

# Economic Valuation of Tiger Reserves in India: A Value + Approach

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*Less than 3500 tigers remain in the wild today with approximately 50 percent in India. Their habitat is deteriorating at an alarming rate. Tigers are apex predators, their conservation results in the conservation of lower trophic levels in an ecosystem. Economic valuation of tiger reserves is a novel step in the direction of drawing attention to the wide range of benefits that ecosystems provide. Better articulation of the tangible and intangible values of tiger reserves will equip policy and decision-makers with the information and framework to allocate adequate funds for conservation and to incentivize sustainable utilization of important functions of these areas.*

*This brief is based on an in-depth study conducted by the Centre for Ecological Services Management (CESM); a Centre of Excellence at the Indian Institute of Forest Management (IIFM) for National Tiger Conservation Agency (NTCA). The study attempts to provide quantitative and qualitative estimates of ecosystem services emanating from and embedded in the selected tiger reserves. It includes assessment of 25 ecosystem services from six tiger reserves in different Tiger landscapes across the country. While natural landscapes such as tiger reserves in all practicality can never be recreated, an attempt has been made to determine the cost of re-creation of a tiger reserve if inadequate protection to existing tiger reserves necessitate establishment of new ones. Additionally, the study also demonstrates application of InVEST – a suite of tools used for mapping ecosystem services.*

## Why Value Nature?

Nature provides us with several services seemingly for free: recharged groundwater, fertile soil and plant biomass created by photosynthesis. We draw extensive advantages from these “ecosystem services”– food, water supply, recreation and protection from natural hazards. Despite the importance of these services to human beings, in the past many have been taken as a right, being

viewed as free and infinite. However, worldwide degradation of ecosystems also impairs their ability to provide such services. The notion of ecosystem services and its valuation provides a starting point towards identifying and managing these services so that the decision-makers can have adequate data on ways to optimize sustainable use of ecosystems.

**Provisioning Services:** Products obtained from ecosystems such as food and timber.

**Regulating Services:** Services obtained from the regulation of ecosystems, including services such as flow, regulation of water, etc.

**Cultural Services:** Non-material services people obtain from ecosystems through spiritual enrichment, cognitive development, recreation and aesthetic experiences.

**Supporting Services:** These are the services that are necessary for the production of all other provisioning, regulating and cultural services.

## Ecosystem Services

The term ‘ecosystem services’ as defined and used by the MA (2005) encompasses both goods, like timber, and services such as air purification. The assessment identified four overarching categories of services provided by ecosystems, i.e. provisioning, regulating, cultural and supporting services.

Many ecosystem services from nature constitute the category of ‘public goods’. These are outlined as ‘non-excludable’ and ‘non-rival’, which means that people cannot be effectively excluded from use, and, use by one individual does not cut back availability to others.

Valuation of ecosystem services can influence policy-making through three distinct impact pathways. Firstly, valuation helps in raising awareness concerning the substantial advantages that ecosystems provide. Nature is valuable is a statement that several individuals accept as true but in a vague, general sense. However, quantification makes it much more explicit in terms that all stakeholders are aware of.

Secondly, valuation will help to focus on resources, to supply the foremost protection of ecosystems and their services with the restricted funds available. Thirdly, it will facilitate to rationalize and frame the decision-making process, providing dots for further discussions and deliberations.

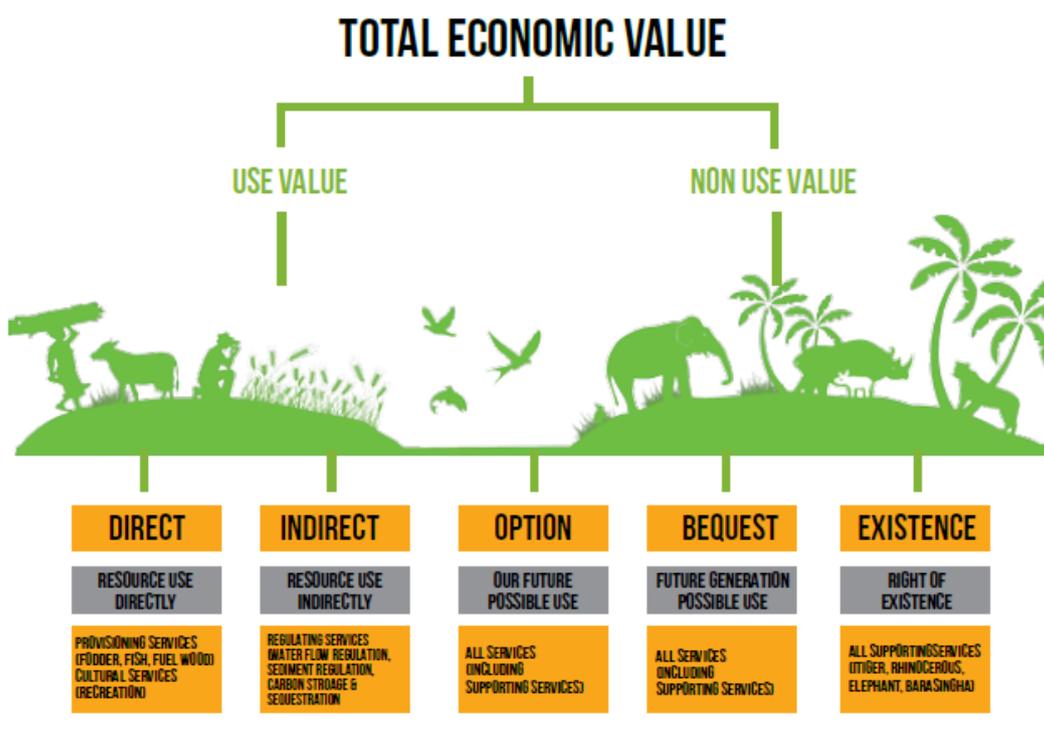


Fig 1: TEV Framework



## Valuing Tiger Reserves for Better Management

India holds over half of the world's tiger population in wild and is considered to have the best chance for saving the population of this magnificent animal in its natural surroundings. Conservation of India's national animal gains significance on account of its role at the apex of the food chain. Its presence is vital in regulating and perpetuating ecological processes and systems. Tiger is an umbrella species whereby its protection also conserves habitats of several other species, thereby ensuring continuity of natural evolutionary processes in the wild. Project Tiger, launched in 1973 by the Government of India, now includes 48 tiger reserves across the country, covering over 2 per cent of India's geographical area.

Besides conserving wilderness, tiger reserves also provide a range of associated economic, social, cultural and spiritual services, which are termed as ecosystem services. Tiger reserves support human life by protecting fish nurseries and agricultural genetic material (wild cultivars) and provide cheap, clean drinking and irrigation water.

Tiger reserves not only help in mitigating natural disasters such as floods and cyclones, but the genetic material found in them is also a source of many medicines and drugs. Natural and cultural resources in tiger reserves are important drivers of tourism, supporting local earnings and employment. In addition, these natural landscapes play an important role in ecosystem-based approaches to climate

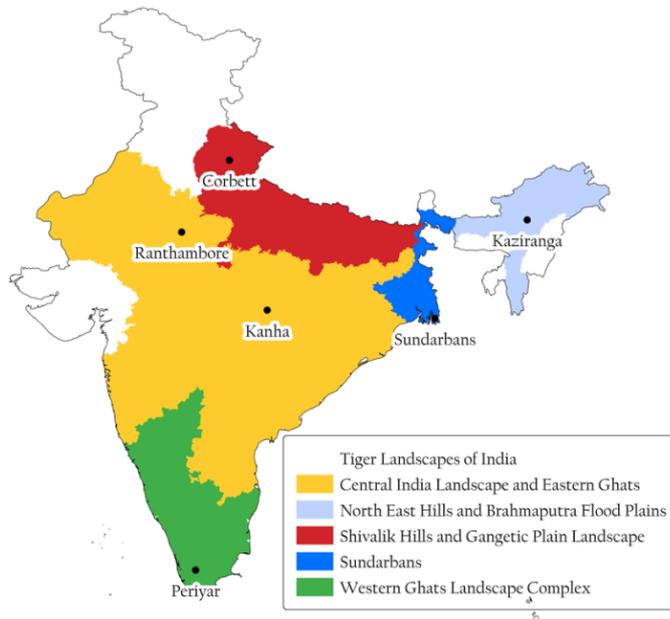
change adaptation and contribute to mitigation by storing and sequestering carbon.



While conservation initiatives till now have largely focused on in-situ conservation of tigers by establishing tiger reserves in India, an important aspect that needs further research is assessment of the economic value of tiger reserves in terms of ensuring the flow of essential ecosystem services that subsequently accrue to local, regional, national as well as global beneficiaries. Thus the study objectives includes estimation of the economic value of ecosystem services emanating from six selected tiger reserves in India using scientific and objective parameters, application of Spatial Mapping tools to understand the flow of Ecosystem Services, a pilot study at two of the selected tiger reserves using “InVEST” mapping package and estimation of the cost of inaction through cost of creating a tiger reserve and willingness to pay for tiger conservation.

## Approach to Value Ecosystem Services of Tiger Reserves

The current study provides conservative estimates of the economic value of six selected tiger reserves in India:



- Corbett
- Kanha
- Kaziranga
- Periyar
- Ranthambore
- Sundarban

These tiger reserves have been selected from different tiger landscapes of the country to provide indicative economic values associated with tiger conservation in India in various ecological and socio-economic contexts. Apart from

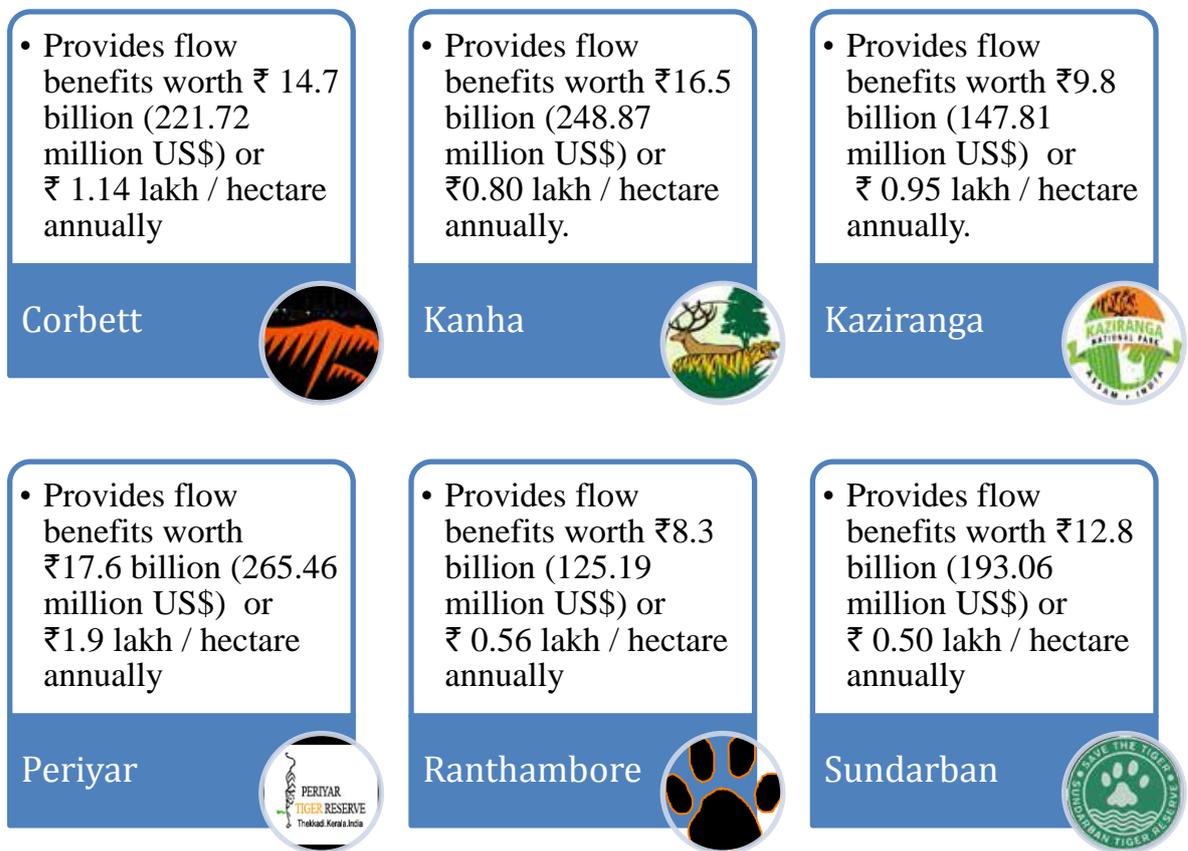
quantitative and qualitative estimates of ecosystem services from selected tiger reserves, the study also explores other dimensions of values. It does so through mapping of ecosystem services in two of the selected tiger reserves and estimating what it would cost to re-create a tiger reserve.

## Need of VALUE + Approach

The study attempted to estimate the economic value of several services we receive from tiger reserves, admittedly there are several services for which the economic value could not or cannot be estimated monetarily. The latter includes many services which can only be quantified in biophysical terms or those which can only be qualitatively described. Thus, the estimated value for any tiger reserve should be looked at through the 'VALUE+' approach.

Acknowledging our limited understanding of natural processes and their associated values, the study uses a VALUE+ approach. The 'VALUE' represents all services for which monetary economic valuation is possible and conducted based on available knowledge and information. The '+' represents all those services for which economic valuation is currently not possible on account of lack of accepted methodologies, knowledge, understanding and requisite data. The economic values derived in the study are thus conservative. A rigorous research process including thorough consultation with key stakeholders has been followed for the study.

It is important to note that the objective of the study is neither to compare the services of the tiger reserve with any economic venture such as mining, nor compare the services across selected tiger reserves.



## Valuation Frameworks

In order to consider the categories of services derived from tiger reserves, the study uses four frameworks under which different services have been categorized and quantified.

1. **Total Economic Value (TEV):** In the context of this study, TEV refers to the gain in well-being or welfare from the tiger reserves captured by the net sum of the willingness to pay (WTP) or willingness to accept (WTA) and comprises use and non-use values. (Refer Fig 1)
2. **Millennium Ecosystem Assessment (MEA):** MEA is a major assessment of the effects of human activity on the environment. During the 1990s, a need was identified by a number of international environmental organizations for a global ecosystem assessment. It was done on a global scale with over 1300 contributors from 95 countries being involved as authors.
3. **Stock and Flow Benefits:** The benefits from tiger reserves can also be categorized into stock and flow benefits. Broadly, stock benefits refer to potential supply, while flow benefits refer to real feasible flow of benefits. In the study context, standing timber and carbon stock refer to stock benefits, while carbon sequestration can be referred to as a flow benefit.
4. **Tangible and Intangible Benefits:** Broadly, tangible benefits from ecosystems refer to goods obtained from the tiger reserves while intangible benefits include the set of services which improve human well-being indirectly. This study puts special focus on intangible benefits as many of these are not marketed and perhaps not appropriately managed.

## Ecosystem Services Across Tiger Reserves

Based on literature review, discussions with local and national experts and consultations with communities in and around each tiger reserve; the study identified relevant ecosystem services for each tiger reserve (Table). Wherever unavailability of data or robust methodology limited the ability to quantify the service in monetary terms, the service has been qualitatively described to demonstrate its significance.

Relevant Ecosystem Services Across Tiger Reserves

Ecosystem Service / Benefit from Tiger Reserves	Corbett	Kanha	Kaziranga	Periyar	Ranthambore	Sundarbans
Employment generation	●			●		●
Agriculture				●		
Fishing				●		●
Fuel wood	●	●		●		
Fodder / grazing	●	●		●		
Timber	●	●		●		
Standing timber	●	●	●	●	●	●
Non-Wood Forest Produce		●		●		●
Gene-pool protection	●	●	●	●	●	●
Carbon storage	●	●	●	●	●	●
Carbon sequestration	●	●	●	●	●	●
Water provisioning	●	●		●	●	
Water purification	●			●	○	
Soil conservation / sediment regulation	●	●		●	●	●
Nutrient cycling / retention	●	●		●	●	●
Biological control	●	●	●	●	●	●
Moderation of extreme events	○			○		●
Pollination		●	●	●	●	●
Nursery function	○		○			●
Habitat / refugia	●	●	●	●	●	●
Cultural heritage	●		●	●	●	●
Recreation	●	●	●	●	●	●
Spiritual tourism				○	○	
Research, education and nature interpretation	○	○	○	○	○	○
Gas regulation	●	●	●	●	●	●
Waste assimilation	●	●	●	●	●	●

● Estimated in monetary terms    ○ Qualitatively described

## Application of InVEST- Spatial Mapping Tool

In the last few years, the ecosystem valuation process has evolved from analytical models to GIS-based spatial simulation models. These simulation models are able to comprehend the local ecosystem characteristics in a better way; thus enriching the overall valuation. Such a mapping of ecosystem services can provide very useful management prescriptions for tiger reserve managements to optimize services from the tiger reserve. The current study applies one of the most widely used tools for mapping ecosystem services, Integrated Valuation of Ecosystem Services and Trade-Offs (InVEST) developed by the Natural Capital Project at Stanford University.

InVEST is a suite of software models used to spatially map and value the goods and services from nature that sustain and fulfil human life. InVEST is a data-hungry tool. On account of paucity of data for collecting the required information, InVEST could only be applied at two of the selected tiger reserves:

Kanha and Periyar. Further, 3 of the 17 models in the InVEST 3.0 package were applied at these two tiger reserves. These include the Carbon Storage and Sequestration: Climate Regulation Model, the Water Yield: Reservoir Hydropower Production Model and the Sediment Retention: Avoided Dredging and Water Purification Model.

The results of the InVEST exercise are envisaged to assist in identification of ecosystem service hotspots within tiger reserves and thus better equip tiger reserve managers in conservation and

### InVEST Outputs

- ✚ 192 and 172 thousand tons of carbons are stored in KTR and PTR respectively.
- ✚ The net water yield is about 1804 and 4366 million KL per annum for KTR and PTR respectively.



management of such areas. Its application in all tiger reserves across the country is thus highly recommended but will require standardized collection of specific input data necessary for InVEST models.

### Cost of Inaction: Cost of Re-creating a Tiger Reserve

While natural landscapes such as tiger reserves in all practicality can never be recreated, the study has made an attempt to estimate the cost of inaction if inadequate protection to existing tiger reserves necessitate establishment of new ones. Based on the objective of maximum conservation gain and minimum human distress, a patch of 1069 km<sup>2</sup> in the Pilbhit-Dudhwa landscape was identified for a hypothetical exercise and basic minimum costs for establishing a tiger reserve on the patch were estimated.

The major costs involved include land acquisition, rehabilitation, resettlement and habitat

Sr No.	Head	Total Estimated Cost ( ₹million)
1	Land Acquisition	3, 85, 330.00
2	Rehabilitation and Resettlement	1, 01, 020.00
3	Habitat Development	4,982.7
4	Park Fencing	4.3
5	Infrastructure	461.1
6	Tourism (excluding buildings)	7.0
<b>Total</b>		<b>4, 91, 805.1</b>

development. The conservative cost estimate based on categories of costs included is approximately equal to ₹491,800 million, which translates to approximately ₹4.62 million per hectare. It is important to note that the estimate only includes a handful of costs and does not account for many other costs due to paucity of required information. Further, even after incurring such an astronomical cost, it cannot be guaranteed that the new area would be able to conserve genetic repository comparable to any existing tiger reserve.

### Key Findings

- ✚ Every rupee spent on management costs leads to services worth ₹200 to 530(3.01 to 7.99 million US\$\*) in the six selected tiger reserves namely Corbett, Kanha, Kaziranga, Periyar, Ranthambore and Sundarbans.
- ✚ Selected tiger reserves protect and conserve stock valued in the range of ₹22 to 656 billion (331.83 to 9,894.42 million US\$).
- ✚ The monetary value of flow benefits emanating from selected tiger reserves range from ₹ 8.3 to 17.6 billion (125.19 to 265.46 million US\$) annually. In terms of unit area, this translates into ₹ 50,000 to 190,000 per hectare per year.
- ✚ A large proportion of flow benefits (as well as stock) are intangible, and hence often unaccounted for in market transactions.
- ✚ The results indicate potential use of InVEST in identifying ecosystem service hotspots and providing valuable management prescriptions to tiger reserve managers.

Would man be able to revive a specie gone extinct?

**Probably not!**



- ✚ The total estimated cost of re-creating a tiger reserve with an area of about 1000 km<sup>2</sup> is estimated to be approximately ₹ 491.8 billion (7417.8 million US\$) or ₹ 4.6 million (0.07 million US\$) per hectare.

## Key Recommendations

- ✚ Adequate investment in tiger reserves is essential to ensure the flow of ecosystem services in future, and is economically rational.
- ✚ Intensive research is required to arrive at a value closer to the actual worth of ecosystem services prevailing within the tiger reserve and park activities should be accordingly prioritized.
- ✚ There is a need to integrate management of tiger reserves into the broader landscapes and enhancement of ecological connectivity among the tiger reserves and their wide environment.

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*CESM is a centre of excellence established in 2007 at the Indian Institute of Forest Management with a mission to conduct action and policy research for ecosystem services management.*

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**Download the complete report from <http://goo.gl/ZuQdMC>**

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\*1 US\$ = ₹ 66.3

