Patterns and Trends in Open Biomass Burning in West Bengal

Report Prepared by

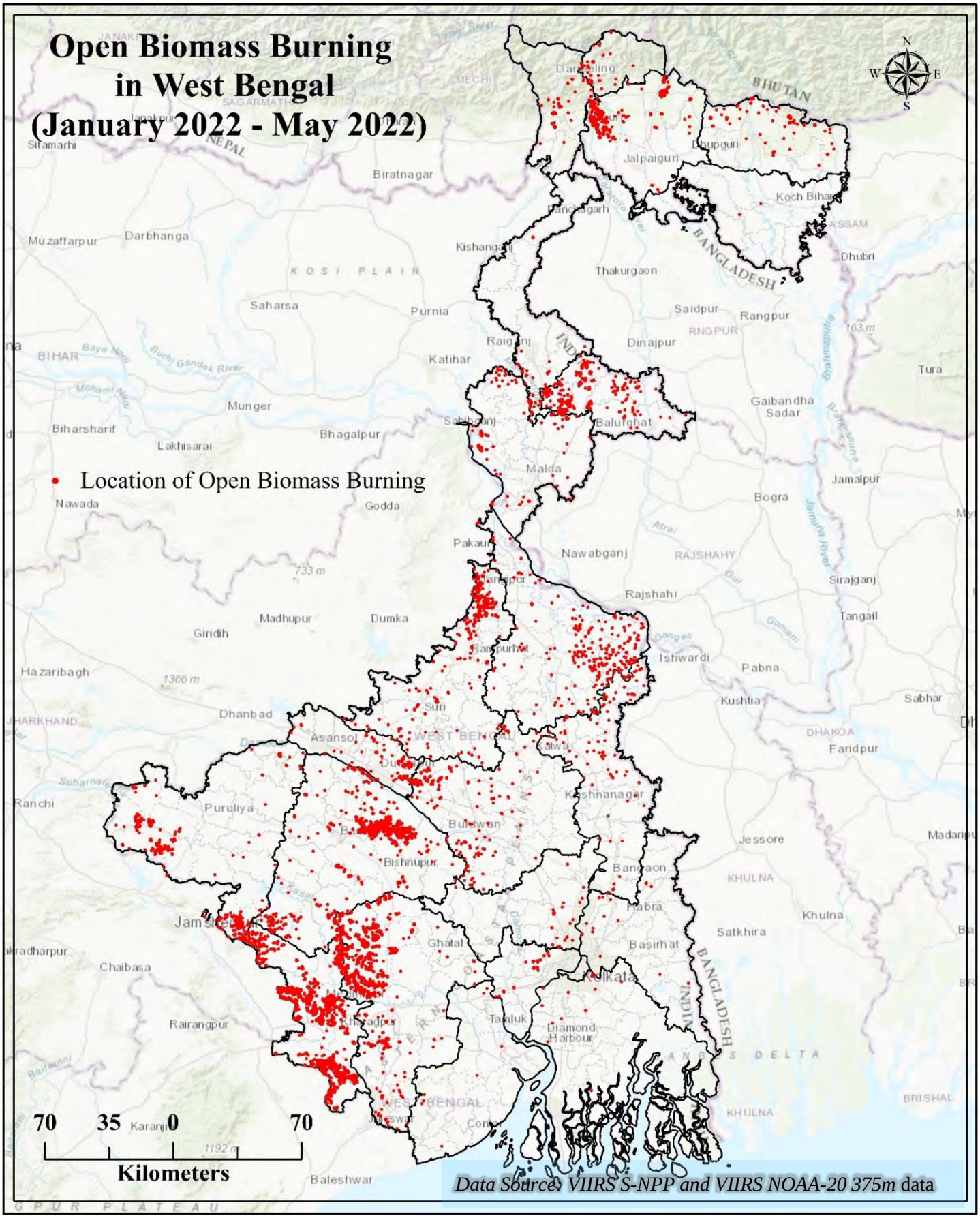
IIT Delhi

Supported by

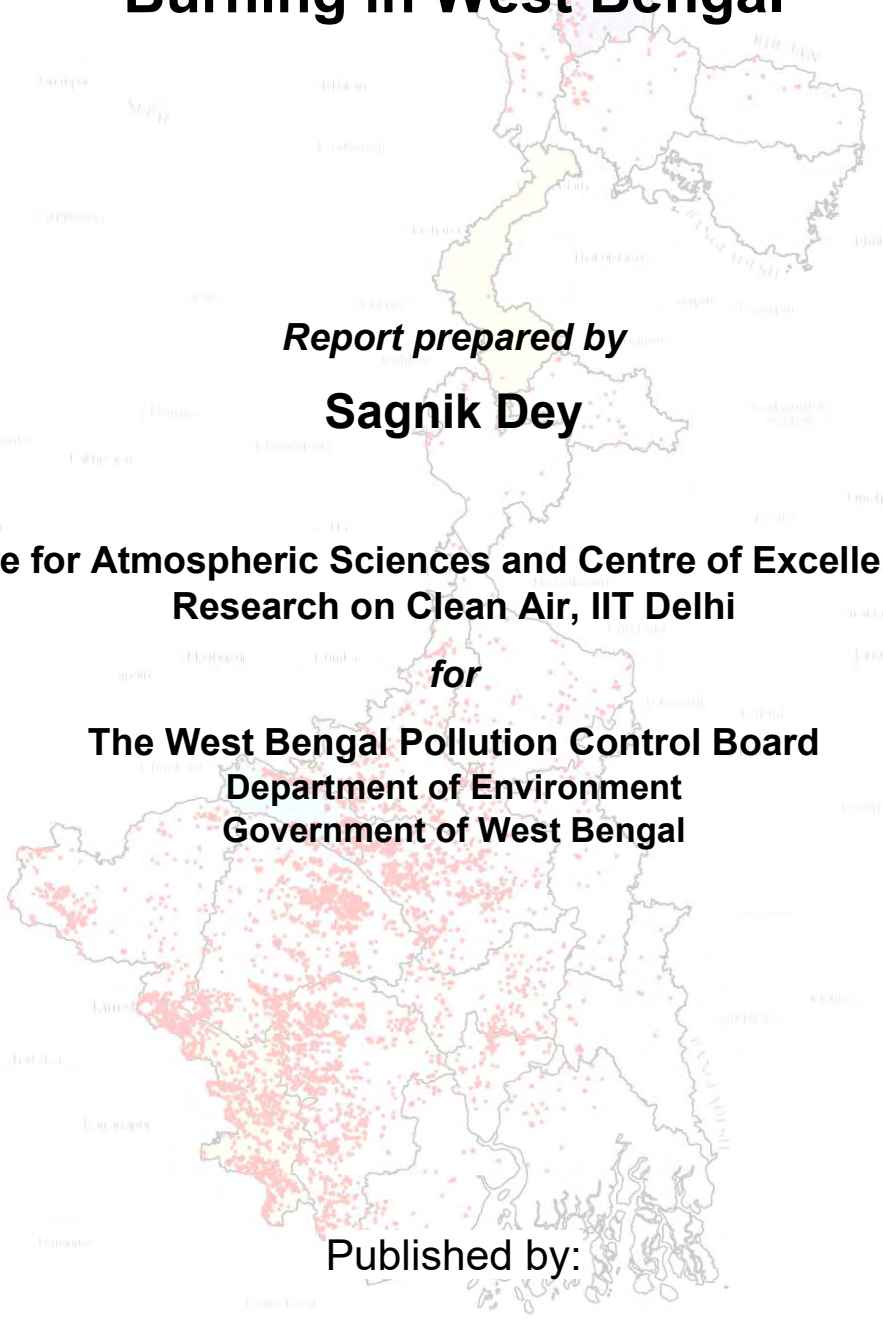
West Bengal Pollution Control Board

Department of Environment

Government of West Bengal


Open Biomass Burning
in West Bengal
(January 2022 - May 2022)
Location of Open Biomass Burning
70 35 0 70
Kilometers
Data Source: VIIRS S-NPP and VIIRS NOAA-20 375m data

Patterns and Trends in Open Biomass Burning in West Bengal



Report prepared by

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for

The West Bengal Pollution Control Board
Department of Environment
Government of West Bengal

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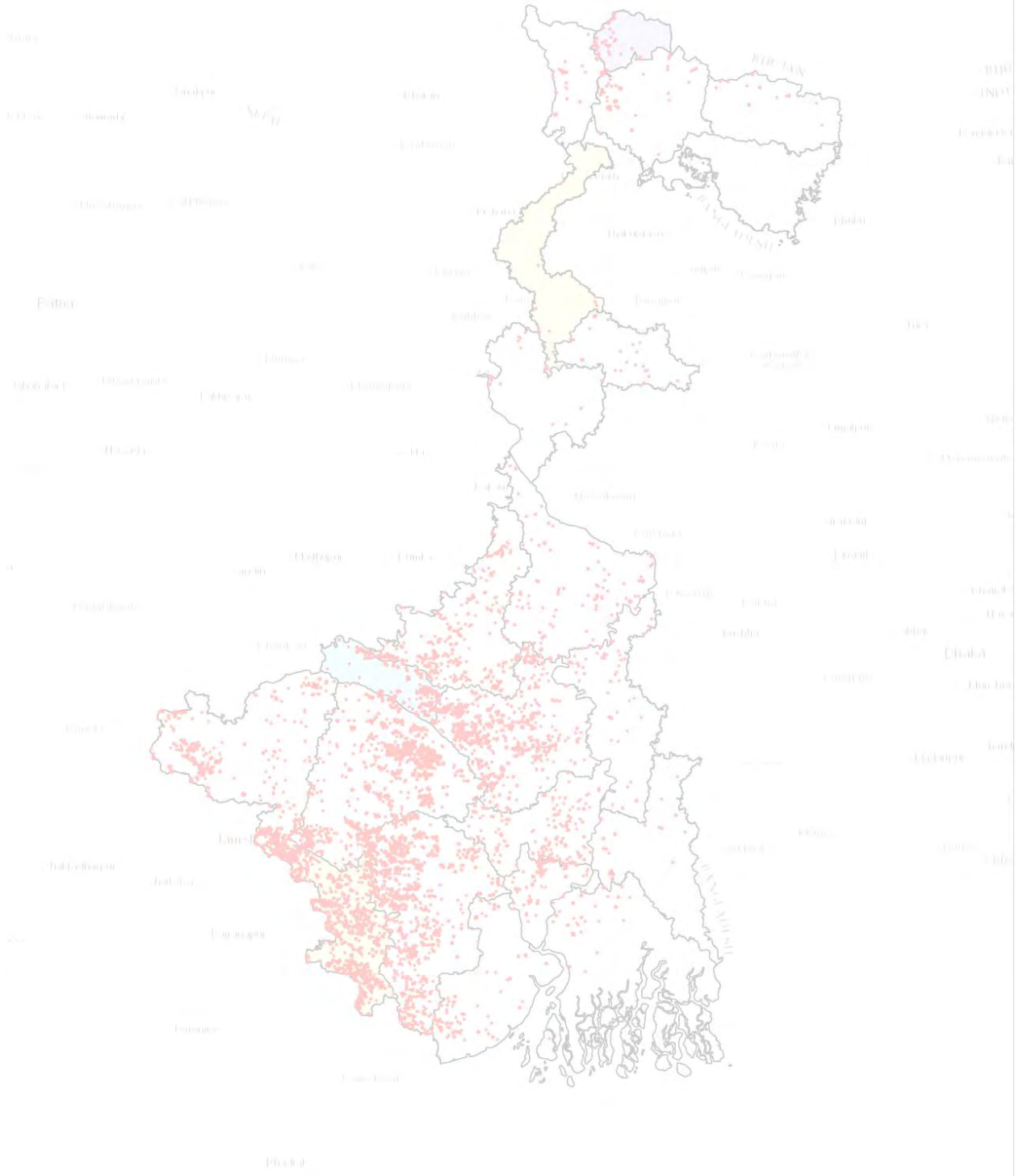
Centre for Atmospheric Sciences and Centre of Excellence for Research on Clean Air, IIT Delhi



ডঃ রত্না দে নাগ
রাষ্ট্রমন্ত্রী (স্বাধীন দায়িত্বপ্রাপ্ত)
বিজ্ঞান ও প্রযুক্তি এবং জৈবপ্রযুক্তি দপ্তর
পশ্চিমবঙ্গ সরকার
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Message

As we know that, air pollution is a burning environmental problem now-a-days all over the world. India is also facing the same challenge and West Bengal is no exception at all. The Govt. of West Bengal is taking all possible measures to combat it across the State.

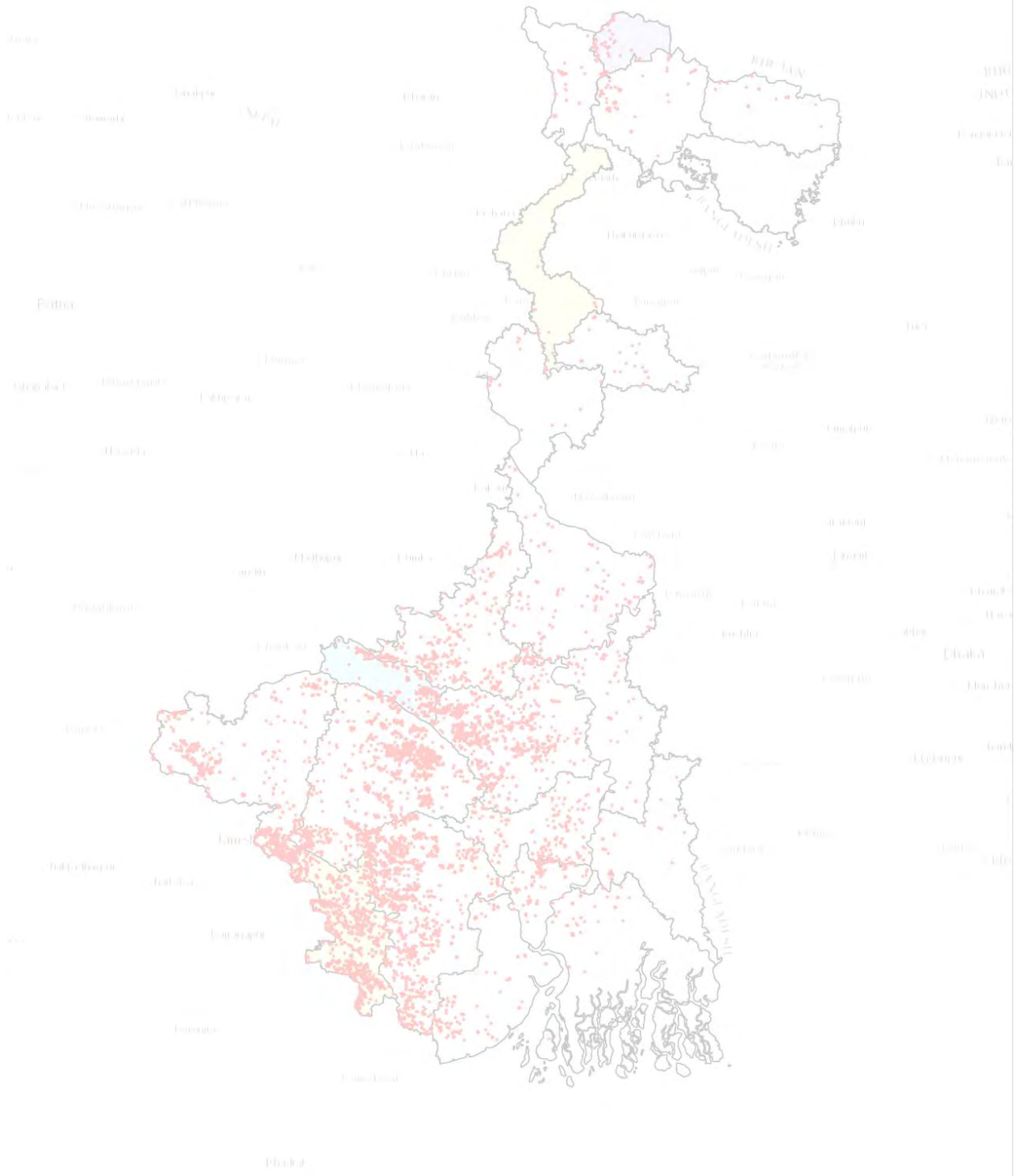
Amongst various causes behind the problem of rising air pollution, crop residue burning or biomass burning in open air and forest fire is one of the major threats in an agro-based State like West Bengal. The State government is considering the matter very seriously and intends to prepare the necessary action plan to tackle the problem efficiently.

In this context, IIT- Delhi had conducted a year-long (July 2020 to June 2021) GIS technology-based study, which was supported by the West Bengal Pollution Control Board. At the end of this study, I am very happy to release the final report, entitled- 'Patterns and Trends in Open biomass Burning in West Bengal' on the occasion of the World Environment Day.

I cordially thank the whole team of IIT-Delhi led by Prof. Sagnik Dey and Shri Arun Duggal for carrying out the important study and presenting their findings along with the valuable recommendations in the form of a compact report. I would also like to congratulate the WBPCB for taking such a fruitful initiative and giving their necessary input as well as support for conducting the study successfully.

Ratna De.

Dr. Rantna De Nag
Minister of State (Independent Charge),
Department of Environment
Government of West Bengal



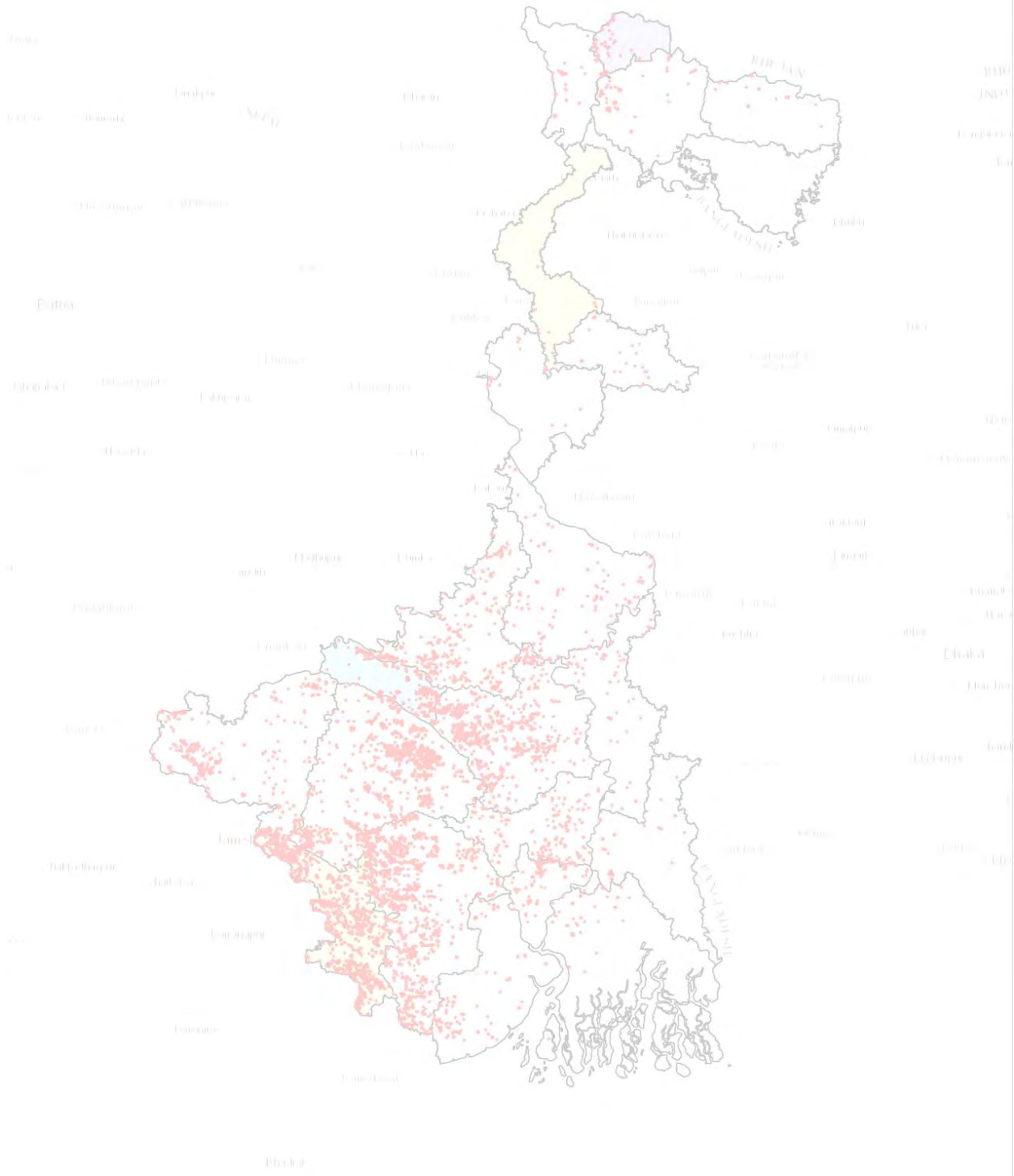
Foreword by the Chairman, WBPCB

It is a matter of great pleasure for me to write the foreword to this important publication. Air quality management has become a challenging issue not only in India but also in many other parts of the world. West Bengal is no exception. Seven cities/towns have already been declared as non-attainment cities/towns. One of the major mandates of WBPCB is to monitor the air quality all over the state. It is also important to identify the sources of pollution and take necessary remedial measures. In this background, WBPCB assigned a project to IIT Delhi entitled "GIS-based information system for air quality management in West Bengal". Prof Sagnik Dey (Centre for Atmospheric Sciences, IIT Delhi and Coordinator, Arun Duggal Centre of Excellence for Research in Clean Air (CERCA), IIT Delhi) took the leadership along with Sri Sanjib Mondal (RS GIS Specialist, Research Fellow). The team worked during the period commencing from 01/07/2020 to 30/06/2021. The work has been done based on a satellite-based monitoring system where near real-time VIIRS fire count data was procured from the Fire Information for Resource Management System and analysed on the GIS platform.

Crop residue burning has increasingly become an important issue in our state. It is observed that, as the month of November to December is the harvesting season of Kharif paddy in West Bengal, crop residue burning is a common phenomenon in several districts of West Bengal during this season. This form of open biomass burning is also prevalent in April following Bodo paddy harvesting, causing significant air pollution. Further forest fires or ignition in forests by humans and burning in coal mining areas deepen our anxiety. Forest fires are mainly found in the Jangal Mahal area of western West Bengal and in the northern hilly forest. Every year, from the end of January to the end of March, this type of incidence is witnessed. It is alarming that most of the forest fires occurred in western West Bengal in March. As the prevalence of different forms of open biomass burning escalates, WBPCB is treating the issue seriously. Trend analysis, constant monitoring, and management of open biomass burning are our main areas of focus. From November 2020 to April 2021, a total of 7004 incidences have been identified. The highest cases were reported in March 2021, with 2765 cases. In this view, the mouza level report is forwarded to the district authorities daily and we urged concerned authorities to take swift action to stop such incidents.

There was a need for a report that would include all the important information regarding open biomass burning, which causes air pollution in our state, to help with environmental planning and policy formulation. I am convinced that the facts offered in this report will assist various state bodies in making decisions.

Dr. Kalyan Rudra
Chairman
West Bengal Pollution Control Board



ডঃ রাজেশ কুমার, আইপিএস
Dr. Rajesh Kumar, IPS

সদস্য সচিব
পশ্চিমবঙ্গ দূষণ নিয়ন্ত্রণ পর্ষদ
Member Secretary
West Bengal Pollution Control Board

Preface

I am very happy that on the auspicious occasion of the World Environment Day-2022, we are going to publish a very useful report, titled- '**Patterns and Trends in Open Biomass Burning in West Bengal**' prepared by the IIT-Delhi. The report is based on the project on GIS-based information system for air quality management in West Bengal, which was supported by the WBPCB. The main objective of this project was to highlight and examine through the patterns and trend analysis using satellite-derived data of 08 years (during 2012 to 2020) of a number of issues like, open biomass burning, crop residue burning, forest fire incidents, unregulated fire in open coal mines etc. which are enhancing the extent of air pollution in West Bengal.

Being an agro-based economic structure with year-round crop cultivation generates a large amount of agricultural waste, including crop residues across West Bengal. The State is vulnerable to the problem of stubble burning and forest fire incidents in the districts like Bankura, Purulia, Jhargram, Paschim Medinipore, part of Purba Medinipore with maximum forest cover; coal fires are common mainly in the northern part of Paschim Bardhaman districts. These types of incidents cause excessive particulate matter ($PM_{2.5}$ and PM_{10}) emissions leading to air pollution. Crop residue burning has become a major environmental problem causing health issues as well as contributing to global warming. The government of West Bengal intends to curtail this problem through the best possible measures promoting sustainable management methods with special thrust on making the farmers and local people aware about the harmful effects of this practice.

This report is a resourceful documentation containing the description about the overview of open biomass burning problem, satellite fire data analysis, its methodology, pattern and district-wise analysis of open biomass burning status in West Bengal and some recommendations towards probable ways to stop such incidents in order to improve the ambient air quality across the State.

In this perspective, on behalf of the WBPCB, I heartily convey my gratitude to the team of IIT-Delhi for taking up such study for the first time and publish this report within the stipulated time period. I hope that the WBPCB will carry out and support many more projects/studies for the sake of environmental protection in the future as committed.

Dr. Rajesh Kumar
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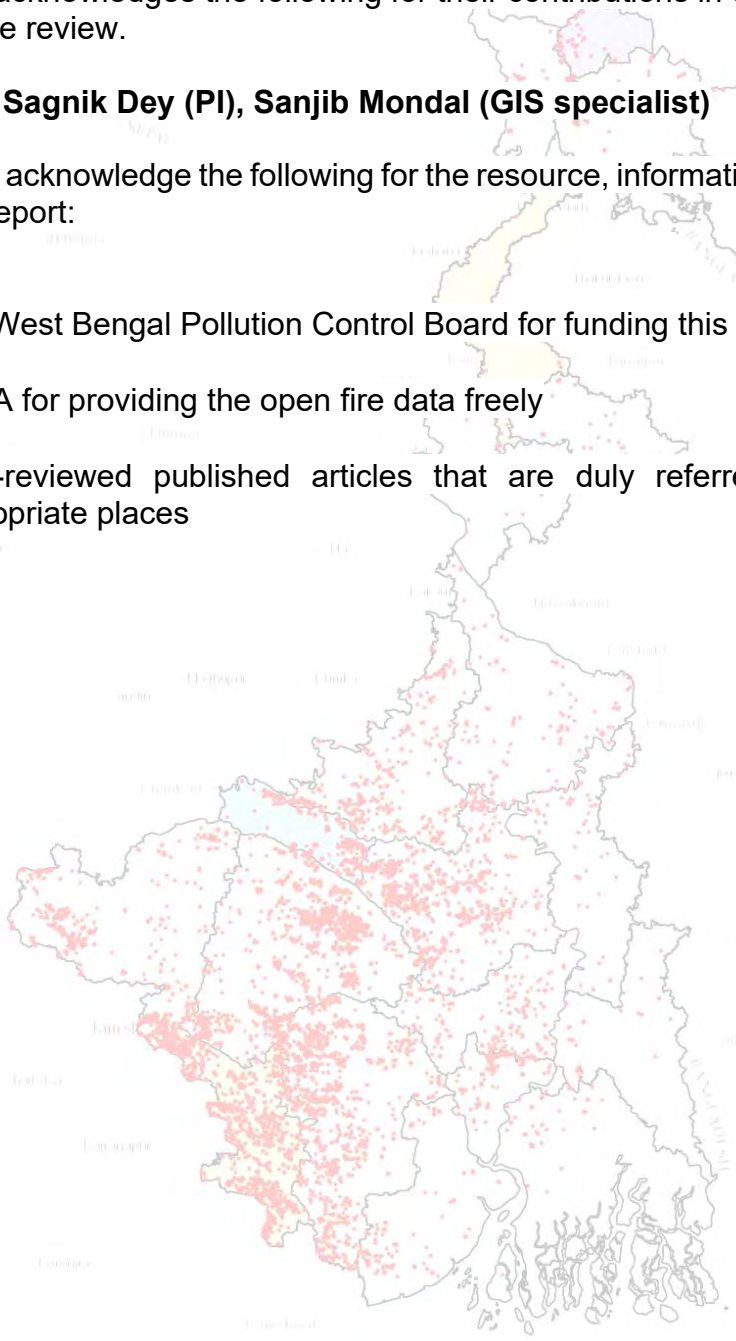
The author acknowledges the following for their contributions in data collection, analysis, and literature review.

Team: **Prof Sagnik Dey (PI), Sanjib Mondal (GIS specialist)**

The authors acknowledge the following for the resource, information, discussion, and data use in this report:

- The West Bengal Pollution Control Board for funding this work
- NASA for providing the open fire data freely
- Peer-reviewed published articles that are duly referred to in the report at appropriate places



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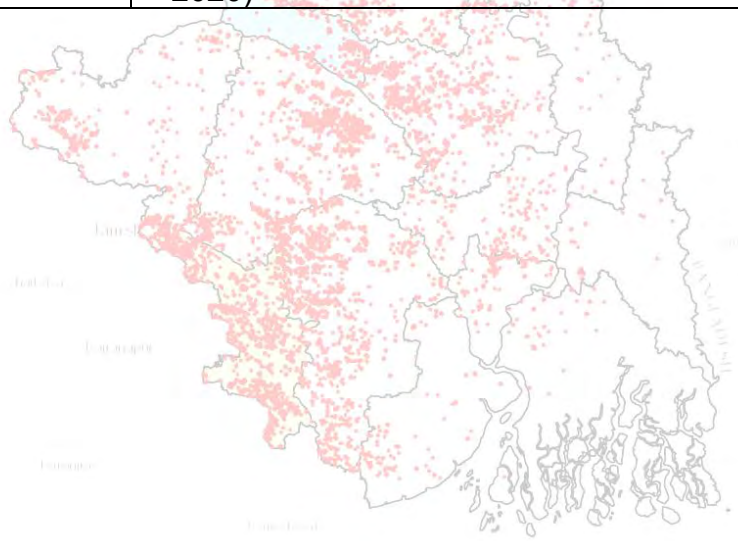

Executive Summary

Open biomass burning is a major source of air pollution. Amongst the various open biomass burning events, crop-residue burning (CRB), and forest fire are quite prominent in West Bengal. In addition, unregulated fire is observed in coal mines. This report, for the first time, examines the patterns and trends in open biomass burning in West Bengal using satellite-derived fire data for the period 2012-2020. The types of burning are identified utilizing the land use data. In this report, municipal solid waste burning is not included.

Farmers in West Bengal burn stubble after the Kharif and Rabi cultivation to prepare their fields for the next cultivation. This is one of the least expensive and quickest ways to remove stubble. 18 Blocks have been identified as regions where a total of more than 200 occurrences of CRB have been reported in the last nine years (2012 to 2020). Domkal in Murshidabad and Harirampur in Dakshin Dinajpur saw the highest number of fire incidents in April, which were caused by wheat residue burning. Purba Bardhhaman's Bhatar and Galsi I Block witnessed fire incidents primarily in December because of rice residue burning. Further, statistics of CRB have been extracted at the mouza level to identify the most vulnerable regions and facilitate the local administrations to take preventive measures. CRB in the post-Kharif season is confined to November until January, with the highest incidences in December. Purba Bardhhaman, Paschim Medinipur, Hooghly, Bankura, and part of Birbhum are the most prominent Districts for the Kharif season burning. In the post-Rabi season, CRB is observed in Murshidabad, Dakshin Dinajpur, Nadia, the northern part of Birbhum, and in part of Malda, mostly in April. It is found that most farmers are unaware of pollution caused by CRB.

From February to April, forest fires are frequent in the forest-dominated region of West Bengal, with a peak in March. Bankura, Purulia, Jhargram, Paschim Medinipur and part of Purba Medinipur are the most affected Districts by forest fire. Forest fires primarily are man-made, set to clean up the entrance to the forest to be able to easily collect Mohua (Madhuca longifolia) flowers. Cleaning of the forest floor also helps forest dwellers to freely gain access to the forest. Some forest fringe areas fall under the elephant corridor, which is frequently used by elephants in search of food. Villagers set fire to prevent elephants from entering the residential areas and destroying crops and houses. Sometimes, bushfires are set by local animal hunters belonging to the tribal community. Interventions from the state government through community engagement program is recommended.

Coal fire is confined only to the northern section of Paschim Bardhhaman. Engagement with farmers and tribal communities, the establishment of a dynamic surveillance system, and affordable solutions for in-situ and ex-situ stubble management are recommended to address open biomass burning in the state.

Chapter I: Open Biomass Burning – Background and Motivation

1.1 Background:

Exposure to air pollution is the biggest environmental health risk in India.[1] According to the Global Burden of Disease study,[2] more than a million people die every year due to air pollution, resulting an economic loss of ~1.36% of the country's GDP.[3] The National Clean Air Program (NCAP) has been launched by the Government of India to accelerate the implementation of intervention policies to curtail the rising air pollution.

Under the NCAP, a national ambient $PM_{2.5}$ database has been created to examine the trends in air pollution over the last two decades.[4] Analysis reveals that ambient $PM_{2.5}$ exceeds double the Indian national ambient air quality standard (NAAQS) of 40 $\mu g/m^3$ in the entire Indo-Gangetic Plain (IGP) (Figure 1.1). West Bengal is situated at the downwind receiving the pollution outflow from the entire IGP.[5] This is eminent from the study by Purohit et al.[6], where only 59% of annual $PM_{2.5}$ in 2015 was found to be contributed by emissions from within the state (Figure 1.1). 17% of annual PM_{25} in 2015 was contributed by emissions from the neighbouring states, 7% from outside India (Bangladesh and beyond), 7% from far away from within India (primarily western IGP states) and the remaining 2% from natural sources like dust and maritime aerosols.

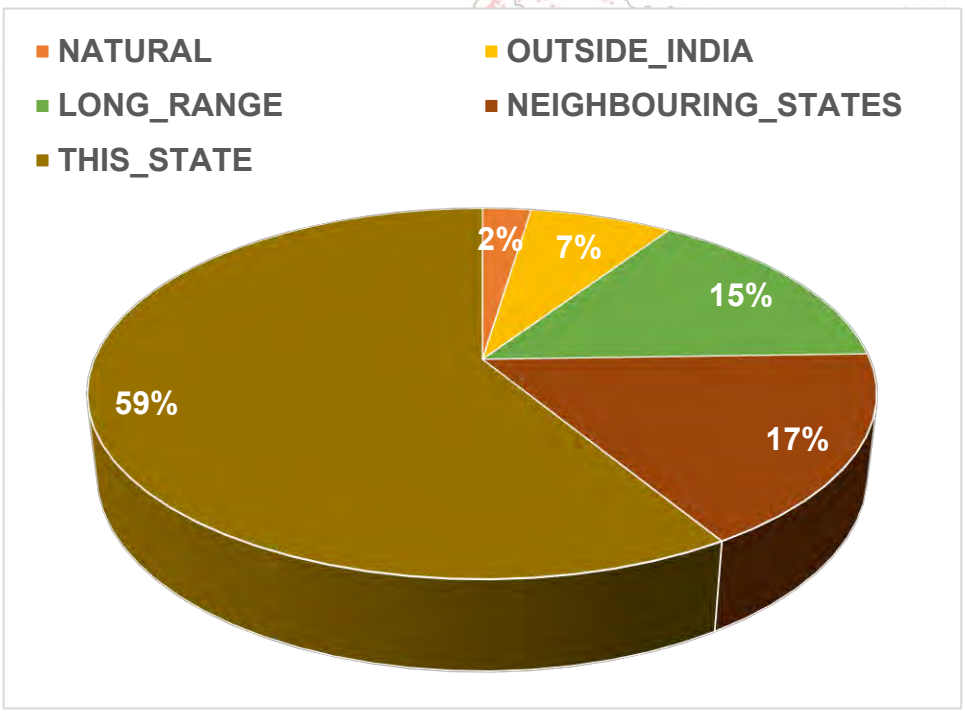

Fig 1.1 *Relative contributions of emissions to annual $PM_{2.5}$ in West Bengal in 2015. Data are taken from Purohit et al.[6]*

West Bengal government has taken continual measures to regulate and manage numerous types of pollution. The same Purohit et al.[6] study also provided the source contributions (Figure 1.2), where the two largest contributors were found to be secondary aerosols (52%) and household emissions (31%). Secondary aerosols are formed in the atmosphere from gaseous precursors via atmospheric processes. Household emissions were the single largest source to ambient $PM_{2.5}$ in 2015 on a regional scale.[7] The penetration of LPG has increased into the rural areas, which is expected to reduce its contribution in more recent years.

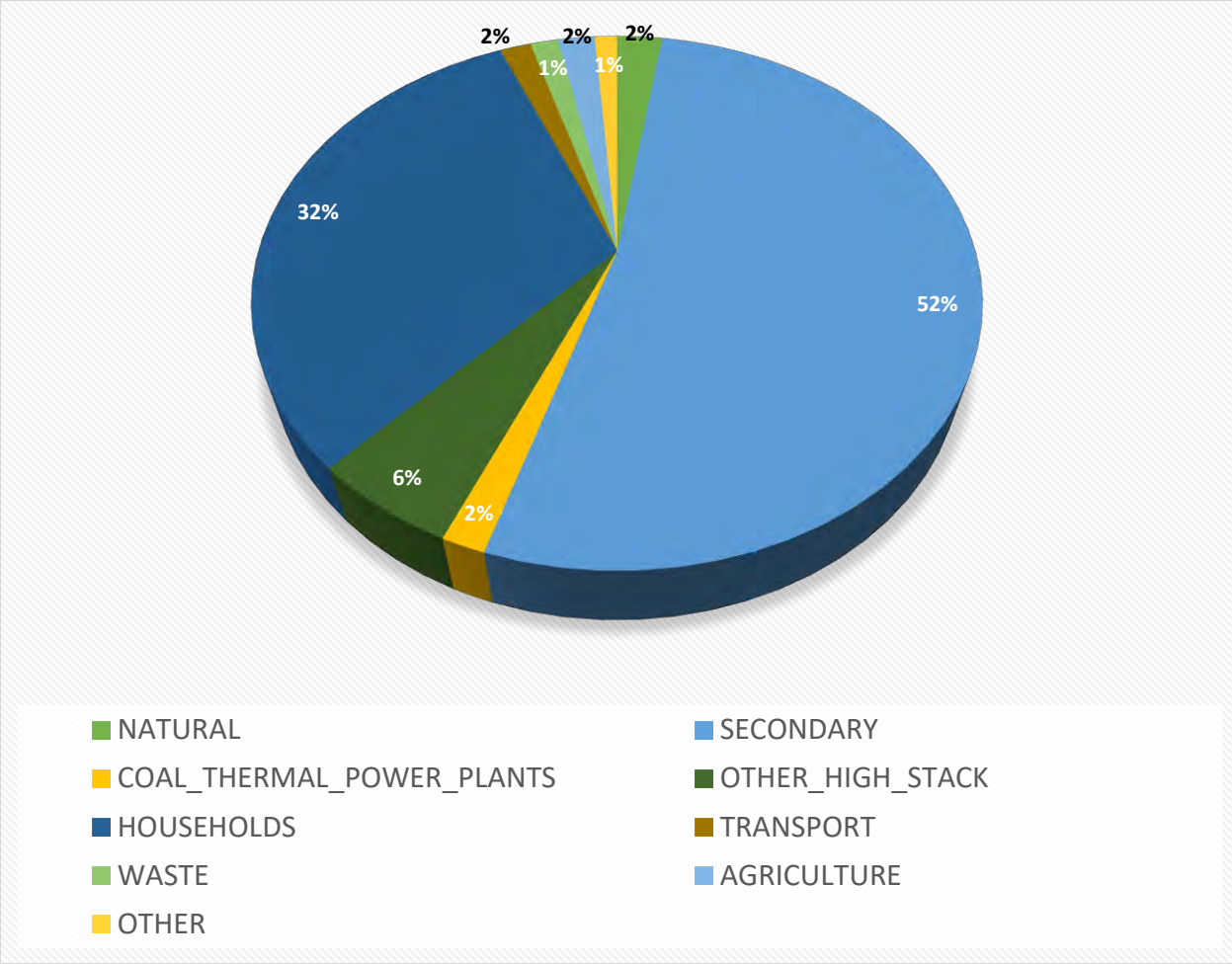

Fig 1.2 *Relative contributions of various emitting sectors to annual $PM_{2.5}$ concentrations in West Bengal in 2015. Data are taken from Purohit et al.[6]*

Open biomass burning is also a major source of air pollution in India producing both primary and secondary pollutants.[8] Open biomass burning mainly emits hydrocarbons, carbon dioxide, nitrogen oxides, volatile organic compounds, and other contaminants, as well as PM10 and PM2.5, which are hazardous to human health and the atmosphere. The net cropped area in West Bengal is 52.05 lakh ha, which accounts for 68% of the geographical area. West Bengal is India's largest producer of paddy and vegetables. The recorded forest area is 13.4% of the total geographical land.

1.2 Motivation:

While the government has implemented a variety of initiatives to reduce air pollution in West Bengal, the current study was designed to generate scientific evidence to assist in policymaking. The Hon'ble National Green Tribunal (NGT) imposed a complete ban on the burning of waste in open places across the country. State governments have implemented a variety of efforts to prevent stubble burning, including regular inspections, incentives, machinery supply, and other logistical support. The efficacy of such actions can be maximized by identifying Districts and mouzas with the highest prevalence of open biomass burning.

1.3 Objectives:

The goal of this report is to evaluate the long-term trend of open biomass burning in West Bengal. This would help in identifying the region, determining the causes, and making recommendations for the management of open biomass burning. The scope of work includes the following tasks.

- Analyse the spatial and temporal trends of open fire over West Bengal using satellite-derived fire counts during the last 9 years (2012-2020).
- Differentiate CRB from forest fires and other forms of open fires spotted by satellites.
- Identifying the peak burning season for CRB and forest fires at the District, Block, and mouza levels.
- Make some management recommendations to reduce open biomass burning.

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Chapter II: Data and Methodology

2.1 Open fire data:

Open fire data are taken from the Visible Infrared Imaging Radiometer Suite (VIIRS) sensor onboard SUOMI National Polar-orbiting Partnership (NPP) satellite, which has equatorial crossing time of 1:30 PM and 1:30 AM.[9] Fires are detected using a combination of thermal, middle infrared and visible bands. VIIRS has two products – one (VPN14) provides data at 750 m spatial resolution, and the other (VNP14ING) provides data at 375 m resolution from 2012 onwards. The data are archived and distributed through LP DAAC.

The level 2 product granules cover a total of 6400 × N × 32 image elements within the 3060-km wide swath. The 8-bit image classification product known as 'fire mask' classifies each pixel into 10 categories as: 'Data not processed due to poor quality' (Class 0), 'Bow-tie deletion at the swath edges' (Class 1), 'Sun-glint' (Class 2), 'Water' (Class 3), 'Cloud' (Class 4), 'Land' (Class 5), 'Unclassified due to insufficient background information' (Class 6), 'Low-confidence fire pixel' (Class 7), 'Nominal-confidence fire pixel' (Class 8), and 'High-confidence fire pixel' (Class 9). High-confidence pixels are associated with daytime and nighttime saturated pixels. Pixels which are free of potential sun-glint in daytime and the temperature anomaly exceeds 15K in both daytime and nighttime are classified as 'nominal-confidence fire pixels'. The pixels where the thermal anomaly is detectable but relatively lower (MIR temperature <15K in daytime and nighttime) and affected by sun-glint are deemed to be of 'low-confidence'.[10]

Compared to other satellite fire detection products, the VIIRS 375-m data provides greater results over fires of relatively micro regions. Hence, in this report, we process the 375-m resolution product (shown in the background image), which identifies a fire event (shown by the red dots) along with its central coordinates. We only consider moderate and high-confidence fire pixels. Each red dot represents a fire event in 375-m by 375-m area. For every swath of the sensor, the fire coordinates are processed and collated to generate the statistics over the desired spatial (Districts, Blocks, mouzas) and temporal (daily, monthly, seasonal, annual) scales.

2.2 Software and ancillary datasets

Census of India administrative map of West Bengal at District, Block and village level has been used for the study. VIIRS open fire data does not segregate crop residue burning (CRB) and other types of fire. The basic land use land cover map has been collected from Bhuvan (Figure 2.1). Google Earth Pro has been used for micro-level land use and land cover identification.

If a fire is detected over cropland, it is classified as CRB; similarly, if a fire is detected over forest, it is classified as a forest fire. QGIS Desktop, Microsoft Office 2019, Anaconda Navigator, Jupiter, and Google Earth Pro software have been used in this study.

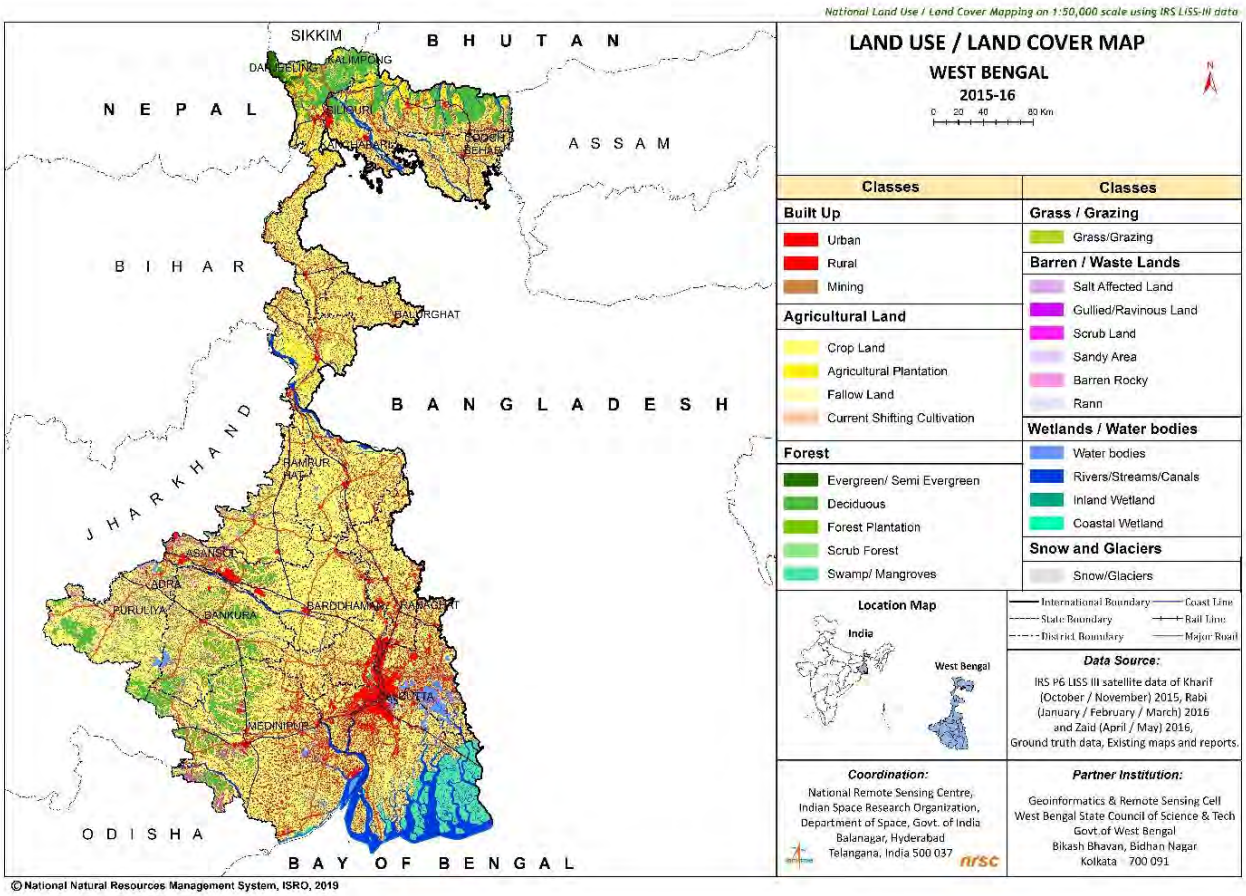

Fig 2.1 *Land use land cover map of West Bengal (NRSC 2019)*

2.3 Methodology:

Data is downloaded for the period 2012-2020 on a daily basis, and statistics for all Districts of West Bengal have been extracted at the District, Block, and mouza levels using QGIS software. The data extracted has latitudinal and longitudinal extension. the point layer has been converted and arrayed according to the needs of the study. all the 375-m pixels that fall within a District/Block/mouza boundary have been considered as a part of that administrative unit. VIIRS extracted data has been further analyzed in Jupiter using Python programming. To extract the statistics at a District level, we added up all the individual fire events whose central coordinates lie within that District for a given period. The same procedure is adopted for the statistics

extracted at Block or mouza levels. We use the shapefiles in a GIS environment to demarcate mouza, Blocks or Districts.

Since the best possible resolution of the current satellites to detect open fire is 375-m, smaller fires cannot be detected. This is the reason why we did not include municipal solid waste burning in this report, which usually occurs at a smaller scale. For CRB and forest fires, the 375-m resolution data is quite adequate, except when the sky is cloudy (during the monsoon). However, open biomass burning does not usually occur on a rainy day.

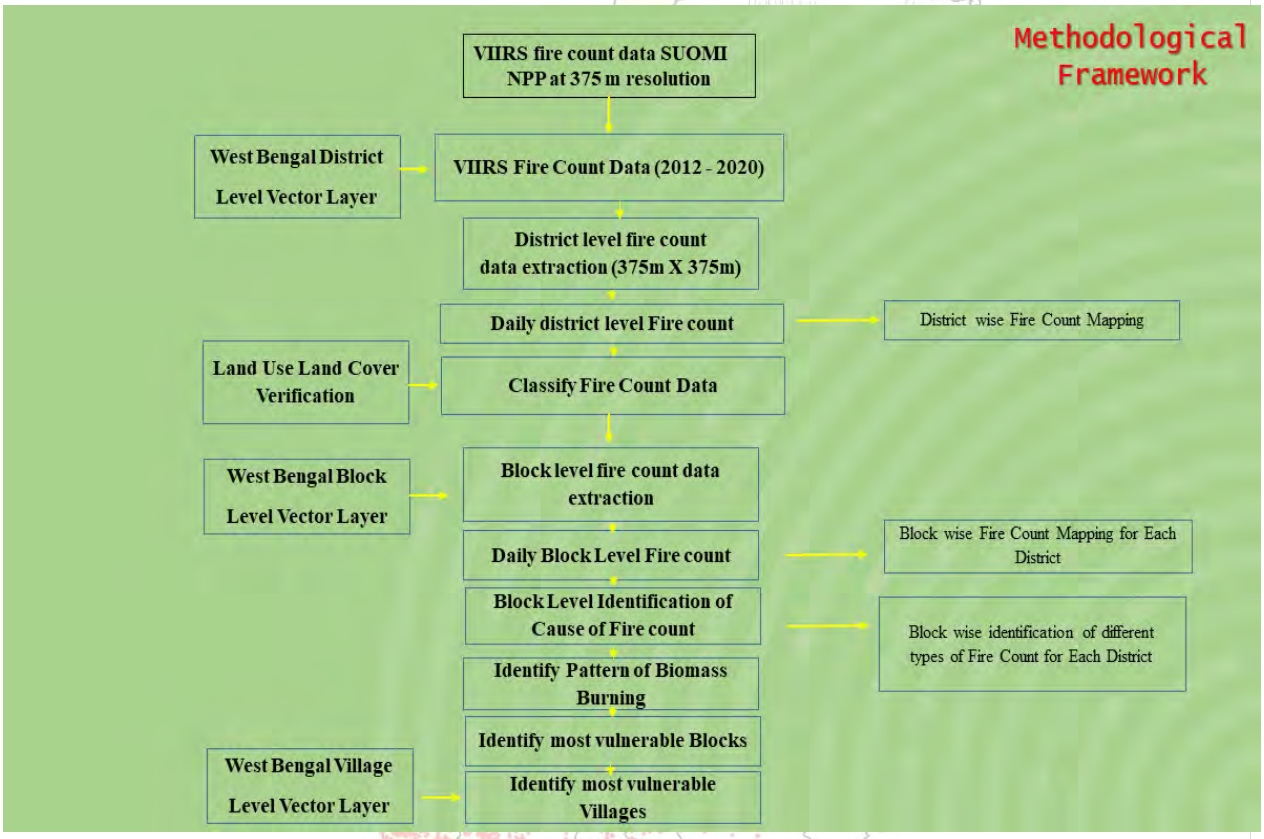

Fig 2.2 *Methodological Framework of Open Biomass Burning data extraction.*

VIIRS active fire does not differentiate between different types of fire — CRB, forest fire, and other fire types (e.g., fire in coal mine area). Hence, Google Earth images and land use data are used to locate the open biomass burning. As active fires are recognized by thermal anomalies, high temperatures from industrial stacks may be misdiagnosed as fires, and hence industrial emissions have been managed with caution. After the identification and differentiation of various types of open biomass

burning through LULC, the temporal pattern and overall trend have been analyzed. The identified filtered data has been intersected with administrative boundaries of West Bengal at various levels, and micro level analysis has been performed for trend analysis. Once the CRB is identified, the most vulnerable Districts, Blocks and mouzas are identified. The trend and regional pattern of CRB have been examined for each District. Figure 2.3 shows the overall flow chart.

The District-wise cropland distribution is shown in Table 2.1. the data extracted from statistics of LULC prepared by NRSC 2019 is available in the Bhuvan web service. The data shows that most of the Districts of West Bengal have a high percentage of cropland.

Table 2.1 Cropland distribution in West Bengal at District Level.

District	Land Area (Hectare)	Cropland (Hectare)	% of Cropland
Bankura	688200	406845	59.12
Purba Bardhaman and Paschim Bardhaman	702400	504503	71.82
Birbhum	454500	353491	77.78
Dakshin Dinajpur	219200	172626	78.75
Darjeeling and Kalimpong	314900	122556	38.92
Haora	146700	71533	48.76
Hugli	314900	2170.81	68.93
Jalpaiguri and Alipurduar	622700	308046	49.47
Kochbihar	338700	238737	70.49
Kolkata	10400	00	0
Malda	373300	288346	77.24
Murshidabad	532400	407142	76.47
Nadia	392700	274418	69.88
North 24 Parganas	397800	111466	28.02
Paschim Medinipur and Jhargram	960100	568731	59.24
Purba Medinipur	448000	2516.46	56.17
Purulia	625900	416603	66.56
South 24 Parganas	1015800	458359	45.12
Uttar Dinajpur	316600	245725	77.61

Data source: *Land use Land cover statistics of West Bengal (NRSC 2019).*

Field validation

The CRB and forest fire statistics can be evaluated based on field visits. Since the satellite data provides information at a high resolution, CRB events can be identified at a village level. However, during the COVID pandemic, it was not possible to do the fieldwork and validate directly the statistics of various types of fires. The current analysis draws upon the experience of applying satellite-detected fires across the globe including India and a vast range of literature demonstrating the accuracy of the satellite detection of open fires. Once the COVID situation improves, field validation will be carried out in the subsequent years to further strengthen the findings.

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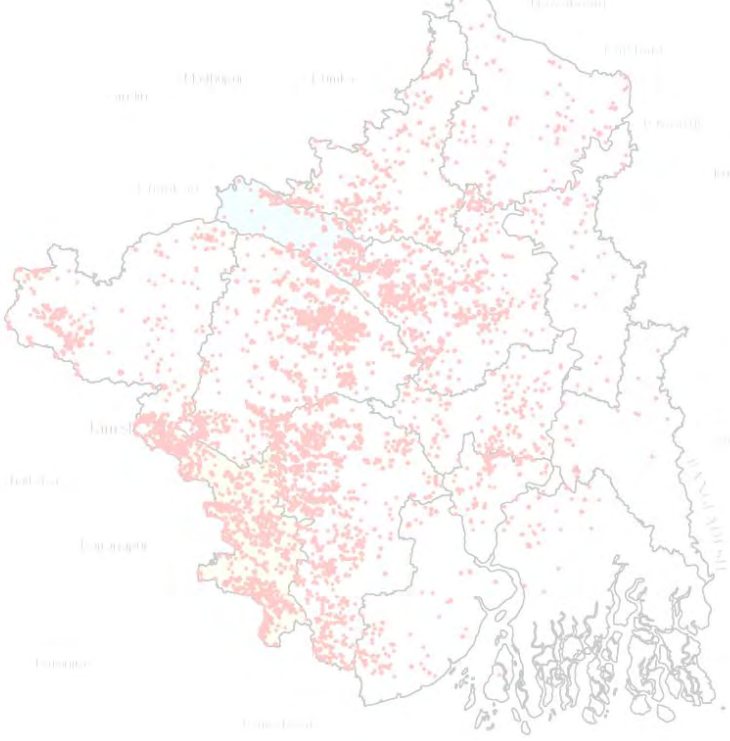
10. Schroeder, W et al. (2014), The new VIIRS 375 m active fire detection data product: Algorithm description and initial assessment, Rem. Sens. Environ., 143, 85-96.



Chapter III: Pattern of Open Biomass Burning in West Bengal

3.1 Open Biomass Burning in West Bengal:

Open biomass burning is most common in the western Districts of West Bengal (Figure 3.1). The most affected Districts in West Bengal are Purba Bardhaman, Paschim Bardhaman, Paschim Medinipur, Jhargram, Bankura, Purulia, Murshidabad, Birbhum and Dakshin Dinajpur. The District-wise annual average number of incidences has been shown in fig no 3.1.

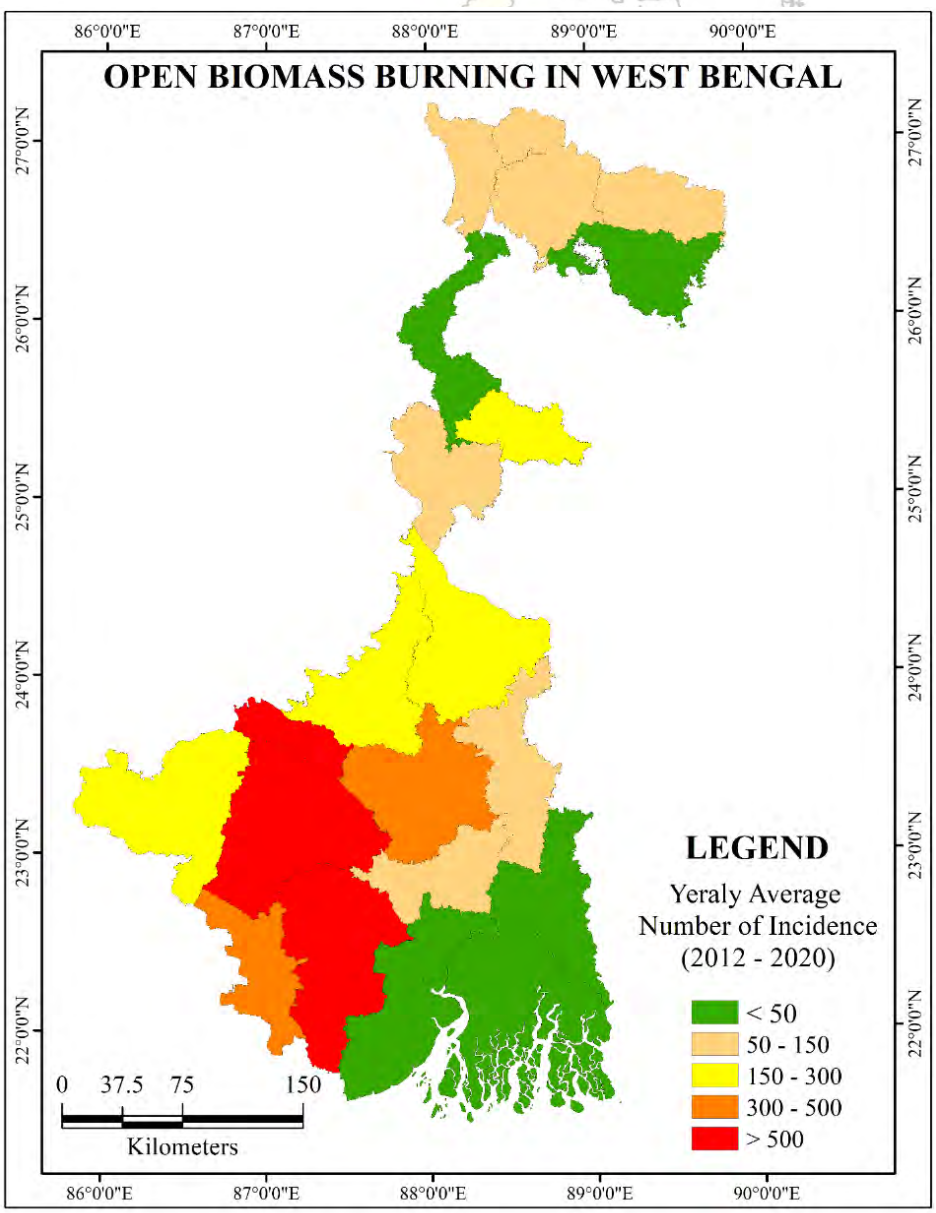


Fig. 3.1: *District wise yearly average fire count of West Bengal (2012-2020)*

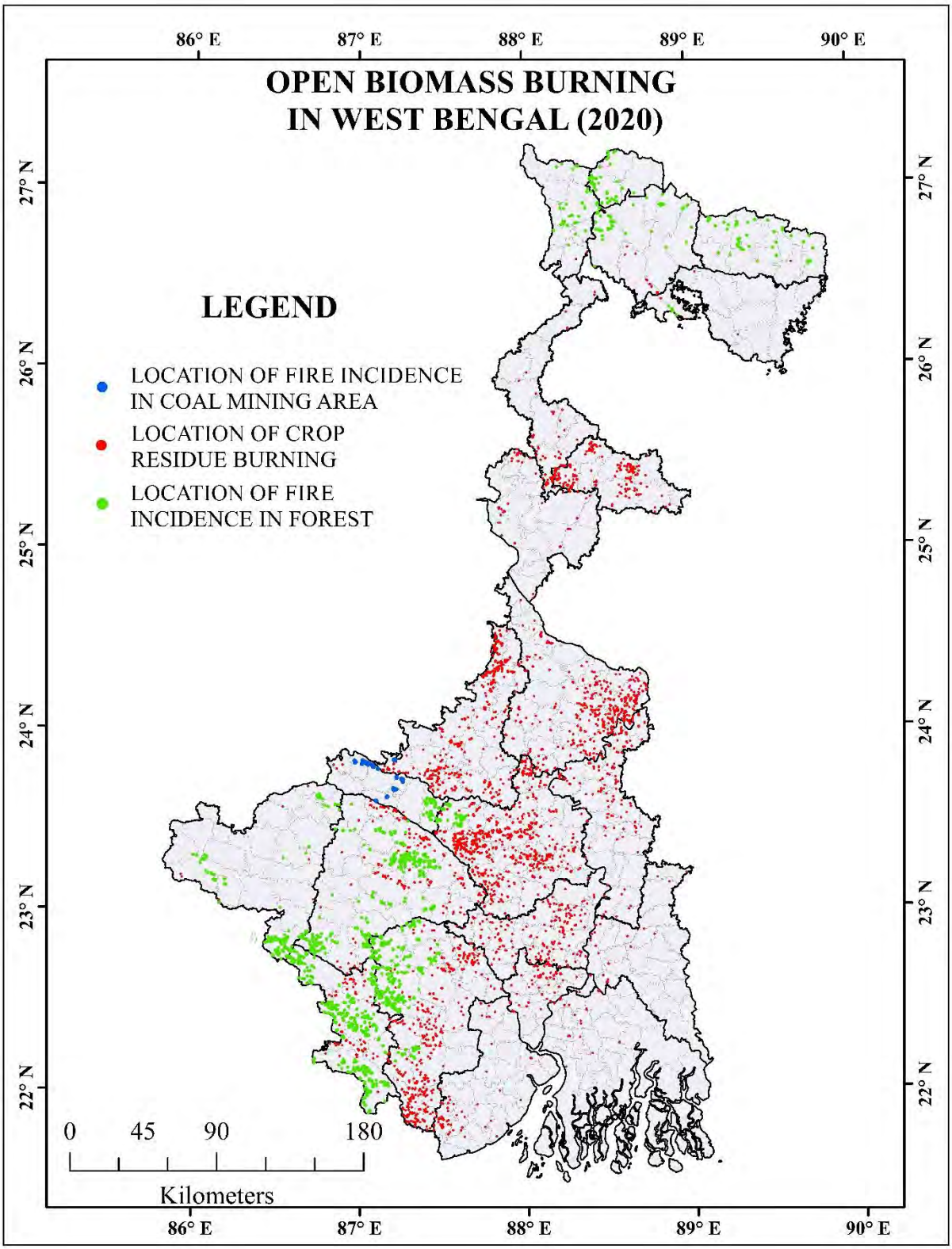


Fig. 3.2: *Location of Open Biomass Burning in West Bengal (2020)*

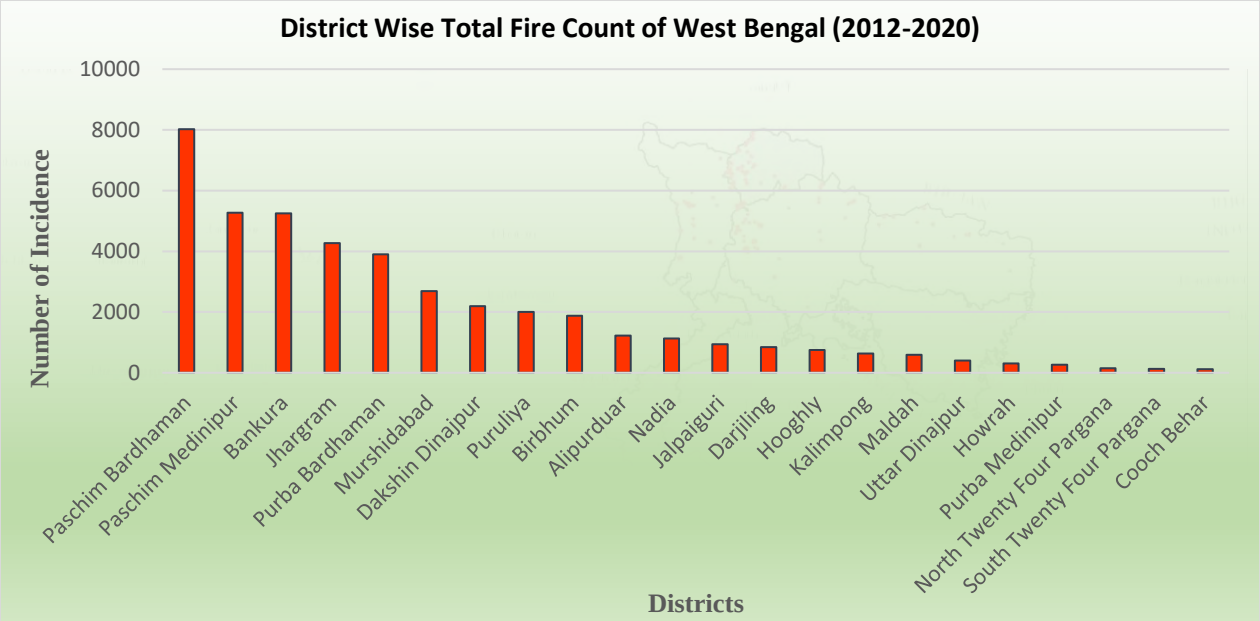


Fig. 3.3: *District wise total fire count of West Bengal (2012-2020)*

After analysing the last 9 years of data, it is found that the overall pattern of open burning is rising. In the year 2020, the maximum amount of open burning incidence has been registered (Fig. 3.3). A total of 3013 open burning cases were registered in 2012, while in 2020, 6211 total cases were recorded.

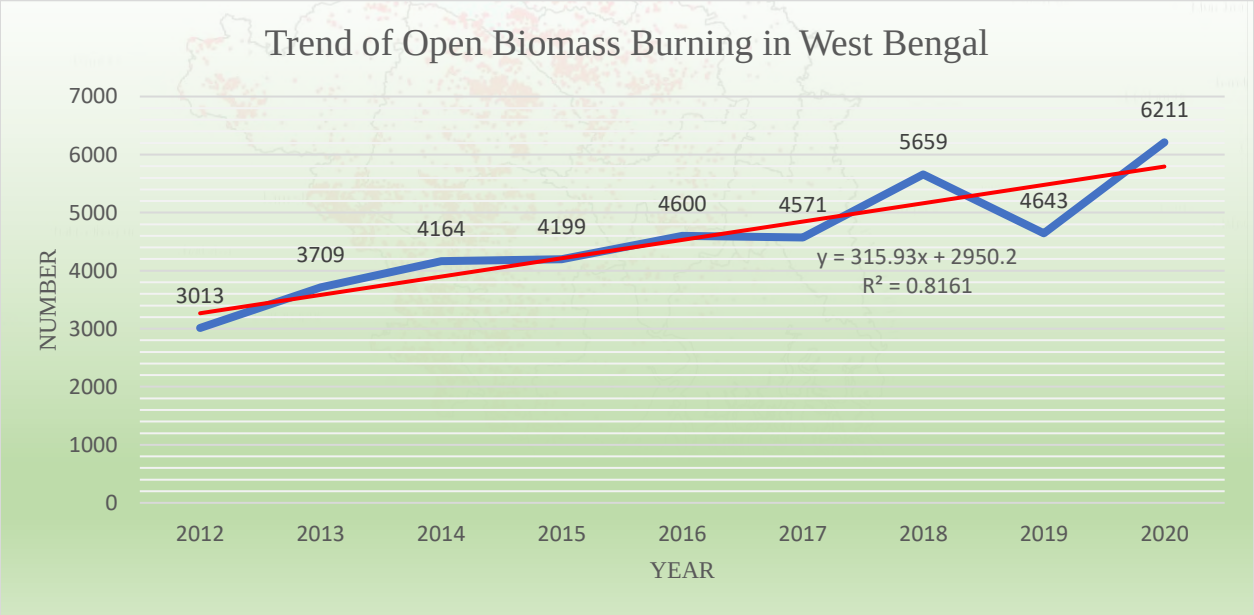


Fig. 3.4: *Trend of yearly total Open Biomass Burning in West Bengal (2012-2020).*

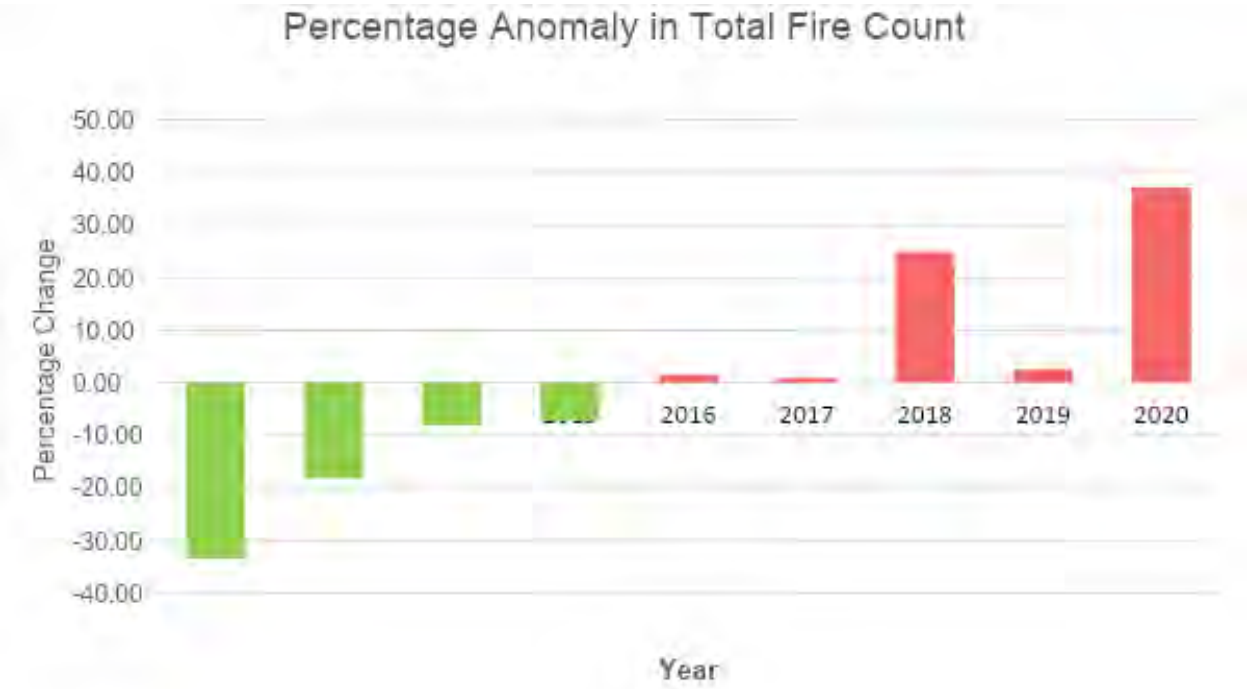


Fig. 3.5: *Temporal anomaly in total fire count with reference to nine-year statistics.*

Temporal anomaly in total fire has been calculated with reference to the nine-year average (Fig. 3.5). There is a steady increase in total fire events from 2012 to 2016. In 2017, total fire events did not increase, then increased by a large margin in 2018. In 2019, it again decreased and then increased by a large margin in 2020. This temporal pattern in total fire is mostly governed by the changes in CRB (shown in Fig. 3.4).

In West Bengal, the pattern of open biomass burning has been monitored daily; it is noted that the location of fire incidence varies by season in different parts of the state. For example, in the Ravi season, crop residue burning is mainly found in Dakshin Dinajpur, Murshidabad, northern Birbhum and Nadia in the month of April, while in the Kharif season, crop residue burning is mainly found in Purba Bardhaman, Paschim Medinipur, Hooghly, Bankura, etc., mainly in November and December. Similarly, forest fires are mostly observed in February and March in the Western Jangal Mahal regions. Monthly open biomass burning in West Bengal has been recorded and displayed in the following figure from November 2020 to April 2021 (Fig no 3.6 to Fig no 3.11).

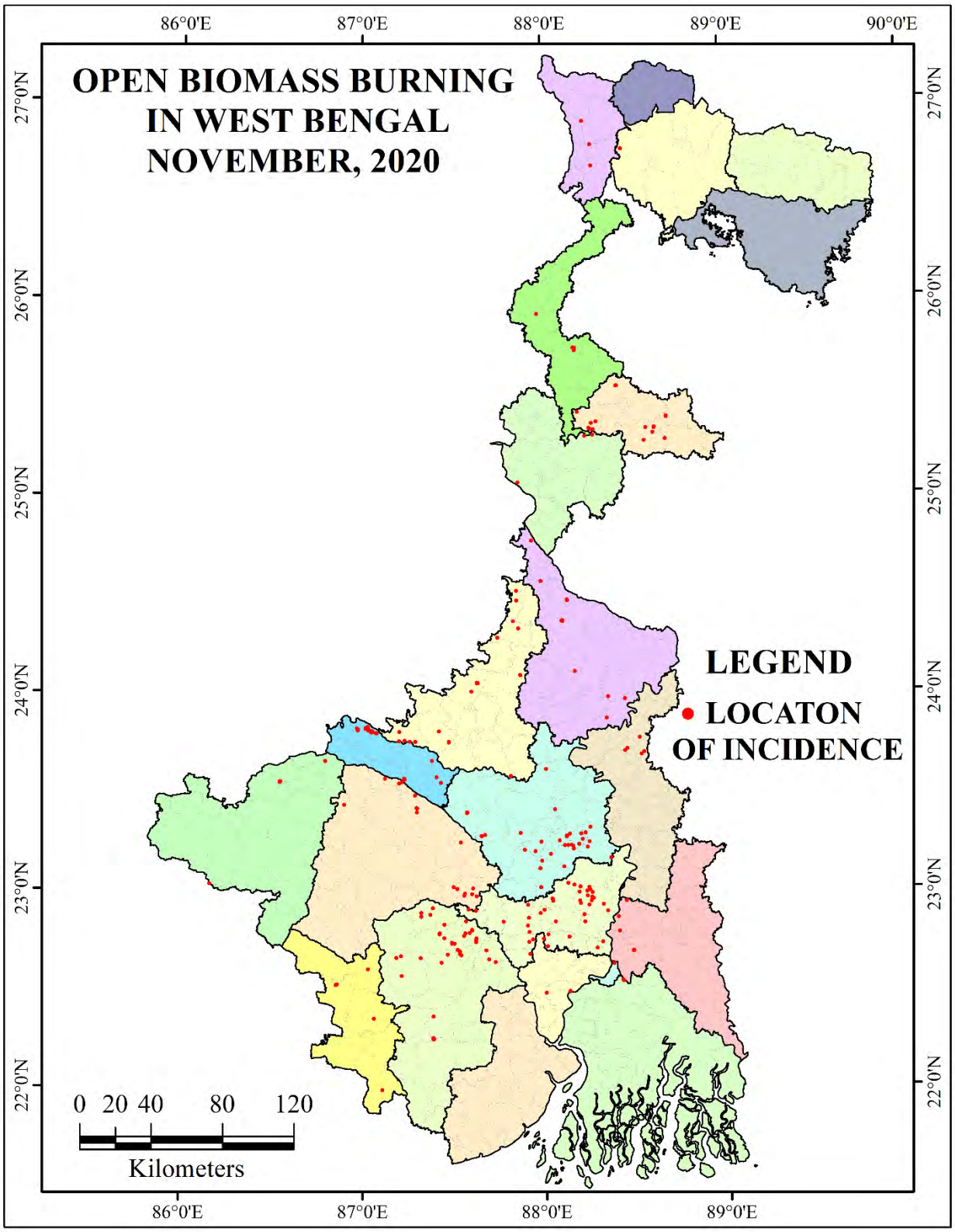


Fig. 3.6: *Open Biomass Burning in West Bengal (November 2020)*

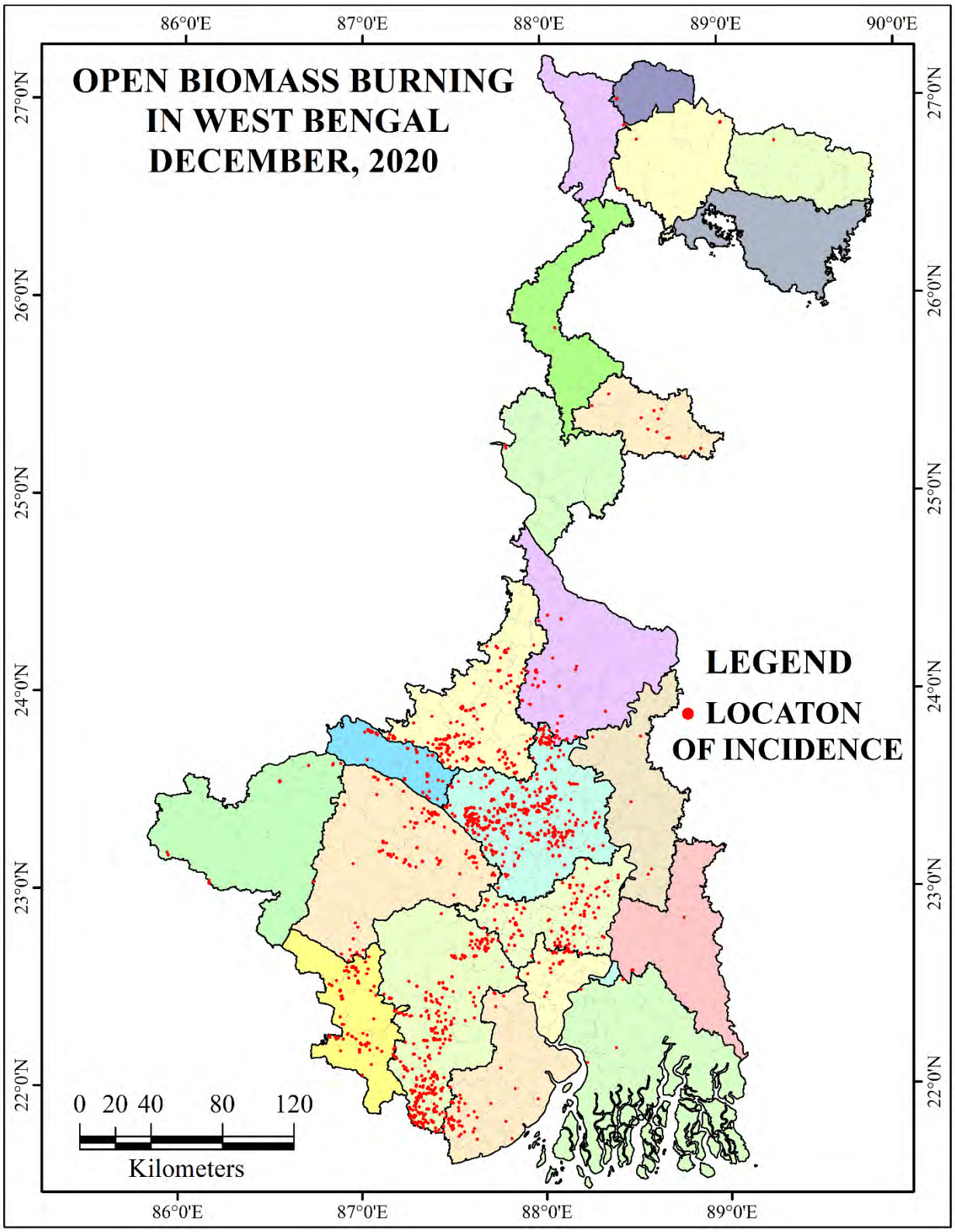


Fig. 3.7: *Open Biomass Burning in West Bengal (December 2020)*

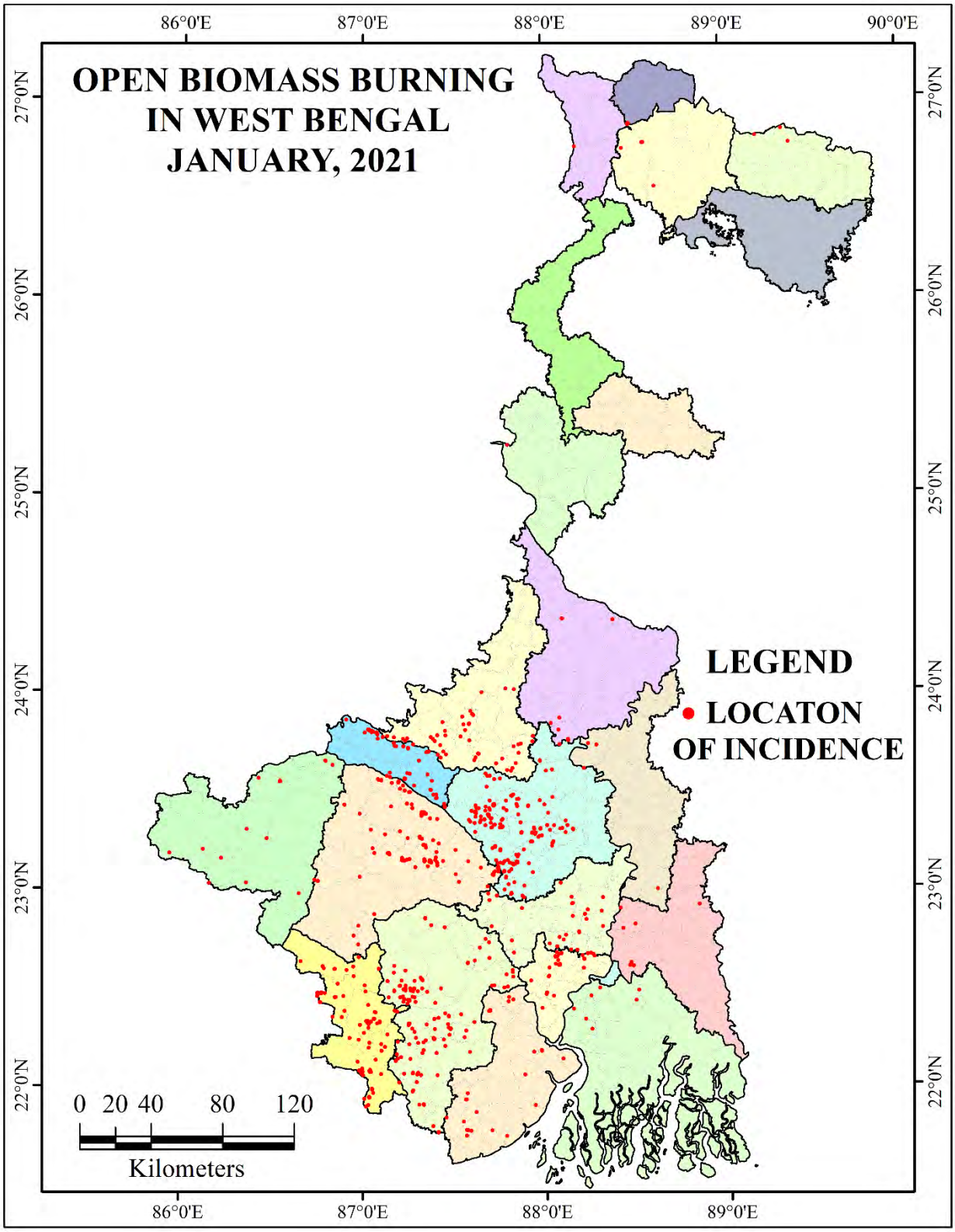


Fig. 3.8: *Open Biomass Burning in West Bengal (January 2021)*

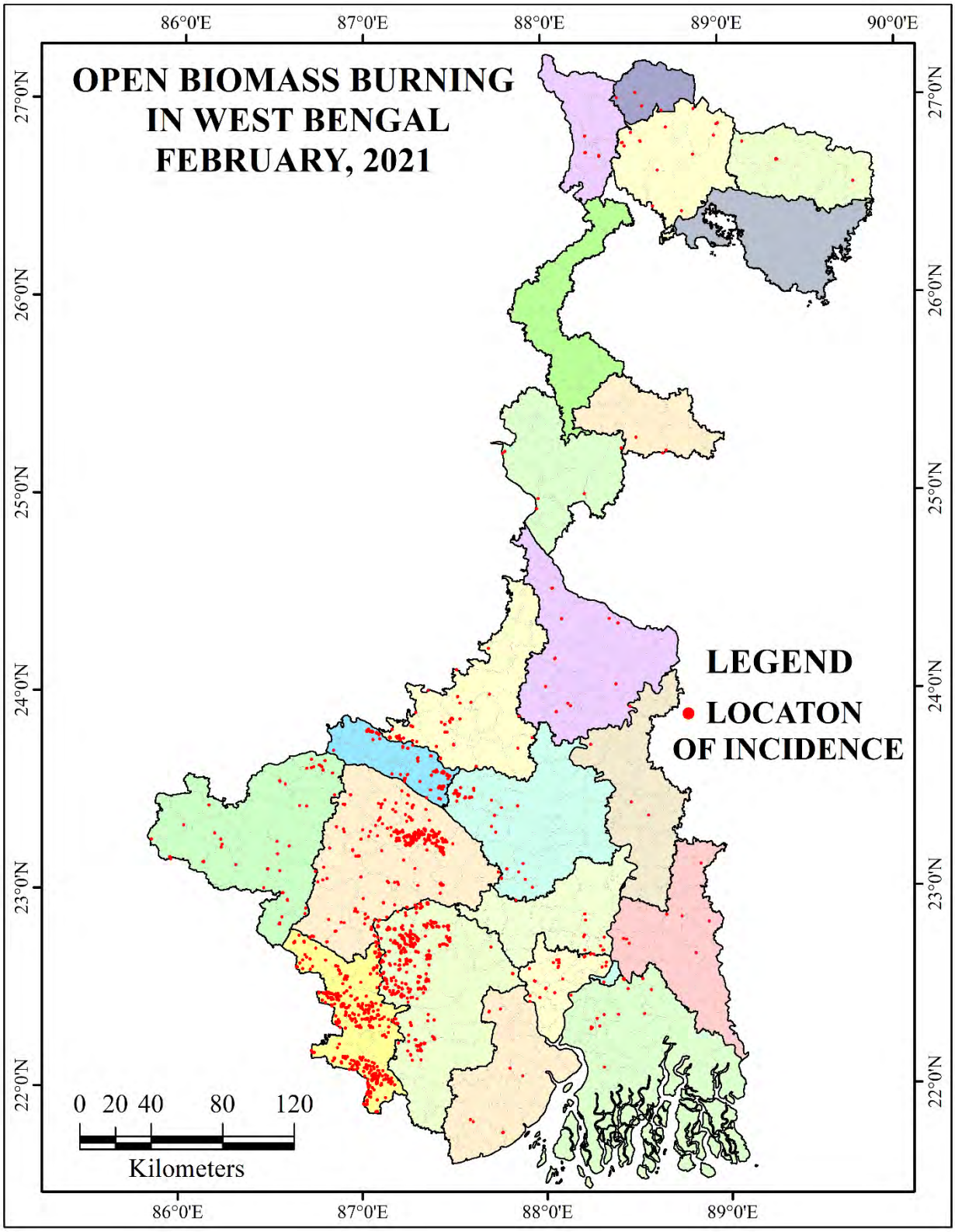


Fig. 3.9: *Open Biomass Burning in West Bengal (February 2021)*

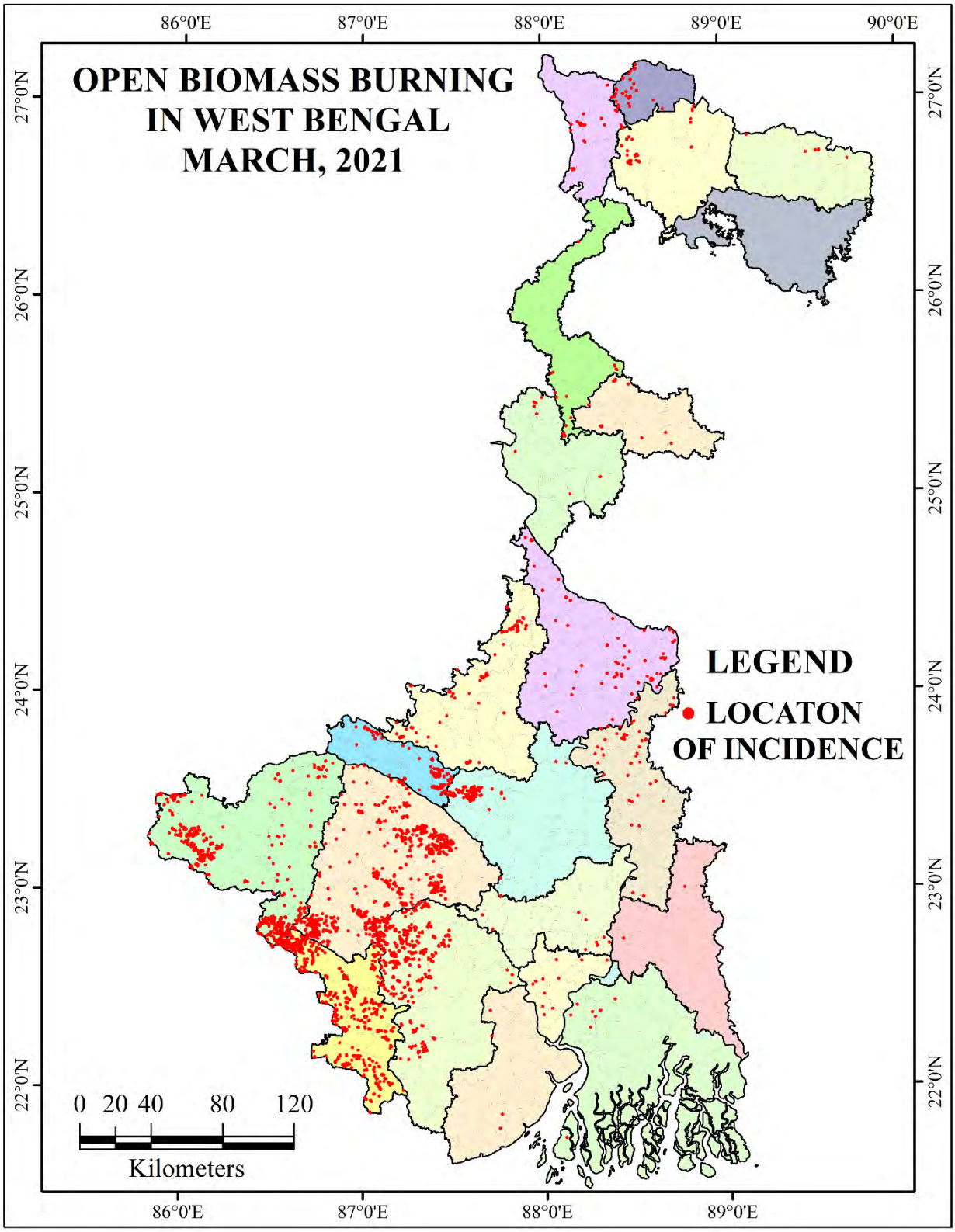


Fig. 3.10: *Open Biomass Burning in West Bengal (March 2020)*

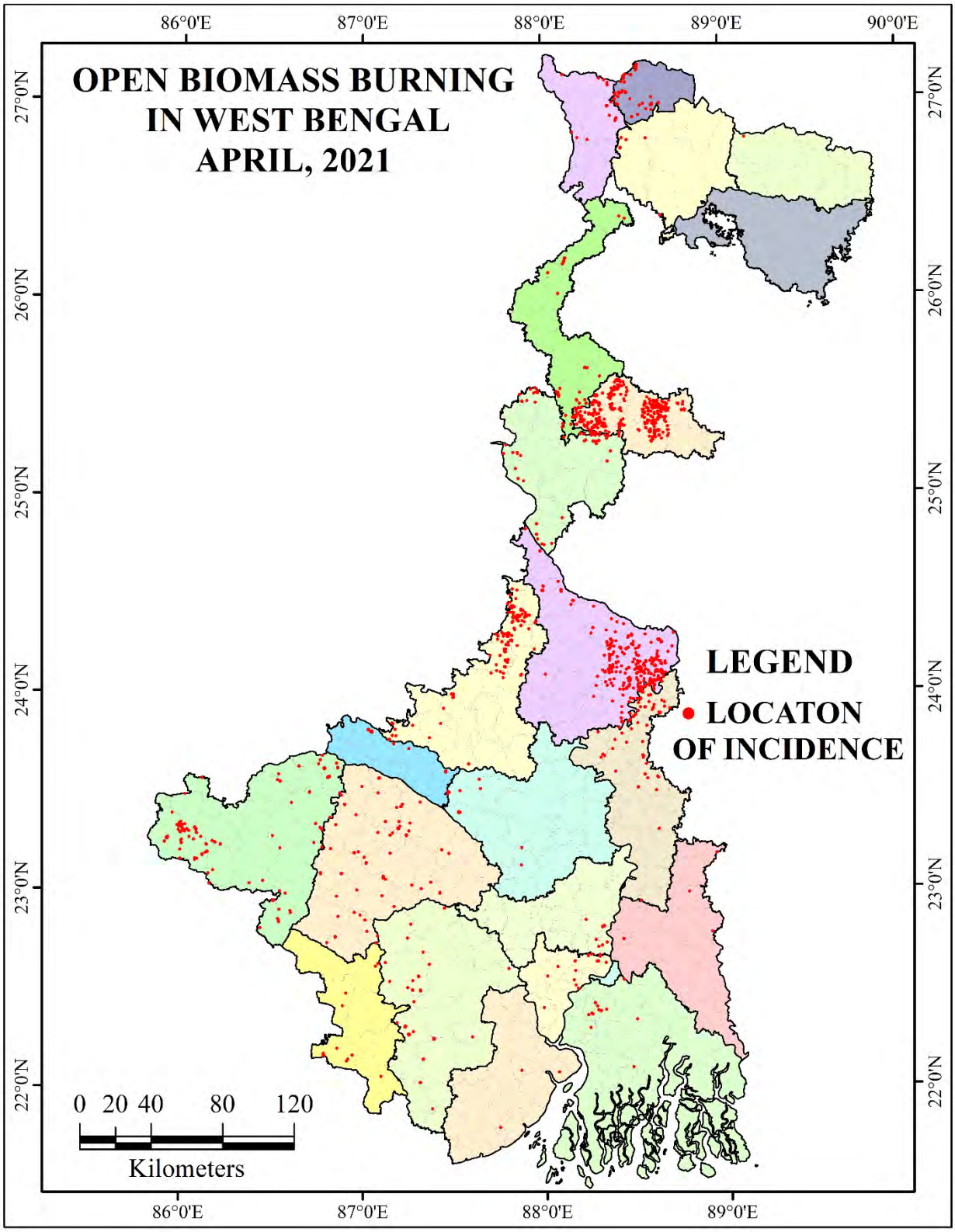


Fig. 3.11: *Open Biomass Burning in West Bengal (April 2021)*

Most of the open burning in West Bengal has arisen as a result of three distinct category of incidents. The following section discusses the different conceptualizations of such categories.

3.1.1 Crop Residue burning: Nowadays CRB is a major problem in India. Crop residue burning is the process of burning leftover straw, referred to as stubble, to rapidly prepare the land for the next crop. The Hon'ble National Green Tribunal (NGT) imposed a complete ban on the burning of wastes in open places across the country. In West Bengal, Crop residue burning is found in paddy fields mainly in December in Purba Bardhhaman, Paschim Medinipur, Jhargram, Bankura, Birbhum and Hooghly. In March-April Crop residue burning observed in Murshidabad, Dakshin Dinajpur, Uttar Dinajpur, Malda and Nadia.

Crop Residue Burning

3.1.2 Fire incidence in coalfield: Air pollution is a widespread phenomenon in the coal mining industry. The main cause of high fire count in the coal mining area is attributable to unregulated fire in the mining region, secondly, deliberate burning of row coal to make it fit for domestic use, and thirdly, the owner or local individuals clean the surface vegetation by way of burning. The northern part of Paschim Bardhaman is affected by Coal fire. The surface of a coal-mining region may be covered by bushes, scrubs, and a few tiny trees that are burned when a fire breaks out on the surface. Because of this, open biomass burning has been applied in coal mining areas.

Fire incidence in coal field

3.1.3 Ignite in Forest floor: Burning of forest floor material during late Spring is common in the Jangal Mahal area of West Bengal. Forest fire found here is due to human activity. There are two major causes of ignition in forests. The forest ignition occurred after cutting down the trees (Sal and QGS), to clean the forest floor from the remaining trunk and weeds, scrub, brush and small trees. Another reason is seasonally erratic ignition in fallen leaves on the forest floor. This affects the quality of the soil, the forest ecosystem, and damaging the air as well. This sort of event has been usually recorded in Paschim Medinipur, Jhargram, Purulia, Bankura and parts of the Jalpaiguri District.

Burning of forest floor

Forest fire in Western West Bengal

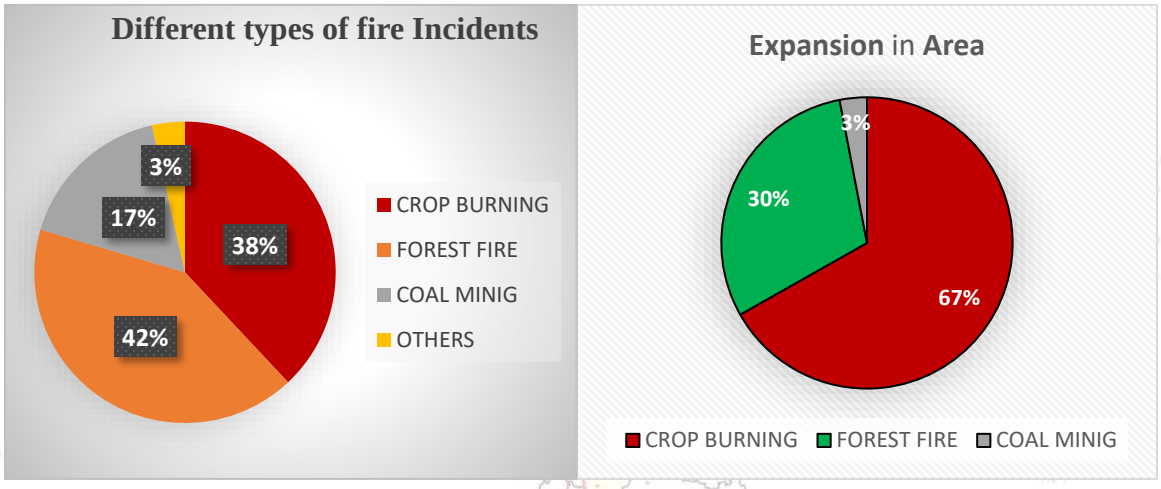


Fig. 3.12: (a) *Percentage distribution of Open Biomass Burning. (b) Area share of total Biomass Burning*.

Table 3.1: Total number of affected Blocks and the total number of occurrences of different types of Open Biomass Burning.

Types Of Burning	Number of Occurrences (2012 - 2020)	Number of CD Blocks
Crop Residue Burning	16894	155
Forest Fire	18473	70
Open coal mine fires	7503	18
Others (not classified)	1573	7

Though forest fires account for around 42% of all biomass burning and crop residue burning events accounts for 38% of overall fire incidence, Crop residue burning has the greatest areal extent. Crop residue burning has been seen in 155 Blocks in West Bengal, while forest fires were seen in 70 Blocks. Open burning in the coalfield area has been observed in 18 Blocks with 17% of total open biomass burning (Fig. 3.12 a, b).

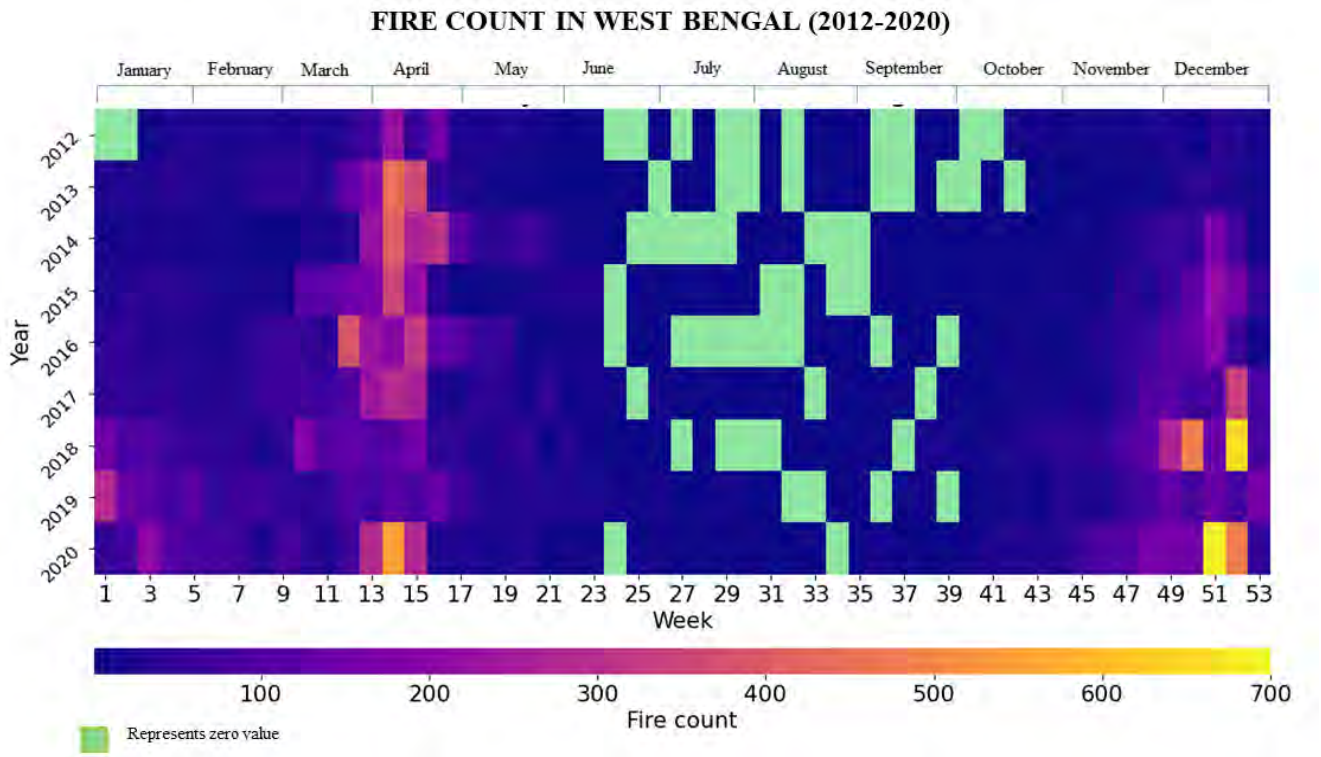


Fig. 3.13: *Distribution of weekly fire count of West Bengal of last nine years.*

The above Hovmöller diagram (Fig no. 3.13) shows that the hotspot is visible every year in the months of March-April and December. The most affected weeks in 2020 are the 13th to 15th week and the 51st to 52nd week. So, in West Bengal, there are two burning seasons: one from November to December and another from March to April. In December mainly crop residue burning is observed and in March Forest fire is dominant. In April crop residue burning is dominant. The table below (Table 3.2) contains a District-by-District overview of the Blocks affected by crop residue burning.

Table 3.2: Crop Residue Burning: Major Districts and Blocks of West Bengal

District	Block	Month
Bankura	Bishnupur	December
	Indus	December
	Kotulpur	December
	Patrasayer	December
	Sonamukhi	December
Birbhum	Bolpur Santiniketan	December
	Dubrajpur	December
	Illambazar	December
	Murari I	December
Dakshin Dinajpur	Balurghat	April
	Banshihari	April
	Gangarampur	April
	Harirampur	April
	Kumarganj	April
	Kushmundi	April
	Tapan	April And December
Hooghy	Arambug	December
	Goghat I	December
	Goghat II	December
	Khanakul I	December
	Polba Dadpur	December
Jhargram	Binpur I	December
	Binpur II	December
	Gopiballavpur II	December
	Jamboni	December
Malda	Chanchal II	April
	Gazole	April
	Habibpur	April
	Harischandrapur	April
	Kaliachak II	April
	Kaliachak III	April
	Manikchak	April
	Ratua I	April
	Ratua II	April

District	Block	Month
Murshidabad	Beldanga I	March- April
	Beldanga II	March- April
	Bhagabangola I	March- April
	Bharatpur II	December
	Burwan	December
	Domkal	March- April
	Hariharpara	March- April
	Jalangi	March - April
	Khargram	December
	Lalgola	March- April
	Nawda	March- April
	Raghunathhganj II	March- April
	Raninagar I	March- April
	Raninagar II	March- April
	Sagardighi	March- April
Nadia	Chapra	March April
	Kaliganj	March April
	Karimpur I	March April
	Karimpur II	March April
	Nakashipara	March April
	Tehatta I	March April
	Tehatta II	March April
Paschim Medinipur	Chandrakana I	December
	Chandrakana II	December
	Dantan I	December
	Garhbeta III	December
	Keshiary	December
	Keshpur	December
	Kharagpur I	December
	Kharagpur II	December
	Mohanpur	December
	Narayangarh	December
Purba Bardhaman	Bhatar	December
	Burdwan I	December
	Burdwan II	December
	Galsi I	December
	Galsi I	December
	Ketugram I	December
	Mangalkot	December

District	Block	Month
Purba Bardhaman	Manteswar	December
	Memri II	December
	Purbasthali I	December
	Raina II	December
Purba Medinipur	Egra I	December
	Egra II	December
	Potashpur I	December
Uttar Dinajpur	Golpokhar I	April
	Golpokhar II	April And December
	Hemtabad	April
	Kaliaganj	April
	Raiganj	April

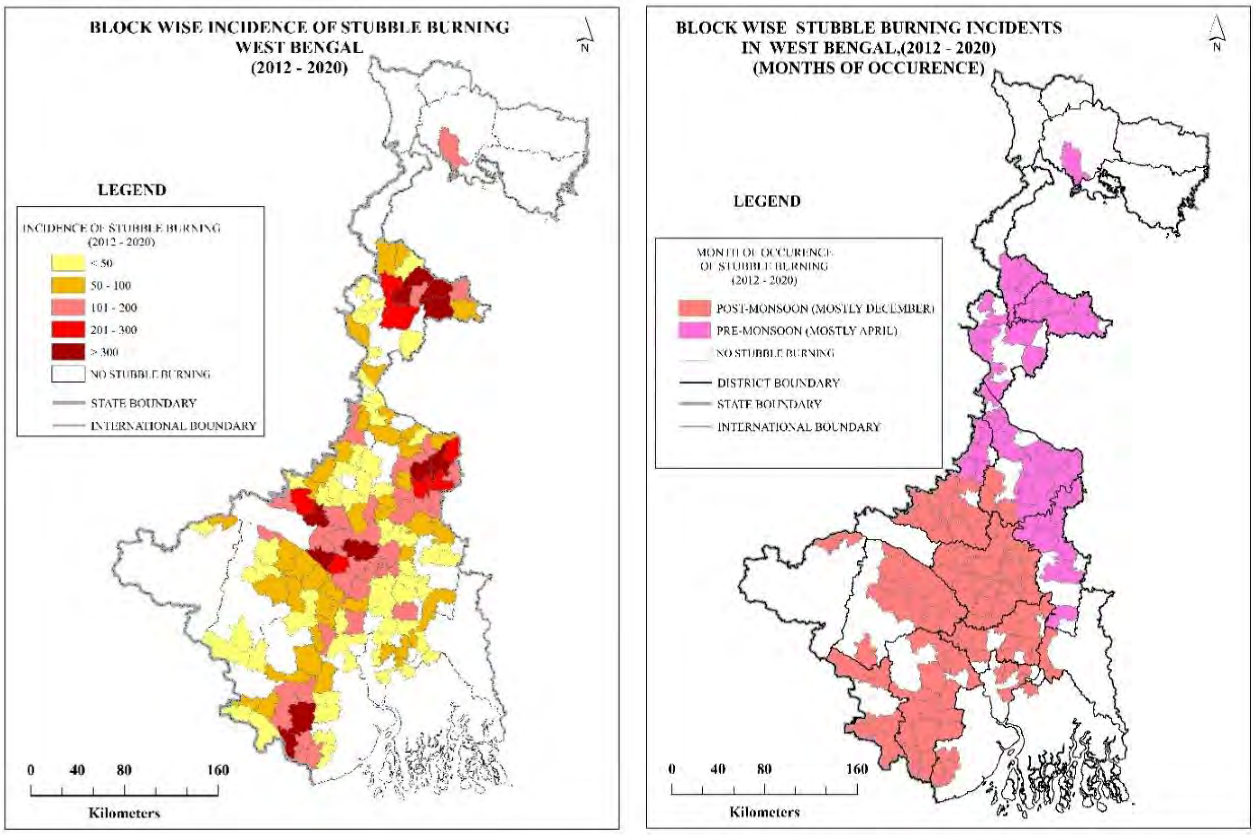


Fig. 3.14: (a) Blocks affected by the incidence of stubble burning (b) Block wise season of incidence of stubble burning.

Table 3.3: Blocks highly affected by CRB

District	Block	Rank
Murshidabad	Domkal	1
Dakshin Dinajpur	Harirampur	2
Purba Bardhaman	Bhatar	3
Purba Bardhaman	Galsi - I	4
Dakshin Dinajpur	Gangarampur	5
Dakshin Dinajpur	Kushmundi	6
West Medinipur	Dantan - I	7
West Medinipur	Narayangarh	8
Murshidabad	Hariharpara	9
Dakshin Dinajpur	Tapan	10
Birbhum	Illambazar	11
Murshidabad	Jalangi	12
Purba Bardhaman	Galsi - II	13
Uttar Dinajpur	Itahar	14
Murshidabad	Nawda	15
Nadia	Karimpur - II	16
Malda	Gazole	17
Birbhum	Dubrajpur	18

18 Blocks have been found where more than a total of 200 stubble burning cases have been registered in the last nine years (2012 to 2020). Domkal of Murshidabad and Harirampur of Dakshin Dinajpur experienced the maximum number of fire incidences which occur in April every year due to wheat residue burning. Bhatar and Galsi I of Purba Bardhhaman experienced fire events mainly in December due to rice residue burning. In the above table (Table no. 3.3), the names of the CRB affected Blocks have been arranged based on the higher number of fire incidences to a relatively lower number of fire incidences. Season wise spatial distribution of stubble burning incidence has been shown in Fig. 3.14 (b) and Block wise intensity of stubble burning has been shown in Fig. 3.14(a).

Forest fire affected Blocks and periods of occurrence per District are listed below (Table 3.4), and fire incidence in the coal mining region is listed in Table 3.5.

Table 3.4: Forest Fire: major Blocks of West Bengal

District	Block	Month
Bankura	Bankura II	Last week of January to March
	Barjora	Last week of January to March
	Bishnupur	Last week of January to March
	Gangajalghati	Last week of January to March
	Jaypur	Last week of January to March
	Onda	Last week of January to March
	Patrasayer	Last week of January to March
	Ranibundh	Last week of January to March
	Sarenga	Last week of January to March
	Simlapal	Last week of January to March
	Sonamukhi	Last week of January to March
	Taldangra	Last week of January to March
Jalpaiguri	Dhupguri	Last week of February to March
	Mal	Last week of February to March
	Nagrakata	Last week of February to March
	Rajganj	Last week of February to March
Jhargram	Binpur I	Last week of January to March
	Binpur II	Last week of January to March
	Gopiballavpur I	Last week of January to March
	Jamboni	Last week of January to March

District	Block	Month
Jhargram	Jhargram	Last week of January to March
	Nayagram	Last week of January to March
Paschim Medinipur	Garhbeta I	Last week of January to March
	Garhbeta II	Last week of January to March
	Garhbeta III	Last week of January to March
	Salboni	Last week of January to March
Paschim Bardhaman	Kangsa	Last week of February to March
Purulia	Arsha	Last week of February to March
	Bagmundi	Last week of February to March
	Balarampur	Last week of February to March
	Bundwan	Last week of February to March

Table 3.5: Fire incidence in Coal mining region

District	Block	Month
Birbhum	Khoyrasol	All Months
Paschim Bardhaman	Barabani	
	Jamuria	
	Ondal	
	Pandobeswar	
	Salanpur	

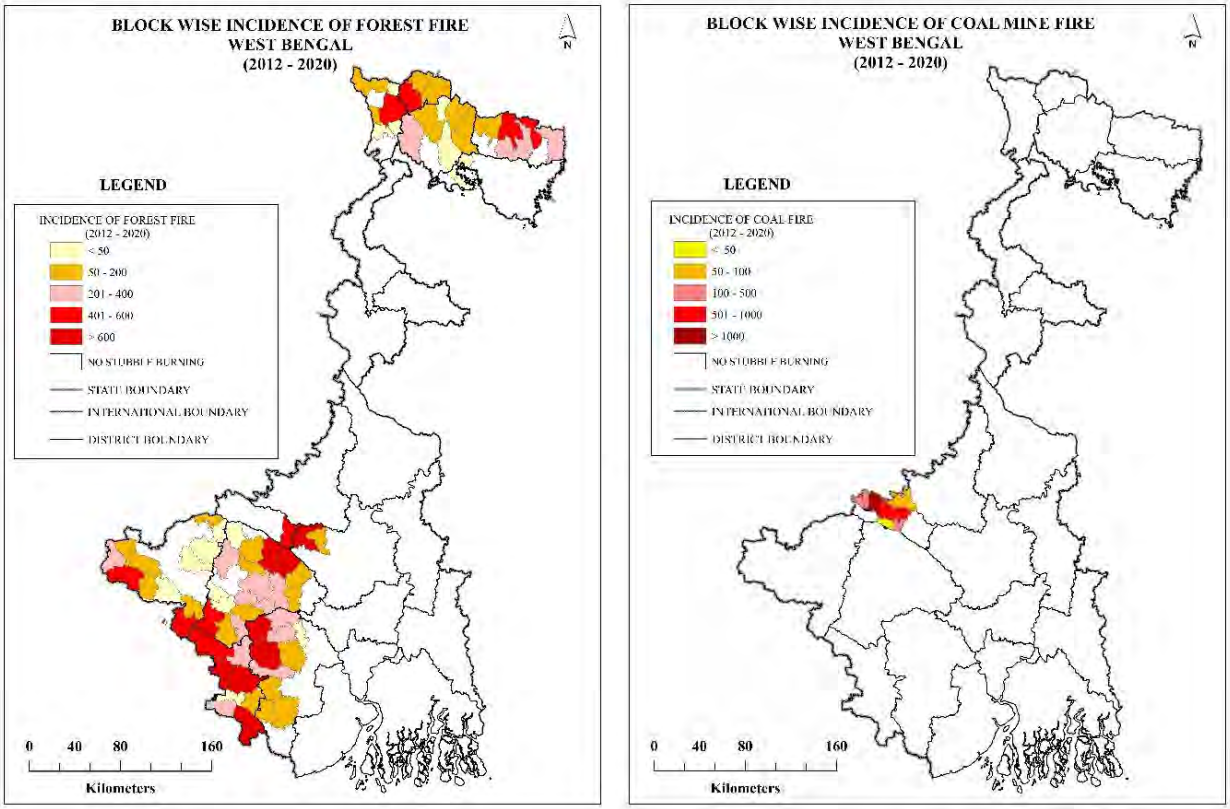


Fig. 3.15: (a) Blocks affected by the incidence of Forest Fire (b) Blocks affected by the incidence of Coal fire.

Forest fires in West Bengal are mainly found in western Districts and northern forest areas. Jhargram, Paschim Medinipur, Bankura and Purulia experienced the maximum number of forest fires. The highest average forest fire has been observed in the Nayagram Block of Jhargram. The list of Blocks where more than a total of 400 fire incidents in the forest have been found in the last 9 years has been listed in table no. 3.6. where rank indicates the highest number of cases to the lower number of cases.

Table 3.6: Blocks highly affected by Forest fire

District	Block	Rank
Jhargram	Nayagram	1
Medinipur West	Salbani	2
Bankura	Sonamukhi	3
Jhargram	Jhargram	4
Bankura	Barjora	5
Jhargram	Jamboni	6
Medinipur West	Garbeta - II	7
Purba Bardhaman	Ausgram - II	8
Jhargram	Binpur - II	9
Paschim Bardhaman	Kanksa	10
Purulia	Bundwan	11
Darjeeling	Kurseong	12
Alipurduar	Kalchini	13
Kalimpong	Kalimpong -I	14
Bankura	Ranibundh	15
Purulia	Bagmundi	16

Table 3.7: Blocks highly affected by Coal fire

District	Block	Rank
Paschim Bardhaman	Barabani	1
Paschim Bardhaman	Jamuria	2
Paschim Bardhaman	Pandabeswar	3

Fires were spotted in a coal-mining region in the northern part of the Paschim Bardhaman District (table no. 3.7). The highest cases were detected in Barabani Block of Paschim Bardhaman.

Chapter IV: District wise Analysis of Open Biomass Burning in West Bengal

A District-by-District review of fire count data is crucial for understanding the current situation and developing management plans. District wise Block and mouza level fire count statistics are described below.

4.1 Purba Bardhaman District:

Purba Bardhaman is a District in West Bengal that is economically reliant on agriculture. Currently, open biomass burning in agricultural fields is a significant issue in the District. With the adoption of new farm equipment such as combine harvesters, the rate of crop field fires continues to rise. Thus, in order to curb air pollution, soil degradation, and habitat imbalance, Crop residue burning must be forbidden with immediate efforts. Purba Bardhaman District recorded the maximum number of fire counts in the month of December due to rice residue burning. The average annual fire count in Paschim Medinipur during the last nine years is 433. The number of fires in this District has reached a record high. In 2018, 2019, and 2020, this District recorded a total of 870, 460, and 766 fires, respectively.

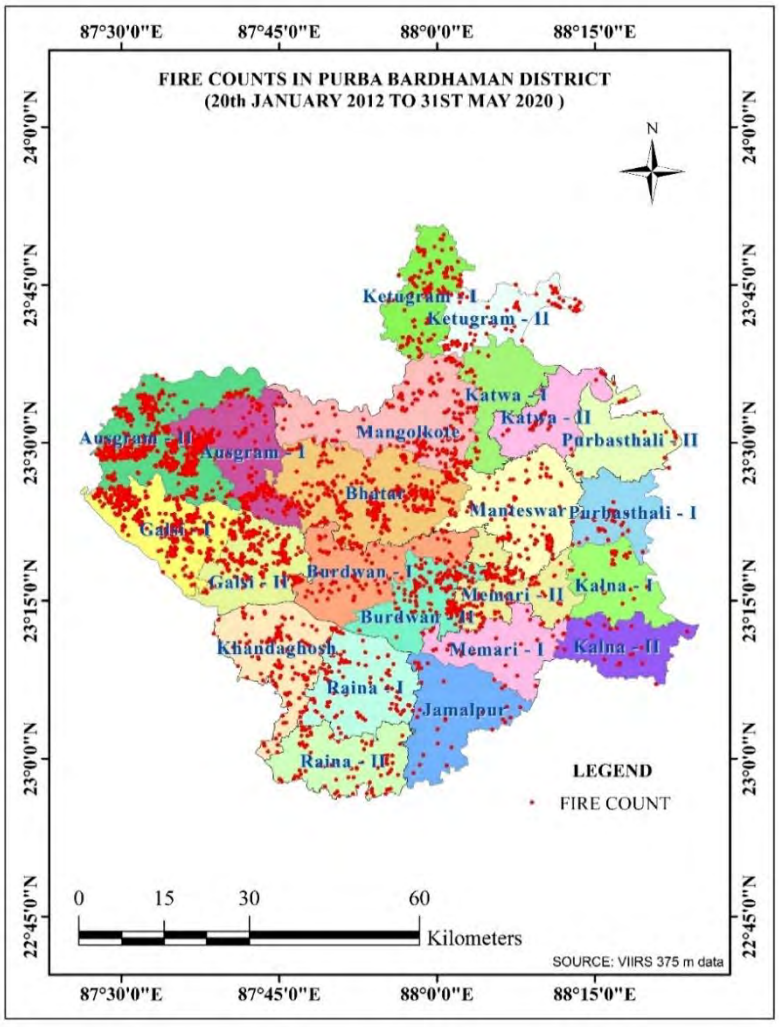


Fig. 4.1: *Incidence of open biomass burning in Purba Bardhaman District.*

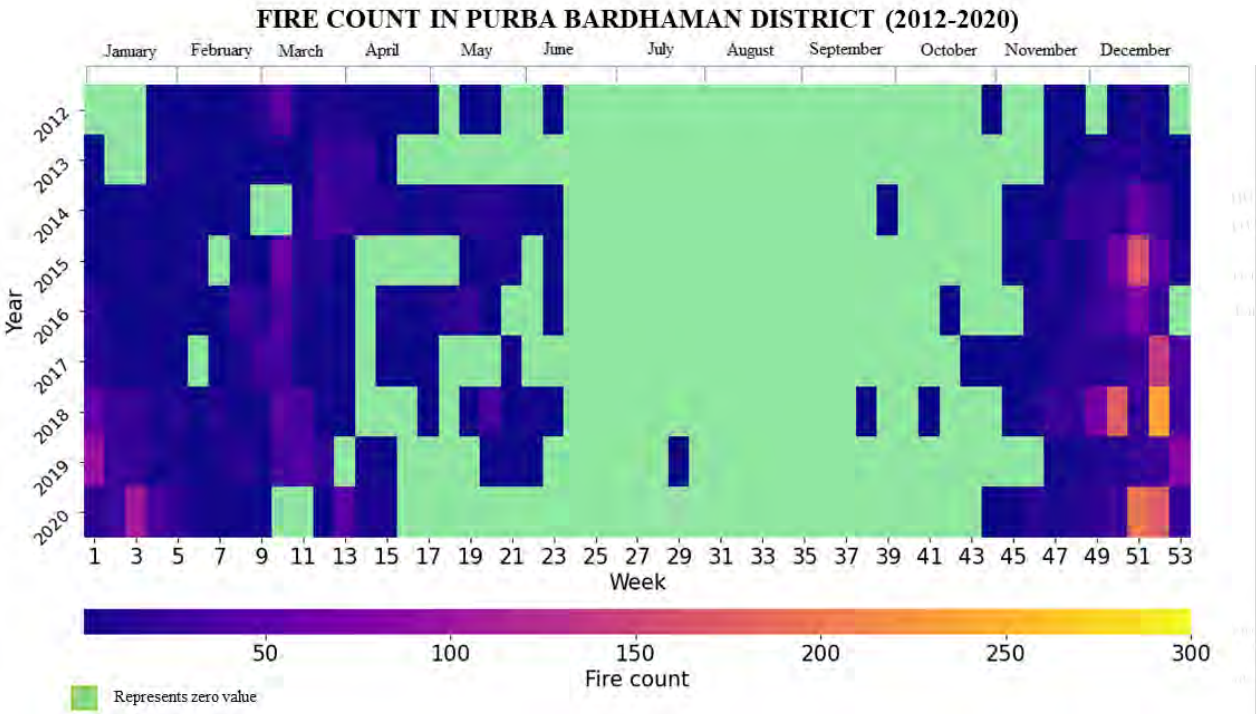


Fig. 4.2: *Distribution of weekly fire count at Purba Bardhaman in the last nine years.*

The above diagram depicts the last nine years of VIIRS 375m results, indicating that fire season begins in mid-November and peaks in December in Purba Bardhaman. The most affected mouzas of the District have been identified and listed below in table no 4.1 for crop residue burning and table no 4.2 for forest fire.

Table 4.1: Mouza wise total Crop Residue Burning in Purba Bardhaman (2012 - 2020)

Block	Mouza	Fire Count	Remarks
Bhatar	Bara Belun	54	Crop residue burning observed in November to February. Dominant month is **December**
Galsi - I	Paraj	50	
Ausgram - II	Kota Chandipur	37	
Ausgram - I	Belgram	33	
Burdwan - I	Mirzapur	33	
Bhatar	Nasigram	32	
Ausgram - I	Dignagar	30	
Galsi - II	Galsi	29	
Galsi - I	Loa	27	
Bhatar	Narjja	26	
Burdwan - II	Karanda	24	
Ausgram - I	Bhota	21	
Galsi - I	Hansoa	21	
Burdwan - I	Nala	21	
Burdwan - II	Samanti	20	
Galsi - II	Sanko	20	
Khandaghosh	Onari	19	
Ketugram - I	Kandara	18	
Bhatar	Chandipur	17	
Bhatar	Dhenria	17	
Galsi - I	Arjjunpur	16	
Burdwan - II	Khargram	16	
Bhatar	Nutangram	16	
Galsi - II	Bahirghanya	15	
Ausgram - II	Eral	15	
Bhatar	Gopinathbati	15	
Bhatar	Khurul	15	
Ketugram - I	Amgaria	14	
Purbasthali - I	Bachpur	14	
Burdwan - II	Begut	14	
Bhatar	Kashipur	14	
Galsi - II	Kurkuba	14	
Bhatar	Eruar	13	
Galsi - I	Golgram	13	
Galsi - I	Haora	13	
Galsi - I	Jot Kolkol	13	
Galsi - II	Khano	13	
Ketugram - I	Kurmadanga	13	
Mangolkote	Majigram	13	
Raina - I	Narugram	13	
Bhatar	Palar	13	

Galsi - I	Potna	13	
Galsi - I	Rampur	13	
Ausgram - I	Belari	12	
Galsi - II	Irkona	12	
Mangolkote	Jabagram	12	
Galsi - II	Kishorkona	12	
Bhatar	Mahachanda	12	
Bhatar	Pashala	12	
Burdwan - II	Shukur	12	
Manteswar	Sonagachhi	12	
Memari - II	Barari	11	
Manteswar	Dewani	11	
Mangolkote	Gobardhanpur	11	
Ketugram - I	Gopalpur	11	
Galsi - II	Kalna	11	
Galsi - I	Karkona	11	
Mangolkote	Kshirgram	11	
Galsi - I	Mallasarul	11	
Ketugram - I	Palita	11	
Galsi - I	Sihigram	11	
Raina - II	Uchalan	11	
Memari - II	Ahira	10	
Ausgram - I	Aligram	10	
Bhatar	Basuda	10	
Galsi - II	Belan	10	
Khandaghosh	Berugram	10	
Galsi - I	Bharatpur	10	
Memari - II	Bijur	10	
Galsi - I	Ghagra	10	
Burdwan - II	Hatgobindapur	10	
Mangolkote	Ichhabargram	10	
Mangolkote	Jagadishpur	10	
Galsi - I	Kondaipur	10	
Katwa - II	Kurchi	10	
Ketugram - I	Murgram	10	
Bhatar	Narayanpur	10	
Bhatar	Orgram	10	
Mangolkote	Syambazar	10	

Table 4.2: Mouza wise total Forest fire in Purba Bardhaman (2012 - 2020)

Block	Mouza	Fire Count	Remarks
Ausgram - I	Alefnagar	80	Forest fire observed in the month of **March**
Ausgram - II	Baradoba	52	
Ausgram - II	Debshala	44	
Ausgram - II	Radhamohanpur	37	
Ausgram - II	Radhaballabhpur	36	
Ausgram - II	Hodogarya	34	
Ausgram - II	Phanrijangal	31	
Ausgram - II	Pratappur	31	
Ausgram - II	Lakshminarayanpur Chak	28	
Ausgram - II	Dombandi	26	
Ausgram - II	Harinarayanpur	24	
Ausgram - II	Sonai	24	
Ausgram - II	Mokota	22	
Ausgram - II	Bhalki	21	
Ausgram - II	Gobindapur	20	
Ausgram - II	Jalikandar	20	
Ausgram - II	Bilaspur	19	
Ausgram - II	Lachminarayanpur	19	
Ausgram - II	Ramharipur	18	
Ausgram - II	Amarpur	17	
Ausgram - II	Balarambati	12	
Ausgram - II	Premganja	11	
Ausgram - II	Babuisol	10	
Ausgram - I	Bahamanpur	10	
Ausgram - II	Kuldiha	10	
Ausgram - I	Ramchandrapur	10	

4.1.1 AUSGRAM II MOUZA:

In Ausgram II Block, most of the fire count was recorded in March due to forest fire incidence. In December, some crop residue burning incidents were also observed in Kota Chandipur and Eral mouza.

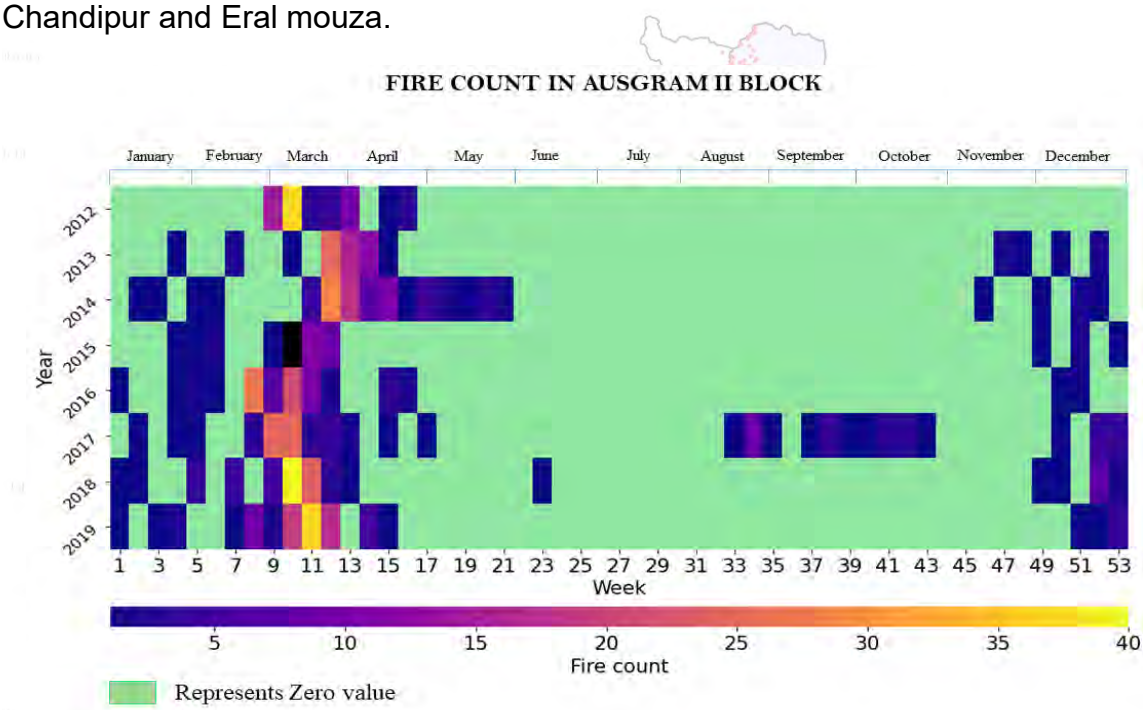


Fig. 4.3: *Distribution of weekly fire count at Ausgram II mouza in last nine years.*

Fig. 4.4: *aerial view of Ausgram II and location of fire incidence*

Some Examples of Block Wise Observation in Purba Bardhaman

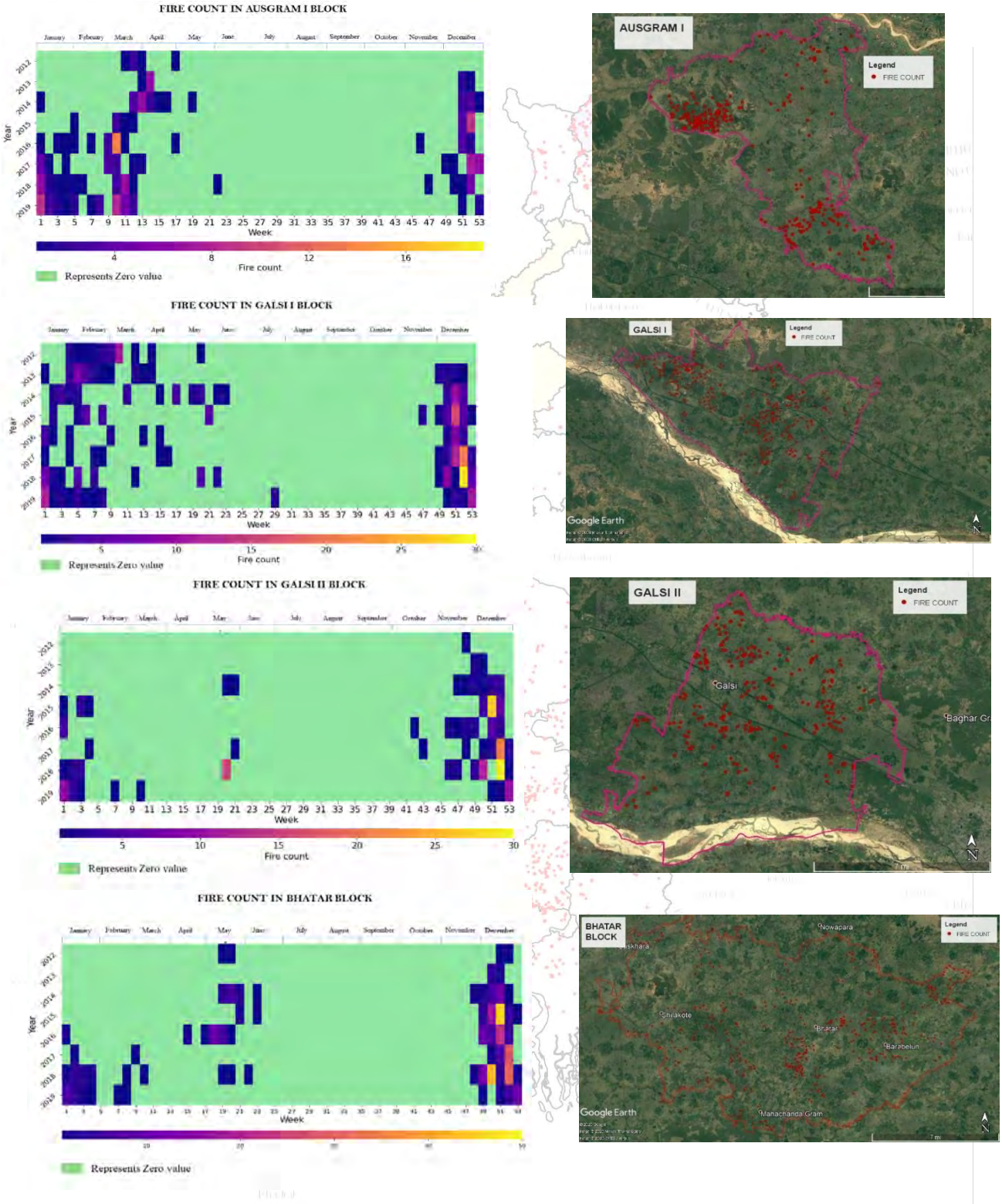


Fig. 4.5 *aerial view and Distribution of weekly fire count of Ausgram I, Galsi I, Galsi II and Bhatar Block of Purba Bardhaman.*

Crop residue burning is indeed a frequent occurrence in Purba Bardhaman. Crop residue burning has affected the majority of the Blocks. It is most common in December, following rice harvesting. The most affected Blocks are Bhatar, Galsi – I, Ausgram – II, Ausgram – I, and Galsi – II. The occurrence of burning in Mouza has been noted in table no. 8.

Forest fires have been discovered primarily in two Blocks in the Purba Bardhaman area, namely Ausgram I and Ausgram II. Alefnagar mouza has the highest number of instances in Ausgram – I Block. There are many mouza in Ausgram II where forest fires have been documented. The mouzas most hit by forest fires are Baradoba, Debshala, Radhamohanpur, Radhaballabhpur, and others (Table no 4.2).

4.2 Paschim Medinipur District:

During the month of November to February, Crop residue burning is commonly reported in Paschim Medinipur. December is the prominent month. In March, forest fires are seen in the forest area. Forest fires have usually plagued the Blocks in the north-east, whereas crop residue burning has primarily afflicted the Blocks in the south. Salbani, Garhbeta II and Medinipur Block have experienced high fire count in the forest region. Crop burning is increasing at a faster rate than forest fires in this District. The last three years 2018, 2019, and 2020 have had a total of 1091, 516, and 677 annual fire count cases, respectively.

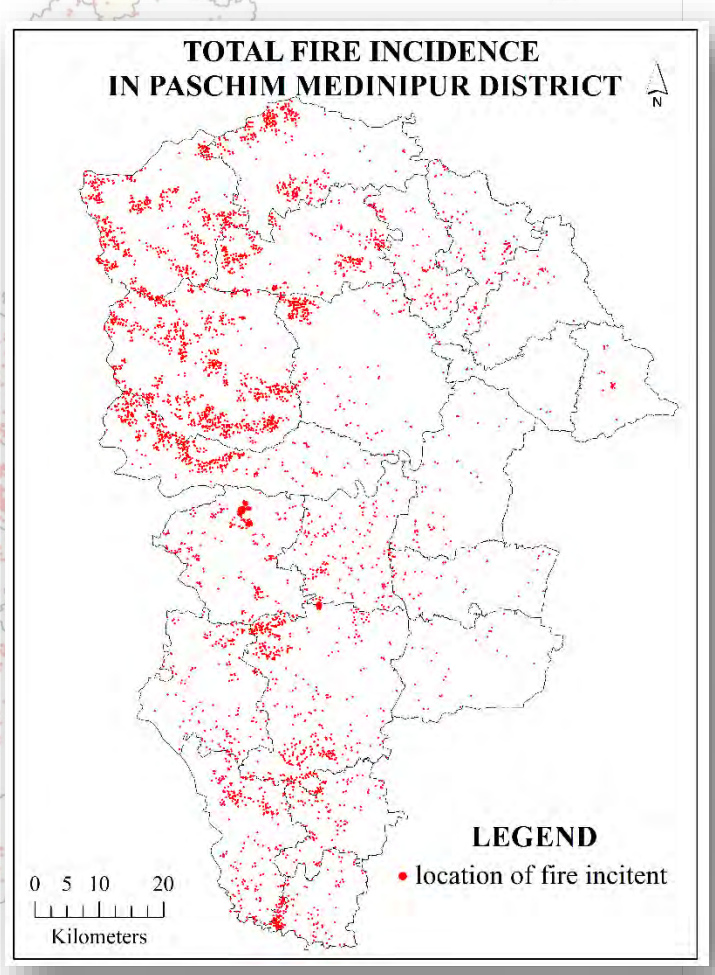


Fig. 4.6: *Incidence of open biomass burning in Paschim Medinipur District (2012 - 2020).*

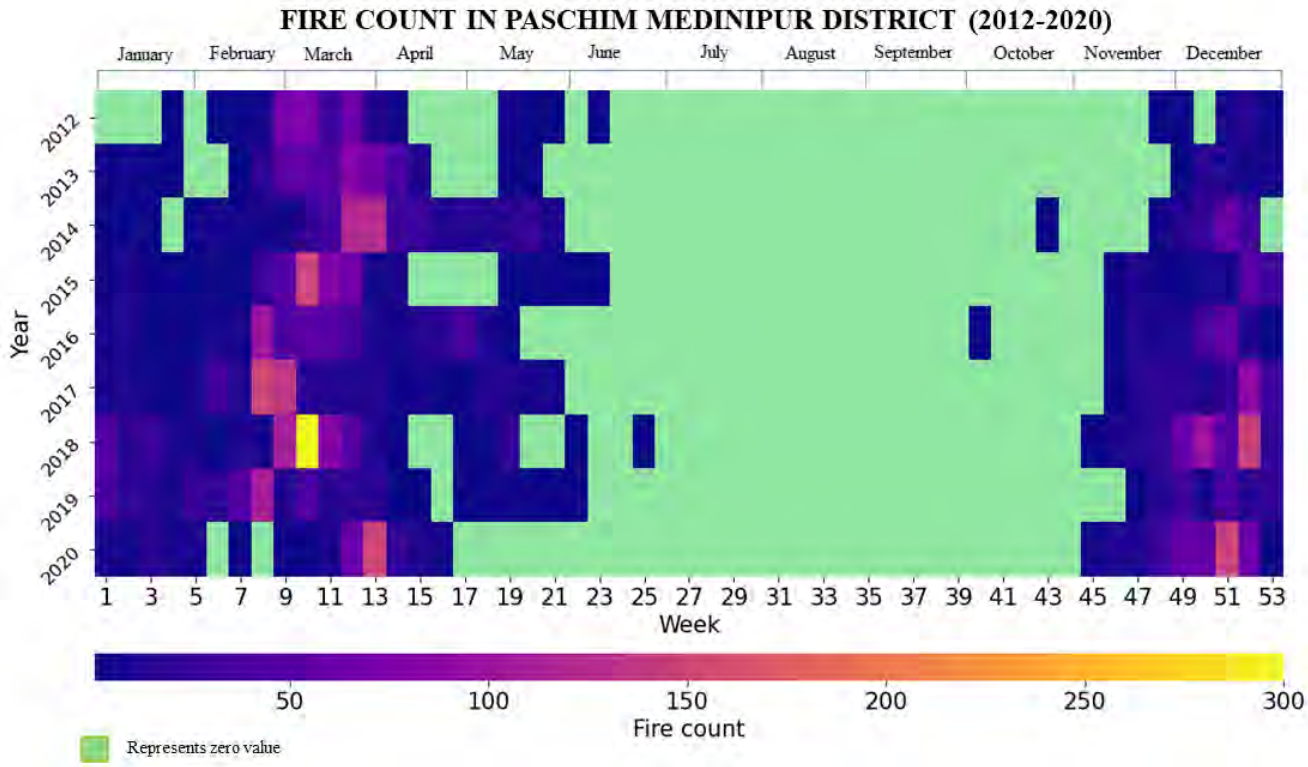


Fig. 4.7: *Distribution of weekly fire count at Paschim Medinipur in the last nine years.*

The above diagram displays the last nine years of open biomass burning, revealing that the fire season begins in mid-November and rises in December, and the fire count in Purba Bardhaman is highest in March every year (Fig no. 4.7). Mouza wise total crop residue burning and forest fire incidence has been recorded in table no 4.3 and table no 4.4 respectively. Kakrajit mouza of Dantan – I experienced the highest number of crop residue burning. Dantan – I, Dantan – II and Mohanpur region have high crop residue burning. And forest dominated Blocks of the District have experienced high forest fire. Salbani suffered the maximum number of forest fire cases.

Table 4.3: Mouza wise total Crop residue burning in Paschim Medinipur (2012 - 2020)

Block	Mouza	Total Fire Count	Remarks
Dantan - I	Kakrajit	34	Crop residue burning is observed from November to February every year. The dominant month is **December**
Kharagpur - I	Kharagpur	28	
Dantan - II	Sabra	25	
Mohanpur	Dhuipara	25	
Dantan - I	Barangi	21	
Mohanpur	Palashia	16	
Mohanpur	Gomunda	15	
Midnapore	Panchkhuri	14	
Dantan - I	Chak Ismailpur	13	
Narayangarh	Mannya	13	
Dantan - I	Tarrui	13	
Dantan - I	Arjjuni	12	
Narayangarh	Banamalipur	12	
Chandrakona - I	Kshirpai	12	
Midnapore	Medinipur	12	
Chandrakona - I	Jagannathpur	11	
Chandrakona - I	Hiradharpur	10	
Daspur - II	Kelegoda	10	
Dantan - I	Kharakhai	10	
Ghatal	Kharar	10	
Dantan - I	Palsandapur	10	
Midnapore	Shiromani	10	

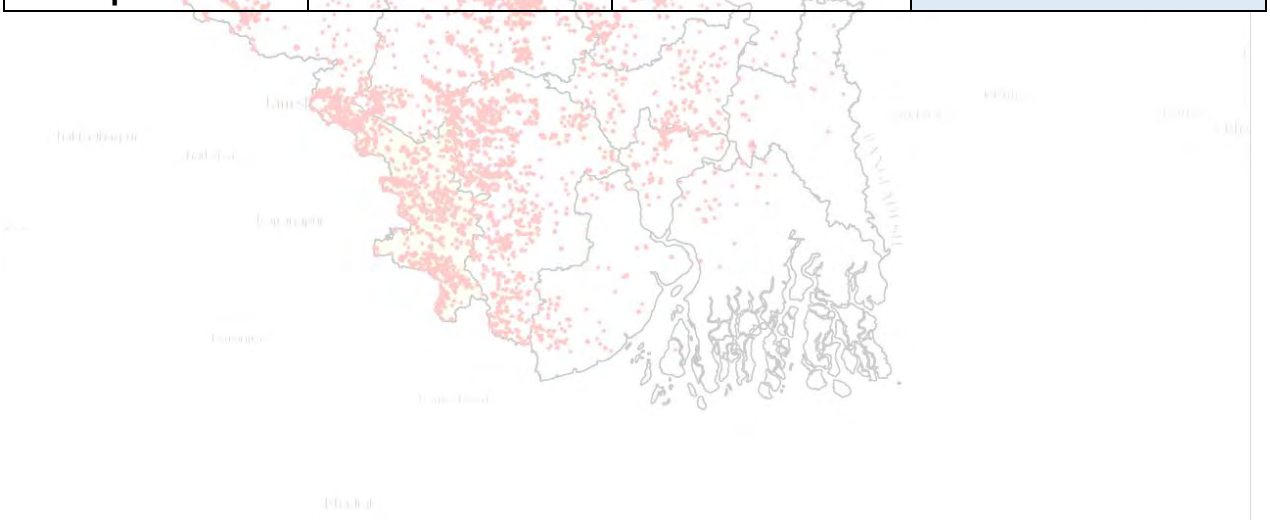
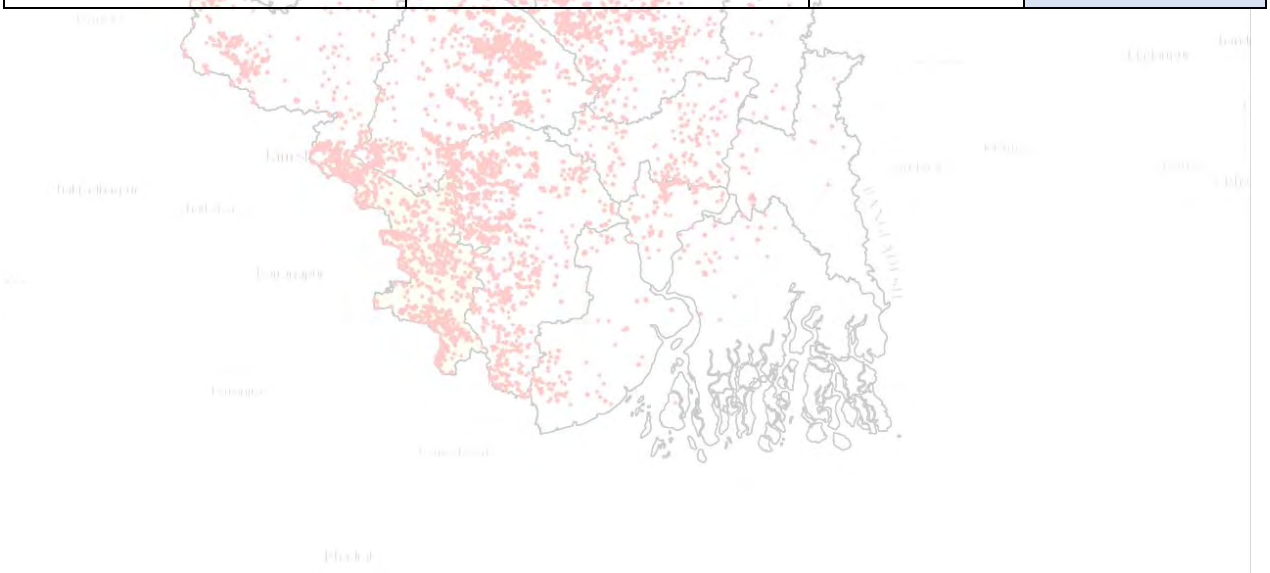


Table 4.4: Mouza wise total Forest Fire in Paschim Medinipur (2012 - 2020)

Block	Mouza	Total Fire Count	Remarks
Salbani	Khasjangal	103	Forest fire observed in the month of March
Narayangarh	Dhanghari	84	
Keshpur	Mahishdubi	64	
Midnapore	Khasjangal Trailokyapur	50	
Salbani	Karamarsolurf Kalibasa	49	
Keshpur	Khas Jangal	47	
Garbeta - I	Gilabani	43	
Garbeta - I	Kharikasuli	41	
Garbeta - II	Metyal	37	
Garbeta - I	Mugurasol	30	
Garbeta - II	Ukhla	30	
Salbani	Chaksrinath	29	
Garbeta - II	Bhuniasol	26	
Keshpur	Jorakeundi	26	
Salbani	Dhobasol	25	
Kharagpur - I	Doarkhol	24	
Garbeta - III	Gurehara	23	
Narayangarh	Binai	21	
Narayangarh	Markunda	21	
Garbeta - II	Mohanpur	20	
Midnapore	Baksibandh	20	
Salbani	Panison	20	
Salbani	Shyamchak	20	
Garbeta - II	Gangarampur	19	
Garbeta - II	Jamdahara	19	
Midnapore	Shuknakhali	19	
Garbeta - I	Asnasuli	18	
Salbani	Andharmara	18	
Salbani	Kadamdiha	18	
Garbeta - II	Barasol	17	
Garbeta - II	Patharmari	17	
Midnapore	Muchibere	17	
Garbeta - I	Nachanjam	16	
Garbeta - II	Chhota Dharampur	16	
Garbeta - II	Dudpatri	16	
Salbani	Bankisol	16	

Garbeta - III	Babuidanga	15	
Midnapore	Chaulpura	15	
Salbani	Jambani	15	
Garbeta - I	Jamdoba	14	
Garbeta - I	Kuilibad	14	
Garbeta - II	Anandanagar	14	
Garbeta - II	Bablapani	14	
Garbeta - II	Balikhunia	14	
Garbeta - III	Dhansala	14	
Midnapore	Bhalukkhulia	14	
Midnapore	Jharia	14	
Narayangarh	Jamuna	14	
Salbani	Bhangabandh	14	
Salbani	Duli	14	
Garbeta - II	Barakadra	13	
Garbeta - II	Pitli	13	
Garbeta - III	Ghagra	13	
Keshiary	Amgerya	13	
Keshiary	Lenga Mara	13	
Salbani	Godapiasol	13	
Midnapore	Jamsol	13	
Salbani	Hartora	13	
Salbani	Lalua	13	
Garbeta - II	Keshia	12	



4.3: Bankura District:

Both agricultural burning and forest fire occurred regularly in the District of Bankura. Forest fire is more often than the burning of crop residue. Every year, in the month of March, fires are set to clean up the forest floor so as to be able to easily collect mohua (Madhuca longifolia) flowers. Cleaning of the forest floor also helps forest dwellers to freely access the forest. Sometimes, local villagers ignite the forest for fun. The most affected mouzas by forest fire and Crop residue burning in the District have been documented in table number 4.6 and table number 4.5 respectively. Between 2012 and 2020, a total of 5254 fires were reported. 558 is the average number of occurrences. The total number of cases reported in 2018, 2019, and 2020 is 933, 511, and 510, respectively. However, from January to April 2021, a total of 1180 open biomass burning incidents have been reported, a record number in recent years.

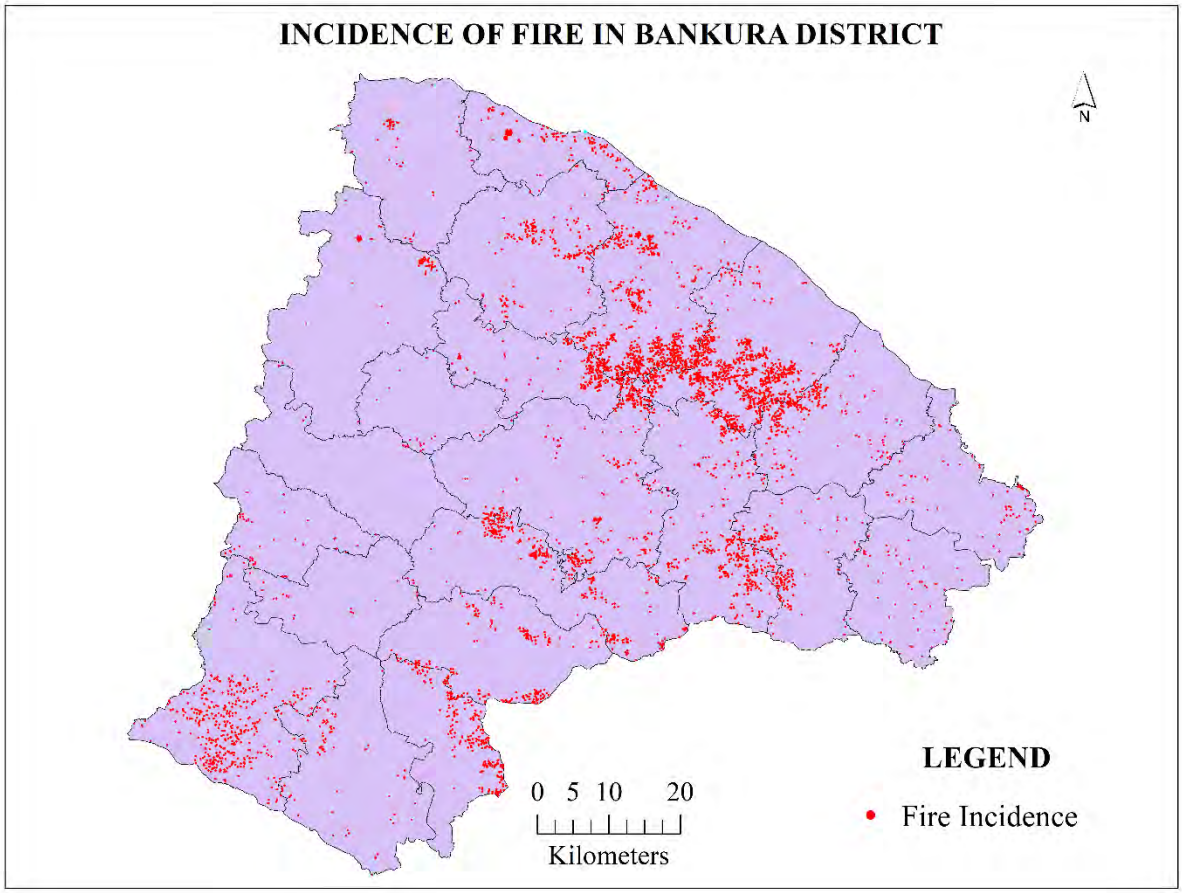


Fig. 4.8: *Incidence of open biomass burning in Bankura District (2012 - 2020).*

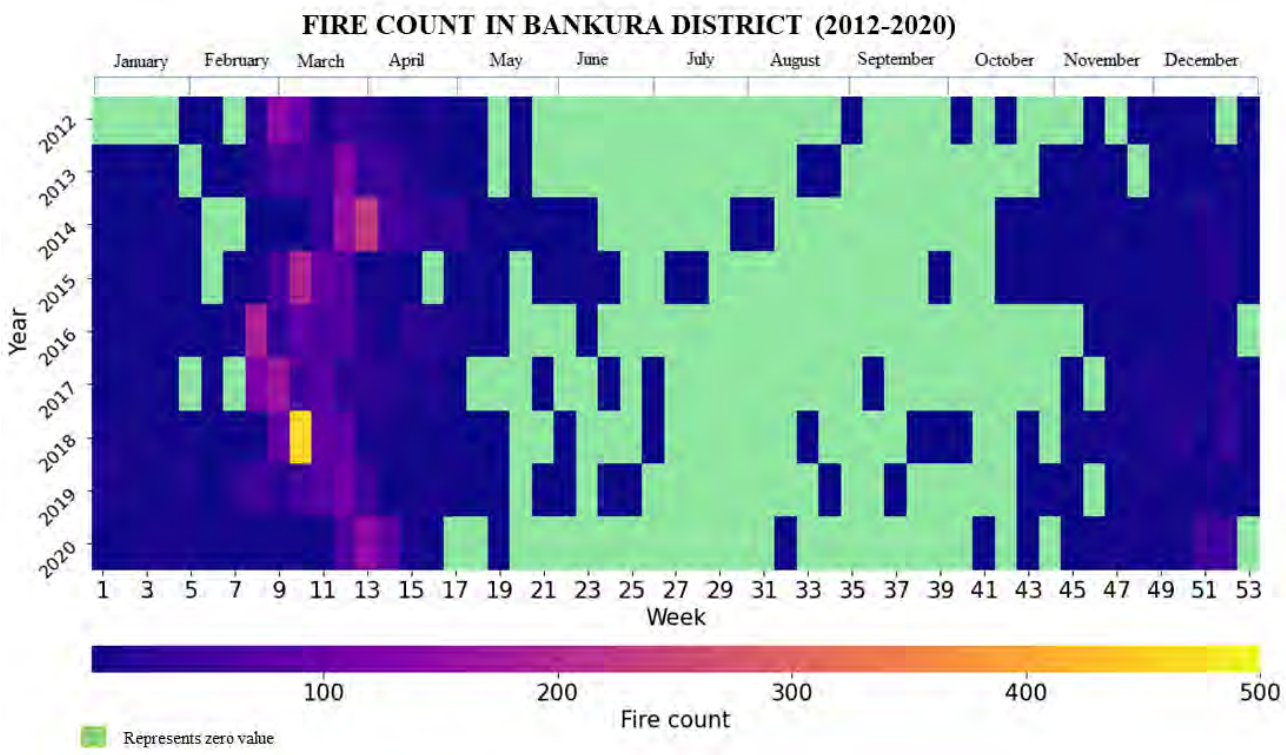


Fig. 4.9: *Distribution of weekly fire count at Bankura District in last nine years.*

Table 4.5: Mouza wise total Crop Residue Burning in Bankura District (2012 - 2020)

Block	Mouza	Total Fire Count
Barjora	Pingrui	22
Bankura - II	Maslia	19
Indus	Akui	15
Mejhia	Dighalgram	13
Mejhia	Mejhia	10

Table 4.6: Mouza wise total Forest Fire in Bankura District (2012 – 2020)

Block	Mouza	Fire Count
Chhatna	Jorhira	278
Barjora	Swargabati	111
Bankura - II	Baramasia	96
Barjora	Saulia	96
Sonamukhi	Rani Bandh	74
Onda	Chak Nakaijuri	61
Bishnupur	Basudebpur	57
Sonamukhi	Bhula	55
Sonamukhi	Bara Naryanpur	52
Barjora	Dhengakend	51
Sonamukhi	Rajda	51
Barjora	Methena	47
Vishnupur	Khana Bari	46
Patrasayer	Satgechhe	46
Patrasayer	Chak Patra Saer	45
Sonamukhi	Ichharia	45
Barjora	Saharjora	44
Taldangra	Belasuli Shyamsundarpur	43
Sonamukhi	Chakdhoyakure	41
Sonamukhi	Pathara	41
Sonamukhi	Kalyanpur	39
Sonamukhi	Karachmani Khayarsol	39
Jaypur	Khanabari	39
Sonamukhi	Indkata	37
Sonamukhi	Kanaipur	36
Bankura - II	Kodalia	36
Sonamukhi	Hurhurjangar	34
Sonamukhi	Mach Doba	34
Taldangra	Chenchurya	33
Simlapal	Dubrajpur	32
Vishnupur	Chua Masina	30
Sonamukhi	Hikimband	30
Chhatna	Shushunia Pahar	28
Vishnupur	Tribanka	28
Onda	Angaria	27
Barjora	Jorshal	27
Simlapal	Krishnapur	26
Gangajalghati	Latiabani	25

Bankura District experienced crop burning and forest fire both but forest fire is more dominant. Jorhira mouza of Chhatna and Swargabati mouza of Barjora Block have the highest number of forest fire cases.

4.4 Birbhum District:

This District is often influenced by Crop residue burning. In the northern part, crop residue burning has been recorded in April, while fire is often seen in the southern Blocks in December. The annual average number of cases in this Block is 209, and the total reported instances in 2020 are 522. It is observed that open biomass burning is increasing in this Block as well.

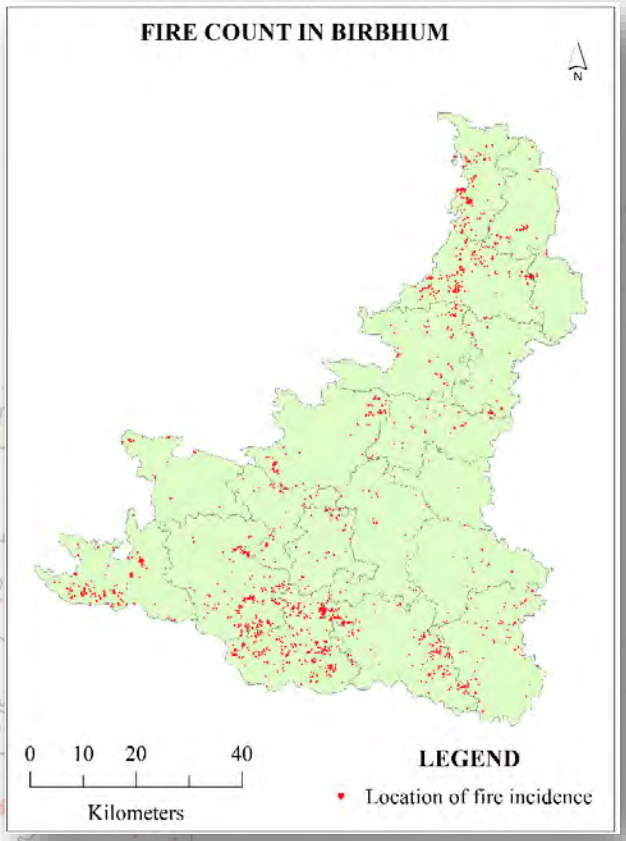


Fig.4.10: *Incidence of open biomass burning in Birbhum District (2012 - 2020).*

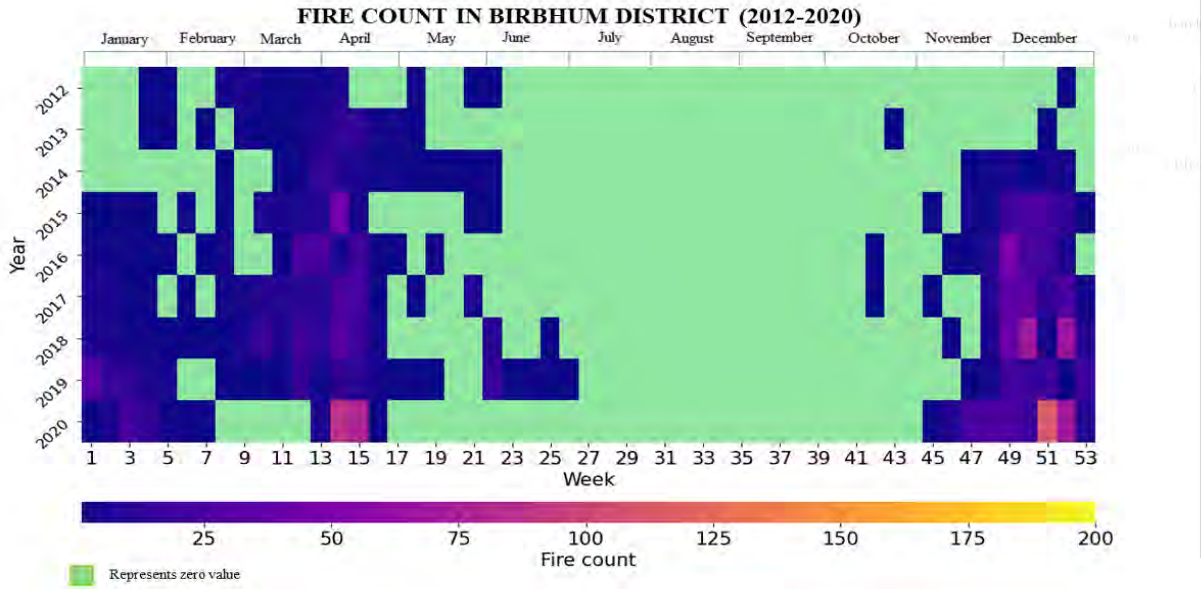
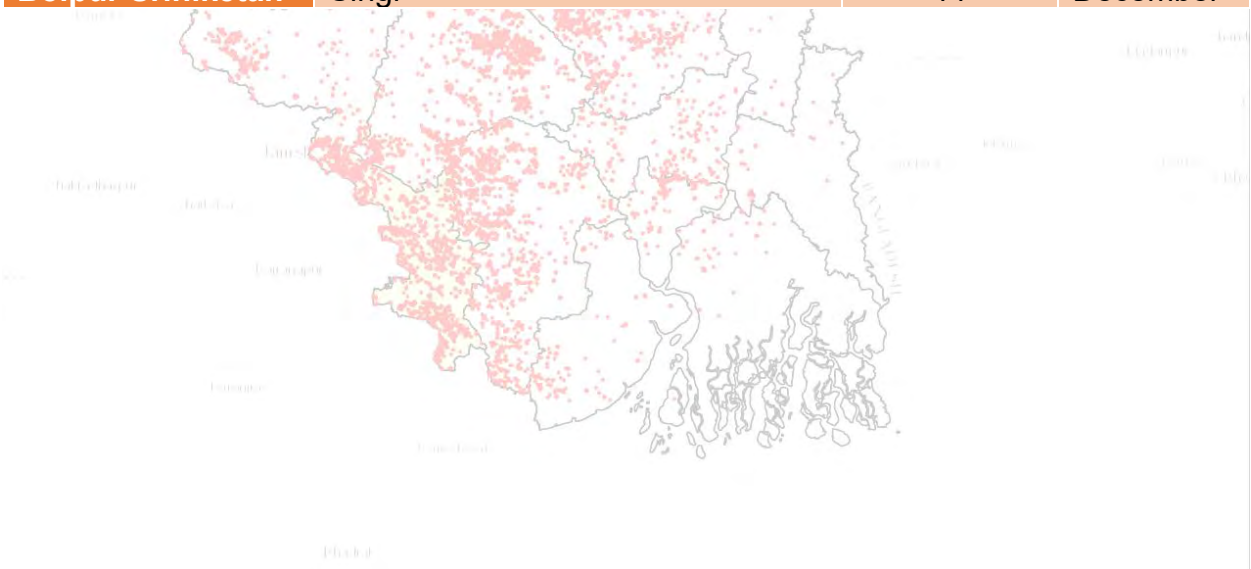


Fig. 4.11: *Distribution of weekly fire count at Birbhum in last nine years.*

Table 4.7: Mouza wise total Crop Residue Burning in Birbhum District (2012 - 2020)

Block	Mouza	Fire Count	Month
Illambazar	Chaupahari Jangal	36	March
Dubrajpur	Khandagram	29	December
Nalhati - I	Bhabanandapur	23	April
Mohammad Bazar	Char Ichharaghubarpur	22	March
Bolpur Sriniketan	Salan	18	December
Murarai - I	Malaypur	17	April
Dubrajpur	Radhamadhabpur	17	April
Mohammad Bazar	Ghagha	15	March
Murarai - I	Mahurapur	15	April
Bolpur Sriniketan	Bheramari	14	December
Murarai - I	Kanakpur	14	April
Nalhati - I	Paikpara	14	April
Nalhati - I	Takipur	14	April
Dubrajpur	Ghoratarai	13	December
Nalhati - I	Kanisail	13	April
Murarai - II	Rudranagar	13	April
Bolpur Sriniketan	Sahajapur	13	December
Nalhati - I	Amalai Bahara	12	April
Murarai - I	Dumurgram	12	April
Nanoor	Hate Serandi	12	December
Illambazar	Ulandi	12	December
Bolpur Sriniketan	Bahiri	11	December
Illambazar	Dhansaha	11	December
Dubrajpur	Paduma	11	December
Bolpur Sriniketan	Singi	11	December



4.5 Jhargram District:

Each year, forest fires have an effect on the Jhargram District. Certain forest fringe regions fall under the elephant corridor; which elephants commonly use in their search for food. Villagers set fire to the area to keep elephants out and prevent them from ruining crops and buildings. As a result, forest fires occur. Cleaning the forest floor enables forest people to enjoy the forest freely. Other causes include unawareness of people about the effect of biomass burning on environment. Jhargram has observed an average of 474 cases. Annual cases reached 295 and 444 in 2019 and 2020, respectively. The highest annual fire count was 722 in 2018, while 961 occurrences were registered between January and April 2021, setting a new record.

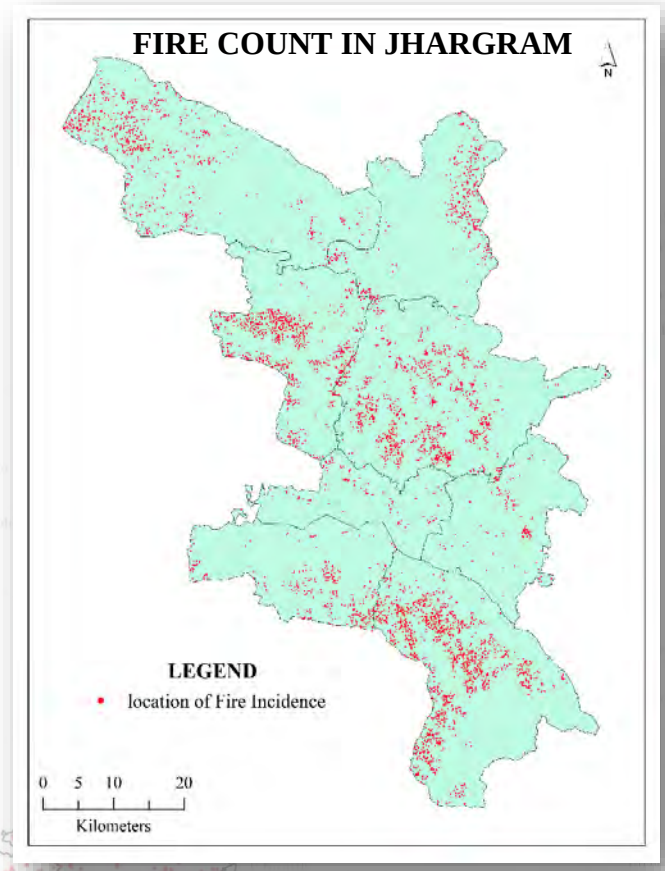


Fig. 4.12 *Incidence of open biomass burning in Jhargram District.*

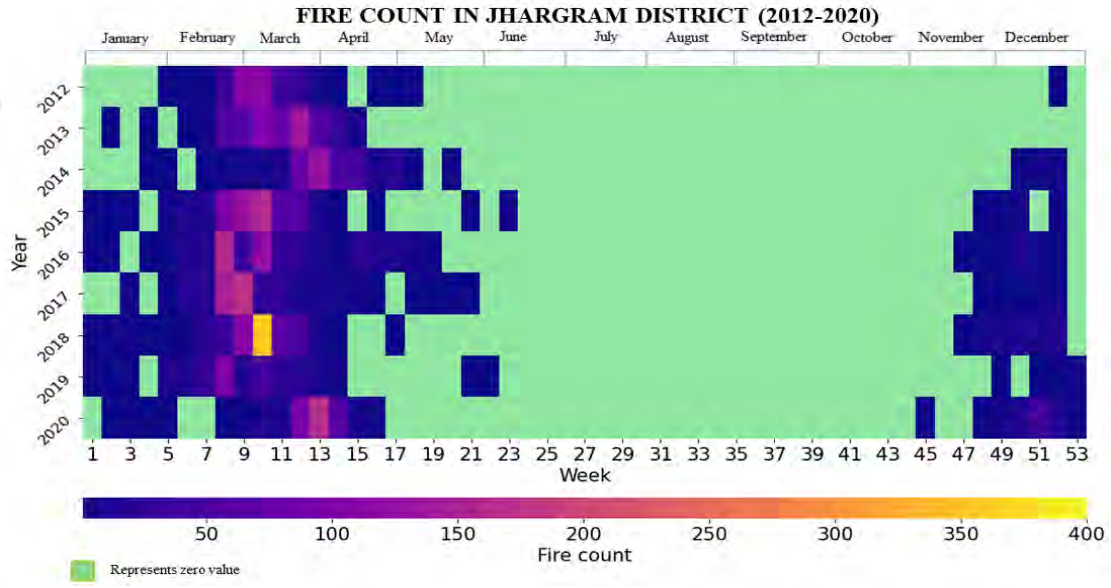


Fig. 4.13: *Distribution of weekly fire count at Jhargram District in last nine years.*

Table 4.8: Mouza wise total Forest Fire in Jhargram District (2012 – 2020)

Block	Mouza	Fire Count
Nayagram	Khas Jangal	159
Jhargram	Khas Jangal	158
Jhargram	Jangal Khas	148
Jamboni	Khas Jangal	98
Nayagram	Tapoban	94
Binpur - I	Jangalkhas	94
Nayagram	Jangal Khas	93
Jamboni	Khat Gerya	72
Nayagram	Khasjangal	64
Binpur - I	Jangal Khas	61
Jhargram	Khasjangal	58
Jamboni	Benchasol	49
Binpur - II	Daldali	44
Nayagram	Kashia	41
Jhargram	Jangalkhas	41
Nayagram	Tilia	40
Binpur - I	Lalgarh Jangalkhas	39
Binpur - II	Amjharna	39
Nayagram	Uthan Nayagram	37
Nayagram	Jamsol	36
Nayagram	Darkhuli	32
Jamboni	Jamunasol	30
Nayagram	Bara Sol	30
Nayagram	Rakhal Ban	30
Gopiballavpur - I	Tarki Dudhia	29
Jamboni	Shushni	29
Nayagram	Damda Sol	28
Binpur - II	Bagdoba	27
Sankrail	Durgahari Jangal	26
Nayagram	Katash	24
Jhargram	Dhobi Jangal	23
Binpur - II	Dangardiha	22
Jamboni	Dumria	21
Binpur - I	Khasjangal	11

4.6 Purulia District:

Forest fire is dominant open biomass burning in Purulia District. The forest fire has primarily impacted Bagmundi, Balarampur, Jhalda – I, and Arsha Block, which are located near Ajodhya hill. Forest fires have a significant impact on both Bundwan and Neturia Blocks. In 2019 and 2020, the District's fire count was just 64 and 144, respectively, but in 2021, forest fires soared to 654 occurrences between February and April.

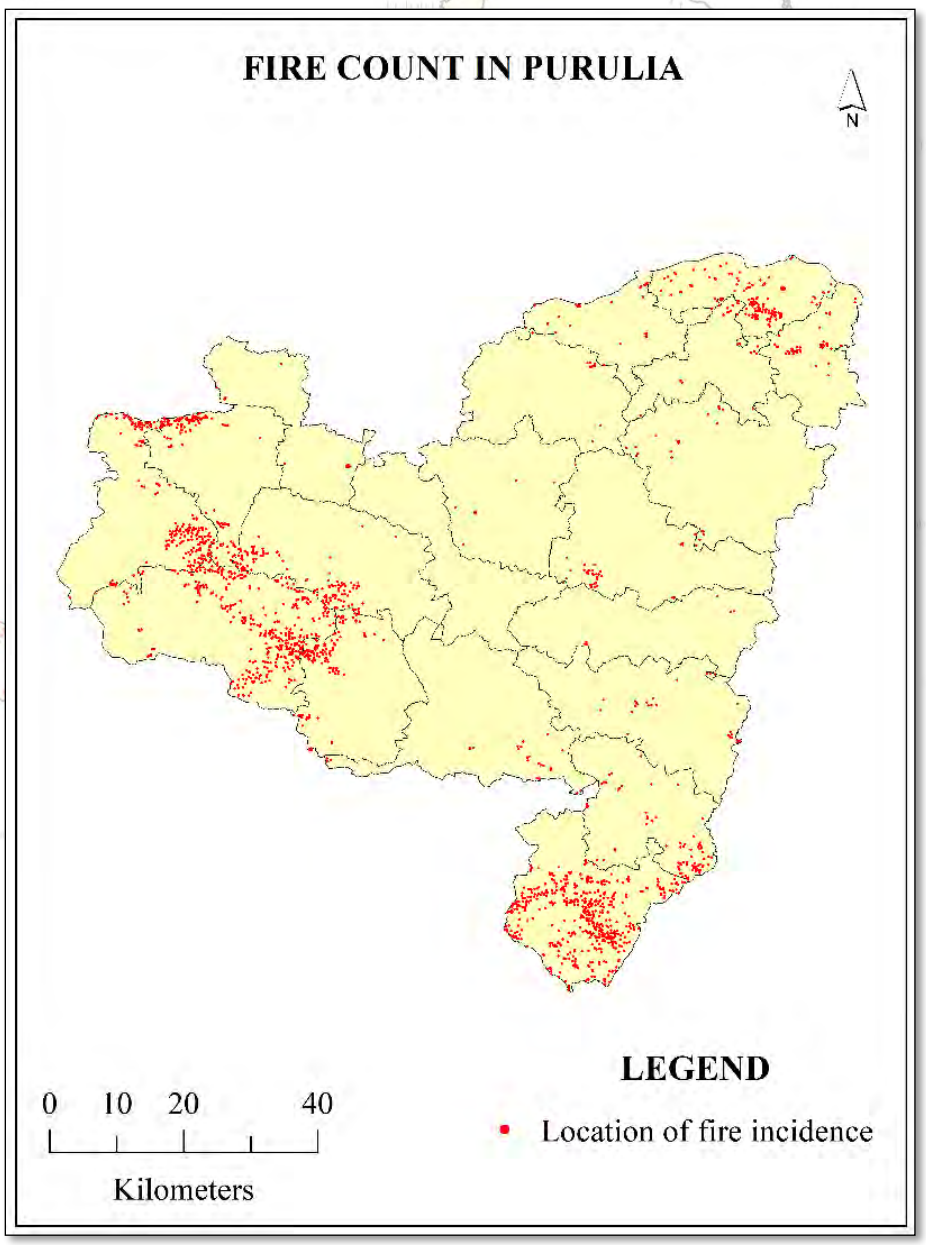


Fig. 4.14: *Incidence of open biomass burning in Purulia District (2012 - 2020).*

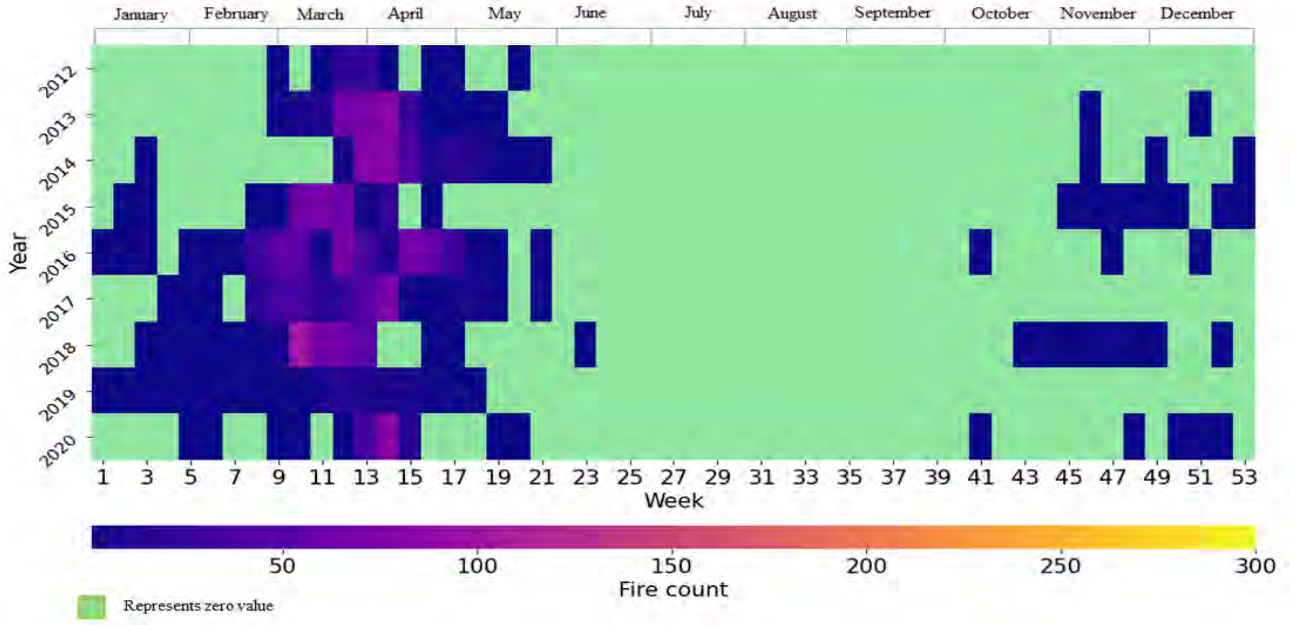


Fig. 4.15: *Distribution of weekly fire count at Purulia District (2012 – 2020).*

Table 4.9: Mouza wise total Forest Fire in Purulia District (2012 – 2020)

Block	Mouza	Fire Count
Neturia	Gar Panchkot	69
Bagmundi	Matha Protected Forest	49
Bagmundi	Pardi	46
Balarampur	Garga	44
Bagmundi	Burda	37
Bundwan	Popo	34
Jhalda - II	Jabar	30
Jhalda - I	Panrri	28
Bagmundi	Barria	27
Bagmundi	Pitidiri	26
Bundwan	Kantagora	25
Bagmundi	Ajodhya	24
Jhalda - I	Kalma	24
Jhalda - I	Kudagara	24
Arsha	Bamni	23
Hura	Keshargarh	21
Bundwan	Barudih	20
Bagmundi	Gobaria	20
Arsha	Rajpati	20

Block	Mouza	Fire Count
Jhalda - I	Tarhad	20
Bundwan	Ghaghra	19
Jhalda - I	Nawagar	19
Bundwan	Mangal	18
Arsha	Bhuda	17
Bundwan	Harada	17
Bundwan	Kukrudabar	17
Arsha	Upargugui	17
Bagmundi	Baghmundi	16
Bundwan	Kushbani	16
Jhalda - II	Maramu	16
Bundwan	Sirisgora	16
Balarampur	Bersa	15
Manbazar - II	Kalapati	15
Bundwan	Udalbani	15
Bundwan	Chhotatalpat	14
Balarampur	Karma	14
Balarampur	Parbad Kashitanr	14
Arsha	Uparjari	14
Bundwan	Asanpani	13
Bundwan	Digha	13
Jhalda - II	Haratan	13
Bundwan	Ledashol	13
Bundwan	Madhuban	13
Jhalda - II	Simni	13
Jhalda - I	Gopalpur	12
Bundwan	Janijhor	12
Bundwan	Jobnagora	12
Bundwan	Mirgichami	12
Jhalda - I	Bagbinda	11
Bundwan	Kuriapara	11
Bundwan	Makopali	11
Jhalda - II	Mamudi	11
Bundwan	Rajauli	11

4.7 Nadia District:

Nadia District is influenced by crop residue burning. The northern part of the District has a higher proportion of incidents. Every year, the month of April is the most common month for fire incidents to occur. This District has an average yearly open biomass burning of 125. In Nadia, the year 2014 has seen the highest annual total of 194 instances of open biomass burning. Annual fire counts have been lowest in 2018 and 2019, at 40 and 54, respectively. However, in March – April 2020 and 2021, more than 100 instances have been reported. In Nadia, rabi season residue burning has been witnessed.

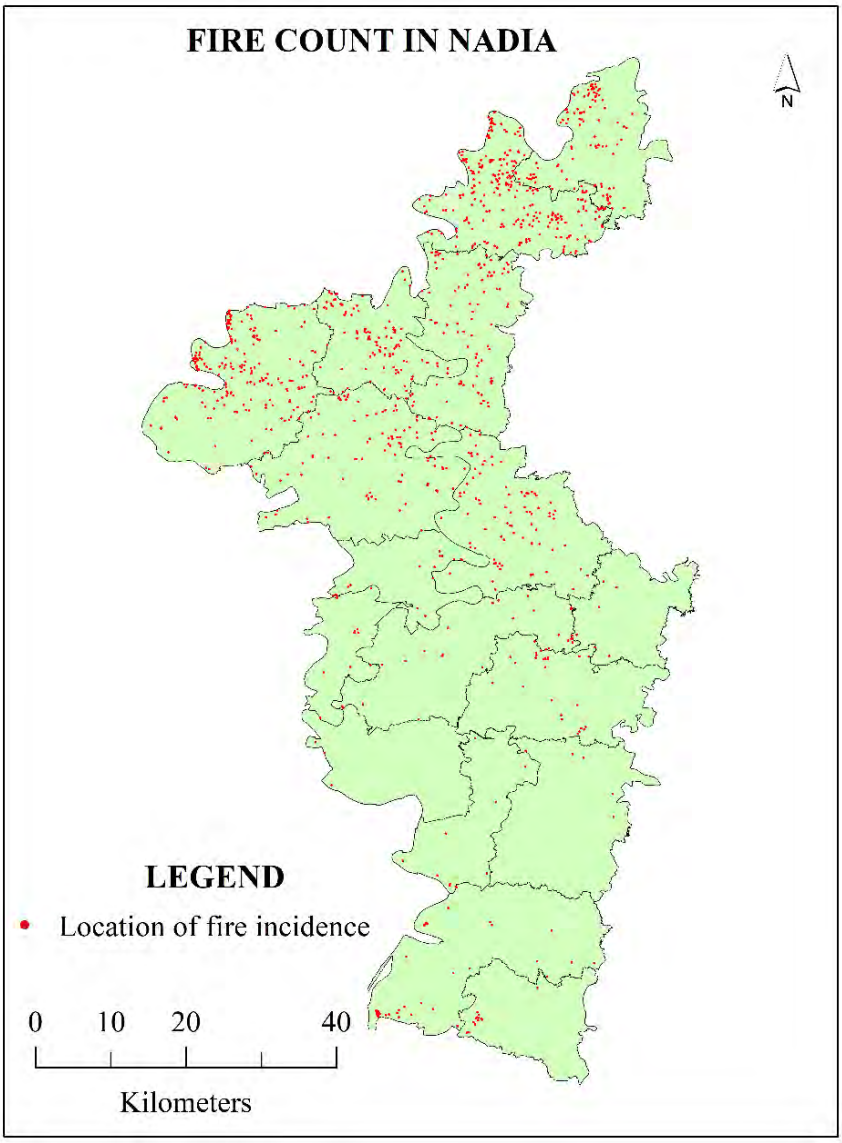


Fig. 4.16: *Incidence of open biomass burning in Nadia District (2012 - 2020).*

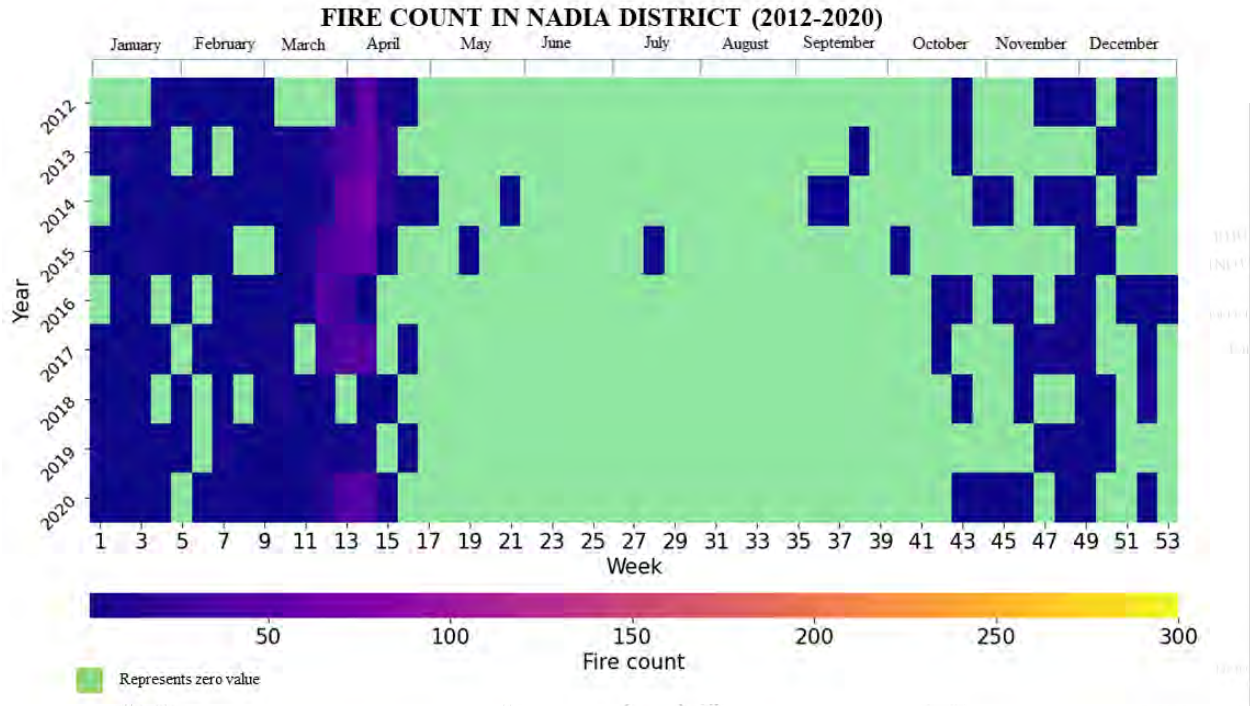


Fig. 4.17: *Distribution of weekly fire count at Nadia District in last nine years.*

Table 4.10: Mouza wise total Crop Residue Burning in Nadia District (2012 – 2020)

Block	Mouza	Fire Count
Karimpur - II	Dogachhi	25
Karimpur - II	Thanapara	25
Chakdah	Char Kancharapara (P)	22
Kaliganj	Char Manikdihi	20
Karimpur - II	Pipulkhola	18
Karimpur - I	Durlabhpur	16
Karimpur - II	Saguna	16
Kaliganj	Debagram	14
Haringhata	Haringhata Farm	14
Tehatta - II	Palsunda	13
Tehatta - II	Palsunda	13
Tehatta - II	Baruipara	12
Karimpur - I	Jayrampur	12
Tehatta - II	Bara Naldaha	11
Chapra	Badelangi Padmamala	10
Hanskhali	Betna	10
Kaliganj	Bhurulia	10
Karimpur - II	Mahish Bathan	10
Tehatta - I	Tehatta	10

4.8 Murshidabad:

Crop residue burning has a significant impact on Murshidabad District every year during the month of April. Wheat residue burning is the primary reason. Sugarcane fields are experienced this type of activity. There is also bush fire on the land along the river intentionally caused by villagers to prepare agricultural land from scrub land. The trend of open biomass burning is increasing in Murshidabad. This District has an annual frequency of 299 incidents; however, 431 cases were reported in 2020. 386 occurrences were registered in rabi season 2021.

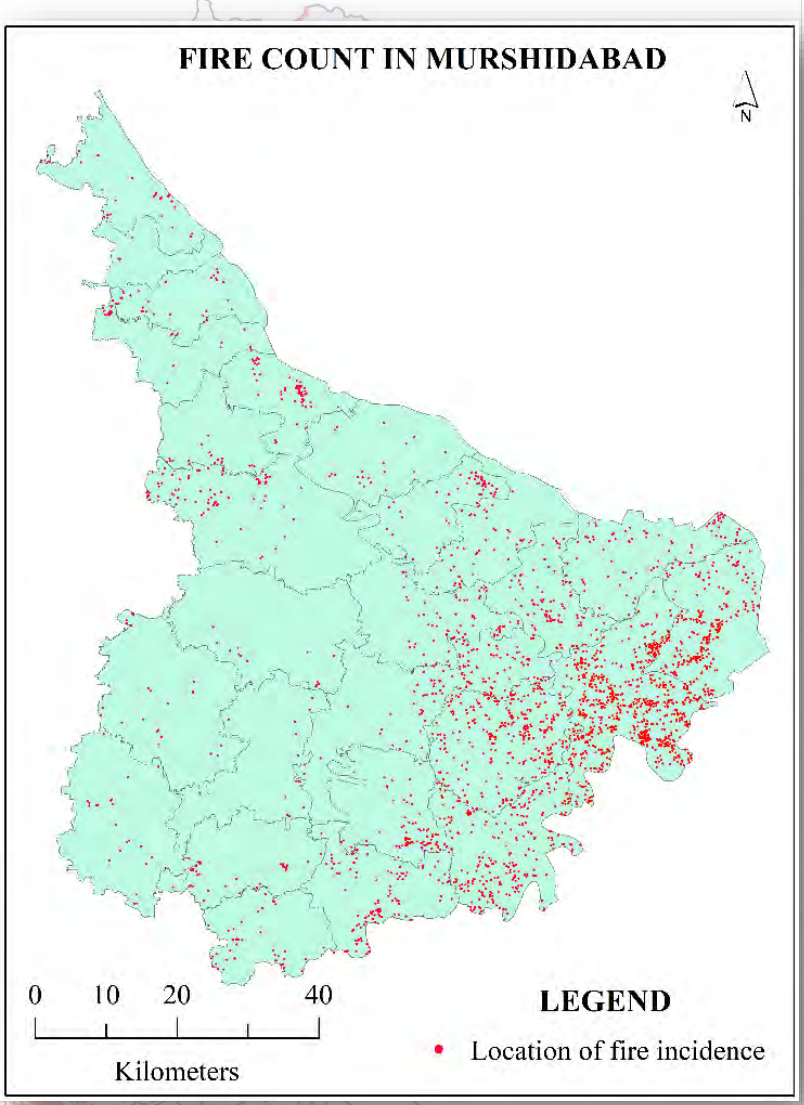


Fig. 4.18: *Incidence of open biomass burning in Murshidabad District (2012 - 2020).*

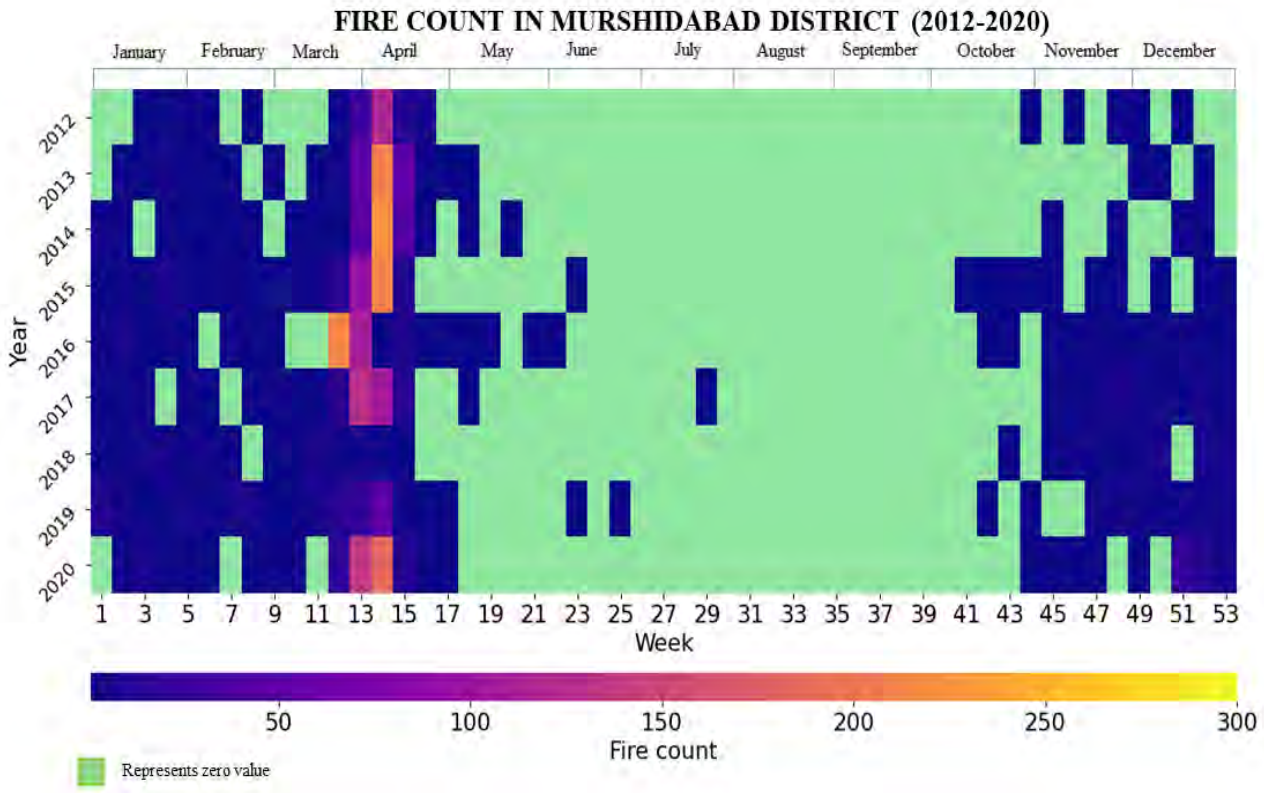


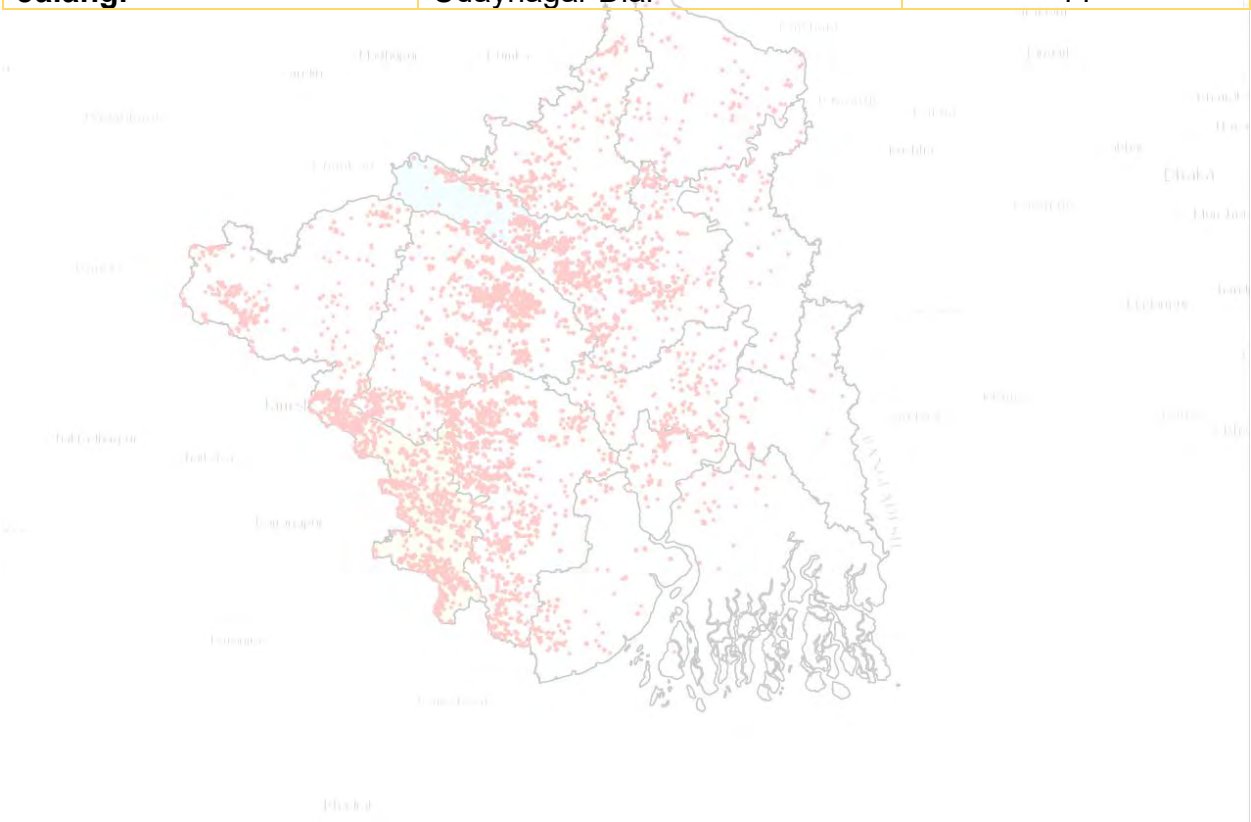
Fig. 4.19: *Distribution of weekly fire count at Murshidabad District in last nine years***.**

In terms of fire incidence, the diagram (Fig. 4.19) above clearly shows that the 12th to 14th week of the year is the most vulnerable in Murshidabad District. It is also observed that in the year 2020, the number of cases has increased as compared to 2018 and 2019. In 2020, most of the cases were recorded in the 14th week or in the first week of April.

Table 4.11: Mouza wise total Crop Residue Burning in Murshidabad District (2012 – 2020)

Block	Mouza	Fire Count
Domkal	Garaimari	65
Jalangi	Bara Bil Raghunathpur	60
Jalangi	Paschim Sahebrampur	48
Domkal	Juginda	47
Nawda	Raypur	42
Jalangi	Debottar Lakshminarayanpur	40
Nawda	Sarbangapur	40
Jalangi	Khayramari	29
Nawda	Dakatiapota	28
Domkal	Sahadiar	28
Domkal	Sibnagar Laskarpur	28
Nawda	Bali	27
Hariharpara	Choa	27
Domkal	Mamenpur	26
Beldanga - I	Kapasdanga	24
Jalangi	Faridpur	23
Domkal	Hari Sankarpur	23
Nawda	Madhupur	23
Hariharpara	Dharampur Ramna	22
Bhagawangola - I	Dakshin Hanumanta Nagar	21
Hariharpara	Gaznipur	21
Beldanga - I	Maniknagar	21
Domkal	Sabdalpur	21
Domkal	Taraf Rasulpurpatnipara	21
Hariharpara	Hariharpara	19
Bhagawangola - I	Dakshini Nayakharida Babupur	18
Domkal	Mohanpur	18
Domkal	Bil Nayankhali	17
Domkal	Kata Kopra	17
Jalangi	Sagarpara	17
Hariharpara	Joykrishnapur	16
Nawda	Chandpur	15
Domkal	Jhaubaria	15
Domkal	Juranpur	15
Domkal	Lakshminathpur	14
Domkal	Mas Danga	14
Domkal	Ramna Etbarnagar Basantapur	14

Block	Mouza	Fire Count
Raninagar - I	Tekaraipur	14
Hariharpara	Biharia	13
Hariharpara	Dasturpara	13
Beldanga - II	Jhikra	13
Berhampore	Selamatpur	13
Domkal	Bagharpur Ramna	12
Hariharpara	Lochanmati Dangapara	12
Raghunathganj - II	Nasipur	12
Domkal	Pardiar	12
Raghunathganj - II	Pirojpur	12
Nawda	Alampur	11
Domkal	Aminabad	11
Domkal	Dakshin Nagar	11
Domkal	Garibpur	11
Murshidabad Jiaganj	Hasenpur	11
Berhampore	Hati Nagar	11
Hariharpara	Kismat Imadpur	11
Jalangi	Paranpur	11
Hariharpara	Tehatta	11
Jalangi	Udaynagar Diar	11



4.9: Dakshin Dinajpur:

Dakshin Dinajpur has higher crop residue burning incidents in April every year due to residue burning in the wheat and sugarcane fields. Harirampur, Kushmundi, Gangarampur and Tapan are highly vulnerable Blocks. In recent years, the District's total yearly fire count has averaged around 200 occurrences.

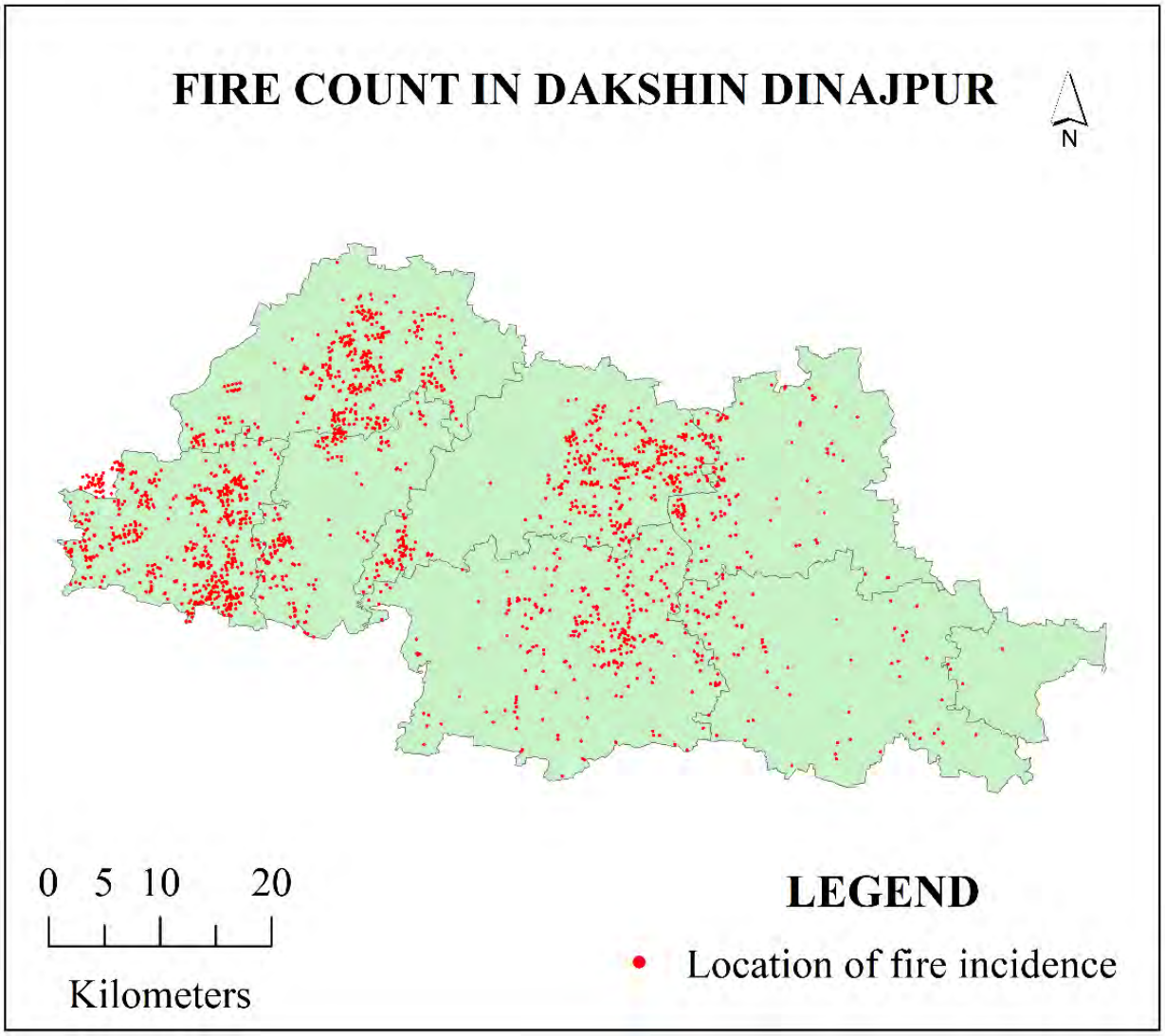
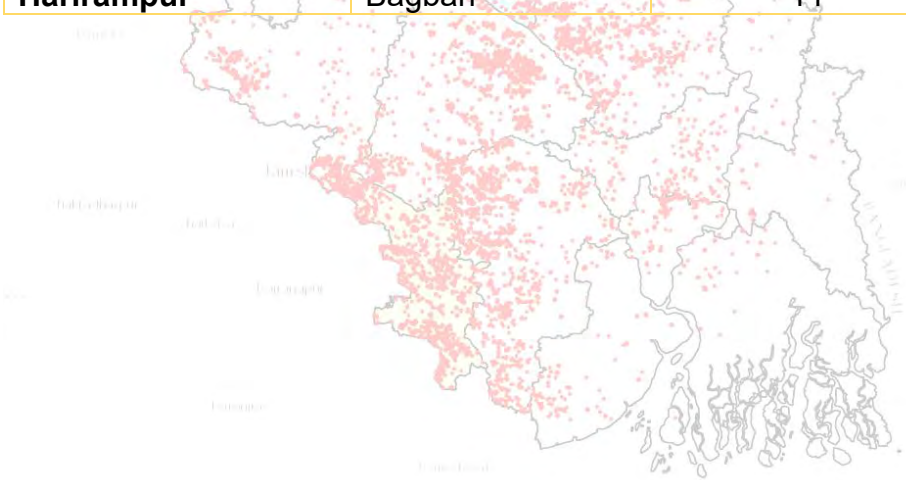


Fig. 4.20: *Incidence of open biomass burning in Dakshin Dinajpur District (2012 – 2020)*

Table 4.12: Mouza wise total Crop Residue Burning in Dakshin Dinajpur District (2012 – 2020)

Block	Mouza	Fire Count	Month
Harirampur	Bairhatta	31	April
Gangarampur	Kurumsur	30	
Kumarganj	Jhara	26	
Gangarampur	Chalun	21	
Gangarampur	Gokulpur	21	
Harirampur	Jathigram (I)	21	
Kushmundi	Kasba	20	
Kushmundi	Lakshmipur	20	
Harirampur	Muskipur (I)	20	
Harirampur	Bagichapur	18	
Harirampur	Gandhnai	18	
Kushmundi	Nahit	16	
Harirampur	Saiyadpur (I)	16	
Kushmundi	Bateshwar	15	
Gangarampur	Nehamba	15	
Harirampur	Dhulinakor	14	
Bansihari	Mahugram	14	
Harirampur	Karanjabari	13	
Harirampur	Monohara	13	
Kushmundi	Shikrishnapur	13	
Gangarampur	Banihari	12	
Harirampur	Bagbari	11	



4.10 Hooghly:

Rice crop residue burning is increasing day by day in this Block. Polba – Dadpur, Goghat – II, Arambag have recorded a higher number of residue fires in recent years. The annual fire count in Hooghly is constantly rising. In 2020, more than 200 incidents have been reported, which is the highest number in the prior nine years.

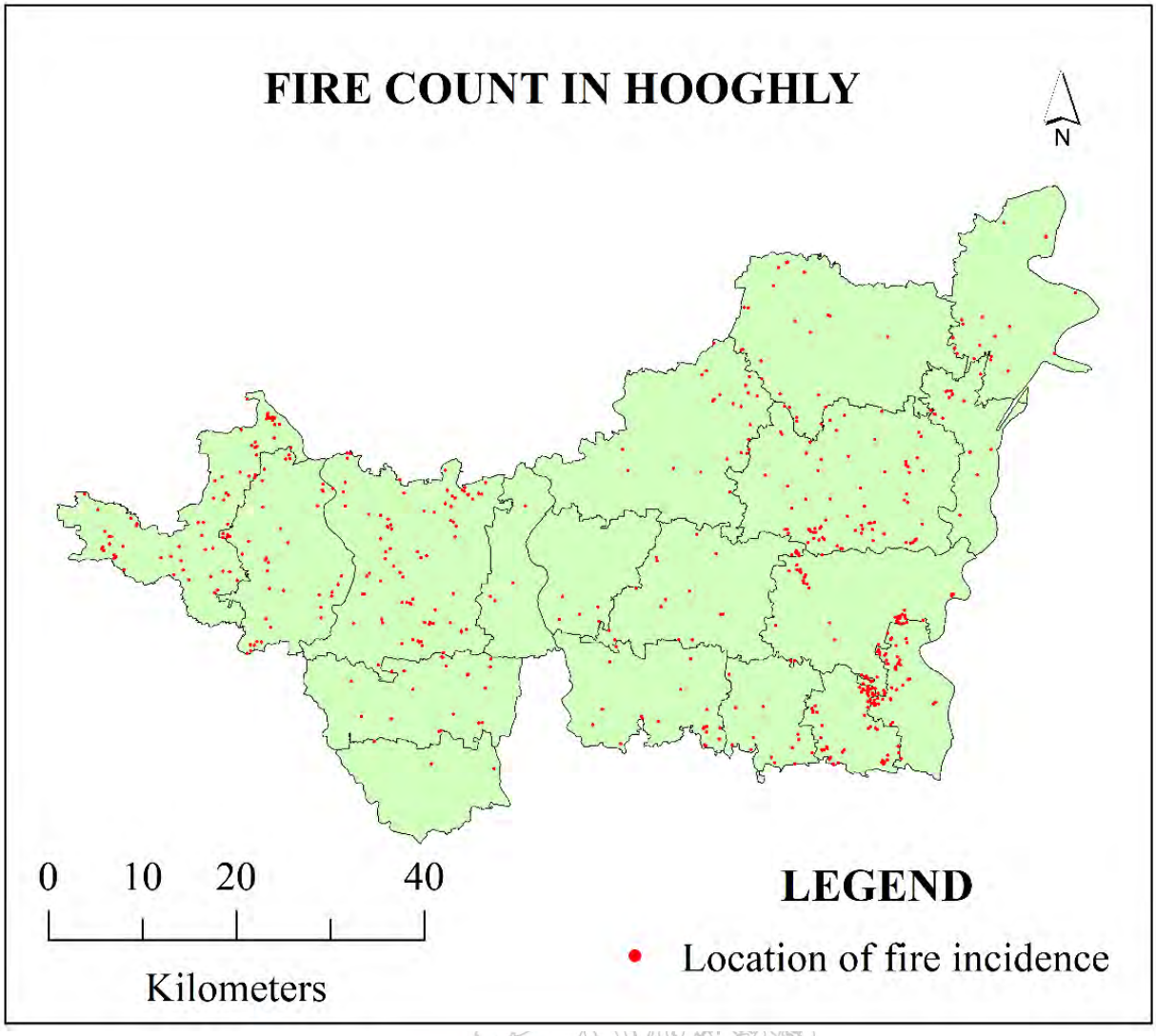


Fig. 4.21*: Incidence of open biomass burning in Hooghly District (2012 – 2020)*

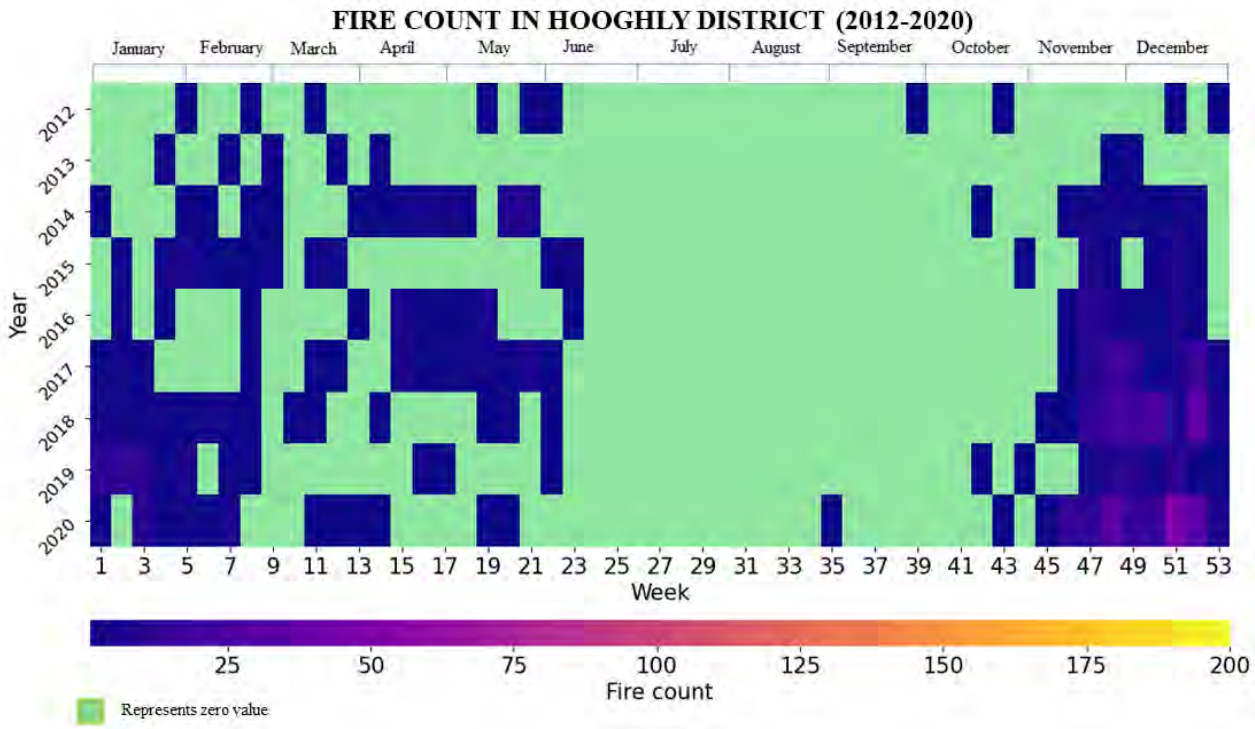


Fig. 4.22: *Distribution of weekly fire count at Hooghly District in last nine years.*

Table 4.13: Mouza wise total Crop residue burning in Hooghly District (2012 – 2020)

Block	Mouza	Fire Count
Serampur Uttarpara	Mollarber	16
Haripal	Mahisatikri	15
Arambag	Arambag	12
Chanditala - II	Jaykrishnapur	10

4.11 Kalimpong:

Kalimpong-I Block saw substantially more forest fire cases than the other two Blocks, most of which were in March, as well as in early April. Long-term, the entire annual fire count has been declining, but from March to April 2021, a total of 78 occurrences have been recorded, which is a significant increase.

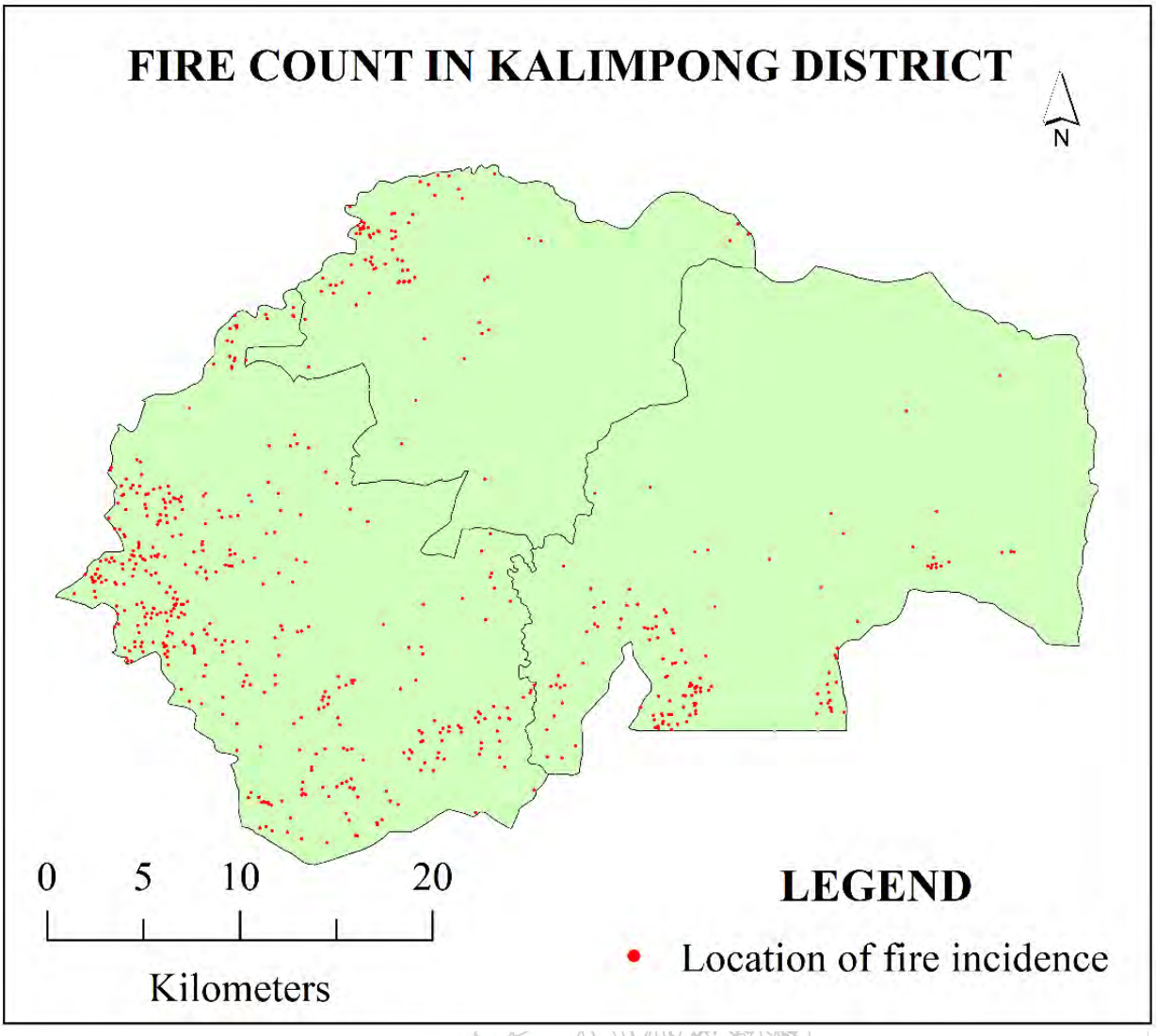


Fig. 4.23: *Incidence of open biomass burning in Kalimpong District (2012 – 2020)*

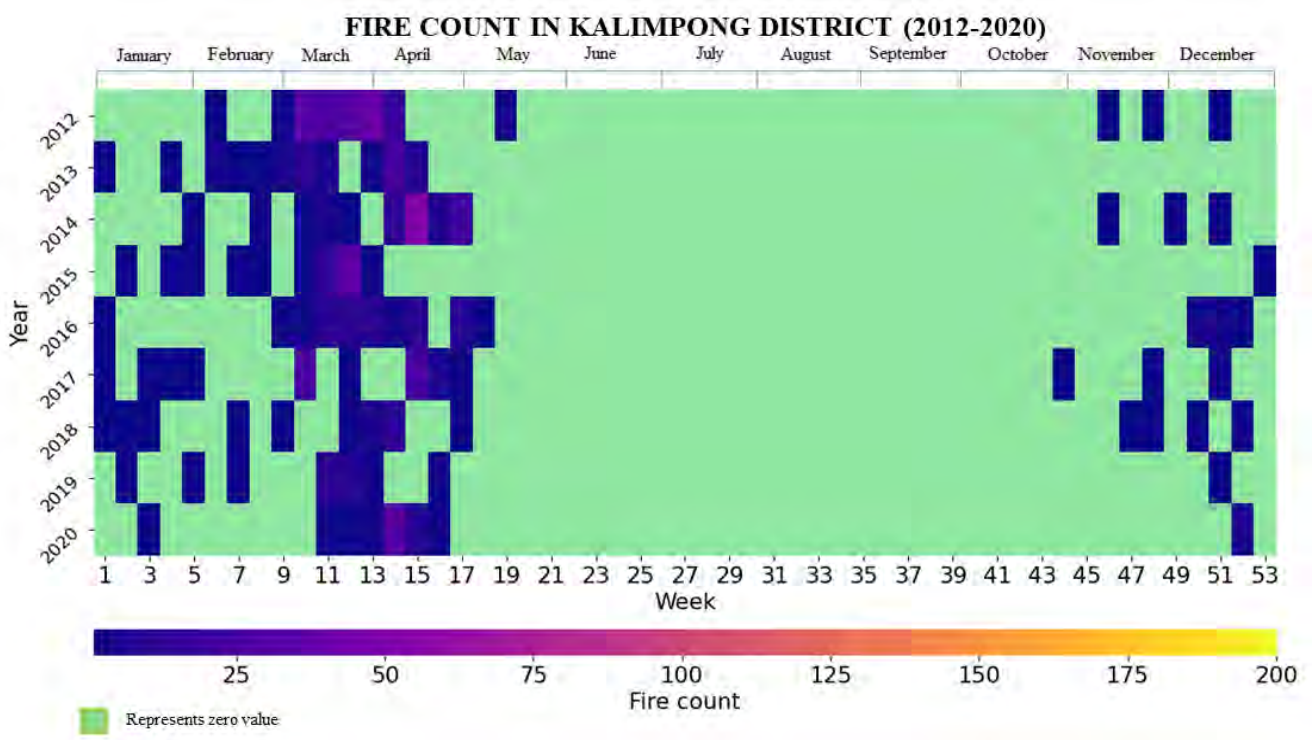


Fig. 4.24: *Distribution of weekly fire count at Kalimpong District in last nine years.*

Table 4.14: Mouza wise total Forest fire in Kalimpong District (2012 – 2020)

Block	Mouza	Fire Count
Gorubathan	Mal Forest	54
Kalimpong -I	Mangpong Forest	44
Kalimpong -I	Mazeok Forest	36
Kalimpong -I	Riyong Forest	32
Kalimpong - II	Rangpo Forest	31
Kalimpong -I	Birik Forest	30
Kalimpong -I	Yang Makum Khasmahal	28
Kalimpong -I	Tashiding Forest	27
Kalimpong -I	Churanthi Forest	23
Kalimpong -I	Bhalukhop Forest	22
Kalimpong -I	Lish Forest	19
Gorubathan	Pogu Forest	19
Kalimpong -I	Gulling Forest	18
Kalimpong - II	Mangchu Forest	13

4.12 Jalpaiguri:

The Blocks of Rajganj and Nagrakata have witnessed a higher number of fires. In Jalpaiguri District, the annual fire count is decreasing. The highest number of fire counts i.e. 178 has been recorded in 2014 and in 2020, 60 cases have been reported.

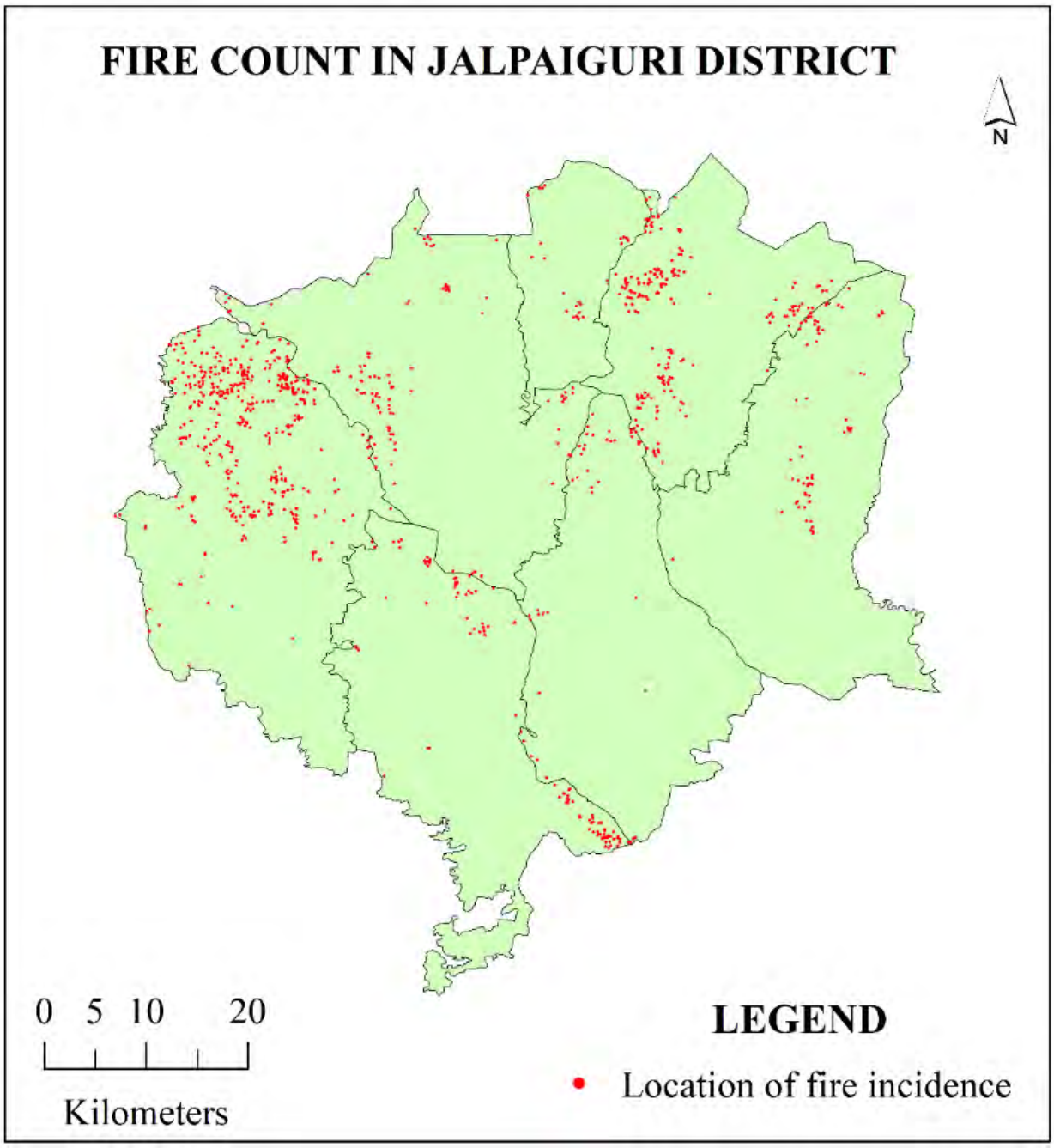


Fig. 4.25: *Incidence of open biomass burning in Jalpaiguri District (2012 – 2020)*

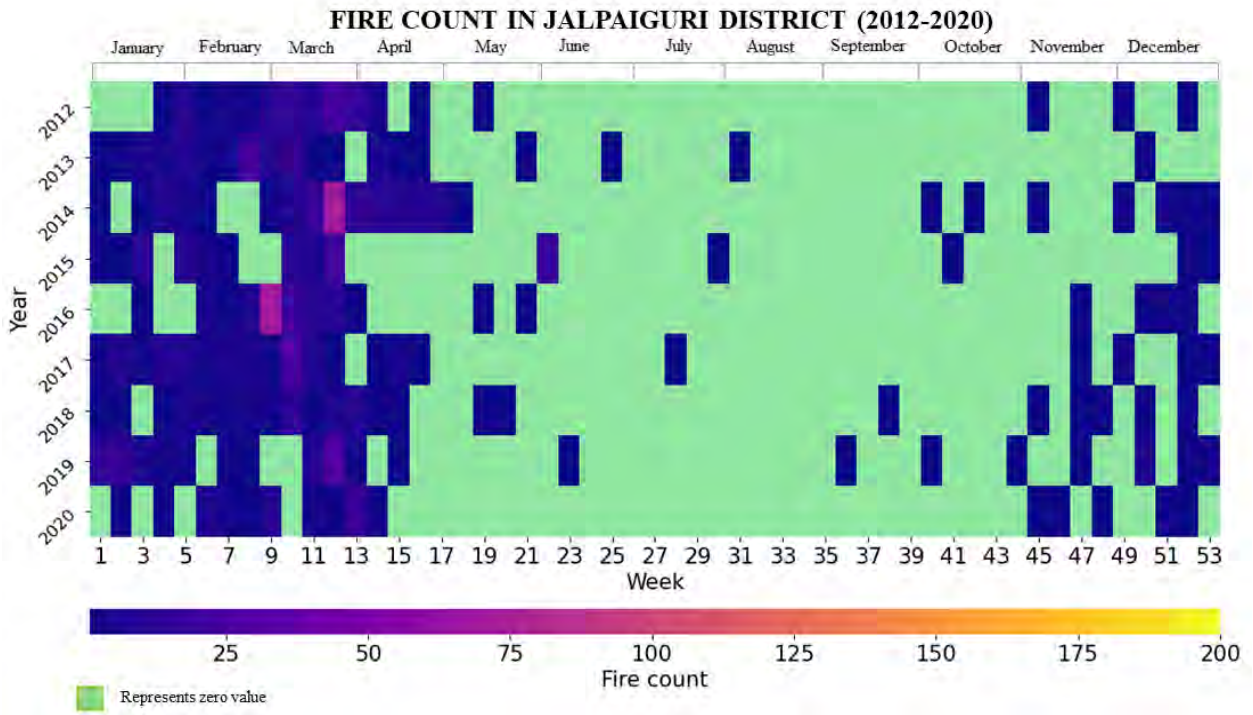


Fig. 4.26: *Distribution of weekly fire count at Jalpaiguri District in last nine years.*

Table 4.15: Mouza wise total Open Biomass Burning in Jalpaiguri District (2012 – 2020)

Block	Mouza	Fire Count
Rajganj	Junglee Mohal	334
Nagrakata	Upper Tendu Forest (M)	143
Mal	Apalchand Forest	47
Nagrakata	Deana Forest (N)	36
Maynaguri	Nimna Tandu Forest	31
Dhupguri	Maraghat Forest (D)	29
Rajganj	Dabgram (P)	24
Rajganj	Mantadari	20
Matiali	Mangalbari	10
Mal	Rangamati Tea Garden	10

4.13 Darjeeling District:

Kurseong is the dominant Block where frequent forest fires are recorded in the months of March and April. In 2012, a total number of 179 cases had been recorded in Darjeeling, but in 2020 only 42 cases have been identified.

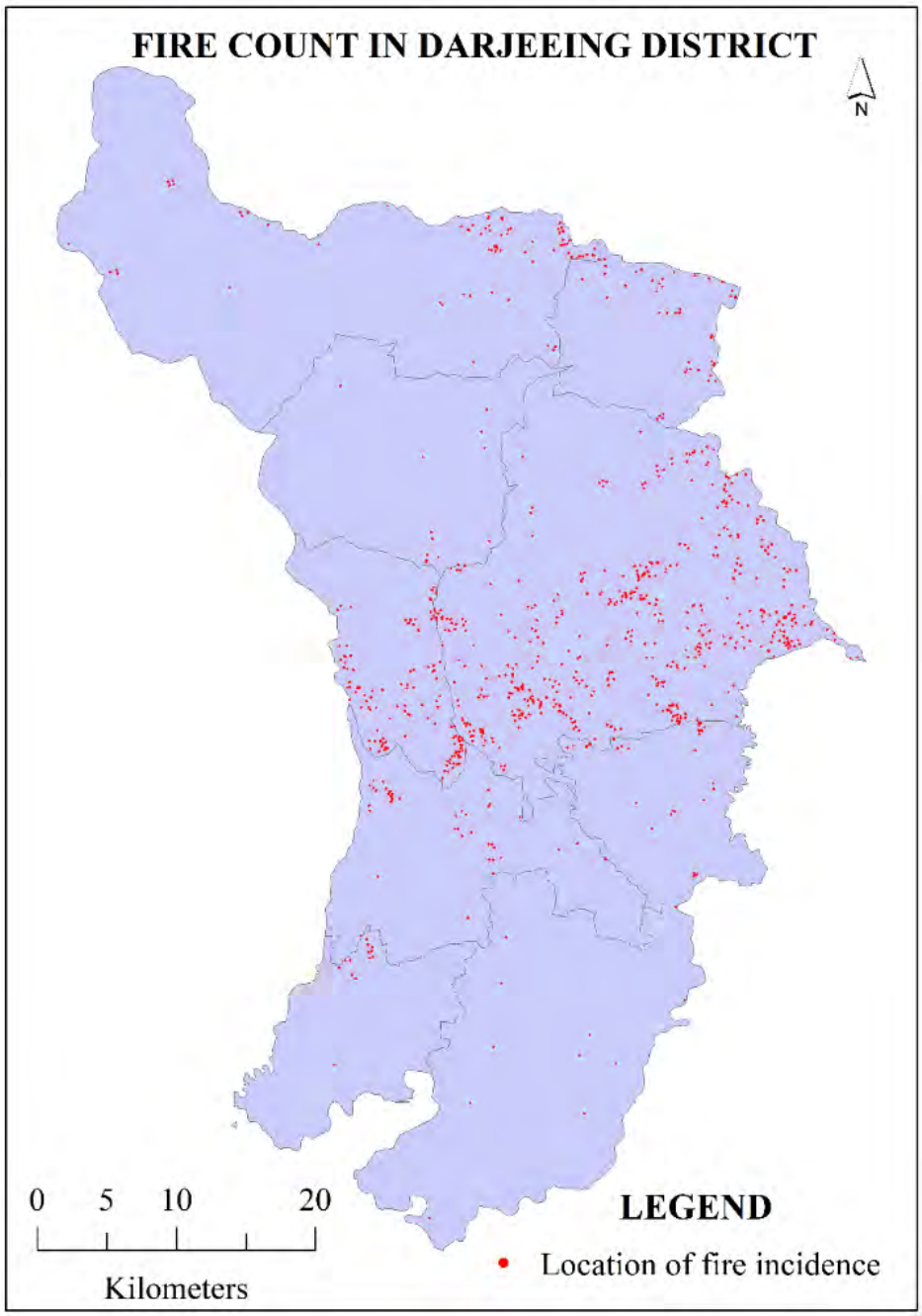


Fig. 4.27: *Incidence of open biomass burning in Darjeeling District (2012 – 2020)*

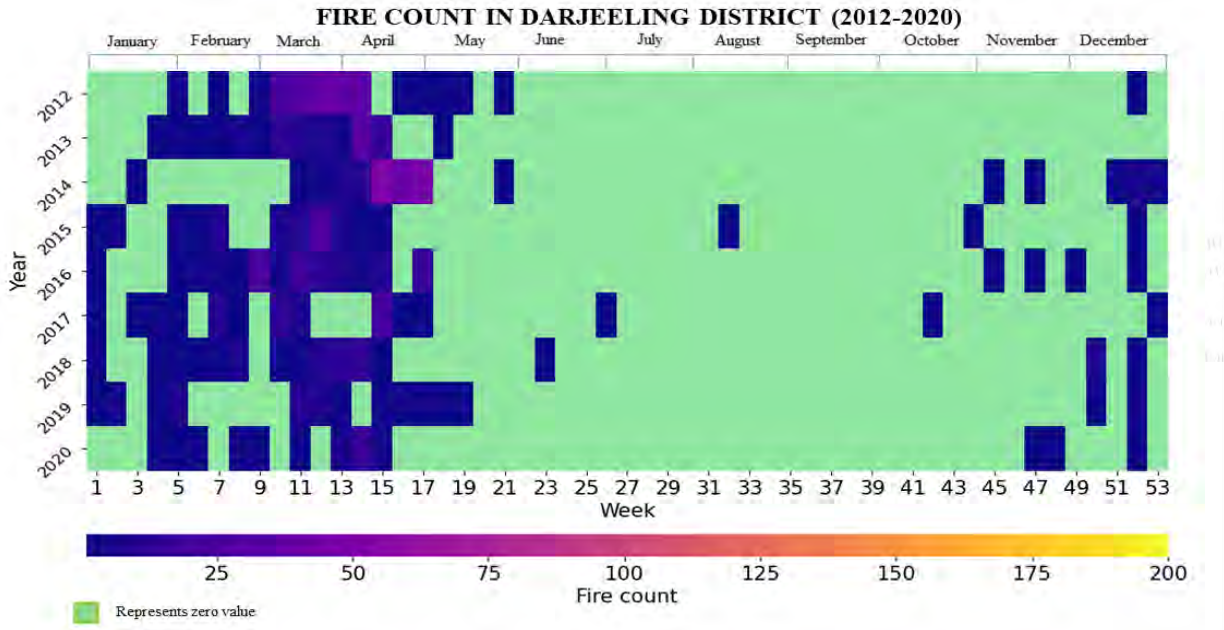


Fig. 4.28: *Distribution of weekly fire count at Darjeeling District in last nine years.*

Table 4.16: Mouza wise total Forest fire in Darjeeling District (2012 – 2020)

Block	Mouza	Fire Count
Kurseong	Choklong Forest	59
Kurseong	Sivoke Forest	49
Kurseong	Rohini Tea Garden	38
Mirik	Panighata	36
Kurseong	Latpanechar Forest	35
Kurseong	Sukna Forest	30
Kurseong	Ambootia Tea Garden	26
Kurseong	Sitong Forest	24
Kurseong	Mohanadi Forest	23
Kurseong	Mangpu Cinchona Plantation	22
Kurseong	Bamonpokhari Forest	16
Naxalbari	Dalkajhar Forest	16
Naxalbari	Mechi Forest	16
Kurseong	Sivok Hill Forest	16
Kurseong	Garidhora (M.Bari)Tea Garden	15
Darjeeling Pulbazar	Rangli Forest	15
Darjeeling Pulbazar	Goke	14
Mirik	New Fallodi Tea Garden(Ghyabari)	14
Rangli Rangliot	Teesta Valley Forest	13
Matigara	Mohorgon Tea Garden	12
Kurseong	Longview Tea Garden	11
Kurseong	Simring Tea Garden	11

4.14 Uttar Dinajpur:

Crop fires have been observed in the southern Blocks of the District. Because of the wheat residue burning, April is the most dominant month for fire incidents. The average number of fire counts in Uttar Dinajpur is 44. The highest total annual fire count was recorded in 2013. In 2020, 68 cases have been recorded and from March to April 2021, 54 cases have been recorded.

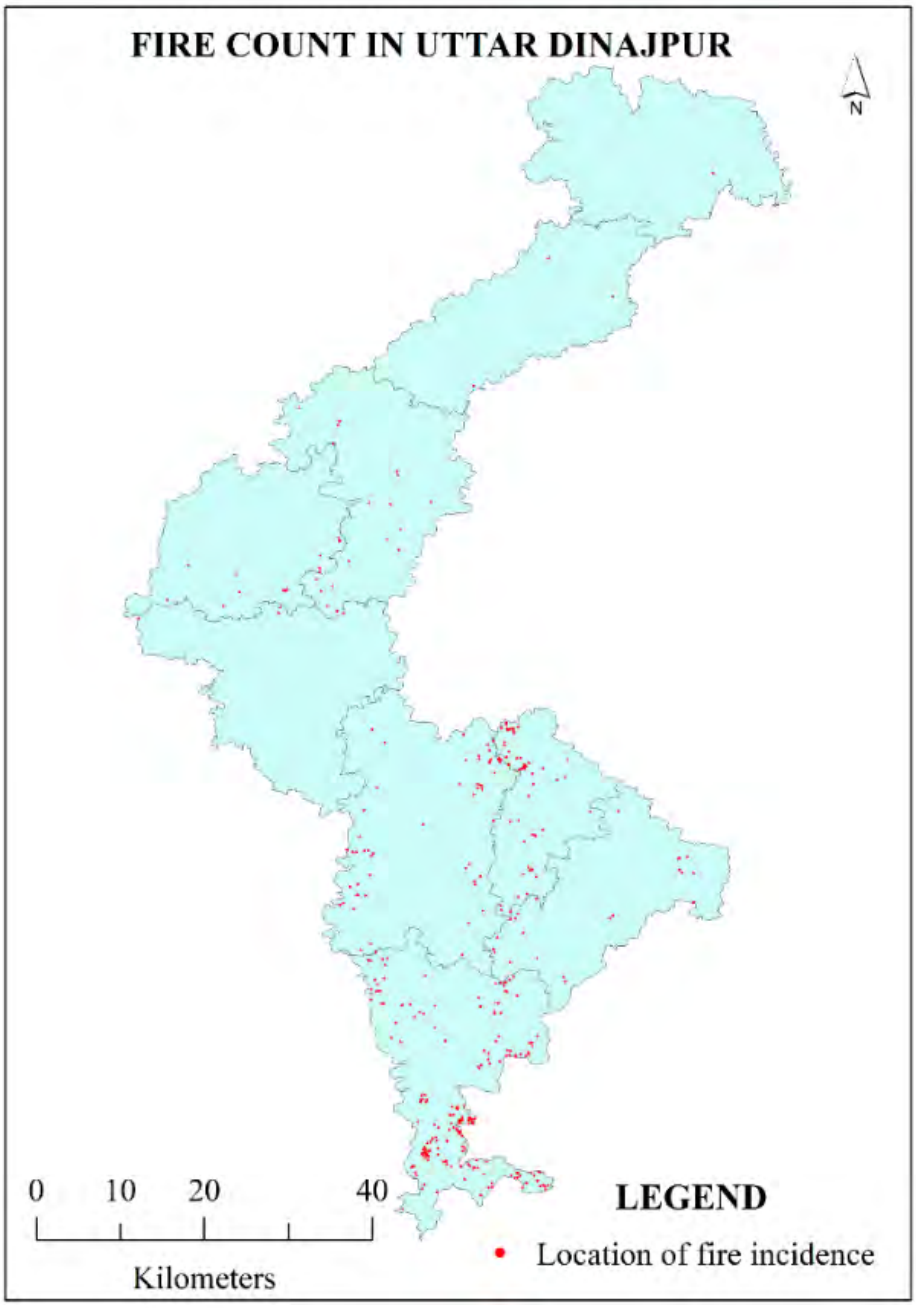


Fig. 4.29: *Incidence of open biomass burning in Uttar Dinajpur District (2012 – 2020)*

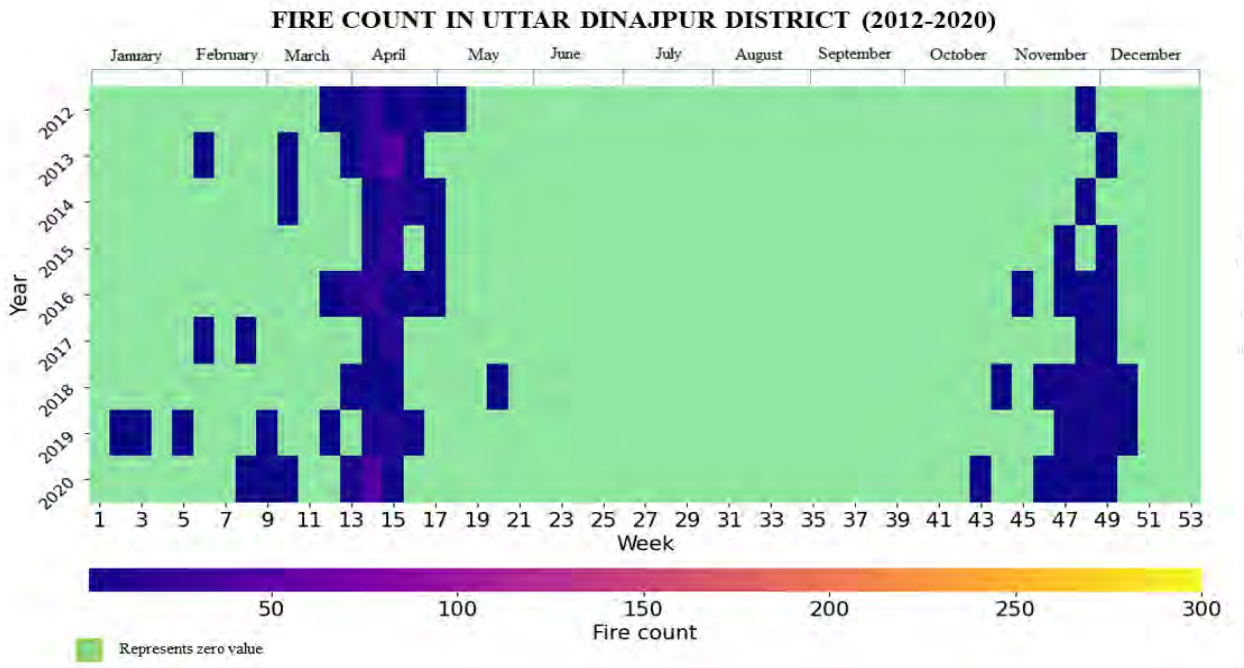


Fig. 4.30: *Distribution of weekly fire count at Uttar Dinajpur District in last nine years.*

Table 4.17: Mouza wise total Crop Residue Burning in Uttar Dinajpur District (2012 – 2020)

Block	Mouza	Fire Count
Itahar	Bhabanipur Bejpukur (I)	29
Itahar	Bimalpara (I)	20
Itahar	Thilbil	11

4.15 Malda District:

Crop residue burning has a significant impact on Gazole Block in Malda District, which occurs primarily in the month of April each year. The average annual open biomass burning incidents is 66. Recent statistics show a decreasing trend in this District. In 2020, only 47 cases have been found but in March 2021, 55 cases have been recorded.

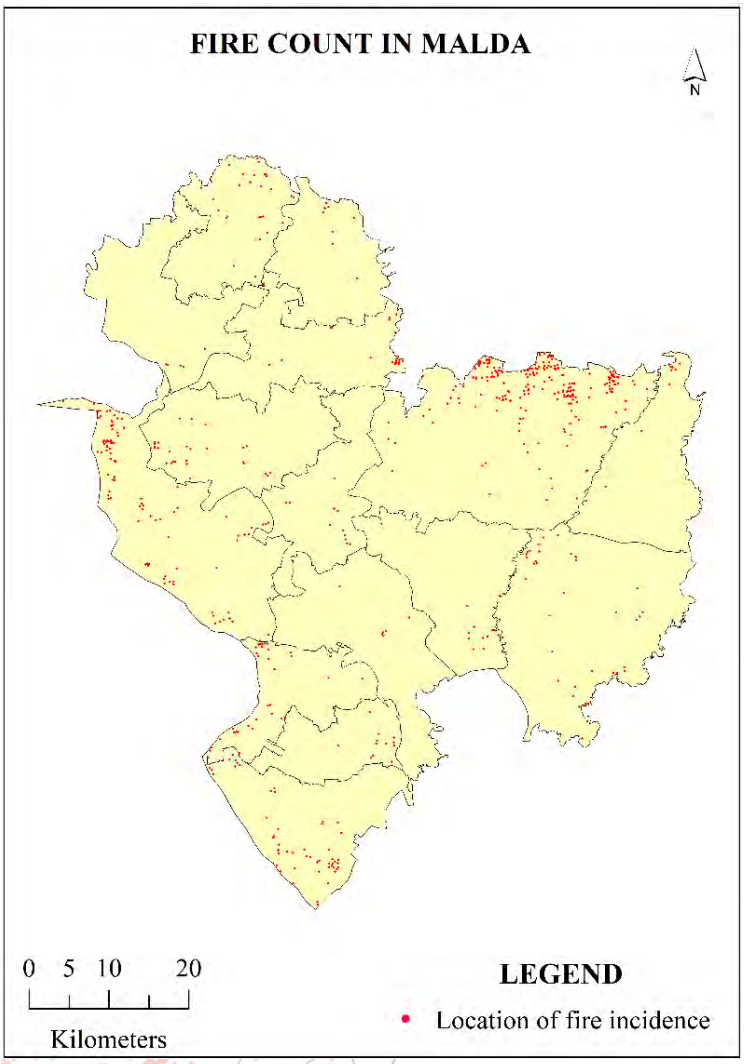


Fig. 4.31: *Incidence of open biomass burning in Malda District (2012 – 2020)*

Table 4.18: Mouza wise total Crop residue burning in Malda District (2012 – 2020)

Block	Mouza	Fire Count	Month
Gazole	Dhaoyail	17	April
Gazole	Bachahar	14	April
Gazole	Uttar Mahinagar	14	April
Chanchal - II	Madhaihat	12	April
Gazole	Deotala	11	April
Manikchak	Gadai	10	April
Gazole	Singal	10	April

4.16 Purba Medinipur:

In Purba Medinipur, fires have been reported on agricultural land in the Block's western section. Open biomass burning is observed from December to March. Purba Medinipur's most affected Blocks are Egra I, Egra II, Potashpur II, and Potashpur I, where open fires are frequently found in agricultural land. These practices can also be found in Panskura and the Bhagawanpur I Block. All crop fire counts in these Blocks were recorded in December and the first week of January. In the last season (December 2020 and January 2021) total of 56 cases have been recorded.

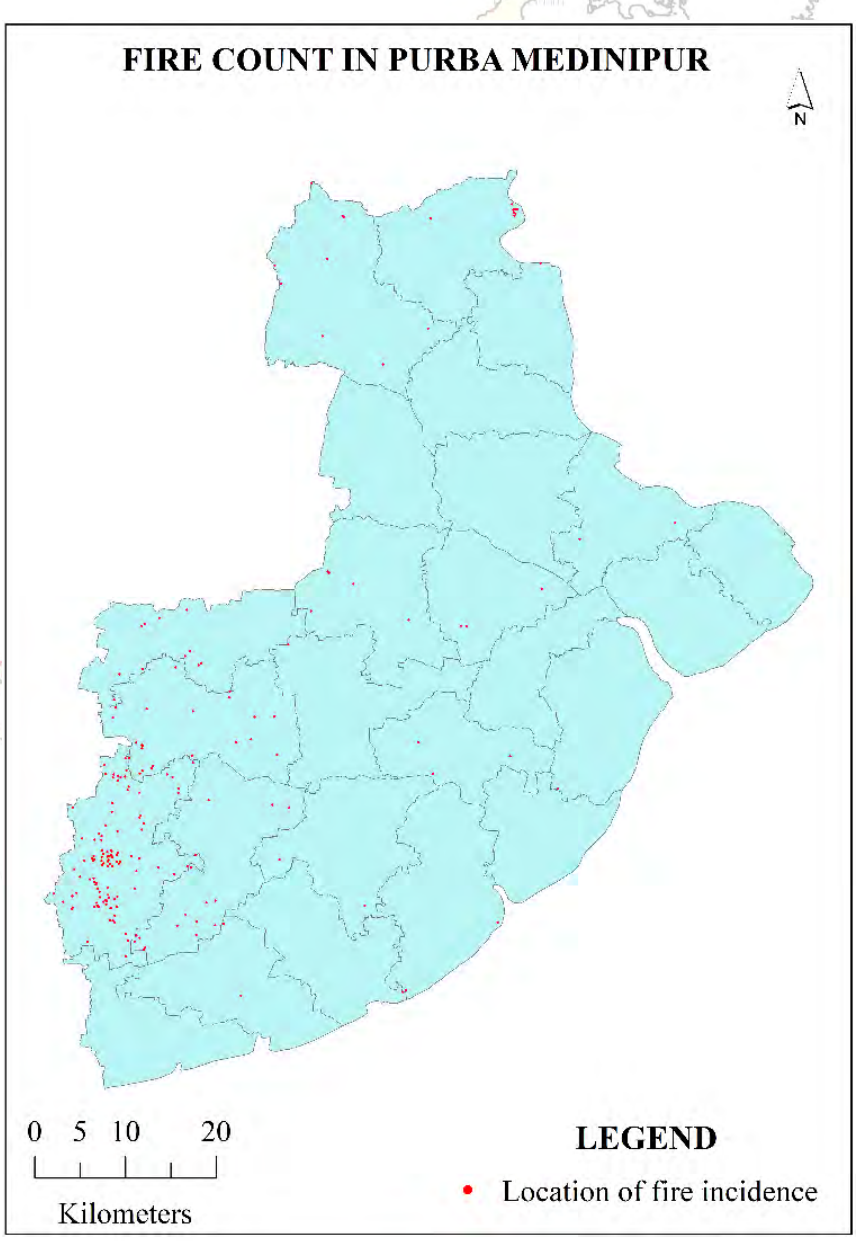


Fig. 4.32: *Incidence of open biomass burning in Purba Medinipur District (2012 – 2020)*

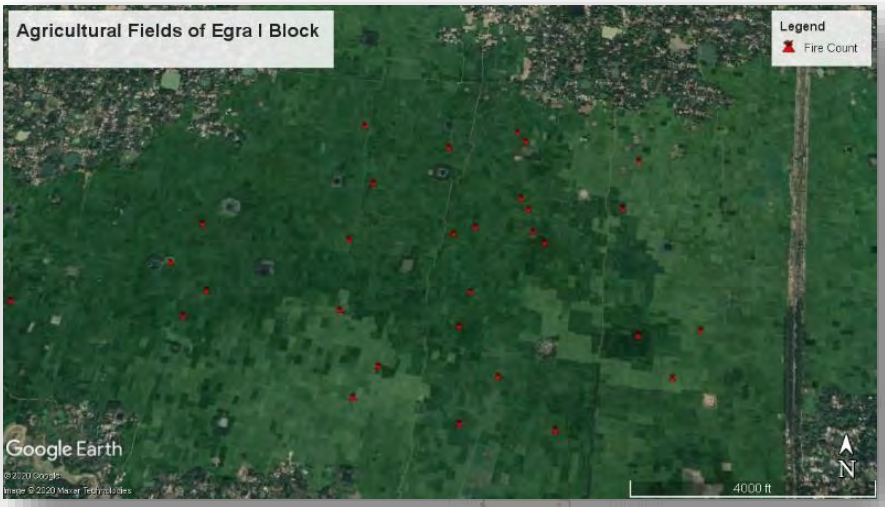


Fig. 4.33: *Incidence of Stubble burning in Egra I Block Purba Medinipur District (2012 – 2020)*

4.17 Paschim Bardhaman:

Paschim Bardhaman is an industrial district of West Bengal. In the coalfield region, open biomass burning was detected, while forest fires were observed in the District's eastern portion. The Kanksa Block is predominantly impacted by forest fires. The Barabani, Jamuria, and Pandabeswar Blocks are primarily affected by biomass burning associated with coal mining.

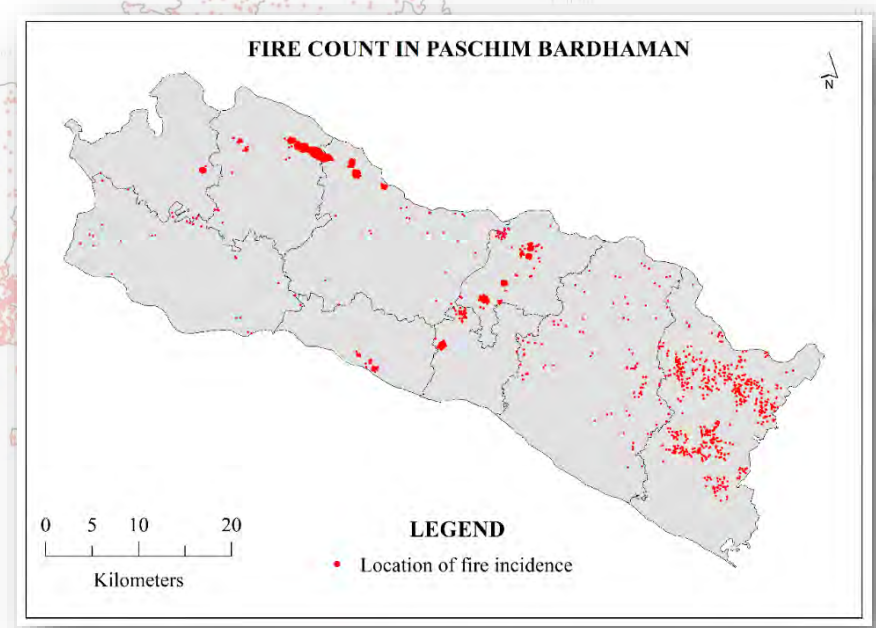


Fig. 4.34: *Incidence of open biomass burning in Paschim Bardhaman District (2012 – 2020)*

4.18 Howrah:

Crop residue burning has been observed in the northern part of the District. Jagatballavpur, Domjur, Amta – I and Bally Jagachha Blocks are mostly affected. A total of 54 cases have been reported from December 2020 to April 2021 and the highest number of incidents has been recorded in January 2021.

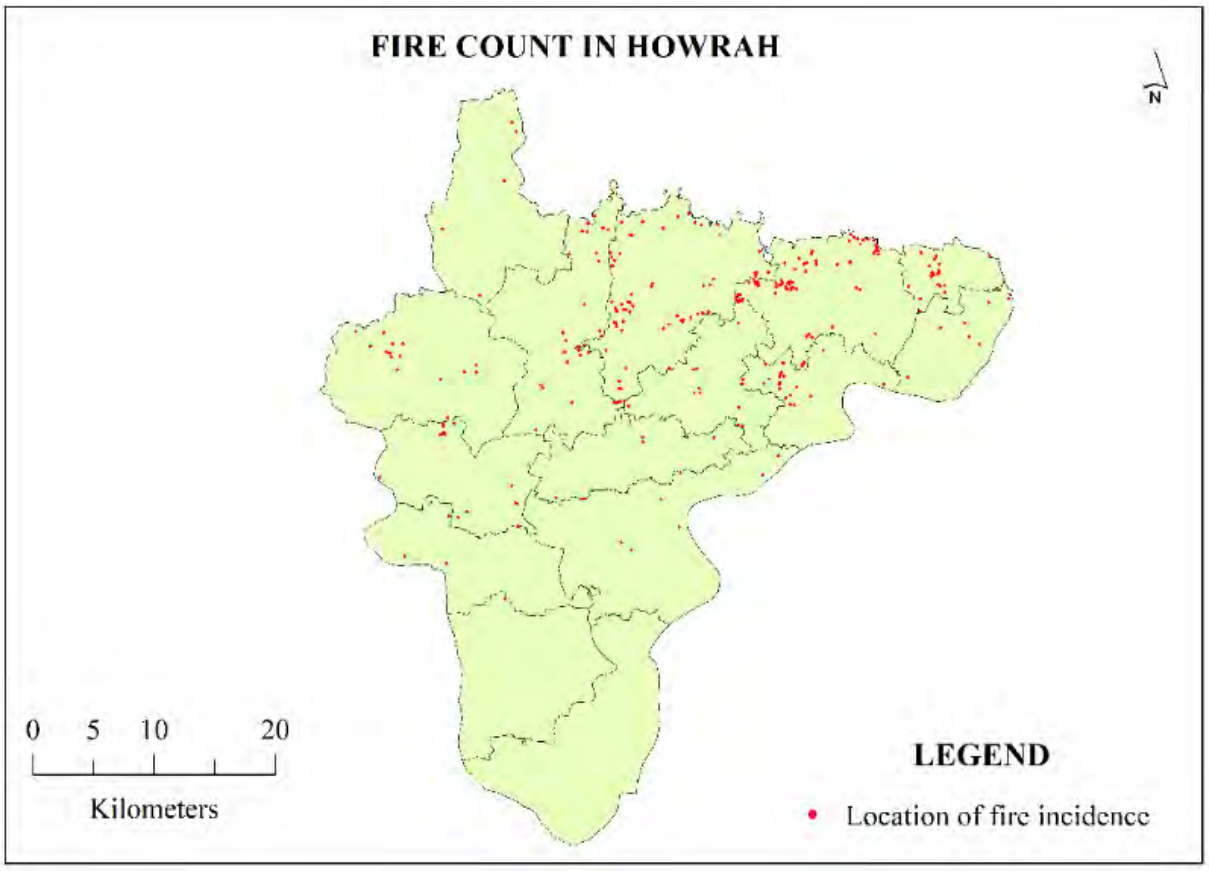


Fig. 4.35: *Incidence of open biomass burning in Howrah District (2012 – 2020)*

Chapter V: Conclusion and recommendations

5.1 Key Conclusions:

Analysis of open biomass burning patterns and trends in West Bengal reveals that a large part of the state is affected by open biomass burning. Total biomass burning and the two most important types of fire - crop residue burning and forest fires, have both increased steadily in recent years. Crop residue burning is largely found in Purba Bardhaman, Paschim Medinipur, Bankura, Hooghly and the southern part of Birbhum due to Kharif paddy harvesting in December. Crop residue burning also occurs in April, particularly as a result of wheat harvests in Murshidabad, Dakshin Dinajpur, Nadia, Uttar Dinajpur and the northern part of Malda. The cropping pattern is mainly responsible for the distribution of crop residue burning pattern. Bankura, Jhargram, Purulia, and Paschim Medinipur in the Jangal Mahal area of Western West Bengal have experienced the most forest fires in March due to primarily human activity. Throughout the region, there has been an increase in the number of forest fires. There have also been reports of forest fires in the northern Districts, i.e., Darjeeling, Jalpaiguri, Kalimpong, and Alipurduar. The total number of forest fire instances is substantially lower, and forest fires are on the decline throughout the Northern District. The fire in the coalfield has been concentrated in the northern section of Paschim Bardhaman. Finally, every open biomass burning hotspot inside the state has been identified.

There are several causes of open biomass burning have been identified. The causes of increasing crop residue burning are decreasing demand for crop residue in rural livelihood, implementation of modern semi-automatic harvesting machines, and lack of awareness about air pollution and soil degradation. It is found that crop residue burning is the easiest way to prepare land rapidly for the next crop.

The success or failure of this year's endeavour of real-time information exchange with local authorities in reducing burning behaviours will be determined by assessing the next season's fire incidence.

5.2 Recommendations:

5.2.1 Establishment of a dynamic surveillance system: The pattern of open biomass burning in West Bengal has been identified in this report. In the last season (2020-21), the burning incidents were observed every day, and a report was prepared at the end of the day identifying the most critical Blocks and mouzas. Going forward, a dynamic surveillance system needs to be established in phase 2. Under this system, the WBPCB can coordinate with the local administrator on a daily basis to take action at a local level once the open burning events are notified. The system would allow examining the efficacy of the various intervention measures taken by the local administrators. The remote sensing & GIS team will work on this in phase 2.

5.2.2 Coordination with different government bodies and local authorities: There should be extensive interaction with the agriculture department to ascertain the socioeconomic drivers of crop residue burning activity and the steps taken to mitigate

them. To combat all forms of open biomass burning, collaboration and cooperation with the forest department, agriculture department, police department, and District and local government should be undertaken.

5.2.3 Knowledge Development and Awareness programmes: Farmer outreach programmes should be implemented to educate them about the negative effects of crop residue burning practices on the environment and human health. Similarly, Forest Protection Committee outreach program should be initiated to prevent forest fires.

5.2.4 Straw Management: There are two types of straw management practices in North India - in-situ and ex-situ management.

5.2.4.1 In situ management: Northern India has used in-situ residue mulching using contemporary machineries such as the super straw management system (super SMS), Happy Seeder, Straw Chopper, Reversible Mould Board Plough, and Rotavator. It is necessary to investigate if typical in-situ management approaches used in northern India would have an impact on soil fertility in West Bengal. It is necessary to promote the production of bio compost from crop residue in collaboration with agricultural scientists.

5.2.4.2 Ex situ Management: Crop residues are typically used as animal bedding products, awning material, livestock feed, soil mulching, biogas generation, and manure/compost production etc.

Kriya Labs, Business Incubator of IITD, has introduced a stubble processing technology which can convert straw into pulp. Ecofriendly plates, bowls, cardboard, bio-foams, packing material and various other ecofriendly products can be made from rice straw. The challenge is the limited availability of the supply (stubble) during the harvesting season, which may not be a sustainable business model. It should be examined which other raw materials can be used to run the pulp industry throughout the year. A centralized stubble collection system should be implemented. The government should collect the stubble through a local stubble collecting center, and industry should be formed in the local area so that farmers can profit from selling their stubble at stubble collecting centers. In Panjab and Haryana, the conversion of waste to electricity has begun. Crop residue can be used in a variety of ways. Therefore, substantial study is required to develop very extensive management plans that target location-specific challenges.

Present Scenario of Open Biomass Burning in West Bengal (November 2021 to April 2022).

District	Number of reported Incidents						
	November, 21	December, 21	January, 22	February, 22	March, 22	April, 22	Total
JHARGRAM	1	17	9	6	1149	119	1301
PASCHIM MEDINIPUR	102	113	39	8	608	112	982
BANKURA	50	38	32	4	579	114	817
BIRBHUM	20	151	47	9	16	241	484
MURSHIDABAD	9	34	19	8	77	165	312
PURBA BARDHAMAN	56	57	82	12	54	40	301
DAKSHIN DINAJPUR	6	23	1	0	8	255	293
PURULIA	0	0	0	0	197	93	290
JALPAIGURI	1	7	1	3	256	0	268
MALDAH	3	3	1	4	11	106	128
HOOGHLY	75	18	4	8	6	10	121
PASCHIM BARDHAMAN	0	2	0	0	48	39	89
NADIA	2	4	2	11	38	30	87
ALIPURDUAR	1	2	20	6	46	0	75
UTTAR DINAJPUR	11	7	0	0	4	34	56
DARJILING	0	2	7	1	42	0	52
KALIMPONG	4	0	2	0	39	0	45
PURBA MEDINIPUR	0	12	4	0	2	0	18
HOWRAH	1	3	2	4	4	2	16
24 PGS (N)	0	0	2	1	5	5	13
COOCHBEHAR	0	6	0	0	1	0	7
24PGS(S)	0	0	2	2	0	1	5
KOLKATA	0	0	0	0	0	0	0
TOTAL	342	499	276	87	3190	1366	5760

Source: *VIIRS S-NPP and VIIRS NOAA-20 375m data*

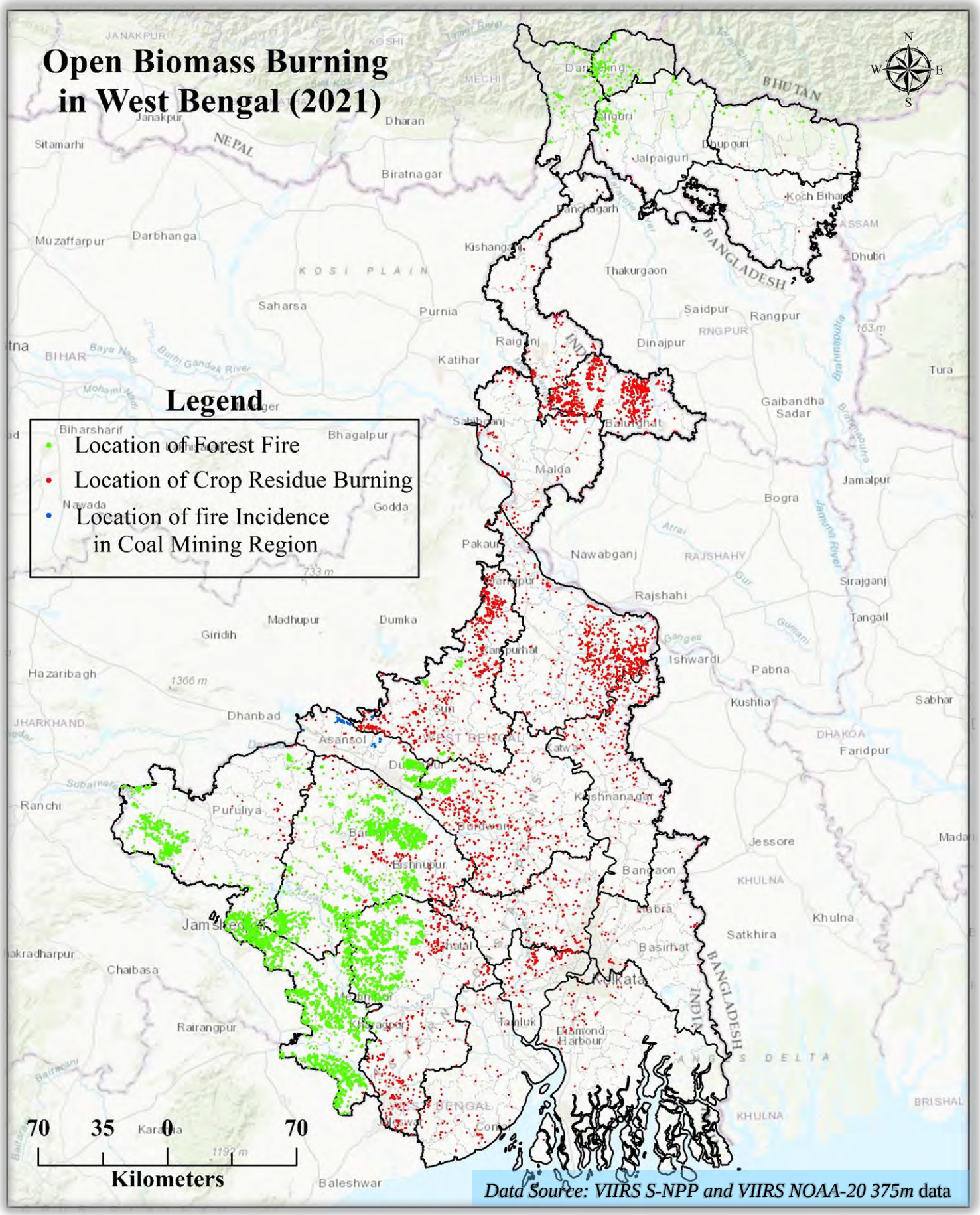
Open Biomass Burning

Village Level Enquiry at
Ranaghat Police District

Village Level Enquiry at
Purba Bardhaman District

Several Action Taken by the Govt. of West Bengal

Interaction with Villagers at
Purba Bardhaman District


Open Biomass Burning in West Bengal (2021)
Legend
Location of Forest Fire
Location of Crop Residue Burning
Location of fire Incidence in Coal Mining Region
70 35 0 70
Kilometers
Data Source: VIIRS S-NPP and VIIRS NOAA-20 375m data