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Green growth and pro-environmental behavior: Sustainable resource management using natural capital accounting in India

Moinul Islam, Shunsuke Managi*

Urban Institute & Departments of Urban and Environmental Engineering, School of Engineering, Kyushu University, 744 Motooka, Fukuoka 819-0395, Japan

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ABSTRACT

The natural capital (NC) of India and its management system are essential conditions of the welfare path to the sustainable development of the country. We conduct an accounting process for India's NC to measure sustainability to ensure that future generations will have the equal total wealth per capita accessible to them as that available to the present generation. We then describe the combination of the renewable and non-renewable NC that is relevant within the concepts of welfare and sustainability. First, we note that India has successful forestation, which has enhanced welfare for its residents. However, the other renewables (e.g., cropland, fishery) and non-renewables (e.g., fossil fuels, minerals) are continuously degraded as a result of economic development and population growth. Second, we discuss the correlation between sustainable resource management and pro-environmental behavior (PEB) and explain the importance of considering these factors to achieve green growth. Third, to provide practitioners with useful information on how to promote PEB and to discover the determinants of PEB, we analyze the survey data of 5,200 respondents from all Indian states. We identify that environmental knowledge is an important determinant of individuals' PEB in India. In the policy analysis, we evaluate the challenges to achieving sustainable development goals (SDGs) using NC accounting in India. We recommend several policy implications to maintain NC at a sustainable level and to achieve SDGs.

1. Introduction

To be sustainable, it is essential for humanity to live within the Earth's carrying capacity. Natural and social scientists and ecological economists have mentioned that to achieve green growth, humanity should consequently preserve the Earth's natural stocks (Daly et al., 1989; Pearce, 1998; Wackernagel et al., 1999). Sustainable development should meet both the present needs and the future demands. Ulgiati and Brown (1998) scientifically identified the link between sustainability and resources. The authors noticed that green growth has been associated with (a) accessibility of natural assets and its carrying capacity; (b) expertise in resource use; (c) integrity in resource shares; (d) equity across generations; and (e) environmental acts and avidness.

As the world population continues to increase, the role of natural resource conservation for sustainability is becoming critical. In the domain of natural assets management and protection, the challenge is to guide human behavior and to achieve the goals of green growth (Huntley and Petersen, 2005). There has been dramatic development in the research on natural assets management in concurrent years. However, few studies have linked the management of natural resource stocks and stakeholder behavior as it is relevant to sustainable resource management.

Why are natural resource stocks, or natural capital (NC), important for sustainable development? NC values the economy and the environment as allies for sustainable development. NC comprises all natural resources, including land, forest, minerals, and fossil fuels. Natural resources provide immense benefits and significance, both explicitly and implicitly, which are crucial for promoting the progression of the economy and human welfare. Therefore, natural resources should be considered as assets, i.e., complementary to existing assets in the economy, that define the share of the total assets of a country (Barbier, 2007).

Ecological economics addresses the significance of NC and its complementary role in economic development (Folke et al., 1994). The contribution of NC has been significant in the economic system and in the environment. Arrow et al. (2012) note that comprehensive economic advancement has been preceded by the exhaustion of NC, diminishing environmental services, and environmental deterioration, which lowers the sustainability of future generations. Humans can destroy NC indirectly by contamination or directly by overexploitation. However, the environmental protection policies that explicitly attempt to conserve NC are very limited.

What can NC accounting measure? Regarding the sustainable

* Corresponding author.
E-mail address: managi.s@gmail.com (S. Managi).

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development of wellbeing, NC — a broader notion than only natural resource stock — should not be ignored. NC accounting is an important part of natural resources and directly benefits a nation's welfare/utility. Valuing NC in economic terms helps to better calculate growth rates and to solve management problems on sounder grounds. This approach will also contribute to more accurately calculating the amount of natural resources a society has and how those resource are distributed among stakeholders (Azqueta and Sotelsek, 2007; Islam et al., 2018).

The access to natural resources has elevated remarkably over the last century. However, the evident degradation of the ecosystem and declining NC challenges the sustainability of these actions. The overharvesting of NC poses serious threats to national and regional prosperity. Economic development methods assume that NC can be substituted by produced capital, but this assumption is not true. The economic development process has successfully overcome the local environmental and NC dependency and is influencing the global ecosystem. The overuse of renewable resources at the regional level is now threatening future economic growth and Earth's ecosystem.

Developed countries, e.g., Australia, Canada, and the United Kingdom, have published details about total national assets, along with at least a few contents related to NC (Australian Bureau of Statistics 2001; Office of National Statistics, 2003; Ryan et al., 2003; Smith and Simard, 2001). This paper represents India's first attempt to formulate state-level reports of its total national assets based on the wealth computing for NC that was established in line with the inclusive wealth approach, which has been used by Managi and Kumar (2018), UNU-IHDP and UNEP (2014, 2012).

There is an increasing belief that human conduct negatively affects the environment, e.g., water pollution, damage biodiversity and others (IPCC, 2007). Hence, it is essential to identify the factors that guide human attitudes to alleviate these problems. Identifying details on why individuals initiate pro-environmental behavior (PEB) is essential for decision makers and researchers to pinpoint the solutions to environmental challenges that require the transformation of attitudes (Clark et al., 2003). According to previous literature, PEB emerges from an individual's values, beliefs, and attitudes, which all affect their conduct. As a consequence, psychologists believe that preconception, education and socioeconomic standing enforce behavioral transformation. This research harmonizes the components from psychology and economics to classify important variables that define an appropriate example of PEB.

To create a set of sustainable development goals (SDGs), representatives of participant countries met at the United Nations Rio +20 summit in Brazil in 2012. In this summit, governments agreed to create SDGs that would be combined with the follow-up to the millennium development goals (MDGs) after the 2015 deadline. The SDGs include 17 goals and 169 targets (UN, 2015). The goals and targets for the SDGs should be assayable and should apply to countries. The SDG construction regulates trade-offs and enlarges harmony between goals; furthermore, an SDG should be applicable from the international to the city scale (Griggs et al., 2013).

PEB, NC, green growth, and SDGs are highly important factors necessary to achieve balanced economic growth. To protect the environment and ecosystem services, PEB has extensive importance, and it has acquired key interest in interdisciplinary research over several decades (Wang et al., 2019). In a case study at the corporate level in China, Lu et al. (2017) noted that PEB was the key method to promote green growth. Guo et al. (2018) also focused on the importance of environmental action to accomplish green growth. Merino-Saum et al. (2018) explained that environmental damage and the excessive use of natural resources threaten human well-being. They also highlighted the relationship between NC and SDGs.

It is challenging to measure the progress of SDGs due to the incorporation of an increasing global population and swiftly growing income per person in substantial advancing countries, such as India, China and others. As a result, the performance of these economies will be crucial for the establishment of SDGs. Therefore, effective resource allocation (e.g., water (Miao et al., 2018)), carbon emissions from sectors (e.g., tourism (Chen et al., 2018)) and other domestic targets related to harmonizing development and green growth are important for the policy makers of emerging countries.

The way humans treat their environment is important, and inappropriate human behavior causes environment degradation. If humans change their behavior quickly in an effort to reduce the harmful effects of environmental damage, it will ensure the environment's well-being (Gifford and Nilsson, 2014). Environmental preservation and restoration are the key risks countered by humanity today, and therefore, it is crucial to identify what factors impact PEB and to accept PEB in the community (Bronfman et al., 2015).

It is also crucial to implement individual PEB to ensure the success of sustainable development (Saphores et al., 2012). Education is an important variable that helps explain the level of environmental awareness and PEB (Zilahy and Huisingh, 2009; Zsóka et al., 2013). Education can ensure solid environmental awareness and enable younger generations to perform sustainable measures (Adomssent et al., 2007; Bradley et al., 1999; Oğuz and Kavas, 2010).

In this paper, we intend to answer why NC assessment and accounting is important and should be considered by India in its effort to monitor the targets of the SDGs. We focus on mainstreaming NC, including its valuation and accounting, which is critical for integrating the value of NC into decision-making processes. Economic tools and methodologies are applied in NC valuing and accounting. We seek to extend the understanding of the relationship between the concern of sustainable NC management and PEB. We also identify the determinants of PEB on policy implications for green growth. The article begins with a brief explanation of the indicators of well-being and presents the construction of a theoretical framework that accounts for NC in Section 2. Section 3 then discusses the NC of India, Section 4 represents the results, and Section 5 presents the conclusions.

2. Methodology

2.1. The basic model of well-being

Arrow et al. (2012) hypothesize a closed economy where there is no trade activity with other countries. In the model, they considered time as continuous and indicate variability by τ and t ($\tau \geq t \geq 0$). In Eq. (1), C_τ represents the consumption at time τ. This value includes the marketed consumer goods, non-marketed relaxation, different health services, and nature-gifted consumption benefits. Arrow et al. (2012) also assume that the population is constant at time τ. Here, $U(C_\tau)$is the utility at τ, and $V(t)$ is the intergenerational well-being at t.

In the conceptual framework (1), we are interested in the change of intergenerational well-being at t:

$$V(t) = \int_t^\infty [U(C_\tau)e^{-\delta(\tau-t)}]d\tau, \quad \delta \geq 0 \tag{1}$$

Assuming equivalence between wealth and wellbeing, this is measured by wealth in practice.

2.2. Natural capital as an indicator of environmental quality and wellbeing

It is important to incorporate NC into decision-making to fulfill prevailing and subsequent human well-being (Guerry et al., 2015). Significant progress has been made for NC accounting in monetary values by economists and by other natural scientists. For instance, the Inclusive Wealth Reports of 2012 and 2014 (UNU-IHDP and UNEP, 2014, 2012) have valued countries' NC stocks and identified the sustainability condition of each country based on growth over time.

We employ NC, which considers both market and nonmarket natural assets that contribute to well-being, as a proxy for environmental quality. The estimated monetary value of NC is obtained by multiplying

the estimated stock of each component of NC, including renewables (e.g., agricultural, forestry) and non-renewables (e.g., fossil fuels, minerals). To avoid estimation bias due to the changes in unit price, constant average prices within the study period are employed after adjusting for inflation using the U.S. GDP deflator.

2.2.1. Renewables

Agricultural wealth is a significant benefactor to the renewables of India. India's agricultural wealth consists of cropland and pastureland. The cropland area available in a particular year is considered the stock. Then, the net present value (NPV) of the subsequent rental flows for the stock valuation is also considered in this approach. Regarding price calculation, we consider market value as the result of the production within a particular year, including the quantity and rental rate of each product. A similar estimate is applied to pastureland wealth, with the available hectares of land used to determine the annual stock valuation.

Forest wealth is another important type of renewable wealth in India. We calculate both the commercial and the noncommercial values of the forest by valuing commercial timber and forest ecosystem services for the 1990–2014 study period. To estimate the timber stock, we calculate the commercially available timber volume through the multiplication of forest area, density of forest and commercially available forest volume. For the shadow price, the World Bank (2011) approach is considered.

This approach adopted a weighted average of industrial round wood and fuelwood. The prices of these woods are calculated from the exported amount and produced amount, respectively. Including the nonmarket value of the forest, the estimation follows the marginal benefit of the ecosystem service flows (ESF) to intertemporal economic well-being (Van der Ploeg and De Groot, 2010). This approach considers the associated values by the contributions of different type of forests in the country. The ESF forest wealth is estimated by valuing the expected annual flows of forest ecological services based on their marginal contributions to economic welfare.

2.2.2. Non-renewables

Non-renewables consist of the fossil fuels and minerals of the states in India. Concerning fossil capital (e.g., natural gas, oil, coal) and mineral capital, we have calculated the stock of the resources for a year prior to 2014. The estimation method was as follows:

$$Stock_{t-1} = Stock_t + Extraction_t \tag{2}$$

The fossil and mineral stock under study in year $t-1$ is estimated from the extraction and the stock in year t. Furthermore, we computed the wealth of the resources from the multiplication of stocks and the rental values during the 1990–2014 study period:

$$Wealth\ of\ resource_{ti} = Stock_{ti} \cdot \overline{Price_{ti}} \cdot Rental\ Rate_i \tag{3}$$

To avoid estimation bias due to changes in unit price, we use constant average prices within the study period after adjusting for inflation using the U.S. GDP deflator. We have used the rental value of minerals from Narayanan (2012) for the corresponding prices.

2.3. Survey data

Our survey data of 5,200 individuals were collected via an internet survey that was based on a systemic random sample from all states of India. We used the geocoded data of the respondents to confirm that all states in India were included. Randomly selected individuals from the states received an email prior to taking the survey. This approach ensured the convenience to respondents that allowed them to answer the questions within a planned time range.

The survey questions were asked in four stages. In part one, we asked the respondents about their PEB and involvement with governmental, nongovernmental and voluntary environmental activities. Stage two inquired about the responsibility for environmental activities. We asked the respondents about their opinion about identifying who the most responsible stakeholders in charge of caring for environmental pollution and damage were. In part three, we asked about the respondents' involvement with their neighborhood and social networks. In the last part, we asked demographic and socioeconomic status questions regarding the individuals and their family members.

2.4. Characterization of pro-environmental behavior

Our analysis sought to identify the variables that were reliably associated with PEB. We also focused on the quantitative analysis to categorize the vitality of the impacts. To characterize PEB, we used the available relevant information of individuals in a logit model. In this model, y_i equals 1 if respondent i has performed a pro-environmental activity included in our survey and 0 otherwise. Eq. (4) represents the PEB variable in our analysis.

$$y_i = \begin{cases} 1 \ if \ y_i^* > 0, \\ 0 \ if \ y_i^* \le 0. \end{cases} \tag{4}$$

We hypothesize that PEB depends on environmental awareness, environmental payment choices, involvement with society, age, gender, education, household and income satisfaction. For $i = 1,\ldots,N$ (N is the number of total respondents), the relationship can be derived from the following regression mode (5):

$$y_i^* = \alpha_0 + \beta x'_i + \mu_i \tag{5}$$

Here, x'_i is the vector of the explanatory variable, β is the vector of unknown parameters, and μ_i is an error term. The descriptive statistics of our model variables are presented in Table 1. We estimated Eq. (5) using a logit regression model.

2.5. Linking sustainable natural capital management and pro-environmental behavior

Our theoretical model regarding the link between sustainable NC

Table 1
Descriptive statistics of model variables.

Variables	Obs.	Mean	Std. Dev.	Min	Max
Dependent variables					
Pro-recycling	5,200	0.548462	0.497694	0	1
Pro-cleaning	5,200	0.469039	0.499089	0	1
Pro-energy saving	5,200	0.724423	0.446848	0	1
Pro-public transport	5,200	0.566154	0.495652	0	1
Pro-forest protection	5,200	0.300769	0.458637	0	1
Pro-cooperative govt. activity	5,200	0.304039	0.460043	0	1
Independent variables					
Gender	5,200	0.416539	0.493032	0	1
Age	5,200	34.53442	11.89105	18	99
Number of children	5,200	0.994231	1.045404	0	10
Household members	5,200	4.2875	1.596495	1	10
Income satisfaction	5,200	3.224615	0.843112	0	4
Education	5,200	7.691538	1.991385	0	11
Environmental awareness					
Environment is important	5,200	0.641923	0.479481	0	1
Know ozone	5,200	4.005577	1.002866	1	5
Know biodiversity	5,200	3.626538	1.090336	1	5
Know energy sustainability	5,200	3.8	1.006232	1	5
Environmental payment preferences					
Interested group pays	5,200	0.449808	0.497522	0	1
Polluting group pays	5,200	0.424808	0.494361	0	1
Government pays	5,200	0.598269	0.490295	0	1
All citizens pay	5,200	0.515385	0.499811	0	1
Involvement with society					
Livable neighborhood	5,200	4.131346	0.764083	1	5
Community attachment	5,200	4.084038	0.833779	1	5
Safe neighborhood	5,200	3.225385	0.734374	1	5

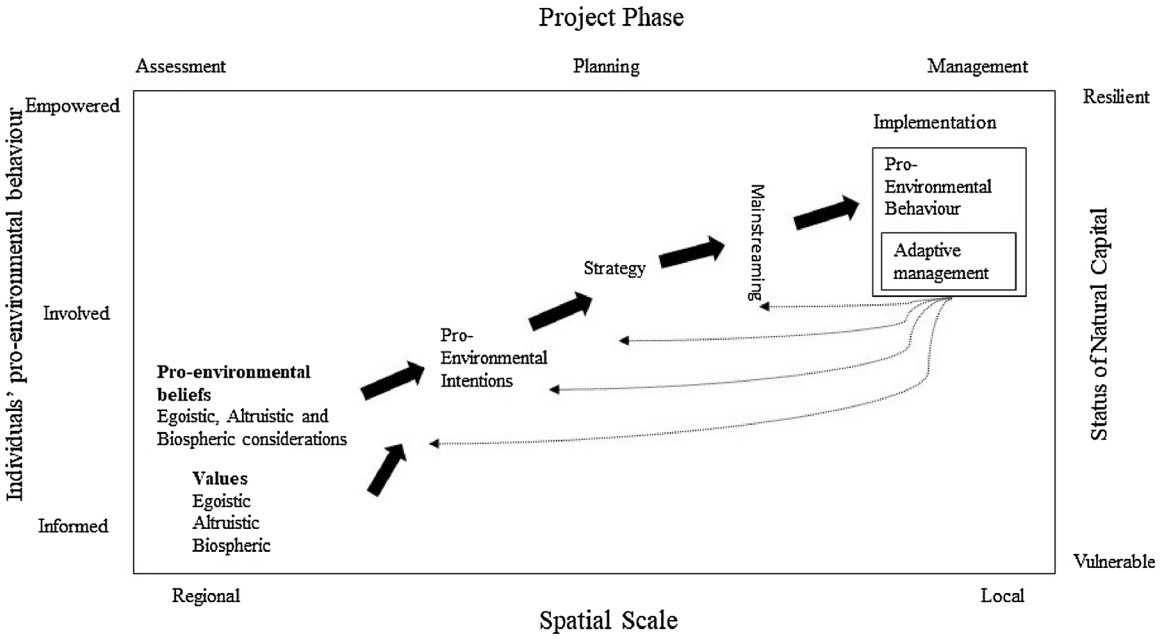

Fig. 1. A model for implementing the sustainability of natural capital.

management and PEB is based on the models devised by Cowling et al. (2008) and Knight et al. (2006). In this model, we focused on the steps to implement the sustainability of NC. In our model, the sustainable status of NC should ensure the arrival at the uppermost right-hand edge shown in Fig. 1. Here, adaptive management involves the stakeholders in the study area. However, it would take decades or even longer to accomplish this target (Olsson et al., 2006). Elements of this pathway to resilience are associated with assessment, planning, and management. The assessment phase, i.e., the top-left hand edge, is a systematic step to gather knowledge in the study area to develop pro-environmental beliefs. The second phase, i.e., the middle of the top of the model, is planning who to involve as the important stakeholders. The aim of this stage is to establish a set of key targets and definite behaviors for preserving NC. Management incorporates the final stage of our working model to obtain resilience in conjunction with NC. The comprehensive target of this step is to initiate and coordinate behavior that establishes the stakeholders' PEBs and provides sustainable NC.

This study seeks to extend the understanding of the relationship between the concerns of sustainable NC management and PEB. The Pearson correlation test is used frequently in behavioral sciences to identify the linear relationship between variables (Jaccard and Becker, 1983). We have employed this parametric approach to assess the correlation between NC and pro-environmental response.

Overall, our approach involved evaluating the sustainability of NC growth for the states of India; NC growth is considered as an important indicator for green growth. To link NC growth and individual PEB, we followed the following three steps. First, we calculated the state-level NC of India. Second, we conducted a survey in all Indian states to identify the indicators of participants' PEB. Third, we related sustainable NC management and individual PEB to assess how it ensures green growth.

3. Natural Capital of India

In this section, we discuss the combination of resources in India and the contribution of NC to total resources. We discuss the status of state-level NC in India to compare sustainability status at a micro level. We use data from the period of 1990–2014 to analyze the sustainability of NC use in India. This analysis consists of the natural resource data at the country level and state level for India. Our NC variables include the renewable forest and land as well as the non-renewable minerals and energy. Fig. 2 shows that the renewable resources in our analysis are primarily classified into (a) forest resources, (b) fisheries, and (c) agricultural land. The forest resources include timber and non-timber forest gains, and the fisheries are calculated from the total catch as well as from prices. Agricultural land is calculated from the value of cropland and pastureland. The non-renewable resources consist of (a) fossil fuels (e.g., oil, natural gas and coal) and (b) minerals (e.g., bauxite, copper, gold, iron, lead, nickel, phosphate, silver, tin, and zinc). Finally, we estimate the total natural resources by taking the physical amount of

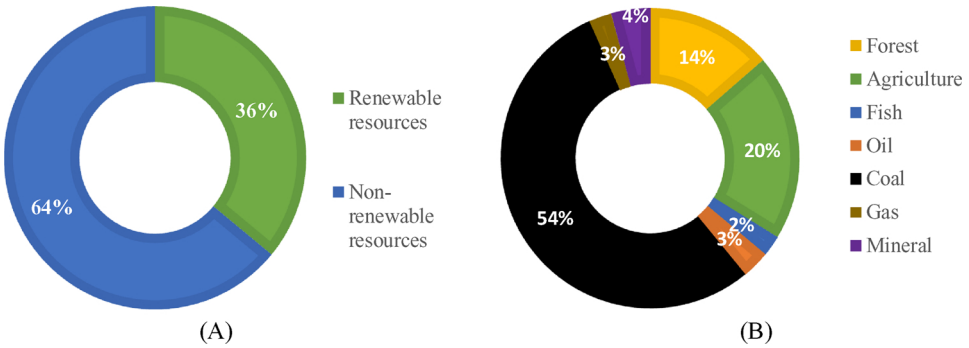

Fig. 2. Shares of renewable and non-renewable resources in NC in India for the period of 1990–2014.

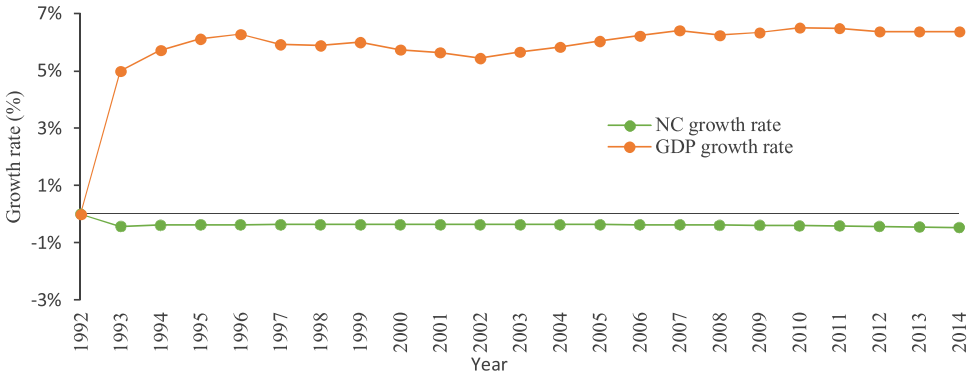

Fig. 3. Annual average growth rate (%) of NC in India for the period of 1992–2014.

Table 2
The growth rate of agricultural land per-capita and forest per-capita for the top 5 Indian states.

Agricultural land		Forest	
States/UTs	Growth rate per capita (%)	States/UTs	Growth rate per capita (%)
Rajasthan	5.11	Daman Diu	5.99
Bihar	0.67	West Bengal	5.44
Orissa	−0.37	Chhattisgarh	2.17
Goa	−0.84	Kerala	1.02
Jharkhand	−1.35	Tamil Nadu	−0.04

Table 3
Top 5 states of India for fossil fuel and mineral growth rates.

Fossil fuel		Mineral	
States/UTs	Growth rate per-capita (%)	States/UTs	Growth rate per-capita (%)
Assam	0.49	Jammu & Kashmir	11.32
Chhattisgarh	−0.24	Jharkhand	10.69
Maharashtra	−0.84	Maharashtra	3.22
Madhya Pradesh	−1.03	Orissa	−0.07
Nagaland	−1.6	Rajasthan	−1.72

the resources and their shadow prices (rents). Non-renewable resources contribute 64% of the NC in India. More specifically, coal, agriculture and forestry are considered the main sources of natural wealth.

The NC growth rate is critical for evaluating the performance of the economy. We calculated the growth of NC, renewable resources, non-renewable resources and forestry in India from 1992 to 2014, and the results are illustrated in Fig. 3. The growth of NC renewables and non-renewables was significantly negative. In contrast, the forest experienced significant positive growth from 1992 onwards. The positive trend of the forest resources growth rate indicates the government's initiative to reduce deforestation. This increase is a key component of sustainable natural resource management in India.

As defined by the FAO, agricultural land comprises cropland and pastureland. The states of India have experienced positive growth rates for agricultural land and per-capita agricultural land in Rajasthan and Bihar. Orissa, Chhattisgarh and Jharkhand have experienced positive growth rates in total agricultural land, although the per-capita agricultural land is shrinking in these states. Excluding Rajasthan and Bihar, the per-capita agricultural land of the Indian states shrank from 2004 to 2014. However, the impact of these changes on the total NC is derived by the total share of the respective resources.

Global food security is highly related to the availability of agricultural land. An excessive demand for the land for alternative uses imposes serious pressures on the supply and demand chain balances. As an emerging economy and a highly populated country, India is facing serious challenges related to using this cultivable land. This challenge is also related to the food safety of the millions of people in this developing country. Population growth and diets have direct impact on the agricultural land demand (UNU-IHDP and UNEP, 2014). The increasing demand by the alternative land uses as well as the increasing forces of food security are considered major challenges that affect the ability to achieve sustainable development in India and to achieve the SDGs by 2030. The growth of cropland has been negative in Indian states over the last 10 years, as cropland has been continuously substituted for other important land uses.

Forest resources are considered an important contributor to India's NC from1990 to 2014. The timber and non-timber forest resources are equally important for maintaining the NC balance in India. From 2004

Table 4
Growth of natural resources (%) in India.

	Growth rate of natural resources in India (%), 1991–2014					
Variable	1991	1995	2000	2005	2010	2014
Natural capital	−0.254	−0.371	−0.362	−0.363	−0.395	−0.461
Renewables	−0.042	−0.165	−0.138	−0.079	−0.056	−0.14
Non-renewables	−0.368	−0.481	−0.482	−0.519	−0.585	−0.642
Agricultural land	0.095	−0.065	−0.027	−0.051	−0.054	−0.047
Forest	0.192	0.239	0.212	0.328	0.353	0.111
Fisheries	−2.034	−2.782	−2.759	−2.495	−2.426	−2.449
Fossil fuel	−0.382	−0.498	−0.5	−0.536	−0.599	−0.658
Minerals	−0.168	−0.227	−0.223	−0.274	−0.366	−0.408

to 2014, the growth of forest resources was positive for 11 Indian states (Punjab, Delhi, Bihar, West Bengal, Jharkhand, Orissa, Chhattisgarh, Tamil Nadu, Kerala, Daman Diu, and Pondicherry), but only 4 states (West Bengal, Chhattisgarh, Kerala, Daman Diu) experienced the expected positive per-capita growth of this resource.

Table 2 shows the top 5 states in India that have experienced positive per-capita growth or minor negative growth of agricultural land and forest. Rajasthan and Bihar experienced positive growth in per-capita agricultural land in the past 10 years (2004–2014). Orissa, Goa and Jharkhand faced minor negative growth in per-capita agricultural land over the same period. In addition, Daman Diu, West Bengal, Chhattisgarh, and Kerala experienced improvements in per-capita forest growth rates from 2004 to 2014. However, Tamil Naidu saw a declining per-capita forest growth rate.

Fossil resources are important sources of energy in India. Fossil-fuel-abundant states have been exploiting the resources significantly. However, the discovery of new mines has guided Assam to experience positive total and per-capita fossil fuel growth. Madhya Pradesh, Maharashtra, and Chhattisgarh have experienced positive total fossil fuel growth, but the per-capita fossil fuel growth has a negative trend in these states. All other states have experienced negative total and per-capita fossil fuel growth rates based on our analysis.

The non-renewable mineral resources have the smallest share in the NC of India. The total and per-capita decline in minerals is consistent across most states. Maharashtra, Jharkhand, and Jammu & Kashmir are three states that had positive total and per-capita growth in minerals from 2011 to 2014. Chhattisgarh and Gujrat saw positive growth in total minerals over the same period. However, the per-capita mineral growth rates of these states were negative. These rates resulted from the decline in mineral resources and the positive population growth. Table 3 represents the top 5 states in terms of the per-capita growth rate of fossil fuels and minerals from 2011 to 2014. Only Assam had positive per-capita growth of fossil fuels during this time. However, Jammu & Kashmir and Jharkhand experienced significant per-capita increases in minerals.

Table 4 shows the growth rates of natural resources in India. Compared to the base year of 1990, India maintained a positive growth rate for forests in 1995, 2000, 2005, 2010 and 2014. However, other resources and NC experienced negative growth rates.

NC is declining in India. However, the rate of decline is diminishing due to multiple environmental protection actions and demographic changes. Environmental awareness is developing among the world's governments and non-governmental organizations. The United Nations Environmental Program (UNEP), environmental protection groups and social media have played major roles in developing this awareness campaign. The use of renewables is becoming increasingly popular, and renewables are being substituted for traditional fossil fuel consumption; furthermore, such efforts have shown significant success in reducing the dependency on non-renewable resources. Afforestation and fishery protections are some key contributors to enhancing the global NC stock. Population control in developing countries also creates less pressure on the natural environment.

4. Results

We explain the determinants of individual PEB based on the survey data collected from all Indian states. We have identified the variables that affect individual PEB. The results from our logit model characterizing the respondents who considered pro-environmental activities in their daily life are reported in Table 5. We have estimated both logit and probit model results; the results are similar, and we have therefore kept the logit results to report here.

The following analysis identifies the impacts of variables, such as socioeconomic and demographic conditions, environmental knowledge, environmental payment preferences, and involvement with society, in profiling green consumers. Most of the dependent variables of this model have significant impacts on PEB, and the results qualitatively support the findings of preceding research.

4.1. Determinants of pro-environmental behavior

According to our results, the negative sign on the gender variable indicates that males have higher levels of PEB than do females. Males are more likely to participate in green issues in India. Previous studies have investigated gender impacts on different socioeconomic, environmental, and attitude variables. According to Diamantopoulos et al. (2003), women have less environmental awareness than that of men. Alternatively, several studies in the 90th century noticed that women were more likely to participate in PEB (Davidson and Freudenburg, 1996; Zelezny et al., 2000). Davidson and Freudenburg (1996) have concluded that the gender impact on PEB is not comprehensively understood.

Overall, age is not related to PEB. Past literature that identifies the impact of age on green attitude justifies this finding (Pickett et al., 1993; Shrum et al., 1995; Wiidegren, 1998). However, in our analysis, the result of electricity-saving behavior was positively impacted by age. It is logical to expect that older individuals are more readily concerned about electricity-saving guided pro-environmental ideologies than are younger individuals. As a result, the anticipation of the positive relationship between age and electricity-saving is valid.

We found that larger families were more likely to recycle, clean up their neighborhoods and cooperate with government-organized environmental action. Grunert (1993) also noted that larger families had better environmental knowledge as well as better attitudes toward environmental protection. Brooker (1976) noticed that families with more household members were expected to have kids in school who would bring environmental discussions into the home. Therefore, parents' attitudes regarding PEB become more visible than those of other individuals. However, in our findings, there was a negative relationship between the number of children and the energy-saving behavior and use of public transportation. These findings are intuitive, as large families are likely to consume more electricity and prefer family transport.

We noticed that household income satisfaction had an ambiguous effect on PEB. Our results indicated that pro-energy saving and pro-public transport behaviors were negatively guided by the individual's income level. Wealthy individuals tended to be less interested in energy saving and made only limited use of public transport. However, these individuals preferred to use solar energy and zero-emission hybrid vehicles. Alternatively, pro-recycling and pro-cooperative government behavior was positively guided by income satisfaction, which implied that wealthy respondents had higher environmental awareness and greener behavior.

We identified the importance of education in guiding individual PEB. One additional year of schooling significantly increased individual pro-cleaning, pro-energy saving, pro-public transport, and pro-forest protection involvement activities. Zilahy and Huisingh (2009) and Zsóka et al. (2013) noted the high responsiveness of educated individuals to pro-environmental activities. Individuals with high education levels seem to have high levels of environmental knowledge.

Table 5
Regression results for the determinants of pro-environmental activities.

VARIABLES	Pro-recycling		Pro-cleaning		Pro-energy saving		Pro-public transport		Pro-forest protection		Pro-cooperative government	
	Coefficient	Odds Ratio	Coefficient	Odds Ratio	Coefficient	Odds Ratio	Coefficient	Odds Ratio	Coefficient	Odds Ratio	Coefficient	Odds Ratio
Socioeconomic and demographic variables												
Gender	0.038	1.039	−0.209***	0.811***	−0.042	0.959	−0.281***	0.755***	−0.299***	0.742***	−0.288***	0.749***
	(0.061)	(0.064)	(0.060)	(0.049)	(0.071)	(0.068)	(0.061)	(0.046)	(0.067)	(0.049)	(0.066)	(0.050)
Age	−0.004	0.996	−0.006	0.996	0.026***	1.026***	−0.001	0.999	−0.005	0.995	−0.004	0.996
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Number of children	0.060*	1.062*	0.033	1.034**	−0.132***	0.877***	−0.116***	0.890***	0.011	1.011	0.104***	1.109***
	(0.033)	0.035	(0.034)	(0.035)	(0.038)	(0.034)	(0.036)	(0.032)	(0.037)	(0.038)	(0.036)	(0.040)
Household members	−0.041**	0.960**	0.031*	1.032*	0.014	1.014	0.031	1.032	0.076***	1.079***	0.071***	1.074***
	(0.019)	0.018	(0.019)	(0.019)	(0.022)	(0.023)	(0.020)	(0.020)	(0.020)	(0.022)	(0.021)	(0.022)
Income satisfaction	0.106***	1.112***	0.034	1.035	−0.235***	0.791***	−0.147***	0.863***	0.053	1.056	0.096**	1.100**
	(0.039)	0.043	(0.039)	(0.039)	(0.044)	(0.035)	(0.039)	(0.034)	(0.042)	(0.045)	(0.045)	(0.049)
Education	−0.010	0.990	0.041***	1.042***	0.079***	1.083***	0.046***	1.048***	0.039**	1.040**	0.018	1.018
	(0.015)	0.015	(0.015)	(0.016)	(0.016)	(0.018)	(0.015)	(0.016)	(0.017)	(0.018)	(0.017)	(0.018)
Environmental knowledge												
Environment is important	0.390***	1.478***	0.371***	1.449***	1.054***	2.868***	0.700***	2.014***	0.628***	1.873***	0.414***	1.513***
	(0.065)	(0.096)	(0.064)	(0.093)	(0.070)	(0.201)	(0.064)	(0.128)	(0.076)	(0.143)	(0.075)	(0.113)
Know ozone	0.121***	1.128***	−0.084**	0.919**	−0.057	0.945	−0.004	0.995	0.017	1.017	0.065	1.068
	(0.039)	(0.044)	(0.038)	(0.035)	(0.045)	(0.043)	(0.039)	(0.039)	(0.044)	(0.044)	(0.045)	(0.048)
Know biodiversity	0.056	1.058	0.122***	1.129***	−0.053	0.948	−0.012	0.988	0.093**	1.097	0.112***	1.118***
	(0.037)	(0.039)	(0.036)	(0.041)	(0.043)	(0.040)	(0.038)	(0.037)	(0.041)	(0.045)	(0.041)	(0.046)
Know energy sustainability	0.175***	1.191***	0.066*	1.068*	0.189***	1.208***	0.059	1.061	0.125***	1.133***	0.131***	1.139***
	(0.037)	(0.044)	(0.036)	(0.039)	(0.043)	(0.051)	(0.037)	(0.039)	(0.042)	(0.048)	(0.042)	(0.047)
Environmental payment preferences												
Interested group pays	0.555***	1.742***	0.057	1.058	0.252***	1.287***	0.163**	1.177**	0.319***	1.375***	0.280***	1.323***
	(0.063)	(0.109)	(0.062)	(0.065)	(0.074)	(0.095)	(0.064)	(0.075)	(0.068)	(0.094)	(0.067)	(0.089)
Polluting group pays	0.330***	1.391***	0.335***	1.398***	0.827***	2.286***	0.373***	1.452***	0.267***	1.306***	0.413***	1.511***
	(0.063)	(0.088)	(0.061)	(0.086)	(0.077)	(0.176)	(0.063)	(0.092)	(0.067)	(0.087)	(0.067)	(0.102)
Government pays	0.172***	1.188***	0.327***	1.387***	0.570***	1.769***	0.462***	1.587***	0.408***	1.504	0.353***	1.423***
	(0.062)	(0.074)	(0.062)	(0.085)	(0.069)	(0.123)	(0.062)	(0.098)	(0.070)	(0.105)	(0.070)	(0.100)
All citizens pay	0.364***	1.438***	0.292***	1.339***	0.487***	1.627***	0.464***	1.590***	0.414***	1.513***	0.502***	1.652***
	(0.061)	0.088	(0.060)	(0.080)	(0.071)	(0.115)	(0.061)	(0.097)	(0.067)	(0.102)	(0.067)	(0.111)
Involvement with society												
Livable neighborhood	0.260***	1.297***	−0.154***	0.857***	0.042	1.043	−0.058	0.944	−0.109**	0.896***	−0.078	0.924
	(0.047)	0.061	(0.045)	(0.039)	(0.052)	(0.055)	(0.046)	(0.044)	(0.050)	(0.046)	(0.051)	(0.047)
Community attachment	0.0820**	1.085**	0.311***	1.364***	0.059	1.061	0.069*	1.071*	0.263***	1.301***	0.390***	1.477***
	(0.041)	0.045	(0.041)	(0.056)	(0.047)	(0.049)	(0.040)	(0.043)	(0.046)	(0.061)	(0.048)	(0.070)
Safe neighborhood	−0.056	0.945	0.128***	1.136***	0.116**	1.122**	0.039	1.039	0.057	1.059	0.001	1.001
	(0.049)	0.046	(0.046)	(0.053)	(0.054)	(0.060)	(0.047)	(0.048)	(0.054)	(0.057)	(0.054)	(0.054)
Constant	−3.357***	0.035***	−2.464***	0.085***	−2.223***	0.108***	−0.731***	0.482***	−3.987***	0.019***	−4.745***	0.009***
	(0.289)	0.010	(0.277)	(0.024)	(0.323)	(0.035)	(0.278)	(0.134)	(0.312)	(0.006)	(0.333)	(0.003)
Observations	5,200		5,200		5,200		5,200		5,200		5,200	

Robust standard errors in parentheses.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

This knowledge translates into green attitudes (Schlegelmilch et al., 1996). In an attempt to derive the reasons for this relationship, researchers identified that educated individuals have a higher awareness of environmental enrichment. Education motivates individual PEB because educated individuals have a higher awareness of environmental problems (Lozano, 2006; Olli et al., 2001).

We define environmental knowledge as individual awareness of environmental protection, and this knowledge plays a significant role in PEB. In our analysis, we consider local people's environmental knowledge as a proxy for the concern of sustainable resource management. The respondents considered the environment as important and knew about the ozone layer, biodiversity and energy sustainability; we

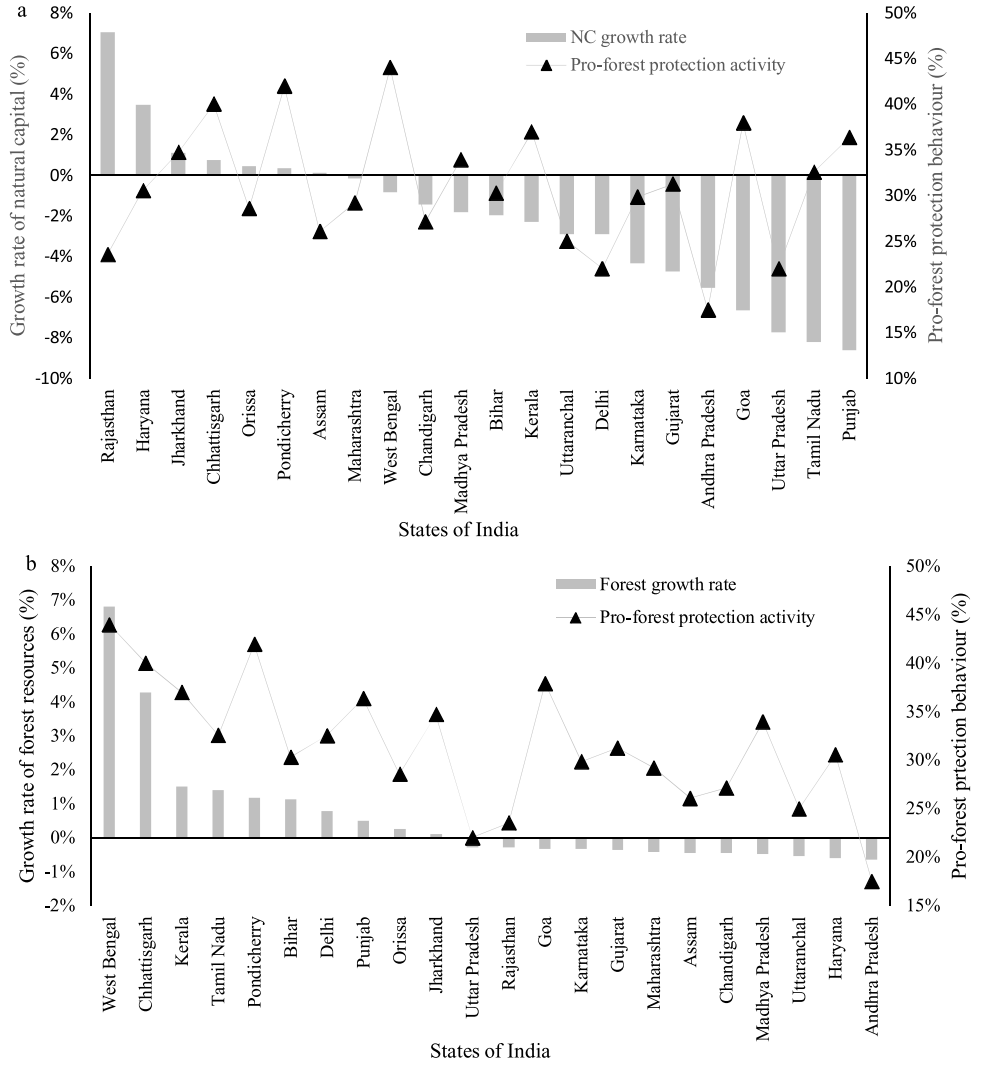

Fig. 4. Natural resources growth and pro-forest protection activities in Indian states. (a) Natural capital growth rate and pro-forest protection activities in Indian states. (b) Forest resources growth rate and pro-forest protection activities in Indian states.

hypothesized that they were also aware of conservation. It was clearly evident that the knowledge of environmental challenges was an important determinant of individual PEB. Our empirical results showed that people who considered the environment important and were knowledgeable about energy sustainability can undertake PEB.

Previous studies have concluded that the empirical evidence of knowledge's impact on PEB is not universal (Kaiser and Fuhrer, 2003; Laroche et al., 2001; Zsóka et al., 2013). Several studies (Bartiaux, 2008; Laroche et al., 2001; Maloney and Ward, 1973) failed to identify significant relationship between knowledge and PEB. Alternatively, Oğuz and Kavas (2010) concluded that individuals with more knowledge of environmental challenges were less likely to act pro-environmentally.

Our results clearly noted the importance of environmental knowledge in taking pro-environmental action. It is crucial to receive information about environmental quality and environmental challenges. Researchers have noted that a shortage of accurate information forces stakeholders to make inaccurate environmental decisions. Barber et al. (2009) noted that well-informed individuals were more likely to act pro-environmentally.

Environmental payment is an important measure used to adapt and mitigate environmental challenges. However, individuals might underestimate the importance of their participation in terms of coping with environmental risks. We argue that an individual's participation in an environmental payment system and willingness to pay (WTP) from their personal interest is significantly important to solve the environmental challenges in India. This strategy to involve oneself with environmental problems is an important step in managing NC. Our empirical findings represent the significantly positive impact of environmental payments on PEB. Although the magnitude of the impact

differs according to the individual's selection of the party that should be responsible for such payments, overall, the impact is always positive. We also suggest the positive association between community attachment and PEB. Community attachment would resolve the environmental contradictions in societies.

4.2. Relation between pro-environmental behavior and natural capital management

The relationship with nature evidently influences environmental behavior (Clayton and Myers, 2015; Gardner and Stern, 1996; Gifford, 2007; Nickerson, 2002). However, it is not always evident that 'a good status of NC' is a guarantee of environmentally friendly behavior and vice versa. Thus, the influence of the relationship on NC growth is not absolute. For instance, to visually notice the relationship, we plotted the NC growth rate and PEB variables in Fig. 4. From Fig. 4a, we noted that there was no significant trend in pro-forest protection activity behavior in Indian states compared to the states' NC growth rates. We also checked the correlation between the natural capital growth rate and pro-forest protection behavior variables and noted a correlation of only 3.85%, which was insignificant and confirmed that they were uncorrelated.

However, we noted an existing relationship between the forest resource growth rate and individual pro-forest protection behavior in Fig. 4b. Significant positive correlations were found between forest resource growth and pro-forest protection activities, and the Pearson correlation test noted a 67.2% correlation between these two variables. Although we cannot conduct an econometric analysis to identify the magnitude of the impact of individual pro-forest protection behavior on forest growth rate due the difference in data matrices, we can clearly note the overall relationship. Therefore, it is important to identify the variables impacting PEB to mitigate environmental challenges and to ensure the sustainable management of resources.

The core elements of our empirical model regarding the implementation of sustainability in NC are social involvement, strategic development and resilient management. Social involvement is guided by individual behavior in the area of study. Without involving local knowledge and proper understanding, policy implementation is likely to be poorly targeted (Knight et al., 2006). Our empirical results show that individual PEB is positively and significantly related to their level of knowledge about the environment. Strategic development is the essential process of decision making, and we argue that individuals' environmental payment preferences are an indicator of their environmental strategies. Our empirical results indicate that individuals' payment preferences are an important indicator of PEB. The final phase of our empirical model to achieve sustainable NC management is guided by undertaking and coordinating pro-environmental actions. Our correlation test and Fig. 4 represent that individuals' decisions to perform PEB in India are not directly related to NC growth; however, these decisions are correlated with state-level forest resource growth. The status of NC is too complex for local respondents to observe, but the status of the local forest resources is easily observed and is clearly correlated to individual PEB. The goal of achieving sustainable NC management is clearly supported by the involvement of local individuals in assessing environmental problems, planning environmental strategy and managing environmental attitudes or PEB.

5. Discussion and conclusion

The continuous decline of NC and the severe environmentally unfriendly activities of consumers make sustainable environmental protection important for India. Green growth must be achieved by economic growth, environmental damage reduction and PEB by stakeholders in India. Inclusive accounting of NC is important for sustainable resource management and to achieve SDGs. This research aims to provide a practical approach to account for NC in India. It also focusses on ensuring green growth by identifying individual PEB determinants.

This paper has studied the role of environmental knowledge and societal involvement as important factors that influence PEB. Environmental knowledge involves individuals that face challenges related to environmental protection, and it guides them to PEB. In addition, involvement with society creates a strong role for self-motivation to conduct pro-environmental activities. Our results suggest that to promote future green growth in India, individual environmental knowledge and involvement in society are important factors to focus on.

More specifically, the correlational evidence between PEB and green growth suggests that the states where individuals conduct pro-environmental activities are also more likely to have significant forest resource growth. This finding has important policy implications. As an important policy tool, natural resource management should consider focusing individual PEB and efforts toward individuals who have found it difficult to obtain environmental knowledge. Alternatively, the analysis suggests the importance of environmental knowledge and awareness to ensure the green growth of NC.

We show that individuals with environmental knowledge have motivations for going green. We suggest that educational institutions in India should develop policy to increase student awareness of environmental perception and environmental status to improve environmental management strategies and resilience. Although socio-demographics are associated with PEB, from the managerial perspective, there is limited scope to improve in India in the short run.

NC accounting information quantifies several SDG indicators. India must adopt strategies to build an environmentally friendly society by 2030. Population growth creates significant environmental challenges and decreases the NC base. Meanwhile, India is also taking action regarding green growth, and environmental awareness is gradually increasing. The government can contribute by ensuring individual access to environmental information, which will guide them to develop their environmental knowledge. Proper environmental knowledge guides residents in their strategies to deal with environmental challenges. As a result, individuals can contribute to environmental sustainability by adopting PEBs.

The findings in this study concerning PEB and NC management have implications for the other states or cities that are starting to focus on their green growth, and three are hints as to where and how to increase the sustainability of NC in the future. States or cities can move forward to implement mandatory environmental knowledge programs rather than voluntary initiatives. It is also important to ensure PEB from the maximum number of citizens to reap the benefits of these programs.

In this paper, we focus on the sustainability of India's NC. Nature, of course, has substantial non-use values, and it has an important role in the local economy. In valuing India's natural assets, some additional challenges remain regarding India's state-level data, including missing values and missing years. This work estimated the NC of India and links it with well-being. We believe that this paper is a pioneer in terms of measuring India's NC at the state level.

The limitations of this research are mostly due to the non-availability of data. NC estimation in this study was very conservative in the

sense that stock and rent data on natural resources depended on the limited regional data set. The value of minerals may be severely undervalued because the process is strictly controlled by government rules. In addition, the mineral market is not perfectly competitive due to the presence of subsidies and cheap labor. These aspects could result in an underestimation of the value of NC. Data scarcity also refrained us from including several important inputs of NC in this effort, e.g., wildlife, biodiversity, and water.

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Annex

The growth rates of the components of natural capital (NC) in India are stated in Table A1.
The growth rates of the components of NC per-capita in India are stated in Table A2.
The survey questionnaire in India is presented in Table A3.

Table A1
Growth rate of natural resources in India's states.

Code/name		Growth rate of natural resources (%)				
ISO	States/UTs	Agriculture land	Crop land	Forest	Fossil fuel	Minerals
AN	Andaman & Nicobar Islands	−3.52	–	−0.24	–	–
AP	Andhra Pradesh	−11.03	−12.50	−0.65	−4.09	−4.33
AR	Arunachal Pradesh	−0.53		−0.47	−5.02	
AS	Assam	−5.82	−14.24	−0.44	2.09	−16.39
BR	Bihar	2.95	3.17	1.14	−1.57	−4.30
CG	Chhattisgarh	0.57	–	4.27	1.81	3.98
CH	Chandigarh	–	–	−0.44	–	–
DD	Daman Diu	–	–	10.63	–	–
DL	Delhi	−3.07	−3.06	0.79	–	–
DN	Dadra & Nagar Haveli	−2.93	−3.06	−0.67	–	–
GA	Goa	−0.06	–	−0.33	–	−5.14
GJ	Gujarat	−3.29	−3.45	−0.35	−1.79	0.99
HP	Himachal Pradesh	−0.58	−5.22	−0.38	–	–
HR	Haryana	−5.79	−5.88	−0.61	–	−4.87
JH	Jharkhand	0.66	–	0.12	−1.31	12.99
JK	Jammu & Kashmir	−3.78	−4.00	−0.12	–	9.49
KA	Karnataka	−2.46	−4.71	−0.33	–	−7.08
KL	Kerala	−3.27	−3.27	1.51	–	−4.30
LD	Lakshadweep	–	–	−0.11	–	–
MH	Maharashtra	−2.84	−3.02	−0.42	0.63	0.02
ML	Meghalaya	–	–	−0.49	−1.57	−4.97
MN	Manipur	−0.06	–	−0.68	–	–
MP	Madhya Pradesh	−6.17	−6.89	−0.47	0.81	−0.53
MZ	Mizoram	−0.06	–	−0.75	–	–
NL	Nagaland	–	–	−1.08	−1.65	−4.87
OR	Orissa	0.93	–	0.26	−1.06	−0.19
PB	Punjab	−3.29	−3.29	0.49	–	–
PY	Pondicherry	–	–	1.18	–	–
RJ	Rajasthan	7.17	7.37	−0.29	−5.02	−0.63
SK	Sikkim	–	–	−0.42	−1.57	−4.83
TN	Tamil Nadu	−7.96	−8.24	1.41	−6.04	−4.30
TR	Tripura	–	–	−0.82	−8.54	–
UK	Uttaranchal	−4.29	−5.08	−0.55	–	−4.91
UP	Uttar Pradesh	−4.60	−4.62	−0.28	−1.57	−4.45
WB	West Bengal	−10.09	−9.89	6.82	−1.24	−5.43

Table A2
Growth rate of per-capita natural resources in India's states.

Code/name		Growth rate of per-capita natural resources (%)				
ISO	States/UTs	Agriculture land	Crop land	Forest	Fossil fuel	Minerals
AN	Andaman & Nicobar Islands	−4.14	–	−0.88	–	–
AP	Andhra Pradesh	−11.96	−13.42	−1.69	−2.09	−7.37
AR	Arunachal Pradesh	−2.79	–	−2.73	−7.19	–
AS	Assam	−7.28	−15.57	−1.99	0.5	−14.3
BR	Bihar	0.67	0.89	−1.1	−3.74	−8.44
CG	Chhattisgarh	−1.45	–	2.17	−0.24	−4.36
CH	Chandigarh	–	–	−1.99	–	–
DD	Daman Diu	–	–	5.99	–	–
DL	Delhi	−4.89	−4.89	−1.1	–	–
DN	Dadra & Nagar Haveli	−7.12	−7.26	−4.96	–	–
GA	Goa	−0.84	–	−1.11	–	−7.66
GJ	Gujarat	−4.98	−5.13	−2.08	−3.51	−5.36
HP	Himachal Pradesh	−1.77	−6.35	−1.57	–	–
HR	Haryana	−7.49	−7.5	−2.39		−5.52
JH	Jharkhand	−1.35	–	−1.87	−3.28	10.69
JK	Jammu & Kashmir	−5.81	−6.02	−2.22	–	11.33
KA	Karnataka	−3.87	−6.09	−1.77	–	−8.06
KL	Kerala	−3.73	−3.73	1.03	–	−6.83
LD	Lakshadweep	–	–	−0.71	–	–
MH	Maharashtra	−4.27	−4.44	−1.88	−0.84	3.23
ML	Meghalaya	–	–	−2.89	−3.96	−6.21
MN	Manipur	−1.75	–	−2.37	–	–
MP	Madhya Pradesh	−7.89	−8.59	−2.29	−1.04	−4.12
MZ	Mizoram	−2.09	–	−2.77	–	–
NL	Nagaland	–	–	−1.04	−1.6	−3.74
OR	Orissa	−0.38	–	−1.04	−2.35	−0.07
PB	Punjab	−4.52	−4.53	−0.79	–	–
PY	Pondicherry	–	–	−1.26	–	–
RJ	Rajasthan	5.11	5.31	−2.21	−6.85	−1.72
SK	Sikkim	–	–	−1.57	−2.71	−4.92
TN	Tamil Nadu	−9.29	−9.56	−0.05	−7.39	−7.72
TR	Tripura	–	–	−2.18	−9.79	–
UK	Uttaranchal	−5.96	−6.73	−2.28	–	−5.55
UP	Uttar Pradesh	−6.33	−6.35	−2.09	−3.35	−8.13
WB	West Bengal	−11.25	−11.06	5.44	−2.52	−6.09

Table A3
Survey questions.

Question code	Response code	Answers
S1		Please tell us your gender.
	0	Male
	1	Female
S2		Please tell us your age.
	17	17 or below
	18	18
	19	19
	:	:
	99	99 and above
Q1		Is the living environment important for you?
Q2		Please select an option that appropriately describes your level of knowledge for each of the following items.
Q2_1	1	Depletion of ozone layer
Q2_2	2	Loss of biodiversity
Q2_3	3	Sustainability of energy supply
	5	Very knowledgeable
	4	Moderately knowledgeable
	3	Average
	2	Not so knowledgeable
	1	Do not have any knowledge
Q3		Please select all actions that you have taken these days. Also please select all activities that you have participated in these days.
	1	Recycling, sorting or reducing rubbish
	2	Cleaning or picking up rubbish in your neighborhood
	3	Energy saving actions (saving electricity, fuel, etc.)
	4	Use of public transportation or bicycles
	5	Environmental action organized by government
	6	Protection of forest (afforestation, regulation of illegal deforestation, etc.)

(*continued on next page*)

Table A3 (*continued*)

Question code	Response code	Answers
Q4		Who should pay for the cost of environmental conservation and policy to reduce energy usage?
	1	People/Organizations/Countries who are interested in Environmental/Energy issues
	2	People/Organizations/Countries with comparatively high energy usage who are polluting or destroying environment
	3	Government
	4	All citizens equally
Q5		How livable is your neighborhood?
	5	Very livable
	4	Moderately livable
	3	Neither
	2	Moderately not livable
	1	Not livable
Q6		How attached are you to your local community?
	5	Completely attached
	4	Slightly attached
	3	Neither
	2	Slightly detached
	1	Completely detached
Q7		Please tell us about safety of your neighborhood.
	4	Very safe
	3	Moderately safe
	2	Slightly dangerous
	1	Very dangerous
	0	Do not know
F1		How many children do you have?
F2		How many people do you have in your household including yourself?
F3		Please select an item that appropriately describes your point of view on your household income.
	4	Satisfied
	3	Neither satisfied nor dissatisfied
	2	Dissatisfied
	1	Do not care
	0	Do not know
F4		Please inform years of education you have completed.

Table A4
Data sources for natural capital accounting at the state level in India.

Variables	Data sources
Quantity of crops produced	Ministry of Agriculture, Govt. of India
Price of crops produced	
Harvested area of crops	
Permanent cropland/pastureland area	
Cropland rental rate	Narayanan (2012)
Cropland discount rate	5%
Forest stocks	Ministry of Environment & Forests, Govt. of India
Forest stock commercially available	
Wood production	
Value of wood production	
Forest rental rate	Bolt et al. (2002)
Mineral reserves	Ministry of Mines, Govt. of India
Mineral extraction	
Mineral prices	
Mineral rental rates	Narayanan (2012)
Coal, gas and petroleum reserves	Ministry of Coal, Govt. of India
Coal, gas and petroleum extraction	
Coal, gas and petroleum prices	
Coal, gas and petroleum rental rates	Narayanan (2012)

References

Adomssent, M., Godemann, J., Michelsen, G., 2007. Transferability of approaches to sustainable development at universities as a challenge. Int. J. Sustain. High. Educ. 8, 385–402.

Arrow, K.J., Dasgupta, P., Goulder, L.H., Mumford, K.J., Oleson, K., 2012. Sustainability and the measurement of wealth. Environ. Dev. Econ. 17, 317–353. https://doi.org/10.1017/s1355770x12000137.

Australian Bureau of Statistics, 2001. Australian System of National Accounts. Consolidated Balance Sheet. ABS, Canberra.

Azqueta, D., Sotelsek, D., 2007. Valuing nature: from environmental impacts to natural capital. Ecol. Econ. 63, 22–30.

Barber, N., Taylor, D.C., Strick, S., 2009. Environmental Knowledge and Attitudes: Influencing the Purchase Decisions of Wine Consumers.

Barbier, E.B., 2007. Valuing ecosystem services as productive inputs. Econ. Policy 22, 178–229.

Bartiaux, F., 2008. Does environmental information overcome practice compartmentalisation and change consumers' behaviours? J. Clean. Prod. 16, 1170–1180.

Bradley, J.C., Waliczek, T.M., Zajicek, J.M., 1999. Relationship between environmental knowledge and environmental attitude of high school students. J. Environ. Educ. 30, 17–21.

Bolt, K., Matete, M., Clemens, M., 2002. Manual for Calculating Adjusted Net Savings. Environment Department, World Bank, pp. 1–23.

Bronfman, N.C., Cisternas, P.C., López-Vázquez, E., Maza, C.de la, Oyanedel, J.C., 2015. Understanding attitudes and pro-environmental behaviors in a Chilean community. Sustainability 7, 14133–14152.

Brooker, G., 1976. The self-actualizing socially conscious consumer. J. Consum. Res. 3, 107–112.

Chen, J., Zhao, A., Zhao, Q., Song, M., Baležentis, T., Streimikiene, D., 2018. Estimation and factor decomposition of carbon emissions in China's tourism sector. Probl. EKOROZWOJU 13, 91–101.

Clark, C.F., Kotchen, M.J., Moore, M.R., 2003. Internal and external influences on pro-environmental behavior: participation in a green electricity program. J. Environ. Psychol. 23, 237–246.

Clayton, S., Myers, G., 2015. Conservation Psychology: Understanding and Promoting Human Care for Nature. John Wiley & Sons.

Cowling, R.M., Egoh, B., Knight, A.T., O'Farrell, P.J., Reyers, B., Rouget, M., Roux, D.J., Welz, A., Wilhelm-Rechman, A., 2008. An operational model for mainstreaming ecosystem services for implementation. Proc. Natl. Acad. Sci. USA.

Daly, H., Cobb, J., Cobb, J.B., 1989. For the Common Good. Beacon Press, Boston (especially Append. index Sustain. Econ. welfare).

Davidson, D.J., Freudenburg, W.R., 1996. Gender and environmental risk concerns: a review and analysis of available research. Environ. Behav. 28, 302–339.

Diamantopoulos, A., Schlegelmilch, B.B., Sinkovics, R.R., Bohlen, G.M., 2003. Can socio-demographics still play a role in profiling green consumers? A review of the evidence and an empirical investigation. J. Bus. Res. 56, 465–480.

Folke, C., Hammer, M., Costanza, R., Jansson, A., 1994. Investing in Natural Capital — Why, What, and How. Invest. Nat. Cap. Ecol. Econ. Approach to Sustain. Isl. Press, Washington, DC, pp. 1–20.

Gardner, G.T., Stern, P.C., 1996. Environmental Problems and Human Behavior. Allyn & Bacon.

Gifford, R., 2007. Environmental Psychology: Principles and Practice. Optimal Books Colville, WA.

Gifford, R., Nilsson, A., 2014. Personal and social factors that influence pro-environmental concern and behaviour: a review. Int. J. Psychol. 49, 141–157.

Griggs, D., Stafford-Smith, M., Gaffney, O., Rockström, J., Öhman, M.C., Shyamsundar, P., Steffen, W., Glaser, G., Kanie, N., Noble, I., 2013. Policy: sustainable development goals for people and planet. Nature 495, 305.

Grunert, S.C., 1993. Everybody seems concerned about the environment: but is this concern reflected in (Danish) consumers' food choice? ACR Eur. Adv.

Guerry, A.D., Polasky, S., Lubchenco, J., Chaplin-Kramer, R., Daily, G.C., Griffin, R., Ruckelshaus, M., Bateman, I.J., Duraiappah, A., Elmqvist, T., 2015. Natural capital and ecosystem services informing decisions: from promise to practice. Proc. Natl. Acad. Sci. USA 112, 7348–7355.

Guo, L., Qu, Y., Wu, C., Wang, X., 2018. Identifying a pathway towards green growth of Chinese industrial regions based on a system dynamics approach. Resour. Conserv. Recycl. 128, 143–154.

Huntley, B., Petersen, C., 2005. Mainstreaming Biodiversity in Production Landscapes. Glob. Environ. Facil., Washington, DC.

Islam, M., Yamaguchi, R., Sugiawan, Y., Managi, S., 2018. Valuing natural capital and ecosystem services: a literature review. Sustain. Sci.

Jaccard, J., Becker, M.A., 1983. Statistics for the Behavioral Sciences. Wadsworth Belmont, CA.

Kaiser, F.G., Fuhrer, U., 2003. Ecological behavior's dependency on different forms of knowledge. Appl. Psychol. 52, 598–613.

Knight, A.T., Cowling, R.M., Campbell, B.M., 2006. An operational model for implementing conservation action. Conserv. Biol. 20, 408–419.

Laroche, M., Bergeron, J., Barbaro-Forleo, G., 2001. Targeting consumers who are willing to pay more for environmentally friendly products. J. Consum. Mark. 18, 503–520.

Lozano, R., 2006. Incorporation and institutionalization of SD into universities: breaking through barriers to change. J. Clean. Prod. 14, 787–796.

Lu, H., Liu, X., Chen, H., Long, R., Yue, T., 2017. Who contributed to "corporation green" in China? A view of public-and private-sphere pro-environmental behavior among employees. Resour. Conserv. Recycl. 120, 166–175.

Maloney, M.P., Ward, M.P., 1973. Ecology: let's hear from the people: an objective scale for the measurement of ecological attitudes and knowledge. Am. Psychol. 28, 583.

Managi, S., Kumar, P., 2018. Inclusive Wealth Report 2018: Measuring Progress Toward Sustainability. Routledge, New York.

Merino-Saum, A., Baldi, M.G., Gunderson, I., Oberle, B., 2018. Articulating natural resources and sustainable development goals through green economy indicators: a systematic analysis. Resour. Conserv. Recycl. 139, 90–103.

Miao, Z., Sheng, J., Webber, M., Baležentis, T., Geng, Y., Zhou, W., 2018. Measuring water use performance in the cities along China's South-North Water Transfer Project. Appl. Geogr. 98, 184–200.

Narayanan, G., 2012. In: Aguiar A, B.A., McDougall, R. (Eds.), Glob. trade, Assist. Prod. GTAP 8.

Nickerson, R.S., 2002. Psychology and Environmental Change. Psychology Press.

Office of National Statistics, 2003. Asset Value of Petroleum and Natural Gas Reserves. Available from the website of the UK's ONS: www.statistics.gov.uk.

Oğuz, D., Kavas, S., 2010. Environmental awareness of university students in Ankara, Turkey. African J. Agric. Res. 5, 2629–2636.

Olli, E., Grendstad, G., Wollebaek, D., 2001. Correlates of environmental behaviors: bringing back social context. Environ. Behav. 33, 181–208.

Olsson, P., Gunderson, L.H., Carpenter, S.R., Ryan, P., Lebel, L., Folke, C., Holling, C.S., 2006. Shooting the rapids: navigating transitions to adaptive governance of social-ecological systems. Ecol. Soc. 11.

Pearce, D., 1998. Auditing the earth: the value of the world's ecosystem services and natural capital. Environ. Sci. Policy Sustain. Dev. 40, 23–28.

Pickett, G.M., Kangun, N., Grove, S.J., 1993. Is there a general conserving consumer? A public policy concern. J. Public Policy Mark. 234–243.

Ryan, L., Thomson, R., Sincock, A., 2003. Accounting for Subsoil Assets in the National Accounts. In: Paper presented at the London Group Meeting. Rome, 5–7 November.

Saphores, J.-D.M., Ogunseitan, O.A., Shapiro, A.A., 2012. Willingness to engage in a pro-environmental behavior: an analysis of e-waste recycling based on a national survey of US households. Resour. Conserv. Recycl. 60, 49–63.

Schlegelmilch, B.B., Bohlen, G.M., Diamantopoulos, A., 1996. The link between green purchasing decisions and measures of environmental consciousness. Eur. J. Mark. 30, 35–55.

Shrum, L.J., McCarty, J.A., Lowrey, T.M., 1995. Buyer characteristics of the green consumer and their implications for advertising strategy. J. Advert. 24, 71–82.

Smith, R., Simard, C., 2001. A Proposed Approach to Sustainable Development Indicators Based on Capital. In: Paper presented by Statistics Canada at the National Conference of Sustainable Development Indicators. March 27, Ottawa, Canada.

Ulgiati, S., Brown, M.T., 1998. Monitoring patterns of sustainability in natural and man-made ecosystems. Ecol. Modell. 108, 23–36.

UN, 2015. UN General Assembly 69th Session.

UNU-IHDP and UNEP, 2014. Inclusive Wealth Report 2014: Measuring Progress Toward Sustainability. Cambridge Univ. Press, New York.

UNU-IHDP and UNEP, 2012. Inclusive Wealth Report 2012: Measuring Progress Toward Sustainability. Cambridge Univ. Press, New York.

Van der Ploeg, S., De Groot, R.S., 2010. The TEEB Valuation Database – A Searchable Database of 1310 Estimates of Monetary Values of Ecosystem Services. Found. Sustain. Dev, Wageningen, Netherlands.

Wackernagel, M., Onisto, L., Bello, P., Callejas Linares, A., Susana López Falfán, I., Méndez Garcıa, J., Isabel Suárez Guerrero, A., Guadalupe Suárez Guerrero, M., 1999. National natural capital accounting with the ecological footprint concept. Ecol. Econ. 29, 375–390. https://doi.org/10.1016/S0921-8009(98)90063-5.

Wang, F., Peng, X., Wei, R., Qin, Y., Zhu, X., 2019. Environmental behavior research in resources conservation and management: a case study of resources, conservation and recycling. Resour. Conserv. Recycl. 141, 431–440.

Wiidegren, Ö., 1998. The new environmental paradigm and personal norms. Environ. Behav. 30, 75–100.

World Bank, 2011. The Changing Wealth of Nations: Measuring Sustainable Development in the New Millennium. World Bank, Washington, DC.

Zelezny, L.C., Chua, P., Aldrich, C., 2000. New ways of thinking about environmentalism: elaborating on gender differences in environmentalism. J. Soc. Issues 56, 443–457.

Zilahy, G., Huisingh, D., 2009. The roles of academia in regional sustainability initiatives. J. Clean. Prod. 17, 1057–1066.

Zsóka, Á., Szerényi, Z.M., Széchy, A., Kocsis, T., 2013. Greening due to environmental education? Environmental knowledge, attitudes, consumer behavior and everyday pro-environmental activities of Hungarian high school and university students. J. Clean. Prod. 48, 126–138.