Encouraging State Governments to Protect and Restore Forests Using Ecological Fiscal Transfers: India's Tax Revenue Distribution Reform

Jonah Busch and Anit Mukherjee

Abstract

In February 2014, India's 14th Finance Commission added forest cover to the formula that determines the amount of tax revenue the central government distributes annually to each of India's 29 states. The Government of India estimates that from 2015–2019 it will distribute $6.9–12 billion per year to states in proportion to their 2013 forest cover, amounting to around $174–303 per hectare of forest per year. Assuming that contemporary forest cover will remain an element of the formula beyond 2020, Indian states now have a sizeable new fiscal incentive to protect and restore forests, contributing to the achievement of India's climate goals. India's tax revenue distribution reform creates the world's first *ecological fiscal transfers* (EFTs) for forest cover, and a potential model for other countries. In this paper we discuss the origin of India's EFTs and their potential effects. In a simple preliminary analysis, we do not yet observe that the EFTs have increased forest cover across states, consistent with our hypothesis that one to two years of operation is too soon for the reform to have had an effect. This means there remains substantial scope for state governments to protect and restore forests as an investment in future state revenues.

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Introduction

The benefits of converting natural ecosystems to agriculture are concentrated locally while the costs of environmental degradation are distributed across a geographically broader public. This motivates the concept of conditional payments for environmental conservation, in which the beneficiaries of ecosystems' services encourage land-use decision makers to protect or restore ecosystems by making payments available conditional on them doing so. Two classes of conditional[1] payments for environmental conservation both involve forests: payments for ecosystem services (PES) and reducing emissions from deforestation and forest degradation plus conservation, sustainable management of forests, and enhancing forest carbon stocks (REDD+). A third class of conditional environmental payments, *ecological fiscal transfers* (EFTs), involves conditional payments from higher levels of a country's government (e.g. national) to lower levels (e.g. state or local) (Table 1).

EFTs have several potential advantages over REDD+ and PES. Payers can take advantage of already-established structures for fiscal transfers between levels of government, avoiding the need to design new institutions or assign new property rights. Because the inclusion of recipients in fiscal transfer systems is commonly universal and automatic rather than voluntary, incentives can be two-sided rather than one-sided; that is, payers can penalize environmental degradation with reduced transfers as well as reward environmental improvement with increased transfers. EFTs can potentially mobilize larger volumes of finance than PES, raising the possibility of achieving both broad coverage *and* substantial dollar-per-hectare incentives. And EFTs could solve, in part, the challenge faced in REDD+ of translating incentives from national governments to more local levels (Loft et al 2016). EFTs could potentially operate in tandem with international REDD+ payments, with payments from external funders to national governments for reducing emissions, and EFTs from national to state- and local-level governments for protecting and restoring forest cover (Ring et al. 2010; Irawan et al. 2014).

However, EFTs also have limitations as an incentive mechanism. First and foremost, the primary purpose of intergovernmental fiscal transfers (of which EFTs are a subset) is to provide lower levels of government with the predictable financial resources they need to provide public services to their citizens (Bird and Smart 2002; Ring et al 2011). Secondarily they may be designed to equalize budgets across local governments (Bird and Smart 2002) or to compensate local governments for forgone resource use (Ring et al 2011). Thus there may be only limited freedom to design EFTs as incentive mechanisms for the increased provision of ecosystem services. Furthermore, EFTs are limited to public sector recipients and don't directly transfer incentives to individual households as PES can.

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[1] In this paper we use "conditional" in its ex post sense of being contingent upon something else having happened first, as in "conditional cash transfers" (Fernold et al 2008), payments for ecosystem services (Wunder 2005), and India's description of its forest-cover-proportional fiscal transfers in its international climate pledge (Government of India 2015), rather than in its ex ante sense of being earmarked for a specific purpose, as used in the report of India's 14th Finance Commission (Government of India, 2014) and previous fiscal transfers literature (Bird and Smart 2002; Ring et al 2011).

Table 1. Characteristics of selected conditional payment programs for environmental conservation.

Program	Scale	Scope	Coverage/enrolled area (ha)	Annual payment ($/ha/yr)	Total payments during period ($)	Period	Source
PES							
Costa Rica	National→Household	Forest protection; reforestation; regeneration; forest management; agroforestry	961,000	$41-294 (2012)	$342 million	1997-2012	Porras et al, 2013
Ecuador (SocioBosque)	National→Household	Forest conservation	528,000	$0.50-30	$8.5 million	2008-2010	de Koning et al, 2011
Mexico	National→Household	Forest conservation	4,270,000	280-1100 MXN	8,586 million MXN	2003-2013	Alatorre-Troncoso, 2014
China (eco-compensation)	National→Household	Watersheds; forests; grasslands; wetlands; marine areas; minerals		$6.70-223	$37.1 billion	2001-2012	ADB, 2016
REDD+							
Brazil	International→National	Reduced deforestation	520,000,000 (Legal Amazon)	$2,424	$1.037 billion	2008-2015	Amazon Fund, 2016
Guyana	International→National	Maintaining low deforestation	15,100,000	$1,835	$190 million	2009-2015	Government of Norway, 2015
REDD Early Movers	International→State	Forest conservation			$61 million		Norman and Nakhooda, 2014
Voluntary carbon market	International→Local	Reduced deforestation and forest degradation, SFM, A/R			$1 billion		Norman and Nakhooda, 2014
EFTs							
16 Brazilian states	State→Local	Protected areas			>R$216 million	2002-2008	May et al, 2012
					>R$403 million	2009	
France	National→Local	Protected areas			~2.7 million €	2011	Borie et al, 2014
Portugal	National→Local	Protected areas	314,000 (conservation areas)	25-50 €	13 million €	2008	Santos et al, 2012
India	National→State	Forest cover	39,470,000 (very dense or moderately dense forest)	$174-303	~$5.7 billion	2016	Reserve Bank of India, 2016

Until 2014 the few examples of EFTs mostly involved protected areas. EFTs for protected areas have been enacted in Portugal (Santos et al 2012), France (Borie et al 2014), and in 16 Brazilian states (Droste et al 2017). EFTs are at earlier policy stages in Germany and Poland (Schröter-Schlaack et al 2014), and have been proposed for the European Union (Droste et al 2016), Indonesia (Mumbunan et al, 2012; Irawan et al., 2014), and India (Kumar and Managi, 2009).

In 2014, the world's first EFTs for forests were enacted in India when the 14th Finance Commission added forest cover to the formula used to determine the amount of annual tax revenue distributed by India's central government to each of its 29 states. In this paper we describe the origins of the reform and discuss its potential effects within India. We conduct a preliminary exploration of the effect of the tax revenue transfers on state-level forest cover using one to two years of post-reform data.

India's ecological fiscal transfers

Indian states are dependent on the central government for nearly half their revenue. 24 percent of states' revenue comes from taxes collected by the central government that are distributed to states' general budgets via a multi-element formula. An additional 20 percent of states' revenue comes from the central government in the form of grants earmarked for specific purposes ("grants-in-aid"). States' own taxes generate 46 percent of their revenue, while other non-tax revenue generates 9 percent (estimates for 2015-2016; Reserve Bank of India, 2016).

The portion of centrally collected revenue that is distributed to states ("vertical devolution") and the formula that determines how much revenue each state receives ("horizontal devolution") are set every five years by the India Finance Commission, which is composed of academics, former bureaucrats, and other fiscal experts, and is regarded as apolitical. The report of the Finance Commission is submitted to the President and as per a long-standing convention its recommendations are accepted without changes by the Indian cabinet.

The horizontal devolution formula has undergone periodic changes from 1949 to present (Figure 1). Population was the only element of the formula from 1950-1954. It remained more than 75 percent of the formula until 1980 when it was reduced to around 20 percent, where it has roughly remained ever since. Measures of poverty and fiscal situation comprised a growing share of the formula, from around 20 percent from 1960-1979 to between 45-75 percent since. Tax effort and fiscal discipline comprised between 10-17.5 percent from 1995-2014; infrastructure comprised between 5-7.5 percent from 1995-2004; area has comprised 5-15 percent of the formula since 1995.

In February, 2014, the 14th Finance Commission introduced states' forest cover circa 2013 as an element of the horizontal devolution formula, comprising 7.5 percent of the tax revenue to be transferred to states from 2015 through 2019. Forest cover has been monitored every two years by the Indian Forest Service at 23.5-meter resolution using satellite-based methods that have been operating since 1987. The measurement of forest cover does not distinguish plantations, tree crops, or gardens from natural forests. Nor does the indicator differentiate

forests based on their conservation value, as proposed by Verma et al. (2014), nor on forests' ownership, land use, or legal status. It does, however, pay only for very dense and moderately dense forest cover (tree canopy density above 40 percent covering an area larger than one hectare) but not for open forest cover (tree canopy density between 10 and 40 percent).

Figure 1. Elements of India's horizontal devolution formula over time, by Finance Commission.

Finance commission
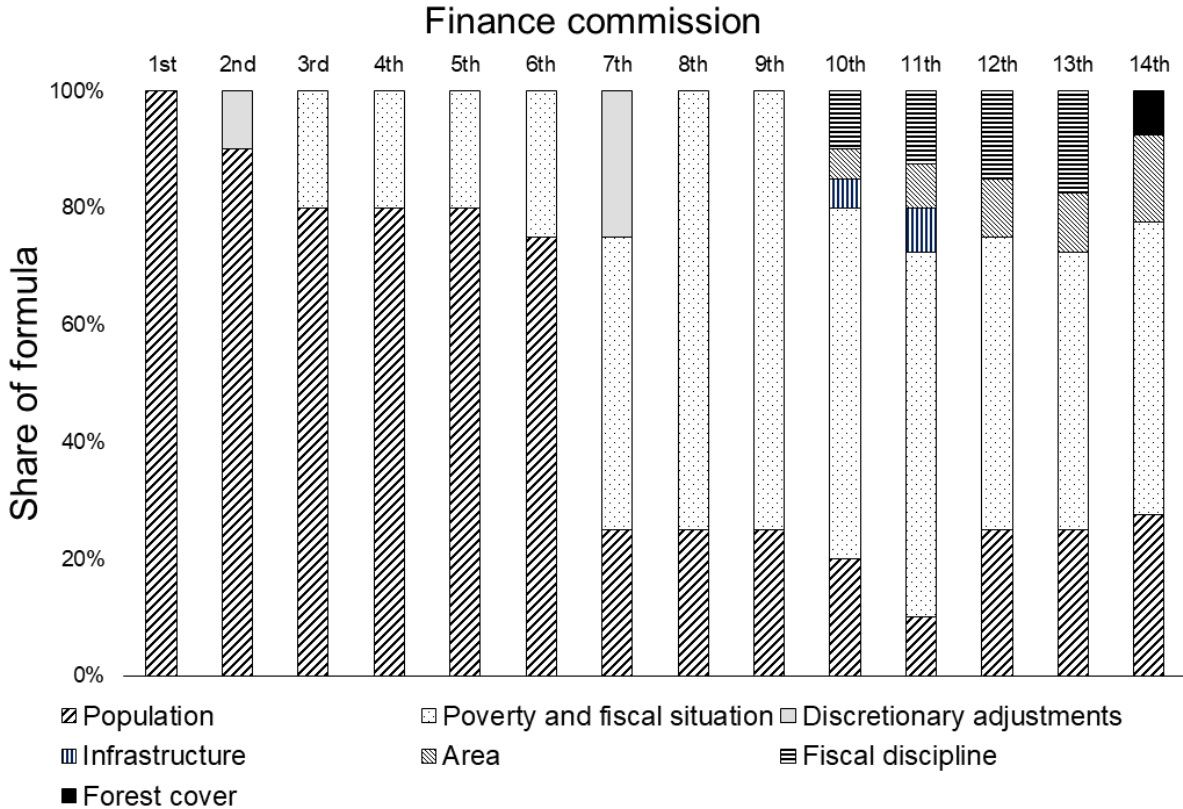
Source: Authors' calculations based on Srivastava et al (2009), Government of India (2009), Government of India (2014).
Notes: 1st Finance Commission: 1950-1954; 2nd Finance Commission: 1955-1959; etc. Population includes "population" and "demographic change." Poverty and fiscal situation includes "poverty ratio," "inverse income," "fiscal capacity," "income distance," "index of backwardness," "social and economic backwardness," and "financial weakness." Fiscal discipline includes "fiscal discipline" and "tax effort." Discretionary adjustments includes "discretionary adjustments" and "revenue equalization." Does not include center-to-state funding through grants.

The primary motivation of the 14th Finance Commission in adding forest cover to the formula was to compensate states for the "fiscal disability" caused by forgone opportunities to convert forests to other uses resulting from implementation of the 1988 National Forest Policy—an issue consistently raised in the Commission's consultations by states with high forest cover concentrated in the Northeast. However, in its authorizing document the 14th Finance Commission justified the inclusion of forest cover on environmental grounds as

well, declaring that "we believe that a large forest cover provides huge ecological benefits" (Government of India, 2014).

The Government of India estimated in its 2015 national climate pledge (Intended Nationally Determined Contribution) that between $6.9-12 billion per year will be transferred to states proportional to their forest cover (Government of India, 2015). In the first post-reform budget in 2015-2016, an estimated 364 billion rupees (around $5.7 billion US Dollars) were transferred to states on the basis of their forest cover (Reserve Bank of India, 2016). This scale of finance dwarfs most previous conditional environmental payment programs for tropical forests in terms of total finance and dollars per hectare (Table 1). By comparison, Costa Rica's flagship payments for environmental services program totaled $342 million from 1997-2012 (Porras et al 2013), and all pledged international REDD+ finance for the decade 2006-2015 totaled less than $10 billion (Norman and Nakhooda, 2015). Only China operates at a similar scale, having disbursed $37.1 billion in eco-compensation payments from 2001-2012 (ADB, 2016). Forest-cover-proportional funds had previously been made available to states by the 12th and 13th Finance Commissions (Verma et al 2014), but the recommendations of the 14th Finance Commission differed from those of its predecessors in three important respects. First, the 14th Finance Commission recommended a quantum of finance some 30 to 250 times larger: around $6-12 billion annually, compared to only around $227 million and around $1 billion over five-year periods recommended by the 12th and 13th Finance Commissions respectively. Second, the release of three-quarters of the funds granted by the 13th Finance Commissions was contingent on the preparation of workplans and other pre-conditions (Government of India, 2009); in contrast the release of the EFTs was automatic with no pre-conditions. And third, grants from the 12th and 13th Finance Commissions had to be spent by states on forest-related budget items, whereas the EFTs operate as a pure transfer into states' general budgets—part of a broader pattern by the 14th Finance Commission of shifting center-to-state payments from earmarked grants to general-purpose transfers.[2]

In order for the EFTs to operate as an incentive mechanism (i.e. to encourage states to increase their forest cover, in addition to merely compensating states for the "fiscal disability" of forgone revenue from converting forests to other land uses), state governments need to expect with some positive probability that future finance commissions will retain contemporary forest cover as a sizeable element of the tax revenue distribution formula. The persistence of many previous elements of the formula through time provides some level of confidence that forest cover may persist as well. Furthermore, though no official statement can prejudge the decisions of future finance commissions, India's 2015 national climate pledge mentioned India's long-term goal of increasing forest cover from 24 percent in 2013

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[2] Distinct from the 14th Finance Commission's tax revenue distribution reform, in 2016 India's Parliament passed the Compensatory Afforestation Fund Bill to unlock more than 400 billion rupees (around US$6 billion) in unspent funds for "conservation, protection, improvement and expansion of forest and wildlife resources" that had accumulated from penalties paid by states for the "diversion" of forest land to other uses. 90 percent of these funds would be divided between state Compensatory Afforestation Fund Management and Planning Authorities (CAMPAs) on the basis of the states from which the original payments into the fund were made, while 10 percent would rest with a national CAMPA (Government of India, 2016).

to 33 percent, and referred to the 14th Finance Commission's decision as a fiscal incentive that "has effectively given afforestation a massive boost" (Government of India, 2015), perhaps suggesting that forest cover may remain a long-term component of the formula.

Assuming that the 15th Finance Commission retains contemporary forest cover as 7.5 percent of the formula for distributing post-2020 tax revenue, then states that increase forest cover will stand to gain tax revenue of roughly US$174-303 per hectare per year in post-2020 tax revenue, while states that lose forest cover before 2020 will stand to lose the same amount (Table 2). Note that the EFTs pay across *all* forested hectares; not just contracted hectares as in PES, or reductions in forest loss as in REDD+. Note also that because the total amount of tax revenue transferred is not affected by total forest cover, every additional hectare of forest in another state also results in a loss of around US$6-11 per hectare per year. This amount is probably too small to encourage "beggar-thy-neighbor" forest-destruction actions across state lines.

Potential effects

India reported 695,000 square kilometers of forest cover circa 2015 (Ministry of Environment, Forest, and Climate Change; 2015), down from 869,000 square kilometers in 1930 (Reddy et al 2016) and up from 663,000 square kilometers in 1989. Of this forest, 401,000 square kilometers were classified as very dense or moderately dense, down from 417,000 square kilometers in 2001. India's forests span three of Earth's hotspots of biodiversity—the Eastern Himalayas, Indo-Burma, and the Western Ghats (Mittermeier et al, 2004). In the Himalayas deforestation is driven by agricultural expansion and settlements; in Northeast India by shifting cultivation, logging, and mining; in the Western Ghats by dams, plantations, agriculture, and infrastructure development; and in the Deccan plateau by agriculture (Reddy et al, 2016). Large amounts of replanting have taken place as well; commercial plantations and orchards comprise around 88,000 square kilometers that could potentially be classified as forest (Ravindranath et al, 2014).

45 percent of India's forests are government-owned (Brandt et al 2017), including 5 percent of forests within protected areas and 40 percent of forests for which the central government provides policy directions and guidelines on common issues and state governments are responsible for management and protection (Ministry of Environment, Forest, and Climate Change 2014). 38 percent of India's forests are under community management while 14 percent are privately owned (Brandt et al 2017).

Authority for land-use and forest-management decisions in India has ebbed and flowed between the central and state governments over the decades (Chaturvedi, 2016). Today state governments are "powerful actors" that are "actively shaping policies and programmes" (Chaturvedi, 2016). They have the authority to approve small development projects (e.g. roads, transmission lines) and can grant "in principle approval" for large development projects (e.g. mines, dams, irrigation). They can allow encroachment on forest lands, subject to the constraints of a 1995 Supreme Court decision. While the central government sets the policy contours of the India Forest Service, state governments influence its personnel through their control of transfers, promotions, and allocation of posts. Central government

Table 2. Forest cover and estimated forest-cover-proportional fiscal transfer by state

State	Very dense or moderately dense forest cover, 2013 (km²)[a]	% of total forest cover	If total transfer is US$6.9 billion per year…			If total transfer is US$12 billion per year…		
			Size of annual transfer	Increase from additional hectare of in-state forest	Decrease from additional hectare of out-of-state forest	Size of annual transfer	Increase from additional hectare of in-state forest	Decrease from additional hectare of out-of-state forest
Andhra Pradesh/Telangana[b]	26,929	6.8%	$469,401,154	$174	$12	$816,349,834	$303	$21
Arunachal Pradesh	52,242	13.2%	$910,633,708	$174	$23	$1,583,710,796	$303	$40
Assam	12,789	3.2%	$222,925,893	$174	$6	$387,697,205	$303	$10
Bihar	3,627	0.9%	$63,222,473	$174	$2	$109,952,128	$303	$3
Chhattisgarh	39,018	9.9%	$680,125,302	$174	$17	$1,182,826,611	$303	$30
Goa	1,128	0.3%	$19,662,242	$174	$0	$34,195,203	$303	$1
Gujarat	5,596	1.4%	$97,544,241	$174	$2	$169,642,158	$303	$4
Haryana	480	0.1%	$8,366,911	$174	$0	$14,551,150	$303	$0
Himachal Pradesh	9,605	2.4%	$167,425,381	$174	$4	$291,174,576	$303	$7
Jammu and Kashmir	12,900	3.3%	$224,860,741	$174	$6	$391,062,158	$303	$10
Jharkhand	12,254	3.1%	$213,600,273	$174	$5	$371,478,735	$303	$9
Karnataka	21,956	5.5%	$382,716,467	$174	$10	$665,593,856	$303	$17
Kerala	10,930	2.8%	$190,521,543	$174	$5	$331,341,813	$303	$8
Madhya Pradesh	41,553	10.5%	$724,313,052	$174	$18	$1,259,674,873	$303	$32
Maharashtra	29,490	7.4%	$514,042,112	$174	$13	$893,986,283	$303	$23
Manipur	6,822	1.7%	$118,914,727	$174	$3	$206,808,220	$303	$5
Meghalaya	10,138	2.6%	$176,716,139	$174	$4	$307,332,415	$303	$8
Mizoram	6,038	1.5%	$105,248,772	$174	$3	$183,041,342	$303	$5
Nagaland	6,034	1.5%	$105,179,047	$174	$3	$182,920,082	$303	$5
Odisha	28,340	7.2%	$493,996,387	$174	$12	$859,124,152	$303	$22
Punjab	736	0.2%	$12,829,264	$174	$0	$22,311,763	$303	$1
Rajasthan	4,496	1.1%	$78,370,069	$174	$2	$136,295,772	$303	$3
Sikkim	2,661	0.7%	$46,384,064	$174	$1	$80,667,938	$303	$2
Tamil Nadu	13,147	3.3%	$229,166,214	$174	$6	$398,549,937	$303	$10
Tripura	4,750	1.2%	$82,797,560	$174	$2	$143,995,756	$303	$4
Uttar Pradesh	6,173	1.6%	$107,601,965	$174	$3	$187,133,853	$303	$5
Uttarakhand	18,896	4.8%	$329,377,408	$174	$8	$572,830,274	$303	$14
West Bengal	7,117	1.8%	$124,056,891	$174	$3	$215,751,115	$303	$5
TOTAL	395,845		$6,900,000,000			$12,000,000,000		
AVERAGE	14,137	3.6%	$246,428,571	$174	$6	$428,571,429	$303	$11

[a] Source: India State of Forest Report (MEFCC, 2015)

[2] Note: the state of Andhra Pradesh split into two states of Andhra Pradesh and Telangana on June 2, 2014.

funding for forest management is low and in some cases requires cost sharing that state governments have historically been unable or unwilling to provide. Neither timber operations nor international donors provide significant sources of funding due to policy restrictions (Chaturvedi, 2016).

India's EFTs provide an excellent test case of the premise that conditional payments can result in the increased provision of ecosystem services by state governments. While we hypothesize that the reform would not yet have produced noticeable results in its first one to two years of operation, we expect that in the medium-to-long term the following actions will occur as the result of a sustained forest-cover-proportional fiscal transfer:

1. State governments increase budgets for forest management
2. State governments increase the use and effectiveness of existing pro-forest policies within their control
3. State governments devise new ways to encourage pro-forest actions by local governments within state boundaries.
4. State governments devise new ways to encourage pro-forest actions by private actors, e.g. citizens, landholders, or businesses within state boundaries.
5. As a result of 1-4, state-level forest cover increases, composed of both reduced deforestation (which can be detected by satellites instantaneously) and increased reforestation (which can be detected only after a lag of several years).

Discussions on REDD+ at the United Nations Framework Convention on Climate Change (UNFCCC) involved considerable energy negotiating safeguards to ensure that new financial incentives for forest conservation would not have adverse social and environmental impacts, resulting in agreement on the Cancun Safeguards and Safeguards Information Systems. India's EFTs are conditional on forest cover alone and have no social and environmental safeguards constraining the means by which states protect and restore forests. Thus it will be useful to observe India to see whether or not two additional actions occur:

1. Lack of social safeguards promotes repressive and unjust exclusion of local people from accessing forest resources.
2. Lack of biodiversity safeguards promotes reforestation with fast-growing commercial species at the expense of restoration of native forest.

In this paper we present a preliminary test of hypothesis (5); we reserve tests of the other six hypotheses for future work. We suggest that five years after the reform may be a reasonable length of time after which to rigorously evaluate its early effects. Such an evaluation could in turn be used to estimate the effects of the reform in dollar-per-hectare-of-forest or dollar-per-ton-of-carbon-dioxide terms.

Preliminary analysis

After the EFTs were introduced, net loss of very dense or moderately dense forest cover decreased by 51 percent, from 1,960 square kilometers of net loss between 2011 and 2013 before the reform to 969 square kilometers between 2013 and 2015 spanning the reform,

according to the India State of Forest Reports (Ministry of Environment, Forest, and Climate Change 2015; Figure 2). However, on its own a decrease in net forest-cover loss after the introduction of the EFTs provides little information about the effects of the reform because deforestation rates are influenced by many other time-variant factors besides this single policy.

Figure 2. Forest-cover change in India, 2001-2015.
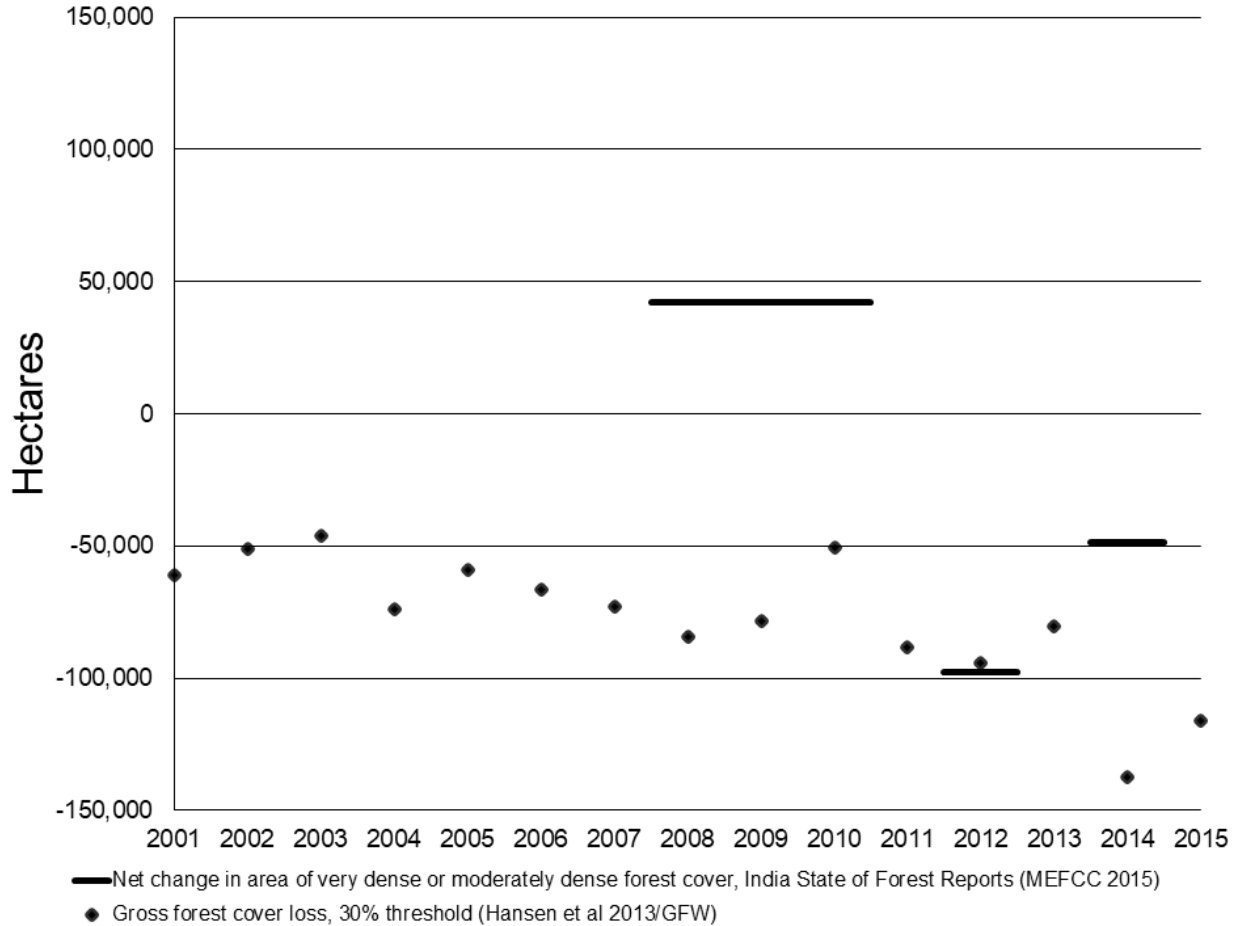
To rigorously estimate the causal impact of the reform, it would be necessary to compare observed rates of forest loss and gain to a counterfactual scenario in which the EFTs were not enacted. However, because the dollar-per-hectare incentive was applied uniformly across the entire country (Table 2), it is not possible to develop a counterfactual scenario based on untreated control regions from within India nor variation in treatment levels across India. Potentially a counterfactual scenario could be developed using data from many countries and synthetic control methods (e.g. Sills et al, 2015), but that is beyond the scope of this analysis.

But while the dollar-per-hectare transfer for forest cover was uniform across all states, we expect that the incentive effect of the forest-cover-proportional transfer would be larger in states where it comprises a greater share of total state revenue from all sources. However, we found no significant correlation (r=-0.03; p=0.89) across states between the forest-cover-

proportional fiscal transfer as a share of total state revenue and improvement in forest cover, as indicated by the increase in a state's net increase in very dense or moderately dense forest cover as a percent of land area between 2011-2013 before the reform and 2013-2015 spanning the reform (Table 3).[3] This finding is consistent with our hypothesis that one year is too soon for the reform to have had a noticeable effect.

As a supplementary analysis, we examined an alternative data set on gross forest-cover loss (Hansen et al 2013/GFW), which is not directly comparable to India's official data due to differences in forest definition and reporting of net vs. gross changes. This independent data set showed that India's gross forest loss (30 percent tree-cover threshold) *increased* by 81 percent from an average of 70,000 hectares/year during 2012 and 2013 before the reform to an average of 127,000 hectares/year during 2014 and 2015 almost entirely after the reform (Hansen et al. 2013/GFW) (Figure 2). Again, we found no significant correlation (r=-0.20; p=0.31) between the forest-cover-proportional fiscal transfer as a share of total state revenue and decrease in forest-cover loss as a percent of land area between the period 2012 and 2013 and the period 2014 and 2015, consistent with our hypothesis that two years is too soon for the reform to have had a noticeable effect.

Comparing state-level changes in net forest-cover increase before and after the reform is only a first-order indication of the effect of the reform; it does not control for the effect of factors that vary across both space and time, such as commodity price fluctuations or the designation of new protected areas. A spatially explicit analysis that attempts to control for such potentially confounding factors is beyond the scope of this analysis.

Discussion

India's EFTs do not appear to have had a positive influence on forest cover yet, at least not consistently across states. This is consistent with our hypothesis that one to two years is too soon for the tax revenue distribution reform to have had a noticeable effect. We stress that this is the result of a simple preliminary analysis and that more rigorous analysis over longer time scales will be necessary to fully understand the influence of the reform.

However, while the reform does not appear to have had an immediate effect, there are several reasons to expect that its effect might grow with time. First, state governments' attention to the fiscal opportunity provided by the EFTs might increase, as might their expectation that forest cover will be retained as an element of the horizontal devolution formula beyond 2019. Second, it might take time for increased attention by state governments to be reflected in state budgets, policies, and land-use decisions, e.g. related to the approval of development projects and encroachments, and for these decisions to

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[3] Technically, the incentive effect of the reform should be related to the increase in the forest-cover-proportional transfer. But since the post-reform fiscal transfer is around 30 times larger than the pre-reform grant-in-aid it replaced, for simplicity we consider the incentive effect of the post-reform transfer only without subtracting incentives arising from the much smaller pre-reform grant-in-aid. Note that because both the pre- and post-reform transfers are proportional to states' forest cover this simplification should have almost no effect on the correlation coefficient.

translate into changes in forest loss and gain. And third, while deforestation can be detected instantaneously, newly planted trees take time to grow so there is necessarily a lag of several years before reforestation can be detected by satellites. Even so, it is worth considering reasons why the reform might not have a noticeable effect—an offer of increased state revenue in the near future might not incentivize public policy changes today; or the fiscal incentive might be too small to influence policy (while large in absolute terms, $5.7 billion per year is still only 1.8 percent of total state revenues); or it might be that too much deforestation is beyond the influence of state governments.

Future Finance Commissions should retain forest cover in the horizontal devolution formula as a way of meeting long-term forest cover and climate goals. For the EFT to operate as an effective forest-conservation instrument, the year of the forest cover indicator needs to be contemporaneous, that is, updated at least every five years rather than fixed circa 2013.

For conservationists in India, EFTs provide an opportunity to convince state government policy makers that increasing forest protection and restoration can be a profitable public investment in future state revenue, and that decisions that divert forest to other land uses will have a fiscal cost. Conservationists may also seek to educate state policy makers on the importance of restoring native forests rather than reforesting with plantation monocultures, given the lack of any inherent requirement or incentive to do so.

India's pro-forest tax revenue distribution reform could potentially be adapted by any country in which revenue is devolved across multiple levels of government, including Indonesia (Mumbunan et al, 2012; Irawan et al., 2014), Brazil's federal government (Droste et al. 2017), and China. Mobilizing financial resources in support of forest conservation is particularly important in the context of climate change, as protecting and restoring forests make up one-quarter of the climate mitigation pledged by countries (Grassi et al, 2017).

Table 3. State-by-state correlations between forest-cover-proportional fiscal transfer as share of state revenue and improved forest condition. Authors' calculations based on Reserve Bank of India (2016); India State of Forest Reports (MEFCC, 2015).

State	Forest transfer as share of state revenue from all sources, 2015	Forest transfer as share of total fiscal transfer, 2015	Land area (km²)	Net increase in very dense or moderately dense forest cover 2011-2013 (km²)	Net increase in very dense or moderately dense forest cover 2013-2015 (km²)	Increase in net increase, as % of land area	Gross loss of forest cover 2012+2013 (km²)	Gross loss of forest cover 2014+2015 (km²)	Decrease in gross loss, as % of land area
Andhra Pradesh/ Telangana[a]	1.3%	7.0%	275,045	-163	-236	-0.03%	91	59	0.01%
Arunachal Pradesh	41.3%	66.5%	83,743	-145	-137	0.01%	236	254	-0.02%
Assam	2.1%	7.1%	78,438	-59	-80	-0.03%	256	360	-0.13%
Bihar	0.3%	0.7%	94,163	116	-3	-0.13%	1	0	0.00%
Chhattisgarh	6.2%	22.1%	135,192	-56	-20	0.03%	49	32	0.01%
Goa	1.0%	5.2%	3,702	0	-6	-0.16%	1	0	0.00%
Gujarat	0.5%	4.0%	196,244	-11	0	0.01%	0	0	0.00%
Haryana	0.1%	0.8%	44,212	-4	-1	0.01%	1	0	0.00%
Himachal Pradesh	3.8%	23.0%	55,673	0	0	0.00%	8	1	0.01%
Jammu and Kashmir	3.1%	14.7%	222,236	0	-24	-0.01%	4	0	0.00%
Jharkhand	2.3%	9.4%	79,716	-253	-3	0.31%	5	2	0.00%
Karnataka	1.7%	8.1%	191,791	0	-112	-0.06%	47	37	0.00%
Kerala	1.3%	7.7%	38,852	94	-106	-0.51%	66	65	0.00%
Madhya Pradesh	3.3%	12.6%	308,252	-73	-22	0.02%	8	7	0.00%
Maharashtra	1.4%	9.3%	307,713	-61	-31	0.01%	17	12	0.00%
Manipur	7.2%	19.4%	22,327	-59	-170	-0.50%	212	323	-0.49%
Meghalaya	11.1%	27.7%	22,429	-70	-105	-0.16%	143	364	-0.99%
Mizoram	7.7%	23.0%	21,081	-182	-42	0.66%	171	395	-1.07%
Nagaland	6.2%	23.0%	16,579	-190	-43	0.89%	228	370	-0.86%
Odisha	3.7%	13.3%	155,707	-86	153	0.15%	91	114	-0.01%
Punjab	0.1%	0.8%	50,362	0	-1	0.00%	2	0	0.00%
Rajasthan	0.4%	1.4%	342,239	-24	6	0.01%	0	0	0.00%
Sikkim	5.1%	12.7%	7,096	0	-1	-0.01%	1	0	0.01%
Tamil Nadu	0.8%	5.7%	130,060	-122	315	0.34%	23	20	0.00%
Tripura	3.5%	23.1%	10,486	-45	-28	0.16%	47	94	-0.45%
Uttar Pradesh	0.2%	0.7%	240,928	-12	82	0.04%	5	2	0.00%
Uttarakhand	6.7%	31.5%	53,483	-33	-540	-0.95%	18	14	0.01%
West Bengal	0.6%	2.0%	88,752	-513	3	0.58%	16	8	0.01%
TOTAL	1.8%	7.5%	3,276,501	-1951	-1152	0.02%	1746	2536	-0.02%
Correlation with forest transfer as share of all state revenue						-0.03			-0.20
p-statistic (two-tailed)						0.89			0.31
Correlation with forest transfer as share of total transfer						-0.08			-0.33
p-statistic (two-tailed)						0.70			0.09

[a] Note: the state of Andhra Pradesh split into two states of Andhra Pradesh and Telangana on June 2, 2014.

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