Environmental Impacts of Construction on Local Ecosystems

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***Abstract*—The environmental impacts of construction on local ecosystems are not well-known nor properly managed. Various types of construction exist that have distorted the natural ecosystems of the human, animal and plant environment giving rise to chaos and an unorganized flow of resources. This article seeks to pin-point the various implications and environmental impacts of construction on local ecosystems and life generally.**

It reviews previous works done in this area, armed with recent happenings that are contributors to ecological imbalance stemming from distortion in the ecosystem as a result of the design and construction of buildings and structures within the local systems of man, animals, plants and micro-organisms.

The designs and construction of these structures that have come in the way of natural ecosystems are not ill-intended, the primary goal of such innovation is to provide better homes, schools, roads, bridges etc. for humankind. However, it is true that a solution at a particular level, is a challenge at another level, hence these structures distort the functionality of ecosystems wherever they are found. By applying sustainable measures in construction, we can mitigate the destruction and constant collapse of different ecosystems within our environment.

The continual distortion and collapse of different sectors of the ecosystems threatens the safety of the whole system as they are all interconnected in a complex manner.

***Index Terms*—Environment: this is the surroundings or conditions in which a person, animal or plant lives or operates.**

Impact: this is the action of one object coming forcibly into contact with another. It could is also a marked effect or influence.

Biodiversity: the term biodiversity, from biological diversity refers to the variety of life on Earth at all of its levels, from genes to ecosystems, and can encompass the evolutionary, ecological and cultural processes that sustain life.

Construction: this can be defined as any project that involves coming up with a design for a structure at a certain location and then putting together all the different elements to build that structure, it can be simply said to be the act of building something, typically a large structure.

Systems: a set of things working together as parts of a mechanism or an interconnecting network; a complex whole.

Ecosystems: this is a community of organisms and their physical environment interacting together.

Civil Engineering: this is a professional engineering discipline that deals with the design, construction and maintenance of the physical and naturally built environments including public works such as roads, bridges, canals, dams, airports, sewage systems, pipelines, structural components of buildings and railways.

I. INTRODUCTION

Structural development is an inevitable trend within the human society and environment, the quest to live better, learn, grow and utilize our resources is continually on the rise with the passage of time. This

has resulted to the demolition of local ecosystems without the due knowledge of the consequences in a bid to replicate the designs that suits our currents needs in form of structures and buildings. As much as these structures and buildings are highly needed, the balance of the local ecosystem is very important to promote health and sustainability.

Civil engineering and construction processes most times utter natural patterns within our environment, thereby causing a distortion of flow in the local ecosystem which in turn brings about drastic changes in other areas of the environment.

II. OVERVIEW OF CIVIL ENGINEERING AND CONSTRUCTION PROCESSES

Civil engineering is the application of physical and scientific principles for the design, development and maintenance of both the constructed and the naturally built environment. Civil engineering projects can come through the public sector, from government agencies, or through the private sector and can be either large or small scale, with civil engineers working in fields such as planning, budgeting, project and asset management, research, analysis, and more. Civil engineering cuts through areas including physics, mathematics, structures and construction, geography, geology, hydrology, environmental and materials sciences, mechanics and more.

Construction processes are the detailed steps required to complete a construction project. These processes are usually broken into phases, including –

- Planning/Design
- Pre-construction
- Procurement
- Construction
- Post-construction

All of these phases make up the entire construction process of structures or buildings. However, these buildings or structures are constructed in communities, systems and ecosystems.

III. ECOSYSTEMS, COMPONENTS AND FUNCTIONS

An ecosystem is a geographic area where plants, animals and other organisms, as well as weather and landscape, work together to form a bubble of life. Ecosystems contain biotic or living parts as well as abiotic factors, or non-living parts.

FIG 1: Plants and Animals within a geographic area.

Biotic factors include plants, animals and other organisms. Non-living components include air, water, land and sunlight. The main functions of the components of ecosystem are: Energy from the sun enters the ecosystem through the plants as they undergo the process of photosynthesis, energy is also transferred from one trophic level to another through consumption of this plants by herbivores, which are in turn eaten by carnivores. The ecosystem and its components controls essential processes, promotes lives and renders stability, it also supports the recycling of nutrients between biotic and abiotic components, it helps in maintaining the usual flow of energy in an ecosystem including carbon cycle, energy cycle, nitrogen cycle, oxygen cycle and water cycle.

FIG 2: Vegetation.

IV. ENVIRONMENTAL IMPACTS

This refers to the effect of human activities or natural events have on the natural environment in the context of construction. It often includes the disruption or alteration of ecosystems due to factors such as, land degradation, water pollution, air pollution, noise pollution, biodiversity loss, soil erosion, waste generation, resource consumption. Measuring these impacts can help assess the sustainability of a construction project and its long-term effects on the surrounding ecosystems.

V. IMPACT OF CONSTRUCTION ON SOIL AND LAND

Soil Erosion and Degradation: Soil erosion is the removal of vegetation which leads to the destabilization of soil, causing erosion and sedimentation in nearby water bodies. The destruction of natural habitats due to excavation, deforestation and land-use charges causes land degradation. Erosion and sediment damages occur both on and off the construction site, and all of society pays for the destructive impacts. Construction activities, such as grading and filling, drastically reduce soil quality on and within construction sites. Soil contamination can also occur as a result of the components of the construction materials.

FIG 3: Soil Erosion and Degradation.

VI. IMPACTS OF CONSTRUCTION ON WATER RESOURCES

Water pollution, contamination of water resources from run-off containing harmful chemicals or construction debris. The construction of buildings, roads and other infrastructures in urban areas often leads to a decrease in the availability of portable water. This is primarily leads to the increased demand for water during the construction process, which can strain the existing water resources. All of these contribute to changes in surface water quality, groundwater depletion and contamination, it also has impact on hydrological cycles.

FIG 4: Water pollution as a result of construction.

VII. IMPACTS OF CONSTRUCTION ON FLORA AND FAUNA

Flora is all the plant life present in a particular region or time, generally the naturally occurring native plants. The corresponding term for animals is fauna, and for fungi, it is funga. Both flora and fauna are interconnected and coexist in harmony, contributing to the overall biodiversity on our planet. In aquatic environments, flora includes various types of algae, seaweeds and aquatic plants like water lilies and mangroves. Wildlife can be killed or injured during construction or when building is finished, a development resulting in more traffic may increase the risk of wildlife road deaths. Habitat loss can cause the loss of wildlife habitats like woodland, grassland or ponds. This diverse range of vegetation forms the foundation of terrestrial and aquatic ecosystems, providing essential resources and habitats for numerous organisms.

The noise produced by construction activities can lead to alteration in feeding and breeding patterns which could prove detrimental to the surrounding flora and fauna. Badgers, bats and great crested newts and bird are the most commonly affected species.

The impacts of construction on flora and fauna include the destruction and fragmentation of the natural habitats of these plants and animals, effects on biodiversity and species displacement, introduction of invasive species.

VIII. AIR POLLUTION

The construction industry's contribution to air pollution is substantial and often underestimated. According to the 2019 London Atmospheric Emissions Inventory (LAEI), construction activities account for approximately 30% of particulate matter (PM10) emissions in the city, along with 8% of fine particulate matter (PM2). The use and type of construction equipment also play a role in producing air pollution. A lot of construction machinery and vehicles run on diesel fuel, which releases a number of pollutants into the air- including carbon monoxide, carbon dioxide, nitrogen oxides and hydrocarbons. Such pollutants in the air can be toxic to sensitive plants, trees and humans, while pollutants in rainfall damage habitats by depositing acids or excess nutrients. Water bodies such as rivers and lakes are also susceptible to the effects of air pollution.

IX. BIODIVERSITY LOSS

The physical encroachment on land gives rise to disturbance and barrier effects that contributes to the overall habitat loss, fragmentation and degradation. These modifications in earth ecological communities cause a compelling concern for ecosystem diversity loss. To be able to construct, you need land to build on, but this land is probably home to a number of species of animals or plants. Consequently, their habitats are destroyed to make way for infrastructure, this is a direct impact of construction on biodiversity.

The air we breathe, the food we eat and the water we drink all relies on biodiversity; we need them all to live. Plants create the oxygen we breathe, bees pollinate plants to give us fruits, nuts and grains, wildlife spread the seeds so the cycle can continue and and we can survive. Biodiversity creates the cycle of life, without which we cannot harness the services nature provides us. Decreased biodiversity creates risks for global food security, increases the likelihood of transmission of diseases and will result in areas being more vulnerable to flooding.

X. WASTE GENERATION

Construction waste includes waste that is generated during construction activities (such as packaging, or the products of demolition) and materials that are surplus to requirements (as a result of over-ordering or inaccurate estimating). The U.S generated over 600 million tons of construction-related waste in 2018. (EPA) Construction & Development waste generation in the U.S increased by 342% from 1990 to 2018. The effect of waste generated in road construction includes water pollution, air pollution, climate change, soil contamination, animal and marine deaths, landfills, human damage, wildlife and ecosystem impact which all ultimately lead to an environmental imbalance.

XI. RESOURCE CONSUMPTION

Construction processes consume resources ranging from time to ample materials which are usually very useful constituents of the ecosystem. Most times, the

resources that are used up or employed during construction processes are natural resources which in most cases cannot be replaced by artificial processes. These resources could range from trees to minerals to macro-organisms to their homes. This distortion in the flow pattern takes a long time to rebuild if it ever gets rebuilt. This distortion makes the cost of living a little more expensive every time it happens, unfortunately this occurrence has become a consistent event, hence the rise in the cost of living.

XII. MITIGATION STRATEGIES

These are ways by which we can reduce or lessen the environmental impacts of construction on the local ecosystem and generally as well. By conducting thorough site evaluations and environmental assessments, construction managers can identify potential site-specific risks and implement measures to address them proactively. Furthermore, regulatory requirements and compliance obligations must be carefully considered during the risk assessment process. The mitigation strategies are as follows;

- Accepting the possibility of risk and impact on the environment.
- Avoiding an impact altogether by not taking a certain action or parts of an action.
- Prioritize the risk and safety of the environment.
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
- Rectifying the impact by repairing, rehabilitating or restoring the affected environment.
- Document and monitor the risks, changes and impacts with time.

The impacts of construction can also be lessened by deliberately ensuring best practices in sustainable construction of roads, buildings and structures generally. The importance of regulatory frameworks in this sector cannot be overestimated, as the need to consistently check the workers at a site and ensure that they are not unnecessarily causing nuisance to the environment by way of pollution all through the construction process. The application of environmental policies will also curtail the impact of construction on our environmental. Enlightening the community members on the importance of balance of the ecosystem within them and also on the effects of construction on their immediate environment, will have them actively engaged, inform their decision-making process on what should be done. It will cause people to look out for themselves and seek to make better decision as regards construction while considering ecological balance.

XIII. CONCLUSION

The impacts of construction on local ecosystems and the environment as a whole is a menace that has come to stay. It can be said to be a problem amidst solutions. Construction of roads, buildings and structures are the pecks of civilization and industrialization, which cannot be put away rather we will have more of such structures on the strength of engineering and technology. This development however, constantly puts the balance of the ecosystem at stake. As it distorts and destabilizes the natural habitats of organisms, flora and fauna, disrupts the flow of the energy chart, reduces the quality of the air, destroys natural resources and a plethora of other cons associated with construction activities and processes.

Civil engineering and construction has in no little way made life better, it still promises to do more. Looking at the effects of construction alone will paint a bad picture of the concept. To reduce these effects this research proposes a more detailed approach in the phases of the construction process to ensure the risks and impacts involved during and after the construction are identified and mitigation strategies are employed.

It also implies that policies against illegal structures and construction would be enacted and taken seriously, people are enlightened on the impacts of construction on the ecosystem and how it affects their life. This simply means that every civil engineer engaging in construction activity must plan not just for the structure but on the effect of the structure on the ecosystem and ways of mitigating such effects.

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