

# TATA's Green Revolution: A Pioneer in Corporate Solutions from Industry to Ecology for SDG-15 and Biodiversity Conservation

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## Abstract

*Population growth, coupled with industrial and colliery activities, is leading to habitat degradation and environmental deterioration, significantly impacting crucial eco-system services. In mining regions, like the Noamundi Iron ore and West Bokaro Colliery, these challenges are particularly evident as resource extraction activities can threaten local biodiversity. SDG-15, "Life on Land", aims to preserve and improve ecosystems while preventing and reversing biodiversity loss and land degradation. In response to these challenges, TATA Steel has executed BMPs (Biodiversity Management Plans) across its operational sites, demonstrating corporate commitment to environmental stewardship. This article examines TATA Group's business plans and their contribution to SDG-15 objectives, particularly focusing on their initiatives to restore natural habitats and maintain ecological balance in mining areas. Their comprehensive approach includes rehabilitation of mined lands, conservation of native species, and enhancement of biodiversity in their operational zones. The company's efforts extend beyond mere compliance, encompassing long-term sustainability goals that align with global environmental standards. It is worth noting that individual initiatives can support multiple Sustainable Development Goals (SDGs) through various interconnected efforts, creating a holistic approach to environmental conservation and sustainable development.*

**Keywords:** SDG-15, biodiversity management plans, TATA steel, environmental conservation, mining operations, sustainable development

## INTRODUCTION

Landscapes are affected by factors, such as industrialization, colliery activities and growing populations, which reduce the overall size and quality of habitats and lead to ecological decline. Even conservative estimates indicate that humanity has entered the sixth major extinction event due to the overall high rate of extinction brought on by human activity [1]. Addressing the climate issue and adaptation initiatives greatly benefits from the preservation of terrestrial ecosystems. SDG-15, or "Life on Land", was created by the UN in 2015 with the goals of preserving, restoring, and improving the use of the terrestrial environment and forest management in a sustainable manner, combating drought, faltering and reversing land degradation, and reducing biodiversity loss [2, 3].

However, the challenges of sustaining life on land will only get worse due to the demands of

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Received Date: January 10, 2025

Accepted Date: February 15, 2025

Published Date: February 26, 2025

**Citation:** R. Vijayaprasath, S. Asokan, Aslam Javeed M., Abhishek G., Krishnakumar G. TATA's Green Revolution: A Pioneer in Corporate Solutions from Industry to Ecology for SDG-15 and Biodiversity Conservation. International Journal of Geological and Geotechnical Engineering. 2025; 11(1): 40–48p.

population growth, economic development, and increased consumption. A key responsibility for SDG-15 is to address these issues. As illustrated in the given picture, there are 12 targets in the framework of SDG-15, and 14 indicators are used to measure them. Fighting drought, preserving, rejuvenating, fostering the sustainable use of land-based ecosystems, taking care of forests responsibly, and halting biodiversity loss as well as soil degradations are the objectives to end desertification and restore degraded land, as previously mentioned.

The Millennium Ecosystem Assessment indicates that agriculture's ecological impact has significantly increased. Consequently, one of the main causes of these issues is food production. Eighty percent of endangered animals have lost their habitat due to expanding agriculture. Plants make up than eighty percent of the human diet, and up to eighty percent of people in rural areas of economically weak countries rely on traditional plant-based remedies for basic medical treatment [4].

Forest makes up about thirty percent of the earth's surface and home to almost eighty percent of all terrestrial animal, plant, and insect species. Approximately, 16,000 lakhs people depend on forests for their livelihoods, while 26,000 lakhs people directly depend on agriculture [5]. By absorbing CO<sub>2</sub> from the atmosphere, maintaining the equilibrium of O<sub>2</sub>, CO<sub>2</sub>, and the atmospheric humidity, and protecting turning points, which supply seventy five percent of the freshwater on earth. Forests help to slow down global warming. Additionally, there is a decrease in natural disasters like landslides, floods, droughts, and other severe weather conditions [6]. Due to rising carbon emissions, degradation of land, and loss of biodiversity, the loss of wooded areas negatively affects the lifestyles of rural inhabitants. Over eighty percent of all land animals, plants, and species of insects are found in woods, making them one of the planet's most bio-diverse ecosystems.

Forests are essential to people's livelihoods and general well-being, especially for women, young people, and the impoverished in rural areas. In addition to offering refuge, revenue, and security to communities that depend on forests, forests sustain about 16,000 lakhs people, including more than two thousand indigenous civilizations [7].

At the United Nations Conference on Sustainable Conference (2012), members of the United Nations declared their recognition of the economic and social significance of effective planning for land usage, includes the soil, particularly its contribution to biological diversity, sustainable farming practices, reduction of poverty, empowerment of women, mitigation of climate change, and enhanced availability of water. They emphasize that the sustainable growth of all countries, especially emerging ones, is still seriously threatened by global issues including drought, land degradation, and drought. Particularly for women, youth, and the poor in rural regions, forests are vital to livelihoods of people and overall wellbeing. Forests support over 16,000 lakhs people, including over two thousand indigenous civilizations, and provide safety, income, and shelter to populations that rely on them (The future we want, 2012).

## ECO-SYSTEM SERVICES

Ecosystem services surround and have or contain inside the benefit, individuals obtain from natural ecosystems working properly. According to Fisher et al. [1] state that these services include the intangible benefits that people derive from their interactions with ecosystems, such as recreational opportunities and aesthetic enjoyment; the physical resources that people obtain from ecosystems, such as food, water, and raw materials; the functions of ecosystems that help regulate the quality of air and soil, such as climate control, water purification, and pest management; and fundamental services that enable other services to exist, such as processes like soil formation and nitrogen cycling [2–5].

TATA Steel's Noamundi Iron Ore Mine and the West Bokaro Colliery are the two main mining operations in the districts of West Singhbhum and Bokaro in the Indian state of Jharkhand. With the goal of restoring and conserving the impacted ecosystems and their services, TATA Steel has

implemented biodiversity management strategies to lessen the severity of these impacts. These plans cover things like reforestation, habitat restoration, and water management techniques [8, 9].

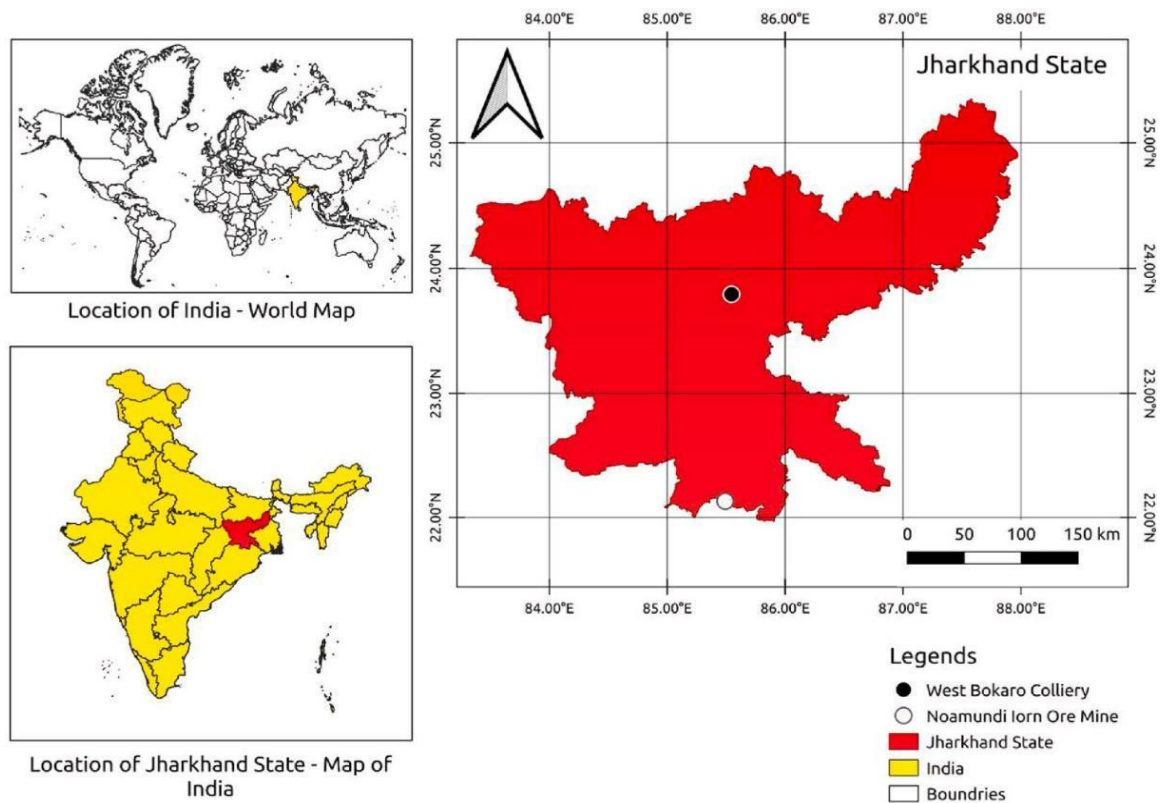
Decisions about conservation tactics, sustainable resource management, and land use planning can all benefit from the application of effective restoration techniques (Figure 1). The following is a summary of this effective restoration strategy's contribution.

- a. In creating a structural framework.
- b. To impact policy on integrated development planning by supporting SDG-15 for localization.
- c. Helping to match ecosystem services with restoration initiatives.

## DATA AND METHODOLOGY

### Noamundi Iron Ore Mine

In the West Singhbhum district of Jharkhand, India, the Noamundi Iron Ore Mine is situated between latitudes 22 04'14 N and 22 10'41 N and longitudes 85 27'09 E and 85 30'06 E [6, 7].



**Figure 1.** Regional location of Noamundi Iron Ore Mine and the West Bokaro Colliery.

Exhibiting an annual production capacity of 100 lakhs tons. In Noamundi town bordering the Indian State Odisha, the Noamundi Iron Ore Mine was praised and awarded a 5- Star ratings in the year 2021-22 for its sustainable operations. Tata Steel implements new technologies and works with IUCN in its Biodiversity Management Plan and Mine Closure Plan to rehabilitate 1160.06 ha of land and reclaim 1019.81 ha for community and environmental aspects [10–13].

### West Bokaro Colliery

In Jharkhand, India, the West Bokaro Colliery is an open pit mine that provides Tata Steel with 19 lakh tons of coal a year. With a focus on community involvement for long-term results, Tata Steel's Biodiversity Management Plan (BMP) for the site focuses on biodiversity restoration via habitat restoration, reforestation, and wildlife corridors. The strategy seeks to rehabilitate local ecosystems and lessen the loss of biodiversity (Table 1).

**Table 1.** Land use and restoration plan.

| Activity                     | Conceptual Land Degradation | Reclamation Measures                               |              |                       |
|------------------------------|-----------------------------|----------------------------------------------------|--------------|-----------------------|
|                              | (Area in Ha)                | (Measures)                                         | (Area in Ha) | (% of the Total Area) |
| Soil storage area            | Nil                         | –                                                  | Nil          | –                     |
| Excavation area              | 1487                        | Afforestation/plantation<br>Agriculture/public use | 1270<br>25   | 72.99%                |
| External overburden dumps    | Nil                         | –                                                  | Nil          | –                     |
| Infra area                   | 63                          | Afforestation/plantation                           | 63           |                       |
| Township and habitation      | Nil                         | –                                                  | Nil          | –                     |
| Roads in mines               | Nil                         | –                                                  | Nil          | –                     |
| Village                      | 25                          | parks/public use                                   | 25           | 1.44%                 |
| Greenbelt along mine barrier | 83                          | Afforestation/plantation                           | 83           | 4.77%                 |
| Garland drains               | 10                          | parks/public use                                   | 10           | 0.57%                 |
| Embankment                   | 10                          | parks/public use                                   | 10           | 0.57%                 |
| Peripheral roads on barrier  | 20                          | parks/public use                                   | 20           | 1.15%                 |
| Total                        | 1698                        | Area under restoration                             | 1506         | 81.49%                |

**Impact Score Calculation for Each Ecosystem Service**

$$\text{Impact score} = \sum \{(n_{vh} * 5) + (n_h * 4) + (n_m * 3) + (n_l * 2) + (n_n * 1)\}$$

where,  $n_{vh}$  = number of preventive measures that have a very high impact on the ecosystem service.

$n_h$  = number of preventive measures that have a high impact on the ecosystem service.

$n_m$  = number of preventive measures that have a moderate impact on the ecosystem service.

$n_l$  = number of preventive measures that have a low impact on the ecosystem service.

$n_n$  = number of preventive measures that have a negligible impact on the ecosystem service (Table 2).

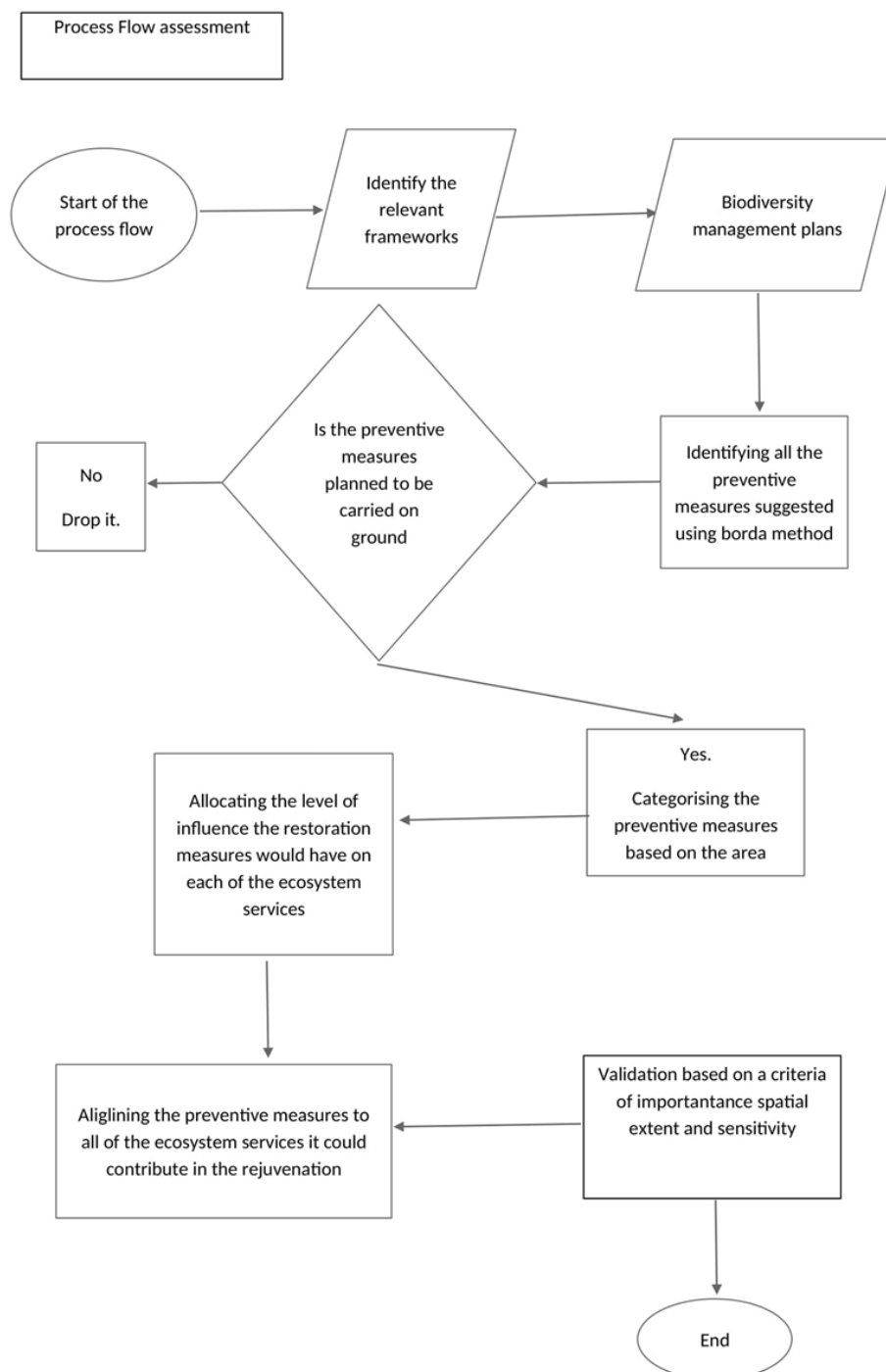
**Table 2.** Ecosystem services.

| S.N. | Type of the Services  | Name of the Service                                                |
|------|-----------------------|--------------------------------------------------------------------|
| 1.   | Provisioning services | Food                                                               |
|      |                       | Raw material – wood biofuels and fibers                            |
|      |                       | Fresh water                                                        |
|      |                       | Medicinal resources                                                |
| 2.   | Regulating services   | Local climate air quality                                          |
|      |                       | Carbon sequestration and storage                                   |
|      |                       | Moderation of extreme events                                       |
|      |                       | Water purification                                                 |
|      |                       | Erosion prevention – soil fertility maintenance                    |
|      |                       | Pollination                                                        |
|      |                       | Biological control                                                 |
|      |                       | Regulation of water flow                                           |
| 3.   | Supporting services   | Habitat for species                                                |
|      |                       | Maintenance of genetic diversity                                   |
| 4.   | Cultural services     | Recreation, mental and physical health                             |
|      |                       | Tourism                                                            |
|      |                       | Aesthetic appreciation and inspiration for culture, art and design |
|      |                       | Spiritual experience and sense of peace                            |

## VALIDATION

$$\text{Impact Score} = (\text{Importance of Ecosystem Service}) \times (\text{Spatial Extent}) \times (\text{Sensitivity})$$

The validation process involves expert consultation to assess the Extensive and Sensitivity of ecosystem services. To assign importance values using Borda Method [8], combined with Z-score standardization, ensures stringent and analogous impact scores. The formula for Impact Score contains the importance, spatial extent, and sensitivity of ecosystem services. This approach supports evaluating restoration efforts at the Noamundi and West Bokaro mines, providing insights into potential ecosystem outcomes across varied environments Figure 2. The formula to calculate z -score is,  $Z = \frac{(X - \mu)}{\sigma}$



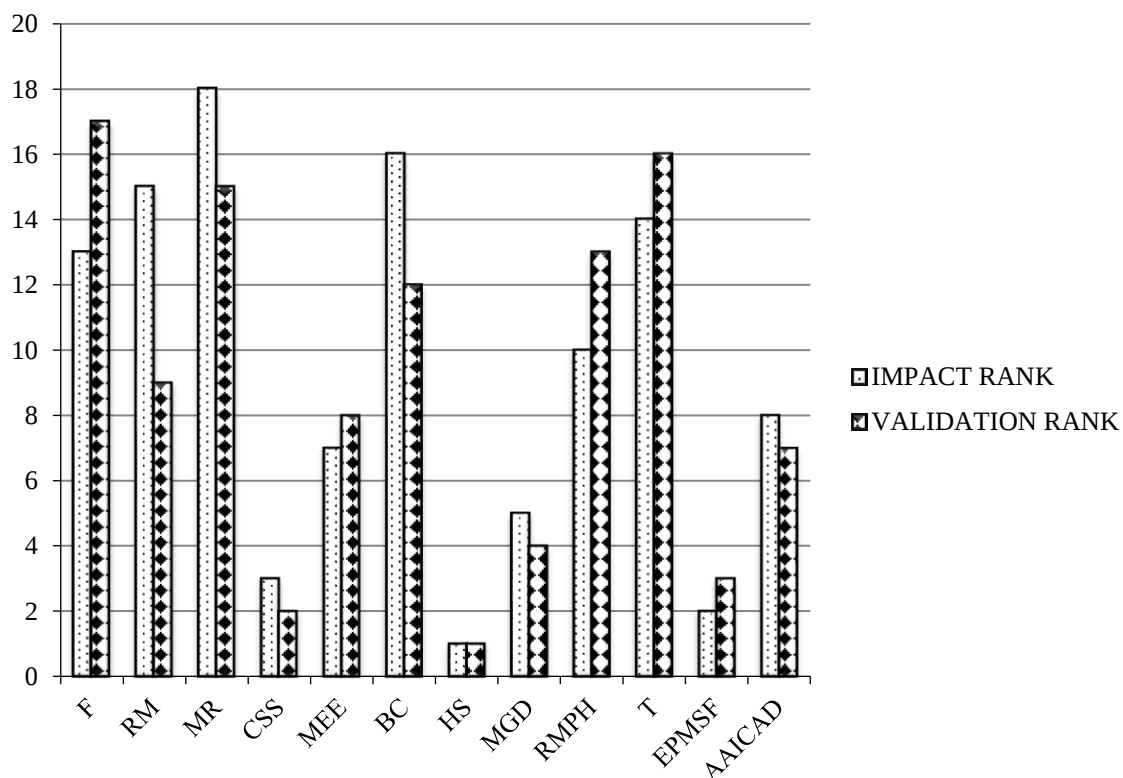
**Figure 2.** Process flow chart.

## RESULTS AND DISCUSSION

The goal of the comprehensive restoration plans for the Noamundi Iron Ore Mine and West Bokaro Colliery is to rehabilitate all their territories, with Noamundi encompassing 1019.81 ha and West Bokaro covering 1740 ha. Whereas West Bokaro would restore 1416 ha (81.38%) as forest and 74 ha (4.25%) as water bodies, Noamundi will have 936.81 ha (91.86%) as forest/plantation and 65 ha (6.37%) as water bodies. West Bokaro has a greater emphasis on public and agricultural property (250 hectares, or 14.37%) as shown in Tables 3-4 and Figures 3-4.

**Table 3.** Impact Score of Ecosystem Services Being Restored.

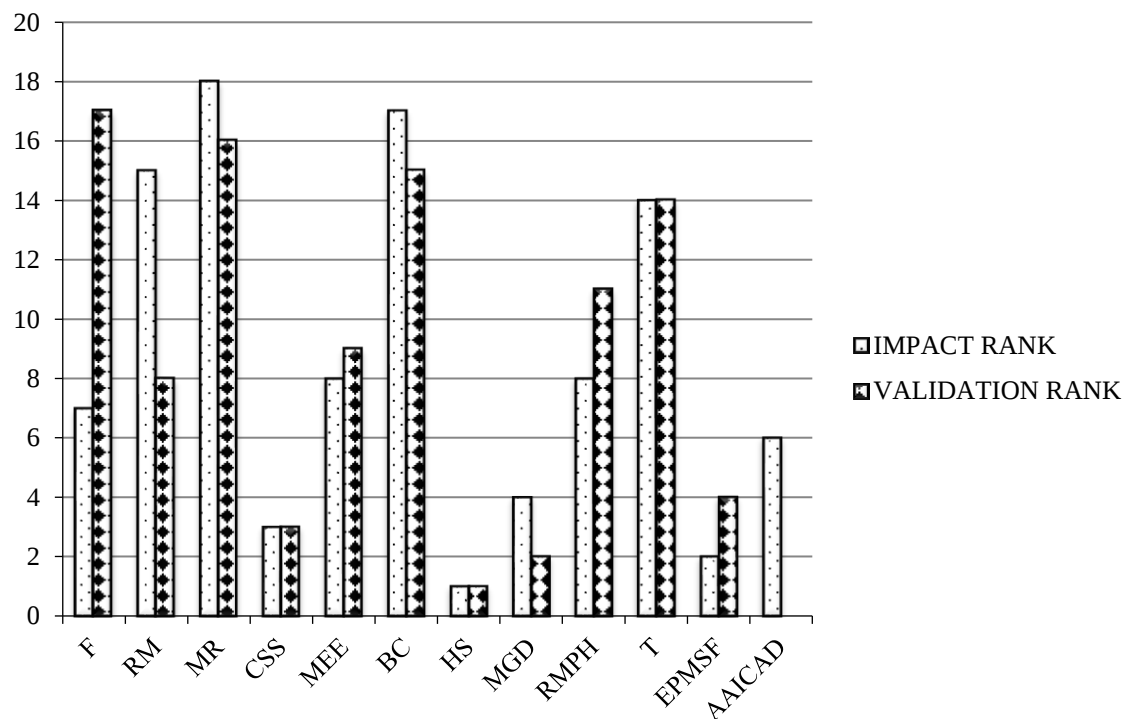
| S.N. | Ecosystem Services                              | Noamundi Iron Ore Mine |             | West Bokaro Colliery |             |
|------|-------------------------------------------------|------------------------|-------------|----------------------|-------------|
|      |                                                 | Impact Score           | Impact Rank | Impact Score         | Impact Rank |
| 1    | Food                                            | 114                    | 13          | 86                   | 6           |
| 2    | Raw material – wood, biofuels, and fibers       | 108                    | 14          | 85                   | 8           |
| 3    | Medicinal resources                             | 83                     | 18          | 51                   | 18          |
| 4    | Carbon sequestration and storage                | 171                    | 1           | 124                  | 1           |
| 5    | Moderation of extreme events                    | 134                    | 6           | 85                   | 8           |
| 6    | Biological control                              | 98                     | 16          | 65                   | 17          |
| 7    | Habitat for species                             | 168                    | 2           | 123                  | 2           |
| 8    | Maintenance of genetic diversity                | 145                    | 4           | 106                  | 4           |
| 9    | Recreation, mental and physical health          | 121                    | 15          | 84                   | 10          |
| 10   | Tourism                                         | 99                     | 6           | 69                   | 15          |
| 11   | Erosion prevention – soil fertility maintenance | 162                    | 3           | 110                  | 3           |
| 12   | Aesthetic appreciation – cultural inspiration   | 134                    | 6           | 92                   | 5           |



**Figure 3.** Comparison of the impact and validation ranks for the Noamundi iron ore mine.

**Table 4.** Comparison of the impact and validation ranks for the West Bokaro colliery.

| S.N. | Ecosystem Services                            | Noamundi Iron Ore Mine |             | West Bokaro Colliery |             |
|------|-----------------------------------------------|------------------------|-------------|----------------------|-------------|
|      |                                               | Impact Score           | Impact Rank | Impact Score         | Impact Rank |
| 1    | Food                                          | 54                     | 13          | 57                   | 10          |
| 2    | Raw material – wood, biofuels, and fibers     | 34                     | 18          | 35                   | 15          |
| 3    | Medicinal resources                           | 35                     | 16          | 29                   | 17          |
| 4    | Carbon sequestration and storage              | 64                     | 8           | 52                   | 11          |
| 5    | Moderation of extreme events                  | 76                     | 6           | 66                   | 6           |
| 6    | Biological control                            | 40                     | 15          | 31                   | 16          |
| 7    | Habitat for species                           | 82                     | 4           | 76                   | 3           |
| 8    | Maintenance of genetic diversity              | 63                     | 9           | 62                   | 7           |
| 9    | Recreation, mental and physical health        | 63                     | 9           | 59                   | 8           |
| 10   | Tourism                                       | 55                     | 12          | 49                   | 13          |
| 11   | Erosion prevention-soil fertility maintenance | 88                     | 3           | 74                   | 4           |
| 12   | Aesthetic appreciation – cultural inspiration | 65                     | 7           | 59                   | 8           |



**Figure 4.** Comparison of the impact and validation ranks for the West Bokaro colliery graph.

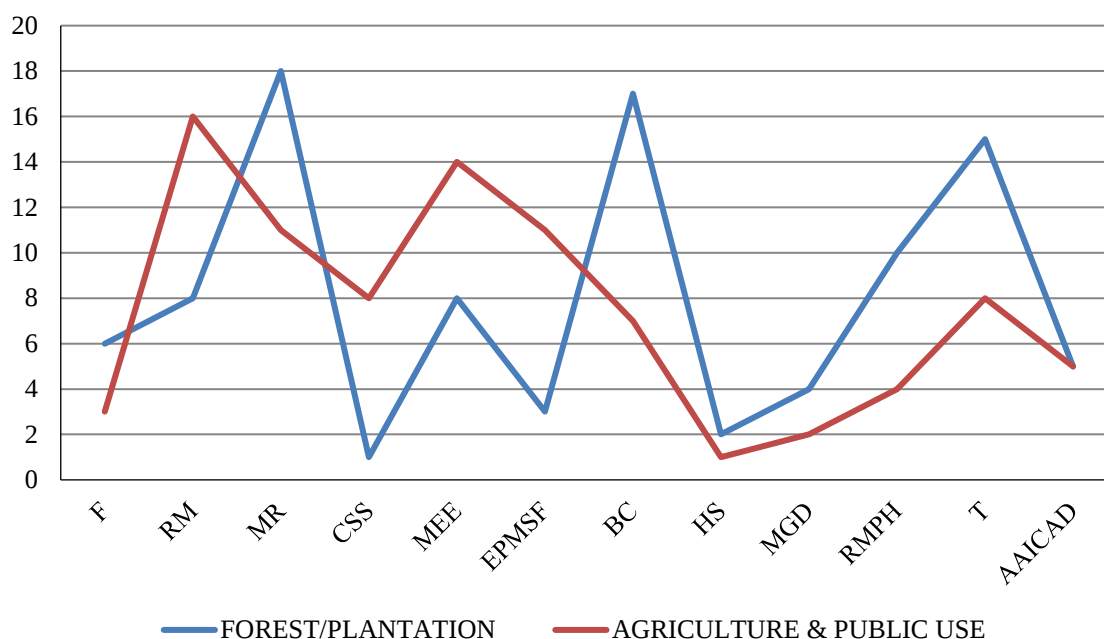
#### INITIATIVES EMPLOYED IN TATA GROUP

Some of the most notable new ideas or methods in Noamundi are as follows

- A 3.3 MW solar power plant will be built atop the mined-out area.
- Reclamation and rehabilitation of 126 Ha of land.
- Adoption of green and clean technologies.

#### Environmental Management Systems (EMS)

These initiatives have been put forward aiming to promote sustainable mining practices and make certain the well-being of the residents. Restoration programs support sustainable resource management, increase ecosystem resilience, and improve environmental health by concentrating on critical services (Figure 5).



**Figure 5.** Comparison of potential restoration of ecosystem services based on the type of area in which the degraded land has been restored for the Noamundi Iron Ore Mine.

## CONCLUSIONS

This article on ecosystems give a practical exhibition on how the effectiveness of BMPs (Best Management Practices) in enhancing ecosystem services. The study offers valuable insights into the role of ecological adaptability. This article highlights the transformative potential of strategic, multifaceted restoration in promoting biodiversity, mitigating environmental impacts.

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