The value of Biodiversity in India's Forests

Haripriya Gundimeda

Sanjeev Sanyal

Rajiv Sinha

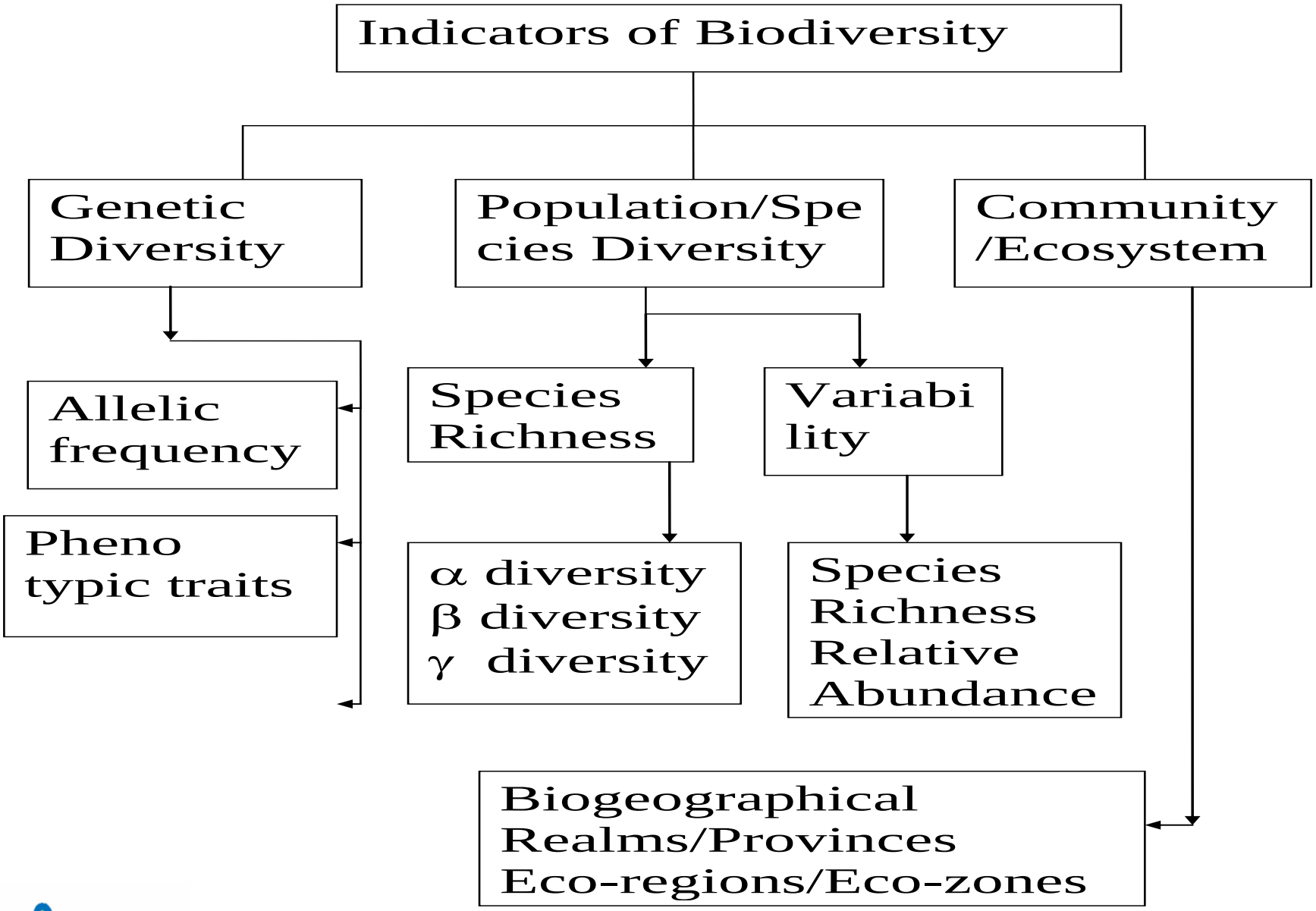
Pavan Sukhdev

Why valuation of biodiversity?

- Biodiversity (contraction of the term Biological Diversity) - shorthand description of a great variety of life that exists on the earth.

- The UN Convention on Biological Diversity defines biodiversity as
- ***". . . the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems" (United Nations Environment Programme, 1992, p. 4).***

- Biodiversity is
- a very valuable
- very poorly understood natural resource
- lost rapidly as a result of human activities.


Indicators of Biodiversity
Genetic Diversity
Population/Species Diversity
Community /Ecosystem
Allelic frequency
Pheno typic traits
Species Richness
Variability
α diversity
β diversity
γ diversity
Species Richness
Relative Abundance
Biogeographical Realms/Provinces
Eco-regions/Eco-zones

Main threats to biodiversity conservation

1. Habitat loss attributed to forest conversion
2. Degradation of habitat due to pollution or pesticides
3. Grazing leading to reduction in plant biomass
4. Fragmentation of habitat
5. Logging
6. Introduction of exotic species from other regions/ continents, or due to climate change etc.

- We are losing biodiversity at an alarming rate
- We do not know how much we are losing
- If biodiversity cannot be measured & valued, there is no way to make rational decisions as to what needs to be preserved.

How bio-diversity matters to society?

Bio-diversity ….

- Can substantially contribute to the productivity of agricultural systems through development of newer breeds of plants and animals.
- Can act like insurance to the human society
- Is a source of knowledge
- Is necessary for proper functioning of the eco-systems on which humans are dependent.

Species Diversity Profile for India

- India occupies 2.4% of world's area , but hosts 7% of global biodiversity
- One of the 12 mega-diversity hot-spot regions of the world
- 150,000 endemic plants species (50% of the world's total)
- Contains globally important populations of some of Asia's rarest animals, such as the Asiatic Lion, Snow Leopard, Bengal Florican
- 3120 species endangered under different threat categories.
- 39 species of mammal, 72 species of birds and
- 1336 plant species are vulnerable and endangered
- 20 species of higher plants - "possibly extinct"

What can be done?

- **Identity indicators to measure biodiversity**
- **Biodiversity should be treated as an asset**
- **Losses should be adequately represented in the national accounts.**

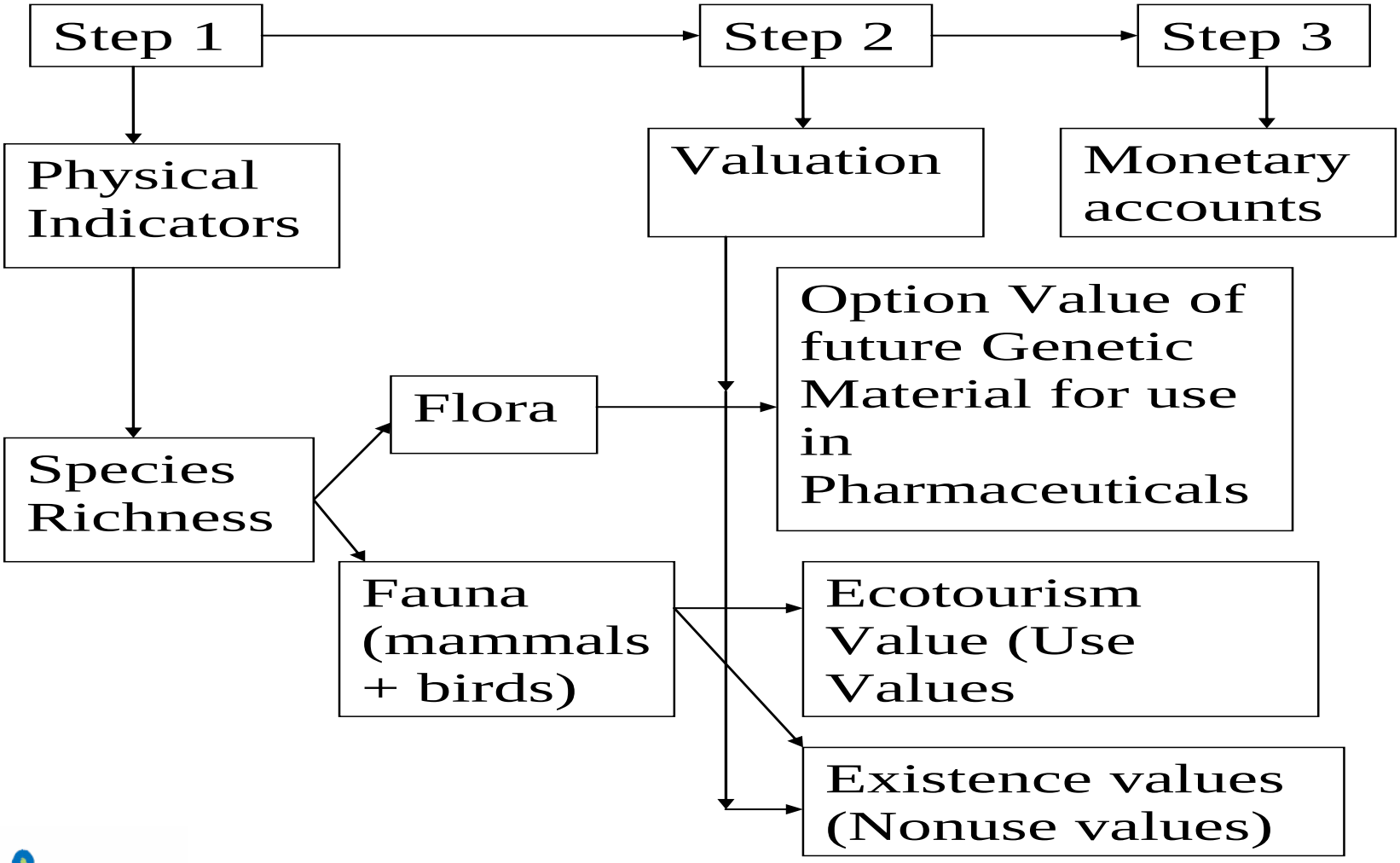
Treatment in the national accounts is the purpose of this Monograph…

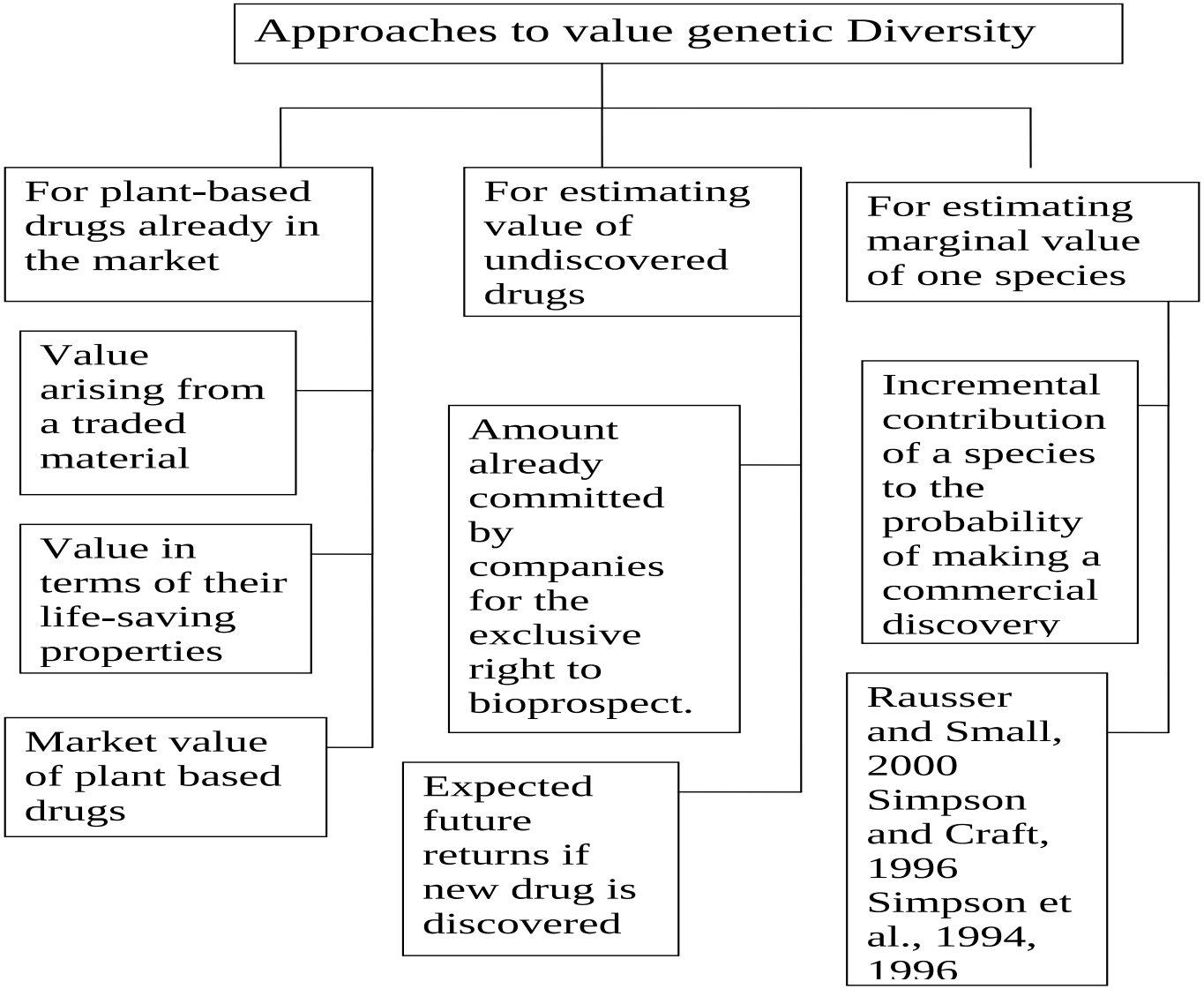
- **India's SNA accounts - include some of the returns provided by biodiversity, but not classified as such**
- **Do not account for the losses that occur when valuable ecosystems are lost to agriculture/ non-forest purposes.**
- **Record expenditures incurred in clearing the ecosystems/improving the ecosystems are recorded under the head Gross Capital Formation.**

Objectives of this paper

- Identify appropriate indicators to assess the state of biodiversity in different states based on the existing secondary data
- Estimate the value of biodiversity in Indian forest ecosystems
- Estimate the value of depletion of forests due to biodiversity loss in different Indian states

Accounting Framework



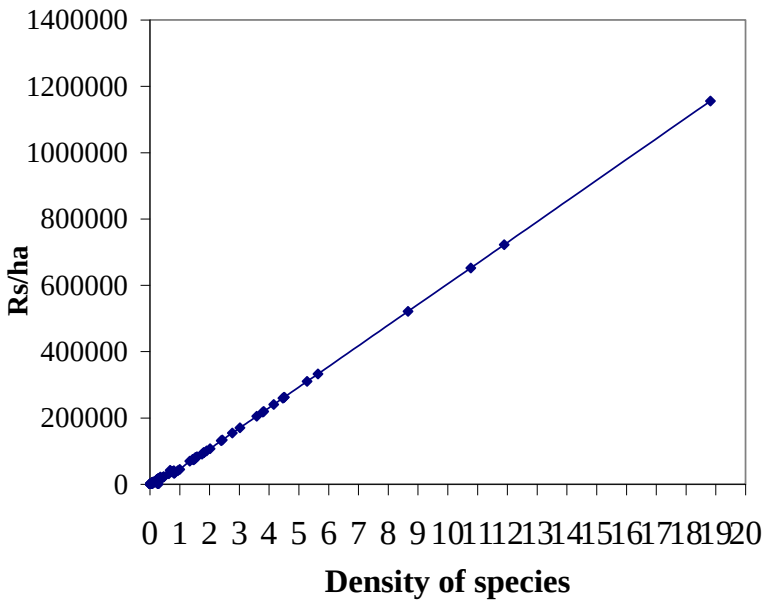

Approaches to value genetic Diversity
For plant-based drugs already in the market
For estimating value of undiscovered drugs
For estimating marginal value of one species
Value arising from a traded material
Value in terms of their life-saving properties
Market value of plant based drugs
Amount already committed by companies for the exclusive right to bioprospect.
Expected future returns if new drug is discovered
Incremental contribution of a species to the probability of making a commercial discovery
Rausser and Small, 2000 Simpson and Craft, 1996 Simpson et al., 1994, 1996

Medicinal Plants in India

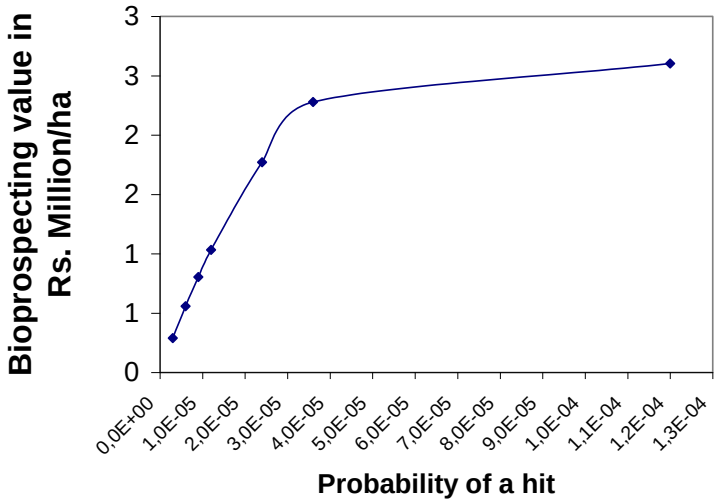
- One of the World's richest medicinal plant heritages.
- 1/5th of the plants in India (8,000 species) - used for medicinal purpose.
- 90 – 95% of these species comes from forests.
- Only 1800 species are documented in ISM
- Rest transmitted as traditional knowledge.
- About 18 percent of species confine exclusively to Himalayan and Trans Himalayan zones,
- 4 per cent belong exclusively to Western Ghats,
- about 77 per cent of species belong to other different bio-geographic zones.

Bioprospecting Values : Sensitive to Species Density, Hit Probability, and Discount Rates

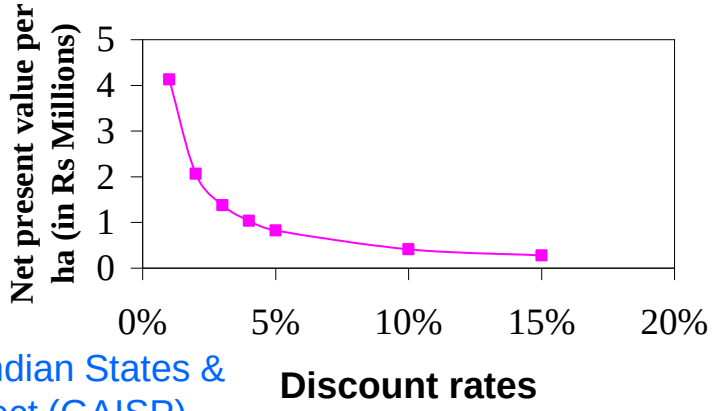
Bioprospecting values for different species density



Bioprospecting value for different probabilities of hit



Bioprospecting value for different choices of discount rates



Bioprospecting Values of Indian Forests			
State	Dense Forest area (Sq.kms)	Density of medicinal plants	Net bioprospecting value /ha
A& N Islands	**6593**	**1.52**	**79,489**
AndhraP	25827	0.19	7,134
Arunachal P	53932	0.16	5,816
Assam	15830	0.76	38,411
Bihar	15159	0.46	22,084
Goa	1785	0.06	6
Gujarat	8673	0.81	40,874
Haryana	1139	0.44	20,844
Himachal P	10429	0.64	31,758
J & Kashmir	11848	0.21	8,439
Karnataka	26156	0.75	37,648
Kerala	**11772**	**1.58**	**83,116**
Madhya P	82264	0.27	11,919
Maharashtra	30894	0.39	18,093
Manipur	5710	0.75	37,934
Meghalaya	**5681**	**1.54**	**80,861**
Mizoram	8936	0.26	10,963
Nagaland	**5393**	**1.80**	**95,028**
Orissa	27972	0.36	16,410
Punjab	1549	0.32	14,521
Rajasthan	6322	0.08	1,261
Sikkim	**2391**	**2.02**	**1,06,876**
Tamil Nadu	**12499**	**1.43**	**75,014**
Tripura	**3463**	**1.81**	**95,633**
UP	27988	0.47	22,290
West Bengal	**6346**	**1.34**	**69,840**
All India	416551		25,553

Contribution of National Parks to Eco-Tourism

- From existing studies which use Travel Costs or CVM…
- We used a **benefits transfer method** based on valuation studies of 8 National Parks across India
- We used a meta regression analysis (instead of transferring demand curve).
- For Consumer Surplus, the following functional form was postulated
- CS/ha/tourist = α + β1*density of fauna + β2*dummy for CVM/TCM + ε
- CS/ha/tourist for different national parks in different states in India is obtained using above relationship
- CS/ha/tourist is multiplied with the total tourists and area of the parks to get the total consumer surplus.
- Amount of expenditure incurred to protect, maintain and upkeep the Protected areas deducted from total consumer surplus to get the net benefit from ecotourism

Contribution of National Parks to Eco-Tourism

- Statistics available on the number of foreign and domestic tourists visiting each state
- Tourists visit different places mainly for recreational, religious or business purposes
- We need to know exactly how much national parks contribute to the tourist activity
- This enables to divide the expenditures incurred for different sites
- We fit a regression between number of tourists in a particular state and the variables influencing the tourism for domestic and foreign tourists.
- $ldomestic = \alpha + \beta 1 * area\_np + \beta 2 * numberofattractions + \beta 3 * connectivitydummy + \varepsilon$
- $lforeign = \alpha + \beta 1 * area\_np + \beta 2 * business + \beta 3 * dummy\_popular + \beta 4 * dummy\_connectivity + \varepsilon$

Eco-Tourism Values - Results

- Correlation coefficients of areas of national parks and tourist visits positive and significant
- Lesser the “connectivity”, lower the number of tourists
- Tourist visitation rate higher in states which are popular destinations – irrespective of Bio-diversity
- A prime business centre attracts higher foreign tourists
- From the regression equation we estimated the amount of consumer surplus *attributable* to visitors *visiting national parks* alone

Implied US $value CS/ domestic & foreign tourists

States	Foreign tourist	Domestic tourist
Andhra Pradesh	1 118	178
Arunachal Pradesh	5 002	798
Assam	7 288	1,162
Bihar and Jharkhand	1 493	238
Goa, Daman and Diu	679	108
Gujarat	2 415	385
Haryana	351	56
Himachal Pradesh	11 139	1,776
Jammu and Kashmir	2 651	423
Karnataka	5 430	866
Kerala	4 130	659
MP & Chhattisgarh	1 943	310
Maharashtra	2 079	332
Manipur	3 573	570
Meghalaya	4 001	638
Mizoram	1 722	275
Nagaland	2 401	383
Orissa	3 994	637
Punjab	347	55
Rajasthan	3 430	547
Sikkim	4 244	677
Tamil Nadu	3 215	513
Tripura	1 715	273
UP & Uttaranchal	5 223	833
West Bengal	5 980	954
A&N Islands	2 151	343
All-India	3 638	558

Value of ecotourism per hectare

	Area under Protected areas (Sq. km)	Total NPV of ecotourism (Rs. Mil)	NPV ecotourism per ha (Rs)
Andhra P	13469.5	95638	37,030
Arunachal P	10074.6	798	148
Assam	2866	8386	5,297
Bihar&J	5428.7	40015	26,397
Goa	755	55264	10,000
Gujarat	17082.3	54397	62,720
Haryana	334.3	865	7,591
Himachal P	**7095.3**	**283992**	**2,72,310**
Jammu	13973.7	47041	39,704
Karnataka	6703.6	183232	70,054
Kerala	**2324.7**	**444578**	**3,77,657**
MP&C	17204.8	43329	5,267
Maharashtra	15685.6	54745	17,720
Manipur	746.5	17033	29,830
Meghalaya	**301.7**	**141211**	**2,48,567**
Mizoram	975	421	471
Nagaland	**222.4**	**179588**	**3,33,002**
Orissa	8952.6	88091	31,492
Punjab	316.7	4625	29,856
Rajasthan	9161.2	91986	1,45,502
Sikkim	2049.1	3172	13,266
Tamil Nadu	**3305.4**	**263280**	**2,10,641**
Tripura	**603.1**	**1654733**	**4,11,610**
UP&U	12627.3	181892	64,989
West Bengal	**2916.7**	**368464**	**5,80,625**
A&N Islands	1620.2	613	929
Total	156796	4307390	91,641

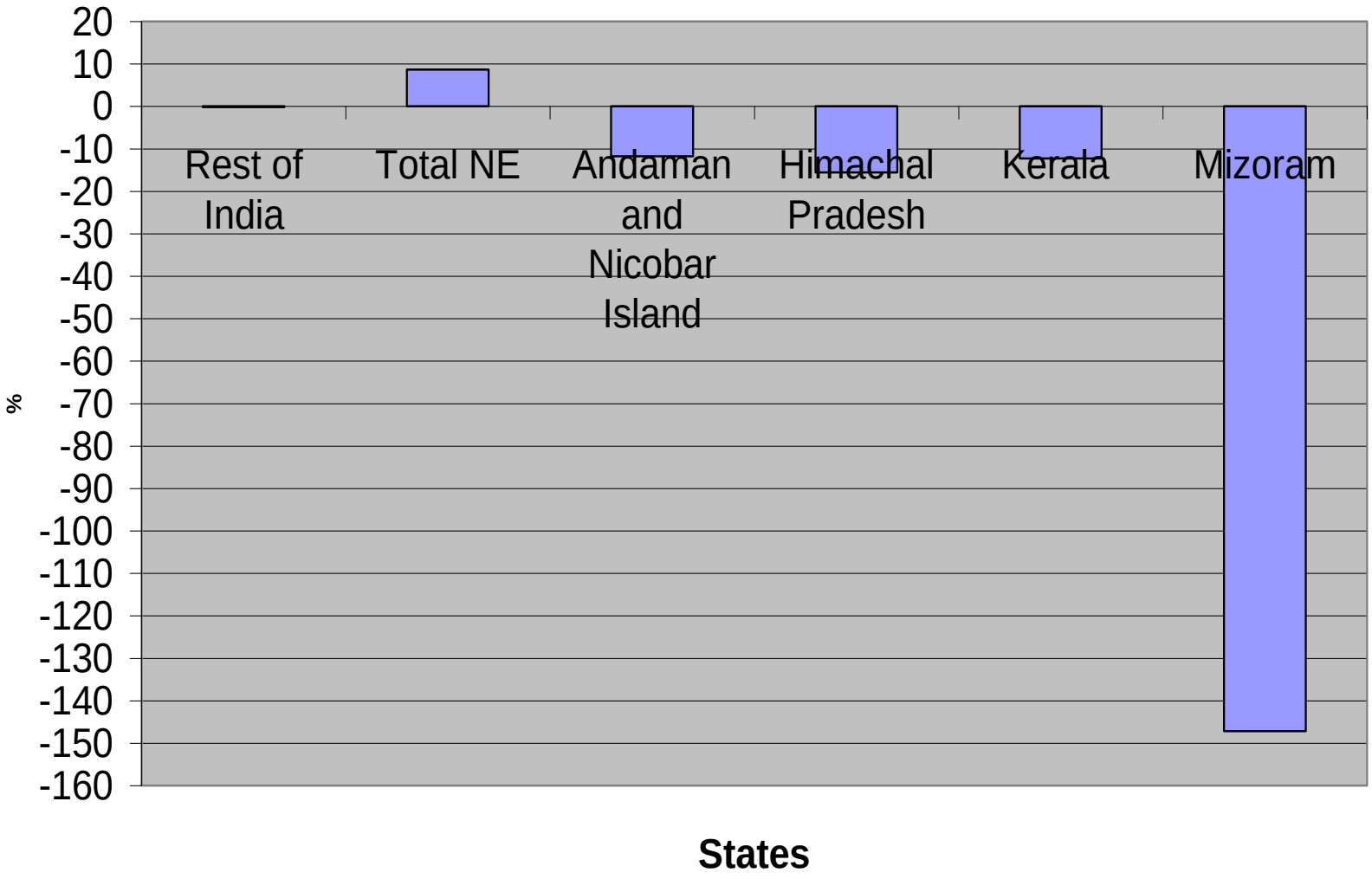
Non-use values for conservation of biodiversity

- **Global community would be willing to pay even if they never use the fauna (e.g. Save the Tiger Fund).**
- Several such initiatives in different countries for endangered species.
- Preference given to a few charismatic species (elephants, pandas, tigers)
- *Kantolean and Swanson (2003)* - WTP of people of OECD for Giant Panda – (**Mean WTP of 14.86 US $/ person for preserving the species in its natural habitat**).
- *Bandara and Tisdell (2004)* - WTP by urban resident to conserve the Asian elephant in Sri Lanka (**Mean annual WTP was 1322 Sri Lankan rupees annually**).
- *Mendonca et al. (2003)* – 3 endangered Brazilian species - Black Lion Tamarin, Golden Lion Tamarin and Cuica . WTP - 10 US $/ household.

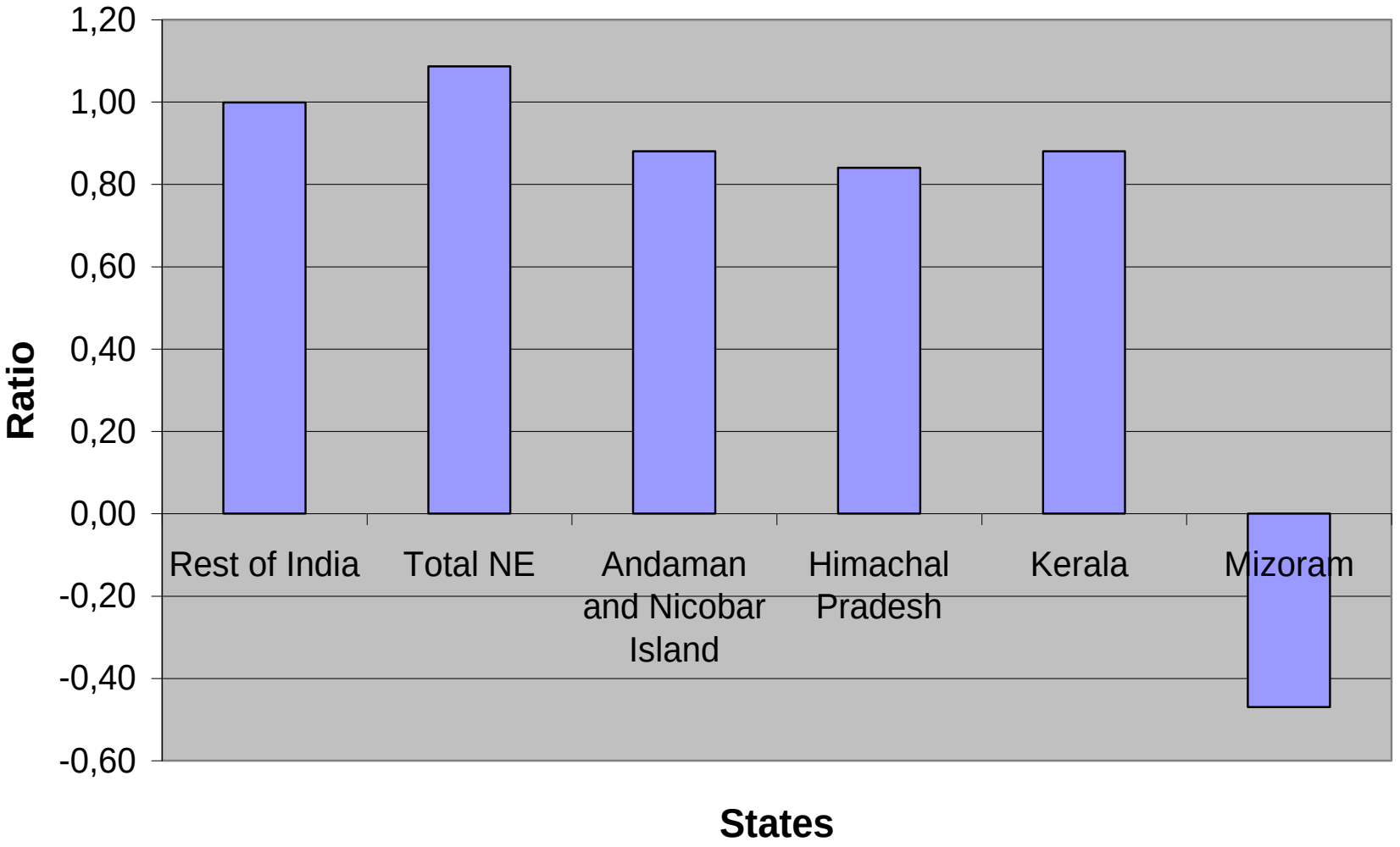
Model Assumptions in estimating WTP for flagship Indian species

- Absence of non-user WTP for conserving endangered and threatened animals in India
- we attempt to give a rough indication of the magnitude of these values for flagship species in India
- Four flagship species considered:
- **Asian elephant, Royal Bengal tiger, Asiatic lion, and one-horned rhinoceros.**
- For the elephant - Asian elephant in Sri Lanka
- Urban population of India above 18 years of age WTP
- Asiatic lion - same assumptions as WTP for elephant
- For the Royal Bengal tiger and the one-horned rhinoceros - WTP values of the Giant Panda
- Adults in High-income Countries (World Bank classification / ratio above 18 years of age) would be willing to pay for its conservation, *plus* Indian *urban* adults as with Asian Elephant & Lion

Loss as % of NSDP per year



ESDP/NSDP


1,20
1,00
0,80
0,60
0,40
0,20
0,00
-0,20
-0,40
-0,60
Ratio
Rest of India
Total NE
Andaman and Nicobar Island
Himachal Pradesh
Kerala
Mizoram
States

Conclusions

- Biodiversity benefits of forests are very material in the aggregate and significant with respect to national and state GDP.
- Significant Loss in Biodiversity values (147.2% in the case of Mizoram, 12.3% in Kerala, 15.6% in HP)
- In Manipur, Meghalaya, Nagaland and Tripura, where there has been an increase in dense forest cover, ´asset value increased ranging from 36% in case of Manipur to 98% in case of Meghalaya.
- Our estimates are extremely sensitive to the choice of values of ecotourism, bioprospecting and non-use values.
- The non-use values in our study may be taken as an upper bound.
- Our study throws light on those states which need a strengthened focus on conservation policy and practice due to their exceptionally high biodiversity potential.