Economic Environmental Zones and Poverty Alleviation

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Abstract

Environmental degradation and poverty are the twin most important problems mankind must try to solve. Innovative concepts of sustainable development for conserving valuable but vulnerable ecosystems along with poverty alleviation are important. Many are aware of the negative link between poverty and nature degradation. Our paper tries to propose an economic mechanism for inversing this link. It's believed that nature's monetary value is only marginally present in market economy. Yet, we would like to present a neo-classical model that cashes on intrinsic economic value within nature reserves. Our aim is to achieve economic growth through active participation in environmental up gradation and Optimum Nature Utilisation (ONU). A special technological innovation is considered in our model. It helps the economic agents achieve deeper insights about market value of natural resources. The model is purely theoretical, yet we would point at empirical justifications and suggest applicable solutions that can be implemented.

Key words: Poverty alleviation, optimum nature utilisation, environment, technological innovations.

Introduction

Nature as a resource has varied uses. It provides us all our basic necessities. It has always been the primal base for all our creations. But today the tables have turned. Our mindless exploitation of environment makes this base unstable. This exploitation is not just limited to non-human matter; it's also enforced on us. Thus we experience unequal income distribution in society. Thus we end up in poverty. The intense combination of environmental degradation and poverty could not have been more concerning than it is at this date of twenty-first century. When they come together the problems just get exponentially worsened.

Yet, as positive members of human race we can't help but hope. Hope to have faith in the creative abilities of human beings, in his age old struggle for existence. With this deep sense of hope we try to present a neo-classical economic model on poverty alleviation in Special Environmental Zones. The class of economic agents who will be our protagonist belongs to Below Poverty Level (BPL). Moreover they reside in areas of Global Environmental Importance. We can term these areas as Environmental Zones (EZ). But our models domain is a bit more restricted. We are interested in members of BPL in **Economic Environmental Zones (EEZ)**. The subtle difference being that in EEZ the environment has a dormant marketable economic value that is yet to be utilized. EEZ $\subseteq$ EZ. This is a reasonable restriction as it would be absurd to accept every area under EZ to have marketable economic value. For example a location in the middle of a desert possibly won't have any marketable economic value. The line of demarcation between EEZ and EZ is assumed to be fixed.

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Another important tool of our model is **Activation Technology (A)**. This crucial factor is like a key! It opens up the dormant economic value in areas under EEZ. It is like, an individual is myopic (i.e. has short distance vision) and 'A' is the right spectacles that makes that person able to see distant views. The point is this technology helps us identify environmental markets and nature resources having marketable value. Now, a given amount of 'A' at a specific time point makes certain amounts of areas (ψ) under EEZ unlocked.

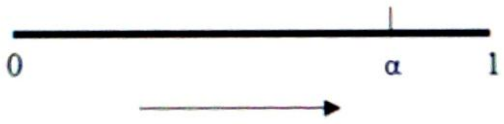
Activation Technology activates dormant areas under EEZ. BPL members in such active areas can provide their labor input in the newly generated Nature Sector. The model tries to prove that wage earned by BPL members by providing labor in Nature Sectors helps them grow out of poverty. We try to compare between wages of Nature Sector (Z_E) and Normal Sector (Z_N). Here Z_N represents the existing market economy. We will find that Z_E gives more return to BPL members than Z_N. Since real factor returns are equal to their marginal product thus the earlier statement implies BPL members are more productive in Z_E. This is a sensible consideration as members of BPL are locals of that area. They know their environment better than anyone else. For example consider BPL members in a forest, let Z_E be eco-tourism in that forest. It is sensible to consider residents of the forest to know their forest better than others.

The Model

Assumptions and Core Concepts –

1. Economic Environmental Zone (EEZ): It is a collection of Ecoregions* (ψ_α) of Global Environmental Importance that has dormant marketable value. $\psi_\alpha \in$ EEZ. ψ_α is homogeneous in all respect barring one. Different ψ_α has different degree of dormancy (α) in marketable value of its environment. Let every point on a unit length be α. Thus ψ_α is atomistic and EEZ has infinite ψ_α's in it. Now, α close to 0 implies ψ_α has lower degree of dormancy, whereas α close to 1 implies ψ_α has higher degree of dormancy. This is shown in Fig - 1.

Fig - 1



$\forall\ \alpha \in [0, 1]$

(Intensity of dormancy increases)

2. Activation Technology (A): It is like a key that can activate dormant Ecoregions. Now activation technology is a function of time, t.
Mathematically,

$A = A(t)$

We assume activation technology to grow at a diminishing rate.
i.e.,

$$\frac{dA(t)}{dt} > 0; \quad \frac{d^2A(t)}{dt^2} < 0; \quad \text{Also, as } t \to \infty,\ A(t) \to \bar{A}, \qquad \bar{A} \in [0, 1]$$

We assume the economy has A_0 amount of initial activation technology at time t_0. Without loss of generality, lets assume A_0 corresponds to $\alpha = 0$, level of dormancy. This implies no ψ_α in EEZ have activated Nature Sector (Z_E) at t_0. Thus each ψ_α only has an active Normal Sector (Z_N) which is assumed to represent the standard market economy. The activation technology we are concerned with is not the technological innovation considered in standard markets. Our 'A' is a special type of technology that establishes market value of environment and brings such

* earlier Ecoregions where mentioned as 'areas'. Moreover, Ecoregions is the short form of ecological regions.

ecological regions under the reach of competitive markets. For issues of simplicity we don't consider standard technological innovation of Normal and Nature Sector to grow over time. Output in both sectors depends on usual factors of production but not on standard technology.

Dormancy is a negative function of activation technology. That is as activation technology increases dormancy falls. In other words, we can also say activation of Nature Sector is a positive function of activation technology. As activation technology increases over time dormant Ecoregions towards the higher end of unit length gets their Nature Sector activated. Let's assume linear and equi-proportional relation between Activation Technology and Dormancy. i.e. for $\alpha = \alpha^*$, $A = \alpha^*$ amount of activation technology required to activate Nature Sector of ψ_{α^*}. This assumption simplifies our case. Also we can normalize activation technology to the scale of unit length. i.e.

$$A(t) = \alpha, \qquad \forall\ \alpha \in [0, 1]$$

Diagrammatically,

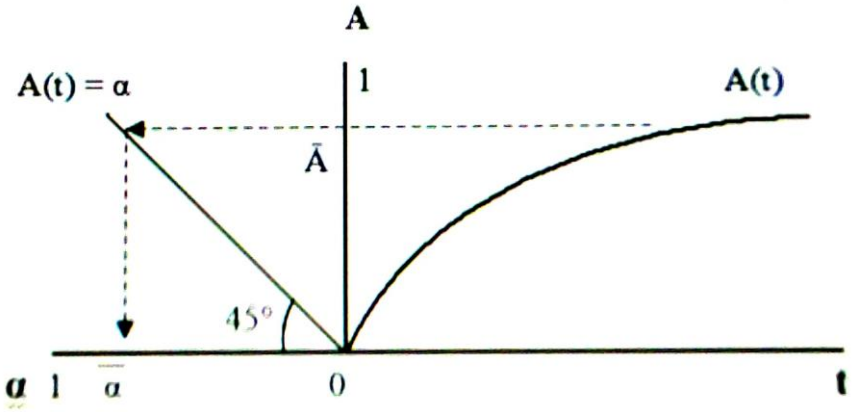


Fig – 2: Relationship between A(t) and α

Explanation: At t = 0, $A = A_0 = 0$ (on the basis of our previous assumptions). Now, as t increases A(t) increases at a diminishing rate. As $t \to \infty$, $A(t) \to \bar{A}$. At any given value of t we have an unique A(t). Since $A(t) = \alpha$, thus we also have an unique α. Since $A(t) \leq \bar{A}$, thus $\alpha \leq \bar{\alpha}$. This means that even if we consider infinite time horizon the technological innovation cannot go beyond $\bar{A}$ and thus activation of dormant Ecoregions is possible up to $\bar{\alpha}$ level of dormancy. Thus the whole of EEZ cannot be activated. Only a part of it can be activated in infinite time. Let this part be called EEZ*.
Now,

$$EEZ^* = \{\ \psi_\alpha^* \mid \alpha \leq \bar{\alpha} \text{ where } \alpha \in [0, 1] \text{ and } \bar{\alpha} = \bar{A}\ \}$$

EEZ* is the ultimate amount of environment that can be brought under market mechanism given the constraint of human beings ability to innovate. Each Ecoregion, ψ_α^*, that belong to EEZ* will get activated at some point of time. All active Ecoregions are homogeneous. All dormant Ecoregions are also homogeneous. ψ_α^* with lower α values are activated earlier, whereas ψ_α^* with higher α values are activated latter in time. All dormant ψ_α^* have an active Normal Sector, only. All active ψ_α^* have both Normal and Nature sectors activated. Since, $A(t) = \alpha$,

thus $t = A^{-1}(\alpha)$ [as, $A(\cdot)$ is invertible]. Thus ψ_α^* activates at $t = A^{-1}(\alpha)$. Any ψ_α that don't belong to EEZ* never gets activated. This model allows poverty alleviation of BPL members in active ψ_α^*.

3. Members of BPL (L_{BPL}): We assume the dormant ψ_α^* have only BPL members (L_{BPL}) residing there. People above poverty line don't live in ψ_α^*. They live in cities or other core economics zones. Thus dormant ψ_α^* is an economically backward but environmentally forward region. Also we assume L_{BPL} knows their environment better than others.

4. The Normal Sector (Z_N): It is the always active economic sector. This sector is outside ψ_α^*.Let the representative output produced in this sector be Y_N. Labor from ψ_α^* migrate each day outside ψ_α^* to work in Z_N and comes back at night. Other than L_{BPL} the production of Y_N uses Normal Capital (K) and Normal Labor (L_N). The factor market is competitive, thus individual factor of production are factor price takers. L_{BPL} comprise an infinitesimally small portion of the labor requirement for Z_N, since it is a huge sector. Fig-3 depicts this situation.

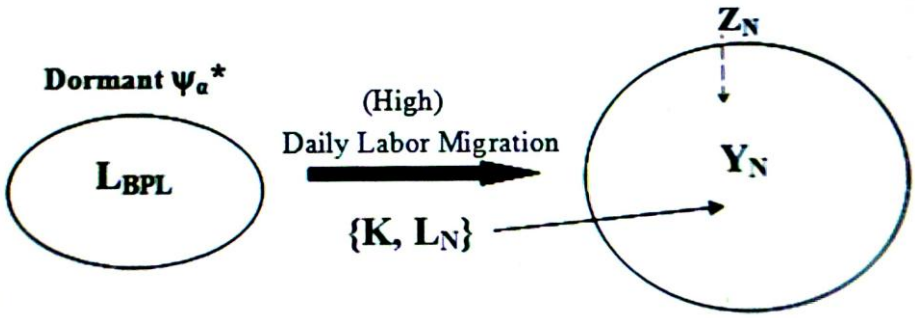


Fig – 3: Daily Labor Migration from dormant ψ_α^* to Z_N

5. The Nature Sector (Z_E): In ψ_α^*, the Z_E activates at $t = A^{-1}(\alpha)$. This sector is inside ψ_α^*, thus small. Let the output produced in this sector be Y_E. Y_E is a commodity that primarily depend on environment. Production process of Y_E does not harm environment, rather it upgrades nature. We consider Optimum Nature Utilisation (ONU) which means optimally using nature such that it do not degenerate. For example, Y_E can be eco-tourism in forests, fish supplied by fishing industry of wetlands, etc. L_{BPL} has an edge when they work in Z_E. This edge comes from their deeper knowledge of their environment. Factor used for production of Y_E other than L_{BPL} are Environmental Capital (K_α), Normal Capital (K) and Normal Labor (L_N). Here also, factor market is competitive. L_{BPL} is employed in both Z_N and Z_E. Z_E might not absorb whole of L_{BPL} population. L_{BPL} that don't get job in Z_E, work in Z_N. Fig-4 depicts this situation.

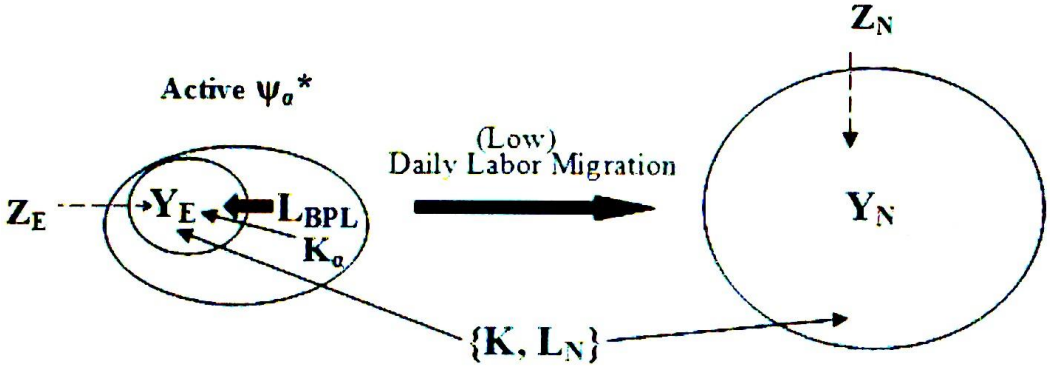


Fig – 4: L_{BPL} working in Z_E stays in active ψ_α^*.

Proposition 1:
Under the setup of this model BPL members of ψ_α^* will remain poor till $t < A^{-1}(\alpha)$.

Proof:
Since $t < A^{-1}(\alpha)$, activation technology haven't reached the level that can activate Ecoregion, ψ_α^*. Thus $\psi_\alpha^* \in EEZ^*$, is dormant. So, population of ψ_α^* must work in the active Normal Sector. This is the only sector that is active at present. BPL population of all Eco-regions in EEZ work in Normal Sector. The Eco-regions are activated with time. Therefore, some members of BPL shift from Normal Sector to their respective Nature Sector. But this movement of BPL labor out of Normal Sector doesn't affect their wage rate. This is so since the Normal Sector is huge and labor from BPL make a very small portion of its total labor force. Thus Normal Sector is insensitive to change the BPL member's employment level. Thus we can abstract away from the changing dynamics of BPL employment.

Production Function of Y_N: $Y_N = Y_N (K, L_N, L_{BPL})$
Cost Function of Y_N: $C_N = rK + w_N L_N + w_\eta L_{BPL}$

Where,
r = Rental rate of Normal Capital,
w_N = Wage rate of Normal Labor, and
w_η = Wage rate of BPL members residing in ψ_α^*.

As total population of the economy is constant over time, therefore demand for Y_N is constant. Thus a steady market clearing price of Y_N is maintained over time. Let us call it P_η.

Profit Function of Y_N: $\Pi_N = P_\eta * Y_N - C_N$
or, $\Pi_N = P_\eta * Y_N (K, L_N, L_{BPL}) - rK - w_N L_N - w_\eta L_{BPL}$

At equilibrium, $FOC = 0$
or, $\frac{\delta \Pi_N}{\delta L_{BPL}} = 0$
or, $w_\eta / P_\eta = \left\{ \frac{\delta Y_N (K, L_N, L_{BPL})}{\delta L_{BPL}} \right\} = MP_{BPL\eta}$

Here, real wage received by L_{BPL} is equal to the marginal product of BPL members. People in BPL don't have apt capability, skill and knowledge. They are less productive in normal sector. Thus, they add very little to normal economic activities. Marginal product of L_{BPL} in Normal Sector is low. Therefore, w_η keeps them inside the vicious cycle of poverty.
For example, labors from East Kolkata Wetlands regularly migrate to Salt Lake City (a local township) for work. They work as servants, in tea-stalls or other such places where they earn very low real wages. Thus remains poor.

Proposition 2:
When $t \geq A^{-1}(\alpha)$, Nature Sector of ψ_α^* gets activated. Thus, the poverty alleviation process for residents of ψ_α^* also gets activated. And in due course of time poverty is alleviated from ψ_α^*.

Proof:
At $t \geq A^{-1}(\alpha)$, the economy achieves the technology required to activate ψ_α^*. Thus ψ_α^* now has its Nature Sector activated. Given the emergence of a new sector inside the eco-region, its resident BPL members have another form of employment. Since the Nature Sector is eco-region specific thus it's very small. Let the output produced in Z_E be Y_E. Nature sector is competitive but also highly dependent on environment. It performs optimum environment utilisation to achieve Y_E. Moreover Nature Sector has a welfare aspect in it initially. It is common knowledge that local BPL members have an inner understanding about their environment. Because of their poverty they are not well trained to instantaneous capitalization on the new nature sector. Thus, Nature Sector initially tries to train the local L_{BPL}. The sector bears this cost as it knows in near future the higher marginal product of BPL members will compensate for the initial training cost. BPL members will have higher marginal product in Nature Sector since here they will express their internal skills. For example, if the Nature sector is eco-tourism in forest eco-region then BPL members who live in that forest can work as guides and managers as they know the forest better than all other. Since the Nature Sector is small thus there might be the case that the whole of L_{BPL} is not absorbed. Then those left out can work in the Normal Sector.

Production Function of Y_E: $Y_E = Y_E (K, K_\alpha, L_N, L_{BPL})$
Cost Function of Y_E: $C_E = rK + r_\alpha K_\alpha + w_N L_N + w_\varepsilon L_{BPL}$

Where,

r_α = Rental rate of Environmental Capital. It can be zero if environment is everyone's property or some positive number if environment belongs to government or state.
w_ε = Wage rate of BPL members residing in ψ_α^* and working in Z_E.

It is assumed price of Y_E is equal to price of Y_N, i.e. P_η.

Profit Function of Y_E: $\Pi_E = P_\eta * Y_E - C_E$
or, $\Pi_E = P_\eta * Y_E (K, K_\alpha, L_N, L_{BPL}) - rK - r_\alpha K_\alpha - w_N L_N - w_\varepsilon L_{BPL}$

At equilibrium, $FOC = 0$
or, $\frac{\delta \Pi_E}{\delta L_{BPL}} = 0$
or, $w_\varepsilon / P_\eta = \left\{ \frac{\delta Y_E (K, K_\alpha, L_N, L_{BPL})}{\delta L_{BPL}} \right\} = MP_{BPL\varepsilon}$

Thus, BPL members in Nature sector gets real wage equal to their marginal product in Nature Sector. Now, $MP_{BPL\varepsilon} > MP_{BPL\eta}$. Thus, $w_\varepsilon > w_\eta$. We know, w_η keeps BPL members in the vicious cycle of poverty, but w_ε help the BPL members to overcome poverty.

Community Income of BPL members in active eco-regions –
We know in active eco-regions because of small size of Nature Sector all the resident BPL members might not be employed. Let γ fraction of L_{BPL} be employed in Z_E. Then $(1 - \gamma)$ fraction will be employed in Z_N.

Community Income (in per BPL labor terms) = $\gamma w_\varepsilon + (1- \gamma) w_\eta$, where $\gamma \in (0, 1)$

It is reasonable to consider that Activation Technology will term a Nature Sector to be active only when employment generated by the Nature Sector leads per capita community income to be above income corresponding to poverty line.

Further Notes

Our Model tried to show how activated nature sector in an eco-region alleviate poverty of members of BPL residing in that eco-region. We showed poverty alleviation is possible in a very simple and abstract framework. But our model can be made more complex and practical. We will state the possible variations of the model that can be considered.

- We assumed both L_{BPL} and L_N to remain constant over time. But L_{BPL} and L_N can grow at constant but different rates. Generally L_{BPL} grows at a higher rate than L_N.
- We assumed away from labour augmenting technological progress in the production functions. Yet we can introduce such technology. Also it would be sensible to assume labor augmenting technology for Normal Sector will have higher growth rate than that of Nature Sector.
- We could also have considered a population of BPL members residing outside eco-regions such as in core economic zones like cities or towns. They can provide their labor in Normal Sector though not in Nature Sector.
- For Normal Sector of smaller sizes it can be assumed that as L_{BPL} shift to Nature Sector their shortage might increase their wage rate in Z_N. Thus changing dynamics of BPL employment can bring changes in BPL wages.
- The economic activities undertaken in Nature Sector can be nature services which individual BPL members can exchange in return of BIORIGHTS (a financial tool that values nature services).
- We considered active Nature Sector in an eco-region will employ resident BPL members of that eco-region. But case where BPL members of other eco-regions can opt for employment in that active Nature Sector is also another interesting exercise.

Many other possible variation no doubt exists. We tried to introduce the concept of Activation Technology and poverty alleviation through BPL service in active Nature Sectors. We felt eco-regions possess inner economic potential that when used optimally can help us alleviate local poverty. The economic potential is such defined as one that cause environmental upgradation. Thus we achieve the dual task of poverty alleviation and environmental upgradation through this model.

Empirical Validation

Throughout history man has tried and tamed nature. Though mostly he has exploited environment harmfully yet there are cases of economic utilisation and sustainable environment development. We mention a few random cases here.

- Travel and Tourism industry at Sundarbans Reserved Forrest.
- Water reservoir and sprinkling irrigation system, in 1995, at Haji Noor Mohammed village in Khinjar Lake helped agricultural production.
- In November 2002, the Ramsar Wetland Conservation Award was presented to the Chilika Development Authority for "outstanding achievements in the field of restoration and wise use of wetlands and effective participation of local communities in these activities".
- East Kolkata Wetlands have effectively reused both the solid and liquid waste of the metropolis, as a nutrient rich medium for agriculture and aquaculture.

Policy Suggestions

From the point of view of our model the most important factor towards poverty alleviation and environmental upgradation is Activation Technology. It is this Activation technology that activates dormant eco-regions. It starts the Nature Sector in an eco-region. We know an active nature sector increase income of local BPL members and pull them out of poverty. Thus it is the responsibility of the policy maker to achieve faster growth in Activation Technology. This can be done by investing in Research & Development that helps at identifying potential eco-regions to be activated. Government or NGOs can see through the initializing process of the Nature Sectors. They can move forward and take steps to see sustainable transition is achieved for BPL members as they shift to the Nature Sectors. This can be done through proper training, micro-finance, subsidies, minimum wage guarantee schemes, and other methods. The authority should see through that the output produced in Nature Sector receives proper marketing. Moreover Government should try to develop a taste for such eco-friendly commodities among the general mass through publicity mechanism.

Conclusion

Our model tried to provide an abstract foundation for pro-cyclical relation between poverty alleviation and environmental development. We introduced a new type of technology, i.e. Activation Technology, to achieve the task. It is evident if the findings of this model get implemented in real world then there is a hope of solving the twin problem. Environment is very important to us, to economize environment and yet maintain its poignant presence is what we wanted to achieve. We showed directing man to do what he does best is the best solution to any crisis. Here, our poor man from the ecological region knew less about everything but more about his own land. He knew his forest, his land, his lakes.. we wanted to help him market what skills he has (i.e. work in the local Nature Sector) and not be part of the Normal Sector that's far different from his own unique birthplace. Allowing humans to remain specialized to what they are born with was the central theme of this model.

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