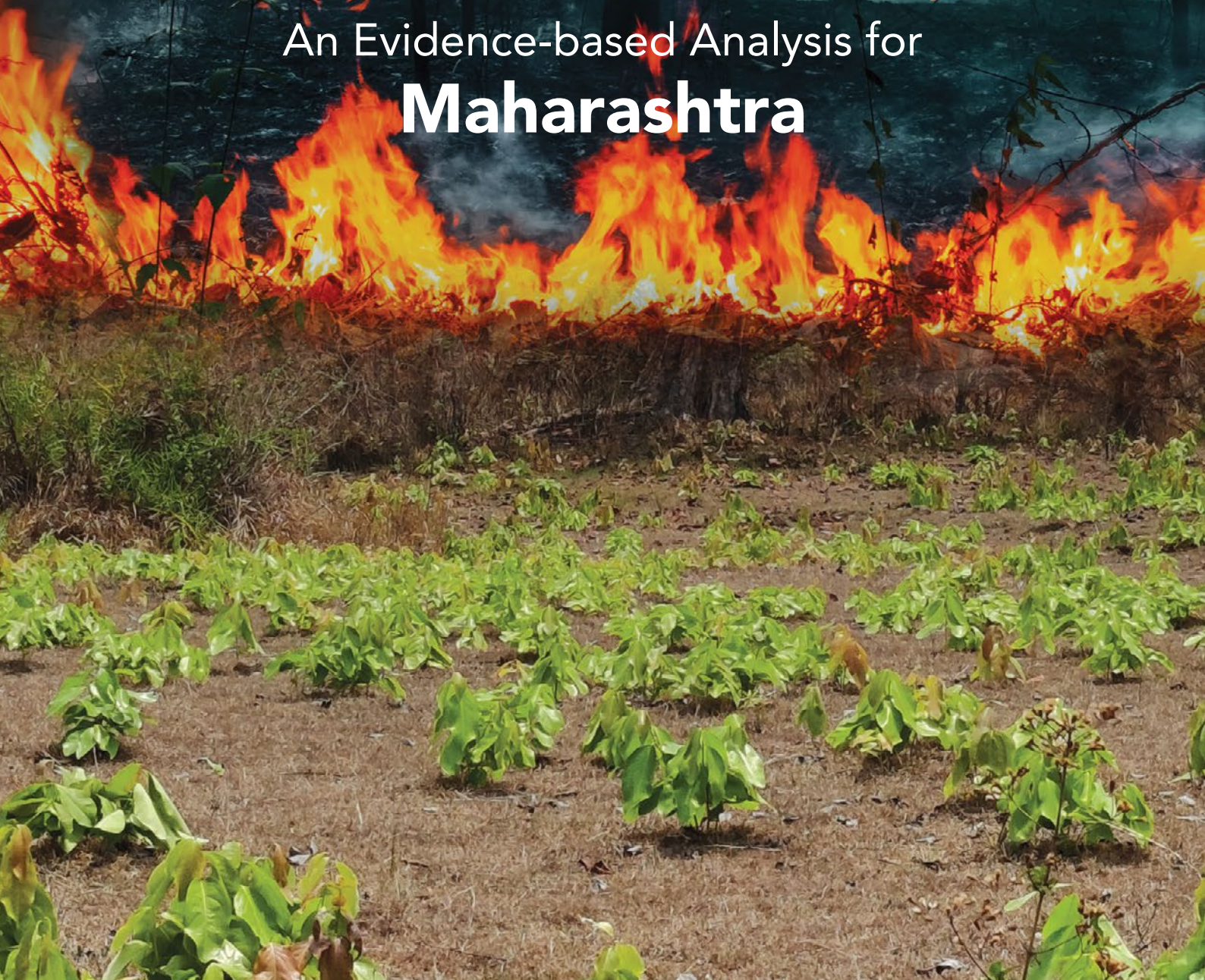


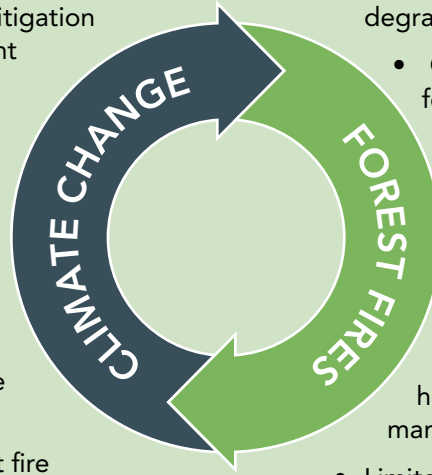
FOREST FIRES, CLIMATE CHANGE AND TENDU PATTA

An Evidence-based Analysis for
Maharashtra



FOREST FIRES – A VITAL CONCERN FOR MAHARASHTRA

- Global temperature increase will exceed 1.5°C & 2°C during the 21st century, making extensive mitigation & adaptation action an urgent priority.
- Extreme weather events are becoming more frequent and intense – being closely witnessed by Maharashtra.
- The State Council for Climate Change is strengthening the state's commitment towards climate action.
- The issue of increasing forest fire incidences needs to be addressed explicitly due to its circular relationship with climate change.



- Carbon sequestration benefits of forests are being threatened by rising degradation/forest fires.
- Over 40% of Maharashtra's forest area is extremely to moderately fire prone.
- 34,025 forest fires were recorded in the state during the last forest fire season (Nov 2020-June 2021), about 10% of India's total.
- While tracking & alert systems have improved, control & management remains inadequate.
- Limited understanding of specific responsible factors (95% human-made) and restricting focused action.

TENDU LEAVES & FOREST FIRES



Leaves of tendu or *Diospyros melanoxylon* tree are widely used for making bidis.

>300,000 mt of tendu leaves collected every year for producing >400 billion bidi sticks.

Uncontrolled fires frequently reported in tendu areas, as there is a traditional practice of using fires to cut back the young exposed shoots of tendu plant and to injure its roots so that they may coppice and produce fresh, green, good quality leaves for bidi rolling.

The practice has no scientific validity and is prohibited by law and discouraged by states, but is widely practiced. The Maharashtra government banned the collection and sale of tendu leaves from the forest fire affected areas in 2012. But data on instances of contract cancellation due to tendu fires is not available.

EXPLORING THE TENDU & FOREST FIRE LINKAGE IS IMPORTANT

- A prominent non-timber forest produce (NTFP) supported strongly by the state machinery – nationalized produce in Maharashtra since 1969
- Maharashtra is the sixth-largest producer of tendu leaves in the country, producing over 3.5 lakh standard bags annually (2017).

Tendu is used primarily to manufacture bidis, estimated to cost the nation ₹800 billion annually in illnesses and early deaths.

Significant contribution to forest health degradation, and the ecology of western ghats housed in the state

IFOREST STUDY OBJECTIVE & APPROACH



- To establish linkages between collection of tendu leaves and forest fires
- To assess the impact in terms of burnt area & emissions

Focus on Chhattisgarh, Maharashtra & Odisha - 36 per cent of forest fires incidences, 35 per cent of tendu leaf collection

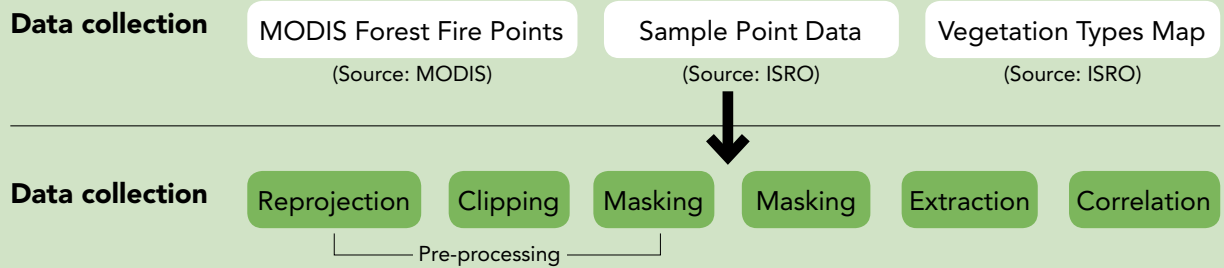


Utilize available satellite data on forest fires, vegetation type & emissions

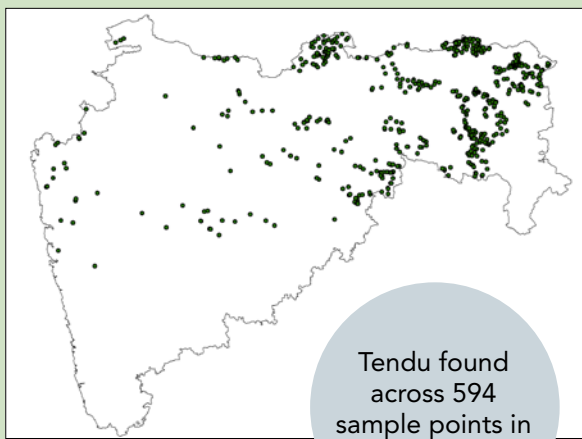
Mix of mapping, spatial, statistical, modeling and back-of-the-envelope analysis tools



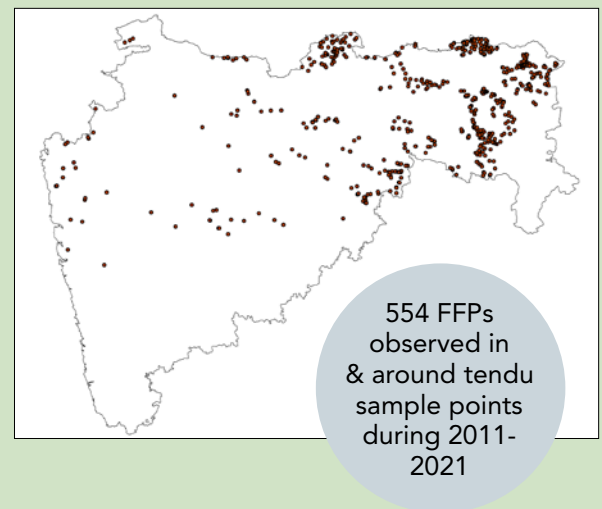
RESULT 1: SUBSTANTIAL OVERLAP IN TENDU AREAS & FOREST FIRE POINTS IN MAHARASHTRA



Distribution of tendu sample points



Distribution of tendu-linked forest fire points for 2011-21

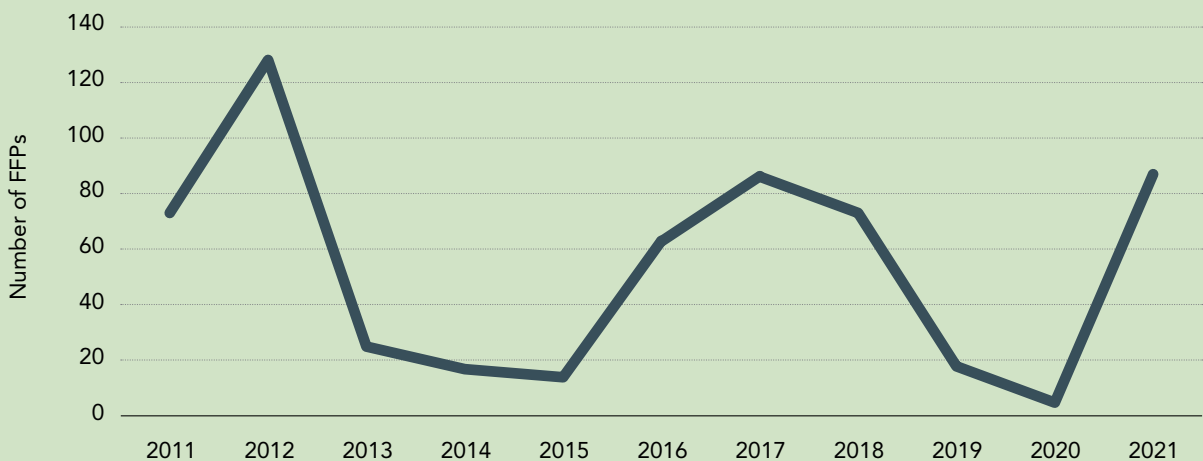


Source for forest fire points (FFPs): NASA's MODIS dataset

Source tendu sample points: P.S. Roy, S.P.S. Kushwaha, M.S.R. Murthy, A. Roy, M.C. Porwal, et al. 2012. Biodiversity Characterization at Landscape Level: National Assessment. Indian Institute of Remote Sensing, ISRO, Dehradun, India, ISBN: 81-901418-8-0

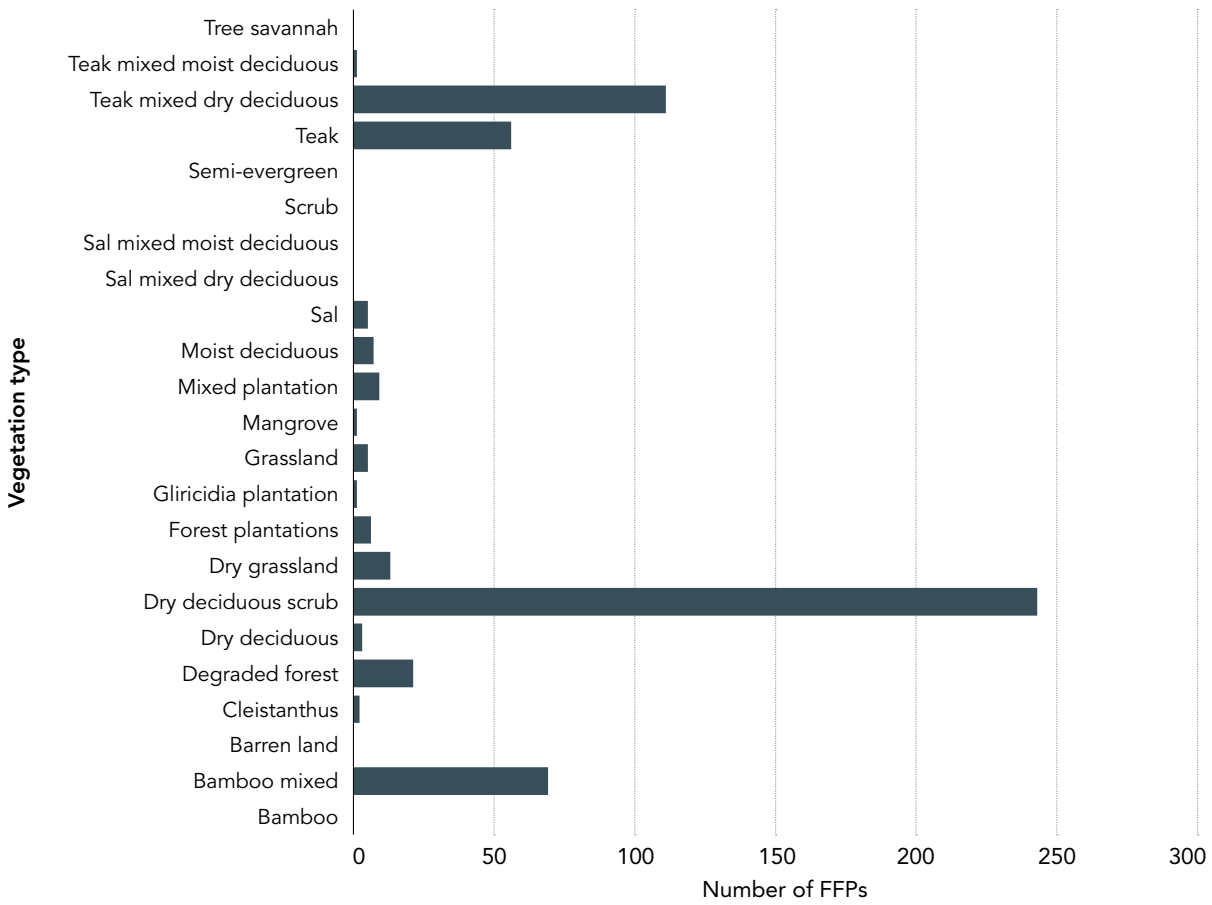
Tendu-linked FFPs observed to be fluctuating during the past decade, showing a decline around the mid-years (2013-2015) and then in 2019-2020

Tendu-linked forest fires during 2011-21



Tendu-linked FFPs observed to be predominantly occurring in dry deciduous, and teak mixed dry deciduous in the state.

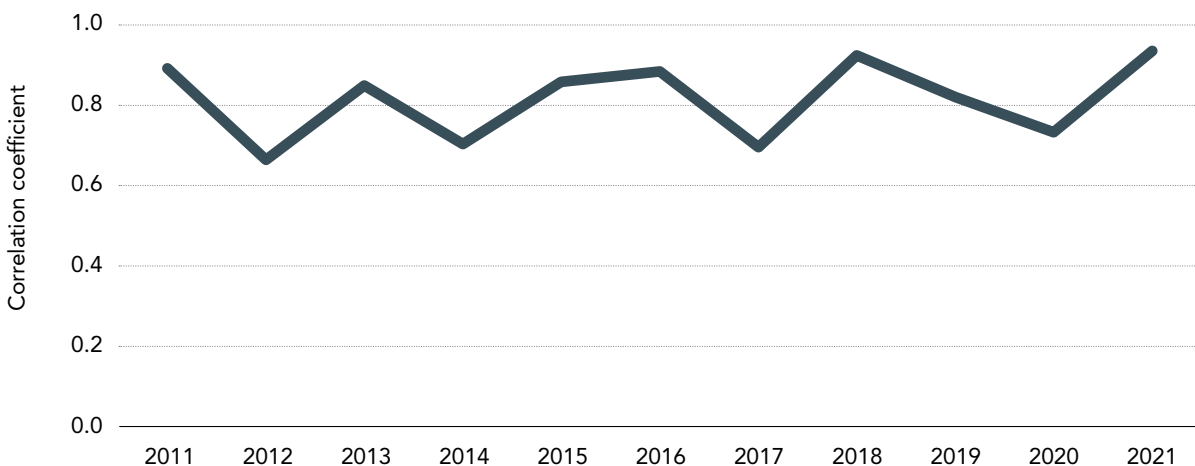
Vegetation type associated with tendu-linked FFPs in 2011-21



RESULT 2: STRONG POSITIVE CORRELATION EMERGING BETWEEN TENDU & FOREST FIRES

Correlation coefficient of over 0.8 for most years indicated tendu producing areas appear to have a very high susceptibility to forest fires.

State-wise correlation between forest fires and tendu



RESULT 3: TENDU-LINKED FIRES AFFECTING VAST TRACKS OF LAND

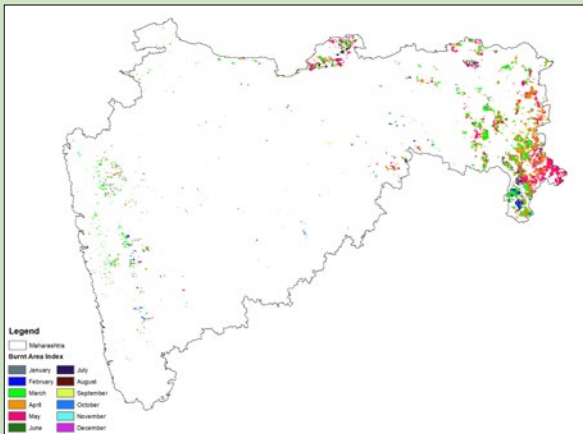
- Data from MODIS Burned Area Monthly Global; 500m resolution downloaded & clipped for 2011-21 for focus states
- Month-wise, state-wise burnt area index (BAI) distribution calculated

- Species distribution model (SDM) developed using Maxent model, tendu sample points & bioclimatic data (WorldClim)
- ROC curve and Jackknife test of variable importance conducted

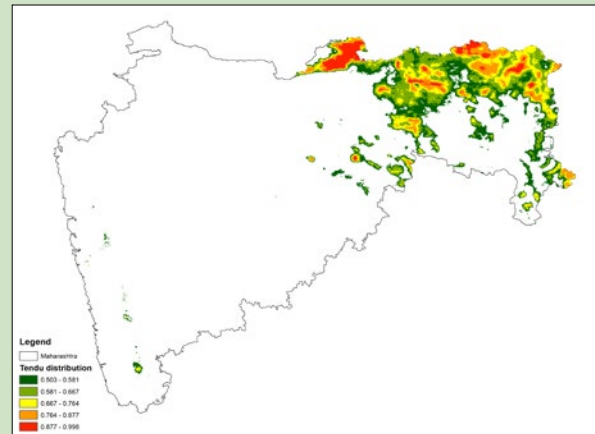
Total burn area due to forest fires in Maharashtra during 2011-21 is observed to be 13,284.5 sq km

SDM finds tendu to be located across 16,957 sq km mostly in eastern Maharashtra ~ quarter of the state's forest land area

Burn Area Index during 2011-21

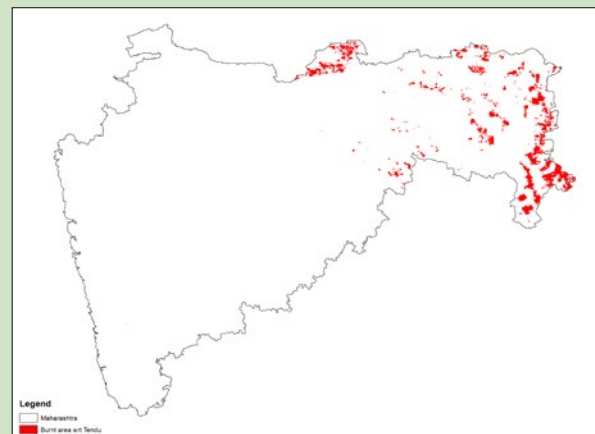


Potential species distribution of tendu



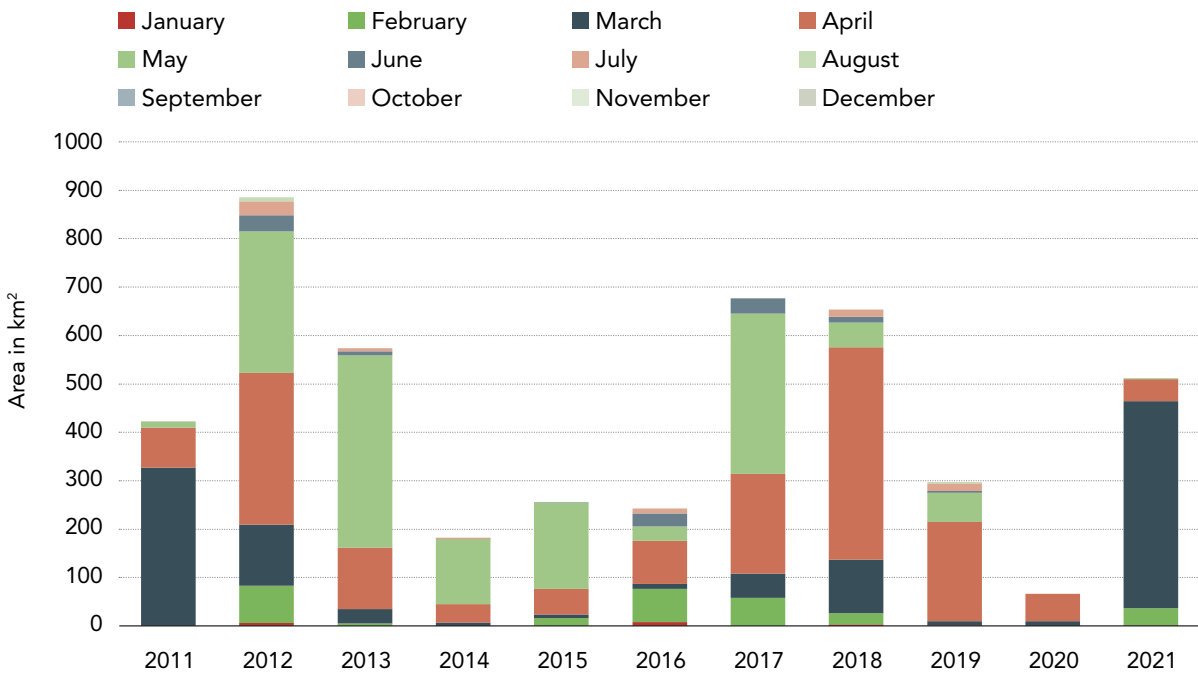
- Potential species distribution of tendu & BAI overlaid to calculate potential burnt area associated with tendu

Burnt area with respect to potential tendu distribution for 2011-21



Burnt area due to tendu-linked forest fires is estimated at 4,767 sq km for the 2011-21 period ~ one-third of the state's total burn area for the period

Year-wise, month-wise tendu-linked burnt area



Majority of the modeled tendu-linked burnt area is in March, April and May

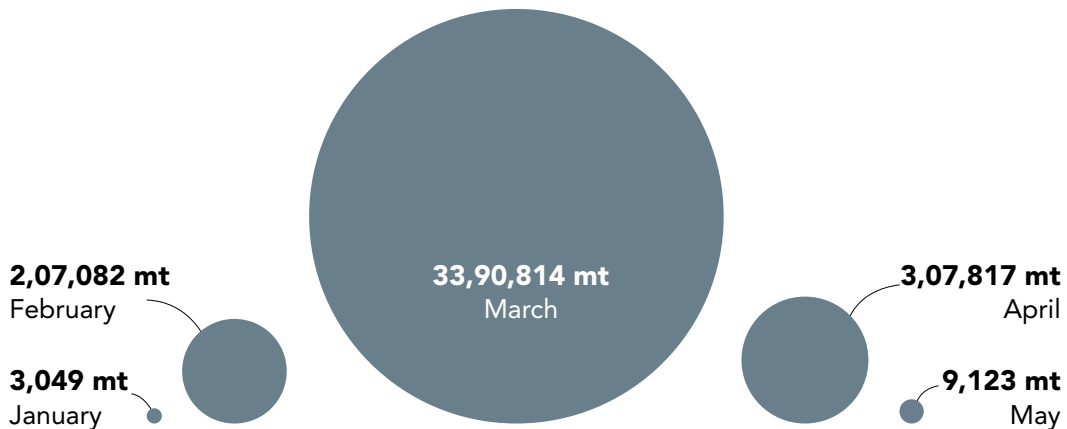
Modeled tendu-linked burnt area highest in 2012, 2017 & 2018, at an 600 sq km to 900 sq km

RESULT 4: TENDU-LINKED FOREST FIRES CONTRIBUTING SIGNIFICANTLY TO EMISSIONS

3.9 mt of CO₂ emissions, equivalent to annual emissions by 1.6 million cars, dominated by tendu related fires in Maharashtra during 2021

Data & Methodology: CO emissions data from the TROPOMI on the Sentinel 5 Precursor (S5P) satellite, treated for background emissions, and clipped for tendu BAI for the three states. CO₂ estimated assuming modified combustion efficiency for forest fires with smouldering combustion for dry deciduous type of forest.

Estimated CO₂ emissions attributed to tendu-forest fires in 2021



CONCLUSION

Fires are being widely used in tendu growing areas of Maharashtra

- iFOREST's study quantifies the association as strong and positive based on satellite datasets.
- While the individual tendu fires may not always be affecting large tracts of land, these fires put together amount to quite a vast land area:
 - » Estimated 4,767 sq km of forest area burnt in Maharashtra during 2011-21 due to tendu, which is nearly half the size of Sholapur district.
 - » Highest annual burnt area observed in 2012 at 885 sq km, which is more than the size of Pune city.
 - » Even in COVID affected 2020, tendu burnt area estimated to be 66 sq km, which is half the size of Mumbai district.
- State and central government laws and rules have had little impact on the ground.

THE WAY FORWARD

A clear and strong requirement emerges for strengthening the regulatory control on the use of fire for tendu patta collection from the climate and environment perspective. However, the way forward requires development and promotion of sustainable alternatives to tendu collection activity.

- Tendu collection, processing and related activities provide crucial short-term employment to a large proportion of forest dependent communities, especially during the lean agricultural season.
- The income being generated is low (estimated at ₹5,000 to ₹10,000 per family per season) but is valued supplementary income, given that the dependent families typically have very low levels of income, education, skills, land holding, and overall limited alternative employment opportunities.
- Any policy action against tendu collection needs to address the wellbeing of the dependent communities and create alternative livelihood opportunities.
- Successful examples exist of communities moving away from tendu collection. For instance, the Pachgaon village in Chandrapur district banned tendu leaves collection in 2012, and has since developed bamboo as a key NTFP for income generation.
- Maharashtra has enormous untapped potential for development of bamboo, palm, palash, chironji, vijaysar and other utility and medicinal NTFPs. Detailed analysis can help identify their growth potential as reliable alternatives for tendu collectors.
- Significant efforts and investments would be required for building market linkages and for developing value add industries to maximize the benefits for communities.
- The booming carbon market is potentially a strong source of funding in order to transition away from tendu, given study's findings on tendu's massive GHG contribution. Already, investment in low-carbon transition future of communities is a key priority area for carbon funds.
- Financial incentives and capacity support for communities would be the key for development of alternatives – critical for phase-out of tendu patta collection activity.