sunk costs in the latter which are time invariant, and hence independent of the premium rates. By all means, it is clear that the vision scenario of "planned retreat and ecosystem regeneration" yields many times higher value than the BAU scenario.

Current Values of the Flows of (net) Benefits (Rs. billion) under various Premium Rate regime

Premium Rate (%)	BAU Scenario	Vision 2050 Scenario	Ratio (Vision 2050/BAU)
10	172306.27	2202762.59	12.78
8	35426.02	522328.21	14.74
6	7221.87	124404.78	17.23
4	1477.37	29914.3	20.25
12	825276.77	9281089.39	11.25
14	3877755.36	38890171.7	10.03
16	17839818.72	161482303.9	9.05
18	80283922.5	662673270	8.25

Source: Estimated by authors

An Opportunity to Act

One needs to take into cognizance that moving population from vulnerable zones has been an accepted mode of adaptation, and is not an aberration. Worldwide, population movement has been an integral component of large infrastructure development projects. At times, movement of population has been conflict-free and has led to development of the affected population.[7],[8] The examples countering this are also galore. The framework presented in this paper essentially talks of a conflict-free organic movement resulting in human development. It is important that the local, state and central governments are involved in this entire process. This paper creates a framework through ecological economic valuation to rationalise whether planned retreat and ecosystem regeneration should be the preferred mode of adaptation or not. In the process, the paper has clearly highlighted the financial gains involved with organic population movement and mangrove regeneration in the context of the ISD. The various stakeholders involved in the process need to be convinced of the same by highlighting the financial gains, as has been shown in this analysis. While worldwide, there have either been talks of "planned retreat" or of "ecosystem regeneration", this is the first time that any number based on scientific ecological economic analysis has been put forth to justify how the combination of the two strategies can actually result in "Pareto improvement".

Secondly, the ecological economic cost-benefit analysis is an important contribution for creating a replicable framework for evaluation of similar adaptation mechanisms. Thirdly, from the perspective of the emerging institutional economic literature, our analysis highlights the criticality of valuation of ecosystem services in complementing institutional analysis, either as a ex-post mode of evaluating the institution, or as an ex-ante objective instrument for rationalising on whether a proposed institutional arrangement is better than the status quo.

Finally, the approach and the framework developed in this paper have policy implications for all such places that are faced with the situation where the combined value of assets, produce and services, due to impacts of climate change, have already fallen or will fall in a meaningful future timeframe, below the cost of protecting the place.

7 Scudder, Thayer and Colson, Elisabeth. 1982. "From Welfare to Development: A Conceptual Framework for the Analysis of Dislocated People." In Hansen A. and A. Oliver-Smith (eds.) *Involuntary Migration and Resettlement*. CO, Boulder: Westview Press.

8 Cernea, Michael M. 2004. Impoverishment Risks, Risk Management, and Reconstruction: A Model of Population Displacement and Resettlement. Keynote address at the UN Symposium on Hydropower and Sustainable Development, October 2000. Typescript. http://www.responsiblemines.org/attachments/254_population_resettlement_IRR_MODEL_cernea.pdf as viewed on July 3, 2015.

Recommendations

- Identify population locations that are vulnerable to impacts of climate change.
- Prioritise locations on the basis of cost of protecting the place vis-à-vis combined value of assets, produce and services. Higher the ratio, higher should be the priority since cost of protection is higher than the value of what is being protected.
- Undertake ecological economic cost-benefit analysis to ascertain whether planned retreat and ecosystem regeneration should be the preferred mode of adaptation.

Appendix

A1. THE BAU SCENARIO: FORMULATION OF THE EXPECTED VALUE

We assume that natural disaster occurs with a certain probability in a particular year. In that case, we may state (1) as:

$$E(Y) = p.Y^{D} + (1-p)\,Y^{ND} \qquad \ldots (1)$$

Where

$E(Y)$ denotes the expected incomes under the BAU with natural disaster scenario;

Y^{D} denotes the income under the BAU scenario with natural disaster;

Y^{ND} denotes the income under the BAU scenario without natural disaster;

p is the probability of a natural disaster.

We further assume that a natural disaster brings down the income by an average proportion λ. Here, it needs to be declared that λ is an indicative average of a host of values taking into consideration the events of various intensities. We assume that in the BAU scenario, the same intensities generally prevail throughout our period of analysis, and hence the value of λ will remain the same throughout the period.

Therefore, $Y^{D} = (1-\lambda)\,Y^{ND}$ ... (2)

In that case, we may state (4.1) as:

$$E(Y) = p.Y^{D} + (1-p)\,Y^{ND}$$
$$= p.(1-\lambda).Y^{ND} + (1-p).Y^{ND} \qquad \ldots (3)$$
$$E(Y) = Y^{ND}(1-\lambda.p) \qquad \ldots (4)$$

We have estimated the total value of the benefit flows from 2050 to 2100 through values of aquaculture, agriculture, and property prices. We assume that the incomes from various sources are updated every year with a premium of 10%. These property values are one-time incomes, and here we assume that the community can sell its properties only once and can earn incomes out of it.

The Vision 2050 Scenario: In order to get into a comparable framework with the BAU scenario, one needs to have the same type of assumptions in terms of the time-periods, agents involved, nature of the ecosystem services, demographic structures, etc. At the same time, both analyses have to be based on a static framework of valuation, with the same rates of premium (or discount) to arrive at the current (or present) value. The way this scenario is envisaged is that we start with the prevailing of the Delta Vision from the present period onwards, and all the costs are incurred between 2011 and 2050 for the implementation of this vision.

It needs to be noted here that almost all the costs associated here are to be incurred only once, while the benefits will flow over the time period under consideration. We are expressing all the sunk costs in the current value prevailing in 2050, though the costs will be incurred much before that. Since, it is difficult to state in which year they would be incurred, for purposes of convenience, it is better to assume them in current values of 2050.

The methods to be used for valuing these services and costs will entail consideration of various opportunity costs, indirect cost methods, existing wages, property prices, and further considers the various values generated from similar studies on similar settings.

It needs to be remembered here that under this scenario, there will be attempts to develop special skill sets for employment generation, development of infrastructure, regeneration of mangroves, development of training institutes, etc, -- all of which emerge as costs. In the cost element, we consider:

i. Cost of mangrove regeneration;
ii. Cost of constructing residences for the relocated population;
iii. Cost of establishing 3 hospitals;
iv. Cost of establishing 5 secondary schools;
v. Cost of establishing an Information Technology (IT) training Institute;
vi. Cost of establishing an Industrial Training Institute (ITI);

All the above six cost heads are essentially sunk costs or capital expenditure, and need to be borne only once. However, there are two cost heads which occur as “flows”.

These are: opportunity costs of Vision 2050 (which occur in the form of loss in incomes that could have been generated in the BAU scenario), and the recurring cost of running the establishments. Assuming an annual premium rate of 10%, this corpus will be able to sustain the running cost till the year 2152, under a situation when costs for the services offered are not recovered. Therefore, we need not take these annual recurring costs in the flow of costs, as they will be covered through the corpus thus created. In the process, while the interests from corpus should appear in the benefits stream, we are not considering them here, as there is no harm in stating that there is an underestimation of the benefits here. However, we consider the corpus fund as another component of cost.

A2. CURRENT VALUE OF (NET) BENEFITS AND BENEFIT FLOW

In each scenario, we present a current value of the benefits and the stream of benefits obtained in the entire planning horizon. We have assumed a premium rate to adjust the incremental values each year. This rate of premium covers the impacts of inflation, and demographic changes. As result, when we express all the current values on the basis of the figures of 2011, we are taking all these changes happening over the years into consideration. Hence, the current value of benefits of year *t* at the base period *o* will be:

$$B_t = B_0(1+r)^t \ldots (5)$$

In (5), B_t is the benefit in year t, B_o is the benefit in the base year 0, while r is the rate of premium. The cost can be expressed in the similar mode. However, sunk costs are one-time costs and enter the stream of benefits and costs over time only once without any updating with the premium rates. Hence, the net benefits under each scenario at time t can be expressed as the following:

$$NB_t = B_0(1+r)^t - C_o(1+r)^t \ldots (6)$$

Where

NB_t = Net benefits at time t;
C_o = Cost at time 0, except the sunk costs.

We further assume that the sunk costs are incurred at $t = 0$. They are denoted as C_S. Therefore, if the planning horizon is from 0 to T years, the flow of net benefits in the entire planning horizon is:

$$\sum_{t=0}^{T} NB_t = B_0\sum_{t=0}^{T}(1+r)^t - C_0\sum_{t=0}^{T}(1+r)^t - C_S \ldots (7)$$

We have estimated the stream of flows of the benefits for each scenario, and have compared them across. For the BAU scenario, we have assumed away the existing costs, and rather assumed the existence of costs for the implementation of the Vision 2050 scenario. We have also assumed that the base period is 2011, and even implementation of Vision 2050 begins from 2011, and have eventually estimated the flows of benefits from 2050 to 2100.

Why we are here

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

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