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Environmental Aspect of Sustainable Development

Abstract

Global development has been responsible for causing many environmental problems such as excessive consumption of resources, pollution in the surrounding environment through Urbanization and Industrial activities. Research on reducing pollution by renewable energy use, green building design and using building materials in judicious way to mitigate environmental impact is already underway. So there is a need to maintain sustainability, considering environmental impact and economical aspect at each stage of development (planning, design, extraction of raw material, manufacturing, transportation and installation, repair and maintenance, and demolition stage).

Keywords: Sustainability, Environmental Impact Assessment (EIA), Life Cycle Assessment (LCA), Resources, Green Built Environment, Reduce, Reuse and Recycle.

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Introduction

The World Commission on Environment and Development(1987) offered a definition of sustainable development modified by Roy F. Weston (1994): "Sustainable Development is a process of change in which the direction of investment, the orientation of technology, the allocation of resources, and the development and functioning of institutions meet present needs and aspirations without endangering the capacity of natural systems to absorb the effects of human activities, and without compromising the ability of future generations to meet their own needs and aspirations".

It is said that technolgy make and move the world and now even make the world communicate. Therefore to make the environment sustainable, science and technology has the biggest responsibility to keep the world continuously growing and moving towards a sustainable future. Most of the economic development involves engineering & construction work. Therefore sustainable development implies sustainable engineering, which is the process of planning, designing, manufacturing, constructing, operating and repairing a built environment with optimum use of energy& resources with minimum impact on environment. While creating such a built environment, environmental technology can ensure sustainability through Environment Impact Assessment (EIA) and Life Cycle Assessment (LCA).Sustainability involves environmental and social issues, greater knowledge of biological and social science is required in order to create effective leadership in sustainable development. Here environmental scientist can take this leadership and fill this void of socio-environmental knowledge and provide interface between engineering development and environmental issues.

Aim of the Study

The main objective of this paper is to illustrate the environmental aspect in ascertaining sustainability in development at various stages through Environmental Impact Assessment (EIA) and Life Cycle Assessment (LCA).

If environmental scientists are to be collaborators in sustainable development, they must be willing to consider and promote reasonable approaches that are based on simple technologies, optimum and efficient design, reduced resource consumption and environmental impact. They should facilitate decisions which are economically feasible, environmentally sound and socially acceptable, concerning future waste management scenarios. Sustainability is about persistence into the future.

Sustainability through Environment Impact Assessment (EIA)

A better way of achieving sustainability in a development project is to consider environmental issues at a stage when design is conceptualized. This can be done through EIA, which has been made mandatory by Govt. Authorities and all prominent development funding agencies such as World

Bank, Asian development Bank (ADB) etc. Through EIA the project proponent and authorities choose a project that is environmentally sound and economically feasible with minimum impact on the surrounding environment.

Development objective has many interfering goals which compete with each other. The interest of stakeholders is often at conflict with each other. The project proponent, the financers tries to maximize their profit with maximum resource utilization, environmentalist and socio-political leaders advocate for protection of environment and their regional resources. In this scenario the environmental scientist have the most important role of coordinating and to provide the interface between these stakeholders by suggesting the most sustainable solution with minimum impact on environment **(figure 1)**.

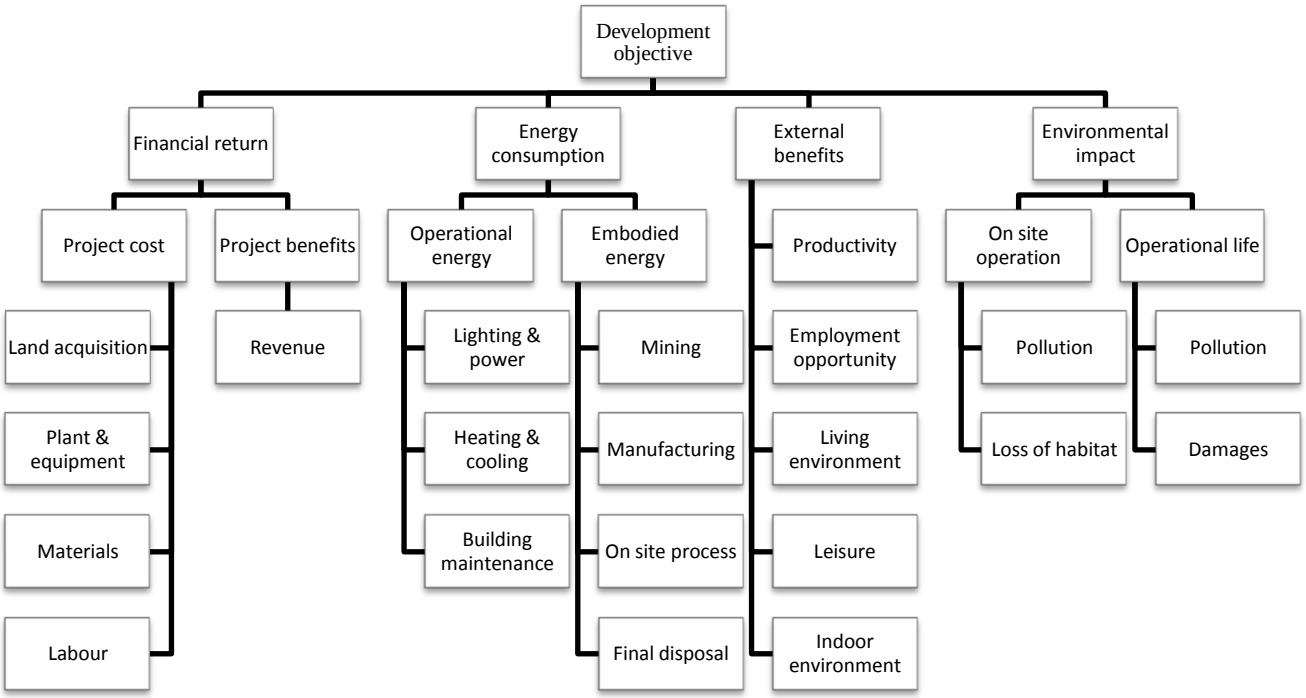
If this EIA is done before and at least along with conceptualizing and modelling the project the suggestion of environmental scientist to avoid and mitigate the environment impact can be incorporated and implemented by multidisciplinary scientists to select sustainable, eco-friendly engineering solution with optimum resource utilization without hampering the development and halting the project all together. For example in case of POSCO steel plant in Orissa, if the environmental scientists had played their role earlier by selecting proper eco-friendly site with minimum effect on habitation, the project would not have halted for decades.

EIA analyst goal should be to find the optimum balance in engineering solution using resources in such a way that it satisfies the needs of human societies while minimizing the impacts on the environment and conserving it for the future generation. Land use, soil health, human habitation, health of ecosystem & climate, maintaining biodiversity, resource utilization & conservation, water quality and quantity, solid and hazardous waste disposal are some of the aspects which a EIA analysts has to take into consideration for long term sustainability.

Following sustainability principle need to be followed for maintaining the carrying capacity of the environment or a particular habitat by the EIA analysts and its associated multidisciplinary team of engineers:

1. Improvement in design life cycle and efficiency of built environment minimizing the absolute use of resources.
2. Use of construction material considering local available options with reuse and recycling of resources.
3. Use of renewable energy resources with reduction in carbon footprint.
4. Minimizing waste water and solid waste, chemicals and pollutants which accumulate in the environment leading to global warming.
5. Designing for deconstruction, reuse and recycling considering End of life (EOL) of project.

Figure- 1:Sustainable Development



Alternative A	Alternative B	Alternative C	Alternative D
Maximize wealth	Minimize resources	Maximize utility	Minimize impact

Sustainability through Life Cycle Assessment (LCA)

The authorities are now concerned with improving the social, economic and environmental indicators of sustainability. Traditional Engineering solutions and practices will not produce sustainable solutions, it will come through critical thinking, innovation and with a mindset which takes social, cultural and environmental aspects into consideration without compromising the interest of future generation. The Life cycle of a built environment or construction project involves extraction of raw material, manufacturing, construction or installation, use of built environment including repair & maintenance and disposal (EOL)

LCA (Life Cycle Assessment) can be applied to optimize these aspects, from the extraction of raw materials to the final disposal of waste material. There is requirement of greater communication and interaction between multidisciplinary sectors in the construction industry to promote sustainability considering the environment aspect. The focus should be on achieving sustainability by efficient allocation of resources, minimum energy consumption, reuse and recycling, pursue quality in creating healthy and non – toxic built environment and protecting natural environment by reducing disposal of liquid, solid and gaseous waste.

Green Built Environment

A Green developed environment is one which conserve and uses less resources, optimizes energy efficiency, generates less waste and provide healthier non-toxic environment to its occupant.

Environmental engineers should focus on designing and developing green built environment with following fundamental principles.

Structural Efficiency

This has largest impact on cost and performance and aims to minimize the environment impact on all life cycles.

Energy Efficiency

Energy efficiency aims to provide natural light & ventilation and energy efficient appliances minimizing use of energy and carbon foot print.

Material Efficiency

Material efficiency aims to use local eco-friendly material, reuse of material, recyclable material and materials which have less carbon footprint and have less global warming potential.

Waste Efficiency

Waste efficiency works on the principle of reduce, reuse and recycle of resources specially the water which is most important commodity in Indian context.

Transforming Built Environment

It has been established that the built environment currently consumes the 40% of Europe's overall energy and the need to transform it in the coming years using green sustainable material and processes is imperative (A. Kylili et al.,2016).This transformation of built environment can be possible while repairing and renovating with sustainable green solutions. Key consideration for environmental engineers are minimizing disposal of waste to land and water, transformation to natural ventilation and illumination, use of energy efficient appliances, reduce use of material with high Global warming potential, reduce and reuse of material, use of recyclable material. All such improvement in built improvement should be done with overall quality control. Poor quality may lead to numerous rework which may defeat the purpose of resource minimization and sustainability.

The reduction in the energy consumption, reuse and use of recycled material, improvement of indoor climate make the environment more sustainable and reduce the carbon footprint. Better indoor quality habitation, less air pollution improves the health and working condition of occupants, which leads to overall economic sustainable growth.

Designing End of Life and Disposal

Built environment should be design to deconstruct and dismantle and not demolish. During the planning and design phase, waste manager should develop a strategy for end of life, including recyclable materials, ease of dismantling and deconstruction and then allows virtual planning that how the building will be reused.

There should be systemic thinking to decide how construction and demolition waste can be minimized. Environmental engineers can make a framework to maximize 3Rs (reduce, reuse and recycle) into planning, design, extraction of reusable material at construction and demolition stage and minimize the disposal of construction waste by implementing sustainable strategy throughout the lifecycle of construction. The waste management significantly reduces the material in the design and planning stage, reducing scrap and waste at site and to landfill reducing the cost and overall impact on environment.

Singapore's Strategies towards Sustainable Construction: A Case Review

Singapore has little natural resources and nearly all construction materials have to be imported,

so sustainable construction is critical to its national development. Singapore has started to adopt sustainable construction strategy through Sustainable Singapore Blue print. One of the key thrust of this Blue print is improving resource efficiency and achieving zero landfill. The two key focus areas are:-

1. Recycling and use of sustainable materials.
2. Efficient design to optimize use of natural resources.

Other initiatives taken for sustainable construction are:-

1. Enforcing Demolition Protocol, which is a set of procedures as how demolition waste should be managed to maximize resource recovery for beneficial reuse and recycling. The Protocol includes Pre-demolition audit, sequential demolition and on-site sorting for meaningful collection of recyclables and reusable materials.
2. An accreditation scheme of C& D waste recyclers, which aims to improve quality consistency of Recycle concrete aggregate (RCA) production.
3. Promoting sustainable construction in private sector: Notable instances are of Goodwood residence, the developer has embarked upon a ”Zero Waste” concept to achieve 100% water recycling. Another commercial building, Tampinesn Concourse, held the distinction as being the First Carbon –neutral building in Asia-Pacific. As a result, more than1000 tonnes of natural sand and granite have been saved and 6750 tonnes of carbon dioxide have been offset during construction.

Conclusion

Industrialization and urbanization are the largest end users of resources and one of the largest polluters of the natural environment. Environmental friendly technologies can improve the performance of development activities with regards to optimization & conservation of resources, reducing, reusing and recycling of waste causing minimum impact on the environment through EIA & LCA. This improvement will indeed encourage greater environmental responsibility and value towards sustainable growth & welfare of society without limiting the interest of future generations. The case of sustainable development in Singapore can be replicated in other countries and states.

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