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Building the Nature Sensitive Way: A Review of Approaches of Ecosystem Replacement and Restoration in Construction Sector

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Abstract - Nature insensitive construction activities have obliterated the fate of life on Earth.Thus the the present paper on "BUILDING THE NATURE SENSITIVE WAY - A Review Of Approaches Of Ecosystem Replacement And Restoration In Construction Sector "gainsimportance. This narrative review focusses on concepts of' Ecosystem Replacement And Restoration'. It aims at sensitization of mindsets of construction sector stakeholders to opt for nature sensitive approaches in decision making. The study builds upon qualitative analysis of secondary data collected through literature review to exploreviable solutions. The paper calls for further research for deeper technological insights and quantification of impacts.

Keywords - Anthropogenic, Ecosystem, Restoration, Replacement

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INTRODUCTION

Unscrupulous human interventions in construction sectorhave replaced land and habitats within ecosystems instrumental for vital ecological services subsequently pressurizing remaining habitats to compensate for it. This demands urgent replacement and restoration action to ensure ecological health by reversing the damages to the structure and/or functions/services of ecosystems. The best solution would be taking nature as a role model for developing nature sensitive strategies, whose products would be integral part of nature. The conservative concept of Ecosystem Replacement or Ecosystem Integration states that any intervention to nature must be modelled as per replications of natural systems so as to minimize negative impacts. Adding upon this is the curative concept of Ecosystem Restoration that propagates ecological retrofitting to recover disturbed ecosystems. As per SER "Ecological restoration is an intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity and sustainability". The present paper qualitatively addresses above concepts and their methods. It excludes the quantification of impacts and technological advancements as it becomes too exhaustive wrt limited space available here. The intent of the review paper is to motivate construction stakeholders to adopt methods that not only result in resource efficient non-polluting climate responsive edifices at the project level but also are ecologically responsible globally. The paper also serves as a organized datum for academia for deeper insights on quantification of their ecological advantages, contextual variations and technological advancements.

With concern for contributing to the healing process of disturbed ecosystems an in-depth study was carried out from secondary internet sources on related scholarly topics and in person experiences, for attaining clarity on concepts and methodologies for Ecosystem Replacement and Restoration. These data were qualitatively analyzed to access the applicability of the above methods in varied Indian contexts. The narrative review concluded with an end note on best applicable Ecosystem Replacement and Restoration solutions in present day scenario.

CONTEMPORARY ECOSYSTEMSCENARIO

The components of ecosystem symbiotically exist at a geographical location within the boundaries of built

world. To make this non-invasive towards nature a clear understanding of nature's environmental activities, actions and reactions of the ecosystem should be reflected in its designing.

Ecosystem is a dynamic complex of plants, animals and micro-organism communities and their non-living environment interacting as a functional unit at different scales ranging from a grain of soil to an entire planet (Article 2 , CBD , 2019). Of the six broad groups of ecosystems as defined by UNTowns , Cities and Farmlands are mostly over exploited by construction sector affecting theirecosystem services namely air & water purification, detoxification, cycling of nutrients, waste decomposition etc. If not recovered well it leads to loss of biodiversity and impairment of the physical environment sabotaging the prospects of our future generations.

Impacts of construction sector

The construction sector is responsible for 23% of global air pollution, 40% of drinking water pollution , and 50% of the landfill dumps. (2021). Though theseimpacts are global in extentbut they need local remedial strategy for sustainability. These impacts can be on-site impacts or off site impacts some of which are listed below:

On site impacts - soil disturbances, sedimentation and erosion, disturbance, fragmentation and destruction of habitats leading to biodiversity loss, air, water table and soil contamination, thermal gain and glare, uncontrolled wind flow, disturbed hydrology, noise and light pollution affecting feeding and breeding behaviors of species, soil, water and air pollution, vegetation loss etc.

**Off site impacts - ** storm water flooding, undue pressure on sewage disposal system, near by water body contamination, air, water and soil pollution, altered hydrology, GHG emissions, wetland drainage etc.

THE HEALING PROCESS

Self cleaning and recovery of ecosystem can be manifestedeither by Ecological Replacement / Integrationand/or Ecological Restoration / Regeneration

Ecological Replacement / Ecological Integration

This conservative concept advocates introduction of eco-sensitive built environment that are best suited to the local ecology and thus act as a perfect replacement for the displaced ecosystems by becoming an integral part of its fabric there by reducing probable damages to it.They are time tested age old methods built upon local climatic, ecological, geographic and geological realities and technological knowhow and are popularly termed as 'Vernacular Architecture'. It is characterized by site adaptation, bio-climatic approach with micro-climatic influences, energy and resource efficiency and non-polluting disposition.

Figure 1: Vernacular Laterite Stone Work In Contemporary Architecture (10 Examples of Contemporary Vernacular architecture, 2022)

Indian vernacular forms are multifarious due to its wide range in climatic, geographic and socio-cultural variations. Prominent examples , but not limited to , found in various geographic contexts are as follows:

Table 1: Prominent Examples of Vernacular Architecture Of India

NAME	PICTURE	LOCATION	CLIMATE	BIO-CLIMATIC FEATURES
Koti Banal		Uttarakhand, Northern India	Cold- Dry	Thick dry stone masonry for thermal mass Minimum opening to trap heat Lowermost and uppermost not for habitation to avoid anthropogenic heat loss Sloped slated roof to accommodate snowfall
Bhunga		Kuchh, Western India	Hot-Dry	Mud brick construction for thermal mass and cooling Opening at low level to trap cool breeze Cylindrical shape to avoid wind load
Bamboo House		Assam, North-Eastern India	Warm-Humid	High plinth for flood safety Open spaces at front and back for cross ventilation Gable / hip roof for draining rain water

Chuttillu		Visakhapatnam, South India	Warm-Humid	Heavy overhang of thatched roof for rain & sun protection Thatch, less openings and mud construction for thermal comfort Circular form and close proximity to bounce off cyclonic winds
Havelis		Jaisalmer, Western India	Hot-Dry	Thick stone walls for thermal mass Courtyards &jallis for cooling Close placements for mutual shading Jharokhas&chhajjas for shading
Courtyard type Kerala houses		Kelara, Southern India	WrmHumid	Central courtyard with deep verandah for cross ventilation and sun protection Water tank in courtyard for rain water harvesting Heavy thermal mass walls

Ecological Restoration / Ecological Regeneration:

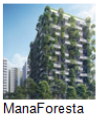
This concept advocates restoration activities introduced into built confines of disturbed ecosystems that initiates or accelerates its revival to the most appropriate contemporary parlance. The methods adopted for this are ecological incorporation and bio mimicry.

Ecological Incorporations :

Ecological incorporation means inclusion of displaced habits within the confines of the built environment aiming to revive ecological services. Some examples in Indian context are are listed below:

Figure 2 : Mangrove restoration at Palk Bay, India (What is ecological restoration ?)

Table 2 : Ecological Incorporations In Indian Context

NAME	DESCRIPTION	EXAMPLE	ECOLOGICAL SERVICES IN INDIAN CONTEXT	ISSUES
Green Roof/Terrace Gardens	Roof top covered fully or partially with plants. Can be intensive or extensive	 CII-Sohrabji Godrej GBC, Hyderabad  Krushi Bhawan, Bhubaneswar	Controls UHI Sound barrier Storm water management Air-water purification Habitat generation Greenery	Heavy load Root intrusion Seepage Special growing media Screening from wind Cost intensive
Green Walls	Vertical structures covered with vegetation	 ELT Green wall at HDFC Mumbai	Aie0water purification Storm water management Air cooling Noise control Psychological relief	Special growing media & irrigation needs Only specific plant species are applicable Moisture damage of vicinity
Water scaping	Imitation of natural water bodies in landscaping	 Vellapaya Amballa Kulam , Kerala	Climate moderation Biodiversity booster Visual and auditory relief	Air Humidification in warm & humid climates Mosquito & insect issues Regular cleaning needs Breeding ground for water borne diseases
Vertical Forests	High rise residential building with staggered balconies for vegetation, housing humans, plants , birds and insects	 ManaForesta , Bengaluru	Psychological relief Anti-sprawl Biodiversity booster Air-water purification Storm water management	Wind abatement needed Insect problems in interiors Heavy loading
Hydroponics& Aeroponics	Modular pods with hydroponic/ aeroponic plants independent of soil & irrigation needs	 Aqua Farms Chennai	Soil & water conservation Independent of geographic & climatic variations Better pest & disease control Nutrient efficiency Maximum yields Air purification	Expensive Dependence on power supply Constant monitoring is needed Water borne diseases Lack of soil barrier affects plants
SUDs	Drainage system integrated into landscaping mimicking natural hydrology like bio-swales, rain gardens, infiltration features , retention detention ponds etc		Storm water management- Urban flood control Controls UHI Air-water body purification Ground water recharge Biodiversity booster Greenery	Limited technical know how Interface of on ground SUDS with other urban systems not yet developed SUDS involves multi-stream contributions that complicates decision making

Artificial Wetlands	Replication of natural wetlands for natural waste water treatment	 South Delhi Biodiversity Park	Natural waste water purification Habitat for wetland organisms Storm water management	Lower hydraulic load and higher performance variability Intensive land use Inadequate decontamination for highly toxic wastes Residues are polluting
Native Species Landscaping	Resource efficient landscaping involving native plants	 Farm Owned By Ajit & Radha Shelat, Pune	Conserve water wrt irrigation, fertilizer, weedicide Reduce pollution Biodiversity booster Low maintenance Cost effective	Look wild & ill maintained Attracts pest
Pollinator parks	Parks housing habitats replication of pollinators	 Pollinator park Uttarakhand	Biodiversity conservation Habitat creation	Viable only in climates that suite the pollinators Involves extensive chunks of land

Bio Mimicry:

As per Bio mimicry 3.8, "biomimicry is learning from and then emulating natural forms, processes, and ecosystems to create more sustainable designs".It doesn'treplace function of old disturbed habitats, rather it designs the buildings and structures so as to contribute to ecological services.Some examples from Indian context are listed below:

Table 3: Bio Mimicry In Indian Context

NAME	IMAGE	LOCATION	CLIMATE	FEATURE	ECOSYSTEM EMULATION
Lotus Temple		New Delhi	Humid Sub-tropical & Semi-Arid	Form replicating lotus flower , high roofing with overlapping petals	Sun protection along with natural daylighting
Lavasa township		Pune,	Tropical Wet & Dry	Water channelled through out the city Roof tops modelled like native banyan fig leaf	Water channelled replicating the ants pattern Roofing helps in self cleansing and water runoff
Hive, residence		Surat,	Tropical Savana Climate	Solar sensor based building façade, replicating honeycomb and carbon crystals	High quality daylighting with thermal comfort
Aakash Skyscraper (Design stage)		Mumbai,	Tropical Wet & Dry	Building replicates tree like structure branching above the city level	Panoramic city view along with air purification
Morarjee Textile Factory		Nagpur	Dry or Semi Humid Tropical Climate	Hierarchical structures in Euplectella glass sponge manifested in light weight roofing	Filtered natural lighting Abundant solar power harvesting
The Tote restaurant		Mumbai,	Tropical Wet & Dry	Elaborate truss system inspired by rain trees present on the site before construction	Psychological contextual continuity

(https://www.re-thinkingthefuture.com/designing-for-typologies/a2949-6-examples-of-biomimicry-architecture-in-india/)

DISCUSSION AND CONCLUSION

Taking lessons from this exhaustive literature studywe understand that construction activities are not fundamentally nature intrusive if carried out according to nature sensitive 'Ecosystem Replacement' concept. Ittakes nature as a inspiration in the built form with multifarious manifestation as per regional contextual realities. Any subsequent disturbance can be recovered and/or general health of the ecosystem can be maintained by 'Ecosystem Restoration' strategies that compensate for the ecological. Thus we conclude that above concepts are inevitable for sustainable survival of life on Earth.

REFERENCES

Society For Ecological Restoration. (2022)."What is ecological restoration ?"

https://www.ser-rrc.org/what-is-ecological-restoration/#:~:text=Ecological%20restoration%20is%20the%20process,environment%20as%20a%20functional%20unit.

ARCHDESK. (2021, March 04). "How Does Construction Affect The Environment?"

https://archdesk.com/blog/how-does-construction-affect-the-environment/

Gretchen C. Daily, Susan Alexander, Paul R. Ehrlich, Larry Goulder, Jane Lubchenco, Pamela A. Matson, Harold A. Mooney, Sandra Postel, Stephen H. Schneider, David Tilman, George M. Woodwell.(2013,March). "Ecosystem Services: Benefits Supplied to Human Societies by Natural Ecosystems"

https://www.esa.org/wp-content/uploads/2013/03/issue2.pdf

Hopkins, W. (2014, November 18). "The nature of cities."

https://www.thenatureofcities.com/2014/11/18/building-ecological-services-restoring-the-ecosystem-services-of-the-habitats-we-are-replacing-with-human-development/

Ogletree, A. (2015, July, 24). " Everything You Need to Know About Environmentally-Friendly Permeable Pavers."

https://www.angi.com/articles/environmental-benefits-permeable-pavers.htm

The Constructor "Constructed-Wetlands-Components-Mechanism-Advantages."

https://theconstructor.org/environmental-engg/constructed-wetlands-components-mechanism-advantages/555730/

Xie, J. (2019, August 09). "Vertical forests may help solve climate change and housing shortages."

https://archive.curbed.com/2017/8/9/16059384/vertical-forest-italy-climate-change

Hydroponics University. "Grow-your-own-what-fits-you-best."

livingreenglobal.com: https://livingreenglobal.com/grow-your-own/grow-your-own-what-fits-you-best/

Hydrologia Sotenible "Sustainable-Urban-Drainage-Systems-suds"

www.hidrologiasostenible.com: http://www.hidrologiasostenible.com/sustainable-urban-drainage-systems-suds/

Hopkins, W. (2014, November, 18). " Building-ecological-services-restoring-the-ecosystem-services-of-the-habitats-we-are-replacing-with-human-development.'

www.thenatureofcities.com: https://www.thenatureofcities.com/2014/11/18/building-ecological-services-restoring-the-ecosystem-services-of-the-habitats-we-are-replacing-with-human-development/

Rethinking Future. (2022)."10 Examples of Contemporary Vernacular architecture.

www.re-thinkingthefuture.com: https://www.re-thinkingthefuture.com/rtf-fresh-perspectives/a1935-10-examples-of-contemporary-vernacular-architecture/

Rethinking Future.(2022)"6-Examples-Of-Biomimicry-Architecture-In-India"

https://www.re-thinkingthefuture.com/designing-for-typologies/a2949-6-examples-of-biomimicry-architecture-in-india/

Levin H.(1995, September). "Building Ecology: An Architect's Perspective -- Plenary Lecture"

https://www.researchgate.net/publication/267631638_Building_Ecology_An_Architect's_Perspective_--_Plenary_Lecture

Teha,S H, Wiedmanna,T, Schinabecka,J, Moorea,S,(2017,04) "Replacement Scenarios for Construction Materials Based on Economy-wide Hybrid LCA"

https://www.sciencedirect.com/science/article/pii/S1877705817316843

Aslem, A J, (2006) "Building with Nature (Ecological Principles in Building Design)"

https://scialert.net/fulltext/?doi=jas.2006.958.963

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