Environmental Issues in the Energy Sector

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Abstract

This paper seeks to investigate the environmental impacts of hydro and thermal power projects, specifically of large dams and coal based thermal power stations. After identifying the likely environmental impacts of such projects, the paper investigates the reasons why such impacts are not adequately controlled in projects in India. The paper also explores the problems with the planning process. It attempts to identify some of the basic problems with the power sector in India and ends by giving a series of specific recommendations which might make the energy sector more friendly to the environment.

1. INTRODUCTION

Power projects have historically had significant social and environmental costs associated with them. The two most common types of such projects in India are hydro and thermal power projects. This paper focuses on the possible adverse impacts of storage dam projects and of coal based thermal power projects.

2. HYDROELECTRIC PROJECTS

Hydroelectric projects, especially those involving large dams, have significant environmental and social impacts. Some of the main impacts are listed below.

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2.1 Major Impacts

Upstream of the dam

1. Degradation of the catchment.
2. There is the threat of backwater build-ups and consequent floods and destruction
3. There is also the threat of reduced water availability upstream, as the water is required to fill the reservoir

At the reservoir and project site:

4. Dust pollution
5. The threat to rim stability
6. The potential for breeding vectors
7. Adverse impact on the aquatic ecosystem and biodiversity
8. Possible adverse impact on fisheries
9. Impact on the water quality, including potential for mineral contamination of water
10. Submergence and destruction of flora and fauna
11. Submergence of agricultural land
12. Submergence of grazing land
13. Submergence of sources of local fuel wood and other non timber forest produce
14. Reservoir induced seismicity
15. Adverse micro climatic changes
16. Human displacement

Downstream

17. Adverse impact on aquatic ecosystem and biodiversity downstream
18. Adverse impact on fisheries downstream
19. Adverse impact on water availability downstream
20. Adverse impact on water pollution levels downstream, especially due to reduced river flow
21. Possible salt water ingress
22. Threat from sudden releases of water
23. Threat from dam failure

activities, lead to a rapid degradation of the remaining forests in the catchments.

This degradation of catchments adversely affects the lives of the local communities dependent on these catchments. These communities, consequently, are forced to adopt environmentally unsustainable ways of meeting their basic needs, that being the only survival option left to them.

Also, during the construction of the project itself, and even subsequently, increased pressure is put on the catchments. The construction of roads and buildings, the significant increase in dust pollution levels, blasting and noise pollution, changes in the micro climate, increased population pressures because of labour and other personnel working on the project, and other disturbances related to the project, all take their toll of the catchment.

Therefore, the protection and regeneration of catchments must be a very important part of any hydroelectric project.

2.2.2 Inadequate Options

Considering the inevitable environmental and social impacts of such projects, it is desirable that these projects be taken up only where no other strategy is possible. Unfortunately, there has been a tendency to look at dams as the first option and, in fact, to try and dam every river, as long as it is technically feasible. The proper strategy would be to look at the needs that are sought to be met by constructing a dam, and to first investigate whether there are alternate, methods available to meet these needs. Where no better, alternative methods are available, then a dam must be considered, but only if it realistically offers substantially greater benefits than the various costs.

2.2.3 Inadequate Cost Benefit Analysis

Historically, even where a cost benefit analysis has been carried out, it has focussed almost exclusively on financial and economic costs. It is important for social and environmental costs to be realistically measured and included as a part of the over all cost benefit analysis. Besides, as our country has considerate social inequities, another dimension that must be evaluated when such projects are planned is whether the project would promote equity. If the costs of the project are to be borne mainly by the poor, as often happens, and the benefits are to go primarily to the relatively rich, then the project is clearly not promoting equity. What is perhaps

needed is a 'class benefit analysis' which assesses projects in terms of the class of people who lose and gain. So, projects where the costs are being paid by the poor and the benefits go to the rich, however attractive they might be in simple financial and economical terms, must be discouraged.

It is also not desirable to do an assessment of the project from the either/or standpoint. That is to say, the assessment should not be based on the costs and the benefits of either having the project, or not having anything. Any meaningful cost benefit analysis must determine the optimality of the strategy from among multiple options. Even where building a dam has been established to be the best option, multiple designs, locations and sizes of possible dams must be compared.

2.2.4 Viability

Notwithstanding all this, even if a dam is the best alternative, it should only be built when its environmental and social costs are found acceptable. Nonviable projects, even if they are the best alternatives, do not promote national and regional interests.

Given the difficulties in realistically calculating, especially in economic terms, environmental and other social costs, a project must build into its financial costs the resources required to do all that is necessary to prevent and mitigate environmental and social costs.

A primarily economic approach to the assessment of such projects is not an acceptable approach. In such an approach, by allocating financial and economic values to elements of the environment and to aspects of social costs, it is argued that it is "cheaper" to let the environmental and social costs occur, than to prevent or mitigate them. However, as already mentioned, the ability to properly capture environmental and social costs in financial and economic terms is severely limited. Consequently, such an approach invariably leads to an undervaluing of the real costs of a project.

2.2.5 Sectoral Approach

Perhaps the real reason why river valley projects have rarely been designed and implemented in a manner such that their costs are minimal and their benefits optimum, is the sectoral approach that prevails in our country. The power or water resources departments whose main, sometimes only, interest is to produce as much power as possible and to

irrigate as much land as possible, are the ones that usually implement river valley projects. However, both the costs and benefits of such projects go beyond the power and irrigation sectors. The correct approach would be to consider a dam as a multi-sectoral project that has both costs and benefits relating to at least the following areas:

i) Power
ii) Irrigation
iii) Drinking water supply
iv) Domestic and municipal water supply
v) Industrial water supply
vi) Flood control
vii) Forest and environment
viii) Health
ix) Social and tribal welfare
x) Agriculture
xi) Tourism
xii) Water transport

A project must be designed in a manner where the benefits for all these sectors are optimised and the costs shared between them. Therefore, for example, it might often be in national and regional interest to curtail the benefits of power in order to enhance some of the other benefits or minimise some of the costs. The process of optimisation must not be only a financial or economic one, but take into consideration all costs and benefits, even the non-quantifiable ones.

2.2.6 Poor Command Area Management and Development

Among the weakest links in the planning and implementation process of river valley projects has been the management and development of command areas. Almost all major dams are multi-purpose and much of their benefits derive from their irrigation potential. However, water logging, due to a variety of causes, has been a serious problem with many such projects. Along with that, poor planning for downstream water use is another common problem. Even the potential benefits of such projects are often not actualised because of these lacunae.

2.2.7 Loss of Public Confidence

Whatever the justification for its construction, when a dam is to be constructed there is likely to be significant social protests against the

project. In order to address the genuine concerns of the people, it is important that advance planning and implementation is done. This could involve, for example, identification of potential sites where a dam could be built and advance action for assessing the social and environmental impacts and for regenerating and protecting the catchments of such sites.

It is important, if public confidence is to be built up, that the planning, assessment and implementation of such projects be done in a transparent manner.

3. COAL BASED THERMAL POWER PROJECTS

Though the adverse environmental and social impacts of thermal power projects are not as dramatic as that of dams, they are still significant. This is especially so if one assesses the impacts from "cradle to grave", i.e., including the impact of mining the coal and of its transportation to the power plant, right to the de-commissioning of the project.

The major environmental and social impacts of thermal power stations are listed below.

3.1 Major Impacts

Construction phase

1. Displacement of people
2. Dust pollution
3. Local level disturbance
4. Destruction of fauna and flora

Operational phase

5. Air pollution
6. Water pollution
7. Withdrawal of water
8. Land pollution, mainly through fly ash
9. Noise pollution
10. Micro climatic changes
11. Ground water contamination due to fly ash leach.

Linked impacts

12. Pollution and degradation due to mining of coal

13. Environmental impacts of coal washeries
14. Air pollution due to transportation of coal
15. Environmental impact of the power transmission system

Unfortunately, thermal power plants are also not properly assessed for their environmental and social impacts, and alternative sites and technologies are rarely explored.

Instead of having a national perspective towards the generation of thermal power, state and local perspectives prevail. This inhibits the location of such power projects at sites that are optimal from the environmental and social perspectives. It also comes in the way of locating coal-based power stations at or near coal pit heads, so that the economic and environmental costs of transporting coal over long distances could be minimised.

3.2 Major Concerns

Perhaps the four most critical issues concerning thermal power stations, in terms of their social and environmental impacts, are as follows.

3.2.1 Appropriate Location

Inappropriate locations imply heavy environmental and social costs and an inability to adequately mitigate these costs without making the project economically nonviable. What is required is a zoning plan that indicates, well in advance of project implementation, the suitable sites for locating thermal power stations. There could be a gradation so that if the plant location was shifted from a green to a not-so-green site, the costs of environmental control would significantly increase. The location of plants next to sensitive areas like national parks, sanctuaries, forests, wetlands and towns and cities must be prohibited. The irrationalities in our laws, which encourage inappropriate siting, must be removed. States must not be penalised if power projects are not located within their state, especially when there are no appropriate sites from the environmental or economic standpoint.

3.2.2 Control of Air Pollution

The threat that thermal power stations pose to air quality is significant. First, this is from the release of suspended particulate matter (SPM), especially fine particles. Though this problem is aggravated due to the high

ash content of our coal., the efforts to tackle the problem of fly-ash in India are very inadequate. It is estimated that by the year 2010 we would be producing 100 million tonnes of fly ash every year. Yet, we hardly use 5% of the ash that we produce.

Infact, fly ash is itself a very valuable raw material which can be used in a variety of ways. By using fly ash bricks for construction, one not only saves the environment from dumped fly ash but also saves valuable topsoil which would otherwise have been used to make bricks. Recent studies suggest that setting up of coal washeries, to reduce the ash content of the coal supplied to power stations, is not only an environmentally desirable measure but in most cases, given the savings in transportation costs, also an economically beneficial measure.

Though our coal has a low sulphur content, SO_2 can also be a problem, especially when the power stations are inappropriately located. The emissions of CO_2 and NO_x also have to be monitored. A recent World Bank sponsored study (ERM 1998) calculated that CO_2 emissions could go as high as 775 million tonnes, and SO_2 and NO_x to 5380 and 3500 K tonnes respectively, by 2014/15.

3.2.3 Use of Water

Thermal power stations are heavy users of water. Where cooling towers and a water recycling system is incorporated, the quantum of water required can be minimised. However, many power stations continue to use the "once-through" system. This makes a heavy demand on local water resources and often results in water pollution and adverse thermal impacts. Considering water is a scarce commodity in most parts of the country, the thermal power sector must become far more efficient in its use of water.

Where fly ash is not utilised but dumped in ash ponds, as is the case with a large number of coal-based stations, huge amounts of water are required to operate the ash-ponds. Apart from depleting the water resources of the region, such ash-ponds often contaminate ground-water sources and sometimes over-flow and pollute surface water and land.

3.2.4 Dumping of Fly Ash

As already mentioned, in many coal-based stations fly ash is dumped into ash-ponds. This implies the destruction of large areas of land,

sometimes very fertile land, and the ousting of the human beings living there or depending on this land for their livelihood.

4. MAKING THE ENERGY SECTOR GREENER

4.1 Environmental Impact Assessment (EIA)

As already mentioned, the assessment of specific energy projects must be comprehensive, especially in terms of their environmental and social impacts. In fact, with the mounting pressure on countries to move towards an environmentally sustainable model of development, it has now become essential to do an environmental and social impact assessment not only of specific projects but of the strategies and policies that these projects represent.

Just as the optimality and viability of specific projects must be established, so also must the optimality and viability of policies and strategies. The need for dams, especially large dams, and for environmentally destructive super thermal power projects in an optimal and sustainable energy strategy, is questionable.

4.2 Major Constraints

The major constraints to such an assessment of our energy strategies are perhaps five:

4.2.1 Technological Mindset

One constraint is represented by the highly trained cadre of technical experts, whose focus is on a particular strategy and who are not equipped and sometimes not willing to consider and adopt alternate strategies.

This is especially true of some civil engineers who have been trained to make dams and believe that the bigger the dam, the greater the technological achievement. It is difficult for them to seriously consider alternate ways of meeting our energy needs.

The problem is exacerbated by the bureaucratic and technocratic tendency to work within the narrow confines of specific disciplines and sectors, without allowing a cross-fertilisation of ideas and approaches. Modern science has also taught some of us to be dismissive of traditional and local community knowledge, which is often categorised as unscientific and superstitious.

Clearly, there are answers to the problems of the society in both modern sciences and technology, and in traditional and local wisdom. Bureaucrats and technocrats must be made sensitive and open to this fact.

4.2.2 Prior Investments

Unfortunately, even if a country decides to alter its strategy for the development of energy resources, another inhibiting factor is that at any given time there are under implementation a large number of unfinished dams and super thermal power projects of the unsustainable variety. Any decision to make the strategy more sustainable would mean abandoning these unfinished projects. This would mean both financial losses and lost opportunities. Even where national governments have recognised the need to change their strategies, they have not usually found the political will to cut their losses and write off these costs as bad investments.

Perhaps what is required is a phased conversion from current, unsustainable, strategies to new, sustainable, ones. For one, there should be a moratorium on the setting up of any new projects which, either themselves or in the strategies they represent, are unsustainable. Of the unfinished projects, an assessment must be made to determine which ones should be abandoned and which ones finished. It might be better to complete those projects where the social and environmental costs have already been incurred. For the rest, they must be written of as bad investments and the nation must cut its losses.

4.2.3 Technological Constraints

A popular argument against alternative strategies for the generation of energy is that either alternate technologies are not available, or that those that are available have greater social and environmental impacts, and are too costly in financial terms.

It is perhaps correct that alternate technologies like micro-hydro electric projects, solar, wind, tidal and geo-thermal methods of producing energy, are not as widely tried and tested as the current large dam and thermal power station technologies. However, it must be recognised that technologies do not develop in a social vacuum. Technological development is motivated and fuelled by social sensibilities and demands. As long as those who have been brought up to believe in the desirability of big, environmentally destructive, projects are allowed to impose such

projects on the society, there is little incentive for developing and perfecting other ways of generating and managing energy.

However, if the resistance to big dams and unsustainable super thermal power projects adequately changes social and environmental perceptions, then a situation might be created where talented young people will see their future in developing alternate technologies. Funding and other support for such research and development would also then become available. Therefore, the perpetuation of the big projects philosophy is in itself the single most powerful factor inhibiting the growth of alternate strategies and technologies.

The argument that alternatives, like micro dams or small thermal power stations, collectively cause more environmental damage than big dams, is clearly misplaced. It might be true, given today's technological levels and the technological biases in favour of large projects, that to generate the same amount of power the area that needs to be submerged through micro dams might collectively be more than what is submerged by a big dam. However, the fact that in micro dams the submergence is not in one continuous area, concentrated in one region, but distributed in small patches, significantly minimises their impact. For example, although the area of land submerged collectively through such micro projects might be greater, it almost never results in the dislocation of many villages. Even if some houses or the whole village has to be shifted, at best it just shifts a few hundred yards without any significant social trauma. Similarly, even where a portion of forest is submerged under such micro projects, it is usually such a small part of the existing forest that the impact on biodiversity and on the general ecosystem is almost negligible. This is in contrast to big dams.

To take an example, if a thousand motor vehicles are spread out over a thousand sq. kms., they would have a much less impact on human health and the environment than if you have five hundred motor vehicles in one sq. km. Admittedly, given the present state of alternate technology, the financial returns on investments might be greater in large projects rather than in small ones. However, with improvements in alternate technology, this can change. Also, big projects might today represent greater financial returns but they also represent huge social and environmental costs.

Finally, as the national mood today is towards decentralisation and the empowerment of the people, this can only be achieved by small projects which are for and of specific communities. Large projects disempower local communities and make it difficult for the people to

demand and get answerability. When the environmental costs have to be borne by the same people who benefit from the project, then they are in a much better position to decide on the correct trade off. Small projects allow for this, while large projects invariably provide benefits to one group of people while imposing the costs on another.

4.2.4 Short-term Benefits

The so-called developing countries, in their haste to catch up with the "developed world", feel that time is passing them by. They persuade themselves to believe that they do not have the option to look at medium and long-term strategies but only to fight fires that are currently raging. Whereas in a few extreme situations fire fighting is clearly a priority, for much of the time the interests of the country and the people would be far better served if medium and long term strategies were developed and adopted.

Instead of thinking about how they can get the maximum in the next year, or the year after, without worrying about whether such a process of maximisation compromises future options, they should focus their sights on what they would want India to be fifty years from now. They should then work their way backwards to see what inputs would be required this year, and the next, and the year after, if in fifty years the country is to stabilise in social, economic and environmental terms. This would not only ensure that the minimum basic needs are met, but would also energise the nation. The people would see a hope for a better future and thereby be more willing to put up with some of the shortages and deprivations that are in any case a part of their destiny. Clearly, any vision for the medium or long term could not accommodate unsustainable projects.

4.3 Economics and the Environment

Till recently, environmental costs were never taken into consideration in the national planning exercises. This is because planning is done primarily in a financial and economic context by financial and economic experts. However, natural resources are the most fundamental of human resources, certainly more fundamental than economic resources.

Given the rapid environmental degradation of the last two decades, many countries began to realise that unless they reflected the state of the environment as a part of their assessment of the nation's growth and economy, they would be presenting a false picture, or at best an incomplete

one. In fact, motivated by such an understanding, the Government of India, in its policy statement on sustainable development, undertook to present before Parliament, each year, a natural resources budget.

At the behest of the World Bank, the Government of India prepared a National Environmental Action Programme (NEAP) and was a party to Agenda 21. Both these documents further reiterate the commitment of the government to move towards a model of sustainable development. But, there is little action on the ground.

In countries of the North, environmental economics is now a popular and fast growing discipline. Unfortunately, the models developed in these countries are not appropriate for India. Despite this, there has been a concerted effort by various countries of the North and international agencies to persuade India and other countries to accept their model of natural resources accounting.

The imperative for natural resource accounting seems, on the face of it, to flow from an urge to integrate natural resource parameters into the national accounting systems. This means that the GNP calculations of a country would reflect, each year, the use and accrual of natural resources. For specific projects and activities, a system of natural resource accounting would mean that the financial and economic costs of natural resources will be reflected in the cost benefit analysis carried out to assess the viability of the project.

The current process of developing natural resource accounts has many problems. Some of them are outlined below:

4.3.1 Classification of Nature

The first problem relates to classification of nature into that which has economic value or, as economists sometimes describe it, has alternate uses, and that which has no economic value for it has no alternate use. The belief that some elements of nature have no alternate use and therefore no economic or financial value seems misplaced. Perhaps, if one takes a very narrow definition of "value" and "use", then one could argue this. However, it is well established that each individual living organism represents a unique element of biodiversity. Therefore, it is difficult to imagine even a single plant or creature that has no use.

4.3.2 Attaching Value

Even more difficult is the method by which economic and financial

value is attached to elements of nature. Unfortunately, economics as a science can only put a replacement value to those goods and services, which are an input into, or an output of, an economic process. Much of nature, critical as it is to human survival, is not an input into or an output of an economic process. Therefore, for economists, it is either invaluable or valueless. As economics cannot handle the notion of invaluable, it tends to consider much of nature as valueless.

As an example, how can economics ascribe a realistic financial or economic value to the last surviving pair of a species of a bird, which currently might have no known economic function? Given the present methodology, such a pair would ordinarily be considered without economic value. Yet, this very species might, if it survives, become of very great economic value in the future. Nevertheless, as there is no way of predicting with any certainty whether this would happen or not, ascribing value becomes an impossible task.

4.3.3 The North-South Divide

Though this is a handicap all over the world, its implications are far more critical for countries of the South, than for the North. Whereas in the Northern countries there is already a high value attached to natural resources even for those functions, like recreation, which can to some extent be measured in economic terms, this is not so in countries of the South. Therefore, if decisions regarding the use and destruction of nature and natural resources in the South were to be made based on the financial value attributed to such resources, it would be very difficult to conserve and protect anything.

Also, given the vast differences in the buying power of different segments of society in countries of the South, and between the North and the South, it is difficult to ensure socially just utilisation of natural resources. This is especially so if decisions were to be made solely or primarily on economic basis.

4.3.4 Undervaluing Nature

There is also a tendency in governments dominated by imperatives for economic growth, to systematically undervalue the role of natural ecosystems. For example, a forest can be contrasted with a human made industry. Whereas the human made industry requires inputs of capital, energy, raw materials, maintenance, replacement, and a labour force to

make it productive, the forest, as an industry, produces goods and services critical to humanity without requiring any of these. It generates its own energy, produces its own raw materials, maintains and replaces itself, and goes on for eternity without needing any human input. However, the economic value attributed to forests never reflects this miracle of productivity and renewability.

4.3.5 The Solution

But what is the solution? Perhaps one way out is to adopt a dual approach of both budgeting and accounting. The elements of this approach are described below.

First, a natural resource, say water, needs to be budgeted in physical terms and allocations made to meet the basic ecological and social requirements. This means that, in a river, the minimum flows required for maintaining the ecological balance of the river and consequently its ability to cleanse itself and support life, must be assured.

Once this is done, then the surplus water must next be allocated for meeting the basic needs of the human populations dependent on the river. This includes their drinking water requirements and other basic needs. If any 'surplus' remains, this can then be subjected to market forces and its use determined based on the paying capacity of the various contenders.

In such a model, where there is industrial demand for water, then the industrial sector must pay for enhancing lean season flows by, for example, regenerating catchments, in order to produce larger surpluses. There is also, then, an economic incentive to invest in water saving technology, as the real cost of water is being charged.

5. CONCLUSIONS

5.1 Strengthening EIA

To ensure that ecologically fragile areas are not degraded or destroyed by inappropriate or badly designed and implemented power projects, a major thrust should be on strengthening the Environmental Impact Assessment procedure and practices in India. This is required not only at the project or the regional level but also at the policy level. Notwithstanding, EIAs having become mandatory, suffer from the following serious draw backs:

- Project proponents still consider EIA to be a formality, which is presumed to be completed as soon as environmental clearance is granted. They rarely understand that EIA, as a decision making tool, can significantly enhance the benefits of the project while ensuring environmental protection.
- The consultants preparing the environmental impact statements on behalf of the project proponents often act as agents of the project proponents, with the result that their reports are often biased, unreliable and remain unimplemented. The consultants tend to tow the line of the project proponents because their future prospects and often even their consultancy fees are dependent on the project being approved.
- Lack of transparency, objectivity and "public participation", which are pre-requisites for making the EIA process successful. Informed and meaningful public participation assumes that there is free access to all relevant information. The need to be transparent has been supported by various court orders.
- Lack of objectivity, accountability and transparency in the screening and assessment processes used by regulating agencies for approving or rejecting projects.
- Ineffective monitoring of the stipulated remedial measures. Accordingly, the following steps need to be taken.

The stipulations in the EIA notification to penalise the proponents and/or their consultants for furnishing false data need to be seriously implemented to make the EIA reports objective.

As accurate and objective EIAs are essential for the wellbeing of the environment and the project, the funding of consultants who are to prepare the environmental impact statements must be from an independent source. This is necessary to ensure that the statements are accurate and objective.

There were initial efforts to make the process of EIA more transparent and participatory. However, the rules under the Environment (Protection) Act, which were first amended to allow such transparency and participation, were very quickly again amended to minimise this. Consequently, this remains a high priority. All efforts to ensure that proper EIA of projects and activities is done would fail if the process were not transparent. Secrecy in these matters only encourages manipulation by vested interests.

Therefore, the rules under the Environment (Protection) Act must be suitably amended. Provisions must be made, if necessary through a special scheme, for making available all information on which EIA is based. It

must be ensured that there is adequate discussion with non-governmental experts and with the affected communities, before a power project is given environmental clearance.

Transparency and accountability in decision-making should be strengthened by permitting public scrutiny, of files regarding projects approved or rejected, for at least one month before the decision becomes effective. Action should be taken against those responsible for indefensible technical and/or administrative decisions.

The practice of granting "pari-passu", or "conditional", approval in cases where environmental action plans are to be submitted later, should be discarded altogether. Experience has shown that the spirit of such conditional clearances is never honoured.

Even when projects are being scrutinised and cleared after stringent environmental scrutiny, the experience is that project authorities often flout the conditions of clearance. There exists, at the moment, a very inadequate system of monitoring projects and activities in order to ensure that they comply with the conditions of environmental clearance. Consequently, it is important to involve the NGOs, educational and research institutions and interested and qualified individuals in monitoring power projects in terms of their compliance with environmental and social safeguards.

Being part of the Government set-up, the regulatory agencies are often subjected to political pressures that sometimes result in biased decisions. It is necessary, therefore, to set up an independent and autonomous Environmental Protection Agency with, among others, the following functions:

- To review the environmental action plans of agencies involved with setting up power plants.
- To adjudicate on controversies regarding the environmental impacts of power projects.
- To appoint environmental appraisal and other expert committees for evaluation of power projects and of policies and programmes related to power generation, distribution and consumption.
- To monitor the implementation of stipulated mitigation plans and compliance with conditions of environmental clearances.

5.2 Zoning

In addition to EIA, appropriate zoning is required to ensure that power projects do not affect ecologically or socially vulnerable areas. The whole country should be zoned in terms of its ecological and social vulnerability

and areas where power projects can be allowed to come up should be clearly indicated. Even in these zones, the technology acceptable, the levels of effluents and emissions allowed and the number of units possible should be clearly specified. To provide incentive for being in compliance with the prescriptions for each zone, rules and laws should be amended so that a less detailed clearance is required where a power project is in conformity with the prescriptions. The fact that, in the present system, there are huge delays and costs involved in steering through the proeess of getting environmental clearances would help in the success of the zonation system.

5.3 Carrying Capacity Assessments

At present, adequate expertise might not available in the country to carry out the required carrying capacity studies for developing a proper system of zones. Therefore, initially the zones might be exclusion zones, specifying the types of activities not permissible in each zone. Meanwhile, a major programme should be taken up, if necessary though collaboration with institutions outside the country, to develop indigenous ability and human power to carry out comprehensive carrying capacity studies. These carrying capacity studies must lead to and form the basis of a rational and scientific land use plan for the country.

5.4 Research

Research efforts, especially concerning issues critical for the proper identification and management of ecologically and socially vulnerable areas, are sadly lacking in India. Regeneration and restoration methods for ecologically fragile areas must be urgently developed. For the purpose, centres of research must be set up within existing institutions, each working on one or two types of fragile ecosystems. The research should be aimed at developing better techniques for protecting, monitoring and restoring fragile ecosystems.

5.5 Time-bound Clearances

Once projects get cleared, most often there is little or no ability to ensure that they meet their environmental and social obligations. As such, it would be better if environmental clearances are given only for two years at a time and the project is required to seek extension after every two-

year period. Such an extension should be given only if the project has complied with the stipulated environmental and social conditionalities.

5.6 Class-benefit Analysis

In a country like India, where one major objective of development is to promote equity, it is not enough to subject power projects to just a cost-benefit analysis. They should also be subjected to a class-benefit analysis. A class benefit analysis should determine which classes of people are paying the costs and who are getting the benefits. Even if a project has a very favourable cost benefit ratio, if it involves the poor primarily paying the costs, for the benefit of the rich, then it should not be considered viable. The converse should also be true.

5.7 Advance Action

As the possible locations of thermal power projects are known well in advance, these sites should be assessed from the environmental and social angle well before the project is to be constructed. Such an assessment should indicate which of these sites are acceptable, and under what conditions. This would allow advance planning and minimise delays to the projects, due to the need to fulfil environmental requirements.

5.8 Fly Ash Utilisation

The use of fly ash should be a priority. Power projects should be set up both to generate electricity and to produce the fly ash which, given current technology, can prove to be a valuable economic resource.

5.9 Beneficiated Coal

Along with this, progressively only beneficiated coal should be supplied to power stations.

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