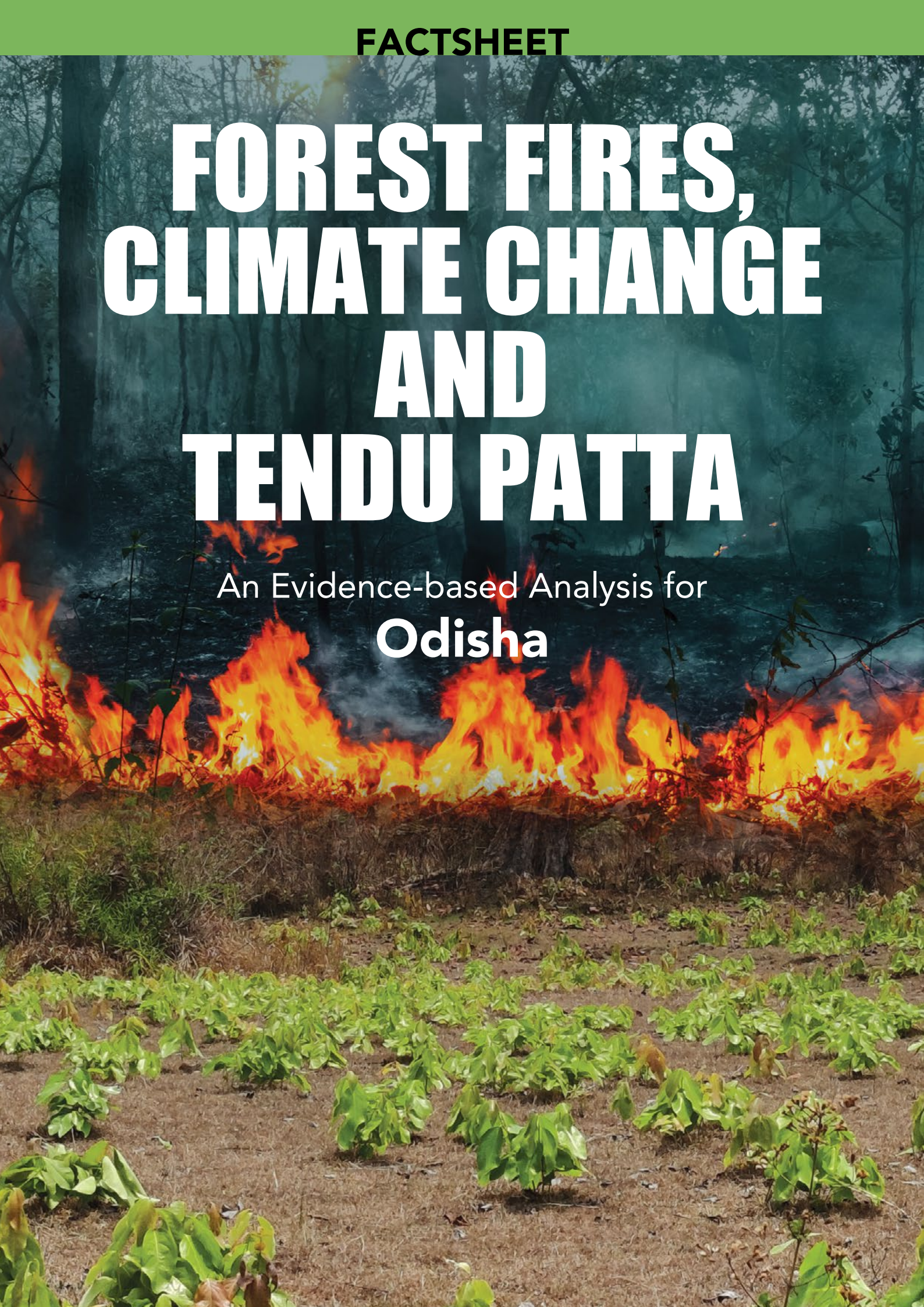


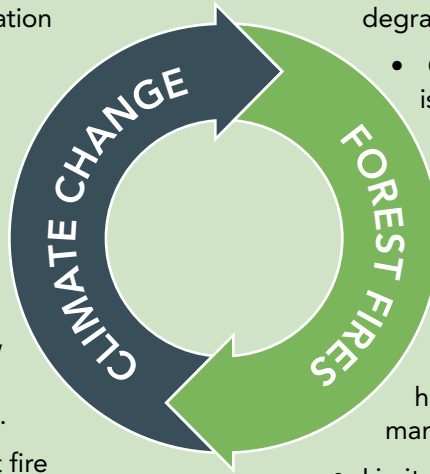
# FOREST FIRES, CLIMATE CHANGE AND TENDU PATTA

An Evidence-based Analysis for  
**Odisha**



## FOREST FIRES – A VITAL CONCERN FOR ODISHA

- 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 Odisha.
- The state has done commendably well in rolling out disaster risk reduction measures, but now needs to focus on proactive approach towards mitigation.
- 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 43% of Odisha's forest area is extremely to moderately fire prone.
- 51,968 forest fires were recorded in the state during the last forest fire season (Nov 2020-June 2021), highest amongst all states.
- While tracking & alert systems have improved, control & management remains inadequate.
- Limited understanding of specific responsible factors (95% human-made), 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 are 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. Odisha government sets aside a budget for funding bush cutting of tendu plants (₹35 crore for crop year 2021) to stop collectors from using fires.

## EXPLORING THE TENDU & FOREST FIRE LINKAGE IS IMPORTANT

- A prominent non-timber forest produce (NTFP) supported strongly by the state machinery – nationalized produce in Odisha since 1961
- Odisha is the fifth largest producer of tendu leaves in the country, producing over 3.6 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, causing massive loss of flora and fauna and depletion of soil and water quality

## 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

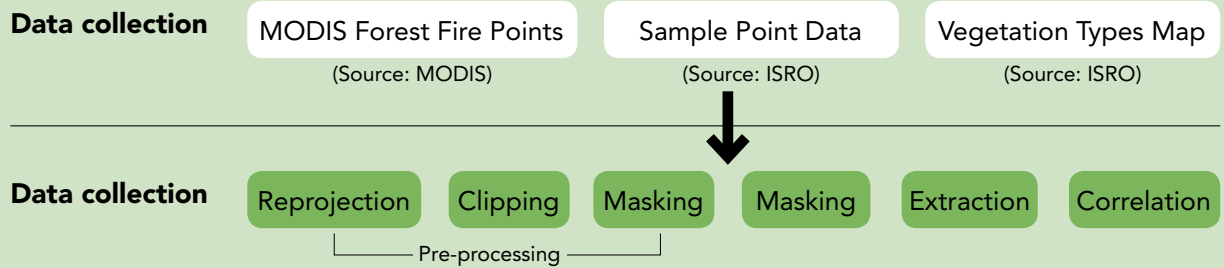


Utilize available satellite data on forest fires, vegetation type & emissions

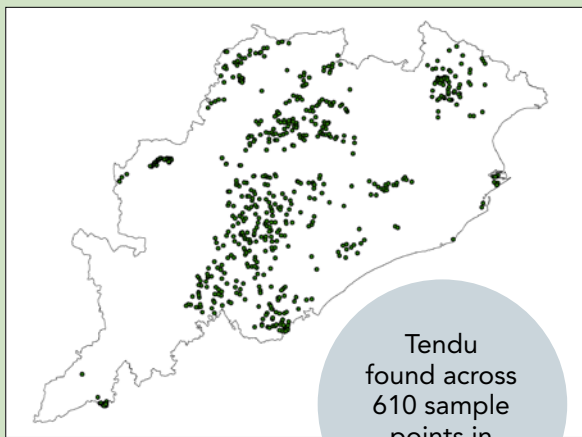
Mix of mapping, spatial, statistical, modeling and back-of-the-envelope analysis tools



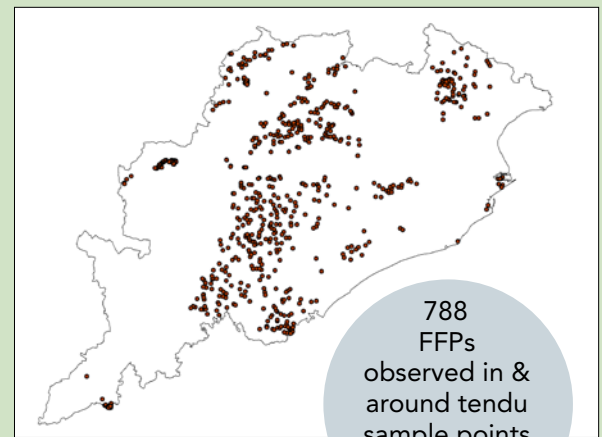
# RESULT 1: SUBSTANTIAL OVERLAP IN TENDU AREAS & FOREST FIRE POINTS IN ODISHA



**Distribution of tendu sample points**



**Distribution of tendu-linked FFPs for 2011-21**

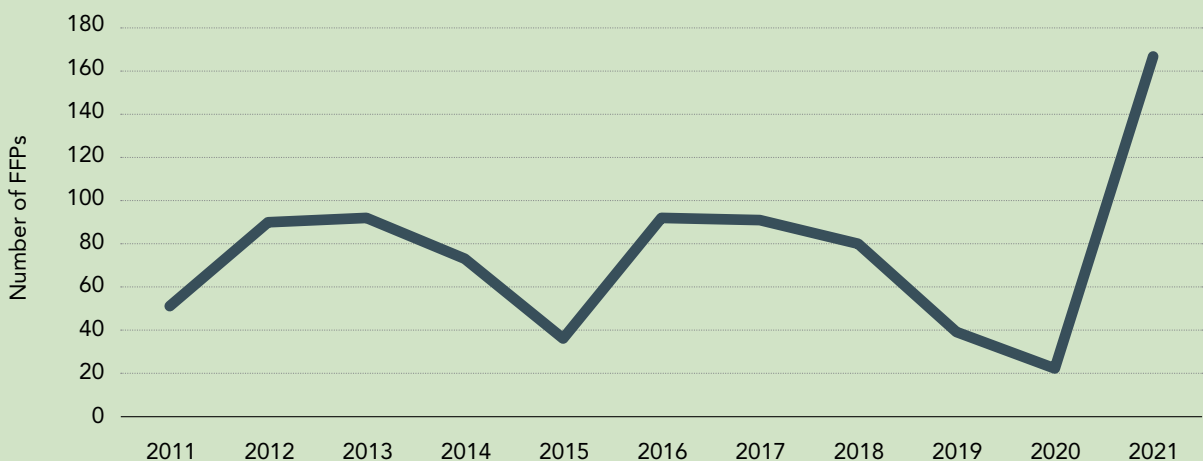


Source for forest fire points (FFPs): NASA's MODIS dataset

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

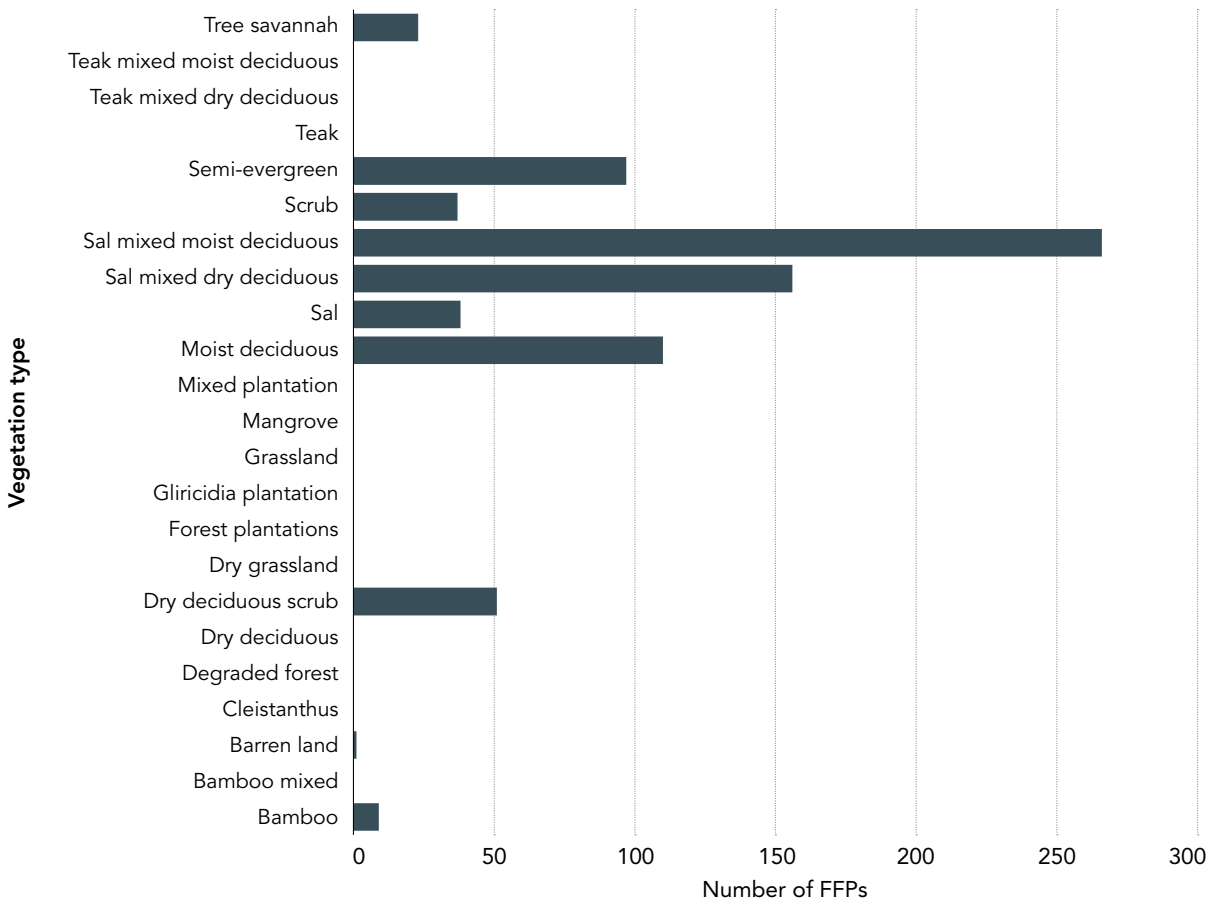
Tendu-linked FFPs observed to be fluctuating during the past decade, showing a decline around the mid-years (around 2015) and then in 2020.

**Tendu-linked forest fires during 2011-21**



Tendu-linked FFPs observed to be predominantly occurring in Sal mixed moist deciduous and Sal mixed dry deciduous forest area.

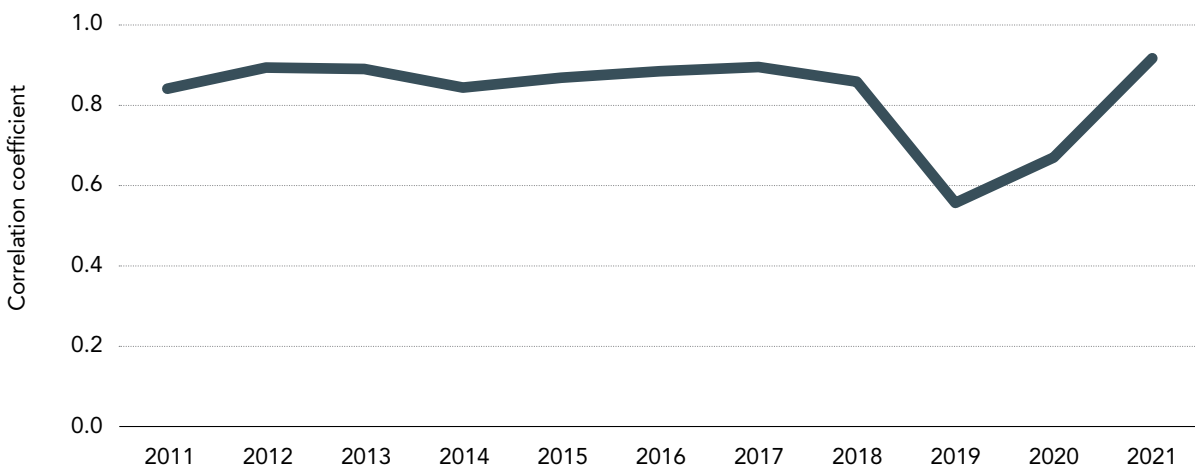
**Vegetation type associated with tendu-linked FFPs in 2011-21**



**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 in Odisha.

**State-wise correlation between forest fires and tendu**



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

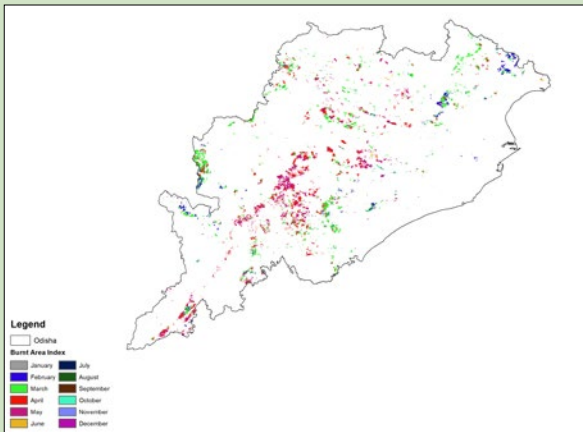
- Data from MODIS Burned Area Monthly Global; 500m resolution downloaded & clipped for 2011-21 for focus states
- Month-wise, state-wise burnt area index (BAI) distribution calculated

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

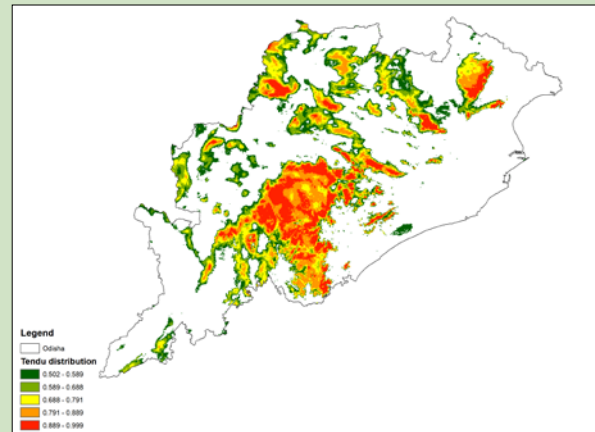
Total burn area due to forest fires in Odisha during 2011-21 is observed to be 9,085 sq km

SDM finds tendu to be located across 22,904 sq km, ~ 37% of the state's forest land area

**Burn Area Index during 2011-21**

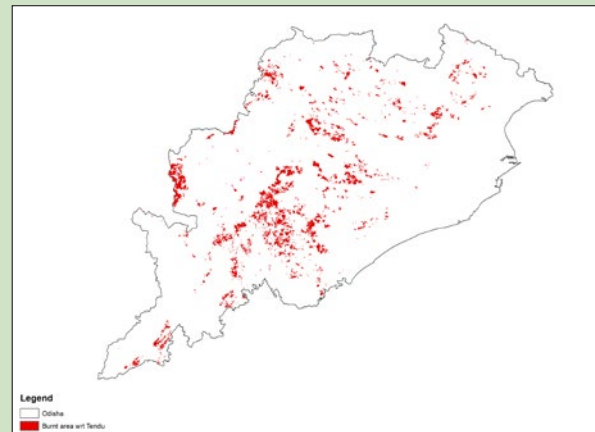


**Potential species distribution of tendu**



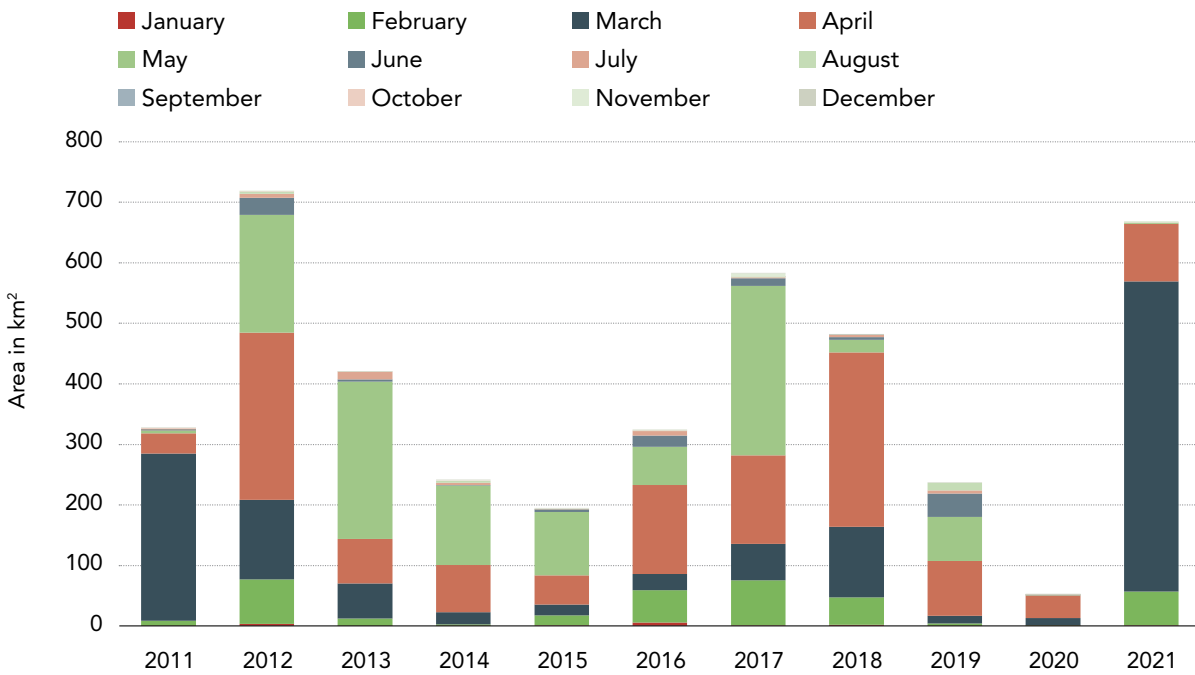
- Potential species distribution of tendu & BAI overlaid to calculate potential burnt area associated with tendu

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



Burnt area due to tendu-linked forest fires is estimated at 3,018 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

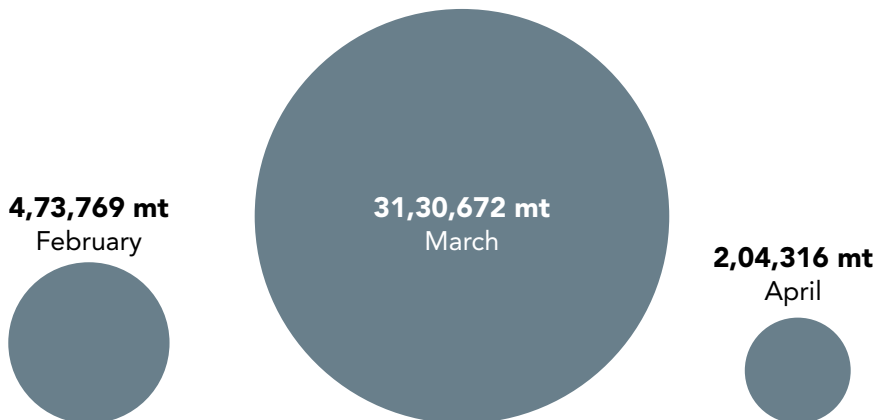
Modeled tendu-linked burnt area highest in 2012, 2014 & 2021, at 500 sq km to 700 sq km

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

3.8 million mt of CO<sub>2</sub> emissions, equivalent to annual emissions by 15.2 million cars, dominated by tendu related fires in Odisha 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. CO<sub>2</sub> estimated assuming modified combustion efficiency for forest fires with smouldering combustion for dry deciduous type of forest.

### Estimated CO<sub>2</sub> emissions attributed to tendu-forest fires in 2021



## CONCLUSION

### Fires are being widely used in tendu growing areas of Odisha

- 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 3,018 sq km of forest area burnt in Odisha during 2011-21 due to tendu, which is nearly equal to the size of Puri district.
  - » Highest annual burnt area observed in 2021 at 676 sq km, which is nearly three times the size of Cuttack city.
- 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 of Maharashtra banned tendu leaves collection in 2012, and has since developed bamboo as a key NTFP for income generation.
- Odisha has enormous untapped potential for development of sal, mahua, chironji, kusum, bhela 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.