ROADMAP FOR SCALING TREES OUTSIDE FORESTS IN INDIA: LEARNINGS FROM SELECT STATES ON POLICY INCENTIVES, ENABLING CONDITIONS, AND BARRIERS

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EXECUTIVE SUMMARY

Highlights

■ Growing trees outside forests (ToF) presents a significant environmental and economic opportunity in India. Nearly 80 million hectares (Mha) can sequester 3.4 gigatons of carbon dioxide-equivalent (Gt CO_2e) by 2040 to help India achieve its international climate commitments (Chaturvedi et al. 2018). It can also support food and livelihood security for rural India, especially for its poor and vulnerable groups.

■ India has several enabling policies and schemes embedding a range of monetary and nonmonetary incentives for the scaling of ToF through interventions such as agroforestry. We analyze incentives implementation in the six states of Gujarat, Karnataka, Maharashtra, Odisha, Punjab, and Telangana to identify enabling conditions that can spur ToF expansion as well as the barriers that impede implementation.

■ Based on our analysis, we propose developing landscape-level restoration strategies and plans, reorienting or shifting incentives to protect, promote, and improve research on traditional ToF systems, targeting the needs of women and marginalized groups who are disproportionately dependent on multipurpose trees, and improving the enabling environment for existing incentives to motivate farmers and other practitioners to protect and expand ToF systems.

CONTENTS

Working Papers contain preliminary research, analysis, findings, and recommendations. They are circulated to stimulate timely discussion and critical feedback and to influence ongoing debate on emerging issues. Most working papers are eventually published in another form and their content may be revised.

Introduction

Growing trees outside forests (ToF) offers manifold environmental and socioeconomic benefits. Key benefits include improved livelihoods, jobs and income generation, enhanced soil health, biodiversity conservation, carbon sequestration, and increased resilience of local communities (GoI 2014). In a separate study, we documented the existence of at least 47 systems of ToF in India including agroforestry, urban forestry, block plantations, and linear plantations.[1] The expansion of ToF can support India's international commitments including the Nationally Determined Contribution (NDC), the Bonn Challenge[2], Land Degradation Neutrality target[3], and Sustainable Development Goals (SDGs). In the last decade, India increased focus on ToF expansion through policies and schemes that incentivize and support farmers and other practitioners to take up ToF systems, particularly agroforestry. Key policies/schemes include the Sub-Mission on Agroforestry (SMAF), National Mission for a Green India (GIM), National Bamboo Mission, and Nagar Van (city forests), among others.

The implementation of these policies/schemes, though, has yet to be optimized. There are several challenges that impede implementation, such as lack of quality planting material; technical capacity and knowledge gaps; market and finance gaps; and inadequate attention to issues around land and tree tenure, gender, and social inclusion (ICFRE 2020; Singh et al. 2020). Enabling conditions and barriers vary from state to state and account for the broad spectrum of differences in the implementation of ToF policies/schemes.
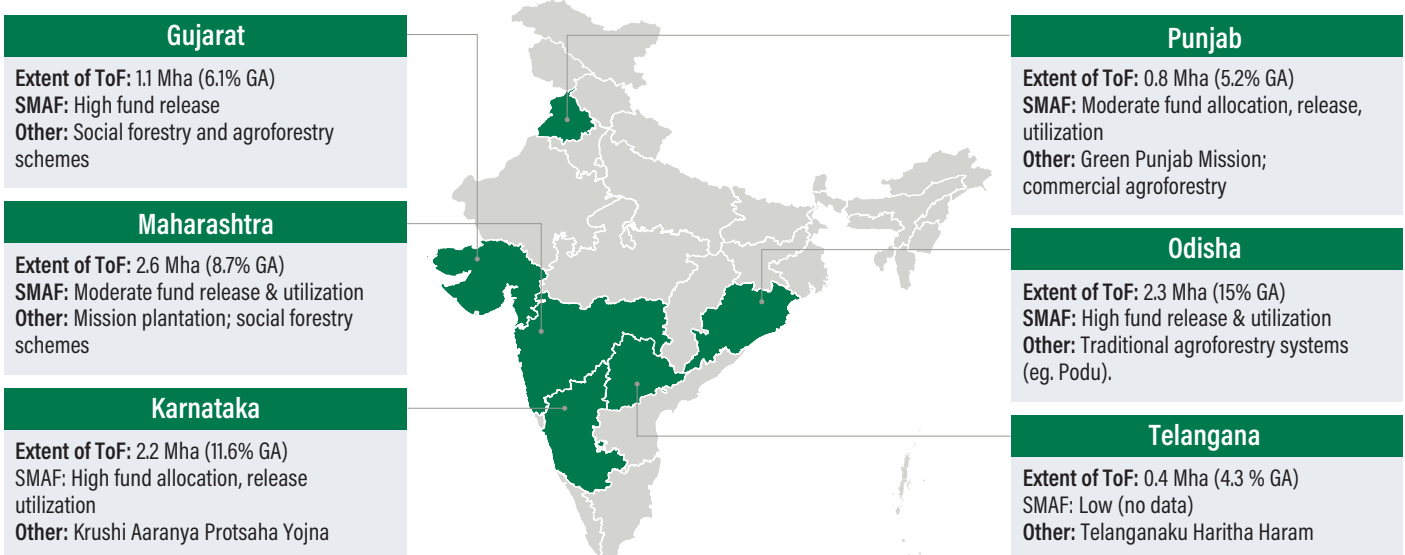
About this working paper

In this paper, we analyze 16 national and 30 state-level policies/schemes for ToF expansion in six states in India. Our aim is to address and answer two specific questions:

- What are the different types of policy incentives in national and state-level schemes for implementing and scaling ToF that are available in the six selected states?

- What are the key enabling conditions for and barriers to achieving results at scale?

We selected the six states for deep-dive analysis based on three criteria: (a) states representing a range of high, medium, and low performance based on SMAF fund data available in the government database; (b) states with high, medium, and low extent of trees outside of forests; and (c) states displaying commitment to ToF expansion through flagship policies/schemes (see Figure ES 1). The selected states—Gujarat, Karnataka, Maharashtra, Odisha, Punjab, and Telangana—represent 13 out of the 20 agro-ecological zones in India. We conducted the comparative analysis of incentives, enabling conditions, and barriers through a mixed-methods approach. We combined systematic literature review of ToF policies/schemes (peer-reviewed and grey literature) with interviews with 43 stakeholders from government, civil society organizations, research organizations, and farmers from the six states.

Figure ES 1 | **States selected for the study**

Gujarat
Extent of ToF: 1.1 Mha (6.1% GA)
SMAF: High fund release
Other: Social forestry and agroforestry schemes

Maharashtra
Extent of ToF: 2.6 Mha (8.7% GA)
SMAF: Moderate fund release & utilization
Other: Mission plantation; social forestry schemes

Karnataka
Extent of ToF: 2.2 Mha (11.6% GA)
SMAF: High fund allocation, release utilization
Other: Krushi Aaranya Protsaha Yojna

Punjab
Extent of ToF: 0.8 Mha (5.2% GA)
SMAF: Moderate fund allocation, release, utilization
Other: Green Punjab Mission; commercial agroforestry

Odisha
Extent of ToF: 2.3 Mha (15% GA)
SMAF: High fund release & utilization
Other: Traditional agroforestry systems (eg. Podu).

Telangana
Extent of ToF: 0.4 Mha (4.3 % GA)
SMAF: Low (no data)
Other: Telanganaku Haritha Haram

Source: WRI India authors.
Map not to scale.

Key findings

Our study shows that India's ToF policies/ schemes offer at least seven types of monetary and three types of nonmonetary incentives to spur ToF. Monetary incentives include input subsidies, performance-based payments, grants, credit, benefit-sharing, minimum support price, and insurance. The nonmonetary incentives are supply chain infrastructure, regulatory incentives, and technical assistance. Agroforestry, which includes trees on bunds or boundaries, farm forestry, fruit orchards, and agri-horti-forestry, emerged as the most common ToF system promoted by the policies/schemes.

The analysis highlighted key enabling conditions that support the six states to implement ToF policies and incentives. Strong political and bureaucratic commitment to expansion of ToF underpins effective implementation of policies, particularly through alignment with other national policies. Nongovernmental organizations (NGOs) and research organizations provide crucial support in research and awareness-building, and often bridge the disconnect between government departments and farmers on the ground. The private sector, through innovative business models and functioning value chains, plays an important role in incentivizing farmers to adopt ToF systems.

We found barriers in the six states that impede success of policies and uptake of ToF. Farmers highlighted the lack of incentives for protecting existing ToF systems and promoting traditional ToF practices with native tree species. Such native systems are prioritized by women and other marginalized people who are dependent on these multipurpose trees for food, fuelwood, fodder, and nontimber forest produce (NTFP). Gaps in research and extension services also limited awareness among farmers on available ToF models and policy incentives. Lack of quality planting material, continuing ambiguities regarding permits for harvest and transit of farm-grown timber across state lines, and poorly developed value chains were highlighted by stakeholders as disincentives preventing farmers from taking up ToF systems. Lack of attention to tree tenure dissuaded tenant farmers and women from practicing ToF interventions.

Way forward

To support the effective implementation of ToF incentives and policies, we need to develop restoration strategies using a landscape approach, reorient or shift incentives to suit the local context, and strengthen the enabling environment for existing incentives. Based on our study, we recommend reorienting incentives to protect existing ToF, promoting traditional ToF models, and improving research and extensions services around native tree species. The reoriented incentives can include targeted provisions for women and marginalized groups (e.g., Scheduled Caste and Scheduled Tribe) that are often the primary practitioners and beneficiaries of traditional ToF systems. There is scope to extend incentives such as minimum support price and supply chain infrastructure to wider timber and nontimber ToF produce from the current narrow focus on just a few tree species.

We found the need to strengthen the enabling environment for existing incentives to achieve better outcomes. For instance, input subsidies can be made effective by establishing quality control and standards for planting material and nurseries. Insurance of ToF systems can be promoted by subsidizing premium payments through government programs or the private sector. Implementing certification standards for farm-grown timber can address transit-related challenges. Promoting participation of NGOs and research organizations through grants or inclusive governance models can provide farmers with the necessary technical assistance for successfully implementing ToF systems. Strengthening the role of the private sector, establishing value chains, and fostering ToF entrepreneurs can also inspire farmers to take up tree-based interventions.

1. BACKGROUND

Landscape restoration

Globally, human-induced land degradation negatively impacts 3.2 billion people, contributing to distress migration and increased conflict. Degrading lands drive species extinction and intensify climate change (IPBES 2018). There is a consensus that land management strategies contribute to climate change mitigation and adaptation, combat desertification, and enhance food security (IPCC 2018, 2019). Landscape restoration, which is the long-term process of regaining ecological integrity and enhancing human well-being, includes a range of interventions such as natural regeneration, mixed-species plantation, and agroforestry, among others (Chazdon et al. 2017). In India, where 700 million people in rural areas are dependent on forestry and agriculture for their livelihoods and sustenance, landscape restoration provides a sustainable pathway for rejuvenating land, strengthening the flow of

ecosystem services, ensuring food and nutritional security, and enhancing livelihoods. The government of India (GOI) has made several international commitments to restore lands. This includes the Bonn Challenge and the Land Degradation Neutrality (LDN target commitment to restore combined 26 million hectares (Mha) of degraded and deforested land by 2030; India's goal under the Nationally Determined Contribution (NDC) to create an additional carbon sink of 2.5 to 3.0 billion tons of carbon dioxide–equivalent (gigatons [Gt] CO2e) by 2030 through improved forest and tree cover; and biodiversity targets to achieve the globally shared Biodiversity Vision 2050. Landscape restoration can also contribute to many of the Sustainable Development Goals (SDGs), as shown in Figure 1 below.
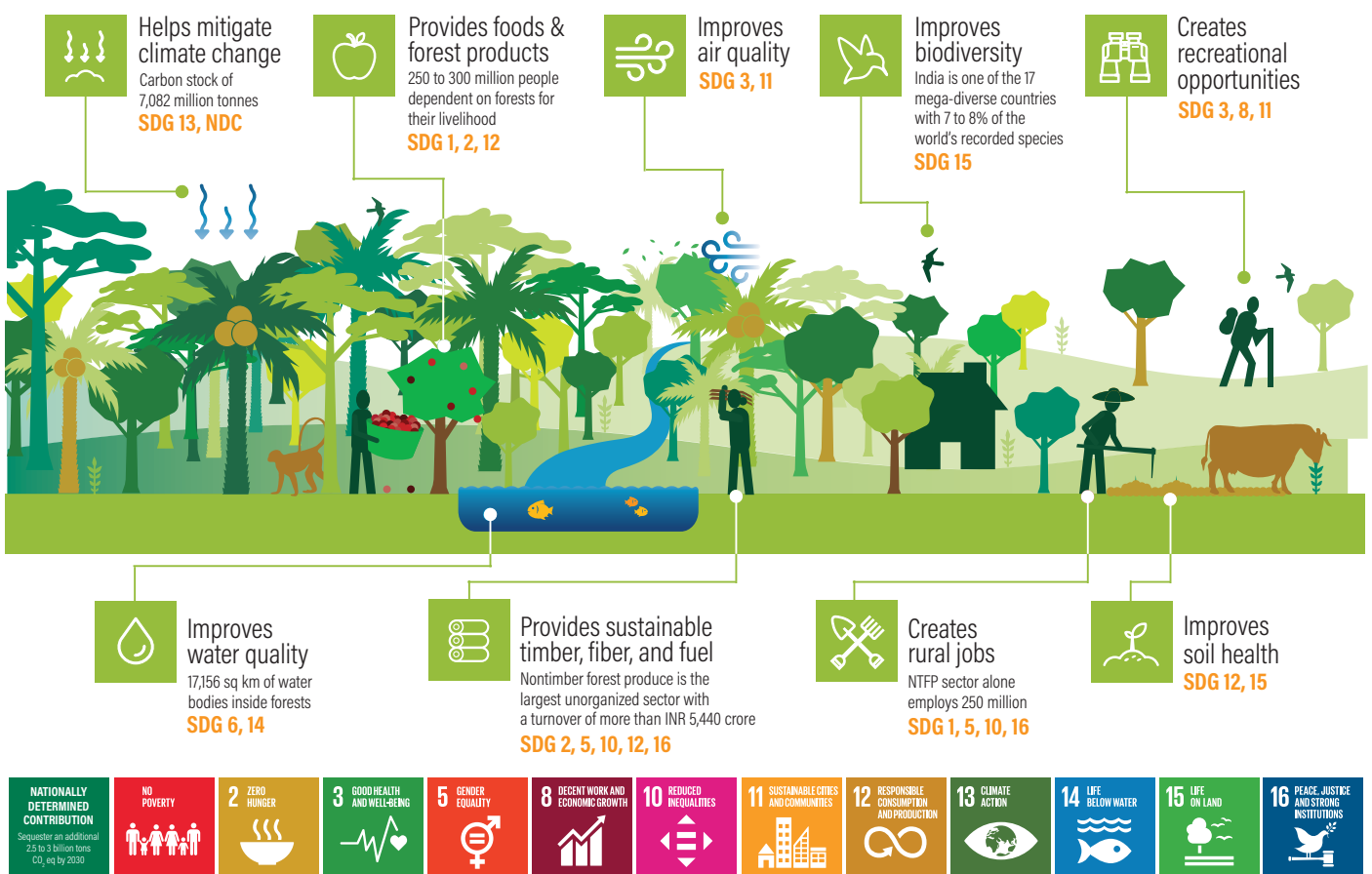
Trees outside forests

In the Indian context, trees outside forests (ToF) refers to tree resources found outside of Recorded Forest Areas (RFAs) (areas recorded as forests by the government) irrespective of patch size or area (FSI 2019). The Forest Survey of India (FSI) estimated the extent of ToF as 29.38 Mha, which is 36.4 percent of the total forest and tree cover in the country (FSI 2019) (see Figure 2). Farmers and other stakeholders practice diverse ToF systems in India. As part of another ongoing study, we are conducting a systematic literature review of the array of ToF systems. Our preliminary results identified at least 47 types of ToF systems, including agroforestry, monoculture or mixed-species plantations in private and common lands, block plantations, fruit orchards, urban forestry, home gardens with trees, and linear plantations along roads and rivers, among others.
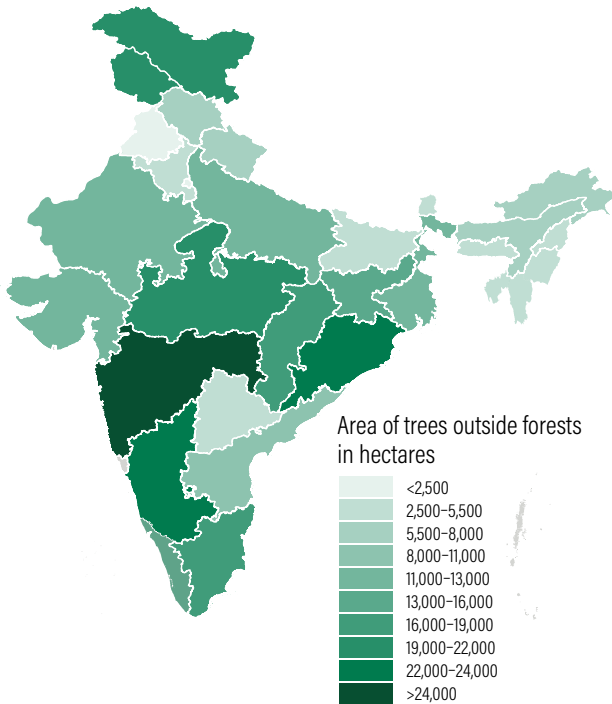
Among the different types of ToF systems, agroforestry emerged as the largest subset. Estimates of area under agroforestry vary considerably. For instance, Dhyani and Handa (2013) estimated agroforests cover at approximately 25.32 Mha while the FSI (2013) estimated 11.1 Mha. Agroforestry is the collective name

Figure 1 | **Landscape Restoration and the Sustainable Development Goals**

Helps mitigate climate change
Carbon stock of 7,082 million tonnes
SDG 13, NDC

Provides foods & forest products
250 to 300 million people dependent on forests for their livelihood
SDG 1, 2, 12

Improves air quality
SDG 3, 11

Improves biodiversity
India is one of the 17 mega-diverse countries with 7 to 8% of the world's recorded species
SDG 15

Creates recreational opportunities
SDG 3, 8, 11

Improves water quality
17,156 sq km of water bodies inside forests
SDG 6, 14

Provides sustainable timber, fiber, and fuel
Nontimber forest produce is the largest unorganized sector with a turnover of more than INR 5,440 crore
SDG 2, 5, 10, 12, 16

Creates rural jobs
NTFP sector alone employs 250 million
SDG 1, 5, 10, 16

Improves soil health
SDG 12, 15

Note: SDG = Sustainable Development Goal; Sq km = Square kilometers; NTFP = Nontimber forest produce; Crore = 10 million rupees; INR = Indian rupee.
Source: Seymour and Busch 2017; image adapted from Faruqi et al. 2018.

Figure 2 | **Extent of Trees outside Forests in India**

Area of trees outside forests in hectares

- <2,500
- 2,500–5,500
- 5,500–8,000
- 8,000–11,000
- 11,000–13,000
- 13,000–16,000
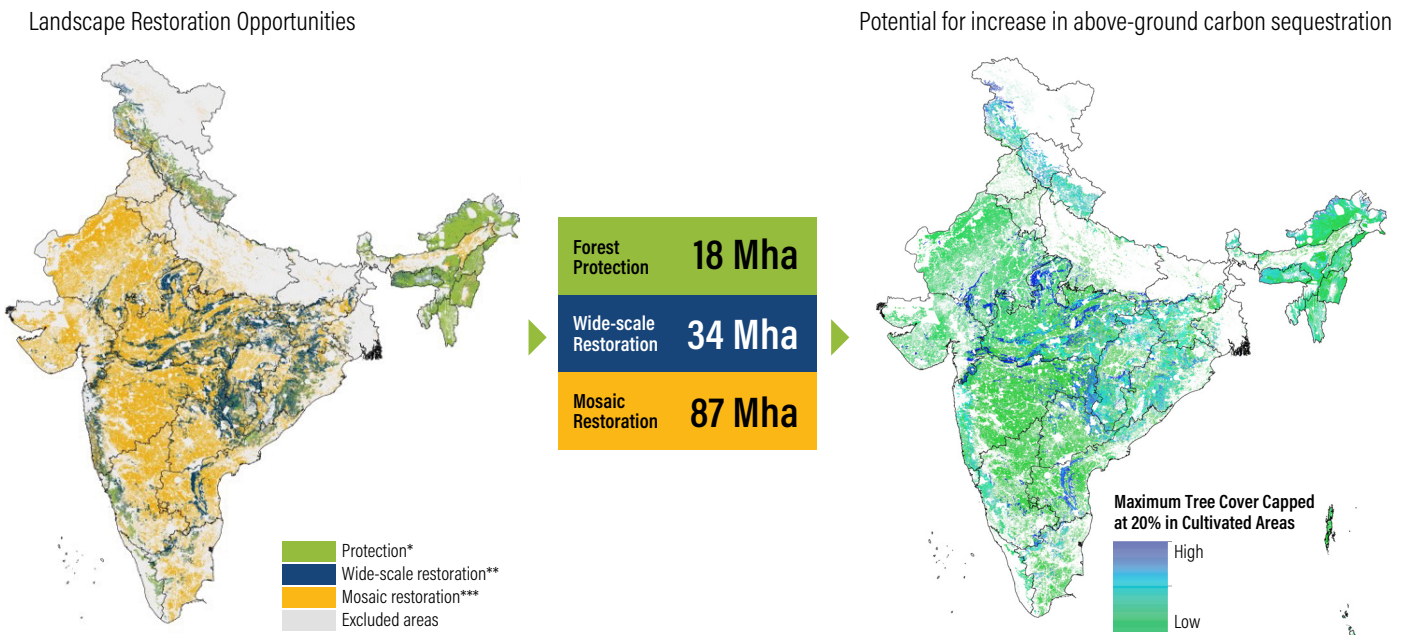- 16,000–19,000
- 19,000–22,000
- 22,000–24,000
- >24,000

Source: FSI 2019.
Map not to scale.

for land-use systems where trees are deliberately integrated with croplands and/or livestock. Agroforestry provides a range of environmental benefits that include soil moisture conservation, improved flow of water, carbon sequestration through above-ground biomass, and improvement in biodiversity (Sarvade and Singh 2014; FAO 2015).

The biophysical potential for expansion of ToF in India is immense. The "Restoration Opportunities Atlas of India" developed by World Resources Institute India (WRI India) identifies an area of over 50 Mha of opportunity for ToF, referred to as mosaic restoration in the atlas (see Figures 3a and 3b). Here, the largest potential is for agroforestry in rainfed farmlands. The tree cover in mosaic areas can have a wide range. One study shows that 60–100 trees per ha or 20 percent of tree cover is a common practice in India (Saxena 2015). Increasing tree cover in the mosaic restoration areas to 20 percent can sequester 3.4 Gt of CO_2e through above-ground biomass alone by 2040 (Chaturvedi et al. 2018).[5]

Figure 3a and 3b | **Potential for Forest Protection and Landscape Restoration and Associated Above-Ground Carbon Sequestration Potential**

Landscape Restoration Opportunities

Potential for increase in above-ground carbon sequestration

Forest Protection	**18 Mha**
Wide-scale Restoration	**34 Mha**
Mosaic Restoration	**87 Mha**

- Protection*
- Wide-scale restoration**
- Mosaic restoration***
- Excluded areas

Maximum Tree Cover Capped at 20% in Cultivated Areas

High

Low

Note: Mha = Million hectares.

*Areas for forest protection include healthy forests that need to be maintained and protected against risks such as fire, land diversion, and fragmentation.

**Wide-scale restoration are areas where near contiguous tracts of forest and tree cover can be established.

***Mosaic restoration is the integration of trees in a patchwork of different land uses including rainfed farmlands.

Source: Chaturvedi et al. 2018.

Maps not to scale.

The GoI has shown its commitment to expansion of ToF through various domestic policies, schemes, programs, and missions. India was the first country in the world to adopt a National Agroforestry Policy, in 2014, which led to the creation of the Sub-Mission on Agroforestry (SMAF) under the umbrella of the National Mission for Sustainable Agriculture (NMSA) (NMSA n.d.). ToF systems such as agroforestry, urban forestry, and linear plantations have been promoted through various national-level schemes and policies like the National Bamboo Mission (NBM), National and State Rural Livelihoods Missions, Mission for Integrated Development of Horticulture (MIDH), National Clean Air Programme, Green Highways Mission, and Nagar Van for urban forestry. These policies and schemes have been augmented with other efforts like the National Bank of Agriculture and Rural Development (NABARD)–supported wadi program[6], subnational initiatives through state governments' social forestry schemes—as well as by projects by NGOs, the private sector, research institutions, and local communities.

Experience of implementation of these policies/ schemes has been varied. India's flagship policy for ToF, the National Agroforestry Policy (2014) and the related mission, SMAF (2016), offer an overview of the opportunities and challenges facing ToF in India. Our consultations with experts and stakeholders show that SMAF has had limited success in the five years since it was initiated. It has lagged in enabling farmers, particularly small and marginal landholders, to successfully implement agroforestry systems. The uptake and implementation of SMAF has been uneven across the states, with varying levels of outcomes. Only 20 states and two Union Territories (UTs) have made the necessary notifications for the relaxation of transit regulations, which is a prerequisite for the availing of the benefits of SMAF (Parliament, Lok Sabha. 2021a)[7]. Among other policies/schemes, the National Mission for a Green India (GIM) achieved only 2.8 percent of its restoration target as of March 2020 due to inadequate budget allocation (GoI 2021; MoEFCC 2019). On the other hand, states have successfully leveraged the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) to expand ToF, by supporting activities related to drought-proofing and agroforestry (See Appendix A).

Incentives play a pivotal role as powerful policy levers. While incentives on their own cannot achieve ToF goals, they are instruments that can be used to set up the right enabling conditions to achieve a policy goal.

Globally, the experience with incentives has been varied. There are several examples where countries have used public incentives to pursue ToF systems such as agroforestry as a development strategy that offers immense learning for India (see Appendix B). The incentives include subsidies, credits, reduced tax rates, payments for ecosystem services (PES), and sustainability certification schemes. Incentives can also take the shape of regulatory reforms that provide use, management, and benefit rights to communities (Urzedo et al. 2020; Cronkleton et al. 2017; Jacobi et al. 2017; Place et al. 2012). In the agriculture sector, for instance, while subsidies have spurred productivity, there are examples of perverse incentives that have led to exploitation of groundwater and land resources. Recent reports explore agriculture subsidies across the world to identify opportunities to repurpose incentives to achieve sustainable outcomes (Ding et al. 2021; FAO et al. 2021). Improving uptake and scaling of ToF systems such as agroforestry through policies/schemes requires motivating farmers and other local stakeholders through easily accessible monetary and nonmonetary incentives.

Aim of this study: Indian policies/schemes on ToF offer a range of incentives such as input subsidies, direct payments, grants, and technical support. A literature review and consultations with stakeholders indicate there is a research gap on the types of policy incentives available, their scope and limitations, and implementation experiences of stakeholders. Addressing key common challenges that individual states face and promoting cross-learning of best practices and failures in the effective deployment of these incentives emerges as critical learning needed to develop a roadmap for scaling ToF. In this working paper we look at six states (Gujarat, Karnataka, Maharashtra, Odisha, Punjab, and Telangana) with diverse geography and ToF systems. We reviewed national and state-level policies to identify the different types of incentives available and to examine the enabling conditions and barriers that need to be addressed for scaling ToF. We hope this study, which is the first such on incentives offered by national and state-level ToF policies/schemes, will provide useful input to policymakers and decision-makers, restoration planners and practitioners, and NGOs.

2. METHODOLOGICAL APPROACH

For the purpose of this study, we use "policy" to refer to any act, rule, regulation, notification, circular, or government order enacted or issued by the national

and/or state governments that relates to ToF systems. "Scheme" refers to schemes, missions[8], or programs of the national or state governments that support ToF systems. Our focus is on policies and schemes that are currently in force in the six states we selected for our deep-dive analysis.

We adopted a mixed-methods approach for conducting this study. The processes we followed are listed below:

- Quantitative analysis of fund allocation, release, and utilization for policy/schemes

- Secondary literature review of implementation experience

- Primary data collection through key informant interviews (KIIs) with 43 key stakeholders from government, civil society, the private sector, and farmers.

2.1 Selection of states

We selected the states of Gujarat, Karnataka, Maharashtra, Odisha, Punjab, and Telangana based on the following criteria (see Figure 4):

- **Fund allocation, release, and utilization under SMAF**: SMAF is the government's flagship mission for promoting ToF in India. The details of funds allotted, released, and utilized by the states are compiled in an official database (NMSA n.d.).[9] The limitation we faced was that only seven states provided data on utilization of funds: Karnataka, Andhra Pradesh, Odisha, Maharashtra, Mizoram, Punjab, and Chhattisgarh (NMSA n.d.). We selected six states that represent high-, medium-, and low-fund allocation, release, and utilization (see Appendix C).

- **Extent of ToF**: We selected a range of states with high, medium, and low area under ToF to ensure we could objectively analyze best practices and challenges. Given the variation in geographic area (GA) of the states, the absolute area and ToF as a percentage of GA were considered (see Figure 2).

- **Other flagship policies on ToF**: Taking into account the paucity in SMAF fund data, we looked at the experience of states with policies/schemes for ToF expansion, such as flagship state-level schemes and history with promotion of traditional and modern ToF systems.

Figure 4 | **States Selected for Deep-Dive Analysis**
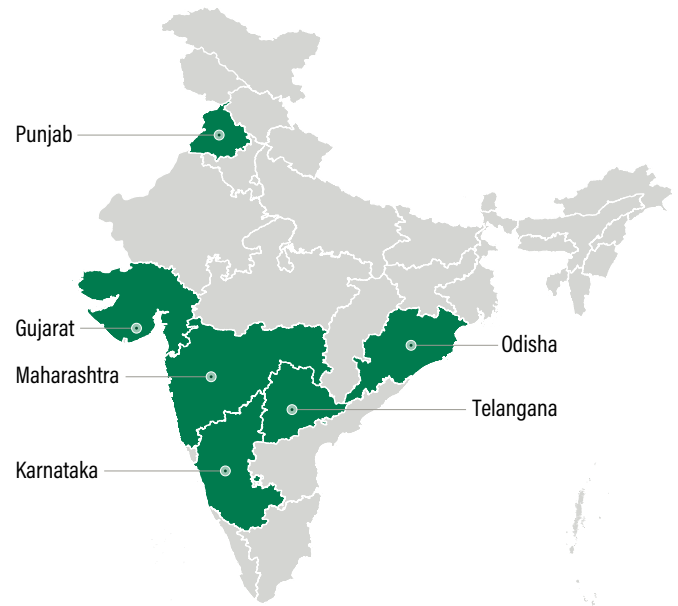
Source: WRI India authors.
Map not to scale.

2.2 Analysis of policy incentives, enabling conditions, and barriers

We created a list of national and state-level policies/schemes focusing on ToF in the six selected states. We compiled this list through a secondary literature review of government documents, including policies, acts, notifications, circulars, orders, and amendments. We reviewed 16 national and 30 state-level policies/schemes/ programs (see Figure 5, Appendix D, Tables D1 and D2). We conducted our review by developing a framework to assess the policies and identify the incentives offered (see Appendix E). We also reviewed operational guidelines, progress reports, and financial reports from the government. We backed this up with a literature review (including peer reviews and grey literature) using combinations of relevant search words in Google Scholar.[10] Our populated framework identified the different types of policy incentives for promoting uptake and scaling of ToF, modality of delivery, institutions/stakeholders involved, monitoring mechanisms, and other factors that supported implementation of the schemes. We noted any shortfalls or challenges in funding and implementation to inform our checklist of questions for the KIIs.

Figure 5 | **National and state policies reviewed for the study**

NATIONAL POLICIES AND SCHEMES

- National Agroforestry Policy, 2014
- Rainfed Area Development under National Mission for Sustainable Agriculture, 2010
- Sub-mission on Agroforestry under National Mission for Sustainable Agriculture (NMSA), 2016
- The Mahatma Gandhi National Rural Employment Guarantee Act, 2005
- Biological Diversity Act, 2002
- National Mission for a Green India, 2014
- Rashtriya Krishi Vikas Yojana, 2007
- Pradhan Mantri Krishi Sinchai Yojana (PMKSY), 2015
- National Rural Livelihoods Mission, 2011
- National Bamboo Mission, 2018 (restructured)
- Mission for Integrated Development of Horticulture (MIDH), 2014
- National Clean Air Programme, 2019
- Green Highways (Plantation & Maintenance) Policy, 2015
- Nagar Van Scheme, 2020
- Weather Based Crop Insurance Scheme (WBCIS)
- Coconut Palm Insurance Scheme (CPIS)

STATE POLICIES AND SCHEMES

Gujarat
- Rehabilitation of Degraded Farm Land (RDFL)
- Adivasi Vruksh Kheti Yojana
- Strip plantation
- Gram van
- Saurashtra Felling of Trees (Infliction of Punishment) Act, 1951

Karnataka
- Raising of seedlings for public distribution
- Maguvigondu Mara Salegondu Vana (A sapling for each child and a forest for each school)
- Krushi Aranya Protsaha Yojana
- Karnataka Preservation of Trees Act, 1976
- Karnataka Forest Rules, 1969
- Karnataka Raitha Suraksha Pradhan Mantri Fasal Bima Yojana (KRS-PMFBY)

Maharashtra
- Kanya Van Samriddhi Yojana
- Atal Bamboo Samruddhi Yojana
- Bhausaheb Fundkar Horticulture Scheme
- Green Maharashtra Mission
- Maharashtra Felling of Trees (Regulation) Act, 1964
- Maharashtra Forest Rules, 2014
- Maharashtra Project on Climate Resilient Agriculture (PoCRA)

Odisha
- Agroforestry Scheme
- Avenue Plantation
- Urban Tree Plantation
- The Orissa Timber and Other Forest Produce Transit Rules, 1980
- Horticulture schemes

Punjab
- Ghar Ghar Hariyali Scheme
- Greening Punjab Mission
- The Punjab Regulation of Wood Based Industries Rules, 2019
- Horticulture schemes

Telangana
- Telanganaku Haritha Haram
- Telangana Forest Produce Transit Rules 1970 (Notification dated Dt.14.02.2018 [G.O.Ms.No.10])
- Horticulture schemes

Source: WRI India authors.

Table 1 | **Policy Instruments and Modality of Delivery of Incentives**

	PROVISION	JUSTIFICATION/REMARKS
Monetary instruments	Subsidies	Subsidy for planting material
		Infrastructure subsidy
	Performance dased payments	Payments based on survival rate of saplings
	Grants	Grants to farmers/farmer groups for taking up ToF
	Credit	Credit-linked back-ended subsidy
		Credit-linked loans
	Benefit-sharing	Benefit-sharing agreements
	Minimum support price (MSP)	MSP for ToF produce
Non-monetary instruments	Insurance	Tree insurance for ToF systems
		Insurance for coconut and horticulture species
	Supply chain infrastructure	Cold storage for horticulture produce and bamboo
	Regulatory incentive	Relaxation of transit permits
		Relaxation of felling regulations
		Permissions/Permits for harvest and transport
	Technical assistance	Capacity-building, technical capacity for planning ToF systems, awareness building on policies/incentives
		Extension services

Note: ToF = Trees outside forests.
Source: WRI India authors.

Types of incentives for ToF: From the review of policy documents, we identified seven types of monetary and three types of nonmonetary incentives embedded at the national and state levels for supporting expansion of ToF. A few incentives such as minimum support price (MSP), insurance, and supply chain infrastructure are available only for limited commercial ToF produce such as coconuts and select horticulture produce. This nuance is highlighted in the Key Findings section below. Table 1 provides a snapshot of the policy instruments and the modality of delivery of different policy incentives.
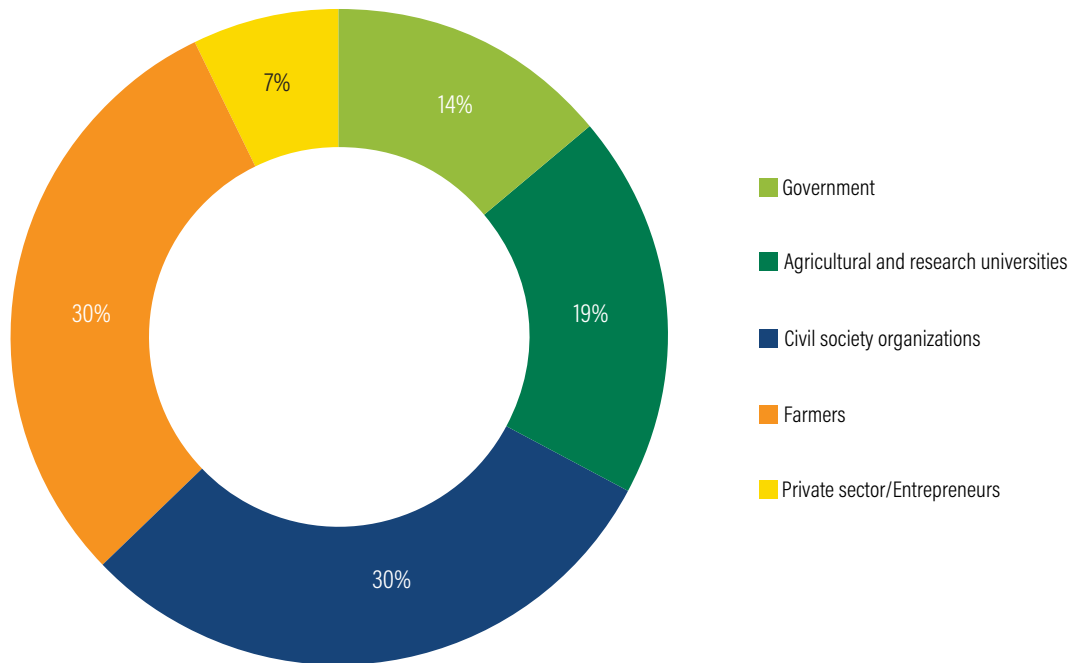
2.3 Key informant interviews

We interviewed key stakeholders from the six states, as well as experts and practitioners from other states working on innovative ToF projects (list of interviewees in Appendix F). In these interviews, we focused on understanding their experience in implementing various ToF-related schemes and in the availing of ToF incentives, best practices, and success factors that could be scaled, and challenges in the implementing or availing of ToF incentives. The checklist/outline of these semi-structured interviews is provided in Appendix G.

We interviewed 43 stakeholders from different sectors (see Figure 6). This included officials from the state nodal agency for SMAF; Forest Department officials; Horticulture Department officials; Bamboo Mission officials; researchers from research organizations, state agriculture universities, and the Central Agroforestry Research Institute–Indian Council of Agricultural Research (CAFRI-ICAR); NGOs working closely with farmers for implementation of interventions; farmers implementing ToF systems, particularly agroforestry; and entrepreneurs involved in agroforestry and restoration businesses (See Figure 6).

Figure 6 | **Institutional Affiliation of Stakeholders Consulted**

Legend:
- Government — 14%
- Agricultural and research universities — 19%
- Civil society organizations — 30%
- Farmers — 30%
- Private sector/Entrepreneurs — 7%

Source: WRI India authors.

3. LIMITATIONS OF THE STUDY

We used the best publicly available and accessible data for this study and engaged with key stakeholders to corroborate findings and address gaps. The challenges we faced can be broadly divided into three categories— data gaps, challenges in analyzing on-ground impact of policies/schemes, and pandemic-related disruptions.

Data on implementation of policies/schemes such as activities conducted, area covered, funds utilized, targets achieved, and beneficiaries are not uniformly available and/or accessible across states. We used the allocation, release, and utilization of funds from SMAF as a proxy indicator to analyze the implementation progress of SMAF. We obtained SMAF fund details from the publicly available database maintained by the National Mission on Sustainable Agriculture (NMSA). Though the database is updated regularly, the information is incomplete if states are unable to submit data on time.

The sparse data that are currently available and accessible are not suitable for analyzing the impact of ToF policies/schemes or their socioeconomic benefits to local communities. One of the biggest challenges we faced with analyzing the "impact" of SMAF and other policies/schemes, is the lack of data on the increase in ToF since the year of implementation. The Forest Survey of India (FSI) analyzed the extent of ToF for the first
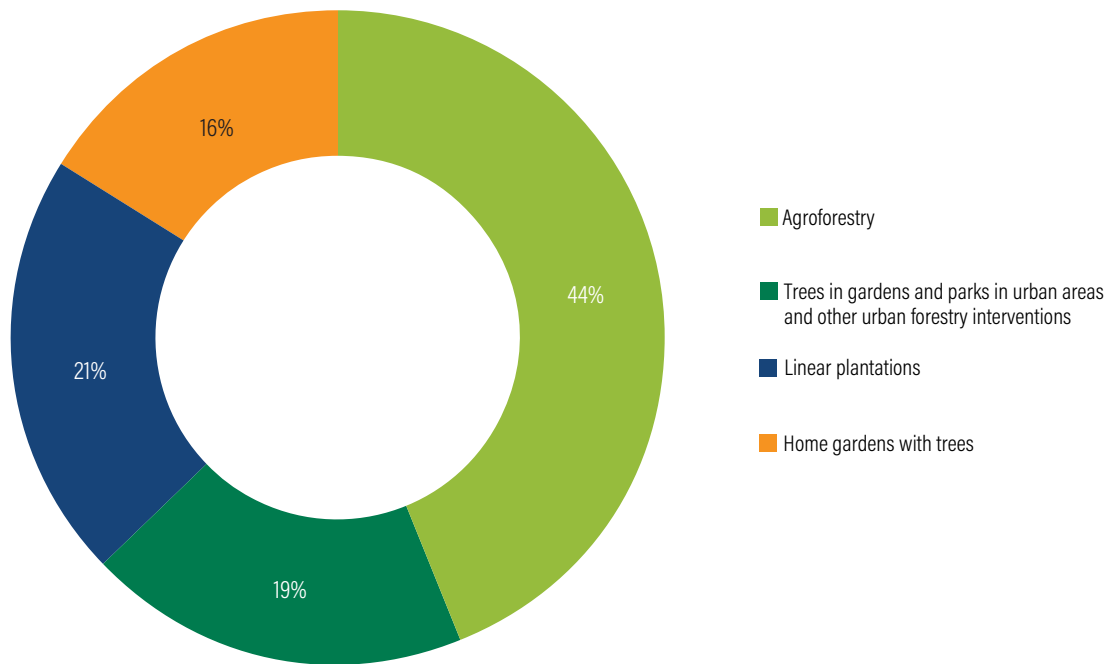
time in 2019. However, comparable data from previous years are not available to assess the temporal change in ToF vis-à-vis implementation of ToF policies/schemes. A causal connect cannot be made between the extent of ToF from FSI 2019 and the implementation of schemes. For schemes such as SMAF and NBM, information on beneficiaries is restricted only to the number of beneficiaries and does not include details on the type of socioeconomic benefits obtained.

Due to COVID-19-related travel restrictions, stakeholder interviews were conducted virtually over zoom and telephone. Interviews with farmers were supported by our partners. Action for Social Advancement (ASA) conducted interviews with farmers in Gujarat, Maharashtra, and Odisha. For Telangana, case studies featuring interviews with farmers practicing agroforestry were shared by the Centre for People's Forestry. In Karnataka, the Institution of Agroforestry Farmers and Technologists (IAFT) helped in reaching out to farmers.

4. KEY FINDINGS

In this section, we present findings from the different types of policy incentives that exist for ToF as well as a comparative analysis of the experience of the six states in their implementation of policies/schemes and incentives (see Appendix D, Tables D1 and D2).

Figure 7 | **Types of Trees outside Forest Systems Supported by Reviewed Policies/Schemes**

- Agroforestry
- Trees in gardens and parks in urban areas and other urban forestry interventions
- Linear plantations
- Home gardens with trees

Source: Compiled from the reviewed policy documents by WRI India authors.

## 4.1 Overview of objectives and scope of the policies/schemes

ToF systems supported by policies/schemes: The policies/schemes we reviewed support a range of ToF systems such as agroforestry; linear plantations along roads, canals, and rivers; home gardens with trees; trees in parks and gardens in urban areas; and other urban forestry interventions. The agroforestry interventions included trees on bunds and boundaries, agri-horti-forestry, and monoculture and mixed-species plantations in private and public lands outside of Recorded Forest Areas (RFAs) through block plantation, farm forestry, and fruit orchards. Agroforestry emerged as the most supported ToF system, followed by linear plantations (see Figure 7). Notably, we observed that protection of traditional ToF systems did not feature in the policies/schemes.

Stated objectives: The key goals, priorities, and objectives envisaged in policies/schemes that were identified through a review of the policy documents are outlined in Figure 8. The size of the cell indicates the number of times a particular goal is highlighted in the policy/scheme.

As evidenced in Figure 8, the expansion of tree cover outside forests and livelihood security emerged as the

Figure 8 | **Intended Goals of Policies/Schemes for Expanding Trees outside of Forests in India**
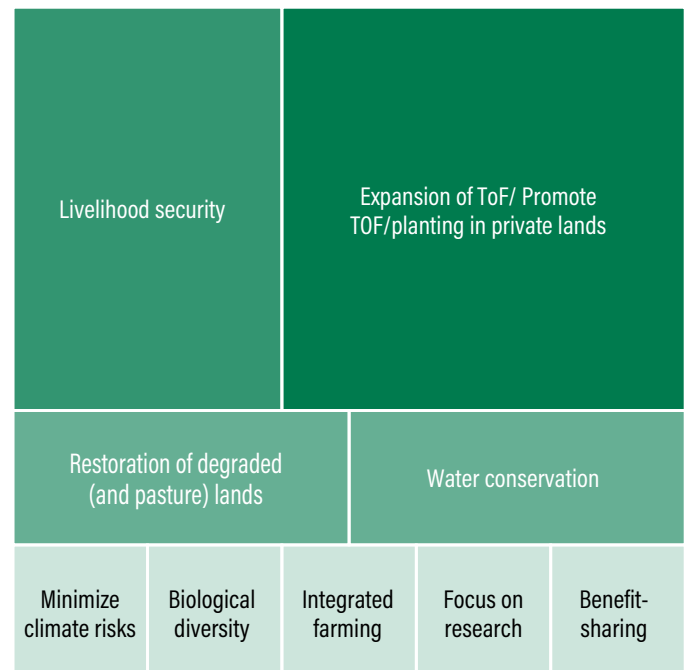
Note: The size of the cell indicates the number of times a particular goal is highlighted in the policy/scheme.
Source: WRI India authors.

key goals of ToF policies/schemes, followed by the restoration of degraded lands and water conservation. It is interesting to note that integrated farming was mentioned only once. The "landscape approach" to planning and implementing ToF was not mentioned in the reviewed policies/schemes and is a major gap. In the absence of a landscape approach, these policies/schemes fail to provide multiple benefits or to integrate a variety of stakeholders in the planning process. Moreover, we observed that emphasis on gender aspects is also lacking.

4.2 Overview of implementation experience of SMAF across the six states
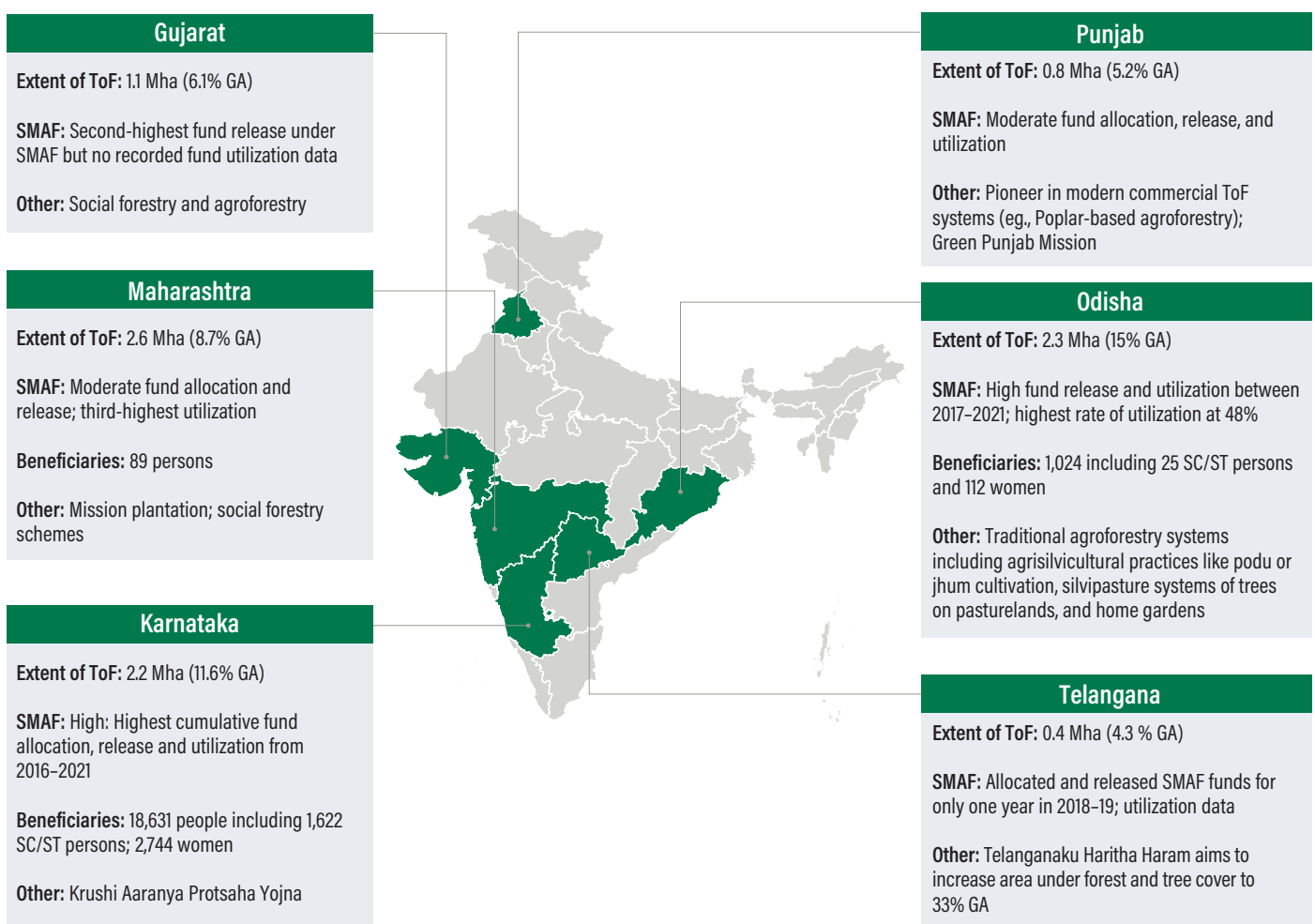
Analysis of policy incentives and budgets (2016–2020) shows that the implementation modalities vary across the six states (see Figure 9). The first year of

implementation of SMAF is taken as the year in which the states enacted the necessary relaxations in transit regulation. In four of the states selected for this study, the Forest Department is the nodal agency for implementation of SMAF. In Telangana and Odisha, the Horticulture Department and the Agriculture and Farmers' Empowerment Department are the nodal departments, respectively.

4.3 Comparative analysis of monetary and nonmonetary incentives

An overview of key monetary and nonmonetary incentives being implemented in the six states through the reviewed ToF policies/schemes is outlined in Table 2. While most states have monetary and nonmonetary incentives for ToF, the implementation modalities are varied. We examine these at length in the next few subsections.

Figure 9 | **Overview of States**

Gujarat
Extent of ToF: 1.1 Mha (6.1% GA)

SMAF: Second-highest fund release under SMAF but no recorded fund utilization data

Other: Social forestry and agroforestry

Maharashtra
Extent of ToF: 2.6 Mha (8.7% GA)

SMAF: Moderate fund allocation and release; third-highest utilization

Beneficiaries: 89 persons

Other: Mission plantation; social forestry schemes

Karnataka
Extent of ToF: 2.2 Mha (11.6% GA)

SMAF: High: Highest cumulative fund allocation, release and utilization from 2016–2021

Beneficiaries: 18,631 people including 1,622 SC/ST persons; 2,744 women

Other: Krushi Aaranya Protsaha Yojna

Punjab
Extent of ToF: 0.8 Mha (5.2% GA)

SMAF: Moderate fund allocation, release, and utilization

Other: Pioneer in modern commercial ToF systems (eg., Poplar-based agroforestry); Green Punjab Mission

Odisha
Extent of ToF: 2.3 Mha (15% GA)

SMAF: High fund release and utilization between 2017–2021; highest rate of utilization at 48%

Beneficiaries: 1,024 including 25 SC/ST persons and 112 women

Other: Traditional agroforestry systems including agrisilvicultural practices like podu or jhum cultivation, silvipasture systems of trees on pasturelands, and home gardens

Telangana
Extent of ToF: 0.4 Mha (4.3 % GA)

SMAF: Allocated and released SMAF funds for only one year in 2018–19; utilization data

Other: Telanganaku Haritha Haram aims to increase area under forest and tree cover to 33% GA

Source: WRI India authors.
Map not to scale.

Table 2 | **Overview of Monetary and Nonmonetary Instruments in Six States**

	KARNATAKA	TELANGANA	PUNJAB	MAHARASHTRA	ODISHA	GUJARAT
Monetary instruments						
Subsidies	✓	✓	✓	✓	✓	✓
Performance-based incentives	✓	✓	✓	✓	✓	✓
Grants	✓	✓	✓	✓	✓	✓
Credit	✓	✓	✓	✓	✓	✓
Benefit-sharing	NA	✓	NA	NA	NA	NA
Tree insurance for ToF	✕	✕	✕	✕	✕	✕
Tree insurance for commercial horticulture produce and coconut palms	✓	✕	✕	✓ / ✕	✕	✕
Minimum support price (MSP) for coconut palm	✓	✓	✕	✓	✓	✓
MSP for ToF produce	✕	✕	✕	✕	✕	✕
Nonmonetary instruments						
Supply chain insfrastructure for horticulture produce and bamboo	✓	✓	✓	✓	✓	✓
Supply chain infrastructure for other ToF produce	✕	✕	✕	✕	✕	✕
Regulatory incentives	✓	✓	✓	✓	✓	✓
Extension services and technical assistance	✓	✓	✓	✓	✓	✓

✓ Applicable   ✕ Not available
Source: WRI India authors.

4.3.1 Overview of subsidies across the six states

One of the most common monetary incentives across the six states is the input subsidy for seeds/saplings and the subsidy for infrastructure such as greenhouses and vermicomposting[11] units. These incentives support ToF systems like agroforestry, monoculture or mixed-species plantations outside RFAs, and fruit orchards (see Table 3).

Further details of state-wise input subsidies are provided in Appendix I.

4.3.2 Performance-based incentives

Many states provide support to farmers for protecting and maintaining saplings for the first three years in the form of direct cash payments/transfers based on surviving saplings. Survival rates are monitored manually through site visits. This incentive is applicable to agroforestry interventions such as trees on bunds and alley cropping, among others, and monoculture and mixed-species plantations outside RFAs. The SMAF allows states to provide performance-based subsidies covering 50 percent of total plantation costs

Table 3 | Input Subsidies

INCENTIVES	GUJARAT	KARNATAKA	MAHARASHTRA	ODISHA	PUNJAB	TELANGANA
Subsidies for saplings	Free saplings provided to farmers through Forest Department schemes such as Rehabilitation of Degraded Farm Land (RDFL), Environmental Plantation, and Gram Van Saplings at nominal cost provided to all interested persons under Van Mahotsav	Free saplings to farmers for agroforestry and/or plantation outside RFA under the Krushi Aaranya Protsaha Yojana (KAPY) and State Bamboo Mission (SBM) 50–80% subsidy for saplings provided to all interested persons for planting trees under the "Raising of seedlings for public distribution" scheme of the Forest Department	Free saplings to farmers under agroforestry scheme of forest department, Kanya Van Samriddhi Yojana, Project on Climate Resilient Agriculture (POCRA), Bhausaheb Fundkar Horticulture Scheme Free saplings and saplings at nominal cost under the Mission Plantation program 50–80% subsidy for bamboo saplings under Atal Bamboo Samrudhi Yojana	75% subsidy on planting material under Horticulture Department schemes and SBM	Free saplings to farmers and other persons under Ghar Ghar Hariyali scheme, Greening Punjab Mission, Punjab Bamboo and Fiber Development Board	Free saplings of preferred species given to farmers under schemes of the Horticulture Department and SBM Free saplings provided to all interested persons under the Telangana ku Haritha Haram (THH)
Subsidy for land development	Forest Department supports farmers with land development at no cost	Convergence with the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) to cover wages related to pitting and trenching of land	Convergence with MGNREGS to cover wages related to pitting and trenching of land	Schemes of Horticulture Department provide support for digging pits and trenches and planting saplings	Convergence with MGNREGS to cover wages related to pitting and trenching of land	Schemes of Horticulture Department provide support for digging pits, trenches and planting saplings Convergence with MGNREGS
Subsidy for building infrastructure	Subsidy for infrastructure under RADP	Subsidy for setting up infrastructure including greenhouse, water recharge structures under the Rainfed Area Development Programme (RADP)	Subsidy for infrastructure under RADP Subsidy for irrigation (farm ponds) and infrastructure under PoCRA	Subsidy for infrastructure under RADP	Subsidy for infrastructure under horticulture scheme	Subsidy for infrastructure under RADP

Note: RFA = Recorded Forest Area.
Source: Parliament, Lok Sabha 2021b; PCCF (SF) Maharashtra 2020; Government of Maharashtra 2021; APCCF (NFAP and Bamboo Mission) Karnataka 2020; Reddy and Chander 2020; PCCF (HoFF) Punjab 2020; PCCF (SF) Telangana 2020; Rizvi et al. 2020; Horticulture Department, Telangana 2020; PCCF (Dev) Karnataka 2020; Sahoo 2020; Directorate of Horticulture Odisha n.d; Gujarat Forest Department n.d. (b).

spread out over the first four years in a 40:20:20:20 pattern of assistance based on survival of saplings. Figure 10 provides details of the implementation of this incentive in six states.

4.3.3 Grants

The grants available for ToF are provided by NABARD's Tribal Development Fund (TDF), the Rashtriya Krishi Vikas Yojana (RKVY) for agroforestry, and the 15th Finance Commission. See Appendix I for further details. NABARD has been instrumental in providing grants for establishing the wadi model of agroforestry (see Figure 11 and Appendix J).

4.3.4 Credit

Among our six selected states, only Gujarat implements a **credit-linked loan** under the Adivasi Vruksh Kheti

Scheme, which incentivizes tribal farmers to adopt plantations of high-value tree crops (see Appendix I). The Punjab Horticulture Department offers a **credit-linked back-ended subsidy** for plantation infrastructure development and for establishment of marketing infrastructure for horticulture produce. These experiences have been difficult to assess due to paucity of data. However, stakeholders consulted from Punjab indicated that the credit-linked back-ended subsidies did not yield good results. There needs to be further examination and assessment to arrive at an understanding of why the state is not seeing the intended result. The National Bamboo Mission (NBM), through financial institutions, provides a credit-linked back-ended subsidy through financial institutions, including banks.[12] We were unable to assess the experience of farmers in the availing of this subsidy due to lack of data across states.

Figure 10 | **Performance-Based Incentives**

GUJARAT	· Direct cash payment of INR 1,400 based on survival rate in 4-year installments (minimum of 50 saplings planted and maintained) · Scheme: SMAF (cash benefits to 121 persons) · Payment for first 3 years based on survival of trees · Scheme: RADL
KARNATAKA	· Direct cash payments to farmers — INR 30 at the end of the 1st year for each surviving sapling; INR 30 after the 2nd year; and INR 40 at the end of 3 years · Schemes: KAPY, SBM · SMAF cash benefits to 10,486 persons
MAHARASHTRA	· SMAF cash benefits to 2 persons
ODISHA	· SMAF cash benefits to 1,693 persons
PUNJAB	· Direct cash payment of INR 50 per sapling for native tree species; and INR 35 per sapling for nonnative or clonal varieties over a period of 4 years · INR 50 per sapling irrespective of species for women and Scheduled Caste beneficiaries · Scheme: SMAF, Greening Punjab Mission · SMAF cash benefits to 2,503 persons
TELANGANA	· Direct cash payment of INR 5 to INR 15 for each surviving sapling per month based on tree species for 3 years · Schemes: THH and Sustainable Management of Tree in Cotton Production in Wetland Forest Ecosystem programs

Note: : INR = Indian rupee; KAPY = Krushi Aranya Protsaha Yojana; SBM = State Bamboo Mission; SMAF = Sub-Mission on Agroforestry; THH = Telanganaku Haritha Haram; RADL = Rehabilitation of Degraded Farm Land.
Source: PCCF (SF) Maharashtra 2020; PCCF (NFAP and Bamboo Mission) Karnataka 2020; PCCF (HoFF) Punjab 2020; Telangana (SF) 2020; Horticulture Department, Telangana 2020;. PCCF (Dev) Karnataka 2020; Sahoo 2020; Directorate of Horticulture Odisha n.d.; Gujarat Forest Department n.d.(b).

Figure 11 | **Grants**

GUJARAT	**NABARD:** 42,000 tribal families; grants totaling INR 1.6 billion **Other:** Catalytic assistance through FC grant
KARNATAKA	**NABARD:** 24,229 tribal families; grants totaling INR 903.5 million **Other:** Catalytic assistance through FC grant
MAHARASHTRA	**NABARD:** 46,624 tribal families; grants totaling INR 1.7 billion **Other:** Catalytic assistance through FC grant
ODISHA	**NABARD:** 45,000 tribal families; grants totaling INR 1.85 billion **Other:** Catalytic assistance through FC grant
PUNJAB	**NABARD:** None **Other:** INR 478 million - Crop Diversion Programme of the Rashtriya Krishi Vikas Yojana (RKVY)
TELANGANA	**NABARD:** 19,846 tribal families, grants totaling INR 841.8 million **Other:** Catalytic assistance through FC grant

Note: : INR = Indian rupee; FC = Finance Commission.
Source: NABARD n.d.; XV Finance Commission 2020; RKVY n.d.

4.3.5 Benefit-sharing

In this area we contended with scarce data on funds available under the National Biodiversity Fund, State Biodiversity Fund, and funds with biodiversity management committees.[13] Details of benefit-sharing agreements and utilization of funds are also sparse, with only the Telangana State Biodiversity Board reporting more than 20 access and benefit-sharing agreements and INR 406,200 received into the State Biodiversity Fund (TSBB n.d.).

4.3.6 Insurance

In Karnataka and Maharashtra, insurance for select annual horticulture crops exists (see Appendix I for further details). There are three insurance companies—United India Insurance, Agriculture Insurance Company of India, and Oriental Insurance Company—that provide tree insurance for agroforestry systems.[14] Our literature review and consultation with stakeholders showed that none of the six states provides or avails of this type of agroforestry tree insurance.

4.3.7 Minimum support price

Among commercial plantation species, minimum support price (MSP) was declared for mature de-husked coconuts for the 2020 season. Earlier, MSP was only available for milling copra (processed and dried coconut used for oil extraction). This made it inaccessible for small and marginal farmers who are unable to hold mature coconuts in storage and have insufficient facility for copra making (MoAFW 2020). MSP is not provided for any other ToF produce—including timber and nontimber produce.

4.3.8 Supply chain infrastructure

Supply chain infrastructure is available for horticulture produce under the Mission for Integrated Development of Horticulture (MIDH) and for bamboo under the NBM (see Figure 12 and Appendix I for further details).

4.3.9 Regulatory incentives

The Ministry of Environment, Forest, and Climate Change (MoEFCC) issued a guideline for relaxing the

Figure 12 | **Supply Chain Infrastructure for the Selected States**

GUJARAT	• 197 cold storage units set up under MIDH • INR 68.7 million given to 1,429 artisans; and 6 Bamboo Clusters formed under NBM
KARNATAKA	• 17 cold storage units set up under the Mission for Integrated Horticulture Development (MIDH) • 1 bamboo bazaar set up under National Bamboo Mission (NBM)
MAHARASHTRA	• INR 104 million provided to 2,250 artisans; 5 bamboo clusters formed; 1 bamboo mandi created (market place and e-trading); and 3 bazaars created under NBM • Information not available on MIDH
ODISHA	• 2 cold storage units set up under MIDH • INR 95 million provided to 2,187 artisans; 3 bamboo rural haats established; and 6 bamboo bazaars created under NBM
PUNJAB	• 37 cold storage units set up under MIDH
TELANGANA	• 8 cold storage units set up under MIDH • INR 31.3 million give to 975 artisans and Chandrugonda Bamboo Cluster formed under the NBM

Note: : INR = Indian rupee; FC = Finance Commission.
Source: NABARD n.d.; XV Finance Commission 2020; RKVY n.d.

Figure 13 | **Regulatory Incentives**

GUJARAT	• Amendments to the Saurashtra Felling of Trees Act (1951) exempted 86 species planted through agroforestry from transit permit and felling regulation. • Eighty six species of trees and bamboo species planted under agroforestry by farmers and not naturally available in neighboring forests are exempted from the transit permit and felling regulation.
KARNATAKA	• Relaxation of restrictions on felling (Karnataka Preservation of Trees Act [1976], and transit of forest products via the Amendment (NO.FEE 15 FAF 98) in Karnataka Forest Rules [1969]). • Change in restrictive regulations over growing and owning sandalwood on private lands. • Exemption of 26 species from felling rules (further, a proposal is there to enlarge this list to include 45 species). Exemption of 42 species from transit rules.
MAHARASHTRA	• Relaxation of restriction on harvest and transit of agroforestry products/timber growing in private lands. • Tree felling permission for only 15 scheduled tree species mentioned in the Maharashtra Felling of Trees (Regulation) Act, 1964. • 17 species of trees have been exempted from transit permit including all species of bamboos.
ODISHA	• Orissa Timber and Other Forest Produce Transit Rules (1980) provide an exemption to more than 10 species grown under farm forestry. • 3 species of bamboo in the whole state and 21 species of other trees are exempted from transit pass.
PUNJAB	• Barring trees growing in foothills, felling and transit permits are not required for any other farm-grown trees (Punjab Forest Produce Transit Rules, 2019). • All agroforestry species exempted from felling. • During stakeholder interviews, it was made known that there are plans for scrapping transit permit rules.
TELANGANA	• Relaxation of harvesting and transit permits through several amendments (last made in 2018) to the Telangana Forest Produce Transit Rules, 1970. • 40 species exempted from felling and transit permissions.

Source: Various felling and transit relaxation rules cited in the table body.

felling and transit process regime for tree species grown on nonforest/private land and advised state governments to exempt popular agroforestry species (GoI 2014).[15] The SMAF also emphasizes relaxation of restrictions and seeks to ensure compliance. Funds from SMAF can be accessed by states only after sufficient relaxation concerning agroforestry farm-grown species are notified.

The MoEFCC exempted farm-grown bamboo and bamboo products from transit permit requirements (MoEFCC 2017). All the states analyzed have enacted legislation to reduce barriers related to felling and transit of farm-grown timber and nontimber produce (Figure 13). Maharashtra, Punjab, and Telangana, in particular, have simplified the process of obtaining permits for felling.

4.3.10 Extension services and technical assistance

All the ToF policies/schemes analyzed included components on technical assistance, research, capacity-building, and/or extension services. Consultations with stakeholders from the states show that uptake of ToF interventions and realization of benefits are enhanced when monetary incentives are supported by and dovetailed with nonmonetary incentives. A few examples are provided in Figure 14.

5. KEY ENABLING CONDITIONS FOR POLICIES/SCHEMES AND INCENTIVES FOR EXPANDING TOF

Our analysis of policy implementation experience in the six states highlighted the following factors or conditions

Figure 14 | **Extension Services and Technical Assistance**

GUJARAT	• Technical capacity-building programs conducted by the Forest Department and Odisha Bamboo Development Agency.
KARNATAKA	• Capacity-building and training for farmers, entrepreneurs, FPCs, and SHGs. YouTube channel run by State Bamboo Mission for bamboo farmers. Extension services through Whatsapp. • The Social Forestry Department has promoted agroforestry through demonstration sites and by showcasing cost-benefit analysis of different agroforestry models.
MAHARASHTRA	• Maharashtra Bamboo Development Board (MBDB) has developed several demonstration plots for training farmers on farming techniques for bamboo. The board also provides artisans and farmers with facility centers with equipment for value addition of bamboo. • Through the centrally sponsored scheme "National Green Corps" the Forest Department supports eco-clubs in schools and other educational institutions.
ODISHA	• Capacity-building for agroforestry uptake under the project "Enabling Smallholders in Odisha to Produce and Consume More Nutritious Food." • Exposure visits arranged by the Department of Agriculture for farmers to view and understand different agroforestry models.
PUNJAB	• Technical capacity-building and extension services through Krishi Vigyan Kendra (KVK).
TELANGANA	• Technical assistance is provided by the Forest Department to farmers and gram panchayats for planting and monitoring seedlings under the Telanganaku Haritha Haram.

Note: : FPC = Farmer producer company; SHG = Self-help group.
Source: Data compiled from multiple sources by WRI India authors: Kothawade 2021; Kora 2021; PCCF (SF) Maharashtra 2020; APCCF (NFAP and Bamboo Mission) Karnataka 2020; PCCF (HoFF) Punjab 2020; PCCF (SF) Telangana 2020; Rizvi et al. 2020; Horticulture Department, Telangana 2020; PCCF (Dev) Karnataka 2020; Sahoo 2020; Directorate of Horticulture Odisha n.d; Gujarat Forest Department n.d.(a).

that underpinned effective implementation and promoted uptake of ToF systems such as agroforestry.

5.1 Political and bureaucratic will

The states' political and bureaucratic commitment to increasing tree cover is a key factor in encouraging farmers and other stakeholders to adopt ToF. States including Telangana and Maharashtra are implementing massive schemes such as the Telanganaku Haritha Haram (THH) and Mission Plantation, respectively, which emphasize ToF (GoT n.d; Maharashtra Forest Department n.d.). Similarly, Punjab has accelerated its efforts to increase tree cover by linking tree-based restoration with the celebration of anniversaries of religious icons.[16] Other states such as Karnataka have flagship missions like the KAPY to support agroforestry. Such schemes have showcased pathways in which different government departments such as forests, agriculture, horticulture, tribal welfare, water, and rural development can work together for achieving ToF goals. There are concerns over the myopic focus of such schemes on tree plantation without an emphasis on following ecological principles in planning. We explore these concerns in the next section.

5.2 Convergence of state-level schemes with other national schemes/policies

The state-level ToF schemes have successfully dovetailed funds from other national policies/schemes such as the MGNREGS. In Karnataka, implementation of KAPY converges funds from the MGNREGS and the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY). Schemes in Telangana also leverage MGNREGS for covering charges related to pitting, planting, and setting-up of nurseries. In Maharashtra, different departments including the Agriculture Department used MGNREGS funds to complete activities for Mission Plantation (PCCF [SF] Maharashtra 2020). Punjab, Gujarat, and Odisha also leveraged MGNREGS for ToF activities.

5.3 Decentralizing and farmer-focused implementation of ToF

Several states have decentralized the implementation of ToF schemes to the panchayat level to ensure healthy survival rates and flow of benefits directly to local communities.[17] For instance, in Telangana, as per the amendment made to Telangana Panchayat Raj Act 2018, gram panchayats are accountable for maintaining at

least 85 percent survival of the plantations in each village. The Karnataka State Bamboo Mission conducts consultations with farmers to identify areas where paddy cultivation has become uneconomical and lands that have turned alkaline due to continuous cultivation of sugarcane. This approach has ensured sustained interest from farmers, along with ecological restoration of degraded areas (APCCF [NFAP and Bamboo Mission] Karnataka 2020). All the states reported some type of process for farmers to register with the responsible department (usually the Forest Department) for their desired tree species for seed and sapling production. Government officials reported higher survival rates when farmers are allowed to choose their preferred tree species.

5.4 Partnership with nongovernmental organizations

State governments and other government institutions have partnered with NGOs for building capacity and supporting farmers to successfully avail of policy incentives. In Telangana, under the Sustainable Management of Tree in Cotton Production in Wetland Forest Ecosystem project, farmers were supported with planting of saplings and site preparation by the NGO, the Centre for People's Forestry (CPF 2020).[18] The wadi model spearheaded by NABARD is an important example that highlights the role of NGOs in capacity-building and extension support. This is a vital resource, especially in terms of selection of the most appropriate agroforestry model and in the organization of farmers into farmer groups or self-help groups (SHGs) (Brockington et al. 2016).

5.5 Role of research institutions

State agriculture universities conduct research and demonstrate different agroforestry models to identify economically viable models that can be scaled to farmers. The Navsari Agricultural University (NAU) in Gujarat, for instance, has developed 17 agroforestry models and techniques, of which five to six have been adopted by farmers (Tandel 2020). In Odisha, the World Agroforestry Centre (ICRAF) implemented different agroforestry systems to improve nutritional security and water availability for local communities in partnership with the state government[19] (Rizvi et al. 2020). State agriculture universities and other research organizations often collaborate with the Indian Council of Agricultural Research–Central Agroforestry Research Institute (ICAR-CAFRI), which has 37 centers across

India. CAFRI has developed over 50 agroforestry models based on the agroclimatic regions. It has also developed a "FarmTree" app that provides information on 20 agroforestry tree species and their management practices (Ram 2020).[20]

5.6 Established value chains and private sector partnerships

ToF systems can be most effectively sustained in areas with established links to markets or the industry. For instance, the Karnataka State Bamboo Mission has made efforts to revive bamboo value chains by establishing holistic linkages. In the past, farmers moved away from bamboo plantations due to dwindling demand for bamboo, compounded by the migration of bamboo artisans toward other employment opportunities. The State Bamboo Mission set up nurseries for supplying planting material, rehabilitated bamboo artisans, linked farmers with artisans, and established common processing centers to revitalize the entire value chain (APCCF [NFAP and Bamboo Mission] Karnataka 2020).[21]

The private sector plays an important role in supporting farmers through technical capacity-building, value chains development, and linkages for an improved market environment.[22] Some farmers have also entered into buy-back arrangements with mills, ensuring sustained markets for their produce (Tandel 2020).

5.7 Innovative business models around ToF

Innovative private business models exist, such as Araku Coffee. Naandi Foundation supported tribal communities with financial, technical, and market linkages in the Araku Valley to establish agroforestry systems with coffee and horticulture trees to rehabilitate the land and strengthen the livelihood of the communities (Naandi Foundation n.d.). Surat-based company Sparkle manufactures sanitary pads from locally sourced bamboo, banana fibre, and corn starch, thus supporting farmers with extra income (Sparkle n.d.). Another example is Black Baza Coffee, which is sustainably produced (see Appendix K).

5.8 Monitoring

Expanding ToF requires not only the uptake of interventions but ensuring the survival and proper maintenance of trees. The six states had mechanisms in place for the respective governments to monitor the progress of restoration and/or expansion. For instance,

as part of its Mission Plantation, the Maharashtra Forest Department hosts the GPS location and images of planted saplings on its portal. In Telangana, a state-level committee headed by the chief secretary ensures coordination among the different government departments to implement plantation activities and monitor survival rates and outreach (PCCF [SF] Telangana 2020).[23] However, we emphasize that restoration is a long-term process that can lead to many benefits for people and the environment. Monitoring mechanisms need to incorporate inclusive indicators such as biodiversity, water flow, soil health, jobs, and livelihoods in addition to the survival rate of saplings to assess the progress of ToF projects. The states we studied did not have inclusive monitoring mechanisms that involved local communities/citizens or that monitored biophysical and socioeconomic benefits of restoration.

5.9 Interest of farmers to shift to agroforestry systems

Stakeholder interviews with farmers showed they have a strong understanding of the benefits of agroforestry. Farmers in Karnataka cited the resilience of agroforestry systems to drought. Trees on farmlands can check soil erosion, increase soil moisture content, and improve groundwater retention. In rainfed systems, these benefits increase the productivity of the land. Trees also ensure farmers have alternate income sources through the sale of tree produce. This is a key benefit that is significant to farmers in rainfed areas. In Maharashtra, farmers highlighted improvement in microclimate, soil health, erosion control, and the use of trees as field shelterbelts that do not compete with nearby crops. Farmers in Odisha and Gujarat noted improvement in soil health and water quality as key potential benefits. All farmers acknowledged the monetary benefits from trees in the long term. Farmers highlighted training and workshops organized by the Forest Department and/or the Agriculture Department, and peer-to-peer learning as key factors that motivated them to take up agroforestry.

6. BARRIERS THAT IMPEDE THE UPTAKE OF TOF

Our analysis of implementation experience through stakeholder consultations highlighted gaps in existing incentives and the need to design customized incentives to suit local contexts. Several of these gaps arise due to the lack of a landscape approach in planning ToF

activities. The barriers impede effectiveness of ToF policies and incentives.

6.1 Lack of incentives for existing ToF and traditional practices

The policies/schemes we reviewed for this study do not contain incentives for farmers to maintain existing ToF systems, particularly for native trees. The policies/schemes overlook protection and maintenance of healthy ToF, which is a key tenet of the landscape approach. For instance, our interview with a farmer practicing agroforestry in the Dakshina Kannada region (adjacent to the Western Ghats) highlighted the growing changes to this landscape, where farmers are increasingly planting clonal, monoculture trees due to better policy support (Bhatt 2021). Monetary incentives, market linkages, and public-private partnerships are currently focused on setting up new ToF systems with fast-growing clonal species, which disincentivizes maintenance and restoration of native species. These concerns were also seen in Gujarat, Maharashtra, Odisha, and Telangana where plantation schemes prioritize fast-growing species.

6.2 Lack of extension services for supporting farmers

Key stakeholders expressed that there are gaps in extension services, and farmers lack the bundling of practices (land development; planting and maintenance of trees on farmlands; harvesting, processing, and connection to industries or markets) required for managing the tree/crop interface in ToF systems. Krishi Vigyan Kendras (KVKs) support initiatives for improving the agricultural economy of districts and link the National Agriculture Research System with extension system and farmers. KVKs often do not have enough members with agroforestry knowledge, and in the absence of training for KVK workers, they are unable to build capacity and awareness among farmers (ICFRE 2020). A majority of farmers are hesitant to adopt agroforestry since the impact of agroforestry on income in the short and medium terms is difficult to manage. This demotivates farmers and negatively impacts their income.

6.3 Lack of quality planting material and standards

Farmers highlighted the lack of good planting material as a key challenge to practicing agroforestry (More 2021). Despite the focus of states on establishing nurseries for production of quality planting material, we observed continuing challenges with the cost and quality of seedlings.[24] Stakeholders interviewed from the state said farmers procure seedlings from private agencies at high rates, which are not subject to quality control procedures (APCCF [SF] Karnataka 2018). The unregulated nature of private nurseries and use of nonscientific methods for producing planting material was a common thread among our stakeholder interviewers and also in our literature review (CAFRI-ICAR 2019). The incentive structure around input subsidy is also under debate. During stakeholder interviews (both government and NGOs), it emerged that a 100 percent subsidy on planting material is suboptimal and leads to wastage of seedlings. Experience shows that a practice of setting nominal rates for seedlings for public distribution fosters a better sense of ownership among beneficiaries and leads to better results.

6.4 Poor awareness and access to existing policy incentives

Stakeholder interviews showed that though different types of monetary incentives are available in the six states, only input subsidies (particularly subsidies for planting material) emerged as the most widely known and accessible incentive. The input subsidy was availed of by 7 out of 13 farmers interviewed, with others acknowledging the existence of the subsidy. Among other monetary incentives, performance-based cash transfers and MSP were highlighted by farmers as important for scaling agroforestry. However, very few farmers were aware of the specific schemes in their states, and none had accessed these benefits. Farmers were also largely unaware of insurance schemes. In Maharashtra, where insurance was available for horticulture crops, the interviews with farmers growing orange trees showed that the insurance schemes were not feasible for small farmers operating less than 2 ha of land as the payment of premiums is unaffordable for them (Saheb 2021).

6.5 Knowledge gaps on ToF models and tree species

Though many stakeholders are involved in the research on ToF models in the six states, there are two key gaps that prevent effective translation of research into wider adoption on the ground:

■ Experts from research institutions noted that even when ToF models are developed, there are constraints in replication and scaling that are driven by

the absence of seed-to-market considerations and inadequate channels to engage with farmers and guide them through the process.

- There is a knowledge gap on traditional ToF systems practiced in different agroclimatic zones of the country. There is little or no information on the extent of these practices or the status of dependent populations. There are also gaps in understanding of the impact of traditional systems on the flow of ecosystem services and benefits, such as biodiversity conservation; improved soil and water; and improved access to food, fuelwood, fodder, and nontimber forest produce (NTFP).

6.6 Gaps in regulatory environment

Stakeholders in all of the states noted that regulatory bottlenecks deter them from adopting ToF models despite the enabling policies/schemes for scaling ToF (ICFRE 2020; TERI 2020; Sharma et al. 2017). Though there is an emphasis on easing the process of exempting specific tree species from felling/harvest and transit regulations, state-level differences in policy and legal ambiguities create conflicts in transporting farm-grown timber across the state line. There is also ambiguity in differentiating between products (both timber and nontimber) obtained from forest and nonforest areas that are controlled by different permit regimes (Bhushan 2018). For instance, while transit permits are not required for farm-grown bamboo, they are still required for forest-grown bamboo. The differences in the list of exempted timber and NTFP (bark, leaves, flowers, gum, resin, etc.) between states also pose a critical challenge for farmers. Such regulatory intricacies and barriers discourage uptake of ToF by farmers.

6.7 Inadequate attention to land tenure and tree tenure

Studies show that farmers are more likely to adopt and reap benefits from agroforestry if they have long-term, secure tenure to land and access to resources that grow in it (Ahmad et al. 2019). Tree tenure consists of a bundle of rights over trees and their produce, which may be held by different people at different times. In India, various estimates show that nearly 35 percent of India's agricultural land is cultivated by tenant farmers who number an approximate 25 million rural households. They are unable to access benefits, incentives, and services due to legal limitations (Patnaik 2016). This is particularly true in the case of agroforestry, since tenant farmers can neither access incentives/benefits nor claim

ownership of trees due to lack of tree tenure. The National Agroforestry Policy 2014 recognizes secure land tenure and tree tenure for tenant farmers as a necessary condition for farmers to take up agroforestry, given the long gestation period and capital and labor investment needed (GoI 2014). However, the six states, much like the rest of India, have lagged in fulfilling the policy's call for creating an enabling environment backed by legislation for land and tree tenure and developing management information systems for agroforestry with sound land records (GoI 2014).

6.8 Poor consideration around gender and social inclusion

Women are central to ToF systems, especially since they are the primary practitioners of interventions, such as home gardens. For women, low land ownership and lack of recognition as farmers imperils their contribution to ToF. Among the states analyzed, women operated between 1 percent (Punjab) and 22 percent (Telangana) of agricultural lands. Women and other marginal groups, such as Scheduled Caste (SC) and Scheduled Tribe (ST) populations, are heavily dependent on trees for fuelwood, fodder, NTFP models, and food. While several policies/schemes contained incentives for women and Scheduled Caste/Scheduled Tribe populations,[25] there is lack of focus on the differentiated needs of these marginalized populations in terms of tree species preference, subsistence and provisioning needs, and other regulatory services (soil, water, etc.). Our research also showed that ToF in the six states predominantly focused on timber and commercial ToF products. The role of ToF in improving food and nutritional security, especially for women and marginalized sections, has not received adequate attention.

6.9 Lack of an enabling environment in ToF markets

The long gestational period for trees and the absence of safety nets such as minimum support price and insurance deter farmers from adopting ToF systems. Many ToF products (timber and nontimber) suffer from lack of value chains, market linkages, viable business models, and marketing infrastructure for agroforestry produce (ICFRE 2020; Chavan et al. 2015). Consultation with stakeholders and farmers from the six states showed that most of them were dependent on local traders and informal networks for the sale of ToF produce. Even among established wood-based industries, such as furniture, plywood, handicrafts, etc.,

value chains remain informal or "unorganized" (NCCF 2021; Bhatt 2021). This makes it difficult to expand markets and build business models (Gautam 2020).[26]

6.10 Lack of a landscape approach in restoration plans

The large-scale plantation drives by states present ecological and social challenges due to poor landscape considerations, such as the planting of ecologically inappropriate species, saplings replacing naturally occurring shrubs and ground vegetation, poorly planned riverine plantations, and lack of involvement of local communities in planning (Sarfaraz and Shrangi 2020; EJAtlas n.d.). The plantation schemes with a singular focus on tree planting fail to recognize the significance of natural ecosystems such as grasslands, natural open forests, scrublands, and other fragile ecosystems. Our consultations with the NGOs working with farmers also revealed that these plantation schemes often reduce the availability of planting material for farmers (Reddy et al. 2020). Though many state schemes, such as the THH, emphasized the involvement of gram panchayats and local communities, there have been instances of conflict between the Forest Department and local communities, particularly in tribal areas, over land tenure and resource rights (Rupavath 2020).

7. RECOMMENDATIONS

Our findings highlight that states have implemented monetary and nonmonetary incentives in multiple ways. There are best practices that can be adopted by other states; however, there are also critical gaps that need to be addressed to scale ToF to the level envisaged by the schemes/policies. We recommend developing restoration strategies using a landscape approach, reorienting or shifting incentives to suit the local context, and strengthening the enabling environment for strengthening incentives (see Figure 15). Based on our analysis, the following recommendations emerge as pivotal in supporting India's ToF goals.

■ **Develop restoration plans and strategies using a landscape approach at state and district levels** that considers multiple land uses, ecosystem service needs, and priorities of local communities. Decision-makers and planners can use the restoration plans to converge ToF activities under various policies/schemes for multiple benefits, including food security, provisioning of fuelwood/fodder, carbon sequestration, and income generation.

■ There is a need for **designing incentives to protect existing ToF and to promote traditional ToF models with native species**. There is scope to explore incentives such as **payment for ecosystem services** that can motivate farmers to take up these practices.

■ **Improve, standardize, and customize input subsidies, which are the most commonly available and availed of incentive**. The subsidies for planting materials will be successful in increasing uptake of ToF systems if quality controls and standards are established for developing plant-

Figure 15 | **Scaling expansion of trees outside forests in India**

| 1. DEVELOP RESTORATION STRATEGIES USING A LANDSCAPE APPROACH | 2. REORIENT OR SHIFT EXISTING INCENTIVES TO SUIT THE LOCAL CONTEXT | 3. STRENGTHEN THE ENABLING ENVIRONMENT FOR EXISTING INCENTIVES |

ing materials and setting up nurseries. Institutions such as the CAFRI-ICAR, ICRAF, and Tamil Nadu Agricultural University (TNAU) have developed such standards. Additionally, capacity-building for development of **decentralized community-ty-based nurseries** can develop saplings suited to local needs.

- **Provide policy and financial support to NGOs and research institutions to spur ToF uptake**. The study highlights the key role of NGOs and extension workers in bridging the gap between state government departments and on-the-ground practitioners by creating awareness of incentives, supporting farmers to avail of these incentives, and providing technical support for implementation. NABARD's wadi program is a stellar example of modalities to include NGOs in ToF initiatives. **Monetary incentives such as grants can be reoriented to include provisions to involve other partners such as NGOs or research institutions.**

- **Provide incentives such as minimum support price (MSP) for timber and nontimber ToF produce and supply chain infrastructure, which are currently available for only limited commercial and horticulture produce**. There is a need to expand these to include ToF species. For instance, the Tribal Cooperative Marketing Development Federation of India (TRIFED) is implementing the Mechanism for Marketing of Minor Forest Produce through Minimum Support Price (MSP for MFP) and development of a value chain scheme with state government agencies across 21 states of the country (MoTA 2021).[27]

- **Tree insurance for ToF systems needs to be promoted with payment mechanisms that are attractive and viable for farmers**. There are successful models that can be replicated. For instance, TNAU has worked out a model whereby industries with buy-back arrangements with farmers are paying the full amount of the premium on behalf of the farmers (Parthiban 2020).[28]

- **Develop innovative mechanisms for delivering nonmonetary incentives**. There is scope to share research on ToF systems and create or scale dedicated extension services and helplines (within or outside of KVK), particularly for agroforestry in each state. Mobile support services can be offered

to farmers to sustain and benefit from ToF systems (ICFRE 2020; Parthiban 2020). This should be supported through regular **capacity-building, peer-to-peer learning, and technical training** of extension service workers on ToF models and tree species, planting techniques, maintenance activities, harvesting, and value-addition.

- **Devise policy instruments to secure land and tree tenure**. This is fundamental in motivating local actors to implement ToF systems (ICFRE 2020). Similar to the prerequisite of relaxation in timber transit regulations, the government can mandate states to notify of appropriate land and tree tenure rules as per the National Agroforestry Policy 2014 to help farmers access funds from the SMAF and develop modalities to ensure the flow of benefits from ToF to women and tenant farmers.

- **Build innovative business and restoration models**. There are many innovative businesses and entrepreneurs combining livelihoods and welfare of farmers with the successful sale of ToF products. There are interesting examples of incubators and accelerator programs that build capacity and support entrepreneurs to grow their ToF businesses.[29] **Scaling existing incubators and accelerators and improving incentives for restoration entrepreneurs** can galvanize ToF entrepreneurship, business models, and implementation on the ground.

- **Factor the needs of local population, women, and marginalized communities in planning for ToF**. These groups are very often the primary implementers and beneficiaries of ToF expansion. Our consultations and literature review show that women and other marginal groups prioritize native species and diverse tree systems that can provide multiple benefits. Scalable examples such as NABARD's wadi model for small tribal farmers and women-led agroforestry interventions exist. There is a need to integrate these lessons learned to shift or reorient existing incentives to support women, SC/ST, and small/marginal farmers to take up ToF.

- **Strengthen blended finance–private sector models** such as linking of farmers to industries that can procure ToF products; corporate social responsibility (CSR) funds for restoration; and carbon finance and payments for ecosystem services, which in turn can help finance ToF. These blended

finance models can be built by exploring the potential for forming business consortiums (e.g., TNAU Consortium of Industrial Agroforestry), increasing demand for ToF from industries, building capacity for the private sector to invest in ToF, and increasing awareness of consumers on ToF produce. Other pathways such as carbon finance for agroforestry can also be explored to identify gaps from previous experience with such projects and to develop guidelines with strong social and ecological safeguards for future projects.

■ **Develop certification standards to overcome legal conflicts related to transit of farm-grown timber**. This can strengthen accountability and traceability of ToF produce. Certifications for timber from agroforestry using international benchmarking of existing management practices and legal/statutory compliances can provide farmers additional avenues for sustainable timber trading. There are also opportunities to certify nontimber services of ToF systems, including criteria for certification of the flow of ecosystem services such as water, soil health, carbon, and biodiversity can help in achieving the twin objectives of ToF—to improve the livelihoods of local communities and to enhance the environment. There is potential for developing criteria and indicators (C&I) for management of agroforestry systems similar to the C&I available for sustainable management of natural forests in India.

■ **Create inclusive monitoring mechanisms for the progress of ToF interventions along with the flow of benefits, challenges, and success stories**. Comprehensive systems should be evolved that include wider restoration indicators such as improvement in soil, water, biodiversity, and carbon sequestration; and increase income and livelihoods. The use of inclusive monitoring mechanisms that leverage citizen science approaches and involve local communities in the monitoring process can lead to the creation of accurate and accessible data. Including such monitoring strategies in policies and developing platforms to make the information accessible, accurate, and reliable can support scaling of ToF implementation in India and record progress against international climate and development targets.

APPENDIX A. EXPERIENCE IMPLEMENTING THE NATIONAL MISSION FOR A GREEN INDIA AND MAHATMA GANDHI NATIONAL RURAL EMPLOYMENT GUARANTEE SCHEME FOR AGROFORESTRY AND TREES OUTSIDE FORESTS

Implementation experience of **National Mission for a Green India** (GIM) and the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) are important to discuss, given their significance for expansion of trees outside forests (ToF) in India.

As one of the eight missions outlined under the National Action Plan for Climate Change, GIM aims to increase forest cover by 5 million hectares (Mha), improve the quality of existing forest on another 5 Mha of land, enhance ecosystem services, and improve forest-based livelihoods for 3 million households. The activities under GIM include several ToF interventions such as agroforestry; restoration of abandoned mine areas; ravine reclamation; linear plantations along roads, river, bunds, and canals; and restoration of wetlands. GIM became operational in 2015–2016, and until the year 2017–2018, a budget of INR 1.6 billion has been allocated (MoEFCC 2019). Although GIM includes an ambitious climate change mitigation and adaptation plan, the 2018 Parliamentary Committee report outlined the major challenges with GIM, for instance, the inadequate budget allocation. Budget allocation of INR 478 million for 2017–2018 was grossly insufficient compared to the committed liability of FY 2015 and FY 2016 of INR 895 million (MoEFCC 2019). The 2018 Parliamentary Committee emphasized that afforestation done under GIM needs to have a holistic view with focus on multiple ecosystem services, especially biodiversity, water, biomass, and preserving mangroves, wetlands, critical habitats, etc., along with carbon sequestration as a cobenefit. The committee also cautioned against plantations of trees like eucalyptus without considering soil and weather conditions.

The **Mahatma Gandhi National Rural Employment Guarantee Scheme** (MGNREGS) is one of the world's largest social security programs and has been the largest source of public funding, accounting for almost 75 percent of all public finance allocations to forest protection and landscape restoration during 2011–2016 (Chaturvedi et al. 2018). It is a demand-driven wage employment program that provides at least 100 days of guaranteed wage employment in every financial year to every rural household whose adult members volunteer to do unskilled manual work. The potential for MGNREGS to build durable natural assets such as tree-based interventions in private and common lands can be beneficial for improving the productivity of land, soil health, and water, while also providing income and promoting inclusive growth (Sharma and Dadwani 2013). In Bastar, Chhattisgarh, an agro-silvi-horticulture and soil conservation model was undertaken using MGNREGS for activities such as bunding, building a percolation well, planting fruit trees, and planting multipurpose trees on bunds. A major outcome of this effort has been the conservation of 6.4 tonnes (t) of soil per ha, whereas 8 t of soil per ha was recorded in untreated lands (MoRD 2013). MGNREGS was factored into the National Agroforestry Policy 2014, and funds from the scheme have been dovetailed with other schemes, such as the National Horticulture Mission, National Mission for a Green India, Rashtriya Krishi Vikas Yojana, and National Rural Livelihoods Mission to undertake agroforestry and trees outside of forest activities. In the selected states, MGNREGS has been used to fund state policies/schemes such as the Krushi Aaranya Protsaha Yojana in Karnataka, Telanganaku Haritha Haram, Mission Plantation in Maharashtra, Guru Nanak Jayanti plantation activities in Punjab, social forestry in Gujarat, and horticulture interventions in Odisha. Across India, NRM activities of MGNREGS can significantly increase the resilience of rural populations to the impacts of climate change (Steinbach et al. 2020). They can also contribute significantly to climate change mitigation; a study assessing the carbon sequestration potential of MGNREGS activities as a cobenefit estimates that in 2017–2018 works under the scheme sequestered approximately 63 million tonne CO_2e (Ravindranath and Murthy 2018).

# APPENDIX B. GLOBAL EXPERIENCE WITH TOF INCENTIVES

Across the globe there are instances of public incentives to support ToF, including direct subsidies, payments for ecosystem services, credit and grants, reduced tax rates, and regulatory incentives in the form of a reduced legal burden and tenure and resource rights. For instance, France facilitated agroforestry scaling in 2010 through a policy that included agroforestry as a legal agricultural land use qualifying for agricultural subsidies, thereby providing investment support to farmers willing to practice agroforestry on farmlands (Place et al. 2012). To protect and restore strategic water supply regions, the government of Brazil developed payments for ecosystem services (PES) schemes that provide financial incentives to individuals protecting and restoring their privately owned lands (Urzedo et al. 2020). One such scheme—

Conservador das Águas—a watershed PES program, established in 2005, promoted native forest conservation in the Brazilian Atlantic Forest and required participating farmers to make individually defined commitments—mostly related to restoration of natural vegetation in and around springs and riverbanks. The payments, given monthly and spread over four years, were based on the total area of farmers' landholdings and on a reference value defined by the municipal administration (equivalent to ~US$87/hectare/year) in 2009 (Cassola 2010). The Systemas Agroforestales (SAF) PES program introduced in Costa Rica in 2004 was effective in overcoming initial economic and

technical obstacles that made adoption of agroforestry unattractive for smallholders. The participating farmers were required to grow a minimum of 350 trees, and a maximum of 3,500 were allowed per contract. Payments (a total of US$1.30 per tree) were given over the first three years (65 percent in the first year, 20 percent in the second, and 15 percent in the third year), on tree survivorship of 85 percent or more. Farmers reported positive economic benefits in the first couple of years of the program, and it was found that participating farmers also planted substantially more trees and more species thereafter than nonparticipant farmers (Arriagada et al. 2012; Cole 2010).

APPENDIX C. STATE'S SHARE IN TOTAL ALLOCATION, RELEASE, AND UTILIZATION OF FUNDS UNDER SUB-MISSION ON AGROFORESTRY

Figure C1 | Share of States in Total Allocation of the Sub-Mission on Agroforestry, 2016–2021
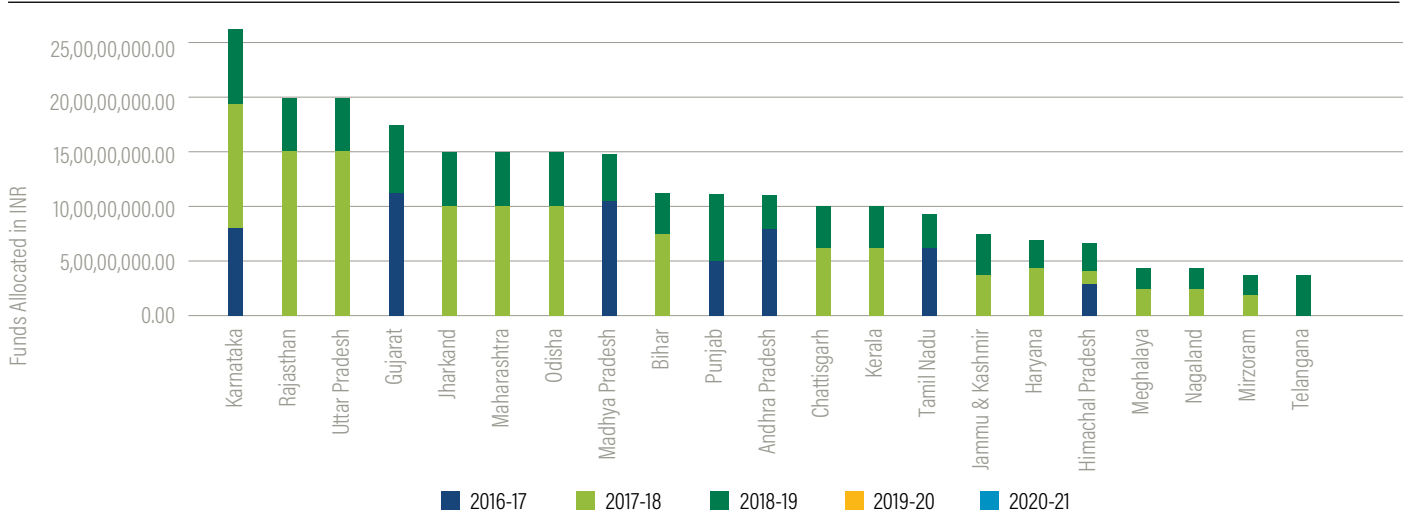
Note: INR = Indian rupee.
Source: National Mission on Sustainable Agriculture n.d.

Figure C2 | Share of States in Total Release of Sub-Mission on Agroforestry, 2016–2021
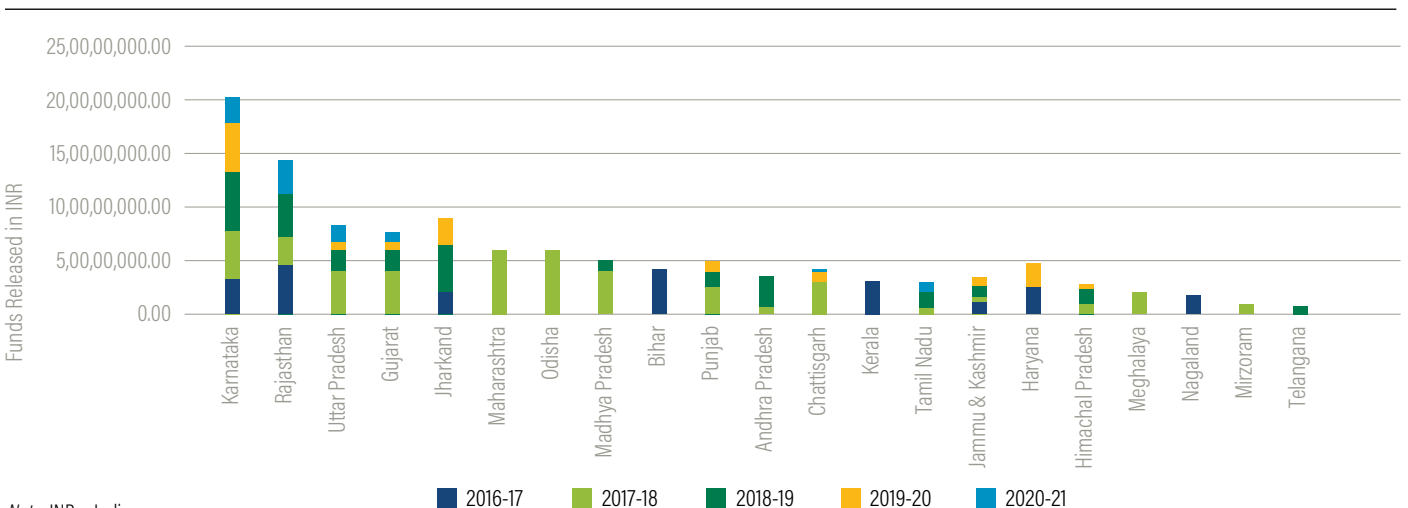
Note: INR = Indian rupee.
Source: National Mission on Sustainable Agriculture n.d.

Figure C3 | **Share of States in Total Utilization of Sub-Mission on Agroforestry, 2016–2021**
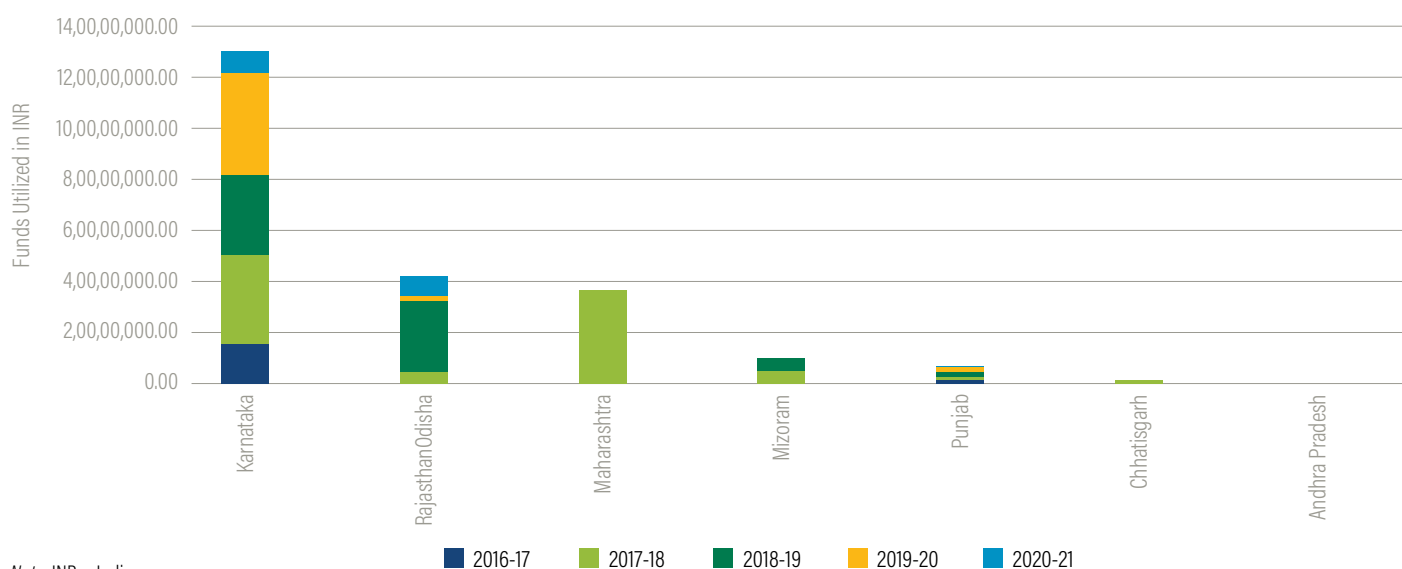
Note: INR = Indian rupee.
Source: National Mission on Sustainable Agriculture n.d.

APPENDIX D. LIST OF NATIONAL AND STATE-LEVEL POLICIES/SCHEMES REVIEWED FOR THE STUDY

Table D1 | **National Policies and Schemes**

NATIONAL POLICIES AND SCHEMES	DESCRIPTION	SOURCE
National Agroforestry Policy, 2014	Setting up a national nodal authority to bring in coordination among different schemes, programs, and policies pertaining to agroforestry spread across diverse sectors of the government to expand tree plantation in complementarity and integrated manner with crops and livestock to improve productivity, employment, and livelihoods of rural households and develop capacity and improve research in agroforestry.	Government of India 2014
Rainfed Area Development under National Mission for Sustainable Agriculture, 2010	Integrated Farming System (IFS) for enhancing productivity and minimizing risks associated with climatic variabilities in rainfed areas.	MoAFW n.d.
Sub-mission on Agroforestry under National Mission for Sustainable Agriculture (NMSA), 2016	The Sub-Mission on Agroforestry (SMAF) under NMSA is an initiative to achieve the goals of the National Agroforestry Policy and its major aim is to expand the tree coverage on farmland in complementary with agricultural crops.	MoAFW 2016
The Mahatma Gandhi National Rural Employment Guarantee Act, 2005	Enhance livelihood security in rural areas by providing at least 100 days of guaranteed wage employment in a financial year, to every household whose adult members volunteer to do unskilled manual work.	Ministry of Rural Development n.d.
Biological Diversity Act, 2002	Conserve Indian biological diversity, regulate access to Indian biological resources, ensure equitable benefit sharing arising from the utilization of those resources	Government of India (GoI) 2002
National Mission for a Green India, 2014	The National Mission for a Green India is one of the eight missions under the National Action Plan on Climate Change and aims to increase forest cover by 5 Mha, improve quality of existing forest on another 5 Mha of land, enhance ecosystem services, and improve forest-based livelihoods for 3 million households.	MOEF n.d.

NATIONAL POLICIES AND SCHEMES	DESCRIPTION	SOURCE
Rashtriya Krishi Vikas Yojana, 2007	Initiated in 2007 as an umbrella scheme for ensuring holistic development of agriculture and allied sectors by allowing states to choose their own agriculture and allied sector development activities as per the district/state agriculture plan. A Centrally Sponsored Scheme that incentivizes States to increase public investment in Agriculture & allied sectors.	MoAFW n.d.
Pradhan Mantri Krishi Sinchai Yojana (PMKSY), 2015	To achieve convergence of investments in irrigation at the field level, expand cultivable area under assured irrigation, improve on-farm water use efficiency to reduce wastage of water, enhance the adoption of precision-irrigation and other water saving technologies, enhance recharge of aquifers and introduce sustainable water conservation practices by exploring the feasibility of reusing treated municipal waste water for peri-urban agriculture and attract greater private investment in precision irrigation system. PMKSY has been formulated amalgamating ongoing schemes viz. Accelerated Irrigation Benefit Programme (AIBP) of the Ministry of Water Resources, River Development & Ganga Rejuvenation (MoWR,RD&GR), Integrated Watershed Management Programme (IWMP) of Department of Land Resources (DoLR) and the On Farm Water Management (OFWM) of Department of Agriculture and Cooperation (DAC).	MoAFW n.d.
National Rural Livelihoods Mission, 2011	Livelihoods promotion through gainful self-employment and skilled wage employment opportunities.	Ministry of Rural Development n.d.
National Bamboo Mission, 2018 (restructured)	Address issues relating to the development of the bamboo industry, with a focus on research and development on bamboo, plantation on forest and non-forest lands and ensuring the supply of quality planting materials.	MoAFW n.d.
Mission for Integrated Development of Horticulture (MIDH), 2014	MIDH is a Centrally Sponsored Scheme for the holistic growth of the horticulture sector covering fruits, vegetables, root & tuber crops, mushrooms, spices, flowers, aromatic plants, coconut, cashew, cocoa and bamboo. Government of India (GOI) contributes 60%, of total outlay in all the states except states in North East and Himalayas, 40% share is contributed by State Governments. In the case of North Eastern States and Himalayan States, GOI contributes 90%.	MoAFW n.d.
National Clean Air Programme, 2019	This national strategy aims to tackle the air pollution problem across the country in a comprehensive manner with targets to achieve 20% to 30% reduction in Particulate Matter concentrations by 2024 keeping 2017 as the base year for the comparison of concentration.	MOEFCC 2019
Green Highways (Plantation & Maintenance) Policy, 2015	Greening of highway corridors across the country to reduce the impact of air pollution by planting trees.	Ministry of Road Transport and Highways n.d.
Nagar Van Scheme, 2020	To develop at least one "City Forest" in each City having Municipal Corporation/ Class I Cities for providing wholesome healthy living environment, and contributing to growth of Smart, Clean, Green, Sustainable and Healthy Cities.	MOEFCC 2020
Weather Based Crop Insurance Scheme (WBCIS)	Aims to mitigate the hardship of the insured farmers against the likelihood of financial loss on account of anticipated crop loss resulting from adverse weather conditions relating to rainfall, temperature, wind, humidity etc. WBCIS uses weather parameters as "proxy" for crop yields in compensating the cultivators for deemed crop losses. Payout structures are developed to the extent of losses deemed to have been suffered using the weather triggers.	Ministry of Agriculture & Farmers Welfare 2016
Coconut Palm Insurance Scheme (CPIS)	A centrally-sponsored scheme with an objective to insure coconut palms against natural and other calamities like cyclone, flood and pest attack. The scheme is applicable to all healthy nut bearing coconut palms; grown as a monocrop or intercropped; on bunds farms or homestead and to all varieties of coconut, including tall, dwarf and hybrids.	Coconut Palm Insurance Scheme 2012

Note: Mha = Million hectares.
Sources: Provided within table.

Table D2 | **State Policies and Schemes**

STATE POLICIES AND SCHEMES		SOURCE
Gujarat		
Rehabilitation of Degraded Farm Land (RDFL)	Private farmlands, especially those with medium to low productivity are selected for tree plantation in block or on the bunds.	Nevase 2016
Adivasi Vruksh Kheti Yojana	Aims at improving the income of tribals through raising teak and other economic species and to improve tree cover. It encourages planting of teak and other economic species on private land in the district and providing it support for maintenance and protection. An assistance of INR 2.5/plant/month is given for 18 years; this subsistence allowance depends on the survival of the plant.	Nevase 2016
Strip plantation	A social forestry scheme that aims to plant trees on land which remained unutilized along roads, railway lines, and canals.	Gujarat Forest Department 2020
Gram van	A social forestry scheme to restore gauchar/pasture lands under Panchayat that have faced soil erosion issues. Upon maturity, the trees grown are auctioned and 75% of the net income (after deduction of expenses) is handed over to the Village Panchayat for use in developmental activities. The remaining 25% amount is deposited in a joint account of Range Forest Officer and Sarpanch, and is utilized for re-plantation activities in the village.	Gujarat Forest Department 2020
Saurashtra Felling of Trees (Infliction of Punishment) Act, 1951	State Act that regulates felling of trees. The Act exempts transit permit and felling restrictions for 86 tree species under agroforestry.	Government of Gujarat 1951
Karnataka		
Raising of seedlings for public distribution	Raising of seedlings for distribution among general public at subsidized rates to plant them in their non-agricultural lands. For this purpose, seedlings of suitable species are raised and kept in the nurseries of the Forest Department.	Government of Karnataka n.d.
Maguvigondu Mara Salegondu Vana (A sapling for each child and a forest for each school)	To create awareness about ecology and environment among school children, seedlings are supplied (by the forest department) free of cost to the school children for planting in their school compounds and in the open space of their residential premises. With the co-ordination of the education department, students from the level of primary schools to colleges all over the state are involved in the tree planting programme.	Government of Karnataka n.d.
Krushi Aranya Protsaha Yojana	A scheme launched in 2011–2012 to encourage afforestation on private and public lands.	Karnataka Forest Department n.d.
Karnataka Preservation of Trees Act, 1976	The Act detail out the restriction on felling of trees and liability for preservation of trees. The Karnataka Preservation of Trees (Amendment) Act, 2014 provided for exemption of more species of trees from felling permission. Currently, 27 species are exempted from felling permissions under this Act.	Government of Karnataka 1976
Karnataka Forest Rules, 1969	The Rules detail out the management of village forests, district forests and private forests, including provisions for felling and removal of trees.	Government of Karnataka n.d.
Karnataka Raitha Suraksha Pradhan Mantri Fasal Bima Yojana (KRS-PMFBY)	Aims to support production in agriculture by providing an affordable crop insurance product to ensure comprehensive risk coverage for farmers' crops against all nonpreventable natural risks from presowing to postharvest.	Government of Karnataka n.d.

STATE POLICIES AND SCHEMES		SOURCE
Maharashtra		
Kanya Van Samriddhi Yojana	Aims to increase the green cover in the state as well as celebrate the birth of a girl child. Farmers are distributed ten saplings (teak and bamboo) and fruit trees on the birth of their girl child.	Government of Maharashtra 2018
Atal Bamboo Samruddhi Yojana	Promote bamboo plantation in agricultural lands that can improve livelihood opportunities and standard of living for farmers.	Government of Maharashtra 2019
Bhausaheb Fundkar Horticulture Scheme	Aimed to promote horticulture plantations and support farmers by providing 100% subsidy on drip-irrigation and planting material.	Government of Maharashtra n.d.
Green Maharashtra Mission	A plantation programme, announced in 2016 with the aim of planting 20 million trees in 2016. To maintain contiguity, the Forest Department in 2017 set the target of plantation of 500 million plantation by 2019 (40 million, 130 million and 330 million saplings in three consecutive years viz. 2017,2018 and 2019).	Government of Maharashtra n.d.
Maharashtra Felling of Trees (Regulation) Act, 1964	State act that governs the felling of trees.	Government of Maharashtra 1964
Maharashtra Forest Rules, 2014	Under Rule 31 of the Maharashtra Forest Rules, 2014, which governs the transit of forest produce, 23 species are exempted from transit pass.	Government of Maharashtra 2014
Maharashtra Project on Climate Resilient Agriculture (PoCRA)	This is a project implemented by the Government of Maharashtra, in partnership with the World Bank in 15 districts of the Marathwada and Vidarbha regions that have been most adversely affected by drought. The project encompasses promoting climate resilient agriculture technologies, investments in creating new assets for increased access to water, diversified cropping system, protected cultivation, and value chain at farm and community level.	Government of Maharashtra 2021
Odisha		
Agroforestry Scheme	Introduced in the year 2013-14 with an aim to increase ToF. Saplings are supplied to the farmers as per their requirement at INR 1/- per sapling. However, the seedlings have been distributed to Government Schools / Educational Institutions and other Public Organizations free of cost.	Government of Odisha n.d.
Avenue Plantation	The scheme is being implemented to create a green belt along the sides of the State's National Highways, State Highways, District & Panchayat roads and urban roads for providing environmental services, shelters during summer and rains and reducing vehicular pollution.	Government of Odisha n.d.
Urban Tree Plantation	Introduced during the year 2007-2008 with an aim to create green pool in crowded urban areas. From the year 2011-12 onwards almost all Urban Local Bodies throughout the State were covered.	Government of Odisha n.d.
The Orissa Timber and Other Forest Produce Transit Rules, 1980	As per Rule 5(1)(J) of Orissa Timber & Other Forest Produce Transit Rules, 1980 schedule III lists 22 species as exempted from timber transit permit.	Government of Odisha 1980
Horticulture schemes	The Directorate of horticulture, Government of Odisha offers schemes to farmers and other practitioner for growing fruit trees.	Directorate of Horticulture Odisha n.d

STATE POLICIES AND SCHEMES		SOURCE
Punjab		
Ghar Ghar Hariyali Scheme	A state campaign to ensure clean and fresh air as well as contribute towards having a green and clean environment. Under the scheme, every citizen of the state would get three and every household 10-15 saplings of varied types free of cost.	Directorate of Information and Public Relations, Punjab, India n.d.
Greening Punjab Mission	Launched in 2012, to increase its forest cover of the state to 15 per cent, by growing 400 million tree saplings by 2020.	Punjab Takes Many Initiatives, Including Planting 40 Lakh Saplings under Green Punjab Mission 2015
The Punjab Regulation of Wood Based Industries Rules, 2019	The rule mandates all wood industries to obtain license and register themselves with the Department of Forests and Wildlife Preservation and to establish the source of raw material which is being used for the industry. A green fee shall be levied annually on all wood industries, which will be used for promotion of agro-forestry in the state and to safeguard the interests of the farmers and maintain the tree cover.	Government of Punjab 2019
Horticulture schemes	The department of horticulture, Government of Punjab offers schemes to share technical knowledge, increase awareness, and diversity horticulture crops in the state.	Punjab Department of Horticulture n.d
Telangana		
Telanganaku Haritha Haram	Increasing the tree cover in the state with a thrust in tree planting initiatives in areas under trees outside forests.	Government of Telangana n.d.
Telangana Forest Produce Transit Rules 1970 [Notification dated Dt.14.02.2018 (G.O.Ms.No.10)]	This notification exempts more than 40 tree species from transit permit under Schedule II of Rule 16 of the Telangana Forest Produce Transit Rules, 1970.	Government of Telangana 2018b
Horticulture schemes	The horticulture department of Telangana offers several schemes to help farmers and other practitioners to grow horticulture trees.	Horticulture Department, Telangana 2020

Note: TOF = Trees outside forests.
Source: WRI India authors compiled information from sources named in table.

APPENDIX E. CRITERIA USED FOR THE FRAMEWORK

CRITERIA CAPTURED IN THE FRAMEWORK	DATA TYPE	RATIONALE/EXPLANATION
Policy/act/circular/rule/regulation/notification/letter of intent	Text entry	
Date of enactment	Text entry	Basic policy feature. Provides helpful temporal and jurisdictional anchors for understanding the political economy context.
Enacted by law/notification/ voluntary	Text entry	
Active	Binary (yes/no)	Indicates whether law/policy remains impactful and politically viable.
Executing ministry (center)/ department (state)	Text entry	Provides context on which ministries are involved in implementation.
Provision relevant to agroforestry	Text entry	Provides key elements of the policy design that support planning, implementing, and scaling of agroforestry.
Incentives	Text entry	Identifies the incentives enshrined in the law/policy for agroforestry. The incentives are analyzed under the following categories—financial, policy, market, technical, infrastructural, institutional, political, and developmental incentives.
Barrier/disincentives	Text entry	Identifies disincentives or perverse incentives that impede uptake of agroforestry—administrative market or technical disincentives.
Enforcement mechanism	Text entry	Indicates whether the policy has built-in compliance mechanisms.
Institutional stakeholders	Text entry	Identifies the key stakeholders at the center, state, and district/panchayat levels who are involved in planting and outreach.
Nodal agency/appropriate authority	Text entry	Provides context on the nodal departments or agencies that are in-charge of implementation.
Land use	Drop-down—forest, agriculture, other	Provides context on the type of land uses where this law/policy is applicable.
Land ownership	Drop-down—revenue, forest, community, private	Provides context on the types of lands and stakeholders who are incentivized or prioritized by this law/policy.
Specific geographic target or hectare quantity	Text entry	Identifies focus of the law/policy.
Land tenure/access type	Text entry	Identifies whether the law/policy is applicable only for certain tenure types; provides for recognition of tenure and/or access to resources.
Interventions that the policy/ act/circular/rule/regulation/ notifications/letters of intent support	Text entry	Identifies whether the law/policy prioritizes particular types of interventions, such as trees on boundaries, agri-horti-forestry, linear plantations, block plantations, etc.

CRITERIA CAPTURED IN THE FRAMEWORK	DATA TYPE	RATIONALE/EXPLANATION
Are extension services/public outreach a part of this policy/act/ circular/rules/regulations/notifications/letters of intent	Text entry	Identifies whether the law/policy provides access to extension services, capacity-building, etc.
Identifiable impact from literature review (articles/papers/status reports)	Text entry	Provides context on success stories or impact as detailed in progress reports, newspaper articles, etc.
Management mechanism for products	Binary option—timber/non-timber forest produce	Identifies whether the act has built-in mechanisms for management of usufructs.
Financial outlay	Text/number entry	Provides context on financial outlay for implementation of the law/policy, including details of allocation, release, and utilization.
Specific geographic scope (find relaxation/incentives for certain areas)	Text entry	Identifies whether special provisions are made for specific regions, such as the North East, Hill States, Schedule V and VI areas, etc.
Does the policy/act/circular/rules/regulations/notifications/letters of intent uphold rights of the marginalized sections and women	Binary (yes/no) and text entry	Provides context of any specific focus on women, SC and ST communities, and smallholder farmers.
Source/link to the document(s)	Text entry	List of sources for the information recorded.

Note: SC = Scheduled Caste; ST = Scheduled Tribe.
Source: WRI India authors.

APPENDIX F. LIST OF EXPERTS/STAKEHOLDERS CONSULTED

NO.	NAME	DESIGNATION	AFFILIATION/ORGANIZATION
1.	A.K. Sahoo	Professor	College of Forestry, Odisha University of Agriculture and Technology
2.	A.M. Annaiah	Farmer, Karnataka and Secretary	Institution of Agroforestry Farmers and Technologists
3.	Abhay Sudhir Sonwane	Farmer, Jalgaon, Maharashtra	None
4.	N/A	Additional Principal Chief Conservator of Forests	NFAP—Bamboo Mission, Karnataka Forest Department
5.	Ajith Oraon	Farmer, Odisha	None

NO.	NAME	DESIGNATION	AFFILIATION/ORGANIZATION
6.	Archana Godbole	Director	Applied Environmental Research Foundation
7.	Arshiya Bose	Founder	Black Baza Coffee Private Limited
8.	Arun Mani Dixit	Senior Program Associate	Centre for Environment and Social Concerns
9.	Asha Ram	Scientist	ICAR-CAFRI, Jhansi, Uttar Pradesh
10.	Ashok Liktkar Saheb	Farmer, Amravati, Maharashtra	None
11.	Bariya Dhirsingbhai Dhanabhai	Farmer, Jalgaon, Maharashtra	None
12.	Bhuriya Rajitsinh Sursingbhai	Farmer, Dahod, Gujarat	None
13.	Dashrath Damodar Kothawade	Farmer, Jalgaon, Maharashtra	None
14.	N/A	Deputy Director	Telangana Horticulture Department
15.	Devashree Nayak	Agroforestry and Gender Research Scientist	World Agroforestry Centre (ICRAF)
16.	Dinesh Reddy	Program Director	Foundation for Ecological Security
17.	Dipak Sarmah	President	Institution of Agroforestry Farmers and Technologists
18.	Eswar Reddy	Project Officer	Centre for People's Forestry
19.	Ganapathy Bhatt	Farmer, Mangalore, Karnataka	None
20.	Ishan Agarwal	General Manager	Foundation for Ecological Security
21.	Javed Rizvi	Director, South Asia Program	World Agroforestry Centre (ICRAF)
22.	Jayant Sarnaik	Joint Director	Applied Environmental Research Foundation
23.	Jestin Paul	Director (Operations and Production)	Aadhimalai Pazhanagudiyinar Producer Company Limited (APPCL)
24.	K. Divya	Assistant Professor	Tamil Nadu Agricultural University
25.	K.T. Partibhan	Professor (Forestry) and Head (Agroforestry)	Forest College and Research Institute
26.	Kamlesh Kora	Farmer, Odisha	None

NO.	NAME	DESIGNATION	AFFILIATION/ORGANIZATION
27.	M.B. Tandel	Assistant Professor	Department of Silviculture and Agroforestry, Navsari Agricultural University, Gujarat
28.	Manmohan J. Dobriya	Professor	Rani Lakshmi Bai Central Agricultural University—Silviculture and Agroforestry (UP)
29.	Poorna Chander	Senior Program Officer	Centre for People's Forestry
30.	Pratiti Priyadarshini	Senior Program Manager	Foundation for Ecological Security
31.	N/A	Principal Chief Conservator of Forests (Development)	Karnataka Forest Department
32.	N/A	Principal Chief Conservator of Forests, Head of Forest Force	Department of Forest and Wildlife Preservation, Punjab
33.	N/A	Principal Chief Conservator of Forests, Social Forestry	Maharashtra Forest Department
34.	N/A	Principal Chief Conservator of Forests, Social Forestry	Telangana Forest Department
35.	Pushpa Mankirdia	Farmer, Odisha	None
36.	Rajendra Singh Gautam	Associate Dean	Institute of Livelihood Research and Training
37.	Rawat Hamirbhai Najirbhai	Farmer, Dahod, Gujarat	None
38.	S.C.V. Reddy	Farmer, Karnataka	None
39.	S. Selvanayaki	Assistant Professor (Agribusiness and Financial Management)	Tamil Nadu Agricultural University
40.	S.K. Dhyani	Senior Agroforestry Specialist	World Agroforestry Centre (ICRAF)
41.	Subhash Pandit More	Farmer, Jalgaon, Maharashtra	None
42.	Vijay Pratap Singh Aditya	Chief Executive Officer	Ekgaon
43.	Yogesh Sawant	Program Coordinator	BAIF

Source: WRI India authors.

APPENDIX G. CHECKLIST OF QUESTIONS FOR KEY INFORMANT INTERVIEWS

Checklist of questions used for government officials, civil society organizations, and experts

- What are the major incentives (from schemes, policies, and otherwise) for agroforestry implementation (in specific state)?

- Who are the different types of farmers involved in agroforestry? Please share about the type of institutional development of farmers.

- What are the type of agroforestry practices prevalent (in specific states)?

- Please share the role of extension services (government as well as nongovernment agencies) in supporting agroforestry.

- What is the role of technology in supporting capacity-building and extension for farmers growing trees?

- What are the different monitoring mechanisms that have been used (in the specific state) for agroforestry implementation?
- Please share examples of successful implementation or learning from other states that have been replicated (in the specific state).

- What according to you are the barriers for scaling agroforestry?

Checklist of questions used for farmers

- When did you start/how long have you been practicing agroforestry?

- What motivated you to start agroforestry?

- What type of trees and crops combination do you grow? What is the area under agroforestry?

- Were the combinations based on traditional knowledge? Did you receive any training or capacity-building?

- Have you been availed of any support/incentive/schemes for agroforestry species (e.g., did you receive free saplings or subsidized saplings or payments based on survival rates)?

- Were you able to avail yourself of any credit or loan for practicing agroforestry from any government schemes?

- Did you get the agroforestry system insured?

- Did you receive any support from the private sector (e.g., buy-back arrangements)?

- How do you sell the products from agroforestry (especially timber and nontimber tree produce)?

- How are the products marketed? Is there any MSP for any product?

- What benefits do you get from practicing agroforestry/growing trees on your farm?

- What challenges do you face?

- Do you have any suggestions as to how schemes/policies could support farmers better in uptaking agroforestry? What types of incentives do farmers need?

APPENDIX H. TRADITIONAL AGROFORESTRY SYSTEMS IN SELECT STATES

India has a historical tradition of growing trees on farms and around homes, with an immense diversity in the combinations of tree species grown alongside agricultural crops.

Traditional agroforestry systems may be described as a set of age-old agroforestry customs and practices that are generally devoid of intentional intensified cultivation of agricultural or forage crops and have been practiced across the world with varying structure, function, socioeconomic attributes, and ecological services (Viswanath et al. 2018). Traditional agroforestry systems vary in their structural complexity, species diversity, productive and protective attributes, and also in socioeconomic dimensions. These systems, which are also agricultural biodiversity repositories, provide a unique opportunity to enhance food security, ensure local livelihoods, and adapt to climate change. Examples of traditional ToF, particularly agroforestry, practiced in the six select states are given in Table H1 below.

STATE	TRADITIONAL AGROFORESTRY
Karnataka	Traditional agroforestry systems, with trees grown alongside crops and/or livestock, abound in the Western Ghats region of Karnataka. Plantation agriculture involving coffee (*Coffea* spp.), and spices in association with a wide spectrum of trees, paddy-based cropping systems, coconut (*Cocos nucifera*)-based cropping systems, and homesteads are prevalent (Kumar and Takeuchi 2009). In Malnad regions of Karnataka that fall in the hot, humid ecoregions, betel nut and paddy is a common combination. In the hot semi-arid ecoregion of Karnataka, ficus trees are grown alongside millets, maize, and oil seeds.
Odisha	In Odisha, shifting cultivation has been a traditional form of agroforestry, especially in the districts inhabited by the Scheduled Tribes. Growing multipurpose trees on farmlands and home gardens with a mix of indigenous fodder, fuelwood, and horticulture tree species is also prevalent in the state (Mohapatra et al. 2007).
Maharashtra	In Amravati District of Maharashtra, falling in the hot semi-arid ecoregion, farmers have been growing teak as a major species on farm bunds for decades. While some farmers prefer only teak on the bunds, mixed tree species on the bunds are also prevalent. Other tree species grown on bunds with teak are *Butea monosperma, Wrightia tinctoria, Terminalia bellirica, Diospyros melanoxylon* and *Ailanthus excelsa* (Bhoyar et al. 2016). In the coastal belt of the state, manga bamboo (*Dendrocalamus stocksii*) has been grown extensively by some villages for centuries. The bamboo species is found as scattered clumps in homesteads, as live hedges, and even as compact block plantations (Viswanath et al. 2018).
Gujarat	One of the major agroforestry practices in the state of Gujarat, characterized by hot and arid climate, involves combining *Prosopis cineraria* with other agricultural crops (Jaimini and Tikka 2007).
Punjab	In Punjab, a hot and semi-arid ecological region, farmers have been known to grow native trees—kikar (*Acacia nilotica*) and khair (*Acacia catechu*) as scattered trees on lands for fodder and fuelwood. In farmlands, native species like neem (*Azadirachta indica*) and shisham (*Dalbergia sissoo*) and toon (*Tuna ciliata*) have been commonly grown on bunds of farmlands.
Telangana	In Telangana, characterized by a hot and semi-arid climate, shifting cultivation has been traditionally practiced to grow millets, oilseeds, and pulses, especially in regions dominated by the tribal community. On average, 10–15 different types of species are grown together. In Adilabad region, farmers currently grow vegetables, oilseeds, and pulses together. The practice of growing millets has, however, decreased, and cash crops like cotton have taken over (Kaushal et al. 2016).

Source: Compiled by WRI India authors

APPENDIX I. ADDITIONAL DETAILS ON POLICY INCENTIVES FOR TREES OUTSIDE OF FORESTS IN INDIA

Key subsidies in select states

Gujarat, Karnataka, Maharashtra, Odisha, Punjab, and Telangana are incentivizing farmers by providing free or subsidized saplings under various state schemes, such as the Krushi Aranya Protsaha Yojana (KAPY), Telanganaku Haritha Haram, Greening Punjab Mission, Maharashtra Mission Plantation, and Kanya Van Samriddhi Yojana, among others.

The states are also providing subsidies for development of infrastructure to support ToF systems. For instance, the Rainfed Area Development Programme (RADP) under the National Mission on Sustainable Agriculture has been implemented in five of the selected states (barring Punjab) on almost 61,500 ha of land during 2015–2019. While data on utilization for specific activities under the RADP are not available, RADP provides financial subsidies for building infrastructure, such as setting up of greenhouses, composting, etc., to support agroforestry.

Under Gujarat's Rehabilitation of Degraded Farm Land (RDFL) scheme, private farmlands, especially those with medium to low productivity, are selected for tree plantation in block or on the bunds. The Forest Department undertakes the raising of plants, digging of pits, and planting in the farm at cost (Gujarat Forest Department n.d. [c]). In Telangana, the horticulture scheme covers charges for pitting, planting, and staking saplings (PCCF [SF] Telangana 2020). In Odisha, the Directorate of Horticulture provides financial assistance for construction of vermicompost units and subsidies for drip irrigation (Directorate of Horticulture Odisha n.d.). In Punjab, the State Department of Horticulture covers 50 percent of the cost of rejuvenation/replacement of senile plantation and canopy management, 50 percent subsidy for building water harvesting systems for horticulture, 25 to 50 percent subsidy for building infrastructure and buying equipment (10 percent increase in subsidy for SC, small and marginal farmers, and women) (Punjab Department of Horticulture n.d.). In Maharashtra, the Social Forestry Department, through its agroforestry scheme, provides a 100 percent subsidy to small and marginal farmers for support with land development for integrating trees in their fields (PCCF [SF] Maharashtra 2020).

The National Bamboo Mission (NBM) provides subsidies to farmers, farmer groups, self-help groups (SHGs), and the private sector on a range of activities. These include a 100 percent input subsidy for setting up hi-tech, big and small nurseries; implementing and maintaining high-density bamboo plantations in government, panchayat, and community lands; and block plantations in farmers' fields (land development and planting) (MoAFW n.d. [b]; NMSA n.d.). The Bamboo Mission is operational in five states (excluding Punjab) with varying levels of engagement. For instance, the number of bamboo nurseries that have been built under NBM are as follows: Karnataka (17), Maharashtra (2), and Gujarat (17). There is a paucity of delineated data on state-level activities, uptake of incentives, and utilization of funds under the Bamboo Mission.

Key grants

The grants available for ToF are provided by NABARD's Tribal Development Fund (TDF), the Rashtriya Krishi Vikas Yojana (RKVY) for agroforestry, and the 15th Finance Commission. NABARD has been instrumental in providing grants for establishing the wadi model of agroforestry. NABARD's wadi model is a type of agroforestry system that focuses on planting a combination of fruit and forest trees in lands owned by small and marginal tribal farmers (<5 acres) with value-added layers such as formation of cooperatives, marketing, and food processing. Barring Punjab, NABARD has sanctioned grants for the wadi scheme in each of the other five states. The RKVY under its Crop Diversification Programme offers a financial incentive of INR 10,000 per ha for poplar-based agroforestry systems (INR 5,000 for critical inputs, INR 2,500 for land development, and INR 2,500 for marketing support). It also provides grants for agroforestry.[30] Recently, the 15th Finance Commission of India recommended catalytic assistance to 12 of the most drought-prone states[31] to develop long-term drought mitigation plans to address the challenges posed by successive droughts in the period 2021–2026 (XV Finance Commission 2020). This assistance funds a range of activities that include agroforestry for mitigating droughts, inter alia.

Credit-linked loans

Gujarat is implementing a **credit-linked loan** under the Adivasi Vruksh Kheti Scheme, which incentivizes tribal farmers to plant high-value crops (80 percent teak and 20 percent bamboo, mango, etc.) in 0.2 ha to a maximum of 1.0 ha area. Assistance of INR 2.50 per plant is provided after 9 months for up to 18 years. There is also provision for 20 percent casualty replacement according to survival of plants in year two. The assistance amount

will be recovered when the plantation is harvested (Gujarat Forest Department n.d. [b]).

Insurance

Karnataka provides insurance against loss of income from crop damage for annual horticulture crops such as pomegranate, papaya, mango, and commercial species such as arecanut under the Karnataka Raitha Suraksha Pradhan Mantri Fasal Bima Yojana (KRS-PMFBY) and Weather Based Crop Insurance Scheme (WBCIS). Maharashtra's restructured WBCIS includes horticulture trees such as orange, sweet lime, pomegranate, and guava. Under this scheme farmers pay only 5 percent of the total insurance premium, while the remainder is paid by the central and state governments.

The Coconut Palm Insurance Scheme minimizes the risk to farmers by providing insurance against pests, diseases, and natural calamities in the coconut-producing states of India. Among the six states, this insurance is available in Gujarat, Karnataka, Maharashtra, and Odisha (CDB n.d.). The Coconut Development Board (CDB) covers 50 percent of premium cost, the respective state governments cover 25 percent, and the farmer pays the remaining 25 percent premium.

Supply chain infrastructure

The Mission for Integrated Horticulture Development provides financial assistance to states covering 35 to 50 percent cost for horticulture produce. Activities include on-farm collection and storage units, integrated pack houses for sorting and grading, precooling units, cold storage units, ripening chambers, postharvest storage and treatment facilities for bamboo, and cold storage units for commercial horticulture (RKVY n.d.). These facilities can be used by ToF farmers, farmer producer companies (FPCs), self-help groups (SHGs), and other user groups involved in sale or value-addition of horticulture produce. NBM provides subsidies to farmers, farmer groups, SHGs, and the private sector for bamboo treatment and preservation, processing and value-addition, machineries and equipment for common value-addition facilities, and for skill development (MoAFW n.d. [b]).

The National Bamboo Mission also assists in setting up various product development units, including handicrafts, furniture, bamboo shoots–processing, incense sticks, etc.; 278 such units have been set up in the country. The Ministry of Micro, Small, and Medium Enterprises (MSME) is implementing the Scheme of Fund for Regeneration of Traditional Industries (SFURTI) to organize traditional industries and artisans into clusters to increase their capacity and income. Thirty-six

bamboo-related clusters have been set up in 13 states (Parliament, Lok Sabha 2021b).

## APPENDIX J. WADI FOR TRIBAL DEVELOPMENT AND ECOSYSTEM SERVICES

NABARD has expanded the implementation of the wadi model across India with 772 wadi projects being promoted with grants of INR 20.9 billion to benefit 529,215 tribal families in different parts of the country through various NGOs or implementing partners.

"Wadi," meaning "fruit orchard" in Gujarati, is a type of agroforestry system that focuses on planting a combination of fruit and forest trees in underproductive agricultural lands with value-added layers, such as the formation of cooperative, marketing, and food processing. The BAIF Development Research Foundation, a not-for-profit organization, conceptualized the model and piloted it for the tribal families of Vansda, Gujarat (Ajwani and Sawant n.d.). With community participation and scientific techniques at the heart of the project, wadi envisions sustainable livelihoods, institution-building, environmental sustainability, and community well-being. A key feature of the wadi concept is the empowerment of people through social mobilization and capacity-building to address issues beyond farming (BAIF n.d.). In 2005, NABARD introduced the Tribal Development Fund (TDF) to implement wadi across India by partnering with civil society organizations that act as Project Implementing Agencies (PIAs).

APPENDIX K. BLACK BAZA COFFEE FOR SUSTAINABLE AND BIODIVERSITY-FRIENDLY COFFEE

Black Baza Coffee is a sustainable coffee company based in Karnataka with a vision to enable coffee producers to enjoy secure and stable livelihoods and strengthen coffee farming practices that conserve biodiversity (Black Baza Coffee n.d.). The company works with small and large coffee producers, farmer producer companies, and other user groups that are willing to adopt biodiversity-friendly coffee-growing practices. Integrating native trees in coffee plantations significantly improves soil moisture content; provides shade, especially during severe heat and drought seasons, to the coffee plants; and provides a habitat for birds and bees that help with pollination and can also act as natural pest-control measures (Bose 2020). Given that many coffee growers are small or marginal farmers, Black Baza Coffee has entered into conservation agreements with individual farmers and groups through which they are trained on sustainable coffee practices. The type of restoration intervention and tree species to be planted are selected through a participatory process with the farmers and local communities. Black Baza Coffee has connected with 396 smallholder farmers and, through their long-term pricing strategy, increased procurement price by 56 percent (Black Baza Coffee n.d.). Farmers involved with Black Baza Coffee are conscious of the ecological importance of native trees and are actively developing metrics to monitor biodiversity and other environmental indicators in the long term (Bose 2020).

Figure J1 | **Illustration Showing Typical Wadi Model**
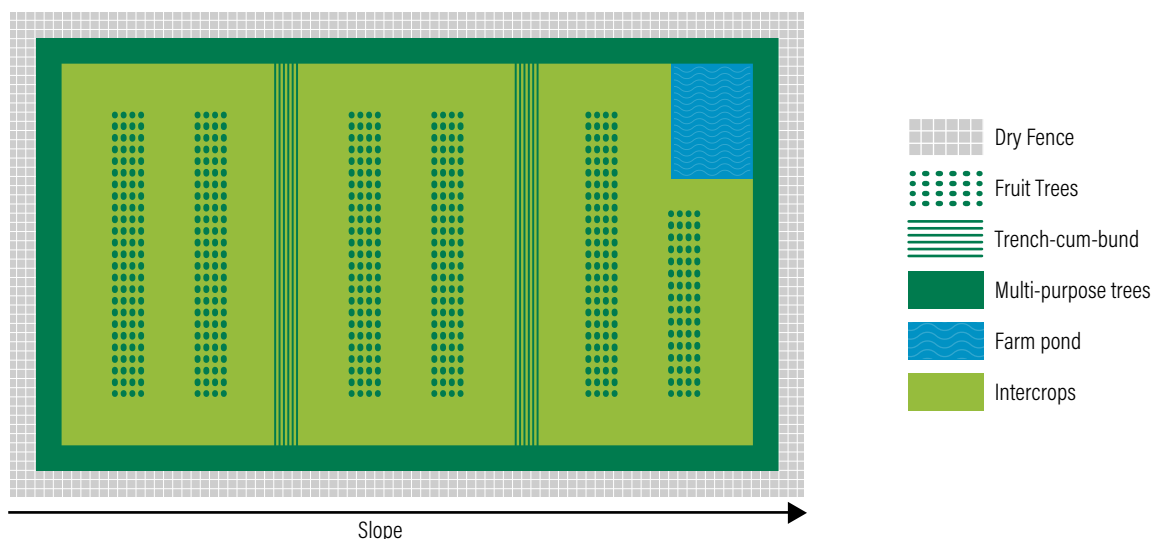
Source: Brockington et al. 2016.

ENDNOTES

1. WRI India conducted a systematic literature review of tree-based landscape restoration to analyze its potential to contribute to climate change mitigation and adaptation simultaneously. The results are being synthesized in a working paper that is under review.

2. The Bonn Challenge is a global goal to bring 150 million hectares of degraded and deforested landscapes into restoration by 2020, and 350 million hectares by 2030.

3. The Land Degradation Neutrality (LDN) target program supports countries to achieve quantifiable targets for improving quality of land resources. To date, over 120 countries have committed to setting LDN targets

4. The atlas excludes areas where tree-based interventions are not ecologically or socially appropriate, such as areas covered by permanent ice and snow, sand dunes, natural scrublands, swamp forests, grasslands, wetlands, and water bodies. National parks, sanctuaries, state reserves and wildlife reserves, and forests with over 70 percent tree cover were also removed to ensure healthy and/or fragile ecosystems are not affected by tree-based interventions. Since the atlas provides data at the national level, areas under surface and groundwater irrigation are excluded since the nuances in trade-offs between food security and restoration cannot be adequately addressed at this scale. In rainfed areas, croplands with tree cover density of more than 40 percent were also removed since these areas already support high tree cover, and further increases may result in trade-offs with food security and other provisioning services. Finally, urban and built-up areas and areas with population density of over 400 people per square kilometer were excluded to mitigate concerns over multiple demands on lands.

5. A landscape approach to ToF can lead to multiple environmental and development benefits. Landscapes encompass a mosaic of land uses including forests, farmlands, pasturelands, built-up areas, etc. The landscape approach provides a "framework to integrate policies and practices for multiple land uses to ensure equitable and sustainable use of land while strengthening measures to mitigate and adapt to climate change" (Reed et al. 2015). A landscape approach to ToF will recognize the interactions between diverse stakeholders and multiple land uses and focus on addressing environmental and socioeconomic problems jointly (GLF 2014). It will help identify areas that need to be protected, maintained, and restored for multiple ecosystem services, such as biodiversity, soil, water, carbon, and provisioning of fuelwood, fodder, and nontimber forest produce.

6. "Wadi," meaning "fruit orchard" in Gujarati, is a type of agroforestry system that focuses on planting a combination of fruit and forest trees in underproductive agricultural lands with value-added layers such as formation of cooperative, marketing, and food processing.

7. The Sub-Mission on Agroforestry is being implemented in 20 states—Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Haryana, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, Mizoram, Meghalaya, and Nagaland, and two UTs—Jammu and Kashmir and Ladakh. The funding pattern is 60:40 between national and state governments for all states except the North East and Hill States, where it is 90:10, and 100 percent in the case of UTs & national-level agencies (Parliament, Lok Sabha 2021a).

8. *Mission* refers to initiatives from the government that have clearly defined objectives, scopes, implementation time lines and milestones, and measurable outcomes and service levels.

9. Data on allocation, release, and utilization (progress/achievement) are collated in the online portal of the National Mission for Sustainable Agriculture (https://nmsa.dac.gov.in/Default.aspx). *Allocation* refers to the funds allocated from the central pool of resources with a funding pattern of 60:40 between the center and state; *release of funds* refers to the actual amount transferred from the center to states, which depends on criteria such as submission of action plans and utilization certificates from the previous financial year; *fund utilization* refers to the amount used by the state to fund scheme-related activities.

10. The search words used were a combination of "agroforestry," "trees outside forests," "success stories," "research and promotion of agroforestry and trees outside forest," "incentive for implementation of agroforestry schemes," "tree planting schemes incentives," "exemplary projects on agroforestry, tree planting." These search words were accompanied with the names of the respective "states" to glean out state-specific incentive mechanisms.

11. Vermicomposting is a managed process wherein worms digest organic matter to transform the material into a beneficial soil amendment.

12. The pattern of assistance in such cases is 50 percent subsidy from government, 40 percent bank loan, and 10 percent payable by the bamboo farmer/entrepreneurs (NBM n.d.).

13. The National Biodiversity Authority (NBA), the State Biodiversity Boards (SBBs), and the Biodiversity Management Committees (BMCs) are involved in the approval of applications from non-Indian and Indian companies/researchers. The funds received through benefit-sharing must be channeled back to the benefit claimers (farmers, communities growing the bioresource) and used to protect and restore biodiversity in the respective forest and nonforest areas as indicated in the application and for socioeconomic development in the area (GoI 2002).

14. The National Agroforestry Policy highlights the importance of expanding insurance and providing tree insurance for tree crops in agroforestry systems to stabilize income from ToF systems and protect farmers from natural hazards. There are three insurance companies—United India Insurance, Agriculture Insurance Company of India, and Oriental Insurance Company—that provide tree insurance covering pulpwood trees, such as *Casurina* spp. (casuarina), *Eucalyptus* spp. (eucalyptus), *Melia dubia* (hebbevu), and *Hevea brasiliensis* (rubber), along with trees like *Ailanthus excelsa* (ardu), *Gmelina arborea* (gamhar), Leu*caena leucocephala* (subabul), and *Dalbergia sissoo* (shisham). Other species include biofuel plants/trees like *Millettia pinnata* (karanja), *Azadirachta indica* (neem), *Madhuca longifolia* (mahua), *Calophyllum inophyllum* (champa), and *Simarouba glauca* (Lakshmi Taru) as well as horticultural crops like *Areca catechu* (arecanut palm), *Theobroma cacao* (cocoa), and *Hevea brasiliensis* (rubber) (Uthappa et al. 2015).

15. Felling trees is banned in India through regulatory frameworks like the Indian Forest Act of 1927 and the Forest Conservation Act of 1980. This was instituted with a view to conserve forest resources. Harvest and transit of farm-grown timber is controlled rigorously and requires prior permission. Consequently, Indian states have stringent timber felling and transit regulations that pose a hindrance to farmers willing to practice agroforestry as a livelihood (TetraTech 2017; GoI 2014).

16. In 2019, to commemorate the 550th birth anniversary of the Sikh guru, Guru Nanak Dev, the state launched a program to plant 550 saplings of native species in panchayat lands of each village in the state.

17. The Panchayati Raj System of local governance in India has three levels: gram panchayat (village level), janpad panchayat (block level), and zilla panchayat (district level). It was formalized in 1992 by the 73rd Amendment to the Indian Constitution. A gram panchayat is the executive committee of a gram sabha, which comprises all the adults of a village.

18. For the project, the implementing partners, Central Research Institute for Dryland Agriculture, CPF, and WWF-India, built the technical capacity of farmers for planting tree-crop combinations and other farming techniques (CPF 2020).

19. Leveraging the Odisha Livelihood Mission that brought together several women SHGs, and converged resources from MGNREGS and the Bamboo Mission for implementing agroforestry (Rizvi et al. 2020).

20. The management practices detailed in the app include details on common name, botanical name, family, potential area, silvicultural requirements, nursery techniques, planting techniques, tending operations, suitable agroforestry systems, tree protection, yield, utilization, and material availability.

21. The Karnataka State Bamboo Mission (SBM) partnered with Industree Foundation with support from the United States Agency for International Development (USAID) to establish a bamboo research center in Channapatna to shine a light on the 900-year-old bamboo-based crafts created by Medhar Tribe artisans. Focusing on women, the project aims to involve over 6,000 women in collectives and make connections with large retailers, such as FabIndia, for the sale of products. The SBM will support the sourcing of bamboo from local bamboo plantations outside forest areas and plan to set up certification and chain-of-custody standards to ensure higher prices for products (Industree Foundation n.d.)

22. In Odisha, for instance, the company ITC Limited promotes farm forestry by providing smallholders with subsidized saplings at INR 1; with the remainder of the sapling costs deposited by the farmer in a group fund, from which loans can be made available (Suresh et al. 2014). In Punjab, private sector companies are credited with providing high-quality planting material to farmers (Chavan et al. 2015). In Gujarat, paper mills and other industries have promoted block plantation by providing planting material and extensive support services (Dixit 2020). Paper mills, particularly in Gujarat, Karnataka, Odisha, and Punjab have provided a number of input subsidies to farmers, particularly through supply of saplings of fast-growing varieties of eucalyptus, acacia, and *Casuarina*.

23. The monitoring system envisages daily delivery of progress reports from the districts to the Principal Chief Conservator of Forests (PCCF). Planting carried out by the Forest Department and Rural Development Department are geotagged to monitor survival rates.

24. Quality planting material would help to improve adaptability to adverse environmental conditions, meet raw material requirements of markets, and ensure a good survival rate. The quality of planting material is determined by origin, the authenticity of variety and stock, vegetation development, and state of health (NCCF n.d.)

25. Scheduled Caste: Castes, races, or tribes or parts of such social groups who form a category defined as "backward classes" or socially deprived people for whom the Constitution of India, Article 341, has made separate provisions for upliftment and protection. Scheduled Tribe: Tribes or tribal communities deemed as "Scheduled Tribes" under Article 342 of India's Constitution. The constitution makes special provisions for the protection of these communities, and the state is expected to execute schemes for their welfare and upliftment.

26. For instance, in 2014 the Andhra Pradesh state government worked out a tripartite agreement with agroforestry farmers and industries for procurement of *Eucalyptus* and *Casuarina* at INR 4,400 per tonne and INR 4,200 per tonne, respectively. However, paper mills bypassed the Agriculture Market Committees and, using agents, procured from farms for prices as low as INR 2,500 and INR 2,000, leading to frustration among farmers (*The Hindu* 2020). Market fluctuations in the past have decreased farmers' interest. For instance, between 2001 and 2005, prices of poplar crashed, severely affecting farmers, especially in Punjab (TERI 2020). This cycle occurred again in 2015 largely driven by the overall global market recession and imbalance in the demand-supply dynamic in favor of buyers in the local market (TERI 2020). Farmers face devastation when they are unable to recover from such crashes.

27. The MSP for MFP scheme came into effect in 2011 to provide a social safety net to underprivileged forest dwellers and tribal MFP gatherers, and to aid in their empowerment. MSPs are now applicable for about 50 MFPs, and the scheme has connections with Van Dhan Yojana and Van Dhan tribal start-ups to improve livelihoods of the tribal population. In light of the COVID-19 pandemic and the impact on livelihoods of forest dwellers, the MSPs were revised with increases ranging from 16 to 66 percent (in some cases such as for giloe/ *Tinospora cordifolia,* the increase has been up to 190 percent) (MoTA 2020a). States can fix MSP up to 10 percent higher or lower than the MSP declared by the GoI. Further, the MSP for MFP scheme promotes value-addition, branding, and marketing of MFPs by establishing Van Dhan Kendras (VDKs) to facilitate creation of sustainable livelihoods for forest-based tribes. Similar incentives that encourage formation of user groups for value-addition can support ToF farmers to earn better incomes.

28. This scheme covers pulpwood trees such as *Casuarina, Eucalyptus* (pulpwood), *Melia dubia* (plywood), *Ailanthus, Gmelina* (matchwood), *Leucaena*, and *Dalbergia sissoo*. The premium for plantation ranges between INR 300 and INR 600 annually, depending on the input cost of the respective tree species, and covers against forest and bush fires, lightning, riot and strike, storm and cyclone, flood and inundation, and loss due to wild animal attack (Parthiban 2016).

29. These include government-led schemes and programs such as Startup India and Rashtriya Krishi Vikas Yojna (RKVY)—Remunerative Approaches for Agriculture and Allied Sector Rejuvenation (RKVY-RAFTA-AR). There are also programs run by NGOs and research institutions that are building capacity and providing financial to restoration entrepreneurs, including WRI's Land Accelerator (The Land Accelerator n.d.), TNAU's Mettupalayam Agroforestry Business Incubation Forum (TNAU-MAFBIF n.d.), and ICRISAT's Agri-Business incubator (ICRISAT n.d.), among many others.

30. The Rashtriya Krishi Vikas Yojana (RKVY) has three subschemes—Bringing Green Revolution to Eastern India (BGREI), Additional Fodder Development Programme (AFDP), and Crop Diversion Programme (CDP)—which provide grants as financial incentives. These grants cover certain agroforestry interventions. The BGREI includes financial incentive of INR 2,000 per ha for cost of saplings for undertaking tree planting on farm bunds in the North Eastern Region. The CDP is being implemented in Haryana, Punjab, and western Uttar Pradesh, and aims to demonstrate and promote improved production technologies of alternate crops for diversification of paddy cultivation and to restore soil fertility. Under CDP, there is a financial incentive for INR 10,000 per ha for poplar-based agroforestry systems (INR 5,000 for critical inputs, INR 2,500 for land development, and INR 2,500 for marketing support).

31. The 15th FC has allocated INR 1 billion each (total INR 12 billion) to the 12 most drought-prone states over five years (2021–2026): Andhra Pradesh, Bihar, Gujarat, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Telangana, and Uttar Pradesh (XV Finance Commission 2020).

REFERENCES

Aditya, Vijay Pratap Singh. 2021. Personal communication between the authors and Vijay Pratap Singh Aditya, CEO, Ekgaon, New Delhi, February 5.

Ahmad, Firoz, Md Meraj Uddin, and Laxmi Goparaju. 2019. "Agroforestry Suitability Mapping of India: Geospatial Approach Based on FAO Guidelines." *Agroforestry Systems* 93 (4): 1319–36. https://doi.org/10.1007/s10457-018-0233-7.

Aimers-Halliday, J., and R.D. Burdon. 2004. "Risk Management for Clonal Forestry with Pinus Radiata—Analysis and Review. 2: Technical and Logistical Problems and Countermeasures." *New Zealand Journal of Forestry Science* 33 (2): 181–204.

Ajayi, C. Oluyede, and Frank Place. n.d. "Policy Support for Large-Scale Adoption of Agroforestry Practices: Experience from Africa and Asia." In *Agroforestry—The Future of Global Land Use*. https://link.springer.com/chapter/10.1007/978-94-007-4676-3_12. Accessed April 20, 2021.

Ajwani, Raji M., and Yogesh Sawant. n.d. "BAIF: Transforming Dreams into Reality for Rural India." Case Study. Pune, India: Bharatiya Agro Industries Foundation (BAIF).

APCCF (Additional Principal Chief Conservator of Forests) (NFAP and Bamboo Mission) Karnataka. 2020. Personal communication between the authors and the APCCF (National Forest Action Programme and Bamboo Mission), Karnataka, September 28.

Arriagada, Rodrigo, Paul Ferraro, Erin Sills, Subhrendu Pattanayak, and Silvia Cordero-Sancho. 2012. "Do Payments for Environmental Services Affect Forest Cover? A Farm-Level Evaluation from Costa Rica." *Land Economics* 88 (May). https://doi.org/10.3368/le.88.2.382.

BAIF (Bharatiya Agro Industries Foundation). n.d. "Approach Paper: Wadi Programme." Pune, India: BAIF.

Bargali, S.S., S.P. Singh, S.K. Shrivastava, and S.S. Kolhe. 2007. "Forestry Plantations on Rice Bunds: Farmers' Perceptions and Technology Adoption." *International Rice Research Notes* 32 (2). http://books.irri.org/IRRN32no2_content.pdf#page=40.

Bariya Dhirsingbhai Dhanabhai. 2021. Personal communication between Ashwin Joshi (Action for Social Advancement) and WRI India authors, and Bariya Dhirsingbhai Dhanabhai, Agroforestry Farmer, Dahod, Gujarat, July 1–7.

Benjamin, Emmanuel O., Oreoluwa Ola, and Gertrud Buchenrieder. 2018. "Does an Agroforestry Scheme with Payment for Ecosystem Services (PES) Economically Empower Women in Sub-Saharan Africa?" *Ecosystem Services* 31 (June): 1–11. https://doi.org/10.1016/j.ecoser.2018.03.004.

Bhatt, Ganapathy. 2021. Personal communication between authors and Ganapathy Bhatt, Agroforestry Farmer, Mangalore, Karnataka, June 5.

Bhoyar, S.M., D. Harshavardhan, R.V. Mahajan, N. Sharma, B. Bohra, and D.N. Nalge. 2016. "Traditional Agroforestry Systems Practiced in Lower Hills of Melghat Region, Chikhaldara Tehsil, Maharashtra, India." *Bioved* 27 (January): 1–10.

Bhushan, Chandra. 2018. "There Is Little Evidence That Permit System Helps Our Forests." *The Financial Express*, February 14. https://www.financialexpress.com/opinion/there-is-little-evidence-that-permit-system-helps-our-forests/1065163/.

Black Baza Coffee. n.d. "Black Baza Coffee." https://blackbazacoffee.com/. Accessed April 29, 2021.

Bose, Arshiya. 2020. Personal communication between the authors and Arshiya Bose, Founder, BlackBazaCoffee Pvt Ltd, Karnataka, September 1.

Brancalion, P.H.S., R.A.G. Viani, B.B.N. Strassburg, and R.R. Rodrigues. 2012. "Finding the Money for Tropical Forest Restoration." *Unasylva* 239 (63): 10.

Braubach, Matthias, Andrey Egorov, Pierpaolo Mudu, Tanja Wolf, Catharine Ward Thompson, and Marco Martuzzi. 2017. "Effects of Urban Green Space on Environmental Health, Equity and Resilience." *In Nature-Based Solutions to Climate Change Adaptation in Urban Areas: Linkages between Science, Policy and Practice*, edited by Nadja Kabisch, Horst Korn, Jutta Stadler, and Aletta Bonn, 187–205.: Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-56091-5_11.

Brockington, James D., Ian M. Harris, and Robert M. Brook. 2016. "Beyond the Project Cycle: A Medium-Term Evaluation of Agroforestry Adoption and Diffusion in a South Indian Village." *Agroforestry Systems* 90 (3): 489–508. https://doi.org/10.1007/s10457-015-9872-0.

CAFRI-ICAR (Central Agroforestry Research Institute—Indian Council of Agricultural Research). 2019. *Guidelines to Produce Quality Planting Material of Agroforestry Species*. Coordination and Technical Editing by A.K. Handa, S.K. Dhyani, and J. Rizvi. New Delhi: CAFRI, and Nairolbi: South Asia Regional Programme of World Agroforestry (ICRAF).

Cassola, Rodrigo. 2010. *Implementation of Payment for Ecosystem Services Schemes by Local Governments: The Water Conservation Project of Extrema/Minas Gerais, Brazil*. Geneva: TEEBcase. http://antarctica.teebweb.org/wp-content/uploads/2013/01/Payments-and-technical-support-for-reforestation-and-soil-conservation-for-watershed-protection-Brazil.pdf.

CBD (Convention on Biological Diversity). 2021. "The Convention on Biological Diversity." Montreal: Secretariat of the Convention on Biological Diversity, March 12. https://www.cbd.int/convention/.

Chandraprakash, Nanditha. 2020. "Mass Tree Planting along India's Cauvery River Has Scientists Worried." *Mongabay Environmental News*, January 22. https://news.mongabay.com/2020/01/mass-tree-planting-along-indias-cauvery-river-has-scientists-worried/.

Chaturvedi, R., M. Duraisami, K.M. Jayahari, C.B. Kanchana, R. Singh, S. Segarin, and P. Rajagopal. 2018. *Restoration Opportunities Atlas of India*. Technical Note. Mumbai: WRI India. https://www.wri.org/research/restoration-opportunities-atlas-india.

Chavan, S.B., A. Keerthika, S.K. Dhyani, A.K. Handa, Ram Newaj, and K. Rajarajan. 2015. "National Agroforestry Policy in India: A Low Hanging Fruit." *Current Science* 108 (10): 9.

Chazdon, R.L., P.H.S. Brancalion, D. Lamb, L. Laestadius, M. Calmon, and C. Kumar. 2017. "A Policy-Driven Knowledge Agenda for Global Forest and Landscape Restoration." *Conservation Letters* 10: 125–32.

CDB (Coconut Development Board). n.d. Coconut Palm Insurance Scheme. New Delhi: CDB, Ministry of Agriculture and Farmers Welfare, Government of India.

Cole, Rebecca J. 2010. "Social and Environmental Impacts of Payments for Environmental Services for Agroforestry on Small-Scale Farms in Southern Costa Rica." *International Journal of Sustainable Development and World Ecology* 17 (3): 208–16. https://doi.org/10.1080/13504501003729085.

CPF (Centre for People's Forestry). 2020. "Success Stories: Experiences of Implementing the Tribal Development Fund (TDF) of NABARD." Field Notes. Secundarabad: CPF.

Cronkleton, P., Y. Artati, H. Baral, K. Paudyal, M.R. Banjane, J.L. Liu, T.Y. Tu, et al. 2017. "How Do Property Rights Reforms Provide Incentives for Forest Landscape Restoration? Comparing Evidence from Nepal, China and Ethiopia," *International Forestry Review* 19 (S4): 16.

Department of Agriculture and Farmers' Empowerment. 2020. Activity Report 2019–20. Bhubaneshwar: Department of Agriculture and Farmers' Empowerment, Government of Odisha.

Dhyani, S.K., and A.K. Handa. 2013. "Area under Agroforestry in India: An Assessment for Present Status and Future Perspective—Indian Journals." *Indian Journal of Agroforestry* 15 (1): 1–11.

Ding, Helen, Anil Markandya, Rafael Barbieri, Miguel Calmon, Manuel Cervera, Marie Duraisami, Ruchika Singh, et al. 2021. *Repurposing Agricultural Subsidies to Restore Degraded Farmland and Grow Rural Prosperity*. Washington, DC: World Resources Institute (WRI).

Directorate of Horticulture Odisha. n.d. "Plans and Schemes, Directorate of Horticulture, Government of Odisha." Directorate of Horticulture, Government of Odisha. http://odihort.nic.in/plans-schemes. Accessed April 28, 2021.

Directorate of Information and Public Relations, Punjab, India. n.d. "'Ghar Ghar Hariyali' Campaign to Change Face of Punjab: Sadhu Singh Dharamsot." http://diprpunjab.gov.in/?q=content/ghar-ghar-hariyali-campaign-change-face-punjab-sadhu-singh-dharamsot. Accessed June 17, 2021.

Dixit, A.M. 2020. Personal communication between the authors and A.M. Dixit, Independent Researcher, Ahmedabad, Gujarat, December 11.

Dobriyal, Manmohan J. 2020. Personal communication between the authors and M.J. Dobriyal, Professor, Rani Lakshmi Bai Central Agricultural University, Silviculture and Agroforestry, Uttar Pradesh, October 19.

EJAtlas. n.d. "Tribals, Forest Rights Activists Oppose Telangana Government's Tree-Plantation Programme, India/EJAtlas." *Environmental Justice Atlas*. https://ejatlas.org/conflict/telangana-government-plantation-programme. Accessed April 29, 2021.

FAO (Food and Agriculture Organization of the United Nations). 2013. "Towards the Assessment of Trees Outside Forests: A Thematic Report Prepared in the Framework of the Global Forest Resources Assessment 2010." Rome: FAO. http://www.fao.org/3/aq071e/aq071e00.htm.

FAO. 2015. "Agroforestry." Rome: FAO. http://www.fao.org/forestry/agroforestry/80338/en/.

FAO, UNDP, and UNEP (Food and Agriculture Organization of the United Nations, United Nations Development Programme, and United Nations Environment Programme). 2021. "A Multi-Billion-Dollar Opportunity—Repurposing Agricultural Support to Transform Food Systems." Rome: FAO.

Faruqi, Sofia, Andrew Wu, Eriks Brolis, Andres Anchondo Ortega, and Alan Batista. 2018. "The Business of Planting Trees: A Growing Investment Opportunity." Washington, DC: World Resources Institute (WRI).

FSI (Forest Survey of India). 2013. "India State of Forest Report 2013."

Dehradun: FSI. 2019. "India State of Forest Report 2019." Dehradun: FSI. https://www.fsi.nic.in/forest-report-2013.

Gautam, Rajendra Singh. 2020. Personal communication between the authors and Rajendra Singh Gautam, Associate Dean, Institute of Livelihood Research and Training, Bhopal, Madhya Pradesh, April 29.

Gill, K.K., Navneet Kaur, and R.I.S. Gill. 2016. "Evaluation of Growth and Yield of Wheat Cultivars Using Agroclimatic Indices under Poplar Based Agroforestry System in Punjab." *Journal of Agrometeorology* 18 (1): 124–27.

GLF (Global Landscapes Forum). 2014. Global Landscapes Forum Website. www.landscapes.org/glf-2014/about. Accessed December 23, 2020.

Godbole, Archana, and Jayant Sarnaik. 2020. Personal communication between the authors and Archana Godbole and Jayant Sarnaik, Applied Environmental Research Foundation, Pune, Maharashtra, October 15.

GoT (Government of Telangana). n.d. "Telanganaku Haritha Haram." http://harithaharam.telangana.gov.in/. Accessed April 27, 2021.

Government of Gujarat. 2012. "The Saurashtra Felling of Trees (Infliction of Punishment) Act, 1951." Gandhinagar: Legislative and Parliamentary Affairs Department, Government of Gujarat. https://www.indiacode.nic.in/bitstream/123456789/4455/1/fellingoftrees.pdf.

Government of India (GoI). 2002. "The Biological Diversity Act, 2002." New Delhi: Government of India. https://www.indiacode.nic.in/bitstream/123456789/2046/1/200318.pdf.

GoI. 2014. "National_agroforestry_policy_2014." New Delhi. https://agricoop.gov.in/sites/default/files/National_agroforestry_policy_2014.pdf.

GoI. 2021. Economic Survey 2020–2021. New Delhi: Department of Economic Affairs, Ministry of Finance.

Government of Karnataka. 1969. "Karnataka Forest Rules." Shivamogga, Karnataka.

Government of Karnataka. 1976. "The Karnataka Preservation of Trees Act." Shivamogga, Karnataka.

Government of Karnataka. n.d. (a). "Karnataka Forest (Amendment) Rules." Shivamogga, Karnataka.

Government of Karnataka. n.d. (b). "Karnataka Raitha Suraksha Pradhan Mantri Fasal Bima Yojana (KRS-PMFBY)." Shivamogga, Karnataka. Accessed April 27, 2021. http://www.samrakshanereports.karnataka.gov.in/.

Government of Karnataka. n.d. (c). "Maguvigondu Mara Salegondu Vana." Shivamogga: Karnataka Forest Department. https://aranya.gov.in/aranyacms/English/IndividualScheme.aspx?BlgeBpdsFX/K/vxvbT7tmA==. Accessed June 17, 2021.

Government of Karnataka. n.d. (d). "Raising of Seedlings for Public Distribution (RSPD)." Shivamogga: Karnataka Forest Department. https://aranya.gov.in/aranyacms/English/IndividualScheme.aspx?5p3/jNf5li2JxMr26wkGNQ==. Accessed June 17, 2021.

Government of Maharashtra. 1964. "Maharashtra Felling of Trees (Regulation) Act." Mumbai. https://mahaforest.gov.in/writereaddata/act_rule_file/1419579128Maharashtra%20Felling%20of%20Trees%20(Regulation)Act1964.pdf.

Government of Maharashtra. 2014. "Maharashtra Forest Rules." Mumbai.

Government of Maharashtra. 2018. "GR Dated 27_06_2018 Kanya Van Samaruddhi.Pdf." Mumbai. https://mahaforest.gov.in/writereaddata/fckimagefile/8)GR%20dated%2027_06_2018%20Kanya%20Van%20Samaruddhi.pdf.

Government of Maharashtra. 2019. "GR Dt_28_06_2019 Atal Bamboo Samruddhi Yojana.Pdf." Mumbai. https://mahaforest.gov.in/writereaddata/fckimagefile/9)GR%20Dt_28_06_2019%20Atal%20Bamboo%20Samruddhi%20Yojana-%20nOT%20Uploaded.pdf.

Government of Maharashtra. 2021. "PoCRA-DigitizingAgricultureForClimateResilience.Pdf." Mumbai. https://mahapocra.gov.in/docs/PoCRA-DigitizingAgricultureForClimateResilience.pdf.

Government of Maharashtra. n.d. (a). "Maharashtra Forest Department: 50 Crore Plantation." Mumbai. https://mahaforest.gov.in/Contentpage/index/RlBrZ3Z1dEZTZnhTWlZRPQ%3D%3D/en. Accessed April 26, 2021.

Government of Maharashtra. n.d. (b). "Scheme-BhausahebPhundkarFalbaagLagvadYojana.Pdf." Mumbai. https://mahadbtmahait.gov.in/Farmer/PDF/Scheme-BhausahebPhundkarFalbaagLagvadYojana.pdf. Accessed June 18, 2021.

Government of Odisha. 1980. "Odisha Forest and Other Forest Produce Transit Rules." Bhubaneswar. https://ttpermitodisha.in/files/6TOTAOFTR_1980.pdf.

Government of Odisha. n.d. "Afforestation." Bhubaneswar: Odisha State Forest Department. https://odishaforest.in/en/afforestation/. Accessed June 21, 2021.

Government of Punjab. 2019a. "Punjab Forest Produce Transit Rules 2019." Chandigarh. http://www.bareactslive.com/Pun/pu963.htm

Government of Punjab. 2019b. "The Punjab Regulation of Wood Based Industries Rules, 2019." Chandigarh. https://upload.indiacode.nic.in/showfile?actid=ACPB_82_969_00005_00005_1567075901323&type=rule&filename=punjab_regulation_of_saw_mills_2019.pdf.

Government of Telangana. 1970. "Telangana Forest Produce Transit Rules." Hyderabad. https://upload.indiacode.nic.in/showfile?actid=AC_TS_86_748_00002_00002_1552890105331&type=rule&filename=8._telangana_forest_produce_transit_rules,_1970_07.07.2019_(final).pdf.

Government of Telangana. 2018a. "Telangana Panchayati Raj Act." Hyderabad. https://www.indiacode.nic.in/bitstream/123456789/8492/1/Act%205%20of%202018.pdf.

Government of Telangana. 2018b. "Notification—Inclusion of Certain Specie to Schedule-II of Telangana Forest Produce Transit Rules, 1970," February 14. Hyderabad. http://forests.telangana.gov.in/Documents/EODB/MIS/Exempted%20Species_14022018EFST_MS10.PDF.

Government of Telangana. n.d. "Telanganaku Haritha Haram." Hyderabad. http://harithaharam.telangana.gov.in/. Accessed June 18, 2021.

Gujarat Forest Department. 2017. "Form of Utilization Certificate, April 17." Gandhinagar.
Gujarat Forest Department. 2019. "Form of Utilization Certificate." Gandhinagar.

Gujarat Forest Department. 2020. "Annual Administrative Report: 2019–2020." Annual Report. Gandhinagar. https://forests.gujarat.gov.in/writereaddata/images/pdf/AAR-2019-20.pdf.

Gujarat Forest Department. n.d. (a). "Agro-Forestry in Gujarat: An Economic Opportunity with Environment Enhancement." Gandhinagar: Gujarat Forest Department. https://forests.gujarat.gov.in/writereaddata/images/pdf/7_Agro-Forestry-in-Gujarat.pdf. Accessed April 27, 2021.

Gujarat Forest Department. n.d. (b). "Flow Chart of Adivasi Vruksh Kheti Scheme." https://forests.gujarat.gov.in/adivasi-kheti-scheme-chart.htm. Accessed October 15, 2020.

Gujarat Forest Department. n.d. (c). "Schemes/Gujarat Forest Department." Gandhinagar. https://forests.gujarat.gov.in/schemes-details.htm#schemeThree. Accessed April 27, 2021.

Handa, A.K, S.K Dhyani, and Ajit. 2013. "Agroforestry for Sustainable Agriculture." In *Climate Change and Sustainable Food Security*, edited by P.K Shetty, S. Ayappan, and M.S. Swaminathan, 229–46. New Delhi: National Institute of Advanced Studies and Indian Council of Agricultural Research.

Horticulture Department, Telangana. 2020. Personal communication between the authors and Official from the Horticulture Department, Telangana, December 4.

ICFRE (Indian Council of Forestry Research and Education). 2020. "Agroforestry Models Developed by ICFRE (A Compilation)." New Delhi: ICFRE. https://www.icfre.org/UserFiles/File/Books/Agroforestry%20Models%20Developed%20by%20ICFRE.pdf.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). n.d. "India Confers Top Accolade on ICRISAT's Agri-Business Incubator for Fostering Entrepreneurship—ICRISAT." Patancheruvu: ICRISAT. https://www.icrisat.org/agri-business-incubator-for-fostering-entrepreneurship/. Accessed August 13, 2021.

Industree Foundation. n.d. *The Bamboo Value Chain: The POWER Project*. Accessed May 24, 2021. https://industreefoundation.wordpress.com/2020/11/02/the-bamboo-value-chain-the-power-project/.

IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services). 2018. "Summary for Policymakers of the Assessment Report on Land Degradation and Restoration of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services." Edited by R. Scholes, L. Montanarella, A. Brainich, N. Barger, B. ten Brink, M. Cantele, B. Erasmus, et al. Bonn, Germany: IPBES Secretariat.

IPCC (Intergovernmental Panel on Climate Change). 2018. "Global Warming of 1.5°C, an IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change." Special Report. Geneva: IPCC. https://www.ipcc.ch/sr15/.

IPCC. 2019. "Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems." Geneva: IPCC. https://www.ipcc.ch/srccl/.

Jacobi, Johanna, Sarah-Lan Mathez-Stiefel, Helen Gambon, Stephan Rist, and Miguel Altieri. 2017. "Whose Knowledge, Whose Development? Use and Role of Local and External Knowledge in Agroforestry Projects in Bolivia." *Environmental Management* 59: 464–76.

Jaimini, S.N., and S.B.S. Tikka. 2007. "Agroforestry Practices and Systems in North Gujarat." *Agroforestry: Systems and Practices*, 163–74.

Karnataka Forest Department. n.d. "Krushi Aranya Protsaha Yojane (KAPY)." Shivamogga. https://aranya.gov.in/aranyacms/English/IndividualScheme.aspx?HkxuiBwcRAlH/nwkzKruPQ==. Accessed June 17, 2021.

Kaushal, Ruchi Kukreti, Gargi Das, Suryakumari, and E. Poornachander. 2016. "A Study of Indigenous Agricultural Practices among the Tribals of Andhra Pradesh and Telangana—the Trajectory of Transition and Impacts on Livelihoods and Food Security." Secunderabad, Telangana: Centre for People's Forestry. http://www.cpf.in/pdf/ImpactAssessments/Livelihoods_FoodSecurity.pdf.

Kora, Kamalesh. 2021. Personal communication between Sushmita, Panigrah (Action for Social Advancement) and WRI India authors, and Kamalesh Kora, Agroforestry Farmer, Odisha, July 1–7.

Kothawade, Dashrath Damodar. 2021. Personal communication between Vivek Shelke (Action for Social Advancement) and WRI India authors, and Dashrath Damodar Kothawade, Farmer, Jalgaon, Maharashtra, July 1–7.

Kumar, B. Mohan, and K. Takeuchi. 2009. "Agroforestry in the Western Ghats of Peninsular India and the Satoyama Landscapes of Japan: A Comparison of Two Sustainable Land Use Systems." *Sustainability Science* 4 (2): 215. https://doi.org/10.1007/s11625-009-0086-0.

Kumar, Yogesh, Tarun Kumar Thakur, and A. Thakur. 2017. "Socio-Cultural Paradigm of Agroforestry in India." *International Journal of Current Microbiology and Applied Sciences* 6 (6): 1371–77. https://doi.org/10.20546/ijcmas.2017.606.161.

Lasco, Rodel D., Rafaela Jane P. Delfino, and Marya Laya O. Espaldon. 2014. "Agroforestry Systems: Helping Smallholders Adapt to Climate Risks While Mitigating Climate Change." *WIREs Climate Change* 5 (6): 825–33. https://doi.org/10.1002/wcc.301.

Manjunatha, A.V, K.B Ramappa, I. Maruthi, and P. Kumar. 2017. *Impact Evaluation of National Horticulture Mission (NHM) and Horticulture Mission for North East and Himalayan States (HMNEH)*. Bengaluru: ADRT Centre, Institute of Social and Economic Change. https://midh.gov.in/PDF/Impact%20Evaluation%20of%20NHM%20HMNEH.pdf.

Ministry of Road Transport and Highways. n.d. "Green Highways/Ministry of Road Transport and Highways, Government of India." New Delhi. https://morth.nic.in/green-highways. Accessed June 21, 2021.

MoAFW (Ministry of Agriculture and Farmers Welfare). 2016a. "Operational Guidelines: Sub-Mission on Agroforestry (SMAF) under National Mission for Sustainable Agriculture (NMSA)." New Delhi: Government of India. https://nmsa.dac.gov.in/pdfdoc/Agroforestory_Guidelines_English.pdf.

MoAFW. 2016b. "Weather Based Crop Insurance Scheme (WBCIS)." Operational Guidelines. New Delhi: Government of India. https://agricoop.nic.in/sites/default/files/FINAL-1.pdf.

MoAFW. 2020. "Government Declares Minimum Support Price for Mature Dehusked Coconut." New Delhi: Press Information Bureau, Government of India, June 23. https://pib.gov.in/PressReleasePage.aspx?PRID=1633521.

MoAFW. 2021. "Minutes of Vitual Meeting of Project Sanctioning Committee of Sub-Mission on Agroforestry (SMAF) Scheme Held on 17th June, 2021 under the Chairmanship of Smt. Chaavi Jha, Joint Secretary (NRM), DAC & FW, Krishi Bhawan, New Delhi." New Delhi: Department of Agriculture and Farmers Welfare (NRM Division), Government of India.

MoAFW. n.d. (a). "Mission for Integrated Development of Horticulture (MIDH)." Mission for Integrated Development of Horticulture (MIDH). New Delhi: Government of India. https://midh.gov.in/. Accessed June 7, 2021.

MoAFW. n.d. (b). "National Bamboo Mission." New Delhi: Government of India. https://nbm.nic.in/. Accessed April 26, 2021.

MoAFW. n.d. (c). "National Mission for Sustainable Agriculture." National Mission for Sustainable Agriculture: Components Sub-Mission on Agroforestry (SMAF). New Delhi: Government of India. https://nmsa.dac.gov.in/frmComponents.aspx. Accessed June 7, 2021.

MoAFW. n.d. (d). "NMSA Guidelines." New Delhi: Government of India. https://nmsa.dac.gov.in/pdfdoc/NMSA_Guidelines_English.pdf. Accessed June 21, 2021.

MoAFW. n.d. (e). "Operational Guidelines for Innovation and Agri-Entrepreneurship Cell under RKVY-RAFTAAR (2017-18 TO 2019-20)." New Delhi: Government of India. http://rkvy.nic.in/static/download/pdf/RKVY-RAFTAAR_Ent.pdf. Accessed August 13, 2021.

MoAFW. n.d. (f). "Pradhan Mantri Krishi Sinchayee Yojana." New Delhi: Government of India. https://pmksy.gov.in/. Accessed June 21, 2021.

MoAFW. n.d. (g). "राष्ट्रीय कृषि विकास योजना (रफ़्तार)/ Rashtriya Krishi Vikas Yojana (Raftaar)." New Delhi: Government of India. https://rkvy.nic.in/. Accessed June 21, 2021.

MoEF (Ministry of Environment and Forests). n.d. "National Mission for a Green India—a Brochure." New Delhi: Ministry of Environment and Forests. http://naeb.nic.in/documents/GIM_Brochure_26March.pdf. Accessed June 7, 2021.

MoEFCC (Ministry of Environment, Forest and Climate Change). 2017. "Inter-state Transport of Bamboo." New Delhi: Press Information Bureau, Government of India, December 27. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1513063.

MoEFCC. 2019. "National Clean Air Programme." New Delhi: Government of India. https://moef.gov.in/wp-content/uploads/2019/05/NCAP_Report.pdf.

MoEFCC. 2020. "Urban Forest Scheme to Develop 200 'Nagar Van' across the Country in Next Five Years." New Delhi: Government of India. 2020. pib.gov.in/Pressreleaseshare.aspx?PRID=1629563.

MoEFCC. n.d. "Forest Landscape Restoration Programmes in India." In *Forest and Beyond: Regional Consultation on Forest Landscape Restoration (FLR)—South Asia*. New Delhi: International Union for the Conservation of Nature.

Mohapatra, A.K., N. Bhola, and R.K. Patnaik. 2007. "*Agroforestry Systems and Practices* in Orissa." Agroforestry: Systems and Practices, 333–46.

Montagnini, Florencia, and Christopher Finney. 2011. "Payments for Environmental Services in Latin America as a Tool for Restoration and Rural Development." *Ambio* 40 (3): 285–97. https://doi.org/10.1007/s13280-010-0114-4.

MoRD (Ministry of Rural Development). 2013. "Report on Convergence Initiatives in India—an Overview." New Delhi: Ministry of Rural Development and United Nations Development Program.

MoRD. n.d. (a) "The Mahatma Gandhi National Rural Employment Guarantee Act 2005." New Delhi. https://www.nrega.nic.in/netnrega/mgnrega_new/Nrega_home.aspx. Accessed June 21, 2021.

MoRD. n.d. (b) "Welcome to National Rural Livelihoods Mission/National Rural Livelihoods Mission." New Delhi. https://aajeevika.gov.in/. Accessed June 21, 2021.

More, Subhash Pandit. 2021. Personal communication between Vivek Shelke (Action for Social Advancement) and WRI India authors, and Subhash Pandit More, Farmer, Jalgoan, Maharashtra, July 1–7.

MoTA (Ministry of Tribal Affairs). 2020a. "Tribal Affairs Ministry Announces Inclusion of 23 Additional Minor Forest Produce Items in Minimum Support Price List: Press Release," May 29. New Delhi: Government of India. pib.gov.in/Pressreleaseshare.aspx?PRID=1627631.

MoTA. 2020b. "TRIFED Launches Its Own Virtual Office Network to Spearhead Tribal Socio-Economic Development in Mission Mode: Press Release," August 7. New Delhi: Government of India. www.pib.gov.in/Pressreleaseshare.aspx?PRID=1644091.

MoTA. 2021. "TRIFED Signs MoU with Government of Arunachal Pradesh for the Implementation of MSP for MFP Scheme and Van Dhan Yojana:Press Release," March 22. New Delhi: Government of India. pib.gov.in/Pressreleaseshare.aspx?PRID=1706675.

Naandi Foundation. n.d. "The Araku Way." Accessed April 23, 2020. https://www.naandi.org/the-araku-way/.

Narayanan, Priya, and Jaya Dhindaw. n.d. "Urban Greening for Cooling Cities." Blog. WRI India. https://www.wri-india.org/blog/urban-greening-cooling-cities. Accessed April 26, 2021.

NBM (National Bamboo Mission). n.d. *Capital Investment Subsidy Scheme under National Bamboo Mission*: *Procedure for Sanction and Release of Subsidy*. Guidelines. New Delhi: NBM.

NCCF (Network for Certification and Conservation of Forests). 2021. "Sustainable Trade of Wood and Wood Based Products in India." Policy Paper. New Delhi: NCCF.

NCCF. n.d. "Quality Planting Material Certification Standard." New Delhi: NCCF. https://www.nccf.in/quality-planting-material-certification-standard/. Accessed August 12, 2021.

Neufeldt, H., P. Kristjanson, T. Thorlakson, A. Gassner, M. Norton-Griffiths, F. Place, and K. Langford. 2011. "Making Climate-Smart Agriculture Work for the Poor." ICRAF Policy Brief 12. Nairobi: World Agroforestry Centre (ICRAF). http://apps.worldagroforestry.org/downloads/Publications/PDFS/BR11267.pdf.

Nevase, Sujit N. 2016. "Forest Department Policy for Tribal Welfare." *Field Forester* 1 (6). http://casfosddn.nic.in/document/field-forester-april-2016.pdf.

NITI Aayog. 2018. *Report of Working Group III Shifting Cultivation: Towards a Transformational Approach*. New Delhi: NITI Aayog. https://www.researchgate.net/publication/327574447_Report_of_Working_Group_III_Shifting_Cultivation_Towards_a_Transformational_Approach_

Contributing_to_Sustainable_Development_in_Indian_Himalayan_Region.

NMSA (National Mission for Sustainable Agriculture). n.d. "National Mission for Sustainable Agriculture: Allocation, Release & Achievement of Funds." New Delhi: NMSA, Ministry of Agriculture and Farmers Welfare. https://nmsa.dac.gov.in/RptAllocationReleaseProgress.aspx. Accessed April 26, 2021.

Parliament, Lok Sabha. 2020. "State-Wise Number of Cold Storage Projects, Capacity and Financial Assistance Sanctioned under Mission for Integrated Development of Horticulture in India (2017–2018 to 2020–2021)." Lok Sabha Unstarred Question No. 310, Answered by the Ministry of Agriculture and Farmers Welfare. New Delhi: Parliament of India, Lok Sabha.

Parliament, Lok Sabha. 2021a. "National Bamboo Mission." Lok Sabha Unstarred Question no. 4399. Answered by Ministry of Agriculture and Farmers Welfare. New Delhi: Parliament of India, Lok Sabha.

Parliament, Lok Sabha. 2021b. "Schemes of Agroforestry." Lok Sabha Unstarred Question no. 3289, Answered by the Ministry of Agriculture and Farmers Welfare. New Delhi: Parliament of India, Lok Sabha.

Parthiban, K.T. 2016. "Tree Insurance—an Innovative Intervention in Industrial Agroforestry." *Indian Forester* 142 (5): 445–50.

Parthiban, K.T. 2020. Personal communication between the authors and K.T.

Parthiban, Professor (Forestry) and Head (Agroforestry), Forest College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, October 22.

Parthiban, K.T., R. Jude Sudhagar, C. Cinthia Fernandaz, and N. Krishnakumar. 2019. "Consortium of Industrial Agroforestry: An Institutional Mechanism for Sustaining Agroforestry in India." *Current Science* 117 (1): 30–36.

Patnaik, Sanjoy. 2016. "Why Restrictions on Renting Agricultural Land in India Must Go." *Scroll.in*, June 10.

Paul, Jestin. 2020. Personal communication between the authors and Jestin Paul, Director (Operations and Production), Aadhimalai Pazhanagudiyinar Producer Company Limited, Kotagiri, Tamil Nadu, June 20.

PCCF (Principal Chief Conservator of Forests) (Development) Karnataka. 2020. Personal communication between the authors and the PCCF (Development), Karnataka, December 7.

PCCF (HoFF) (Head of Forest Force) Punjab. 2020. Personal communication between the authors and the Principal Chief Conservator of Forests (Head of Forest Force), Punjab, October 12.

PCCF (SF) (Social Forestry) Telangana. 2020. Personal communication between the authors and the Principal Chief Conservator of Forests (Social Forestry), Telangana, October 16.

PCCF (SF) Maharashtra. 2020. Personal communication between the authors and the Principal Chief Conservator of Forests (Social Forestry), Maharashtra, September 28.

Place, Frank, Oluyede C. Ajayi, Emmanuel Torquebiau, Guillermo Detlefsen

Rivera, Michelle Gauthier, and Gérard Buttoud. 2012. "Improved Policies for Facilitating the Adoption of Agroforestry." In *Agroforestry for Biodiversity and Ecosystems Services—Science and Practice*. Edited by Martin Kaonga. http://www.intechopen.com/books/agroforestry-for-biodiversity-and-ecosystem-services- science-and-practice/improved-policies-for-facilitating-the-adoption-of-agroforestry.

Punjab Department of Horticulture. n.d. *State Department of Horticulture, Government of Punjab*. Accessed November 25, 2020. https://punjabhorticulture.com/Schemes.html.

Ram, A. 2020. Personal communication between the authors and A. Ram, Scientist ICAR-CAFRI Jhansi, Uttar Pradesh, December 22.

Rasch, Sebastian, Tobias Wünscher, Francisco Casasola, Muhammad Ibrahim, and Hugo Storm. 2021. "Permanence of PES and the Role of Social Context in the Regional Integrated Silvo-Pastoral Ecosystem Management Project in Costa Rica." *Ecological Economics* 185 (July): 107027. https://doi.org/10.1016/j.ecolecon.2021.107027.

Ravindranath, N.H., and Indu Murthy. 2018. "Estimation of Carbon Sequestration under MGNREGA: Achievement and Potential in India." New Delhi: Department for International Development (DFID)-India. https://assets.publishing.service.gov.uk/media/5cefa31b40f0b650d8050688/NREGA_Carbon_Sequestration_Report.pdf.

Rawat Hamirbhai Narjibhai. 2021. Personal communication between Ashwin Joshi (Action for Social Advancement) and WRI India authors, and Rawat Hamirbhai Narjibhai, Farmer, Dahod, Gujarat, July 1–7.

Reed, James, Liz Deakin, and Terry Sunderland. 2015. "What Are 'Integrated Landscape Approaches' and How Effectively Have They Been Implemented in the Tropics? A Systematic Map Protocol." *Environmental Evidence* 4 (1): 2. https://doi.org/10.1186/2047-2382-4-2.

Reddy, Eswar, and Poorna Chander. 2020. Personal communication between the authors and Reddy and Chander, Centre for People's Forestry, Secunderabad, Telangana, September 29.

Reddy, Dinesh, Ishan Agarwal, and Pratiti Priyadarshini. 2020. Personal communication between the authors and Dinesh Reddy, Ishan Agarwal, and Pratiti Priyadarshini, Foundation for Ecological Security, October 7.

Rizvi, Javed, S.K. Dhyani, and Devashree Nayak. 2020. Personal communication between the authors and Javed Rizvi, S.K. Dhyani, and Devashree Nayak, World Agroforestry Centre (ICRAF), October 19.

RKVY (Rashtriya Krishi Vikas Yojana). n.d. "Integrated Post Harvest Management." Ministry of Agriculture and Farmer Welfare: New Delhi. https://rkvy.nic.in/static/schemes/IntegratedPostHarvestManagement.html. Accessed April 30, 2021.

Rupavath, Prudhviraj. 2020. "Telangana: Tribals Resist 'Haritha Haram' on Their Podu Lands." *NewsClick*, July 22. https://www.newsclick.in/Telangana-Tribals-Resist-Haritha-Haram-Podu-Lands.

Saheb, Ashok Liktkar, Personal communication between authors. 2021. Interview with agroforestry farmer from Amaravati, Maharashtra (January 23).

Sahoo, A.K. 2020. Personal communication between the authors and A.K Sahoo, Professor, College of Forestry, Odisha University of Agriculture and Technology, Bhubaneshwar, December 18.

Sarfaraz, Kainat, and Vatsala Shrangi. 2020. "'Plantation Drive Harming Ecology of Central Ridge': Experts." *Hindustan Times*, October 2, sec. Cities. https://www.hindustantimes.com/delhi-news/green-experts-alarmed-at-indiscriminate-plantation-drive-at-ridge-want-l-g-to-intervene/story-9nIYgPFrqPVidYyG0dsRPI.html.

Sarmah, Dipak, and A.M. Annaiah. 2020. Personal communication between the authors and Dipak Sarmah and A.M. Annaiah, Institute of Agroforestry Farmers and Technologists, Bengaluru, Karnataka, October 22.

Sarvade, S., and Rahul Singh. 2014. "Role of Agroforestry in Food Security." Popular Kheti 2 (2): 5.

Sawant, Yogesh. 2020. Personal communication between the authors and Yogesh Sawant, Bharatiya Agro Industries Foundation (BAIF), October 19.

Saxena, N.C. 2015. "Farm and Agroforestry in India—Policy and Legal Issues." New Delhi: Planning Commission, Government of India. http://planningcommission.nic.in/reports/articles/ ncsxna/index.php?repts=agro.htm.

Seymour, Frances, and Jonah Busch. 2017. "Forests and SDGs: Taking a Second Look." September 11. Washington, DC: World Resources Institute (WRI). https://www.wri.org/blog/2017/09/forests-and-sdgs-taking-second-look.

Sharma, Kavita, Amanda Gant, Will Anderson, and Ashna Rustagi. n.d. "These South Asian Companies Are Restoring Farms and Forests." Blog. WRI India. https://wri-india.org/blog/these-south-asian-companies-are-restoring-farms-and-forests. Accessed April 29, 2021.

Sharma, Kavita, and Ashna Rustagi. 2021. "Why Land Restoration Startups Should Tap into Government Support." YourStory.Com. June 25. https://yourstory.com/socialstory/2021/06/accelerator-rural-development-sustainable-livelihoods-startup-india/amp.

Sharma, Prashant, M.K. Singh, Prabhat Tiwari, and Kamlesh Verma. 2017. "Agroforestry Systems: Opportunities and Challenges in India." *Journal of Pharmacognosy and Phytochemistry* 6 (6S): 953–57.

Sharma, Rajesh, and Manish Didwania. 2013. "Performance Analysis of MGNREGA: A Case Study of District Jind." *International Journal of Business Economics & Management Research* 3 (8): 155–65.

Sharma, S.K., M.P.S Yadava, and R.K. Chopra. 2017. "Agroforestry through Captive Plantations on Farmer's Degraded Land Ensuring Sustained Supply of Raw Material and for Capacity Building of Farm Communities: A Remarkable Journey since 2006 by SARA-WCPM." In *Holistic Development of Agroforestry*, 127–35. New Delhi: Jaya Publishing House.

Singh, Ruchika, Karishma Shelar, Rohini Chaturvedi, Marie Duraisami, and Rajendra Singh Gautam. 2020. "Restoring Landscapes in India for Climate and Communities." Mumbai: WRI India. https://www.wri.org/research/restoring-landscapes-india-climate-and-communities.

Singh, Vijai Shanker, and Deep Narayan Pandey. n.d. "Multifunctional Agroforestry Systems in India: Science-Based Policy Options." Jaipur, India: Climate Change and CDM Cell Rajasthan State Pollution Control Board. https://krishi.icar.gov.in/jspui/bitstream/123456789/32624/1/Existing%20and%20improved%20agroforestry%20systems%20in%20low%20rainfall%20areas%20of%20India.pdf.

Sonwane, Abhay Sudhir. 2021. Personal communication between Vivek Shelke (Action for Social Advancement) and WRI India authors, and Abhay Sudhir Sonwane, Farmer, Jalgaon, Maharashtra, July 1–7.

Sparkle. n.d. *Sparkle*. https://sparkle.life. Accessed May 13, 2020.

Steinbach, Dave, Marek Soanes, Sam Barrett, Vivek Venkataramani, and Tashina M. Cheranda. 2020. "Deepening Knowledge of MGNREGS' Contribution to Climate Resilience: A Study of Rajasthan and Uttar Pradesh." Working Paper. London: International Institute for Environment and Development (IIED). https://pubs.iied.org/10206iied.

Suich, Helen, Mega Lugina, Muhammad Zahrul Muttaqin, Iis Alviya, and Galih Kartika Sari. 2017. "Payments for Ecosystem Services in Indonesia." *Oryx* 51 (3): 489–97. https://doi.org/10.1017/S0030605316000259.

Suresh, Sangeetha, M. Suchitra, Rajit Sengupta, and Priyavrat Bhati. 2014. "Forest to Farms." *Down to Earth*, July 31. https://www.downtoearth.org.in/coverage/forest-to-farms-45285.

Sursingbhai, Bhuriya Ranjitsinh. 2021. Personal communication between Ashwin Joshi (Action for Social Advancement) and WRI India authors, and Bhuriya Ranjitsinh Sursingbhai, Farmer, Dahod, Gujarat, July 1–7.

Swathi, V. 2015. "Haritha Haram: Afforestation vs. Displacement." *The Hindu*, December 31. https://www.thehindu.com/News/Cities/Hyderabad/Haritha-Haram-Afforestation-vs-Displacement/Article8047472.Ece."

Tandel, M.B. 2020. Personal communication between the authors and M.B Tandel, Assistant Professor, Department of Silviculture and Agroforestry, Navsari Agricultural University, Gujarat, December 15.

TERI (The Energy and Resources Institute). 2020. "Proceedings of Webinar on: 'Contribution of Agroforestry to Achieve Additional Carbon Sink of 2.5 to 3 Billion Tonnes of CO_2 Equivalent through Additional Tree Cover in India by 2030.'" Proceedings of webinar. New Delhi: TERI. https://www.teriin.org/sites/default/files/2020-07/webinar-proceedings-8july20.pdf.

TetraTech. 2017. "Promoting Trees outside Forests: Action-Learning Pilot Program in Hoshangabad Landscape." Washington, DC: USAID. https://www.climatelinks.org/resources/promoting-trees-outside-forests-action-learning-pilot-program-hoshangabad-landscape. Accessed April 22, 2021.

The Hindu. 2020. "Low Rates Leave Social Forestry Planters in Despair." *The Hindu*. https://www.thehindu.com/news/national/andhra-pradesh/low-rates-leave-social-forestryplanters-in-despair/article30653115.ece#. Accessed May 30, 2021.

The Land Accelerator. n.d. "Companies—the Land Accelerator." Washington, DC: The Land Accelerator, World Resources Institute (WRI). https://thelandaccelerator.com/network/companies/#lasa. Accessed April 30, 2021.

TNAU-MAFBIF (Tamil Nadu Agricultural University-Mettupalayam Agroforestry Business Incubation Forum). n.d. "Mettupalayam Agroforestry Business Incubation Forum" Mettupalayam: Forest College and Research Institute. https://tnau.ac.in/college-fcri-mettupalayam/mettupalayam-agroforestry-business-incubation-forum/. Accessed August 13, 2021.

TSBB (Telangana State Biodiversity Board). n.d. "Telangana State Biodiversity Board." Hyderabad. http://www.tsbiodiversity.org/. Accessed April 23, 2021.

Uppuleti, Jahnavi. 2020. "Haritha Haram and Forest Rights: How a Scheme to Increase Green Cover Has Upended the Lives of Telangana's Tribals." *Firstpost*, September 18, sec. *India News*. https://www.firstpost.com/india/haritha-haram-and-forest-rights-how-a-scheme-to-increase-green-cover-has-upended-the-lives-of-telanganas-tribals-8827481.html.

Uthappa, A.R., Sangram Chavan, and A.K Handa. 2015. "Tree Insurance: A New Initiative in India." *Krishi Sewa*.

Urzedo, Danilo Ignacio, Jeffrey Neilson, Robert Fisher, and Rodrigo G.P. Junqueira. 2020. "A Global Production Network for Ecosystem Services: The Emergent Governance of Landscape Restoration in the Brazilian Amazon." *Global Environmental Change* 61 (March): 102059. https://doi.org/10.1016/j.gloenvcha.2020.102059.

Vailshery, Lionel Sujay, Madhumitha Jaganmohan, and Harini Nagendra. 2013. "Effect of Street Trees on Microclimate and Air Pollution in a Tropical City." *Urban Forestry and Urban Greening* 12 (3): 408–15. https://doi.org/10.1016/j.ufug.2013.03.002.

Venkataraman, K. 2008. "Access and Benefit Sharing and the Biological Diversity Act of India: A Progress Report." *Asian Biotechnology and Development Review* 10 (3): 69–80.

Verma, D.P.S. 1991. "Evaluation of Agroforestry Practices in Gujarat State, India." *Forest Ecology and Management, Agroforestry: Principles and Practice* 45 (1–4): 325–35. https://doi.org/10.1016/0378-1127(91)90227-M.

Verma, P., A. Bijalwan, M.J.R. Dobriyal, S.L. Swamy, and T.K. Thakur. 2017. "A Paradigm Shift in Agroforestry Practices in Uttar Pradesh." *Current Science* 112 (3).

Viswanath, S., P.A. Lubaina, S. Subbanna, and M.C. Sandhya. 2018. "Traditional Agroforestry Systems and Practices: A Review." *Advanced Agricultural Research & Technology Journal* II (I): 18–29.

XV Finance Commission. 2020. "Finance Commission in COVID Times: Report for 2021–26." New Delhi: XV Finance Commission.

Zanella, Matheus A., Christian Schleyer, and Stijn Speelman. 2014. "Why Do Farmers Join Payments for Ecosystem Services (PES) Schemes? An Assessment of PES Water Scheme Participation in Brazil." *Ecological Economics* 105: 166–76. https://doi.org/10.1016/j.ecolecon.2014.06.004.

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ABOUT WRI INDIA

WRI India is a research organization that turns big ideas into action at the nexus of environment, economic opportunity, and human well-being.

Our Challenge

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our Vision

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our Approach

COUNT IT

We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT

We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure that our outcomes will be bold and enduring.

SCALE IT

We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.