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Green Accounting Methodology for India and its States

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Synopsis

Classical GDP measures under the SNA omit material externalities , and focus on GDP as a growth metric contributes towards unsustainable development. We argue that India does exhibit symptoms associated with unaccounted depreciation of natural resources, including a lack of focus on sustainability, and we set out a rationale for Green Accounting for India.

In this paper, we describe how, applying and developing SEEA (2003) methodology further, our "Green Accounting for Indian States & Union Territories Project" ("GAISP") has set up "top-down" economic models for State-wise annual estimates of adjusted Gross State Domestic Product (GSDP) in order to capture at a State level the main externalities from unaccounted flows of non-marketed services & unaccounted changes in human capital & natural capital stocks. We outline the approach used by GAISP in all key areas, and we also comment on the degrees of conservatism built into our approach.

Our preferred methodology as outlined has the advantage of having been feasibility-tested, as we have (at the time of writing) completed most of our project work. The dissemination of our results and the adoption of a Green Accounting methodology in India's 5-year plans and in presenting annual growth statistics could enable policy makers and the public to engage in a debate on the sustainability of growth, enable inter-state comparisons to be made, and support more appropriate budgetary allocations to areas which provide economic value but are not recognized in conventional national accounts.

1. Background and Introduction

The main objectives of this paper are to argue the case for Green Accounting for India (i.e. a framework of national accounts and state accounts showing genuine net additions to wealth) and to present a preferred methodology and models to reflect natural capital and human capital externalities in India's national accounts, measuring as depreciation the depletion of natural resources and the future costs of pollution, and rewarding education as an addition to human capital stock. Our over-riding purpose is to show that Green Accounting for India is desirable, feasible, realistic and practicable and that a start can be made with available primary data already being collected by various official sources of the Government of India.

There is a dearth of focused sustainability analysis and information provided to policy makers at the National and State levels in India. As a result, the processes of public debate, government planning, budgetary allocation, and the measurement of economic results are in effect being conducted without a sustainability framework. High GDP growth usually accompanies investment in physical infrastructure, which places mounting pressure on the country's environment and natural resources. However, there is an asymmetry between man made and natural capital in that depreciation in the former reflects in GDP accounts but the latter does not. Recognizing that GDP growth is too narrow a measure of economic growth and not a measure of national wealth, we propose a "Green Accounting" framework for India and its States and Union Territories.

This paper is an outcome of the "Green Accounting for Indian States & Union Territories Project" ("GAISP")[1] which aims to set up top-down economic models for annual estimates of adjusted Gross State Domestic Product ("GSDP") for all Indian States, thus capturing true "value addition" not just at a National level but at State level too. India has a federal political structure - State legislature and administration has considerable impact on local environmental policies and standards. Whilst states are governed by the same national laws on environment, forests, and wildlife, their environmental attitudes and policies differ, & the range and effectiveness of their environmental and forest management programmes differ quite considerably. Known anecdotally, this feature is not captured systematically. There are no metrics to distinguish sound and unsound environmental performance by India's State governments. Sustainable development at a State level remains un-measurable, and therefore un-manageable.

The Central Statistical Organisation (CSO) in India is working on a methodology to systematically incorporate natural resources into national accounts in different states for land, water, air, & sub-soil assets. However, the CSO approach develops accounts for some states & for some sectors, and their studies are still in progress. In contrast to the CSO approach, we use a top-down or macroeconomic approach to model adjustments to GDP/GSDP accounts, for two reasons.

Firstly, a top-down approach has the advantage of providing a consistent and impartial national framework to value hitherto unaccounted aspects of national and state wealth and production. Secondly, it optimises extensive existing research which is not yet tied together in a manner to be useful for policy analysis. Thus we hope to provide a much-improved toolkit based on international best practice for India's policy makers to evaluate the economics of their policy trade-offs, and will enable them and the public to engage in a better informed debate on the sustainability of economic growth, using national as well as inter-state comparisons. The materiality of calculated externalities in sectors such as education, health and natural resources are particularly interesting as these sectors are essential contributors to both sustainable development and poverty eradication.

[1] Information about GAISP and copies of its reports can be obtained from www.gistindia.org

Specifically, this project aims to re-calibrate the existing annual GSDP accounts to incorporate changes in each state's stock of natural capital (minerals, arable land, forests & freshwater) and its investment in human capital (education, health, and pollution control).

2. Rationale for a system of "Green Accounting" for India

India has spent the past decade building a growth dynamic that was missing in the earlier quasi-socialist regime. The cumulative impact of the reform process appears to be generating growth, however, it is also desirable to monitor and channel the forces of growth and investment in order to ensure that they truly improve the quality of life for current and future generations, and to manage the economy sustainably, one must also measure it with the lens of sustainability. Furthermore, there is an asymmetry between man made and natural capital in that depreciation in the former reflects in GDP accounts but the latter does not. In this context, it should be recognized that GDP growth is too narrow a measure of economic growth and not a measure of national wealth, and this is why we propose a "Green Accounting" framework for India and its States and Union Territories.

Key externalities in the form of creation and destruction of Human Capital and Natural Capital both need to be explicitly measured, because they have a significant impact on the long-term *sustainability* of India's growth.

2.1. Human Capital Externalities : Education and Health

Education and health are key components of human capital, and our adjusted measure of state wealth must therefore include estimates of investment in these two areas. Public investment in education as a % of GDP has been low in India (in comparison to China and developed nations) and much of this has traditionally been skewed towards tertiary education. However, the primary school enrollment rate is now at about 95% due to private spending and the work of NGOs (and some improvement in targeting by government as well). Unfortunately, according to ADB data, only 65% of girls and 70% of boys who enter the first grade are able to reach the fifth grade. The equivalent rates in China are 94% for girls and 93% for boys. India's traditional skew towards tertiary education has supported the country's recent success in the hi-tech services sector. However, this phenomenon will not spread through the rest of the economy unless primary and secondary schooling is also strengthened, as it provides a productive foundation as well as a means of identifying the highest potential from amidst a gigantic human resource pool.

Public spending on health as a % of GDP is even lower than on education, and also lower than the corresponding percentages in China. The threat to public health is compounded by the poor state of civic amenities such as water supply, drainage and sanitation. Privatization of education and health are observable trends in India, and the authors believe that to be the right direction. Nonetheless, we feel it is important to quantify the scale and effectiveness of both public and private efforts. In our view, this would allow proper targeting of public spending and improvement in the framework for attracting private funding.

2.2 Natural Capital Externalities : Freshwater, Forests, Agricultural Land and Sub-soil Assets

India's Natural Capital, apart from its Human Capital, is the other large area of unaccounted externalities. India's record in conserving natural capital over the last fifty years is mixed, and reflects a combination of factors and circumstances. On one hand, there has been an effort towards creating protected areas around the most precious accumulations of bio-diversity.

India has 592 protected areas, National Parks and Sanctuaries, predominantly forested, covering 4.6 % of land mass (MOEF, 2003) and extensive protective legislation has been enacted since independence. On the other hand, there is widespread violation of regulations by encroachers, illegal miners, property developers, poachers and loggers. Legal action by mining and logging interests to overturn protective legislation is not uncommon, although this have been countered quite effectively by environmental NGO's and citizens interest groups.

Whilst the pace of conversion of forest land to other uses is the most visible depletive trend impacting natural capital, there are many other forms of depletion of natural capital – sometimes helped by populist or insensitive government policy. For example, subsidies have often led to the use of inappropriate agricultural technology and crop choice that have led to falling water tables, rising salinity, water logging, surface water pollution and impoverishment of cropland. Similarly, India's mineral wealth has been exploited directly or indirectly by government without adequately considering import alternatives that would have come at a lesser environmental cost. Failures range from the use of out-dated technology to out-dated policy frameworks that have not been changed from the days of 'import substitution' as a key policy objective.

The declining quality of freshwater in India has received occasional attention when it is raised by the press in the context of specific "point sources" of pollution in various locations, and when it affects the quality of drinking water in high-profile cities. It passes notice that the decline in water quality due to chemical pollutants from ill-managed industrial wastes, use of fertilizers and pesticides in agriculture, and from the accumulation of poisonous solid wastes in and around cities and towns is a nation-wide phenomenon of significant proportions. There is enough tracking of water quality, but no widely-accepted means of evaluating the damage done in economic terms, in the form of potential costs towards purification and restitution of water quality.

2.3 Inadequacy of Democratic 'Checks and Balances'

Despite the above problems on both the Natural capital and Human capital fronts, two positive influences are present which can take India along a path of sustainable development. Firstly, India is a vibrant constitutional democracy with the attendant democratic institutions, especially an independent judiciary and a free press. We feel that public interest does prevail if long-term costs and benefits are clearly demonstrated in specific cases. Secondly, the growing exposure of citizens to the rest of the world (helped by widespread use of the English language) and the educational work of NGOs has increasingly sensitized sections of the urban public about environmental degradation and to the value of education as a means to better employment. Nevertheless, there are limitations to what can be achieved by an educated public and the checks and balances of democracy. In reality the action taken by the public boils down to sporadic or narrowly focused public interest litigation. Albeit well-meaning, such public action can only have limited conservation or sustainability benefits whilst the vastness of India's lands and the opaqueness of its public information systems (again, notwithstanding appeals made under the Right to Information (RTI) Act) prevents material achievement on the sustainability front through this route.

Since we do not see the efforts of NGO's and public interest litigation as sufficient action to reverse the current trend in India towards natural capital degradation, we point to the need for incorporating the importance of natural resource evaluation and management into the mainstream of public policy and administration. This in turn argues for the creation of an appropriate set of metrics for natural resource accounting at the National and State level - quite simply, one cannot manage what one does not measure.

2.4 Traditional ('SNA') GDP Accounting versus Green Accounting

The only yardsticks of growth or development that are available today -Gross Domestic Product (GDP) at the National level or Gross State Domestic Product (GSDP) at the State level - is unfortunately not designed to capture the significant gains/ losses to human capital and natural capital that happen year after year and affect the true or holistic wealth of the nation and its people. Much recent work on 'inclusive wealth' measurement (e.g. Arrow, Dasgupta & Maler, 2003) highlights the importance of holistic measures of wealth. National wealth should include not just a measure of manufactured assets and financial assets (physical capital), but also natural capital (oil, other minerals, forests, freshwater resources, cropland, fisheries, etc), human capital (knowledge and skills), and social capital (institutional and legal infrastructure, political maturity, social harmony, etc). Sustainable growth is then defined as that which increases per-capita national wealth, defined in this 'inclusive' or holistic manner. In the absence of any measure of sustainable growth, it is not surprising that India and its States often embark on unsustainable growth initiatives, at a very large future cost to the economy, to society, and to the natural ecosystems within which they survive.

The emphasis of SNA on "GDP" as the key measure of growth will probably be studied by future generations as the single most significant design defect in the economic history of mankind. An appropriate alternative, Green Accounting, entails the estimation of prices for all national assets, including natural and human capital assets, and their inclusion in the 'financial statement' of the nation, so it is no mean task. 'Green Accounting' is a methodology for capturing the so-called 'externalities' of 'mainstream' economics (which include most material and unaccounted changes in natural capital, human capital, and social capital) by estimating their stock or net asset values, and thus bringing them within a common framework of value accounting for the nation. In practise, Green Accounting involves an array of quantitative estimations : modelling and valuing the non-marketed services of environmental assets such as forests, calculating the value of education as a generator of future incomes, present-valuing future liabilities in the form of pollution abatement costs and healthcare costs, etc. This appears quite daunting an exercise, however, as we describe below, there is a sufficient body of work and precedent which will enable India to implement holistic Green Accounts. The benefits are immense, as Green Accounting would better enable governments to evaluate choices without a bias against future generations, or a bias in favour of man-made assets as against natural assets. It would present in a different & holistic economic light choices such as conserving precious ecosystems rather than surrendering them at throwaway prices to logging interests for a relatively minor economic gain.

There are other legitimate grounds for dissatisfaction with GDP as a measure of growth, such as the inability of GDP- optimizing policies and systems to engender financial and economic inclusion, but in this paper we do not address this issue. However, we do wish to point out that Green Accounting - driven policy focuses on conserving forest resources (a significant dependency for the poor household) and on investing more in primary and secondary education (important means of providing the poor with better future livelihoods) can only serve to improve India's current and disappointing state of financial and economic inclusion.

2.5 Qualitative Indexes and their Shortfalls

It is important to differentiate "Green Accounting" from what are sometimes represented as alternative ways of evaluating changes in holistic wealth. We refer to various indexes, such as the Environmental Sustainability Index ('ESI'). Another index which is sometimes discussed in the context of sustainability is the Human development Index ('HDI").We use the ESI as an example to explain why adjusted national accounting is a preferable exercise. The ESI was a pilot study on the relative environmental sustainability of national economies, launched at the World Economic Forum's annual meeting in January 2000 at Davos.

ESI data used 21 indicators across five sustainability components :
- state of environmental systems (including air & water quality)
- level of stresses & risks (eg: rates of pollution)
- human vulnerability (eg: population without access to safe drinking water)
- social/institutional capacity (including expertise and knowledge)
- stewardship (a country's sense of responsibility towards global commons)

It should be noted that the ESI is an *index* and *not* a quantitative measure of growth, whereas the focus of Green Accounting is to adjust traditional measures of growth & to re-cast them as measures of sustainable growth. ESI data are a blend of relevant statistical information, but they cannot answer the straightforward question "Is this growth sustainable ?". In contrast, an adjusted GDP approach such as we propose can and does provide a quantitative answer to that question. ESI measures are not an alternative to Green Accounting. At best they indicate where problems lie, but they do not provide yardsticks for economic evaluation of competing choices. Having said that, the surge of international interest that followed immediately from the publication of the first ESI rankings is instructive. That the evaluated participant governments sought to understand and improve their rankings provides insight into the possible reaction of India's State Governments to being evaluated by an independent survey on a 'true' measure of their competitive sustainable performance versus their peers.

We outline below some other useful but qualitative indicators showing environmental performance and human well being, noting again that they do not and cannot replicate a formal framework of Green Accounting.

Indicators	**Main features**
Ecological Footprint, Biocapacity and Ecological Debt (WWF, Zoological Society of London and Global Footprint Network)	Categories of demand, supply and gap (overshoot) based on areas of productive land (global hectares per person)
Barometer of Sustainability, Human Well-Being Index and Ecosystem Well-Being Index (Prescott-Allen)	Human well-being and ecosystem indicators are combined hierarchically within a two-axes scale
Human Development Index 'family of indicators', including e.g. the Environmental Behaviour Indicator by De la Vega and Urrutia	The human development index can be modified by adding an environmental dimension of by relating it to a well-know measure, such as the ecological footprint
Index of Sustainable Economic Welfare	The Gross Domestic Product is corrected

(ISEW) and Genuine Progress Indicator, Daly and Cobb	for not taking into account the welfare loss due to environmental degradation and other losses

(Source: Comim, Kumar and Shervan, 2007)

3. Green Accounting Methodology and SEEA, 2003

Green Accounting is an evolving science, and not every component of natural capital or human capital can be valued in a manner which is accurate, consistent and widely accepted as a norm by expert academic opinion. Furthermore, some components may be capable of measurement, but are unlikely to come within the purview of State policy-making over the critical horizon for sustainability and climate change, which many are now estimating as the next decade (IPCC report) thus limiting the usefulness of inclusion in such a project. The use of subjective judgment in selecting what adjustments to prioritize and the need for simplifying assumptions in making them in a timely fashion is therefore necessary, and a key purpose of our paper is to outline these assumptions and preferred methodologies.

The premise on which national accounts were originally built was to serve primarily as broad indicators of aggregate output. Nowadays, national accounts are also used to analyze resource allocation, productivity, growth, and income distribution. Hence, it is necessary to make appropriate adjustments in the framework and in the underlying concepts of national accounting. The UN's new manual on environmentally adjusted accounting (SEEA, 2003) is welcome begininning. The SEEA approach which came as response to the Brudtland Commission Report (WCED, 1987) attempts to integrate environmental information with conventional economic accounts. .SEEA avers to follow the ecological and economic approaches to sustainable development , but it fails to justify the omission of critical ecosystem services. SEEA 2003 defines assets such as fisheries, water, forestry etc and then prepares physical accounts, and then monetizes the changes in the changing stock over a period of time A lacuna is that not all uses of natural assets are addressed. It would not, for example, take into account the environmental values of forests which, for their flood prevention, rainwater storage and drought prevention value alone, are worth significantly more then their accounted timber or carbon values. Of late there has been a serious attempt by agencies like the European Union (EU) to highlight this lacuna in the SEEA2003 and an attempt is being made to capture some of the ecological services of natural resources in the template provided by the SEEA[2i] Thus whilst our methodological approach is based on SEEA's guidelines, we go a step further – foe example, to value various ecosystem services such as prevention of soil erosion, water augmentation and flood damage reduction by dense forest. (see Monograph 7).

'Strong sustainability' is based on the concept that natural capital is a complement to manufactured capital, rather than a substitute. Note however that we propose to base our study on an assumption of 'weak sustainability', or the idea that one form of capital is equivalent to another, and growth is sustainable only if the net change in natural, human, & physical capital is positive, resulting in "true savings" year on year.

We recognize the limitations of this approach as we drill down to smaller units – such as a District. For example, sharp depletions of forest cover in particular regions can cause calamitous changes in micro-climate, geology, and local bio-diversity (such instances are not unheard of in India) which cannot really be replaced by any other form of capital. We should defer the choice of evaluating policy alternatives on the basis of 'strong sustainability' to the State-specific studies envisaged in a later phase of implementation.

[2] Ongoing work on a 'Stern like report on Biodiversity and ecosystems ' is an example. EEA is attempting the accounting for land ecosystem services to improve the existing SEEA2003.

4. Green Accounting Methodology for India

Firstly, to introduce the system of Green Accounting for India, we believe it suffices to begin with what we describe as a "top-down" approach to measure the sustainability of growth across all of India's States and significant Union Territories. All databases chosen for primary data inputs for calculating Green Accounting adjustments must preferably be national databases, which house data state-wise, such that regional biases or regional variations in data collection methods do not come in the way of a true and fair accounting framework. (See example - Annexure 2)

Secondly, the use of standard models and standard projections is essential across all States. This will not only ensure a common and consistent methodology, it will also enable us to bridge time gaps between the publication of various slices of official data by the States and the Government of India.

The third consideration is that our selected areas of externalities must be material as a component of adjusted GDP and policy relevant as well in terms of being potentially targeted by policy change. As regards natural capital, our aim is to select those categories which are (a) material in an overall context, (b) measured by existing statistical databases, or soon to be captured by NRSA databases, and (c) realistically manageable as components of national or state government policy over the next decade or so. Following these three criteria, therefore, we include in our evaluation forests, agricultural cropland & pasture land, cattle, known mineral deposits, and surface freshwater resources, but we shall exclude subsoil water, undiscovered mineral deposits, and livestock other than cattle.

Data quality is an issue which needs to be addressed with both candour and vigour. As the public and the press in India is increasingly sensitized to the negative consequences of unchecked deforestation, and as NGOs and the courts time and again remind legislators and bureaucrats of the need to do their duty towards conserving these national assets, official data on natural resources is increasingly prone to "virtuous transformation". This is a phenomenon whereby positive skew is applied by official calculation agents at every stage of a multi-stage, bottom-up, national data collection process. To this are added definitional changes, interpretations, and large-scale re-classifications. The net result is that official statistics regarding this highly emotive arena tend to appear positive or even rosy, often showing "good news" (increasing forest cover, increasing tiger populations, etc.etc.) whereas the ground reality may be quite different. Some of our choices in following a "top-down" approach are guided by the need to select unbiased and unfiltered databases, and we accept the apparent sacrifice of precision in doing so in the interest of genuine accuracy.

4.1 Forests

Forests are probably the most challenging and significant area of evaluation for our project, and the quality and robustness of our results will be a measure of the success of our project. At the outset, we state that we evaluate both 'direct use' values of forests (timber, fuelwood, non-timber forest products, eco-tourism, etc) as well as 'indirect use' values (the value of flood and drought control, watershed maintenance, carbon storage, etc). Our preference for this broad-based selection is borne by our early results (GAISP, Monographs1, 4, and 7) which suggest that indirect use values exceed direct use values. Other values of forests – the so-called option values (i.e. willingness to pay for conservation for the option of future use) and non-use or 'existence' values (i.e. willingness to pay for conservation for its own sake) are not easy to address *ab initio* as there is insufficient "willingness-to-pay" research and data at this point for India's wildlife and bio-diversity.

This paper is an overview of methodology – with a particular focus on our recommended methodology for India - so we are not going into a detailed review of the literature and theory. However, interested readers are referred to Chapters 7 and 8 of the SEEA manual (UN et al., 2003) for more detailed discussion of forest accounts. Vincent and Hartwick (1997) provide a review of forest accounting in the early 1990s, and Lange (2004) provides a more recent update with an emphasis on the public policy applications of forest accounting. Eurostat (2002a, 2002b) provides a good overview of the work done by several EU members. For a review of some of the theoretical issues, readers are referred to Atkinson and Gundimeda (2006).

The approach we have followed is to cast in sequence physical accounts, monetary accounts, and finally, integration into national accounts. Physical accounts are constructed both in area as well as volume terms, and they generally have the following format :-

- Opening stocks
  - Changes due to economic activities
  - Other changes
- Closing stocks

Monetary accounts are based on depreciation adjustments computed from the valuation of opening stocks and closing stocks, as well as adjustments for the unaccounted services of forests. If they are indirect use values, then appropriate contingent valuation methods are used. This is followed by integration into National Accounts, by adjusting for unaccounted service flows, as well as for unaccounted changes in stocks.

In our 'Green Accounting for Indian States Project' (GAISP), all three steps – physical accounts, monetary accounts, and integration into national accounts – are carried out on a state-wise basis for each material group of externalities. Our project work has clustered forestry externalities into three clusters (GAISP Monographs 1,4,& 7 respectively)as follows,

- Biomass : Timber, Carbon, Fuelwood & Non-timber Forest Products
- Biodiversity : Eco-tourism & Bio-prospecting
- Ecological Services : Soil Conservation, Water Augmentation & Flood Prevention

The importance of the breadth of above coverage should be highlighted, as it represents a departure from published World Bank data on Adjusted Net Savings (World Development Indicators, Little Green Data Book, etc). We note however that the World Bank's publications as well as important papers on the subject (eg: Estimating National Wealth, 1998, Kunte, Hamilton et al , and Genuine Savings Rates in Developing Countries, 1998, Hamilton et al) all make certain simplifying assumptions in their empirical estimates. In particular, they valued natural capital primarily as resource inputs into production. This meant, for example, that forests were valued only as stumpage, i.e., the value of timber net of extraction costs. The reason for this simplification, in the case of the World Bank, was that they have to standardize data for their sample of over 100 countries, and they would accept fully that there are benefits of forests that they are not taking into account, which will vary according to location.

4.1.1 Tmber, Fuelwood, Non-timber Forest Products & Carbon

'Forestry and logging' is a component industry of State macro-economic statistics, and this enables us to estimate the value of timber extraction. It also enables us to model the volume of forest biomass lost to logging which is a deduction from natural capital. Timber extraction is modelled for forested areas other than protected areas (national parks and sanctuaries) for which it is assumed that the main economic purpose from a purely 'bio-mass' perspective is carbon storage and not timber or fuelwood extraction.

Forests act as high-density carbon stores, and conversion of forests to agricultural lands and pasture loses much of that value. Conservative estimates of that loss of value based on a carbon credit value of $ 20 per tonne C have been made (Atkinson and Gundimeda, 2006) and may be extended to all forest area which is capable of being lost to other uses – including protected areas, forest fringes up to a standard distance, and all isolated stands of forest including private forests, thickets in cultivated areas, & sacred groves etc. NRSA data analysis will help determine inputs to this valuation.

Fuelwood and non-timber forest produce (NTFP) comprise a very significant part of the household incomes of forest-dwelling or forest-edge communities (Pearce, 2003), a fact which is not necessarily captured by the economic value per hectare of NTFP. It is easy to overlook the stabilizing social role of NTFP as a sustaining value stream for local communities, and therefore as a means of poverty alleviation. A study on communities in Madhya Pradesh, Orissa & Gujarat (Bahuguna, 2000) estimates these components to be 49% of household income. Whilst we have been very conservative in estimating the value of NTFP, a more aggressive alternative could have been to estimate NTFP losses inherent in deforestation at an appropriate multiple of forest-dweller household income annuity streams, present valued. This is on the basis that forest destruction burdens State governments with the social responsibility to provide alternative livelihoods, infrastructure, and supervision for displaced forest communities.

4.1.2 Bio-diversity Values

India's 590 National Parks and Sanctuaries are potential future magnets for eco-tourism, if attendant infrastructure is properly developed, without destroying the forests and wildlife which are on display. We estimate the annual rents that could be derived from the rapid growth of this sector both in terms of volume and per-capita visitor contribution. This proves more difficult to model than expected, as there is no centralized database on tourist arrivals and expenditures. Even at the listed National Parks and Sanctuaries such information was not forthcoming .

For estimating value of biodiversity in Indian forests with a particular focus on eco-tourism, the most often used methods have been the travel cost method and the contingent valuation methods, for which primary surveys are required. For a top-down study such as ours, conducting a primary survey covering all of India’s national parks and sanctuaries was out of the question. Hence, we used an approach called the ‘benefit function transfer’ method, which refers to the use of existing knowledge to new contexts. Using all available consumer surplus estimates from different studies (See GAISP Monograph 4,) we obtained a function linking consumer surplus per hectare to site specific variables of interest, i.e, the number of flora and fauna. Using this function we extrapolated the per hectare consumer surplus values for different states. These “per hectare” values were multiplied with the total tourists visiting the park and the area of the park. However, as tourists visit multiple destinations and not national parks alone, we estimated the share of consumer surplus attributable only to national parks by using an econometric specification which links the number of tourists in a particular state with the variables influencing tourism so that the contribution of national parks alone can be segregated. This simulation was carried out with separate parameters for domestic and foreign tourists, given their differing levels of consumer surplus and behaviour.

Almost all new pharmaceutical drugs and remedies are discovered in forests first, then replicated by industrial processes. The pharmaceutical value of "hot spot" land areas in India have been estimated by various authors before us, such as in Rausser and Small, 1998 (for the Western Ghats and the Eastern Himalayas). Later on, Rausser and Small, 2000, developed a slight variation of their methodology to estimate the marginal value of

species for the 18 hotspots in the world. We use the same methodology to derive these values for different Indian states (see GAISP, Monograph 4). This model involved partitioning the information on total species found in forests into different leads (a species which has a chance of yielding valuable drug) of varying quality. Here each and every state is assumed to have species of different quality. The next step is to compute the probability of a hit in proportion to the quality of the lead. The probability of a hit is assumed to be directly proportional to the density of species in that state. Setting the search program to be optimal and random, and using financial parameters such as the cost of discovering a species and revenues obtained by different pharmaceutical companies which use this species, we estimated the option value of pharmaceuticals as a component of the value of the bio-diversity of India's forests.

4.1.3 Soil Conservation, Water Augmentation, & Flood Prevention

Probably the most critical of all aspects of natural capital in India is the value of forests as watersheds for lakes and rivers, helping to store rainwater and release it gradually over the dry months, thus regulating flows. The cost of devastation wrought by cycles of floods and droughts is well documented (eg: CSE, 3rd Citizen's Report on the Environment). Arable land, standing crops, cattle, farms, houses, and human lives are lost in floods with regularity, and widespread deforestation is represented as a key cause. It is important to filter out the natural level of forest loss due to geophysical disturbances and climatic extremes, and establish (or otherwise) causality above this 'baseline' .State-wise data on flood and drought related losses are published by the Central Water Commission (CWC) as well as the Rashtriya Barh Ayog (RBA, the National Commission on Floods) .

4.2 Agricultural Cropland & Pasture Land

Agricultural cropland and pasture lands have been incorporated into the national accounts by first analyzing the changes in land use. The effect of the changes in land use under this category has been estimated from the annual crop value, Annual rents from cropland, set at appropriate percentages of crop value (after factoring in a return on irrigation), projected using appropriate growth rates of area and yield and discounted at the standard discount rate being used for all rentals-based appropriate rate. For India, state-wise agricultural land-use statistics are readily available from the Ministry of Agriculture, Gov't of India, and state-wise distribution of crops as well as productivity data is available from the Ministry of Agriculture.

An open issue is the use of international prices for foodgrains, in this paper and in World Bank's -UN SEEA, an approach which is essential for equitable analysis across countries, but one which may overstate or understate relative resource rents for a study such as ours which values most forms of capital (physical – from SDP accounts; human – from domestic earnings data) on the basis of domestic prices in India. We chose domestic prices as consistency within an Indian policy framework was more important, and this can always be amended as an input parameter for international comparisons.

If land is used sustainably it can have an infinite life. No adjustment of degradation is required and the whole resource rent can be considered as income. However, the use of land for agriculture using unsustainable practices would mean degradation of the land due to soil erosion in the form of loss of nutrients from the top soil, movement of soil, salinization due to improper irrigation practices, etc. In such cases, an adjustment to income derived from agriculture is necessary. We estimated the value of degradation of agricultural land using an approach very similar to SEEA, 2003. We estimated the value of

degradation due to soil erosion both on-site (impact of loss of top soil) and off-site (impact of sedimentation of waterways) using approaches such as replacement cost, loss of productivity, and maintenance cost methods.

4.3 Sub-Soil Assets

Subsoil assets such as coal, iron ore, petroleum and natural gas are very valuable assets being finite and non-renewable, and they play an important role in the Indian economy. They constitute vital raw materials for many industries and are a major resource base for development. Clearly, minerals being non-renewable resources, their extraction and sale definitely increases income but does not contribute to increase in asset stock. The current treatment accorded to mining in the national accounts is valid only if the mineral resources are infinite to the extent that the current extraction would not have any impact on the stock. As this is not the case, the gains from extraction should be adjusted with loss or gain in mineral stock.

To enable proper accounting of mineral wealth, we developed physical accounts in the format suggested by SEEA, 2003 and valued the depletion or appreciation of the value of mines using the net price of the resource. The depreciation of the assets is obtained as the difference between the value of mineral stocks of the previous and current year. Sustainable income can be estimated by deducting depreciation from the gross value added. It is not necessary that depreciation is always a deduction ; reserve variations due to new discoveries and reclassifications which may exceed depreciation caused by extraction, thus depreciation may be a net addition in such circumstances.

4.4 Freshwater

The change in physical stock of surface and ground water is assumed to be constant at least in the time span of 10-15 years, in the strict sense of hydrological science, but the human use of water and therefore its quality changes. In our GAISP report (Monograph 8) this change in quality of surface and ground water has been estimated, and by adopting the replacement cost approach, these changes on a yearly basis have been monetized. This has been treated as depreciation in natural capital – freshwater, and has been adjusted against each State's gross (GSDP) performance.

4.5 Human Capital – Education

Evaluating the knowledge, experience, and skills resident in population is at the heart of our modelling of human capital. As with most national accounts, India's GDP and SDP accounts capture as 'investment' only that element which is spent on fixed assets, such as new university campuses. Current expenditures (eg: teachers salaries, subsidies for books, scholarships) are treated a consumption, which is clearly incorrect. The effect of including human capital investment can be quite significant. A telling example (Hamilton & Clemens, 1998) demonstrates in the case of Chile how its 3% of GNP spent on education, re-expressed under 'green accounting' rules, helped keep genuine savings rates positive in the late eighties, and notionally countered nearly half the natural capital depletion in1993 & 1994.

We observe that estimates of human capital creation are often derived on the basis that growth in the non-manufactured component of GDP is attributable to human capital. We prefer not to follow this approach, as it would contaminate this important measure with a number of unspecified economic variables, and thus bring into question the public policy relevance and value of our framework.

One of the earliest attempts to estimate the money value of a human being and to apply that to estimate a country's stock of human capital was made as early as 1691 by Sir William Petty. It is noteworthy that the results of many different studies exhibit high ratios (5:1 is a rough median) for the value of human capital : physical capital, a result which underlines the significance of omitting this component from national wealth following the traditional SNA methodology. Two approaches are possible to address this positive externality ; the cost-based approach and the income approach. The cost-based approach estimates human capital based on the assumption that the depreciated value of the dollar amount spent on those items defined as investments in human capital is equal to the stock of human capital. This is a backward-looking method because of its focus on the historical costs of production. The income-based approach (capitalized earnings procedure) measures the stock of human capital by summing the total discounted values of all the future income streams that all individuals belonging to the population in question expect to earn throughout their lifetime. It was first developed by Farr (1853), who estimated the capitalized value of earning capacity by calculating the present value of an individual's future earnings net of personal living expenses. Jorgensen and Fraumeni (1989) provide a contemporary analysis and framework for the income-based approach.

We recommend such an income-based approach for India, and we find that earnings data from the NSSO (National Statistical Survey Organization) is sufficient to provide data input into this approach (for a detailed exposition, see GAISP Monograph 5, Estimating the Value of Educational Capital Formation in India, 2007). To simplify, our model for the value of education is based on a state-wise statistical study of relative income levels across selected age cohorts and sexes, with assumptions about their implied educational requirements. To illustrate the principle, a study of the annual incomes of 24 year old men in a state across the following five professions (a) farm hand (b) village shop assistant (c) clerk at district post office (d) accountant at private corporation (e) programmer at a Bangalore based Information Technology house could reflect the income impact of primary education (b-a), secondary education (c-b), tertiary education (d-c) and vocational training (e-d). These earnings differentials were computed over the expected working lives of our 'model' population, and present-valued appropriately. To these present-values of the different components of education we would apply annual school-leaving rates, annual graduation rates, and annual passing-out rates for vocational training.

The multiple of these quantities would give us an estimate of educational capital creation across each category of education, which would be a statistic of considerable public policy significance for budgetary allocations to education.

4.5 Human Capital - Health

In common with education, much of the investment in health is classified as 'consumption'. Capturing investment in health is further complicated by the fact that it is affected by factors that are not explicitly classified as part of the healthcare sector (for example, pollution control, provision of public toilets and so on). This is a major flaw because healthcare has important externalities that affect sustainability. Most importantly, improving health and education (especially for women) have a strong influence over population growth. There is growing evidence that birth rates have already declined sharply in many parts of India due to human capital investments and, in turn, this has important implications for the rate of natural resources depletion required for sustaining a given standard of living.

At the time of writing, we are exploring alternative models to be used , recognizing also the need to tie in an appropriate model for pollution abatement costs as a component of the adjustments which will be applied to GSDP accounts.

5. Conservatism built into our Forest Valuations

Our estimates for Indian forest valuation are considered to be conservative or "floor values" because, firstly, they do not capture several values of forests which we have found too difficult to estimate from available data, including,

a) **Spiritual, cultural, and historical amenity values** - from innumerable places of human and religious interest such as sacred groves, pilgrimage sites, river sources, etc, in each state across the country

b) **Health protection values** - both air purification benefits for the general population as well as psychological benefits to urban visitors especially in the case of Parks/ Sactuaries within easy reach of urban agglomerations, thus contributing to a reduction of the State's health bill.

c) **Social security benefits** – it is estimated (eg : Bahuguna, 2000, for MP, Gujarat, Orissa) that almost half of the household incomes of communities living close to forests comprises forest products. In the absence of this sustenance, social responsibility to provide alternative livelihoods, infrastructure, and law-and-order /supervision for displaced forest communities would devolve on State governments, at a huge cost as these displaced poor migrate to nearby towns & cities.

Secondly, we have been somewhat conservative in estimating those forest values which we did estimate (i.e. for Timber, Fuelwood, NTFP, Eco-tourism, Bio-prospecting, Ecological Services, etc,). In the paragraphs below, we describe conservatism in detail. We can of course lift these conservative assumptions, and that immediately results in higher values for India's forests, but we believe that firstly these conservative "floor values" should at the very least find their way into a formal Green Accounting system to represent the ' lower bound ' economic value of forest stock for India and its states and Union territories.

5.1 Conservatism in valuing non-timber forest products

In addition to timber, forests yield non-timber forest products (ntfps) such as bamboo, sandalwood, lac, honey, fodder, resin, gum, tendu leaves etc. These are also referred to as minor forest products (mfps). The value of ntfps are estimated based on a very nominal 'royalty' (the rates have not been revised since many years).The official statistics do not report the quantity of ntfps harvested but give only the "revenue generated" through collection or sale of ntfps. The revenue generated from ntfps is actually very low. However, given the large-scale dependence on the population on common property resources of which forests are a major part, including fuelwood, fodder, thatching materials, fruits, bamboo, canes, reeds, honey and other products (from a survey carried out by the National Sample Survey Organisation (NSSO) – see Monograph 1), we know that the "revenue generated" is a severe underestimation of the actual or potential revenue. We also know that the locals sell their products to agents who make much higher revenue than what they actually pay the locals. This is especially true in case of medicinal plants (where the final value generated is extremely high compared to what is actually paid to the tribals for collecting the medicinal plants). For all these reasons, we believe our ntfps estimates are very much on the conservative side.

5.2 Conservatism in valuing the ecological services of forests

In estimating the value of soil erosion prevention contributed by forests we use the "replacement cost" method, which is more conservative than the "productivity loss " approach as the latter uses revenues rather than costs. Furthermore, for our replacement cost estimation, we assume that all we need to replace are the 4 key nutrients (Nitrogen, Phosphorous, Potassium, and Organic Matter). We also assume that this replacement is totally efficient, i.e., it neither degrades nor washes away on application, nor requires any other intervention to restore soil to its original quality. All these effects are real, and thus we have under-estimated the true replacement cost and hence the value of the forests in avoiding these costs.

As for the role of forests in mitigating economic damage, which is determined using a correlation analysis over a 50-year cycle, we have worked out this correlation, but we have taken only 35% of the total damage as attributable to de-forestation.

6. Conclusions

Based on our empirical work and contingent valuations for material externalities which are omitted in the traditional System of National Accounts (SNA) followed by the Government of India in presenting its national (GDP) and state (GSDP) accounts, we conclude that it is indeed possible to use a 'top-down' approach and construct Green Accounts for India and its States and Union Territories. Details of this work may be obtained through our series of eight Monographs on various important but inadequately captured categories of national assets in the areas of natural capital and human capital. We further conclude that a "top-down" approach is both feasible and desirable to capture effectively the relativities of sustainable development across India's states. However, due to the absence of a standard for national data collection periodicity across the diverse categories of data required (from employment demographics, to forestry, to agriculture, to water quality, etc) we have found it necessary to make certain assumptions and interpolate or extrapolate as appropriate, thus introducing a degree of inaccuracy in our estimations. Furthermore, not all data for all categories of Green Accounting adjustments is entirely reliable, or complete, or current. Where we have had to rely on modelling assumptions, we have opted for conservatism such that the size of adjustments calculated by us form the 'lower bound' for the resource category in question. Notwithstanding these constraints and inaccuracies, we find that the results of our empirical studies are useful in assessing, evaluating and comparing performance in areas which are highly significant components of well-being and wealth across India and its States and Union Territories, but are not captured in our National and State Accounts.

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ANNEXURE 1

GIST's "Green Accounting for Indian States Project" Publications

During the course of "Phase 1" (2004-2007), GAISP will research and publish eight subject Monographs and a Final Report which addresses policy recommendations.

Each of the subject monographs evaluates externalities in a particular area or related set of areas, calculating adjustments to Gross State Domestic Product (GSDP) accounts for all of India's states and union territories, subject to the quality and availability of data .

These eight monographs are as follows:-

Monograph 1 : The Value of Timber, Carbon, Fuelwood, & Non-Timber Forest Products in India's Forests (January 2005)

Monograph 2 : Estimating the Value of Agricultural Cropland and Pasture Land in India (December 2005)

Monograph 3 : The Value of India's Sub-Soil Assets (planned : Q1, 2008)

Monograph 4 : The value of Biodiversity in India's Forests (July 2006)

Monograph 5 : Estimating the Value of Educational Capital Formation in India (June 2007)

Monograph 6 :Investments in Health and Pollution Control and their Value to India (planned : Q2, 2008)

Monograph 7 : Accounting for the Ecological Services of India's Forests (April 2006)

Monograph 8 : Estimating the Value of Freshwater Resources in India (Nov. 2007)

ANNEXURE 2

Example of a "top-down" approach using National databases analysed by State / Union Territory : FSI Data on Forests

We illustrate with an example (Forests) which is pertinent to our project. A 'Top-Down' approach to estimating forest cover and biomass of varying categories may begin with what is available, but needs to migrate soon to a less filtered and more reliable database.

Comprehensive data on forests are published bi-annually by the Forest Survey of India, (FSI) Dehradun. This data has never been consistent with the land-use data released from time to time by the Government of India (Ministry of Agriculture). Secondly, collection and collation of such data is based on a combination of field work and analysis of aerial photography and digital satellite imagery, a process which is not free of interpretative biases. Some years ago, and defying all observations of deforestation, official (FSI, 2000) data showed that overall forest cover increased in India from1997-1999, and by a sizeable 237,000 hectares. It appears that a change in mapping resolutions accounted for this, and that the two successive surveys were therefore not directly comparable.

There is an effort under way to create a unified system called the the National Spatial Data Infrastructure (NSDI).It is expected that this will be available on line and will be open to the public, and it may be an ideal and lasting source for our "top-down" Green Accounting adjustments for States and Union Territories.

Data on forest cover, surface/underground water resource, and land use statistics are also available from Govt of India publications, as well as from occasional studies. The National Remote Sensing Agency (NRSA) in Hyderabad has good information which, appropriately analysed by GIS experts, could provide an independent source and a check on published Gov't of India statistics , although as with all satellite imagery it is difficult to distinguish plantation from forest . Medium-term, our recommendation is to use NRSA data and develop GIS expertise to overcome the complications introduced by official re-classification.

At the time of writing, the Forest Survey of India had not yet released its "State of the Forests" report covering the 2-year period 2003-2005. Their previous bi-annual report, on the years 2001-2003, released in July 2005, was thus the latest available official source of forest cover data, and this is what our Green Accounting work has incorporated.