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From the Editor's

Dear Readers,

In the January issue of our Newsletter, we received several popular articles from diverse fields. All the authors deserve great appreciation for sharing articles in huge numbers. Please continue sending articles to our Publication team and share published newsletter with your friends also.

I would like to thank the Editorial team including Print, Designer and Publication committee for their efforts throughout the edition.

Your suggestions are always welcomed for improvement.

Dr. R. S. Tomar
Editor-in-Chief

THE SILENT SHIFT: TUSKLESS ELEPHANTS AND INDIA'S WILDLIFE FUTURE

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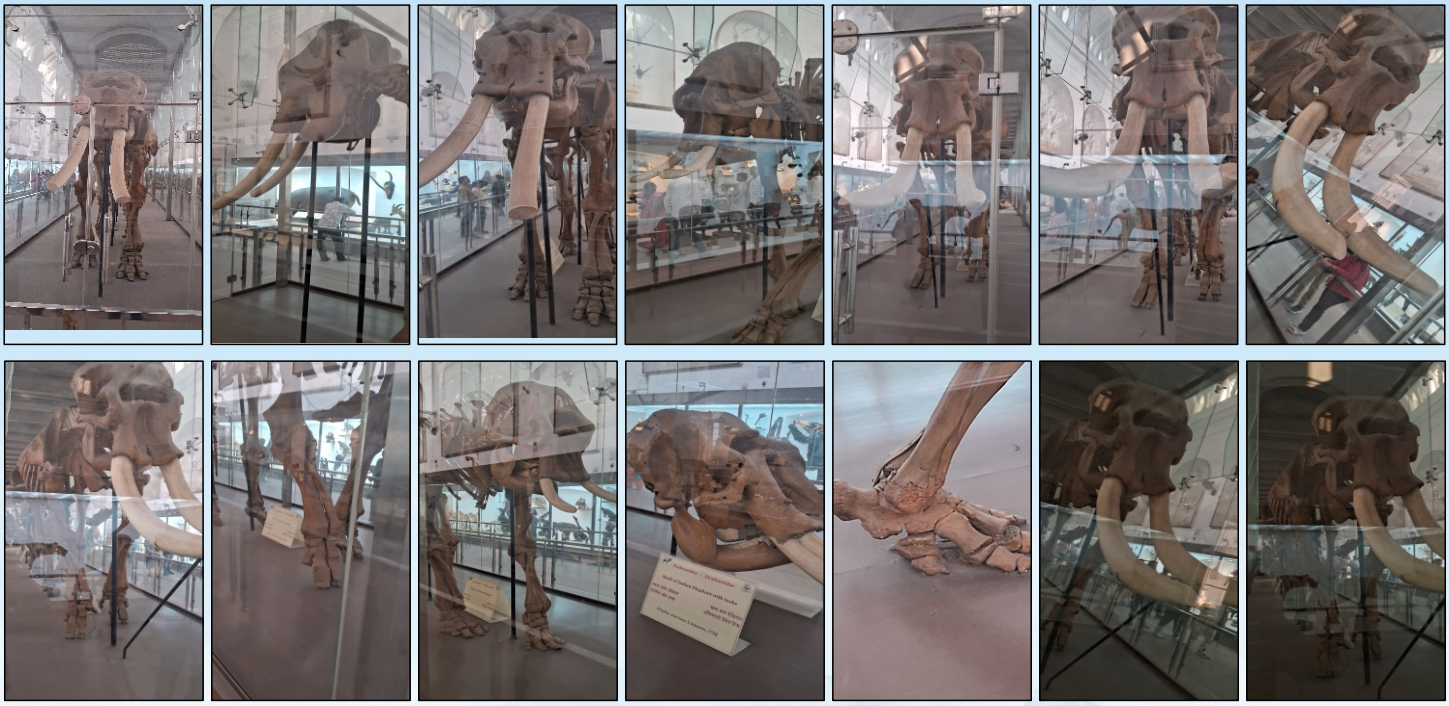
Just like others, I love wildlife and biodiversity; and am concerned about their successful conservation. What prompted me to work on this particular article was a recent visit to the Indian Museum in Kolkata. I was amazed to locate the gigantic skeletons and tusks of Indian elephants displayed in the Zoology Gallery of the museum from the early 1900s and earlier. The monumental heights of these preserved skeletons and lengths of the tusks in display made me look into the past, searching answer for a question. Do current elephant populations in India demonstrating smaller average body heights and shorter tusks compared to their ancestors? Yes, there is some evidence suggesting that modern elephant populations in India are showing trends toward smaller body sizes and shorter tusks compared to their ancestors. These changes are likely the result of both natural and human-influenced selection pressures, including:

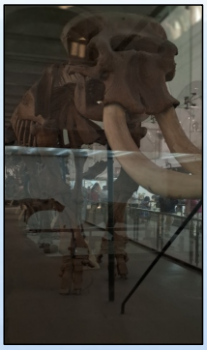
1. **Poaching and Human Conflict**: Elephants with larger tusks are more likely to be targeted by poachers. Over time, this has led to increased survival and reproduction of elephants with smaller or no tusks. In some regions, tusklessness in Asian elephants (which already occurs naturally in some females and a minority of males) may be increasing.

2. **Habitat Fragmentation**: With reduced and fragmented habitats, smaller-bodied elephants may have a survival advantage, requiring less food and being more manoeuvrable in tight forested areas.

3. **Historical Comparisons**: Historical records, temple carvings, and colonial-era accounts often describe or depict larger elephants with prominent tusks.

Comparisons with skeletal remains and fossil records support the idea of a gradual size reduction over centuries, though data can be limited. These changes are more





noticeable over generations and may vary by region. There's still ongoing research on how significant and widespread these trends are in Indian elephant populations. There is compelling evidence that Indian elephant populations are exhibiting trends toward smaller body sizes and shorter or absent tusks compared to their ancestors. These morphological changes are influenced by a combination of human-induced pressures and environmental factors.

Tusklessness and Shorter Tusks

Regional Variations in Tusklessness: In North Eastern India, particularly in Assam and neighbouring states, studies have found that approximately 60% of male elephants are tuskless (known as "makhnas"). This contrasts sharply with southern India, where less than 10% of males are tuskless. The high prevalence of tusklessness in the Northeast is attributed to centuries of selective removal of tusked males for military use and ivory trade, leading to a genetic shift in the population.

Impact of Poaching on Tusk Size: In regions like Karnataka, rampant poaching between the 1970s and 1990s significantly reduced the number of large-tusked males. This selective pressure has led to a noticeable decrease in tusk size over generations. For instance, tusks seized before the 1980s often weighed over 80 kg and measured up to nine feet, whereas recent seizures rarely exceed 40 kg.

Body Size and Habitat Fragmentation: While direct studies on reductions in body size are limited, habitat fragmentation and loss have likely influenced elephant morphology. Between 1930 and 2013, India lost approximately 24.68% of its forest cover in elephant ranges, with core forest areas shrinking by nearly 40% . In the Western Ghats, over 16 lakh acres of elephant habitat were lost between 1960 and 2004, severing critical corridors and increasing human-elephant conflicts.

In fragmented landscapes like the Anamalai Hills, elephants have adapted by altering their habitat use patterns. They prefer riparian vegetation and rainforest fragments, especially during the day, and avoid large monoculture plantations and human settlements. These behavioural adaptations may favour smaller body sizes, which require less food and are more manoeuvrable in constrained environments.

Ongoing Research and Conservation Efforts: Researchers from institutions like the Indian Institute of Science are conducting genetic studies to understand the decline in tusk size and the increase in tusklessness. By analyzing DNA from tusks and blood samples, scientists aim to identify the genes responsible for tusk development and assess how these have changed over time.
Conservation initiatives, such as Project Elephant, have been launched to address these challenges. Established in 1992, Project Elephant focuses on habitat protection, mitigating human-elephant conflicts, and ensuring the long-term survival of elephant populations through a landscape-level approach.

Here are more detailed insights on regional patterns and conservation programs related to elephant tusk and body size changes in India:

1. **Regional Details**:
Northeast India (e.g., Assam, Arunachal Pradesh)

High tusklessness: Up to 60% of males are tuskless (makhnas).

Historical pressure: Elephants were captured for logging and military use; tuskers were preferred, reducing their numbers.

Genetic implications: This selective pressure likely passed on tuskless traits.

Southern India (e.g., Karnataka, Tamil Nadu, Kerala)

Tusked elephants more common, but with shorter tusks than in historical records.

Poaching impact: Intensive poaching in the 70s–90s significantly reduced large-tusked bull populations.

Recovery slow: Males with large tusks are now rare, and shorter tusks are increasingly common.

Western Ghats (Nilgiris, Anamalais, Periyar)

Habitat fragmentation has isolated elephant groups.

Adaptations: Elephants in fragmented forests may be evolving toward smaller body sizes due to limited forage and space.

2. **Conservation Programs & Research**
Project Elephant (MoEFCC, 1992–present)

Aims to:

Protect elephant habitats and corridors.

Reduce human-elephant conflict.

Monitor populations scientifically.

Includes monitoring tusk trends in states like Odisha and Jharkhand.

Genetic Research by Indian Institute of Science (IISc)

Ongoing studies on genetic factors influencing tusklessness.

Uses DNA from confiscated ivory and blood samples.

Early results suggest heritable factors driving the change in tusk size.

NGO-Led Corridors Projects
NGOs like the Wildlife Trust of India and WWF have mapped 88 elephant corridors.






Efforts are being made to secure and restore these corridors, improving gene flow and habitat access.
While a detailed, up-to-date map is not readily available, existing studies provide insights into regional variations:

Northeast India (e.g., Assam, Arunachal Pradesh): Reports indicate that up to 60% of male elephants are tuskless, known locally as makhnas. This high prevalence is attributed to centuries of selective removal of tusked males for warfare and, more recently, ivory poaching.

Southern India (e.g., Karnataka, Kerala, Tamil Nadu): Tusklessness among male elephants is significantly lower, with estimates below 10%.
These patterns suggest that historical human activities have influenced the genetic makeup of elephant populations in different regions.

Summaries of Key Scientific Studies on Tusklessness

1. **Historical Human Influence on Tusklessness in Northeast India**

   Findings: Centuries of selective capture of tusked elephants for military purposes and sustained ivory poaching have led to a higher proportion of tuskless males in Northeast India.

   Implications: This long-term human intervention has likely caused genetic shifts favoring tusklessness in the region's elephant populations.

2. **Genetic Basis of Tusklessness in African Elephants**
   Study: Research in Mozambique's Gorongosa National Park observed a rise in tuskless female elephants from 18.5% to 50.9% following intense poaching during the civil war.

   Genetic Insights: The tuskless trait is linked to mutations on the X chromosome. Females with one copy of the mutation become tuskless, while males inheriting the mutation may not survive, explaining the scarcity of tuskless males.

   Relevance to Indian Elephants: While this study focuses on African elephants, it underscores how intense poaching pressure can drive rapid evolutionary changes, a concept applicable to Indian elephant populations as well.

Tusklessness in Indian Elephants: Regional Insights

Assam: A High Prevalence Region

Makhnas (Tuskless Males): In Assam, tuskless males, locally known as makhnas,

Tusklessness Trends in Indian Elephant PoPopulations

Assam

Tuskless Males (Makhnas): 64.5%

Tusked Males (Tuskers): 32.8%

Ganesh-type Males: 2.7%

These figures highlight the dominance of tuskless males in Assam's elephant population.

Kerala

Total Elephant Population (2023): Approximately 2,386 individuals

Makhnas: Data not explicitly available; however, the adult sex ratio is 1:2.56 (male:female), indicating a higher proportion of females.

Tamil Nadu

Total Elephant Population (2023): Approximately 3,063 individuals

Makhnas: Data not explicitly available; the adult sex ratio is 1:2.03 (male:female), suggesting a balanced male-to-female ratio.

While specific percentages for tuskless elephants in Kerala and Tamil Nadu are not easily available data, the provided figures offer insights into the general trends. Assam exhibits a significantly higher proportion of tuskless males compared to the southern states.

Photo credit: ***Saikat Kumar Basu***

Solar power significantly benefits the environment by providing a clean, renewable energy source that reduces greenhouse gas emissions, lowers air pollution (nitrogen oxides, sulfur dioxide), and cuts down on carbon footprints. It reduces dependence on fossil fuels, conserves water, minimizes land degradation, and promotes sustainability.

BOOK REVIEW: 'BANKURA CHARCHA' (STUDY OF BANKURA)

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'Bankura Charcha' (Study of Bankura) edited by Ashis Pandey and published by Banglar Abhash Prokashoni on January, 2026 [Soft Paper back, 256 pages, Rs. 315/] is an ambitious edited volume that seeks to map the many dimensions of Bankura district in West Bengal from its deep history and living cultures to its ecological features, socio-economic fabrics, literary expressions and numerous future possibilities. Bringing together scholars from literature, linguistics, history, anthropology, geography, geology, economics, art history, agriculture, environmental and development studies, the edited book offers readers a comprehensive portrait of one of eastern India's most intriguing yet under-represented regions.

The strength of this volume lies in its design. Rather than treating Bankura through a single lens, the editors have organized the book into thematic sections that reflect perspectives, place, people, and progress.

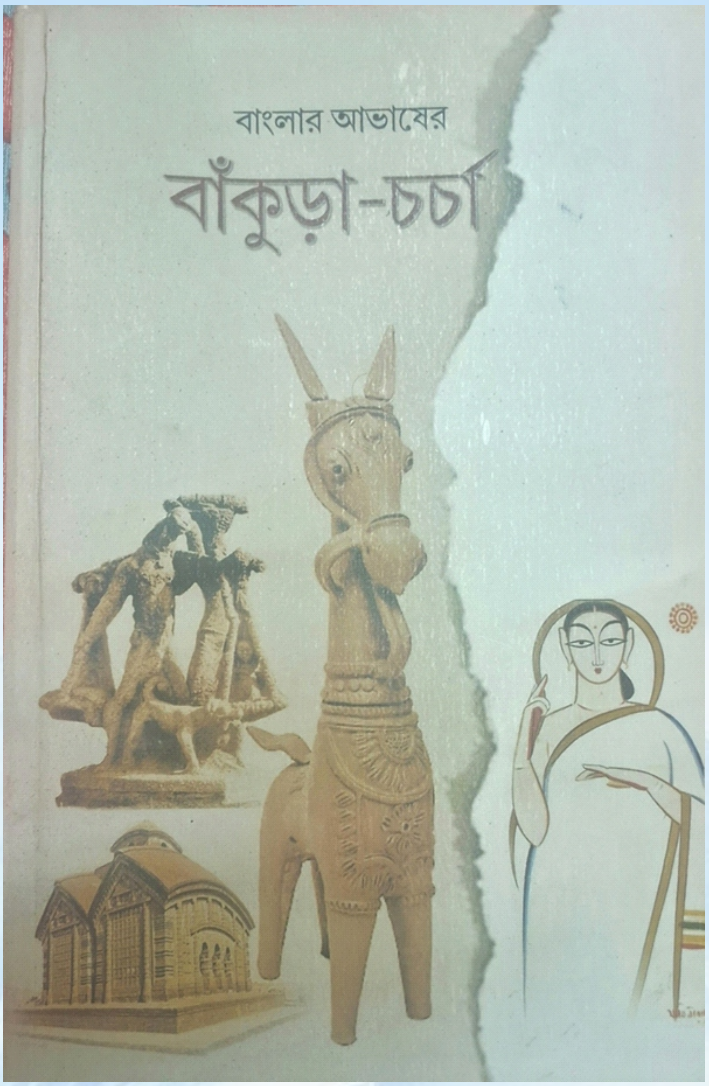
Historical and archaeological foundations:
Essays in this section trace Bankura's past from prehistoric settlement patterns and archaeological finds to medieval polity and the dynamics of colonial encounters. Contributors vividly reconstruct how the district's identity was shaped over centuries, grounding contemporary realities in deep time.

Culture, religion, and material traditions:
This section is among the most entrancing. Rich descriptions of terracotta art, folk music (including Bhawaiya and tribal song traditions), and ritual practices reveal how creativity and spirituality animate everyday life in Bankura. These chapters balance academic rigor with storytelling; making them accessible beyond specialist audiences.

Socio-economic landscapes: Demography, agrarian change, rural livelihoods, and migration feature heavily here. Clear data analysis is paired with on-the-ground vignettes, offering readers both macro trends and the texture of lived experience. Discussions around caste, gender, labor, and education thoughtfully illuminate structural inequalities while also pointing to local agency and resilience.

Ecology, environment, and land: Bankura's varied terrains from the lateritic plateaus to forest margins; get careful ecological attention. Topics include groundwater stress, soil conservation challenges, biodiversity surveys, and community responses to climate pressures. These essays are both scientifically grounded and policy-relevant.

Governance, development, and futures: The final section assesses public policy, governance mechanisms, rural



infrastructure, tourism potentials, and cultural heritage conservation. It rounds out the volume by asking not just "what is Bankura?" but "what might Bankura become?" — making this book especially valuable for planners, activists, and educators.

What works well-interdisciplinary collaboration: The editor's greatest achievement is his unique ability to let multiple disciplines talk to each other without losing depth. The editors' curation ensures thematic continuity while preserving disciplinary integrity.

Balance of theory and practice: Academic sophistication is always anchored in empirical examples. Readers learn concepts and see how they play out in everyday Bankura life.

Inclusivity of voices: Alongside academic essays, the volume features narratives from local artists, government officials, farmers, and activists — a decision that democratizes knowledge and challenges top-down representations.

Constructive Critiques
Variable writing styles: Given the multidisciplinary authorship, some chapters lean toward dense academic

language. A clearer editorial tone across pieces would strengthen readability for general audiences.

Urban bias in some sections: While rural life is prominently featured, a few planning and development chapters rely heavily on comparisons with urban models that may not fully reflect rural priorities or grassroots imaginaries.

Limited engagement with digital transformations: While the book explores many contemporary changes, more attention to digital connectivity — its effects on youth culture, education, and local economies — would make the volume even more comprehensive.

Lack of visual and cartographic support: Maps, photographs, and interpretive charts could have enhanced better understanding, especially for readers unfamiliar with Bankura's geography or cultural markers.

Conclusion

'Bankura Charcha' is a landmark contribution that succeeds not just as a regional volume but as a model for place-based interdisciplinary scholarship. It opens Bankura to readers, researchers, policymakers, and practitioners alike — inviting them to appreciate the district as a lived, layered, and dynamic space rather than a flat administrative unit.

Whether you are a student of South Asian studies, a development professional, a curious traveler, or someone with roots in Bankura, this book offers fresh insights, respectful representation, and a compelling invitation to think deeply about place, people, and possibility. A must-read for anyone who seeks to understand Bankura beyond postcards — rooted in history, rich in culture, and responsive to the challenges of our times.

REGENERATIVE AGRICULTURE: A NEW WAY FORWARD FOR INDIA AGRICULTURE RESEARCH & BENEFITS TO INDIAN FARMERS

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Introduction

Indian farmers achieved food security from early on to the practices implemented from green revolution. But it also had heavy pressure on the soil, water, and the environment. The overuse chemicals, monocropping, residue burning has weakened the soils. Farmers today face rising input costs, unpredictable weather, and declining soil fertility. Similarly, groundwater levels are falling, irrigation costs are rising, and farming has become increasingly dependent on external inputs. At the same time, climate change has made weather patterns more unpredictable—long dry spells, sudden floods, and heatwaves now threaten crops with little warning. Especially smallholders, agriculture has become riskier, more expensive, and less reliable. Regenerative agriculture is emerging as a hopeful alternative. Instead of viewing land simply as a resource to be exploited. It treats the farm as a living system. Its focus goes beyond short-term yields to long-term soil health, water balance, biodiversity, and climate resilience.

History of Regenerative Agriculture

Regenerative agriculture practices are not the new practices for the farmers. For centuries, around the world and India the farmers are practicing the traditional practices. Followed by principles mixed cropping, livestock integration, organic manures, and respect for natural cycles. It gained recognition in the 1980s by Rodale institute. The concept emphasized about sustainability, not just maintaining resources, but actively restoring soil and ecosystems.

What Is Regenerative Agriculture?

Fig 1: Regenerative Agriculture and its principles.

Regenerative agriculture is an approach to farming that aims to restore and strengthen soil, water, and ecosystems while producing food. Instead of exhausting natural resources, it works with biological processes to rebuild soil organic matter and improve farm resilience.

Its core principles include:
1. Minimal soil disturbance
2. Keeping living roots in the soil year-round
3. Crop diversification in time and space

4. Reduced dependence on chemical inputs
5. Integration of livestock and trees

World-wide adoption of new approaches

Several countries around the world are now embracing regenerative agriculture as a key part of their climate action and food security strategies. In the United States, farmers are increasingly adopting practices such as cover crops, no-till farming, and rotational grazing, supported by advanced satellite-based monitoring systems that track adoption and impact across millions of agricultural fields. Across Europe, countries like Switzerland and France are promoting regenerative practices in both croplands and vineyards, closely linking them to goals of soil carbon storage, biodiversity conservation, and sustainable land management. Meanwhile, Australia and parts of Latin America are using regenerative grazing and agroforestry systems to restore degraded lands and improve ecosystem health. What makes these international efforts effective is not just the practices themselves, but the strong foundation of scientific monitoring, farmer incentives, and long-term policy support, which together ensure that regenerative agriculture delivers measurable and lasting benefits.

India adoption approaches

In India, regenerative agriculture is taking shape in many practical ways, driven by state governments, research institutes, farmer groups, and private companies working together. For example, in Andhra Pradesh, natural farming movement has encouraged lakhs of farmers to reduce chemical use, improve soil biology, and lower input costs through methods such as mulching, mixed cropping, and natural inputs. Diageo India, working with The Nature Conservancy India, has launched a regenerative agriculture programme in Punjab and Haryana to support rice–wheat farmers. The focus is on direct seeding, crop residue management (to reduce stubble burning), efficient irrigation, improved soil health, and agroforestry practices that save costs and protect the land. At the same time, science-based organisations like International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), in partnership with the Government of Odisha, are helping farmers restore degraded lands through soil conservation, rainwater harvesting, and diversified cropping systems. These efforts show farmers that regenerative agriculture is not about complicated technology it is about better soil, lower costs, and more reliable harvests.

Role of agricultural research in regenerative farming

Agricultural research institutions and scientists are supporting regenerative agriculture through advanced tools such as remote sensing, soil carbon models, and field-based measurements. Satellite data help monitor crop cover, residue retention, tillage, and land-use changes at large scales, while models like RothC estimate long-term soil carbon dynamics under different practices. Field soil sampling validates these results, making regenerative agriculture measurable, reliable, and scalable for policy support and farmer incentives.

Fig 2: Regenerative agriculture: remote sensing, soil carbon models, and field-based measurements.

Regenerative Agriculture Benefits Indian Farmers

1. **Lower Farming Costs:** As soil health improves, farmers rely less on chemical fertilizers, pesticides, and frequent irrigation. This reduces production costs and dependence on external inputs.
2. **Improved Soil Fertility and Yield Stability:** Healthier soils retain nutrients and water more efficiently. While yields may not increase immediately, they become more stable over time, even under stress conditions like droughts or excess rainfall.
3. **Greater Climate Resilience:** Regenerative farms are better able to withstand climate shocks. Improved soil structure reduces crop failure risks and protects farmer incomes.
4. **Multiple Income Opportunities:** Practices such as agroforestry, livestock integration, and diversified cropping provide additional income sources from fodder, fruits, timber, and livestock products.

Carbon Credits: Soil Health into Income source

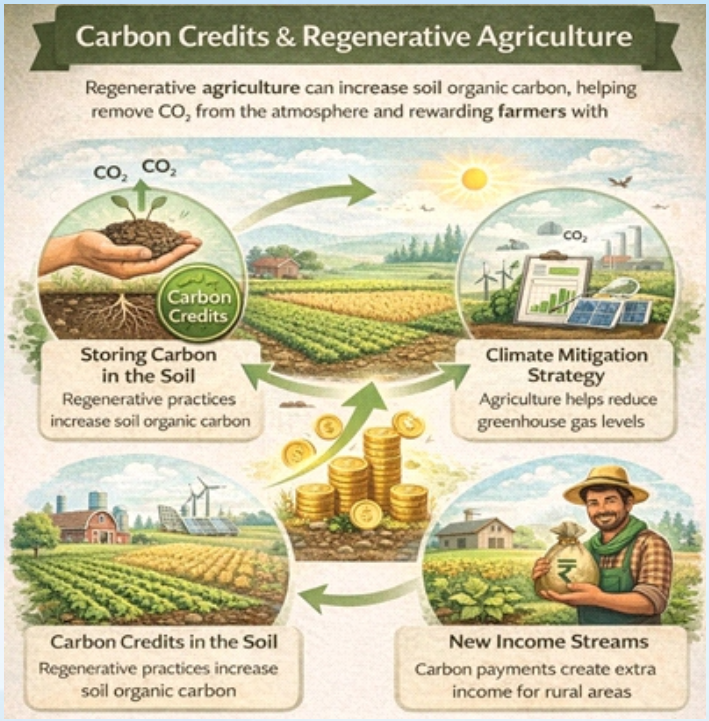

Fig 3.: Carbon credits for maintaining soil health.

One of the most promising opportunities linked to regenerative agriculture is carbon credits. As regenerative practices increase soil organic carbon, they help remove carbon dioxide from the atmosphere.

With reliable scientific monitoring:

1. Farmers can be rewarded for storing carbon in their soils
2. Agriculture becomes part of climate mitigation strategies
3. New income streams emerge for rural households

Conclusion

Regenerative agriculture offers more than a new set of farming practices—it offers a new vision for Indian agriculture. By combining traditional knowledge with modern research tools like remote sensing and soil carbon modelling, India can restore its soils while strengthening farmer livelihoods. For Indian farmers, regenerative agriculture means lower costs, healthier land, and greater resilience. For the nation, it means sustainable food security, climate action, and long-term ecological balance. In healing the soil, regenerative agriculture points toward a future where farming supports not just crops—but communities, ecosystems, and generations to come.

THERANOSTICS: IMAGING-GUIDED SMART DRUG DELIVERY SYSTEMS

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Introduction

The field of pharmaceutics is witnessing a rapid transition towards precision medicine, which involves the development of personalized treatments for patients. One of the most significant milestones in this direction is theranostics, a novel strategy that aims to combine both therapeutic and diagnostic capabilities in a single drug delivery system. Theranostic systems have the ability to deliver drugs to targeted tissues and visualize the distribution of the drug in real time. This is especially useful in cancer treatment, where the ability to assess the effectiveness of the treatment in the early stages is essential.

Concept and Importance

Conventional drug delivery systems have several disadvantages, including a lack of targeting, systemic toxicity, and delayed assessment of therapeutic response. Theranostics overcomes these challenges by providing a combination of targeted drug delivery and advanced imaging capabilities that enable the assessment of drug localization and therapeutic efficacy in real time. This is a major transition from conventional treatment to precision medicine.

Role of Nanotechnology

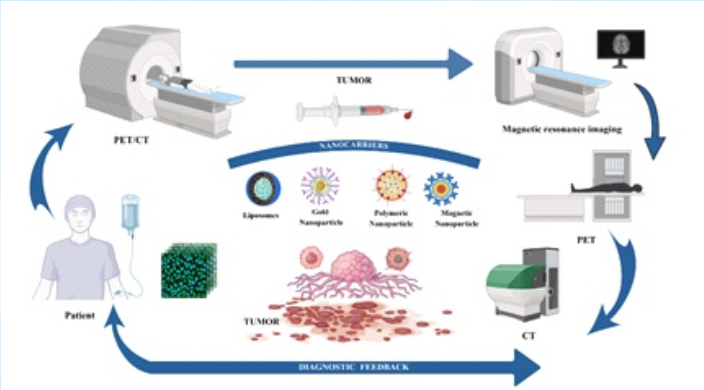
Nanotechnology is the core of theranostics. Nanocarriers can be engineered to deliver therapeutic and imaging agents to the target location simultaneously, thus increasing the efficiency of targeted therapies. The most popular nanocarriers are liposomes, polymeric nanoparticles, gold nanoparticles, and magnetic nanoparticles. These nanocarriers are multifunctional and can increase the accumulation of drugs in targeted tissues while decreasing the cytotoxic effects, thus increasing the efficiency of therapies.

Imaging and Analytical Tools

Theranostic agents use advanced imaging techniques such as fluorescence imaging, magnetic resonance imaging (MRI), positron emission tomography (PET), and computed tomography (CT) imaging to monitor the biodistribution of drugs in real time. Flow cytometry is also an important tool in preclinical research for analysing the cellular uptake of nanoparticles, apoptosis, and immune responses. These

tools together provide a comprehensive understanding of drug performance at the cellular and whole-body levels.

Applications in Cancer Therapy
Cancer therapy is the most prominent application of theranostics. Imaging-guided nanoparticles can be designed to selectively target tumors, deliver chemotherapeutic agents, and monitor the therapeutic response simultaneously. Examples of such theranostic agents include gold nanoparticles for photothermal therapy, magnetic nanoparticles for hyperthermia, and liposomal formulations containing imaging agents.



Future Outlook
The future of theranostic systems looks promising with advancements in AI-assisted nanoparticle design, stimuli-responsive drug carriers, and gene delivery monitoring. As imaging and pharmaceutical sciences are expected to merge further, theranostics is all set to change the future of targeted drug delivery.

Conclusion
Theranostics is a paradigm shift in the field of pharmaceutics, where diagnosis and therapy are combined into a single smart system. Imaging-guided drug delivery systems are opening a new chapter in the development of the next generation of precision medicine.

Reference

1. **Salgueiro MJ, et al.** Theranostic nanoplatforms in nuclear medicine. *J Nucl Med Mol Imaging*. 2025;6(4):27. Available from: https://www.mdpi.com/2624-845X/6/4/27
2. **Shanahan K, et al.** Polymer-based nanoparticles for cancer theranostics. *Explor Biomed X*. 2025; Article 101342. Available from: https://www.explorationpub.com/Journals/ebmx/Article/101342
3. **Yang Y, et al.** Magnetic nanomaterials for imaging and therapy in precision medicine. *Front Chem*. 2025;13:1595376. Available from: https://www.frontiersin.org/journals/chemistry/articles/10.3389/fchem.2025.1595376/full
4. **Wu Y, et al.** Nanotechnology for cancer theranostics and brain metastasis. *[Journal Name]*. 2025;[Volume(Issue)]:[Page numbers]. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC12151088/
5. **Li M, et al.** Companion theranostics and personalized medicine. *Nano Biomed Eng*. 2025; Article 9290112. Available from: https://www.sciopen.com/article/10.26599/NBE.2025.9290112

HIGHWAYS TO EXTINCTION? UNDERSTANDING ROADKILL'S ROLE IN BIODIVERSITY LOSS

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Understanding road kill: Definition and Scope
Road kill refers to wildlife that has been struck and killed by motor vehicles on roads and highways. While it might conjure a casual image of an animal on the roadside, the phenomenon represents a significant and often overlooked environmental issue with broad ecological, economic, and conservation implications.

Animals killed on roads range from small mammals and reptiles to large mammals like deer, as well as amphibians, birds, and even insects. In many parts of the world, roadways intersect natural habitats, creating zones of high wildlife mortality. Although the term usually refers to the carcass itself, scientists use “road kill” to denote the broader phenomenon of animal–vehicle collisions and resulting wildlife mortality.

Why Road kill Occurs: Key Contributing Factors
Road kill doesn't happen randomly. It is driven by a complex interplay of ecological behaviours, land use, road design, and human activity:

Wildlife behaviour and ecology: Animals move across landscapes to find food, mates, water, or shelter; often crossing roads in the process. Many species undertake seasonal migrations or daily movements between habitats. For example, amphibians migrating to breeding ponds in spring are highly vulnerable. Roads often attract animals because roadside vegetation or spilled food on roads can act as an unintended food source. Some animals regularly cross roads to patrol territories or seek mates.

Roadway characteristics: The design and layout of roads influence collision rates. More vehicles increase the likelihood of collisions. Higher vehicle speeds reduce drivers' ability to see and avoid animals. Wider roads with limited visibility at night make it harder for both drivers and animals to detect one another. Dense vegetation can obscure animals until they emerge suddenly onto pavement.

Habitat fragmentation: Roads act as barriers that fragment wildlife habitats. Roads can split continuous habitats into smaller isolated patches, forcing animals to cross open pavement. Some species adapt poorly to fragmented landscapes and may attempt riskier movements.

Human and environmental factors: Many animals are most active at dawn or dusk - precisely when visibility for drivers is lower. Rain, fog, or snow can reduce driver visibility and animal behaviour may change during certain weather conditions. As more land is developed and road networks expand, encounters between vehicles and wildlife increase.

Road kill's impact on ecology and conservation
Road kill is more than just an animal casualty — it has deep ecological and conservation consequences.

Loss of wildlife populations: For species with large ranges or small populations, repeated road kill events can significantly reduce numbers over time. Species already endangered or with low reproductive rates are especially vulnerable. Even small increases in mortality can push populations toward decline or extinction.

Genetic consequences: Roads can isolate populations, limiting genetic flow between groups and increasing the risk of inbreeding. Regular mortality at roads reduces gene pools, which can reduce resilience to disease and environmental change.

Ecosystem imbalance: Predator-prey dynamics is critical. If certain species (*e.g.*, small mammals) suffer heavy mortality; it can ripple through food webs. Dead animals along roads attract scavengers like birds or mammals. While this might seem benign, it can alter natural scavenging patterns and potentially increase secondary road kill.

Bird populations: Birds are among the most frequent victims, especially near highways. Flight paths that intersect roads expose species like raptors and ground-nesting birds to collisions.

Economic and human safety costs: Collisions with large animals like deer lead to substantial repair costs. In some regions, animal collisions result in serious accidents for drivers and passengers. Domestic animals near roads may also be hit, affecting local livelihoods.

Mitigating Road kill: Conservation Approaches
Conservationists, engineers, and planners have developed a range of strategies to reduce wildlife mortality on roads.

Wildlife crossings and fencing: Overpasses and underpasses are important for protecting wildlife from accidental road kills. Specially designed crossings allow animals to pass safely across or beneath roads. Proper fencing guides animals toward safe crossings and prevents random road access.

Road design and planning: Infrastructure planners increasingly factor in animal movement corridors when routing new roads. Clearing dense roadside vegetation improves visibility for drivers and animals.

Signage and speed reduction: Warning signs are important is saving lives as it alert drivers to areas with high wildlife activity. Reduced speeds during migration seasons can reduce collision rates.

Public awareness and technology: Education campaigns: Informing drivers about peak wildlife activity times and "hotspot" areas increases vigilance. Sensors detect large animals near roads and trigger warning signals for drivers in real time.

Data and monitoring: Apps and reporting platforms help track road kill occurrences, allowing targeted mitigation. Monitoring population trends and collision data guides effective conservation strategies.

Case Studies: Conservation success and challenges
Across the globe, varied initiatives have demonstrated both the challenges and promise of addressing road kill.

Amphibian tunnels in Europe: In several European countries, volunteers temporarily fence roads during migration seasons and help thousands of frogs safely cross.

Large mammal overpasses in North America: Structures in regions populated by elk and deer have resulted in substantial reductions in collisions. Secured and fenced crossing pathways across highways and railway tracks cutting through forests have been successfully designed in US & Canada too for big mammals.

Urban planning in Australia: Coordinated studies of koala road kill have influenced the placement of crossings and lowered speeds in sensitive eucalyptus corridors.

India: Overpasses are already there in Valparai, Gavi, Nelliyampathy, and Anamalai as well n Southern India. Similar rope ways are provided at Karnala bird sanctuary near Mumbai over Mumbai Goa National Highway.

Sri Lanka: Lion-tailed Macaque and other primates that include langurs, small mammals like squirrels also using overpasses designed exclusively for them to avoid road kills.

Despite these efforts, road kill remains a pervasive issue-particularly in developing regions where rapid infrastructure expansion often outpaces ecological planning.

Conclusion

Road kill is a highly complex and often ignored; but, serious conservation challenge. It illustrates the collision of human infrastructure with natural ecosystems. While the phenomenon may seem incidental, its aggregate effects on wildlife populations and biodiversity are profound. Addressing road kill requires multidisciplinary solutions, combining engineering, ecology, public policy, and community engagement. Ultimately, designing roads that respect both human mobility and wildlife needs is a key challenge of 21st-century conservation and how we manage road kill will have lasting impacts on the health and diversity of ecosystems worldwide.

Photo credit: **S. K. Basu**

Planting trees is essential for a healthier planet, as they clean the air by absorbing and pollutants while releasing oxygen. A single mature tree can provide oxygen for two people annually. They also cool cities, combat climate change, prevent soil erosion, and support biodiversity.

"Plant a tree and keep the flood at bay".

"Save the forests and change the climate".

"It is our collective and individual responsibility to protect and nurture the global family, to support its weaker members, and to preserve and tend to the environment in which we all live."

— Dalai Lama

Let's clear the air for Earth's future.

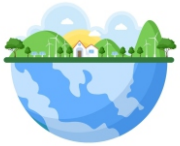
NESA Members are requested to share articles / write up for publications in NESA Newsletter
- Editor-in-Chief

NESA Members are requested to please send / share a short article on ***Agriculture / Environment and other related fields*** for the NESA Newsletter which is published monthly to circulate among the ***NESA Members and scientific / academic community***.

Chief Editor

Plant Tree

Save Environment



ENROLL YOURSELF TO
NESA NEWSLETTER EDITORIAL BOARD MEMBER

Editorial board members of NESA newsletter will be revised for the year 2026. All the interested applicants may send their curriculum vitae to **Editor in Chief** by **31st March., 2026.**