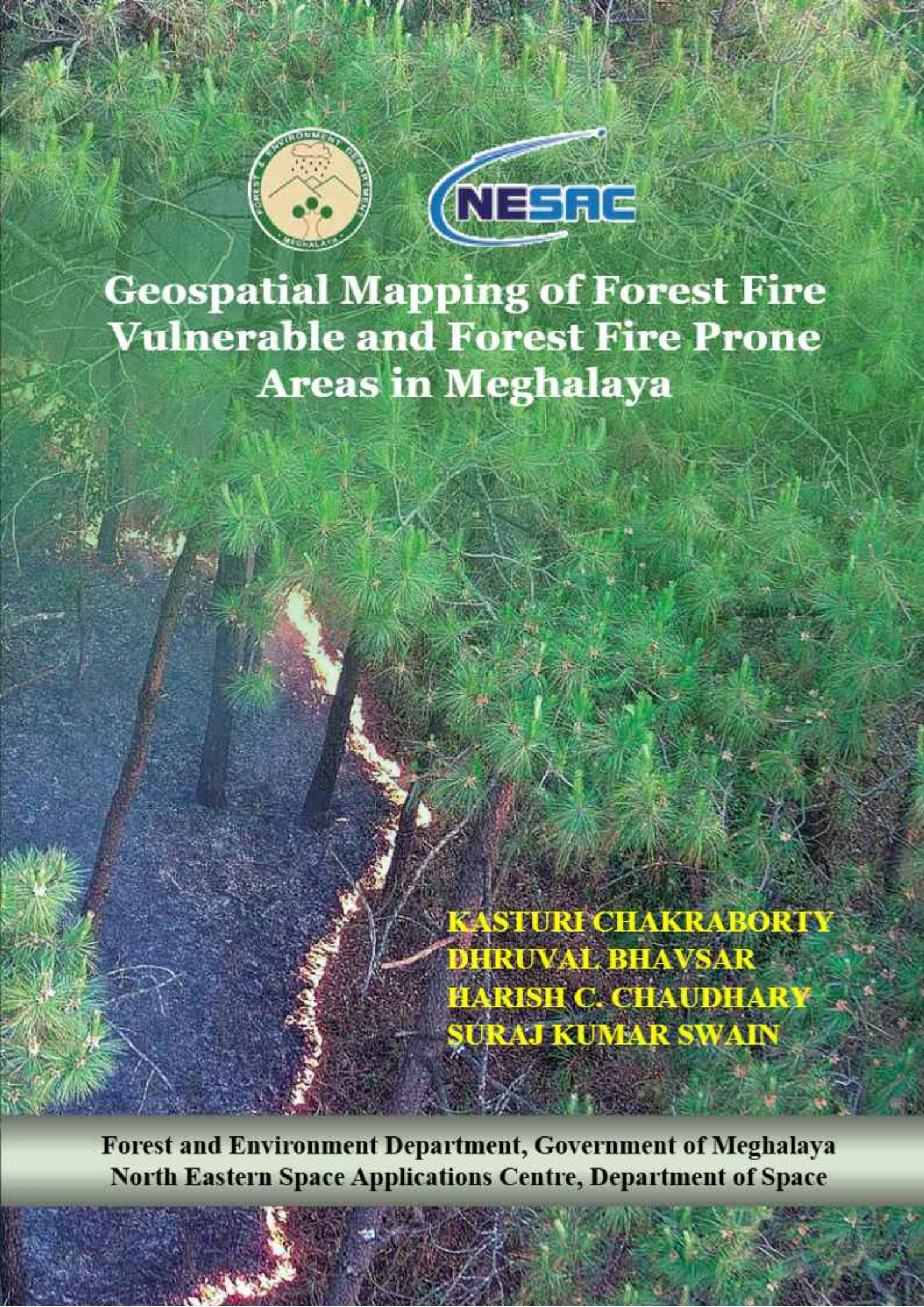


Geospatial Mapping of Forest Fire Vulnerable and Forest Fire Prone Areas in Meghalaya

KASTURI CHAKRABORTY
DHRUVAL BHAVSAR
HARISH C. CHAUDHARY
SURAJ KUMAR SWAIN

Forest and Environment Department, Government of Meghalaya
North Eastern Space Applications Centre, Department of Space

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Kasturi Chakraborty
Dhruval Bhavsar
Harish C. Chaudhary
Suraj Kumar Swain

Forest and Environment Department, Government of Meghalaya
North Eastern Space Applications Centre (NESAC)

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Project Team

Dr. Kasturi Chakraborty, Scientist 'SF'- PI
Dr. Dhruval Bhavsar, Scientist 'SC'- Co-PI
Shri H. C. Chaudhary, IFS, PCCF
Shri Suraj Kumar Swain, Research Scientist

Supporting Team

Shri Puyam S Singh, Scientist 'SF'
Shri Nilay Nishant, Scientist 'SE'
Shri Siddharth Bhuyan, Scientist 'SD'
Dr. Jakesh Mohapatra, Research Scientist
Shri Praveen Kumar, Research Scientist
Shri Balajied Lyngdoh, Project Assistant
Shri Brandon Rynjah, Project Assistant
Shri Joydeep Dey, Project Assistant
Shri Nirjhar Jyoti Biswas, Project Assistant

Overall Guidance

Dr. K. K. Sarma, Group Head
Remote Sensing Applications Group, NESAC

Shri Conrad K. Sangma
Hon'ble Chief Minister & Minister In-charge
Forest and Environment Department
Government of Meghalaya



FOREWORD

Fire is one of the dominant disturbances in forests that widely impact the ecology, environment, and socio-economics of nations across the globe. Forests fires are as old as the forests themselves. Though crown fires having potential to cause human and livestock death and damage to dwelling houses do not occur in Meghalaya, every year large number of ground fires are reported in various parts of the State. Apart from causing damage to flora and fauna, especially young regenerating plants and micro-organisms, forest fire results in increased soil erosion, landslides, poor recharging of aquifers and floods. Forest fires also aid in carbon emission and air pollution.

As per the historical data, almost all forest fires in Meghalaya are man-made. Creating awareness among the masses about the ill effects of the forest fires and precautions to be taken to prevent the forest fires can greatly help to prevent and minimise damage caused by forest fires.

It gives me immense pleasure to learn that Working plan, Research & Training and District Council Affairs Wing in Forest and Environment Department has joined hands with the North Eastern Space Application Centre to undertake an in-depth study to identify and delineate the areas vulnerable and prone to forest fires.

I am sure, the dashboard and the mobile application developed under the study will greatly help in formulation and execution of areas specific plans to prevent, minimise and mitigate forest fires in a cost-effective and efficient manner to protect precious floral and faunal wealth of the State.

I congratulate and compliment all the officers and the scientists involved in the study for their efforts in bringing out a very informative report and a highly interactive and easy to use dashboard and mobile application.

(Conrad K. Sangma)

Shri Pravin Bakshi, IAS
Commissioner & Secretary
Forest and Environment Department
Government of Meghalaya



MESSAGE

Meghalaya is home to diverse forest types ranging from tropical evergreen forests to sub-tropical pine forests. Forests in Meghalaya are habitat of a fascinating array of wild animals, including major species like Asian elephant, Himalayan black bear, Sun bear, Gaur, Clouded leopard, Leopard, Leopard cat, Golden cat, Marbled cat, Jungle Cat, Serow, Pangolin etc. The State has rich population of Western Hoolock gibbon, the only species of ape found in India. Insect eating Pitcher plant is naturally found in abundance at several places in Meghalaya. Numerous limestone caves and forests in the State are habitat of 66 species of bats, including the nation's rarest bat species.

Forest fire is one of the major threats to rich floral and faunal wealth of the State. Every year large tracts of forests are burnt by forest fire. Damage to the precious flora and fauna from the forest fires can be greatly minimised if the limited physical, financial and human resources available with the State are utilised in a focussed and targeted manner. Identification and delineation of the areas vulnerable and prone to forest fires is therefore *sine qua non* for scientific forest fire management in the State. Study undertaken by the North Eastern Space Application Centre has therefore bridged a foundational gap in the forest fire management in the State.

I am sure, the report of the study along with the dashboard and the mobile application developed by the North Eastern Space Application Centre will be utilised by all stakeholders involved in planning and execution of various interventions for management of forest fire in the State.

(Pravin Bakshi)

Shri R. S. Gill, IFS
Principal Chief Conservetor of Forest & HoFF
Forest and Environment Department
Government of Meghalaya



MESSAGE

The forests of Meghalaya are rich in terms of forest type, forest cover, biodiversity and endemism presenting a picturesque landscape of the State. The undisturbed primary forests are botanist's delight. The rich forests of Meghalaya are a source of livelihood, clean air, water and several other ecosystem services. Due to the presence of large number of primitive flowering plants, the State was described as 'Cradle of Flowering Plants' by J.D. Hooker. The availability of rich bamboo resources plays a pivotal role in the socio-economic development of the region.

The forest fire incidences in the State every year are leading to destruction of valuable flora and fauna, harmful gaseous emissions, huge loss of carbon sequestered in the forest. In view of the prevailing forest fire scenario in the state, the Meghalaya Forest and Environment Department has entrusted the task of Geospatial assessment of occurance of forest fire in Meghalaya to North Eastern Space Applications Centre (NESAC).

I am happy to share the report which has been generated from the project which contains elaborate information on forest fire at State, district and block level. I compliment NESAC for successfully completing the project.

I am helpful the project output will guide the forest fire managers of our department. I also earnestly hope that with the use of geospatial technology the incidences of forest fire in the region will be mitigated effectively.

(R.S. Gill)

Shri H.C. Chaudhary, IFS
Principal Chief Conservetor of Forest (Working Plan, Research & Training and District Council Affairs)
Forest and Environment Department
Government of Meghalaya



MESSAGE

Forest fires are a recurrent annual phenomenon in Meghalaya. Forest fires cause immense damage to fresh recruits and young plants in regenerating forests and young plantations. They also adversely affect growth of trees, especially the young and middle-aged trees.

Forest fires in the State may be divided into *Jhum* fires and non-*jhum* fires. As the name suggests, *jhum* fires are limited to *jhum* cultivation areas. Such areas are normally home to broad leaved evergreen forests. High moisture regime and comparatively high ambient temperature in these areas results in fast decomposition of litter. Annual fires in these areas are therefore normally limited to *jhum* fields. Such forest fires can be controlled only by controlling *jhum* cultivation.

Non-*jhum* fires in the State normally occur in coniferous pine forests and deciduous forests. Management of the forest fires in non-*jhum* areas should ideally be directed to the management of its source *i.e. a* thick contiguous layer of dry combustible litter. Management may include diversion, destruction and division of the litter.

Diversion of the litter may involve collection and use of litter for productive uses such as fuel (briquette), fiber (rope weaving), fertilizer (composting) and furnishings (filling for mattresses, pine cone handicrafts). Destruction may involve increasing the rate of decay of the litter by improving moisture regime in forest floor by construction of check dams, contour trenches, interception trenches, and other moisture conservation structures; gradual replacement of conifer and deciduous species by evergreen species and periodic controlled burning of accumulated dry litter. Division includes fragmentation of the contiguous layer of the litter by construction and regular cleaning of conventional dry fire lines consisting of about three meters wide strips completely devoid of any litter or living vegetation and self-sustaining natural wet fire lines consisting of strips or shelterbelts of evergreen species at regular intervals.

I am sure, the study undertaken by the North Eastern Space Application Centre will greatly help in scientific management of forest fires in the State.

(H.C. Chaudhary)

Dr. S P Aggarwal
Director
North Eastern Space Applications Centre
Department of Space
Government of India



PREFACE

Forest fire plays a long-term role in the health of the forest ecosystems. Many ecosystems, including boreal forests and grasslands require periodic burning to reproduce. But, in the recent times, climate change and land use change have led to more frequent and intense forest fire occurrence globally. As per the reports from World Resources Institute, forest fires burn nearly twice as much tree cover today as they did 20 years ago, resulting in 3 million more hectares of tree cover loss per year compared to 2001. According to the report, the year 2021 was one of the worst years for forest fires since the turn of the century, causing an alarming 9.3 million hectares of tree cover loss globally. Multiple studies have found that climate change has already led to an increase in wildfire season length, and frequency. Although climate change is a major driver of increasing fire activity, fires can generate large amounts of smoke pollution and release greenhouse gases impacting climate.

The occurrence of forest fire due to human activities is a matter of concern. Forest fire in major parts of Meghalaya is attributed to shifting cultivation practiced by the local communities, controlled burning for forest floor clearing in pine forest and broom stick cultivation. It is observed that in recent times, the forest fire in Meghalaya has increased compared to previous years. In this direction, this report brings out the temporal and spatial extent of forest fire in Meghalaya along with the estimation of forest area burned by forest fire using Remote sensing and GIS. I am sure that the Forest Fire Incident Reporting App and Meghalaya Forest Fire Information System developed under the project will help decision maker to take appropriate measures. I hope that the output and recommendations under the project will be implemented at the ground level by Forest and Environment Department of Meghalaya for the development of appropriate fire mitigation strategies.

I thank Forest and Environment Department, Government of Meghalaya for taking up this initiative to carry out this detailed study on forest fire monitoring.

Dr. S P Aggarwal

ACKNOWLEDGEMENT

The project team would like to place on record gratitude and sincere thanks to Forest and Environment Department, Government of Meghalaya for entrusting the work to North Eastern Space Applications Centre (NESAC).

The project team wishes to express gratitude and indebtness to Shri H.C. Chaudhary, IFS, Principal Chief Conservator of Forest (Working Plan, Research & Training and District Council Affairs), Government of Meghalaya and Dr. S P Aggarwal, Director, NESAC for their valuable guidance and constant encouragement during the course of the study.

The downloaded forest fire points, the recent forest type map and forest cover maps from Forest Survey of India, Dehradun is duly acknowledged. The support of Natioanl Remote Sensing Centre Data Centre (NDC) in providing the satellite imagery helped us to carry out our work conveniently. The project team would like to thank Google Earth Group for GEE cloud platform for the burned area mapping. The project team would like to express gratitude and thankfulness to all the staffs of Meghalaya Forest Department who have provided logistic support during the field works.

The project team acknowledges the support and timely cooperation received from NESAC colleagues during the work. Our heartfelt thanks to Dr Dibyajyoti Chutia, Head, Geoinformatics and IT Division (GID), Shri Avinash Kr Chauhan, Scientist, GID, Shri Puyam S Singh, Scientist, GID and Gregory Kurbah, Project Associate for support in development of the dashboard and mobile App.

Project Team

Executive Summary

Humans directly influence the natural evolution process through their unnatural interventions. The variation in forest fire trend is also result of the same. Identification of variables for fire occurrence is of utmost importance for managing fire risk. The present study uses the information on historical fire incidents with integration of different spatial layers (forest type, forest density, topography, proximity to road and settlement) to generate forest fire vulnerable and forest fire prone areas of Meghalaya state.

The forest fire incident alerts obtained from Forest Survey of India (FSI) have been utilized for the assessment of forest fire vulnerable and forest fire prone areas in the State of Meghalaya. In addition to MODIS, the alerts from Suomi National Polar-orbiting Partnership (SNPP) – Visible Infrared Imaging Radiometer Suite (VIIRS) has enhanced the forest fire detection. In the present study, the historical fire analysis from the year 2003 - 2023 reveals that Ri Bhoi (16670) and West Khasi Hills (12445) districts have highest fire incidents while South West Garo Hills district has recorded least (482). Year 2006 (3151) and 2009 (3081) recorded highest forest fire incidents in the state as per the MODIS data. The analysis with the forest types of the State shows East Himalayan moist mixed deciduous forest has highest fire occurrence while Assam alluvial plains semievergreen forest is least affected. Density of the forest also plays an important role as it determines the amount of fuel for forest fire. Dense forests have recorded higher number of forest fire incidents irrespective of the forest type. Similarly impact of anthropogenic factors like roads and settlements have been taken into accounts.

Multi Criteria Decision Analysis (MCDA) has helped to identify the factor affecting forest fire vulnerability, with the historical fire data, the nature of fire occurrence with respect to fuel characteristics, topography and proximity to road and settlement were assessed. The forest fire vulnerability has been categorized into very high, high, moderate, low and very low. Forest fire vulnerability assessment for the state has been carried out separately in Jhum (Shifting Cultivation) and non jhum prone areas at 1:10000 scale. It is found that more than 60 % of the total forest cover of the state is in moderate to very highly vulnerable zone, 24.42 % of forest cover in the state is under high vulnerable zone and only 13.21% forest cover is under low vulnerable zone. East Garo Hills, Ri Bhoi and West Khasi Hills have larger area under high to very high vulnerable zones.

The forest fire vulnerability analysis of all important areas such as Reserve Forests, Protected Forests, National Parks, Wildlife Sanctuaries, Community Reserves, Biosphere Reserve, Eco-Sensitive Zones and Sacred Groves has been carried out at 1:5000 scale. The result shows that, Umsaw RF is having highest percent (99.77%) of its total geographic area under high and very high category of forest fire vulnerability.

Forest fire prone area analysis dipicts the frequency of fire incidents over a period of time and space. Identification of fire-prone areas is crucial for erffective forest fire mitigation. The frequency of forest fire occurrence has been computed within a grid area of 1km x 1km to generate the fire prone map. The fire prone map contains five risk zones named as Very High, High, Moderate, Low and Very Low. The fire prone analysis in Meghalaya indicates total around 49% of total forest cover is highly prone to forest fire. The figures are higher than the national estimates of 10% by the Forest Survey of India. In the study, it is found that Ri Bhoi district has maximum area under extreme fire prone i.e. 50% (1068.72 km^2) of the total forest cover of the district. Among the Blocks, Rongjeng Block in East Garo Hills district has been found to have 74.3% of forest cover under very high fire prone category. The statistical analysis for forest fire vulnerability and forest fire prone areas including core and buffer (500 m) zone have been generated for all forest units.

Forest burnt area using Normalized Burned Ratio was also mapped using Google Earth Engine for the state of Meghalaya for the years from 2015 to 2021. Highest burnt area is found in year 2020 (1144.35 km^2). West Khasi Hills district has highest burnt area (more than 100 km^2) throughout all the years. Mawshynrut in West Khasi Hills district is the most affected Block in the State having highest burnt area.

All the information generated under the study has been brought into a single window dashboard platform named as "Meghalaya Forest Fire Information System". This dashboard has forest fire information about entire Meghalaya. The dashboard has interactive facility to visualize and analyze the forest fire for districts, blocks, Government owned forests, protected areas, biosphere reserve, ecosensitive zones and sacred groves along with user provided area of interest. The dashboard has additional information on area under shifting cultivation (2005-21), burnt area (2015-2021), village, road, settlements, and satellite base layers. In addition to dashboard, a mobile App named "Forest Fire Incident Reporting App" has also been developed to record information from field. The App is available in Google play store. The App has the facility to collect information on location, area and type of the forest fire, both in online and offline mode. The App can be downloaded by any individual to

collect forest fire related information. The information can be generated for most common languages *viz.,* English, Garo, Khasi and Jaintia spoken in Meghalaya.

This report presents a comprehensive sptio-temporal assessment of the forest fire scenario of the State for effective disaster risk reduction planning. The results of this study can help to design effective preventive and mitigation measures. The recommendations contained in the report can support future actions for fire prevention, management and climate change adaptation.

कार्यकारी सारांश

मनुष्य अपने अप्राकृतिक हस्तक्षेपों के माध्यम से प्राकृतिक विकास प्रक्रिया को सीधे प्रभावित करते हैं। वनाग्नि की प्रवृत्ति में भिन्नता भी उसी का परिणाम है। अग्नि जोखिम के प्रबंधन के लिए अग्नि घटना के कारकों की पहचान अत्यंत महत्वपूर्ण है। वर्तमान अध्ययन मेघालय राज्य के वन अग्नि भेद्यता और वन अग्नि प्रवण क्षेत्रों को उत्पन्न करने के लिए विभिन्न स्थानिक परतों (वन प्रकार, वन घनत्व, स्थलाकृति, सड़क और निपटान से निकटता) के एकीकरण के साथ ऐतिहासिक आग की घटनाओं की जानकारी का उपयोग करता है।

भारतीय वन सर्वेक्षण (एफएसआई) से प्राप्त जंगल की आग की घटनाओं के अलर्ट का उपयोग मेघालय राज्य में जंगल की आग के आकलन के लिए किया गया है। MODIS के अलावा, सुओमी नेशनल पोलर-ऑर्बिटिंग पार्टनरशिप (SNPP) - विज़िबल इन्फ्रारेड इमेजिंग रेडियोमीटर सुइट (VIIRS) के अलर्ट ने जंगल की आग का पता लगाने में वृद्धि की है। वर्तमान अध्ययन में, वर्ष 2003 - 2023 के ऐतिहासिक अग्नि विश्लेषण से पता चलता है कि री भोई (16670) और पश्चिम खासी हिल्स (12445) जिलों में आग की सबसे अधिक घटनाएं हुई हैं, जबकि दक्षिण पश्चिम गारो हिल्स जिले में सबसे कम (482) दर्ज की गई हैं। MODIS डेटा के अनुसार वर्ष 2006 (3151) और 2009 (3081) में राज्य में सबसे अधिक जंगल की आग की घटनाएं दर्ज की गईं। राज्य के वन प्रकारों के विश्लेषण से पता चलता है कि पूर्वी हिमालय के नम मिश्रित पर्णपाती वन में सबसे अधिक आग लगती है, जबकि असम के जलोढ़ मैदानी अर्धसदाबहार वन सबसे कम प्रभावित होते हैं। जंगल का घनत्व भी एक महत्वपूर्ण भूमिका निभाता है क्योंकि यह जंगल की आग के लिए ईंधन की मात्रा निर्धारित करता है। घने जंगलों में जंगल की आग की घटनाओं की संख्या अधिक दर्ज की गई है, चाहे जंगल का प्रकार कुछ भी हो। इसी प्रकार जंगल की आग की घटनाओं के अनुसार सड़कों और बस्तियों जैसे मानवजनित कारकों को लिया गया है।

मल्टी क्राइटेरिया डिसीजन एनालिसिस (एमसीडीए) ने जंगल की आग की संवेदनशीलता को प्रभावित करने वाले कारक की पहचान करने में मदद की है, ऐतिहासिक आग डेटा के साथ, ईंधन विशेषताओं, स्थलाकृति और सड़क और निपटान के निकटता के संबंध में आग की घटना की प्रकृति का आकलन किया गया था। जंगल की आग की संवेदनशीलता को बहुत अधिक, उच्च, मध्यम, निम्न और बहुत कम में वर्गीकृत किया गया है। मेघालय के जंगल की आग की संवेदनशीलता का मूल्यांकन झूम (शिफ्टिंग खेती) और गैर झूम प्रवण क्षेत्रों में 1:10000 पैमाने पर अलग से किया गया है। यह पाया गया है कि राज्य के कुल वन क्षेत्र का 60% से अधिक मध्यम से अत्यधिक संवेदनशील क्षेत्र में है, राज्य में 24.42% वन क्षेत्र उच्च संवेदनशीलता क्षेत्र के अंतर्गत है और केवल 13.21% वन क्षेत्र कम संवेदनशीलता क्षेत्र के अंतर्गत है। पूर्वी गारो हिल्स, री भोई और पश्चिमी खासी हिल्स का बड़ा क्षेत्र उच्च से बहुत उच्च भेद्यता क्षेत्र के अंतर्गत है।

सभी महत्वपूर्ण क्षेत्रों जैसे कि आरक्षित वन, संरक्षित वन, राष्ट्रीय उद्यान, वन्यजीव अभयारण्य, सामुदायिक रिजर्व, बायोस्फीयर रिजर्व, पर्यावरण-संवेदनशील क्षेत्र और पवित्र उपवनों का जंगल की आग की संवेदनशीलता का विश्लेषण 1:5000 पैमाने पर किया गया है। परिणाम से पता चलता है कि, उमरसॉ आरएफ अपने कुल भौगोलिक क्षेत्र का उच्चतम प्रतिशत (99.77%) जंगल की आग की संवेदनशीलता की उच्च और बहुत उच्च श्रेणी के अंतर्गत है।

वन अग्नि प्रवण क्षेत्र समय और स्थान की अवधि में आग की घटनाओं की आवृत्ति को दर्शाता है। प्रभावी वन अग्नि शमन के लिए अग्नि प्रवण क्षेत्रों की पहचान महत्वपूर्ण है। अग्नि प्रवण मानचित्र तैयार करने के लिए जंगल में आग लगने की आवृत्ति की गणना 1 किमी x 1 किमी के ग्रिड क्षेत्र के भीतर की गई है।

अग्नि प्रवण मानचित्र में पाँच जोखिम क्षेत्र शामिल हैं जिन्हें बहुत उच्च, उच्च, मध्यम, निम्न और बहुत निम्न नाम दिया गया है। मेघालय में अग्नि प्रवण विश्लेषण से पता चला है कि कुल वन क्षेत्र का लगभग 49% जंगल की आग से अत्यधिक प्रभावित है। ये आंकड़े भारतीय वन सर्वेक्षण द्वारा दिए गए 10% के राष्ट्रीय अनुमान से अधिक हैं। अध्ययन में, यह पाया गया कि री भोई जिले में अत्यधिक आग की आशंका वाला अधिकतम क्षेत्र है, यानी जिले के कुल वन क्षेत्र का 50% (1068.72 किमी 2)। ब्लॉकों में से, पूर्वी गारो हिल्स जिले के रोंगजेंग ब्लॉक में 74.3% वन क्षेत्र बहुत अधिक अग्नि प्रवण श्रेणी के अंतर्गत पाया गया है। सभी वन इकाइयों के लिए कोर और बफर (500 मीटर) जोन सहित वन अग्नि संवेदनशीलता और वन अग्नि प्रवण क्षेत्रों के लिए सांख्यिकीय विश्लेषण तैयार किया गया है।

वर्ष 2015-2021 तक मेघालय राज्य के लिए Google Earth इंजन का उपयोग करके सामान्यीकृत जले हुए अनुपात का उपयोग करके वन जले हुए क्षेत्र को भी मैप किया गया था। वर्ष 2020 में सर्वाधिक जला हुआ क्षेत्र (1144.35 किमी2) पाया गया है। पश्चिमी खासी हिल्स जिले में सभी वर्षों में सबसे अधिक जला हुआ क्षेत्र (100 किमी 2 से अधिक) है। पश्चिमी खासी हिल्स जिले का मावशिनरुट राज्य का सबसे अधिक प्रभावित ब्लॉक है, जहां सबसे अधिक जला हुआ क्षेत्र है।

अध्ययन के तहत उत्पन्न सभी जानकारी को "मेघालय वन अग्नि सूचना साइटेम" नामक एकल विंडो डैशबोर्ड प्लेटफ़ॉर्म पर लाया गया है। इस डैशबोर्ड में पूरे मेघालय के जंगल की आग की जानकारी है। डैशबोर्ड में जिला, ब्लॉक, सरकार के स्वामित्व वाले जंगल, संरक्षित क्षेत्रों, बायोस्फीयर रिजर्व, पारिस्थितिक संवेदनशील क्षेत्रों और पवित्र उपवनों के साथ-साथ उपयोगकर्ता द्वारा प्रदान किए गए रुचि के क्षेत्र में जंगल की आग की कल्पना और विश्लेषण करने के लिए इंटरैक्टिव सुविधा है। डैशबोर्ड में स्थानांतरित खेती के तहत क्षेत्र (2005-21), जले हुए क्षेत्र (2015-2021), गांव, सड़क, बस्तियों और उपग्रह आधार परतों के बारे में अतिरिक्त जानकारी है। डैशबोर्ड के अलावा, फ़ील्ड से जानकारी रिकॉर्ड करने के लिए "वन अग्नि घटना रिपोर्टिंग ऐप" नामक एक मोबाइल ऐप भी विकसित किया गया है। ऐप गूगल प्ले स्टोर पर उपलब्ध है। ऐप में ऑनलाइन और ऑफलाइन दोनों मोड में जंगल की आग के स्थान, क्षेत्र और प्रकार की जानकारी एकत्र करने की सुविधा है। ऐप को कोई भी व्यक्ति जंगल की आग से संबंधित जानकारी एकत्र करने के लिए डाउनलोड कर सकता है। जानकारी मेघालय में बोली जाने वाली तीन सबसे आम भाषाओं (गारो, खासी और जैन्तिया) में तैयार की जा सकती है।

यह रिपोर्ट प्रभावी आपदा जोखिम न्यूनीकरण योजना के लिए राज्य के जंगल की आग के परिदृश्य का व्यापक स्थानिक-अस्थायी मूल्यांकन प्रस्तुत करती है। इस अध्ययन के नतीजे प्रभावी निवारक और शमन उपायों को डिजाइन करने में मदद कर सकते हैं। रिपोर्ट में शामिल सिफारिशें आग की रोकथाम, प्रबंधन और जलवायु परिवर्तन अनुकूलन के लिए भविष्य की कार्रवाइयों का समर्थन कर सकती हैं।

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CHAPTER - 1

1. INTRODUCTION

Forests are a major natural resource playing an important role in maintaining ecological balance. At present, with increasing population and urbanization, forests are threatened by both forest loss and degradation. Forest fires are a major environmental problem in the forest ecosystems with large forest areas being affected every season. The causes of forest fire may be many but a high proportion of these fires are attributed to man-made reasons, either deliberate or accidental. Along with various factors, forest fires are a major cause of degradation of forests. In recent decades, forest fires have been increasing (Bowman et al., 2020), mainly caused by human activities (Lewis et al., 2015); they represent a threat to the remaining tropical forests around the world a mere (48.84%) of the 3.6 billion hectares of their initial coverage area (International Sustainability Unit, 2015). Large areas of tropical forests have diminished in spite of conservation efforts over the last 25 years (Keenan et al., 2015). The research on tropical forests fires is not sufficient (Juarez-Orozco, 2017). Forest fire is one of the major degenerating factors, which extensively damages the growing stock making the area vulnerable to erosion (Satendra and Kaushik, 2014).

Out of the 647 districts in India, nearly 380-445 districts encountered forest fires every year from 2003 to 2016 (World Bank, 2018). Approximately 37,059 forest fires were detected in 2018 in India (Forest Survey of India, 2011) using MODIS (Moderate Resolution Imaging Spectro radiometer) forest fire detections, of which maximum numbers of forest fire are detected in North Eastern region (55%). In this region the fires are concentrated in smaller area subjected to repeated burns due to practice of shifting cultivation/jhum (Sewak et al., 2021).

1.1. Types of Forest Fire

Forest fires have been categorized into three broad categories:

Ground fires: A ground fire spreads within rather than top of organic matter and it consumes organic matter like duff, musk or peat present beneath the surface litter of the forest floor. It is difficult to detect fire burning in tree roots unless it follows a root near the soil surface. It can smolder for days or weeks with no flame and little smoke. So, ground fires are most hard to handle and there should be proper policy and practices for control of ground fires.

Surface fire: Surface fire is characterized by a fast moving fire that produce flaming fronts, which consumes needles, moss, lichen, herbaceous vegetation, shrubs, small trees, and saplings. Surface fires can ignite large woody debris and decomposing duff, which can burn (glowing combustion) long after surface flames have moved past. High-severity surface fires kill most of the trees affected by it.

Crown fires: Crown fires advances from top to top of trees or shrubs and is the fastest to spread and most destructive for trees and wildlife. Crown fires are strongly influenced by wind, topography, and tree (crown) density.

1.2. Status of satellite based detection of forest fires and monitoring

The fire stages, flaming and smoldering are characterized by different fire intensity, temperature, combustion efficiency and emission ratio. Smoldering and flaming can be distinguished using infrared remotely-sensed measurements if the fire temperature varies significantly between these two stages. Flaming temperature can be anywhere between 800 K and 1200 K, and as hot as 1800 K while smoldering should be under 850 K and above 450 K. A given fire pixel may have areas that are not burned, areas that are smoldering and areas that are in flames. The 1.65 μm channel is very sensitive to flame and the flaming energy but not very sensitive to smold and its energy. The 2.13 μm channel is very sensitive to flame and somewhat sensitive to smold. Since the thermal energy is more concentrated in the flaming fire, the sensitivity to thermal energy is independent of smoldering or flaming. The 4 μm channel is sensitive to both flame and smoldering and is five times more sensitive to the thermal energy emitted from flaming than from smoldering. For MODIS, the fire detection is performed using a contextual algorithm (Giglio et al., 2003) that exploits the strong emission of mid-infrared radiation from fires.

Fire monitoring has become easier with the availability of satellite data such as Terra and Aqua, IRS P4 (OCEANSAT), IRS P6-AWiFS (Indian Remote Sensing - Advanced Wide Field Sensor), ATSR-2, SPOT-VGT (Système Pour l'Observation de la Terre-Vegetation), NOAA-AVHRR (National Oceanic and Atmospheric Administration -Advanced Very High Resolution Radiometer), EOS-MODIS etc. obtained with high temporal repeatability, spectral variability and wide spatial coverage (Giriraj et al., 2010). Satellites like the advanced very high resolution radiometer (AVHRR) launched in 1998 and the MODIS launched in 1999 have been widely used in forest fire monitoring and assessment. The MODIS sensor onboard NASA's Terra and Aqua satellites are used widely to scan the Earth's surface for fires on a daily basis. The Visible Infrared Imaging Radiometer Suite (VIIRS) onboard the Suomi NPP

(SNPP) with higher resolution images of the Earth's surface is also contributing to the forest fire detections. These satellites have similar orbits, but the spatial resolution of their sensor's thermal bands is different. The thermal band of MODIS has a 1,000 meters resolution per pixel whereas VIIRS has a 375 meters resolution per pixel. This higher resolution enables VIIRS to detect fires that MODIS overlooks.

The GOFC/GOLD (Global Observations of Forest and Land Cover Dynamics) Fire Monitoring and Mapping Team links regional self-organized networks working with the detection and monitoring of forest fires and is partnering with the Global Fire Monitoring Center (GFMC), and the United Nations International Strategy for Disaster Reduction (UNISDR) Wildland Fire Advisory Group/Global Wildland Fire Network (Source: http://gofc-fire.umd.edu). The US national weather service NOAA provides the FIMMA product (Fire Identification, Mapping and Monitoring Algorithm) which uses AVHRR based data The Canadian Wildland Fire Information System (http://cwfis.cfs.nrcan.gc.ca) also uses data based on the previously described methods using AVHRR and MODIS. The Canadian and US services offer broad information related to forest fires.

NASA Fire Information for Resource Management System (FIRMS) distributes Near Real-Time (NRT) active fire data from the MODIS aboard the Aqua and Terra satellites, and the VIIRS aboard S-NPP and NOAA 20 (formally known as JPSS-1). Globally these data are available within 3 hours of satellite observation, but for the US and Canada active fire detections are available in real-time.

In Europe, the European Forest Fire Information System (EFFIS) supports the services in charge for the protection of forests against fires in the EU countries and provides the European Commission and the European Parliament with updated and reliable information on wildland fires in Europe (http://effis.jrc.ec.europa.eu). EFFIS collects and provides forest fire related data and information on pre-fire to post fire levels.

SERVIR-Himalaya at ICIMOD in close collaboration with the Department of Forests of Nepal has developed forest fire detection and monitoring system for Nepal based on MODIS imagery. The information is also published on ICIMOD's Mountain GeoPortal.

Indian Forest Fire Response and Assessment System (INFFRAS) was established with a scope to integrate process and disseminate various types of data bases related to pre fire, during fire and post fire scenarios. In resent times, ISRO disseminates forest fire incidents through its Bhuvan Portal. However, the nodal agency for dissemination of forest fire

information is being carried out by Forest Survey of India at the beat level for Indian forests.

Forest fire burned area products like GBA2000 (2000), GLOBSCAR (2000), L3 JRC (2000-2007), GlobCarbon (1998-2007), MCD64A1 c6, etc. are available from different sources.

Forest fires are a major environmental threat in North East Region (NER) of India. Large tracts of forests are lost every year due to forest fires. Under the North East Regional-Disaster Risk Reduction (NER-DRR) program, NESAC has been monitoring the various disasters taking place in NER from time to time. NESAC has been supporting various stakeholder department of NER by providing inputs for the disaster mitigation primarily under flood, landslide and forest fire. Under NER-DRR program forest fire assessment is being carried out since 2014.

1.3. Scope of the work

This project has been carried out under the Plan of Action (PoA) projects envisaged during the NESAC Society meeting held on 23rd January, 2021 at Shillong, chaired by Shri Amit Shah, Hon'ble Union Home Minister & President, NESAC Society. Considering the increasing forest fire incidents in the state of Meghalaya, the project has been taken up on request from State Forest and Environment Department, Govt. of Meghalaya.

CHAPTER - 2

2.1. STUDY AREA

Meghalaya, 'the Abode of Clouds' is one of the North Eastern states of India. Its geographical area is 22,429 km^2. The State located between 24°58'N to 26°07'N latitude and 89°48' E to 92°51'E longitude bordered by Assam in the north and east and shares international boundary with Bangladesh in the south and west. Meghalaya is an important Bio-geographic zone (along with Assam, Nagaland, Manipur, Mizoram and Tripura) as it represents a transition zone between the Indian, Indo-Malayan, Indo-Chinese bio-geographic regions as well as a meeting place of Himalayan mountains with that of Peninsular India. The region is one of the richest in biological values with vegetation types ranging from tropical rain forest in the foothills to Alpine meadows and cold deserts. The state also represents an important part of the Indo-Burma biodiversity hotspot. The data have been assessed and analysed separately for districts (Figure 1), Blocks (Figure 2), Government owned Forests (Figure 3), Protected Areas (Figure 4), Biosphere Reserve (Figure 5), Community Reserve (Figure 6), Eco-Sensitive Zone (Figure 7) and Few Sacred Groves of Khasi and Jaintia Hills regioins (Figure 8) of state.



Figure 1. Map of Study Area



Figure 2. Blocks in different districts of Megahalaya

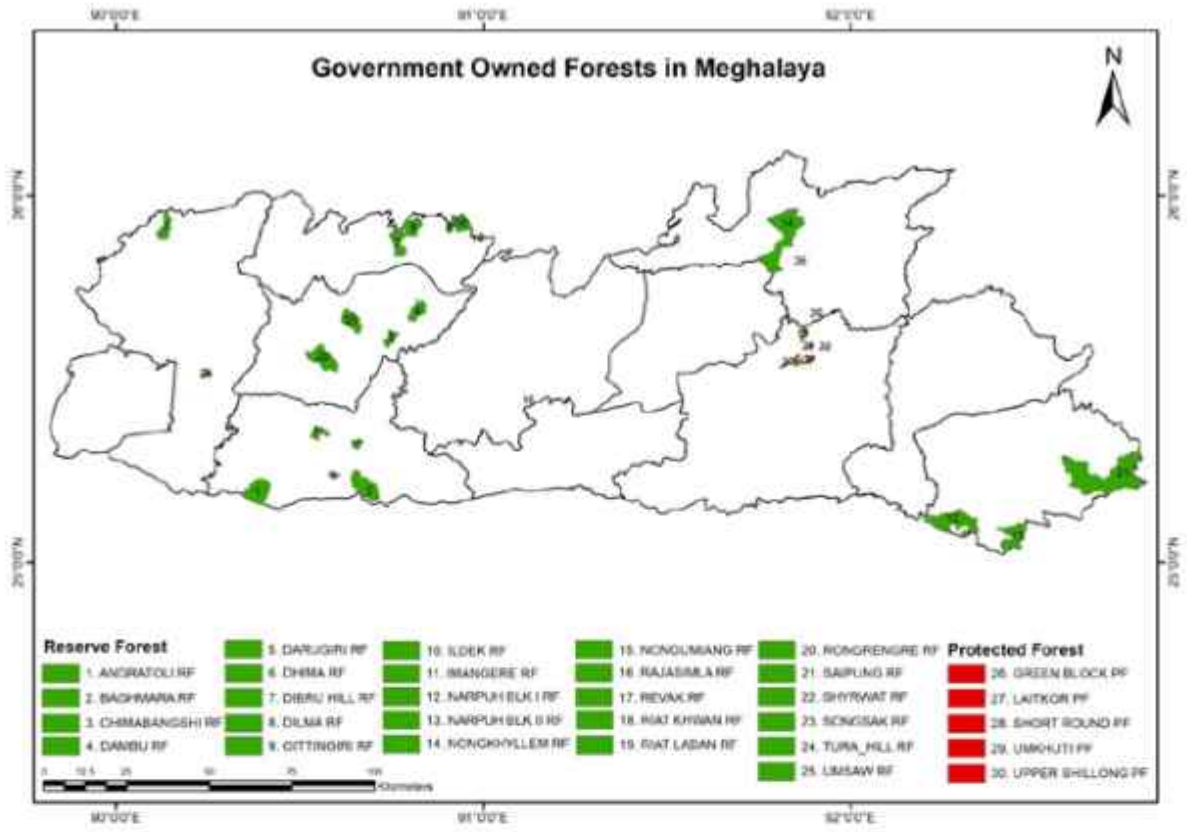


Figure 3. Government owned Forest of Meghalaya

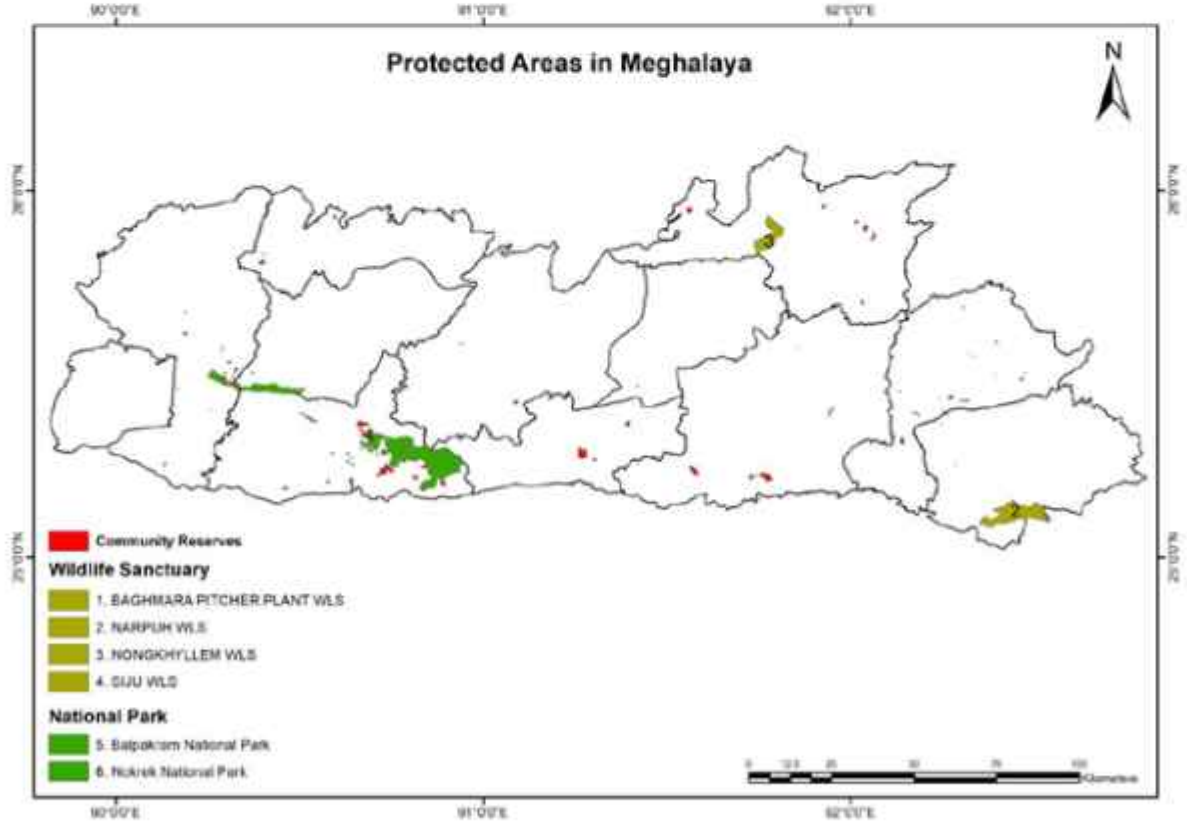


Figure 4. Protected Areas (PA) of Megahalaya

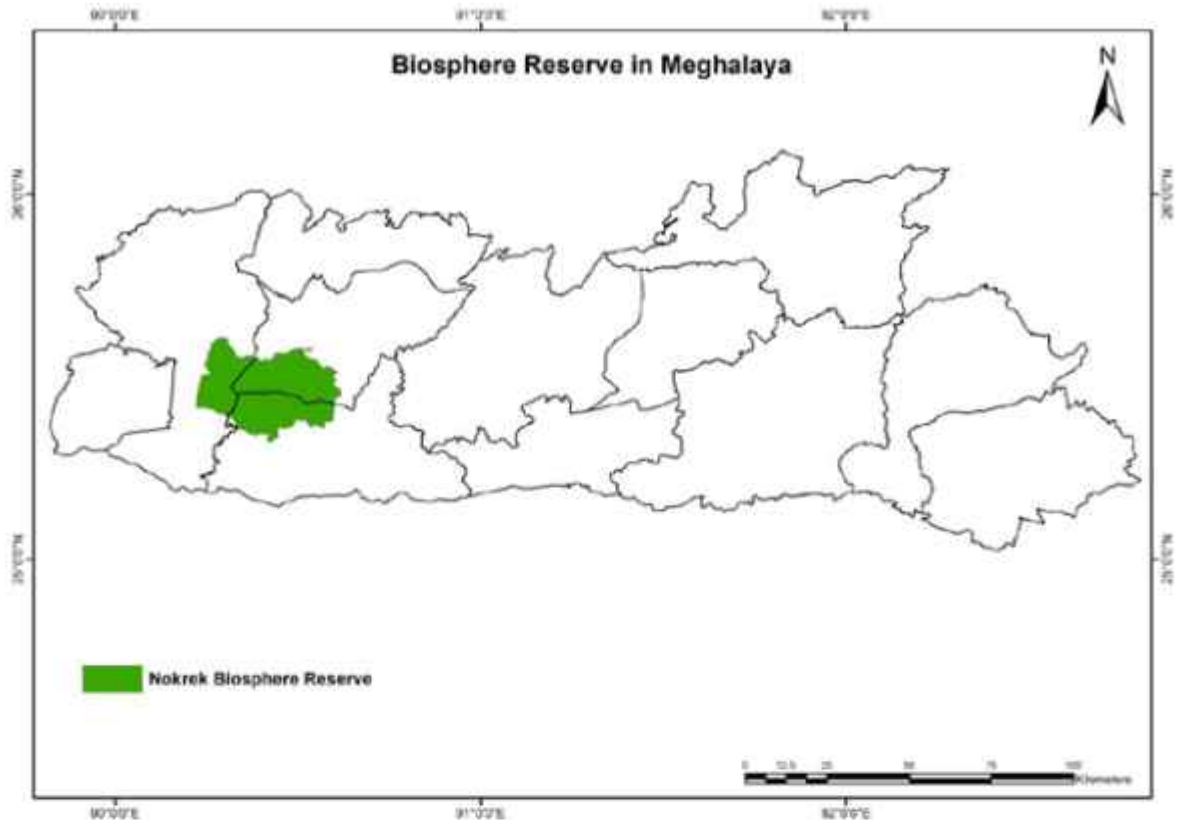


Figure 5. Biosphere Reserve (BR) of Megahalaya

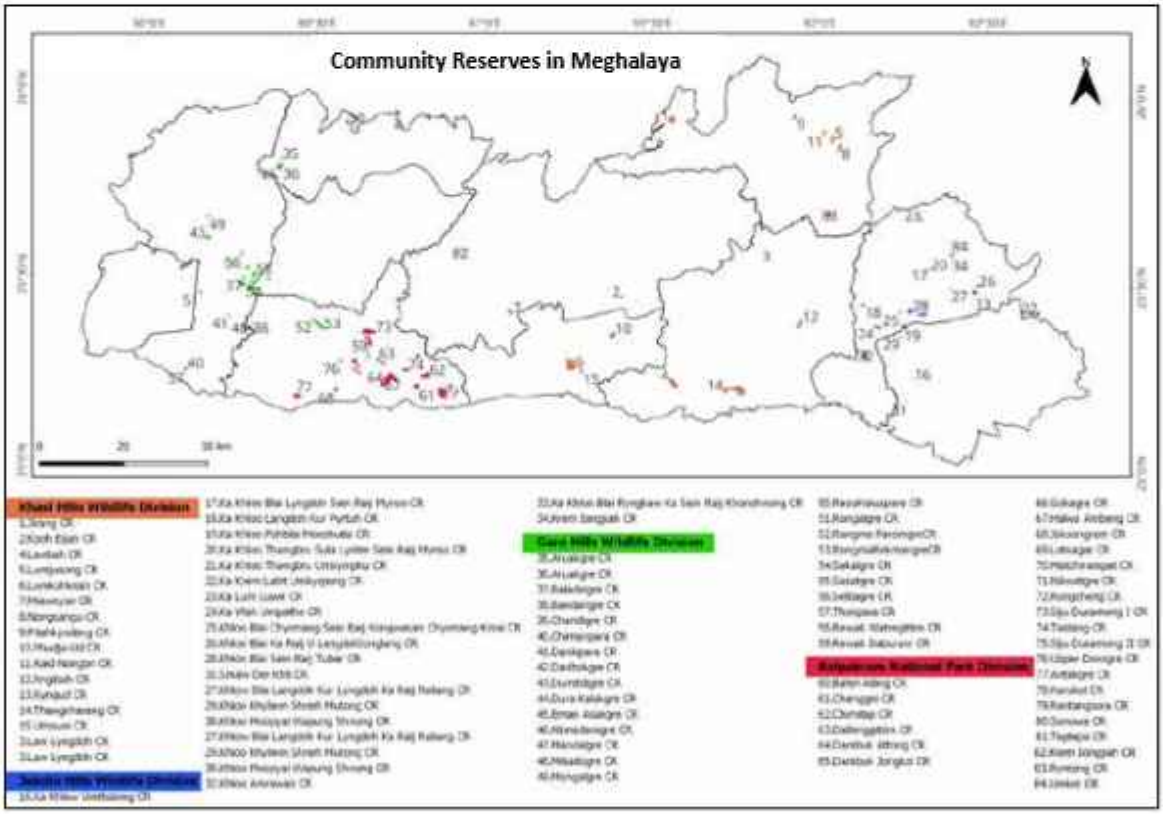


Figure 6. Community Reserves (CR) in Meghalaya

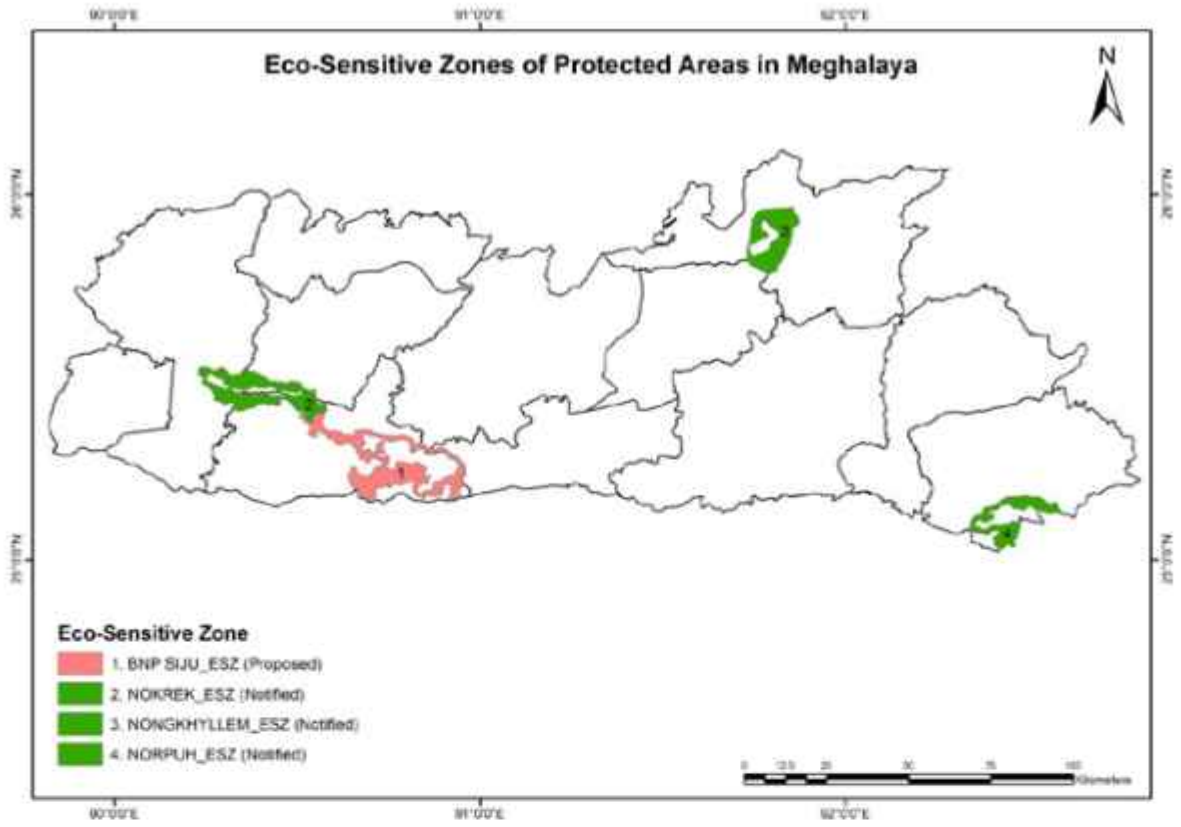


Figure 7. Eco-Sensitive Zones (ESZ) of Meghalaya

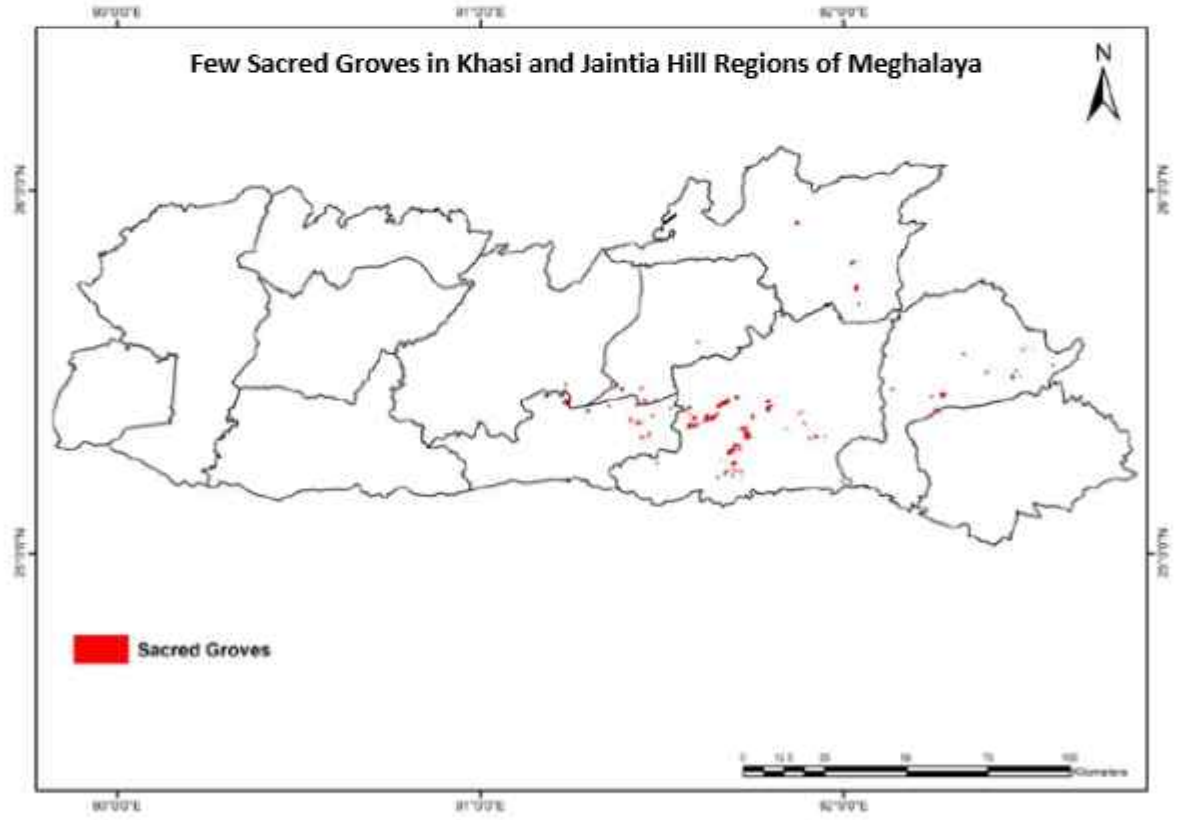


Figure 8. Few Sacred Groves (SG) in Khasi and Jaintia Hills Regions of Meghalaya

Forests in Meghalaya are largely under the community and private ownership. Community and private forests are under the administrative control of the three Autonomies District Councils viz., Khasi Hills, Jaintia Hills and Garo Hills. Only 1,113 km^2 of forests, comprise of Reserve Forests, Protected Forests, Green Blocks, National Parks and Sanctuaries are under the direct control of the State Forest Department. Two National Parks, four Wildlife Sanctuaries and 84 Community Reserves constitute the Protected Area network of the State covering 2.22% of its geographical area. According to India State of Forest Report 2021, the Forest Cover in the State is 17,046 km^2 which is 76 % of the State's geographical area. In terms of forest canopy density classes, the State has 560 km^2 (3.28%) under Very Dense Forest (VDF), 9,160 km^2 (53.73%) under Moderately Dense Forest (MDF) and 7,326 km^2 (42.97%) under Open Forest (OF). The dominant forest types of Meghalaya according to Champion and Seth (1968) classification are East Himalayan moist mixed deciduous forests, Khasi Sub-Tropical Wet Hill Forest, Cachar Tropical Evergreen Forest, Assam Sub-Tropical Pine Forest, Khasi hill Sal.

2.2. OBJECTIVES

The Study has been taken with the following objectives:

i) Preparation of forest fire vulnerable and prone area map of Meghalaya State using geospatial technique at 1:10,000 scale
ii) Preparation of forest fire vulnerable map in different Forest Units viz., Reserve Forests, Protected Forests, Green Blocks, National Parks, Wildlife Sanctuaries, Community Reserves, Biosphere Reserve and Sacred Groves using high resolution satellite imagery at 1: 5000 scale
iii) Assessment of forest fire burnt area by generating forest fire burned area map from 2015 to 2021.
iv) Development of a Field Based Mobile Application and Dashboard on forest fire.

CHAPTER - 3

3. MATERIALS & METHODOLOGY

3.1. Data used- includes following satellite data (high resolution and open source), derived products, fire incidences and base maps.

i. High resolution satellite image for 1:10000 map using IRS LISS IV
ii. Very High-resolution satellite image for 1:5000 map using Cartosat 2 Series
iii. High resolution DEM (CartoDEM 10 m resolution available with NESAC)
iv. FSI forest fire points
v. Forest type (2015, FSI)
vi. Forest Density (generated under this project at NESAC and FSI map used as reference)
vii. Road, settlement and water body maps generated from Satellite data
viii. LISS III/Sentine 2/ Landsat in GEE for burnt area analysis
ix. Protected Areas Boundaries (Meghalaya Forest Department)
x. LULC of Meghalaya for year 2005-06, 2011-12, 2015-16 (NeSDR, NESAC)
xi. Jhum map of Meghalaya for year 2017-18 prepared under a Project sponsored by NITI Ayog

3.2. Data analysis and product generation

The study is composed of following four components:

a) Historical Forest Fire data analysis
b) Forest Fire Prone Analysis
c) Forest Fire Vulnerability Analysis
d) Forest Fire Burnt Area Analysis

Historical Forest Fire data analysis: Historical Forest fire incident data has been obtained from Forest Survey of India (FSI) for the year 2003 to 2023 for the analysis.

Forest Fire Prone Anlysis: Frquency of fire occurance has been computed within a uniform grid of 1km×1km using historical forest fire incidents to generate forest fire prone map classified into different fire prone categories.

Forest Fire Vulnerability Analysis: The forest fire vulnerability analysis has been done using satellite data and ancillary data. From satellite data three variables have been generated *viz.*,

Land Use/Land Cover (LULC), Topographic Variables and Anthropogenic Varibles. From LULC, Forest Density and Jhum area maps have been generated. Forest Density has been classified as per FSI classification scheme. Percent of tree canopy cover 10-40 is classified as open forest, canopy cover 40–70 is classified as moderate forest and canopy cover > 70% is classified as dense forest. For the jhum prone area mapping, the spatial distribution has been obtained by mapping Jhum areas of the year 2021, and jhum area information for the years 2005-06, 2011-12, 2015-16, 2017-18 has been extracted from LULC maps available with NESAC using uniform grid of 1km×1km. Topographic variables consists of slope, aspects and elevation which has been generated from CartoDEM (10 m resolution available with NESAC).Slope classes (in degree) are classified into 7 classes; <5, 5-10, 10-20, 20-30, 30-40, 40-50 and >50. Aspect zones are also classified into 8 zones; North, North-East, East, South-East, South, South-West, West and North-West. Zonation of elevation of categorized into 7 ranges; 0-200m, 200m-400m, 400m-600m, 600m-800m, 800m-1000m, 1000m-1500m and >1500m. For proximity analysis of road and settelements LULC has been used for extraction of Road and settlement data with creation of buffer zones from different distance with respect to the fire points. Road buffer zones are varies from 200m to >3500m and for settlement the buffer zone is varies from 500m to >1500m. Ancillary data like forest types and historical fire points has been used, which has been acsessed from Forest Survey of India (FSI).

Forest fire Burnt Area Analysis: Archived satellite images such as Landsat 8 have immense potential to be used in the determination and evaluation of forest area disturbance due to forest fire. Differenced Normalized Burn Ratio (dNBR) is the widely used method to detect and map these burned forest areas with high accuracy (Gulci et al., 2021). Considering the success of previous studies in detection of burnt area using Landsat 8 images, the global annual burned area map (GABAM) products and other regional fire products (Liu et al. 2018; Hawbaker et al. 2017), similar approach has been used to generate burnt area maps. In this study, forest fire burnt area analysis was assessed on the Google Earth Engine (GEE) extension plugin of Qgis python console using dNBR method. GEE is a cloud- based platform provides computational infrastructure using APIs (JavaScript and Python), that enables the quick operational spatial data analysis (Gorelick et al. 2017). GEE is more concerned with remote sensing, big volumetric satellite image preprocessing, land cover classification, and data on agriculture, forestry, and vegetation (Tamiminia et al. 2020). It shows that GEE has exceptional accuracy and is independent of time and computer specifications. Therefore, the temporal Landsat 7/8 satellite imageries for the years from 2015 to 2021 have been analysed for the entire state of Meghalaya to estimate the burnt area patches. Pre and Post time series data has been used to

extract the burnt area patches. Necessary preprocessing steps such as cloud masking, atmospheric correction and image compositing have also applied to ensure working with clean satellite imagery. A specifc threshold value has been used for every individual month to delinite the burnt area patches. For visulaization different colour palletes have been used to highlight the burnt and unburnt areas.

The flow chart of data analysis and product generation for all the above mentioned components is given in Figure 9.

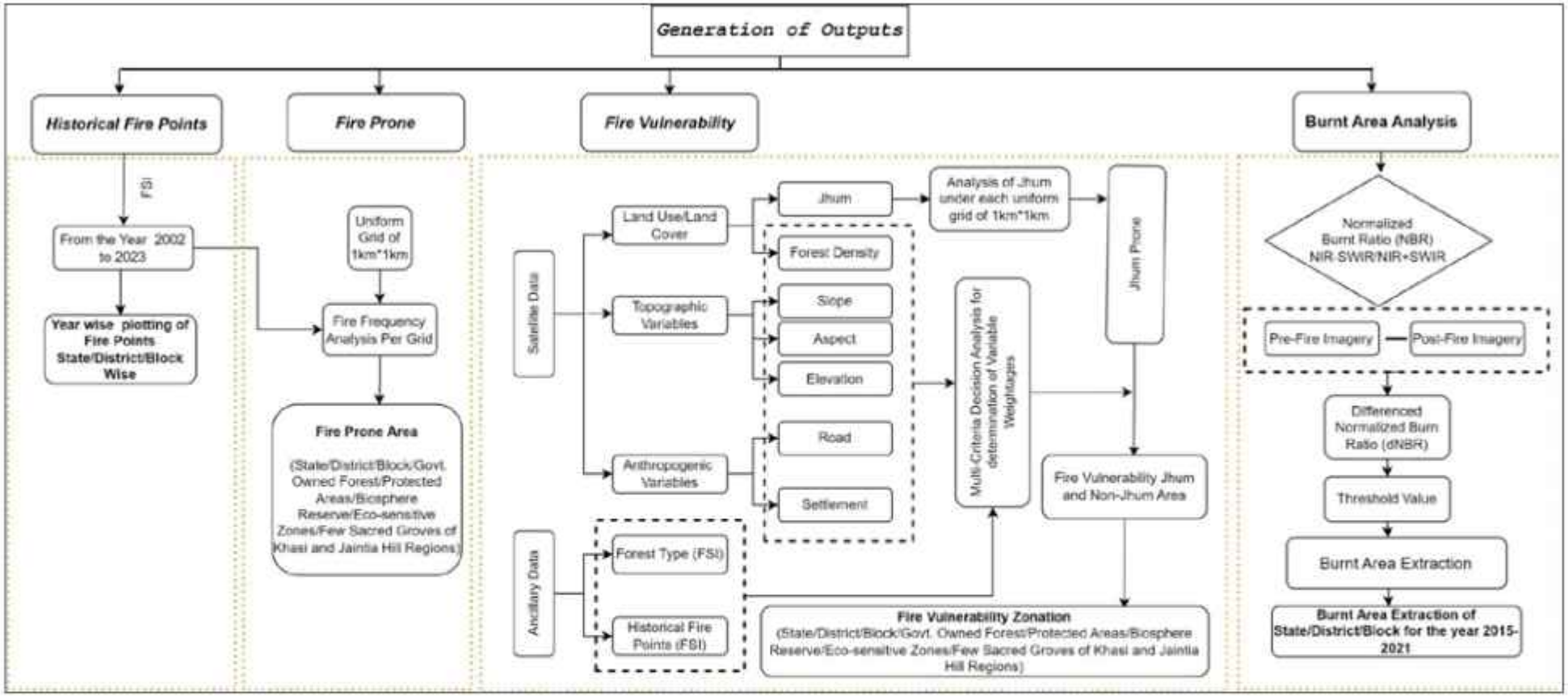


Figure 9. Methodology for Generation of all Outputs

Note: *The Vulnerability map has been generated at 1:10000 scale for State/District/Block level and 1:5000 Scale for Government Owned Forest/Protected Areas/Biosphere Reserve/Eco-Sensitive Zones/Few Sacred Groves of Khasi and Jainitia Hill Regions.*

3.2.1. Analysis of historical forest fire incidents of Meghalaya

The historical forest fire data for the period from 2003 to 2023 have been downloaded from Forest Survey of India (FSI) for analysis of forest fire spatial and temporal dynamics. The forest fire distribution has been analysed for State, Districts, Block and different Forest Units (Reserve Forest, Protected Forest, National Park, Wildlife Sanctuary, Biosphere Reserve, Sacred Groves, and Community Reserves).

3.2.2. Generation of forest fire vulnerable area map

The forest fire vulnerability map has been generated based on historical forest fire event analysis, incorporating weightage-based comparisons of each parameter such as forest type, forest density, elevation, slope, aspect, distance from roads and distance from settlements. The various input datasets used to generate the forest fire vulnerability map are presented in Figure 10 to 18. The occurrence of forest fire incidents in each variable is shown in Figure 19 to 25. The vulnerability map has been generated within forest cover area of FSI. For the analysis of forest fire vulnerability jhum maps for the period from year 2005 to 2021 was also taken into consideration (Figure 26). Jhum area map for the year 2021 was prepared under the study while remaing year's jhum layers were taken from the source mentioned in section 4.1. The vulnerability analysis was carried out for jhum and non jhum areas. The jhum prone areas have been derived from the LULC map available at NESAC for the years 2005-06, 2011-12, 2015-16, 2017-18 and jhum area map of 2021. The final vulnerability layers from both the categories were merged into one.

An analytic hierarchy process (AHP) was followed to define the influence of each variable to output a raster map for the fire vulnerability. A precedence weighting was derived and combined to determine the global ranking score of each relevant criterion (Saaty and Vargas, 2012). A two step AHP has been employed to generate the vulnerability map i.e. i) assessment of weightage within the category/parameters and ii) comparisons of the weightage between the categories/parameters. For the assignment of weightage within a variable, the forest fire points per unit area under each class (Figure 19 to 25) was considered and scaled from 1 to 9 for relative importance. Value '1' denotes "equal importance" between the two classes, and the value '9' denotes the "extreme importance". The normalized relative weight was calculated by dividing each element of the pair-wise matrix by the sum of its column. The weights of each layer were decided using the principal eigenvector of the square matrix of each criterion. The higher the weight the more was the influence of the class on the forest fire based on its relative importance. Similar analysis was carried out for the second stage AHP where the pair-wise

comparative matrix analysis was carried out between the variables. Using the weightages of different variables for forest fire vulnerability formula was developed as given below:

$$Vulnearability = Forest\ Type \times 0.29 + Forest\ Density \times 0.21 + Settlement * 0.19 + Slope \times 0.15 + Road \times 0.06 + Aspect \times 0.05 + Elevation \times 0.05$$

To check the consistency of the decision making and reduce the bias in the process, a consistency ratio (CR) was obtained with Equations given below:

$$CR = \frac{CI}{RI}$$

$$CI = \frac{\lambda max - n}{n - 1}$$

Where, CR is the consistency ratio, CI is the consistency index and RI is the random index in Equation. λmax is the maximum value in the average of dividing the sum of the weights, and n is the number of criteria. CR values of 0.10 and lower are considered tolerable (Malczewski, 2015).

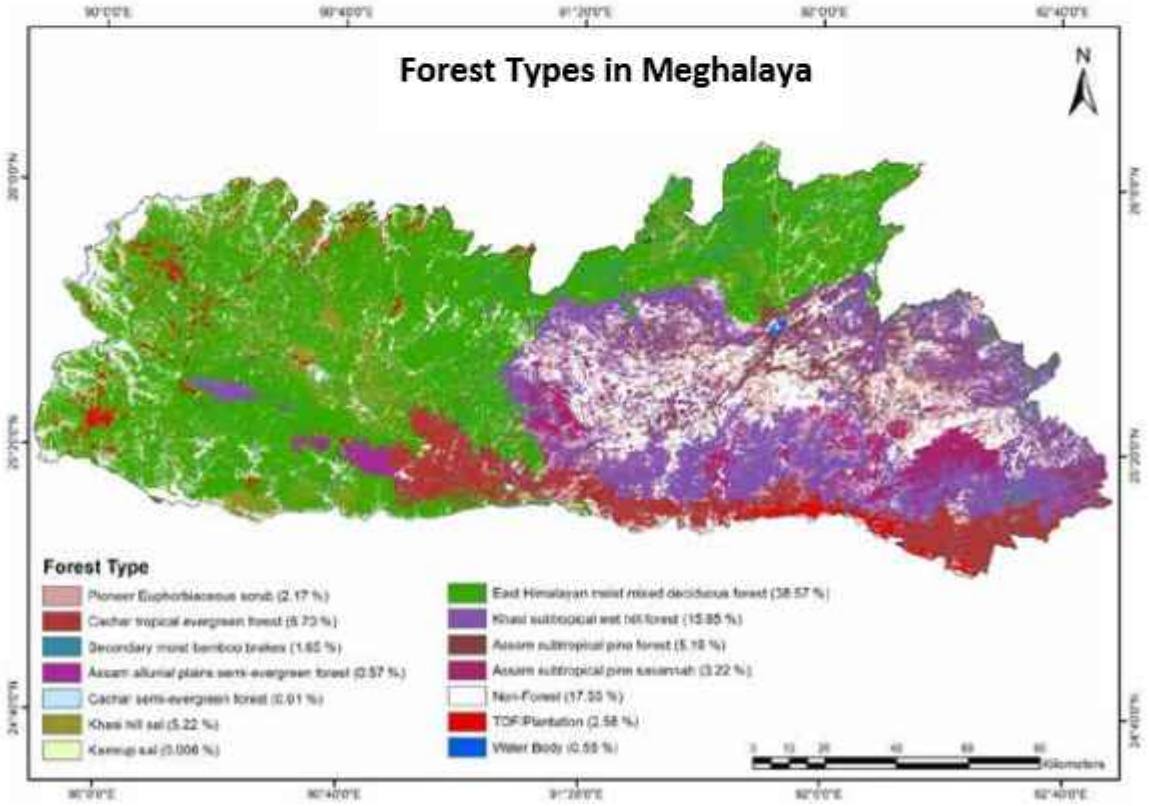


Figure 10. Forest Types in Meghalaya [Source: FSI, 2019]

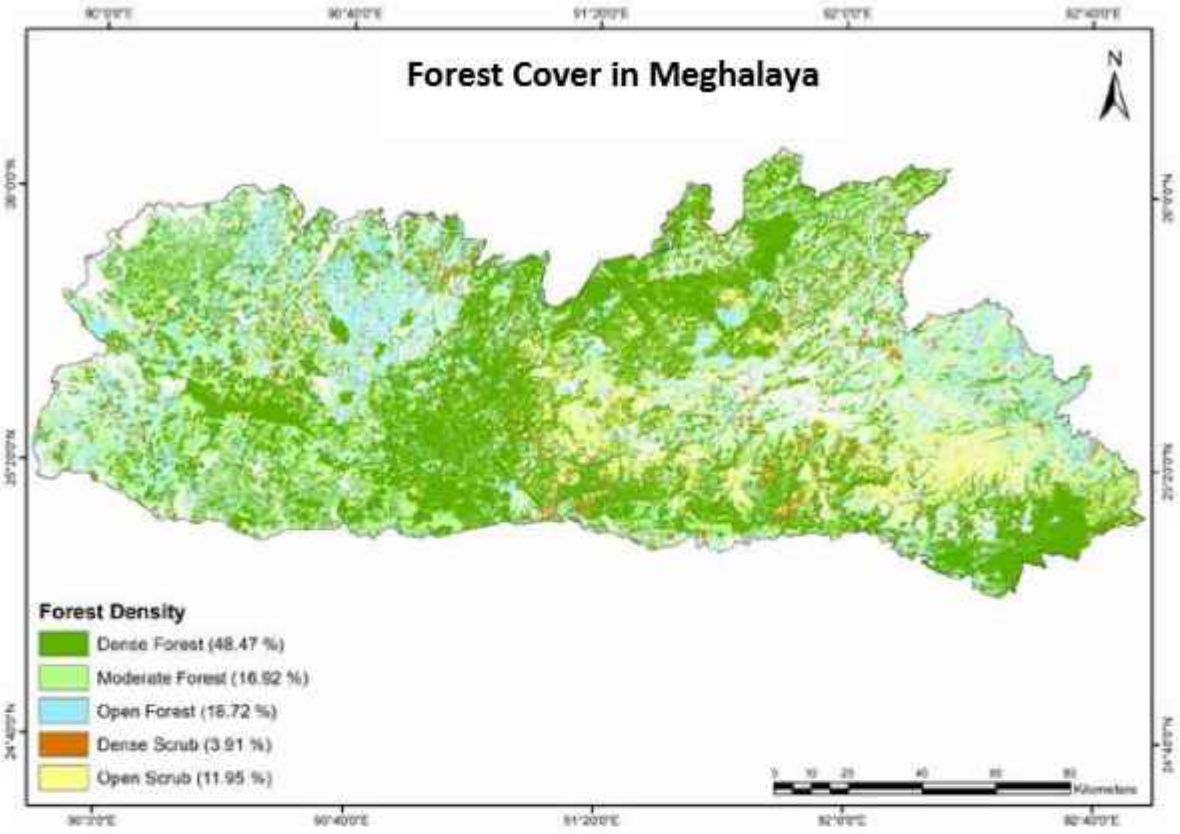


Figure 11. Forest Cover in Meghalaya [Source: NESAC, 2019]

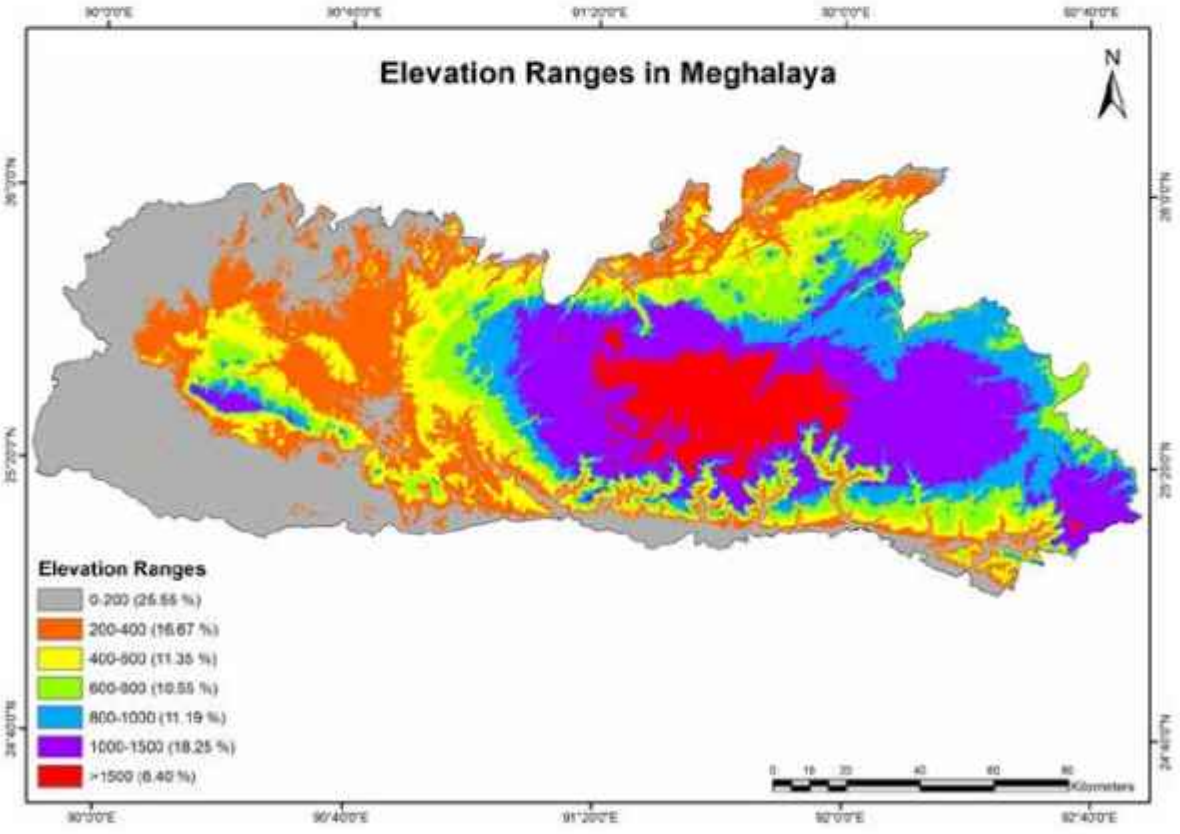


Figure 12. Elevation (m) Ranges in Meghalaya [Source: NESAC]

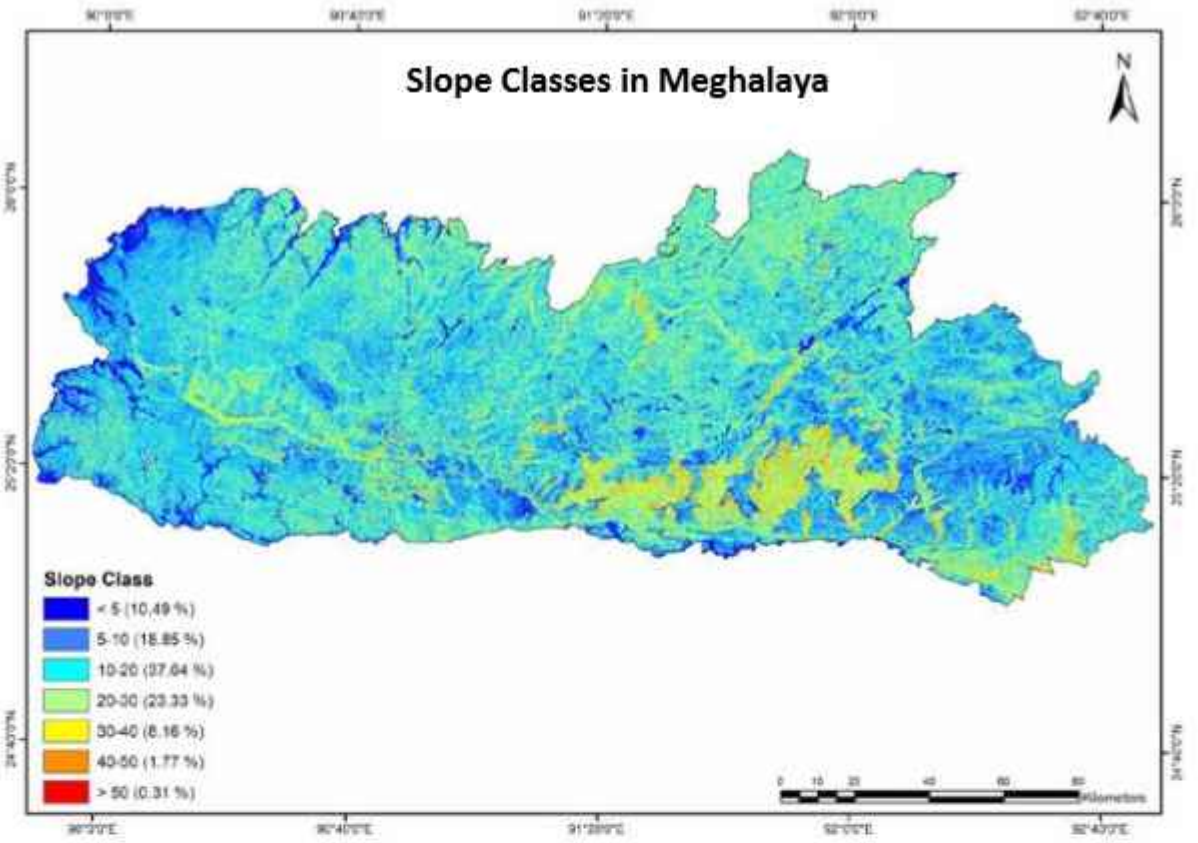


Figure 13. Slope (°) Classes in Meghalaya [Source: NESAC]

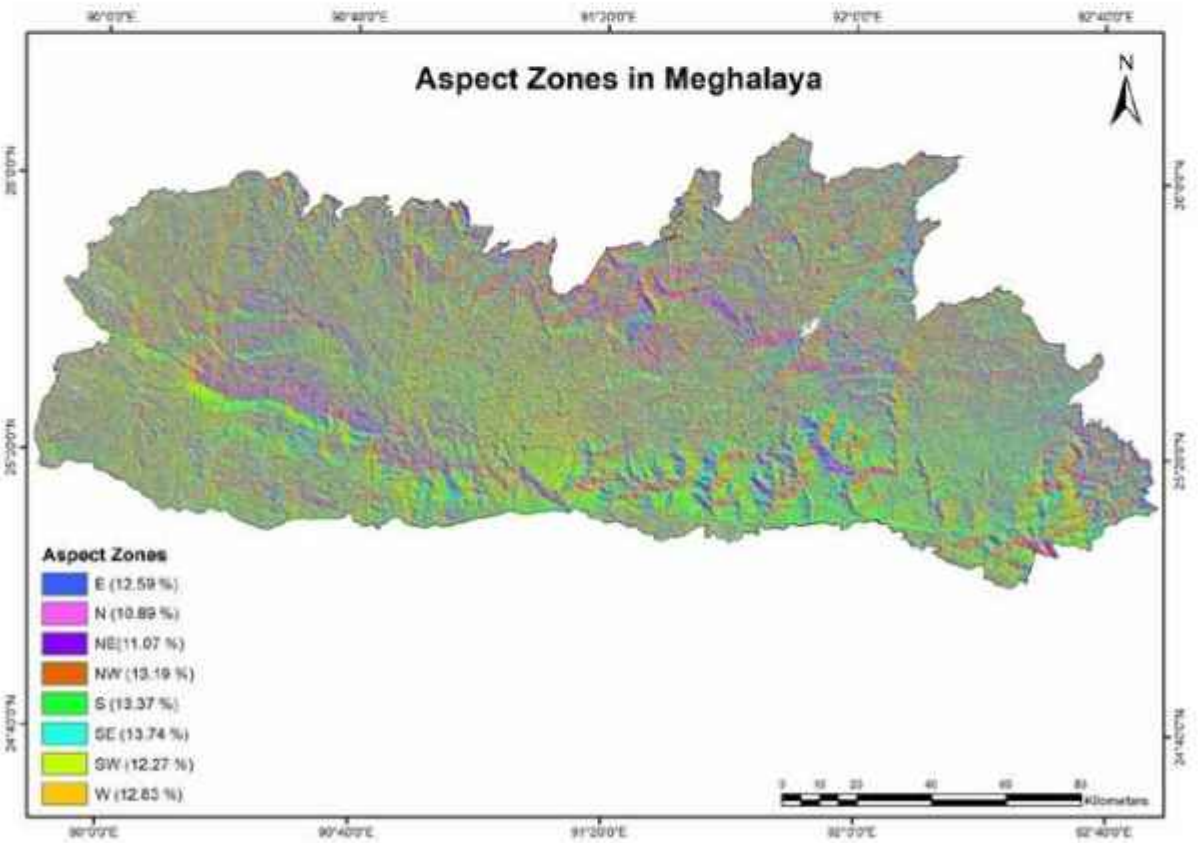


Figure 14. Aspect Zones in Meghalaya [Source: NESAC]

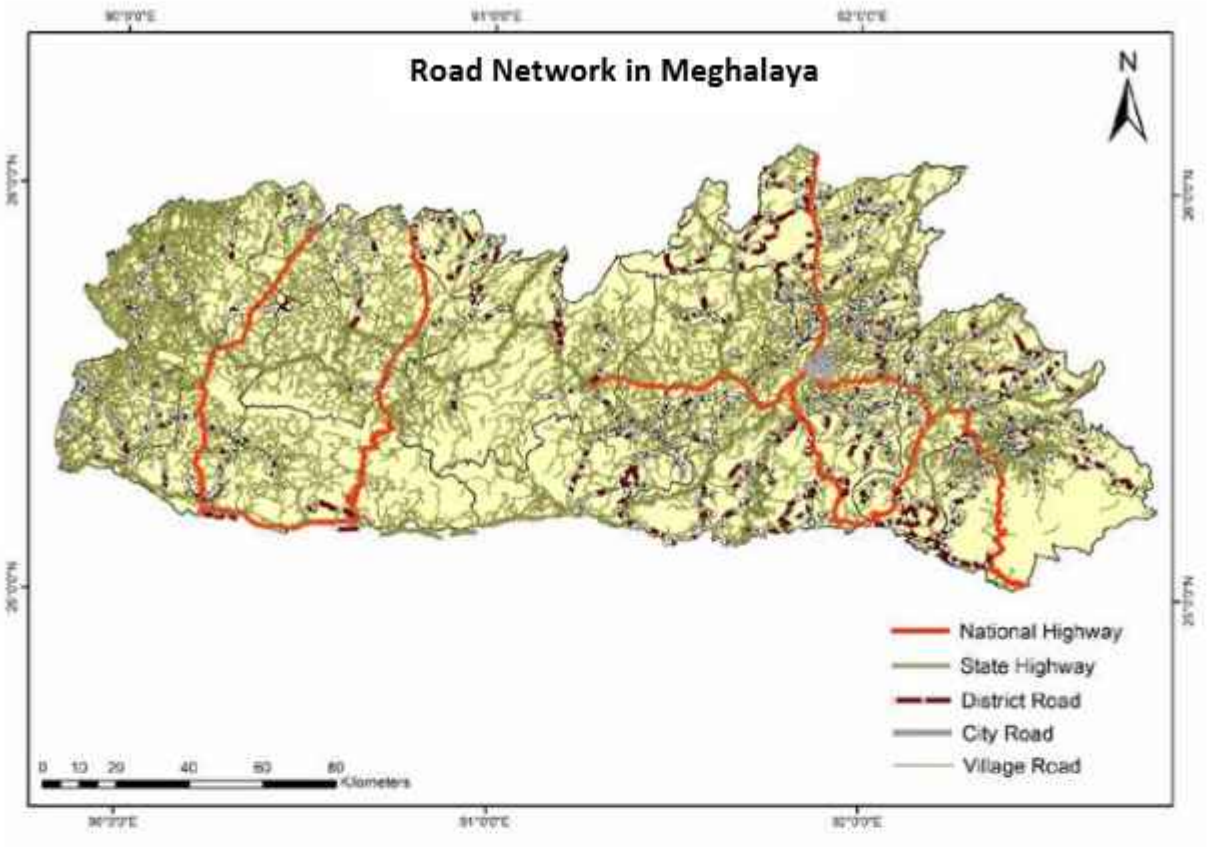


Figure 15. Road Map of Meghalaya [Source: NESAC, 2019]

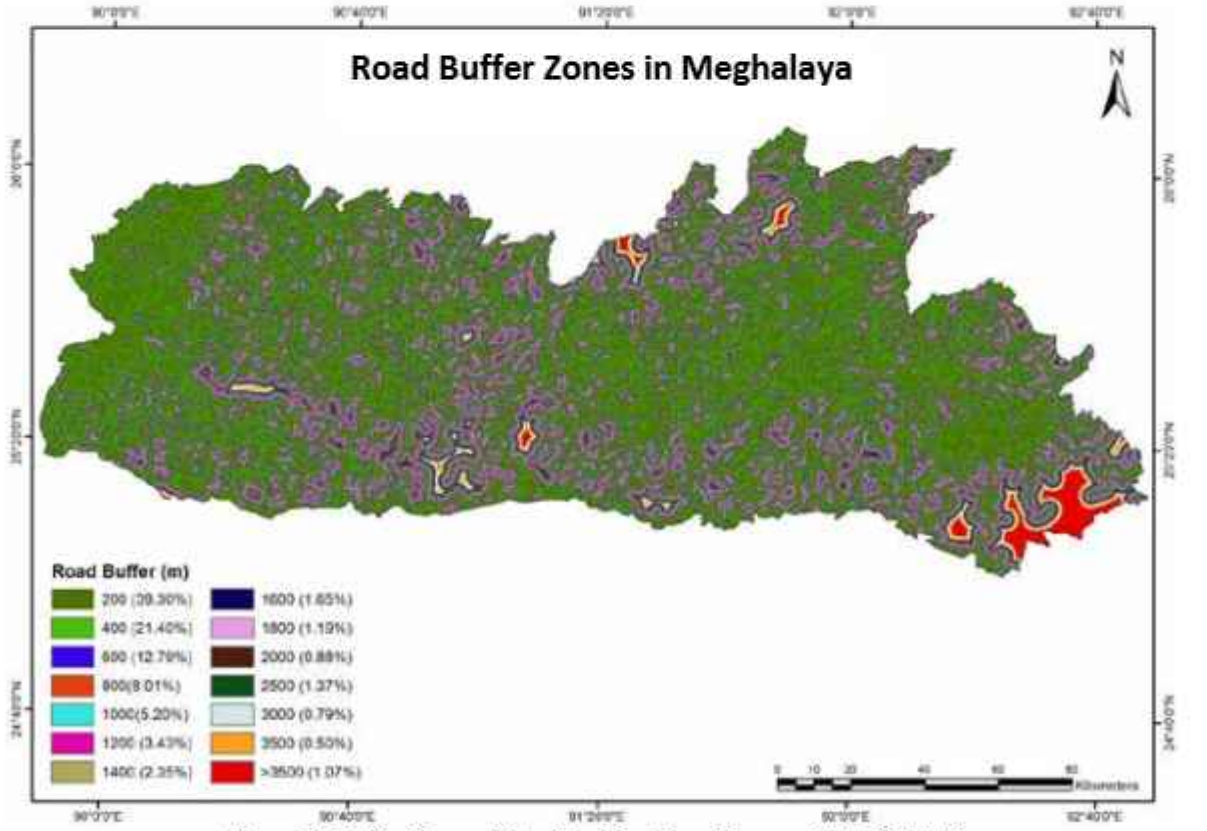


Figure 16. Buffer Zones of Roads in Meghalaya [Source: NESAC, 2019]

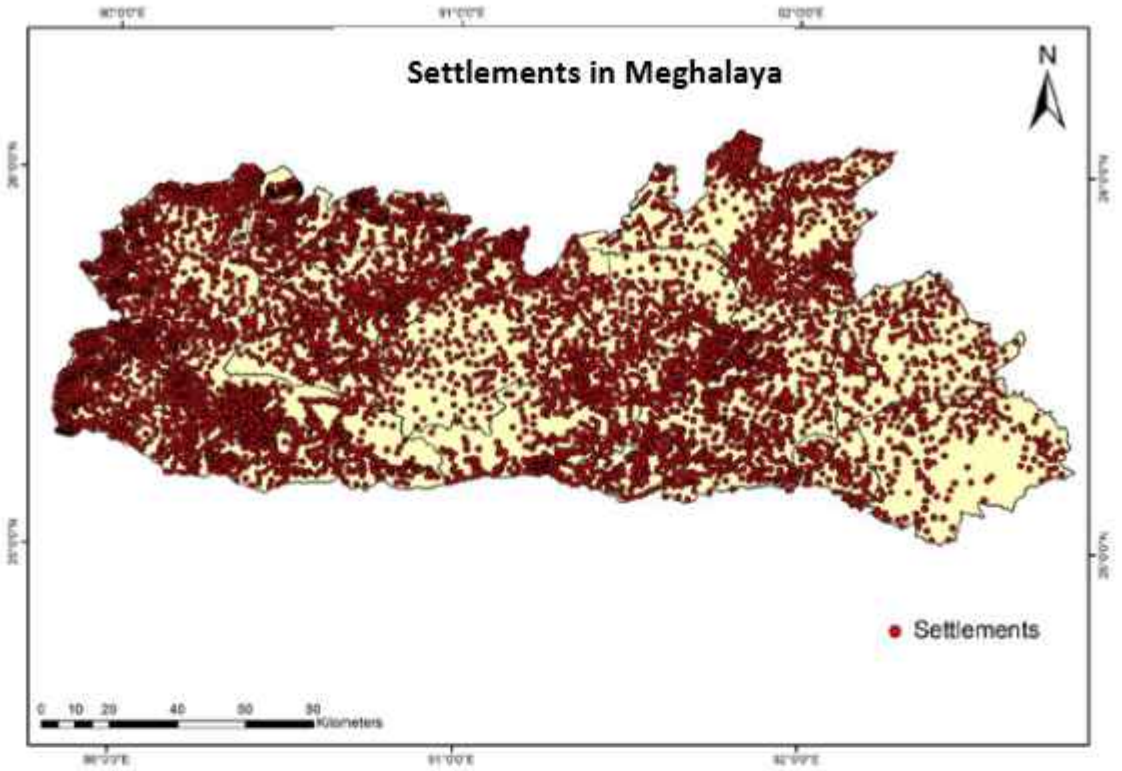


Figure 18. Settlements in Meghalaya [Source: NESAC, 2019]

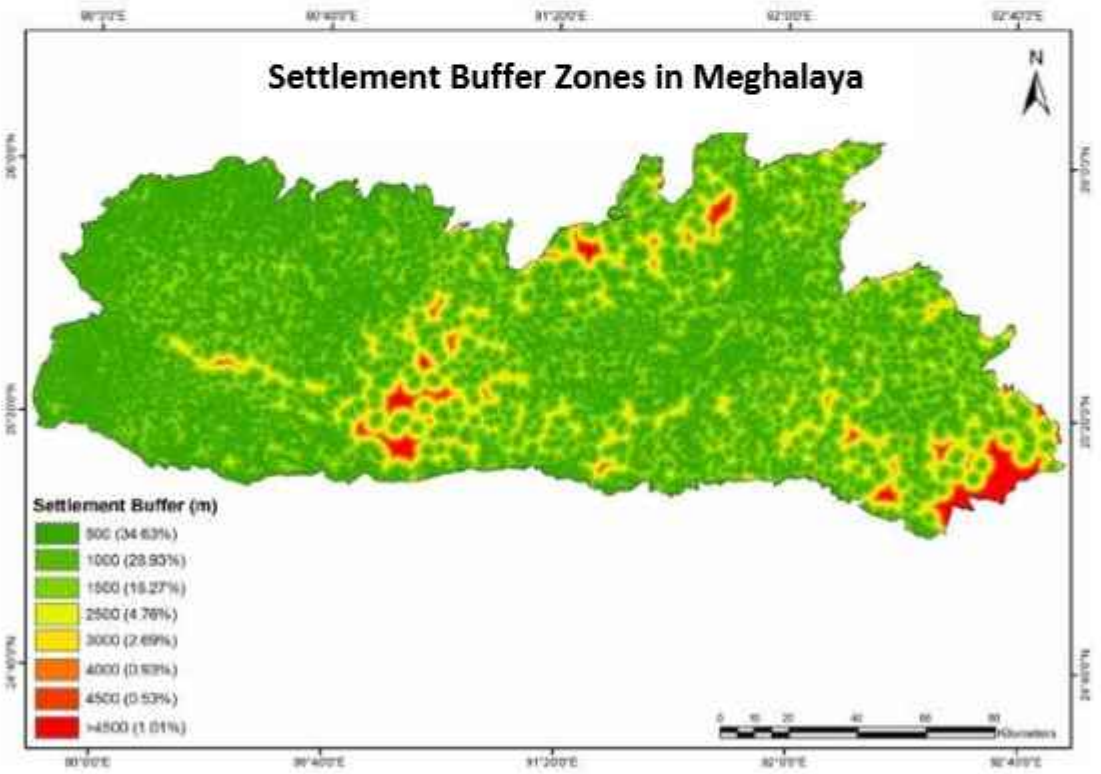


Figure 17. Buffer zones of Settlements in Meghalaya [Source: NESAC, 2019]

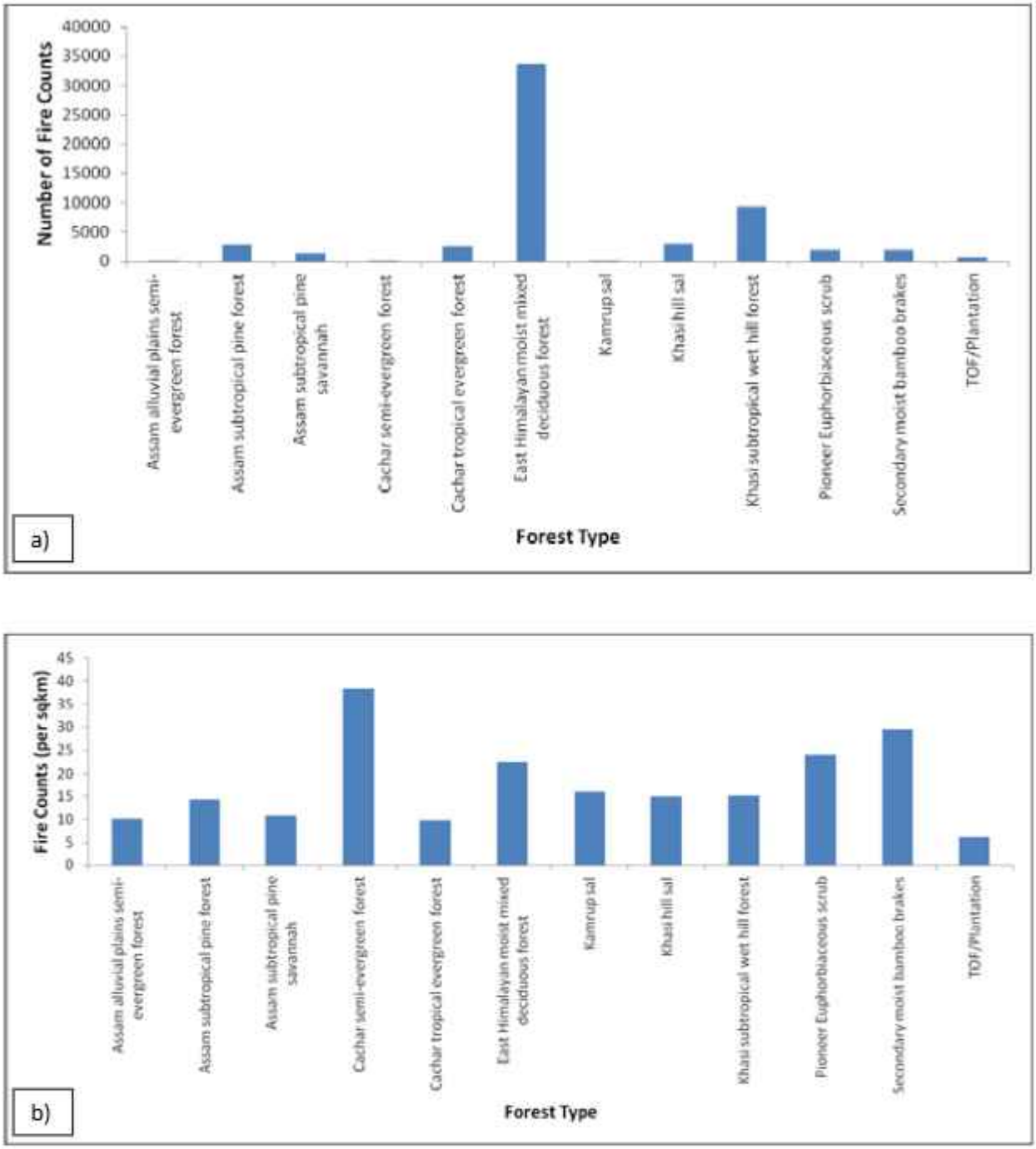


Figure 19. a) Forest Fire Counts in different Forest Types of Meghalaya b) Fire Counts per sqkm in different Forest Types

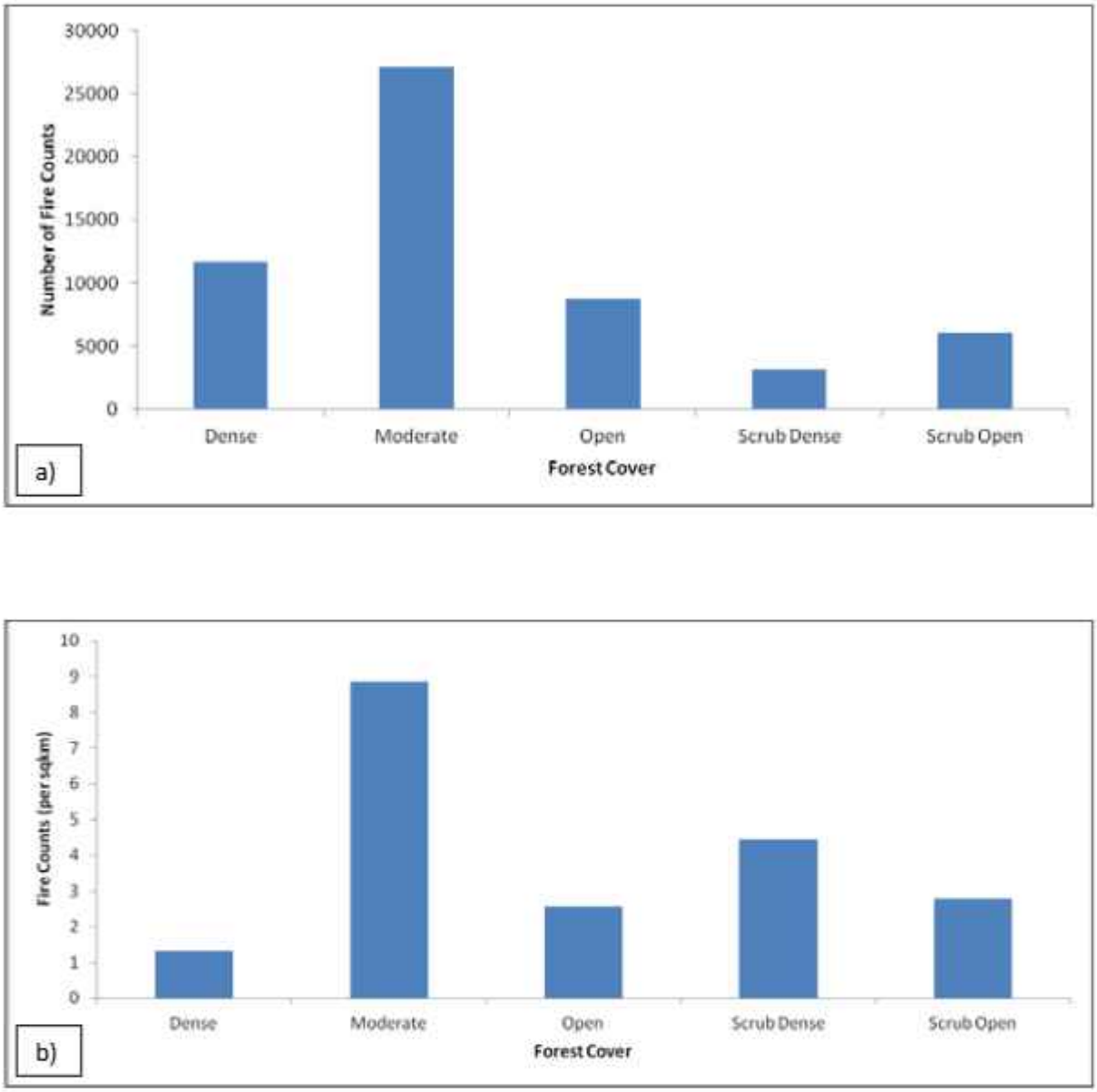


Figure 20. a) Forest Fire Counts in different Forest Density of Meghalaya b) Fire Counts per sqkm in different Forest Density

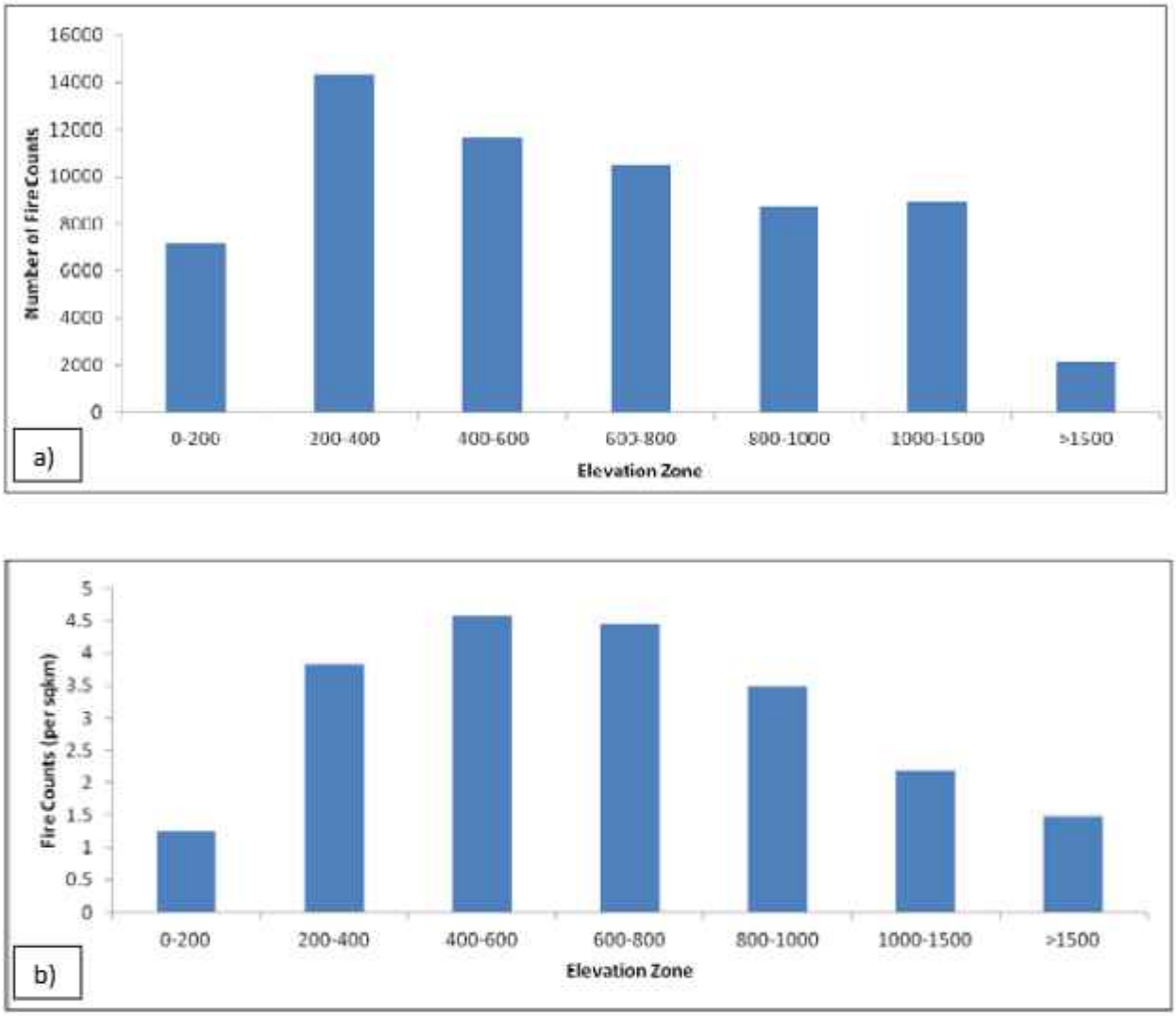
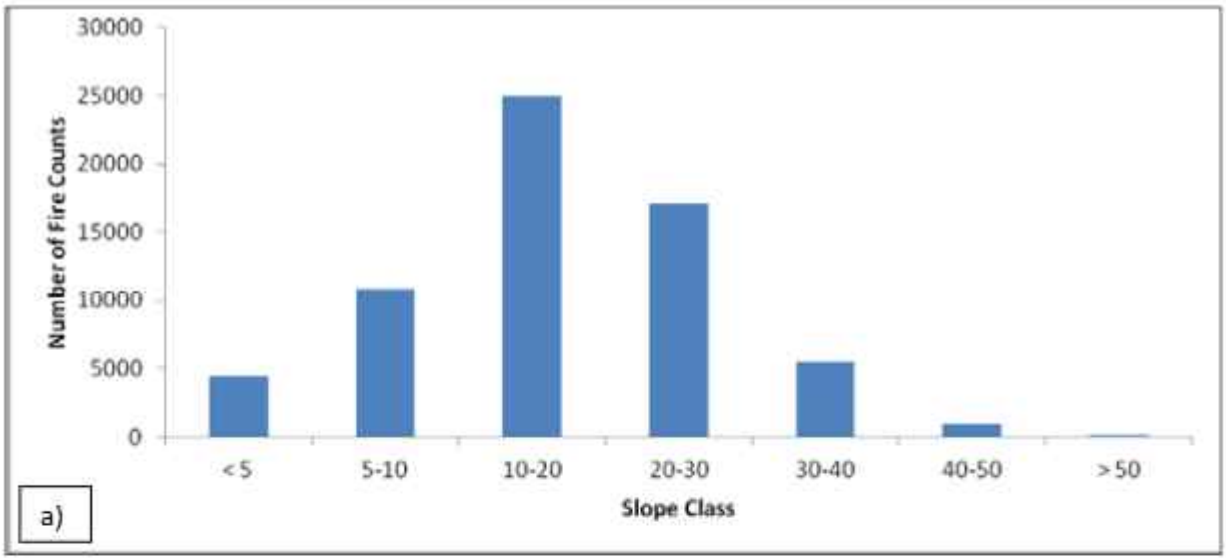


Figure 21. a) Forest Fire Counts in different Elevation Zones (m) of Meghalaya b) Fire Counts per sqkm in different Elevation Zones (m)



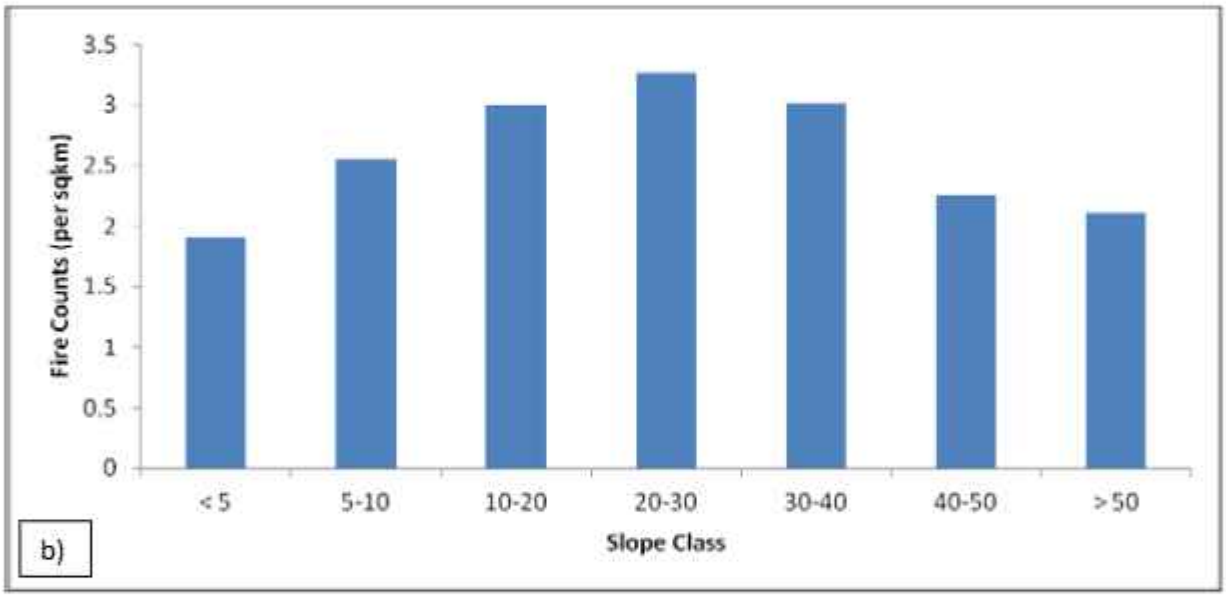


Figure 22. a) Forest Fire Counts in different Slope Class (°) of Meghalaya b) Fire Counts per sqkm in different Slope Class (°)

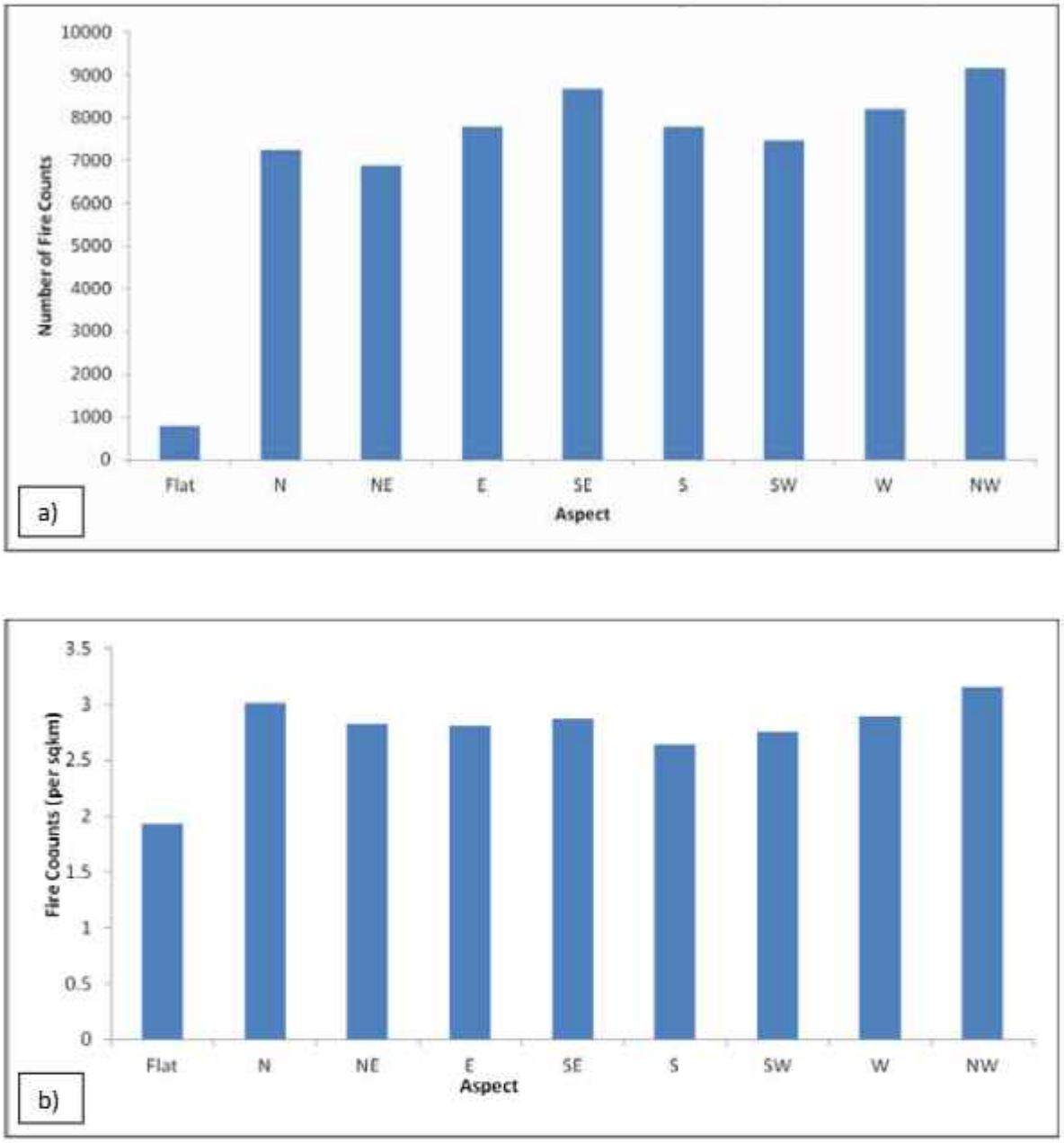


Figure 23. a) Forest Fire Counts in different Aspect Zones of Meghalaya b) Fire Counts per sqkm in different Aspect Zones

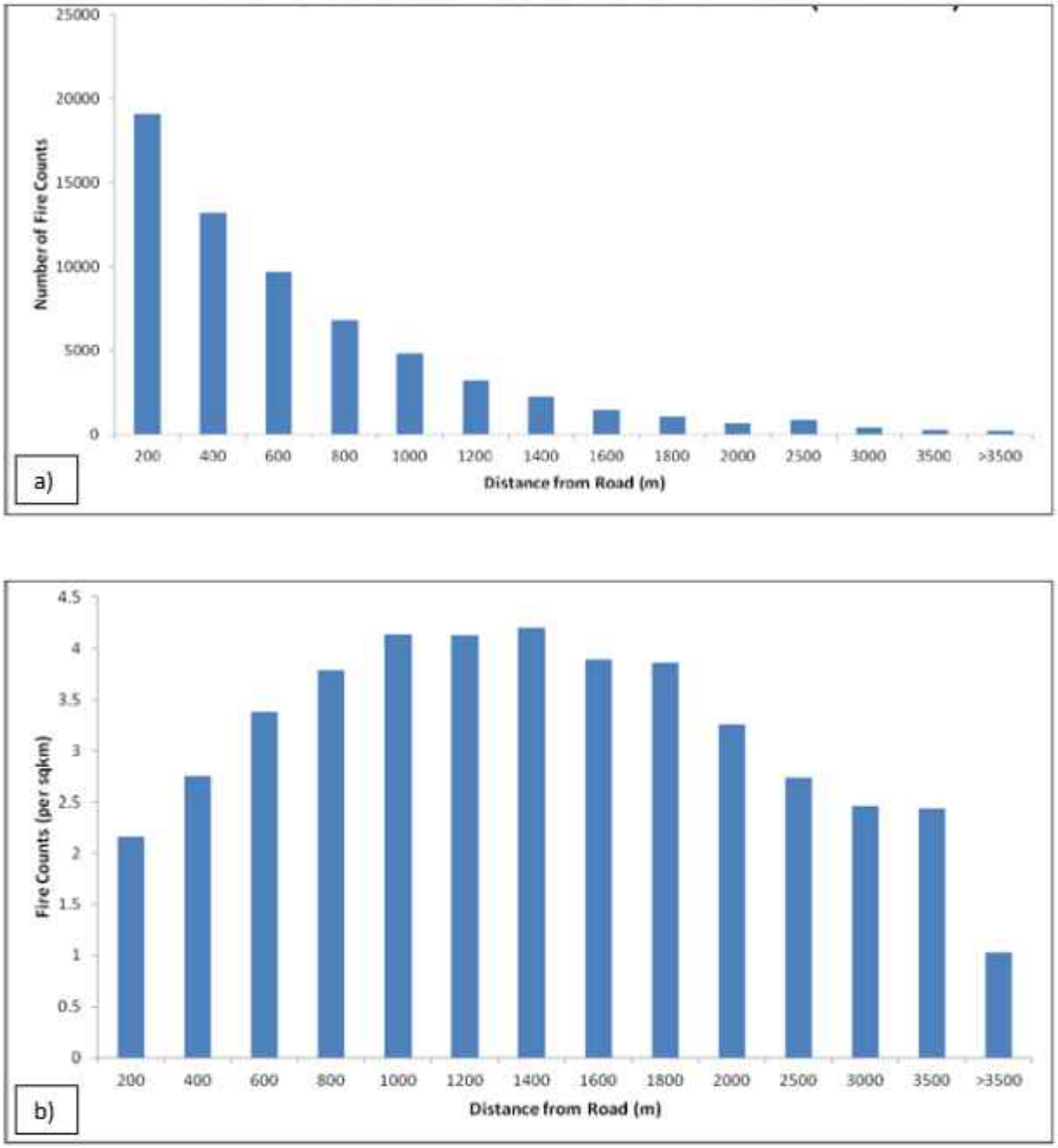
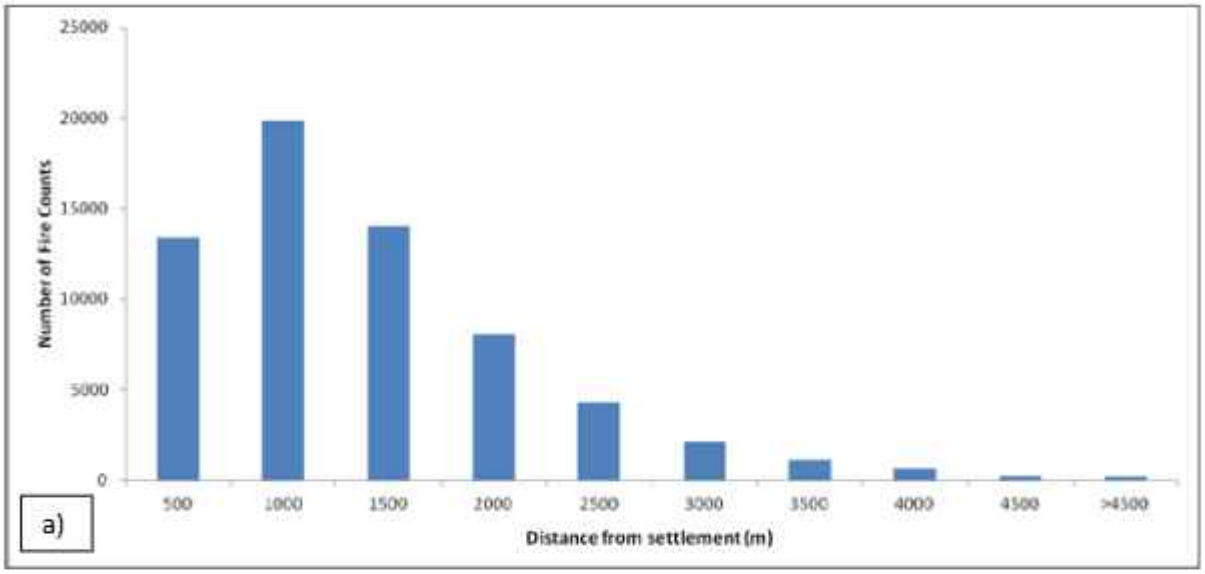


Figure 24. a) Forest Fire Counts at different distance from Road b) Fire Counts per sqkm at different distance from Road



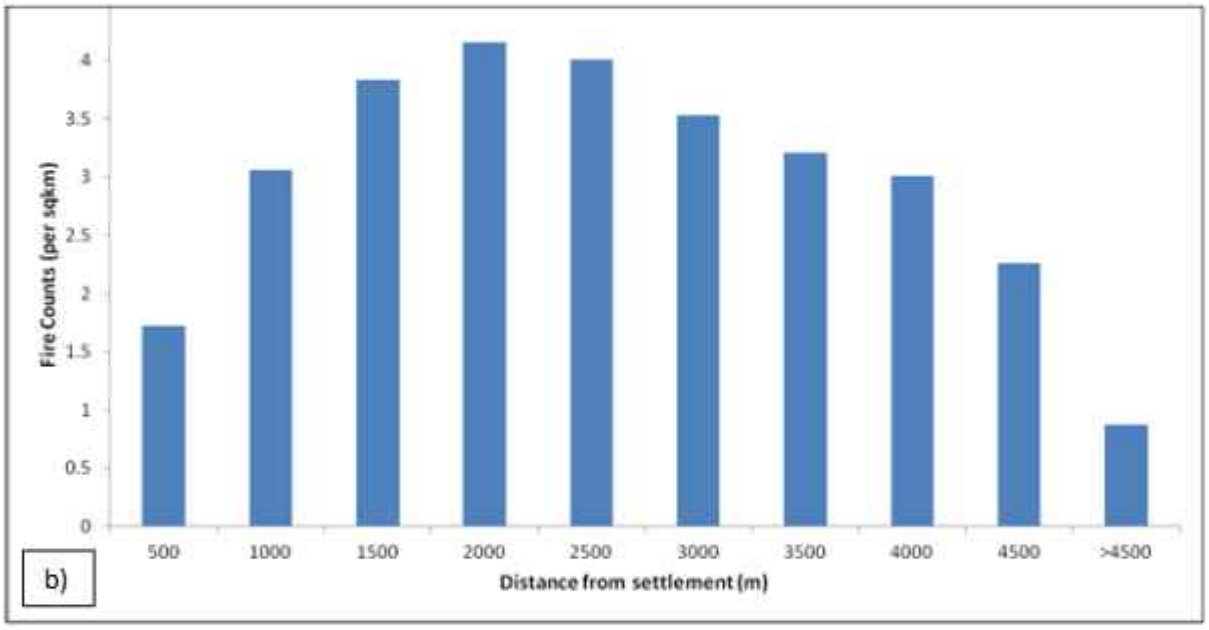


Figure 25. a) Forest Fire Counts at different distance from Settlement b) Fire Counts per sqkm at different distance from Settlement

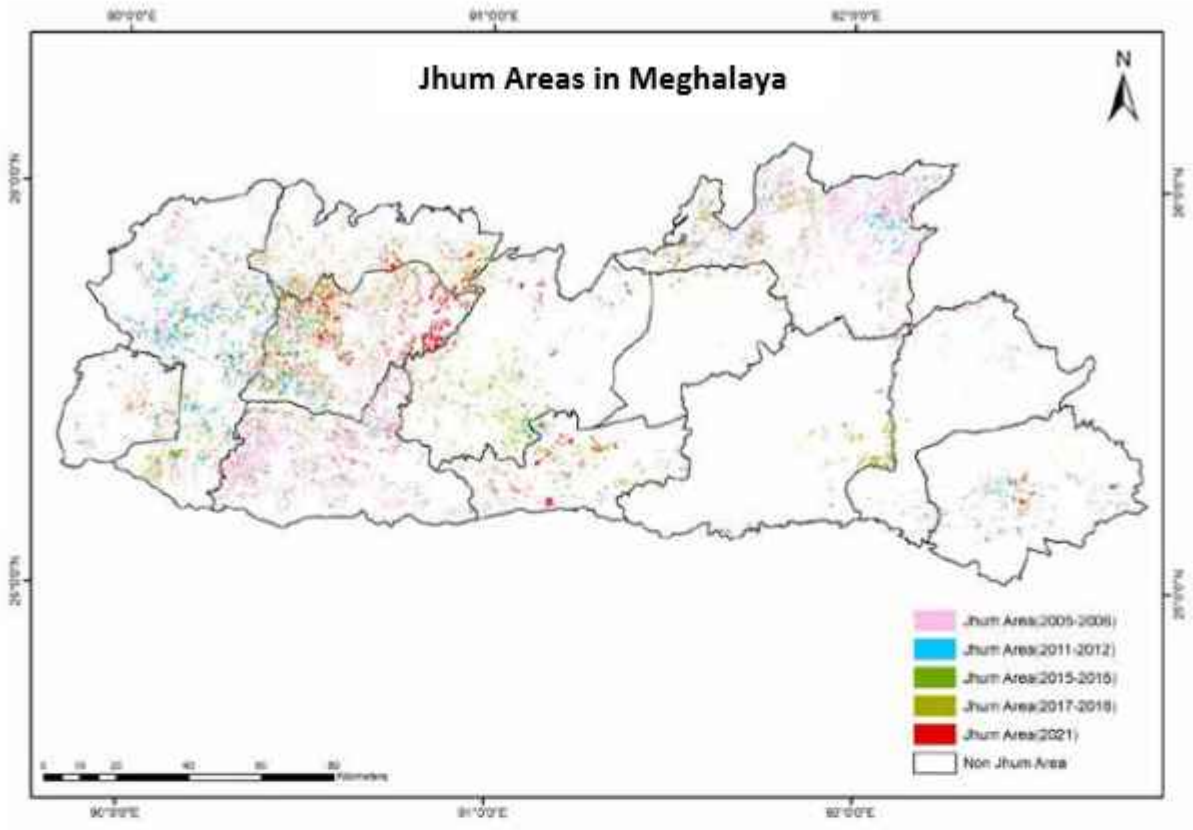


Figure 26. Jhum areas in Meghalaya from year 2005 to 2021 (Source: NESAC)

3.2.3. Generation of forest fire prone areas map

Forest fire prone map indicates the frequency of fire occurrence in an area. The basic requirement for the fire prone map is the number of forest fire points in different years. For generation of forest fire prone map, the frequency of forest fire occurrence has been computed within a grid area of 1km x 1km using forest fire points for the period from 2003 to 2023. The fire prone map has been generated as per the FSI forest cover area. The flow chart of the methodology of fire prone area map generation is presented in Figure 27.

The average annual frequency has been calculated by dividing the total frequency by the number of years and fire prone areas were categorized into severity classes (Kumar et al., 2019) based on average frequency of forest fire in a grid per year.

i) Very High - Average frequency ≥ 0.48
ii) High - Average frequency ≥ 0.24 and < 0.48
iii) Moderate - Average frequency ≥ 0.12 and < 0.24
iv) Low - Average frequency ≥ 0.06 and < 0.12
v) Very Low – Average frequency < 0.06

3.2.4. Generation of burned area map

Forest fire burnt area has been generated using a combination of satellite images like Landsat 8, Sentinel and Resouresat- 2 LISS III. The images were downloaded from USGS. The Landsat and Sentinel data have been extensively used due to their temporal and spatial coverage. The satellite data available in 15 days cycle have been used to generate monthly estimate of burnt areas which has been later used to estimate the annual burnt area maps and statistics. The burnt area mapping has been carried out in Google Earth Engine (GEE) platform by using Normalized Burn Ratio (NBR). NBR typically responds to the substantial decrease in near-infrared reflectance (NIR) due to plant canopy damage (Chuvieco et al., 2006) and a substantial increase in shortwave infrared reflectance (SWIR) due to consumption by fire (White et al., 1996). NBR is calculated as the normalised ratio between NIR and SWIR bands as follows:

$$NBR = (NIR-SWIR) / (NIR+SWIR)$$

Where, NIR is the Near Infrared Band and SWIR is the Short-wave infrared Band

The post-fire NBR image was subtracted from a pre-fire NBR image to get the "differenced NBR" (dNBR) as follows:

$$dNBR = (prefireNBR - postfireNBR) \times 1000$$

Thresholding of dNBR was done to extract forest fire burnt area patches. Different thresholds were applied on the dNBR to remove the noise and determine the actual burnt area in the respective time period of the analysis.

3.2.5. Forest fire dashboard and mobile app

The forest fire dashboard has been developed to provide the easy access of the forest fire data during fire season for preparatory activities for forest fire management. The dashboard contains the various forest fire information generated for the state of Meghalaya like jhum prone area, forest fire vulnerability, fire prone area and historical fire incident points. The dashboard has the capability to automatically update the forest fire incidents. The dashboard has the functionalities to select the year and range of date to analyze the forest fire information in different units like reserve forests, community forests, sacred groves, protected forest etc. provided by Forest department. The boundary of the units is limited to the information received from Meghalaya Forest dept. However, there is facility for the user to generate and

estimate by selection of the polygons already available in the dashboard or by drawing own study area polygon or by uploading the external shapefiles. User interface has interactive window with facility to zoom in/out, pan the study area etc. along with the graphical representation of the estimates at different levels. There is also segregation on fire incidents based on jhom prone area and non jhum area. The jhum prone area was prepared at grid size of 1km×1km using jhum layers available at NESAC for the years 2005-06, 2010, 2015 and 2021. In addition to this, there are several other base maps like road, settlements, villages, links of ISRO Bhuvan, Google map, ESRI Terrain maps etc. have been added for visualization.

The mobile app generated for the state has the provision to collect ground information of the forest fire incidents. The app has been developed to collect various information pertaining to forest fire like type of forest being burned, area of the forest burnt, vegetation type information etc. with the facility to collect and upload the field photographs in the server for validation purpose. The app has also been provided with facility to traverse the boundary of the burning area and generate the area statistics. The app has provision to report the burnt area as jhum fire or non jhum fire, which will be helpful in discriminating the source of forest fire. The user has been provided with facility to collect data in English, Garo, Jaintia and Khasi Languages. As soon as the user submits the ground data, it get uploaded in the server along with coordinate information which can be accessed by Forest dept. officials to regularly monitor the fires which are missed out in the satellite data due to timing of the satellite pass over the specific area. The forest fire app also has the facility to upload the field points in offline mode so that the same gets uploaded once the internet connection is available. Flowchart of the steps involved in collection of information through mobile app is given in Figure 27.

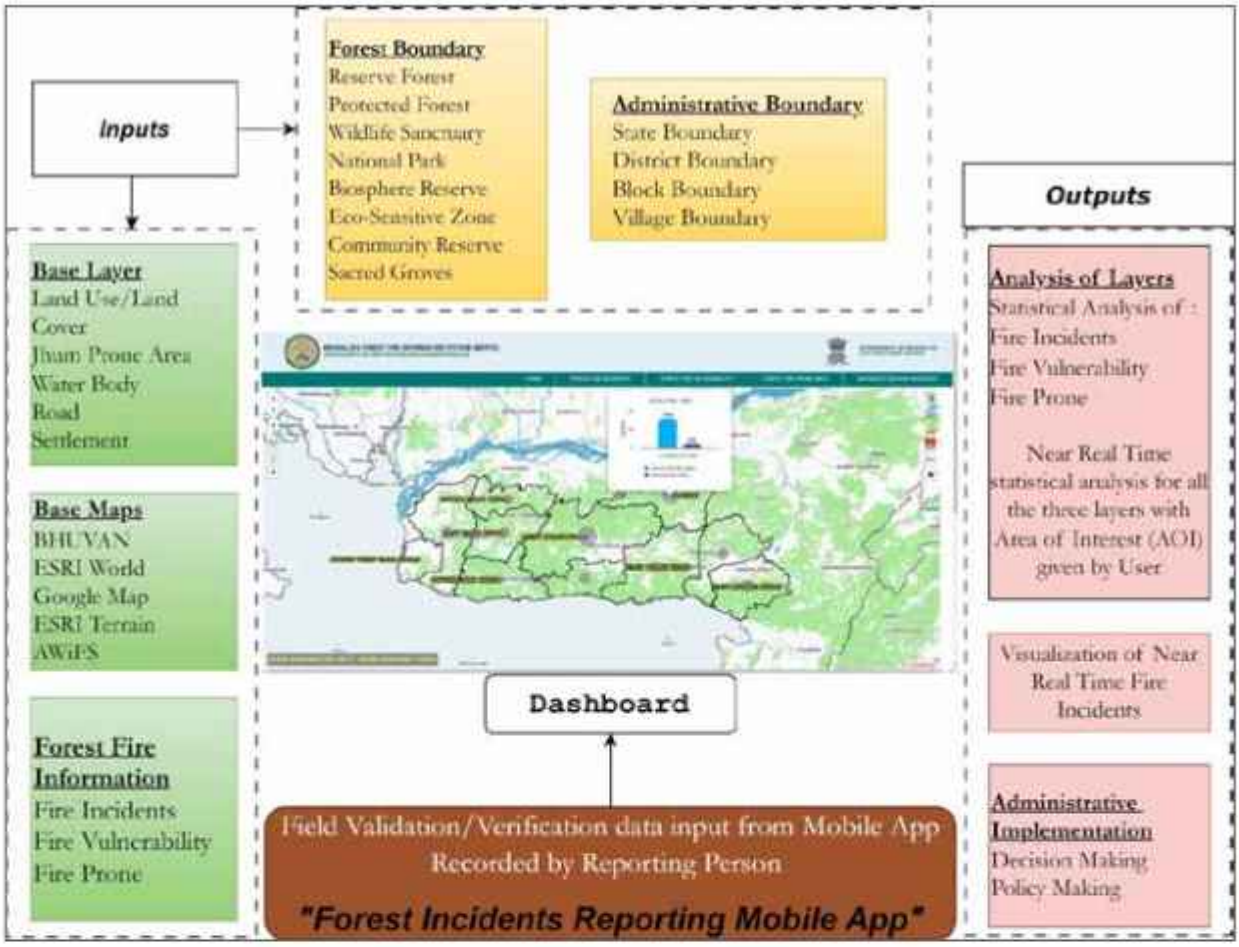


Figure 27. Information content of Dashboard and Mobile App based incidents fed into the dashboard

3.2.6. Field validation of the maps

Detailed field work has been carried out in entire Meghalaya. The field work locations and the photographs are given in Annexure IX.

CHAPTER - 4

4. RESULTS & DISCUSSION

The forest fire incidents have been observed from the year 2003 to 2023 for the entire state, districts and blocks. It may be noted that additional forest fire counts were obtained from SNPP-VIIRS from 2018 onwards. Since SNPP based incidents were available for year 2018 onwards, therefore the analysis has been carried out using MODIS based fire counts for this study.

The forest fire prone and forest fire vulnerability maps have been generated for the entire state, districts and at block level. Similar information has been generated for the various forest administrative units *viz;* reserve forests, protected forests, wildlife sanctuaries, national parks, biosphere reserve, ecosensitive zones, community reserves and sacred groves. The results of the analysis are given below.

4.1. Fire Incidence

4.1.1. State Scenario

The State of Meghalaya has witnessed forest fire in all the years from 2003 to 2023. A total of 77280 numbers of forest fire incidents have been observed. Maximum number of 3151 and minimum number of 1923 fire counts have been observed in the year 2006 and 2019 respectively. Overall fire incidences in the state from 2003 to 2023 from MODIS and SNPP are presented in Figure 28.

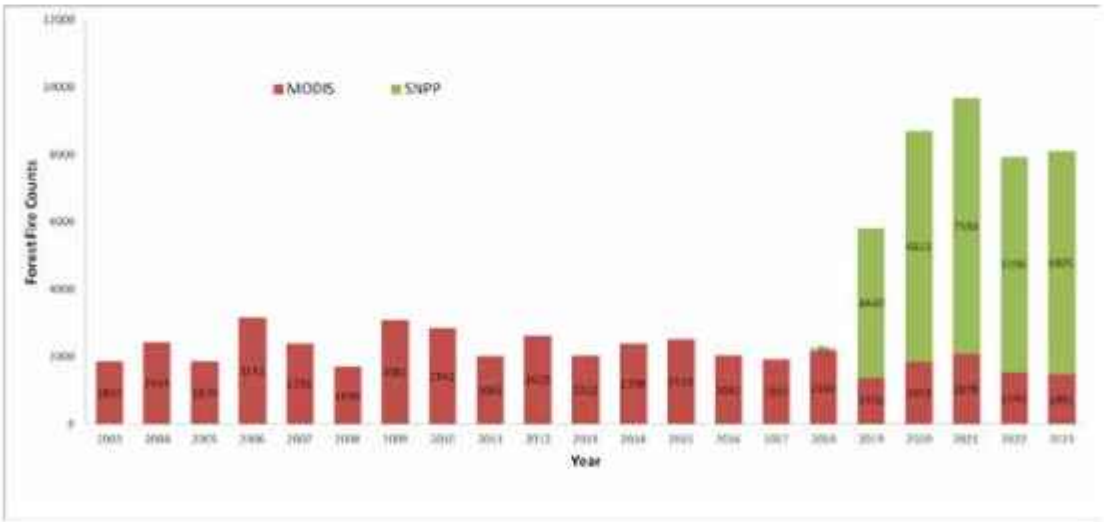


Figure 28. Forest Fire Incidences in Meghalaya (2003-2023)

****SNPP-VIIRS Detection: This includes large, continuous and repeated detections.

4.1.2. District Scenario

All the districts of Meghalaya have witnessed forest fire incidents throughout the years. Amongst the districts RiBhoi district has witnessed maximum number of forest fire incidents per sqkm. followed by West Khasi Hills district and East Garo Hills district. Whereas, South West Garo Hills district has witnessed the minimum number of fire incidents per sqkm. Table 1 and Figure 29 show the detailed information of forest fire count in each district.

Table 1. District Wise Forest Fire Incidences (2003-2023)

Year	Number of Forest Fire Incidences												Total
	East Garo Hills	East Jaintia Hills	East Khasi Hills	Eastern West Khasi Hills	North Garo Hills	Ri Bhoi	South Garo Hills	South West Garo Hills	South West Khasi Hills	West Garo Hills	West Jaintia Hills	West Khasi Hills	
2003	154	148	131	106	82	328	175	37	142	280	75	201	1859
2004	228	170	114	153	198	537	198	33	126	253	88	336	2434
2005	261	157	76	80	170	358	202	31	111	190	49	185	1870
2006	359	259	220	194	199	646	270	45	142	295	110	412	3151
2007	243	222	83	79	187	381	275	58	148	339	61	315	2391
2008	131	142	66	73	116	409	155	30	90	200	41	237	1690
2009	331	251	260	118	244	597	206	26	190	263	125	470	3081
2010	468	172	183	124	326	479	118	7	124	241	111	489	2842
2011	331	186	104	87	107	342	162	25	85	229	119	224	2021
2012	265	182	235	214	173	471	163	12	190	156	125	443	2629
2013	256	194	95	87	134	490	113	17	121	120	99	296	2022
2014	280	217	154	130	163	520	169	10	148	193	113	301	2448
2015	296	258	130	74	167	537	202	12	157	221	96	368	2518
2016	181	205	54	121	161	546	124	11	109	141	82	306	2111
2017	258	115	54	111	124	452	143	5	75	219	110	257	1923
2018*	267	202	111	105	146	480	162	14	132	134	109	373	2235
2019*	656	483	309	248	419	1509	273	22	331	338	395	833	5816
2020*	1050	838	422	517	679	1891	375	39	589	408	332	1505	8680
2021*	761	963	702	533	520	2279	333	20	663	441	607	1849	9706
2022*	1018	892	406	406	623	1619	246	10	284	381	486	1443	7849
2023*	729	928	480	446	456	1859	225	18	699	229	498	1402	8004
Total	8523	7184	4389	4086	5394	16670	4289	482	4656	5271	3831	12445	77280

*Due to the addition of SNPP data with the existing MODIS data, the recorded fire incidents have increased from 2018 onwards.

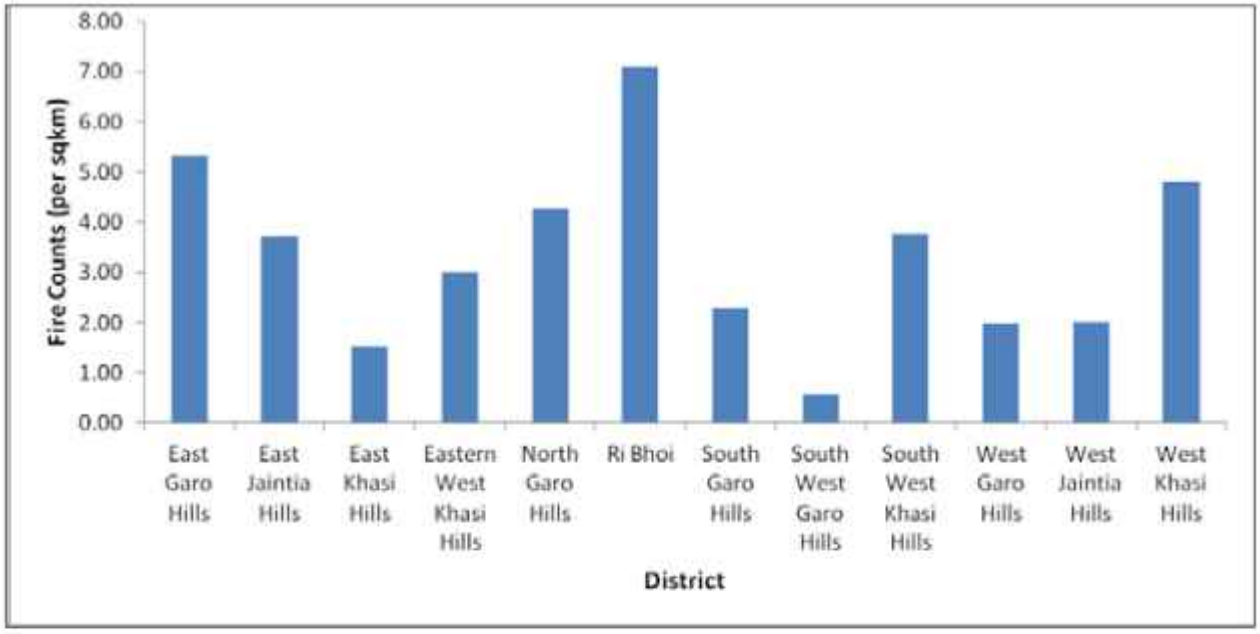


Figure 29. District Wise Forest Fire Counts

4.1.3. Block Scenario

All the blocks of Meghalaya have witnessed forest fire incidents throughout the years. Amongst the blocks Jirang block has witnessed maximum number of forest fire incidents per sqkm. followed by Kharkutta block and Rongjeng block. Whereas, Betasing block has witnessed the minimum number of fire incidents per sqkm. The detailed information of forest fire counts in each block is given on Figure 30.

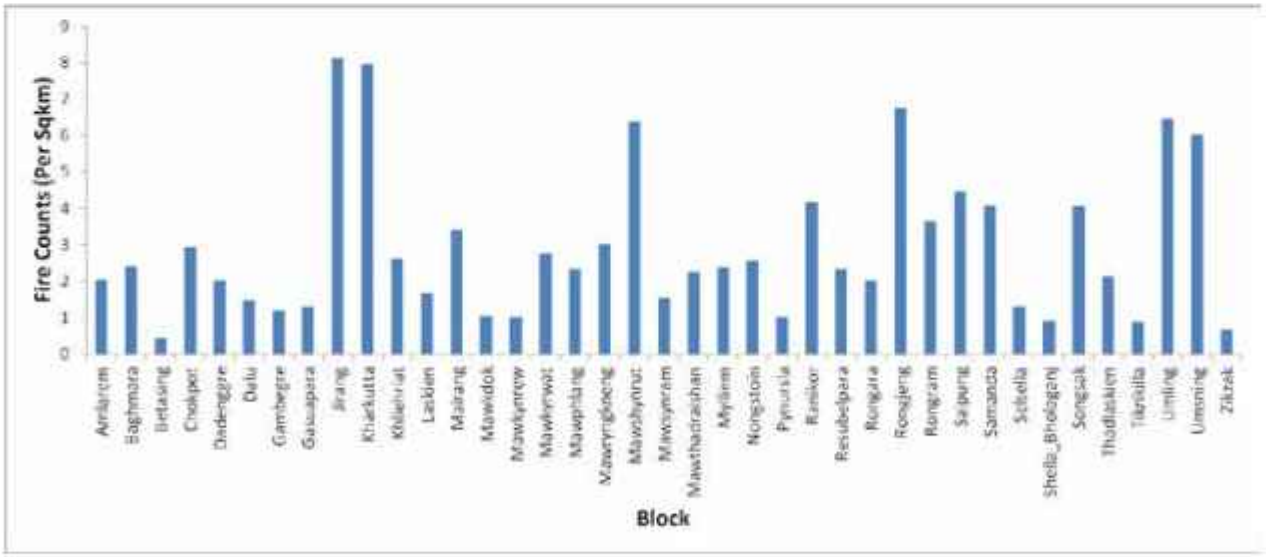


Figure 30. Block Wise Forest Fire Counts

4.2. Forest Fire Vulnerability Analysis (OBJECTIVE – I)

Forest fire vulnerability has been categorized into five classes, viz. Very Low, Low, Moderate, High and Very High as per the FSI scheme of classification.

4.2.1. State Scenario

The forest cover of the entire state has 24.42 % under High and 17.53 % under very high vulnerability category and 22.83% area is under very low vulnerability category. Compared to the state geographical area *approx.* 19% and 14% area falls under high and very high category respectively and *approx.*18% area is under very low vulnerability category. The detail of the area under each category is presented in Table 2 and Figure 31. The spatial distribution map of forest fire vulnerable areas of the entire state is given in Figure 32.

Table 2. Area under Different Forest Fire Vulnerability Category

Fire vulnerability class	Area(km^2)	Area (%) as per forest cover	Area (%) as per geographical area
Very Low	4030.10	22.83	17.96
Low	2332.54	13.21	10.40
Moderate	3880.69	21.98	17.29
High	4311.85	24.42	19.22
Very High	3095.70	17.53	13.80

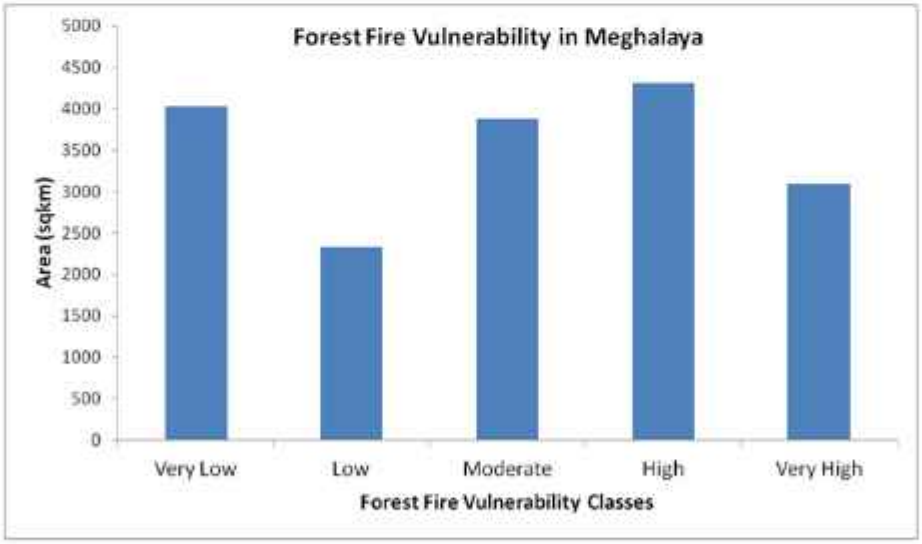


Figure 31. Area under Different Forest Fire Vulnerability Category in Meghalaya

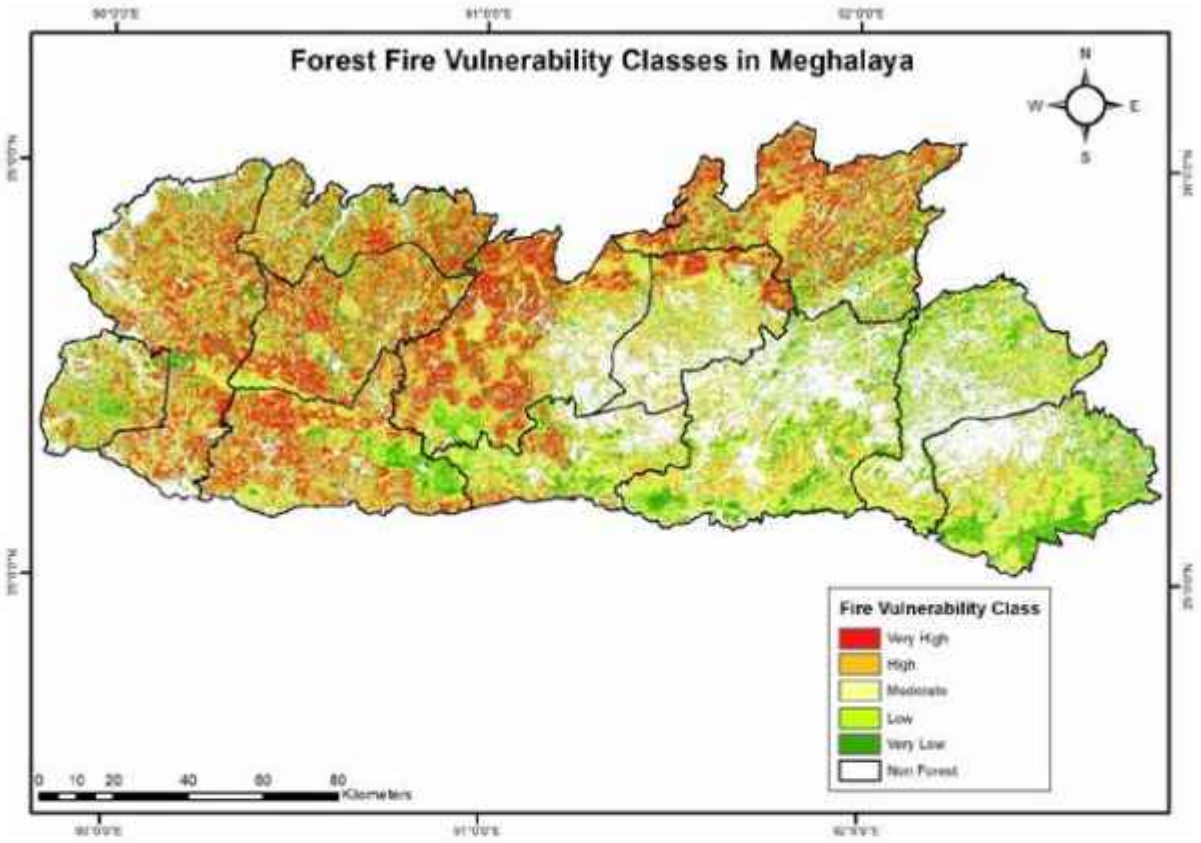


Figure 32. Forest Fire Vulnerability Map of Meghalaya

4.2.2. District Scenario

East Garo Hill district has maximum percentage (28.46%) of its total forest area under very high category of vulnerability, whereas East Jaintia Hills District has minimum percentage (0.66%) of its total forest area under very high category of vulnerability. About 22% geographical area of Ri-Bhoi district falls under very high vulnerability class, whereas about 13% of its geographical area falls under very low vulnerability category. However, in East Jaintia Hill district only 0.5% geographical area falls under very high avulnerability class. About 22% geographical area of the East Jaintia Hills district falls under the very low vulnerability class. District-wise area under different forest fire vulnerability classes is given in Table 3 and Figure 33. As may be seen, West Garo Hills, North Garo Hills, Ri Bhoi, South Garo Hills and West Khasi Hills distyricts have more than 20% of their forest cover as well as geographical area under very high vulnerability class. District wise Forest fire vulnerability maps are given in **Annexure I**.

4.2.3. Block Scenario

Chokpot block has maximum percentage (34.65%) of its total forest area under very high category of vulnerability, whereas Mawphlang block has minimum percentage (0.16%) of

forest area under very high category of vulnerability. About 32% geographical area of Chokpot block falls under very high vulnerability class, whereas about 11% of its geographical area falls under very low vulnerability category. However, in Mawphlang block only 0.07% geographical area falls under very high avulnerability. About 19% geographical area of the Mawphlang block falls under the very low vulnerability category. Block-wise area under different forest fire vulnerability classes is given in in Table 4 and Figure 34. Block-wise Forest fire vulnerability maps are given in **Annexure II.**

Table 3. District Wise Area under Different Forest Fire Vulnerability Category

Districts	Fire Vulnerability									
	Very Low		Low		Moderate		High		Very High	
	Area (km^2)	% of Area	Area (km^2)	% of Area	Area (km^2)	% of Area	Area (km^2)	% of Area	Area (km^2)	% of Area
West Khasi Hills	355.62	16.38	188.45	8.68	405.28	18.67	633.14	29.17	588.28	27.10
West Jaintia Hills	386.09	30.88	309.94	24.79	402.56	32.20	139.4	11.15	12.19	0.98
West Garo Hills	420.97	19.99	131.96	6.27	352.74	16.75	635.69	30.19	564.16	26.79
South West Khasi Hills	211.69	22.40	225.29	23.84	271.45	28.72	163.56	17.31	73.16	7.74
South West Garo Hills	187.18	30.12	62.32	10.03	99.27	15.97	191.78	30.86	81.00	13.03
South Garo Hills	289.93	17.17	188.92	11.19	325.72	19.29	481.59	28.52	402.67	23.84
Ri Bhoi	460.00	21.65	132.42	6.23	402.39	18.94	587.47	27.66	541.99	25.51
North Garo Hills	280.55	25.60	61.25	5.59	154.1	14.06	322.63	29.44	277.54	25.32
Eastern West Khasi Hills	171.74	19.09	84.03	9.34	265.93	29.56	268.44	29.83	109.62	12.18
East Khasi Hills	549.68	29.10	440.08	23.30	599.84	31.75	284.45	15.06	14.98	0.79
East Jaintia Hills	432.51	31.33	428.14	31.01	360.92	26.14	149.87	10.86	9.12	0.66
East Garo Hills	284.13	19.21	79.72	5.39	240.48	16.26	453.83	30.68	420.97	28.46

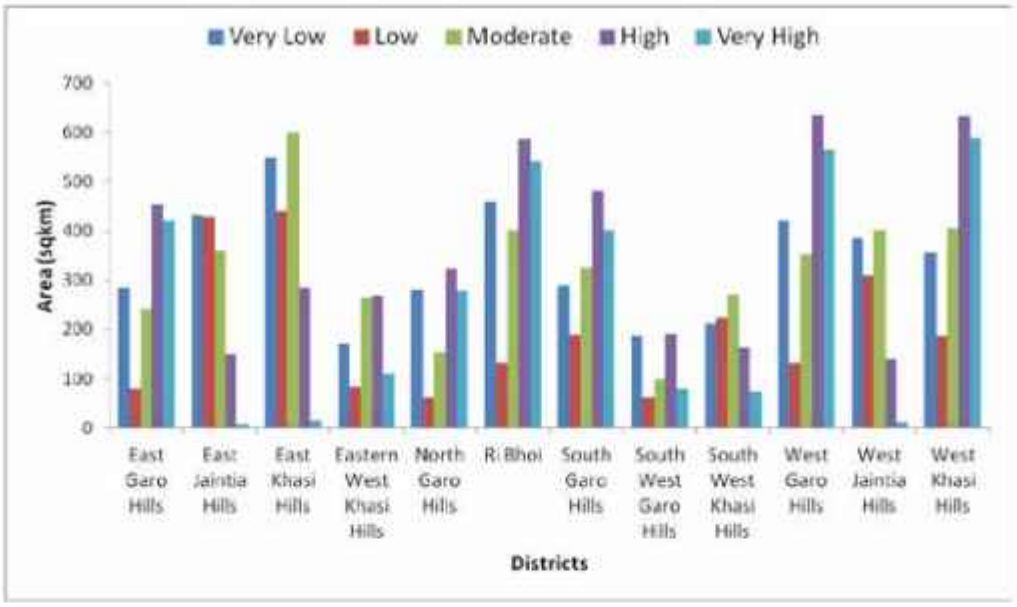


Figure 33. District Wise Area under Different Forest Fire Vulnerability Classes

Table 4. Block Wise Area under Different Forest Fire Vulnerability Category

Block	Fire Vulnerability									
	Very Low		Low		Moderate		High		Very High	
	Area (Km^2)	% of Area	Area (Km^2)	% of Area	Area (Km^2)	% of Area	Area (Km^2)	% of Area	Area (Km^2)	% of Area
Amlarem	65.22	22.37	82.76	28.38	90.69	31.10	49.27	16.90	3.64	1.25
Baghmara	59.05	13.68	38.22	8.85	99.59	23.07	133.12	30.83	101.79	23.58
Betasing	73.44	28.60	23.67	9.22	41.98	16.35	78.41	30.53	39.32	15.31
Chokpot	60.51	12.72	20.31	4.27	75.94	15.97	154.02	32.39	164.77	34.65
Dadenggre	95.44	17.89	41.49	7.78	95.15	17.84	152.26	28.54	149.13	27.95
Dalu	39.25	14.76	11.86	4.46	46.99	17.67	91.90	34.56	75.94	28.56
Gambegre	34.05	13.17	17.39	6.73	51.13	19.78	90.35	34.95	65.62	25.38
Gasuapara	42.52	14.48	26.60	9.06	68.10	23.18	89.97	30.63	66.54	22.65
Jirang	99.87	15.75	43.29	6.83	122.52	19.32	191.50	30.19	177.09	27.92
Kharkutta	96.60	26.90	11.68	3.25	38.30	10.66	94.85	26.41	117.72	32.78
Khliehriat	169.40	28.43	186.57	31.31	157.83	26.49	77.30	12.97	4.74	0.80
Laskien	122.13	27.96	101.33	23.20	156.40	35.80	51.48	11.79	5.48	1.25
Mairang	116.83	18.43	62.54	9.86	178.02	28.08	180.11	28.41	96.49	15.22
Mawkdok	25.28	32.75	18.76	24.31	22.03	28.54	10.51	13.62	0.60	0.78
Mawkynrew	77.92	34.10	52.90	23.15	59.82	26.18	35.93	15.72	1.94	0.85
Mawkyrwat	65.10	25.46	48.02	18.78	85.30	33.36	53.92	21.09	3.36	1.31
Mawphlang	40.48	45.85	19.56	22.15	22.14	25.08	5.97	6.76	0.14	0.16
Mawryngkneng	54.94	37.40	33.24	22.63	44.99	30.63	13.39	9.12	0.34	0.23
Mawshynrut	214.18	15.73	106.56	7.82	197.37	14.49	380.95	27.97	462.77	33.98
Mawsynram	138.14	24.35	140.00	24.67	192.96	34.01	90.91	16.02	5.39	0.95
Mawthadraishan	54.91	20.66	21.50	8.09	87.91	33.08	88.33	33.23	13.13	4.94
Mylliem	34.92	34.54	17.92	17.73	34.30	33.93	13.77	13.62	0.18	0.18

Block	Very Low		Low		Moderate		High		Very High	
	Area (Km^2)	% of Area	Area (Km^2)	% of Area	Area (Km^2)	% of Area	Area (Km^2)	% of Area	Area (Km^2)	% of Area
Nongstoin	141.45	17.48	81.90	10.12	207.92	25.70	252.19	31.17	125.52	15.52
Pynursla	110.18	29.55	91.06	24.42	114.28	30.65	54.62	14.65	2.68	0.72
Ranikor	146.59	21.26	177.28	25.71	186.15	27.00	109.64	15.90	69.80	10.12
Resubelpara	183.96	24.96	49.57	6.73	115.80	15.71	227.78	30.91	159.82	21.69
Rongara	127.85	26.21	103.79	21.28	82.09	16.83	104.48	21.42	69.57	14.26
Rongjeng	98.03	20.39	15.73	3.27	57.64	11.99	172.50	35.88	136.81	28.46
Rongram	108.00	20.57	29.61	5.64	76.19	14.51	151.50	28.86	159.64	30.41
Saipung	263.11	33.53	241.57	30.78	203.09	25.88	72.57	9.25	4.38	0.56
Samanda	95.04	17.62	43.20	8.01	106.81	19.80	150.86	27.97	143.47	26.60
Selsella	64.95	23.26	20.07	7.19	50.13	17.95	84.11	30.12	59.99	21.48
Shella Bholaganj	67.82	22.10	66.65	21.72	109.32	35.63	59.36	19.35	3.69	1.20
Songsak	91.06	19.84	20.80	4.53	76.03	16.56	130.47	28.42	140.69	30.65
Thadlaskien	198.74	38.09	125.85	24.12	155.47	29.80	38.65	7.41	3.07	0.59
Tikrikilla	79.27	32.57	11.54	4.74	33.14	13.62	65.56	26.94	53.84	22.12
Umling	100.95	15.75	27.58	4.30	115.12	17.96	190.16	29.66	207.24	32.33
Umsning	259.18	30.53	61.55	7.25	164.75	19.41	205.81	24.24	157.66	18.57
Zikzak	113.75	31.19	38.64	10.59	57.29	15.71	113.37	31.08	41.68	11.43

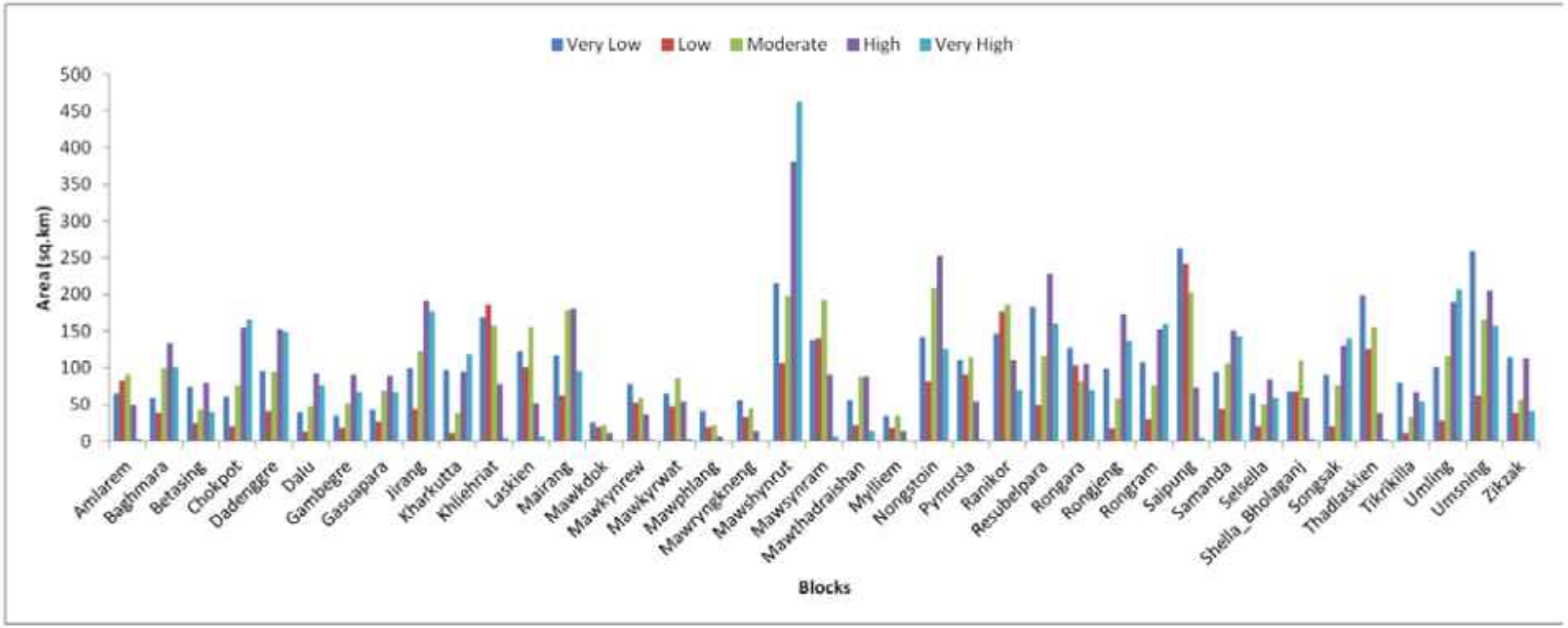


Figure 34. Block Wise Area under Different Forest Fire Vulnerability Classes

4.3. Forest Fire Prone Analysis (OBJECTIVE – I)

For this study Forest fire prone has been categorized into five classes, viz. Very Low, Low, Moderate, High and Very High.

4.3.1. State Scenario

The forest cover of the entire state has 13% under High and 6% under very high prone category and 45% area is under very low fire prone category. Compared to the state geographical area *approx.* 10% and 4% area falls under high and very high fire prone category respectively and *approx.* 35% area is under very low fire prone category. The detail of the area under under each category is presented in Table 5 and Figure 35. The spatial distribution map of forest fire prone areas of the entire state is given in Figure 36.

Table 5. Area under Different Forest Fire Prone Category

Fire Prone Class	Area(km^2)	Area (%) as per forest cover	Area (%) as per geographical area
Very Low	7995.22	45.30	35.63
Low	2373.43	13.45	10.58
Moderate	3944.85	22.35	17.58
High	2284.34	12.94	10.18
Very High	1051.62	5.96	4.69

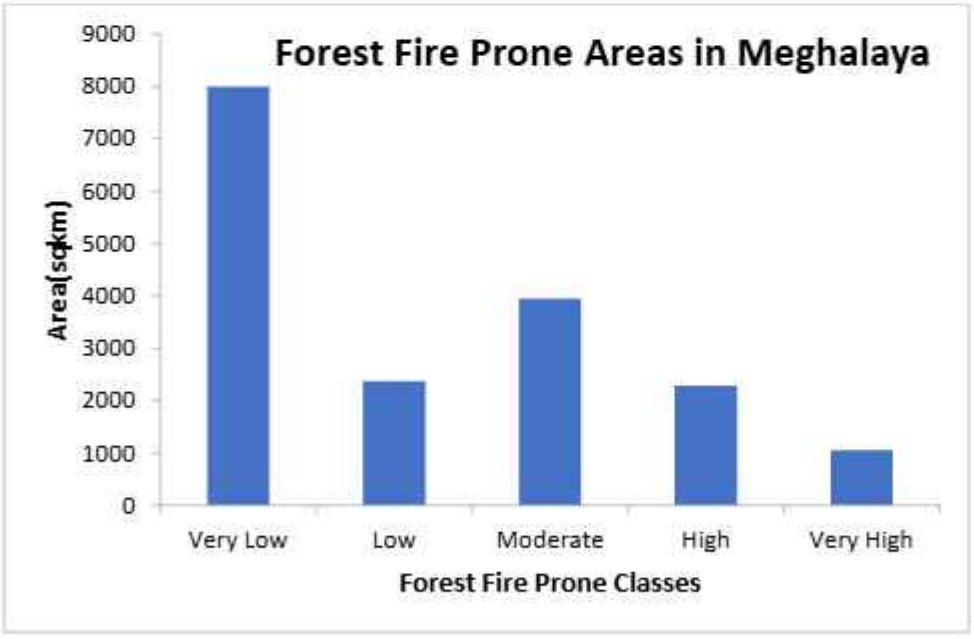


Figure 35. Area of Different Forest Fire Prone Classes in Meghalaya

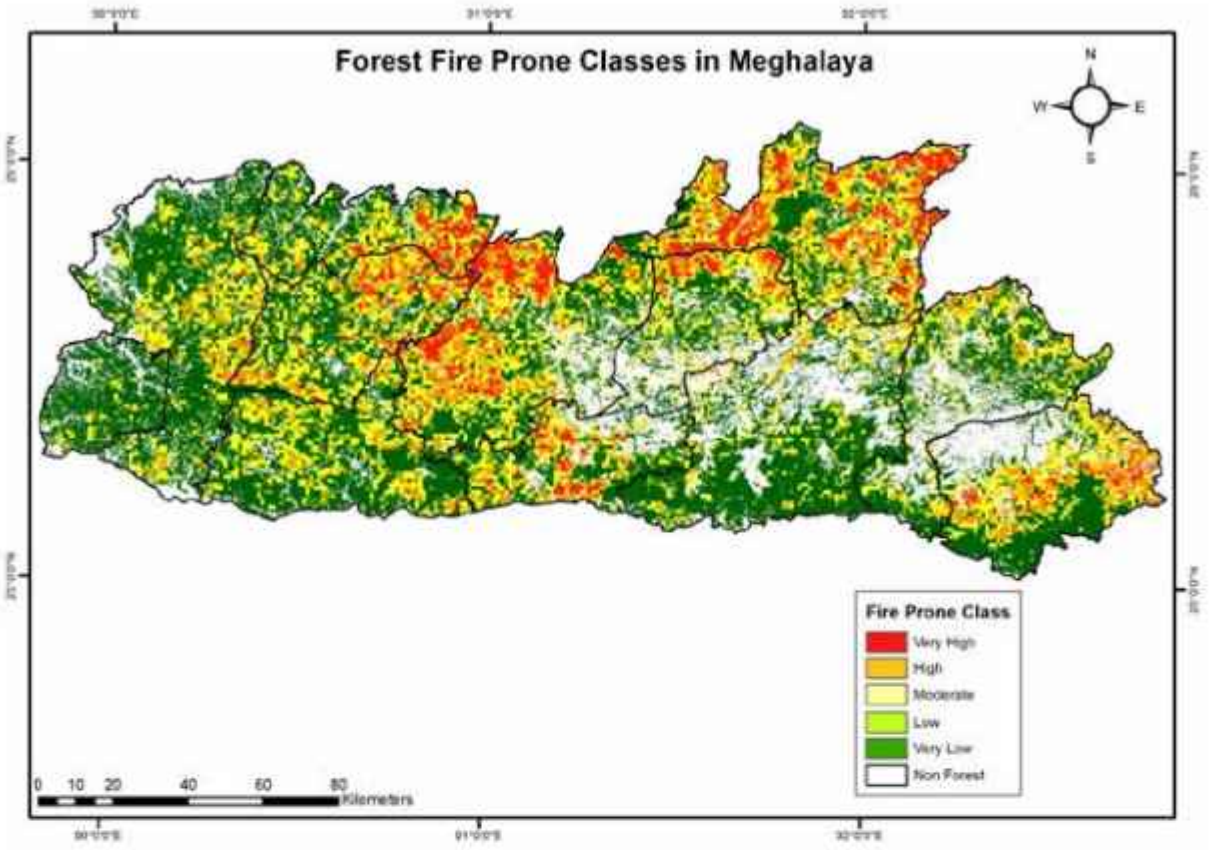


Figure 36. Forest Fire Prone Map of Meghalaya

4.3.2. District Scenario

Ri Bhoi district has maximum percentage (16.47%) of its total forest area under very high category of fire prone, whereas South West Garo Hills is the only district has no area of its total forest cover falls under very high fire prone category. About 15% geographical area of Ri-Bhoi district falls under very high fire prone category, whereas about 21% of its geographical area falls under very low vulnerability category. However, in South West Garo Hills District has *approx.* 64% area falls under very low fire prone category. Area under forest fire prone for each district of Meghalaya is shown in Table 6 and Figure 37. As may be seen, North Garo Hills and West Khasi Hills have more than 10% of forest cover as well as geographical area under very high fire prone category. District wise Forest fire prone maps are given in **Annexure III**.

Table 6. District Wise Area under Different Forest Fire Prone Category

Districts	Fire Prone									
	Very Low		Low		Moderate		High		Very High	
	Area (km^2)	Area (%)	Area (km^2)	Area (%)	Area (km^2)	Area (%)	Area (km^2)	Area (%)	Area (km^2)	Area (%)
East Garo Hills	510	34.48	204.02	13.79	417.07	28.20	251.44	17.00	96.56	6.53
East Jaintia Hills	551.71	39.96	150.44	10.90	318.9	23.10	276.63	20.04	82.82	6.00
East Khasi Hills	1289	68.25	248.03	13.13	255.58	13.53	87.09	4.61	9.06	0.48
Eastern West Khasi Hills	351.03	39.02	133.12	14.80	242.7	26.98	119.33	13.26	53.51	5.95
North Garo Hills	454.66	41.48	127.5	11.63	258.01	23.54	144.62	13.19	111.26	10.15
Ri Bhoi	500.99	23.58	210.64	9.92	540.51	25.45	522.17	24.58	349.89	16.47
South Garo Hills	899.2	53.24	280.63	16.62	399.57	23.66	100.44	5.95	8.96	0.53
South West Garo Hills	526.99	84.80	63.69	10.25	28.79	4.63	1.97	0.32	0	0
South West Khasi Hills	372.68	39.43	131.4	13.90	229.56	24.29	147.93	15.65	63.52	6.72
West Garo Hills	1243.51	59.07	322.6	15.32	404.99	19.24	125.22	5.95	8.96	0.43
West Jaintia Hills	668.75	53.51	210.83	16.87	273.17	21.86	90.57	7.25	6.55	0.52
West Khasi Hills	626.7	28.87	290.53	13.38	576.01	26.54	416.9	19.21	260.53	12.00

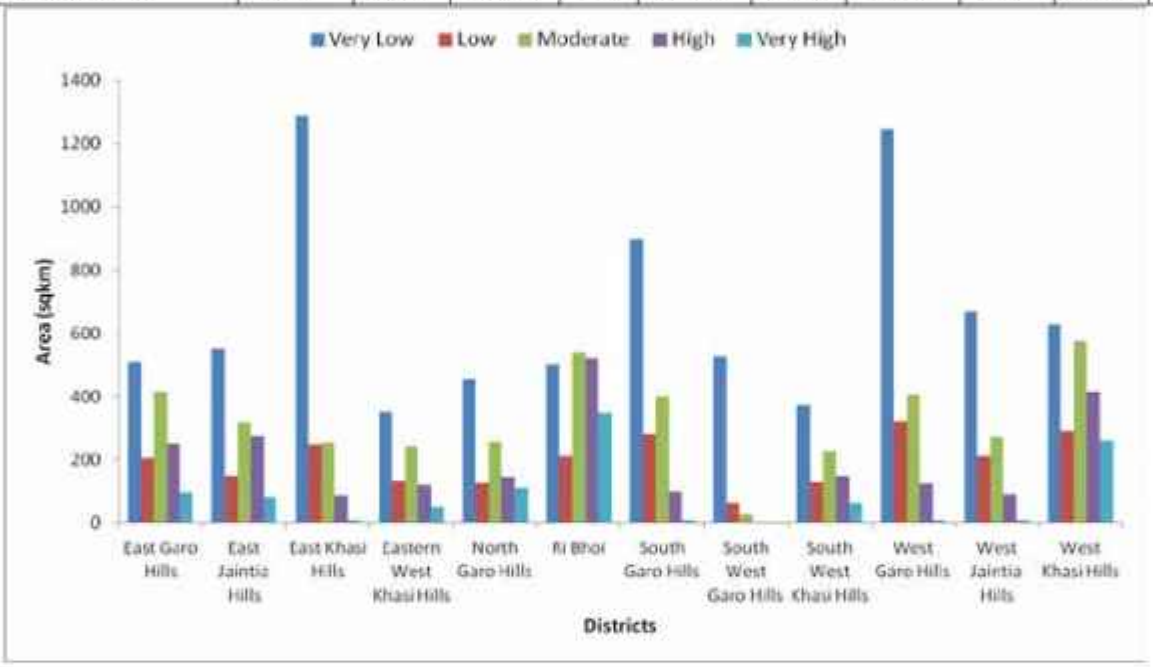


Figure 37. District Wise Area under Different Forest Fire Prone Category

4.3.3. Block Scenario

Kharkutta Block has maximum percentage (28.39 %) of its total forest area under very high category of fire prone, About 25% geographical area of Chokpot block falls under very high fire prone class, whereas about 17% of its geographical area falls under very low category of fire prone. However, 10 blocks of the state have no area of forest cover as well as geographical under very high category of fire prone. Block wise area under different forest fire prone category is given in Table 7 and Figure 38. Block-wise forest fire prone maps are given in **Annexure IV.**

Table 7. Block Wise Areas of Different Forest Fire Prone Categories

Block	Fire Prone									
	Very Low		Low		Moderate		High		Very High	
	Area (km^2)	Area (%)	Area (km^2)	Area (%)	Area (km^2)	Area (%)	Area (km^2)	Area (%)	Area (km^2)	Area (%)
Amlarem	178.20	61.13	39.64	13.60	58.10	19.93	15.56	5.34	0.02	0.01
Baghmara	220.87	51.16	78.92	18.28	103.65	24.01	25.33	5.87	3.00	0.69
Betasing	230.06	89.59	19.95	7.77	6.77	2.64	0.00	0.00	0.00	0.00
Chokpot	189.13	39.77	97.21	20.44	150.75	31.70	34.50	7.26	3.97	0.83
Dadenggre	328.41	61.56	84.71	15.88	94.61	17.74	22.30	4.18	3.44	0.64
Dalu	164.39	61.83	43.87	16.50	44.04	16.56	13.59	5.11	0.00	0.00
Gambegre	197.23	76.28	33.30	12.88	24.36	9.42	3.68	1.42	0.00	0.00
Gasuapara	207.15	70.53	38.57	13.13	44.78	15.25	3.21	1.09	0.00	0.00
Jirang	117.30	18.49	49.14	7.75	144.29	22.75	184.12	29.03	139.39	21.98
Kharkutta	70.88	19.73	25.07	6.98	73.11	20.35	88.15	24.54	101.98	28.39
Khliehriat	293.23	49.22	62.37	10.47	126.91	21.30	88.67	14.88	24.60	4.13
Laskien	244.07	55.89	79.19	18.13	84.98	19.46	26.72	6.12	1.74	0.40
Mairang	228.08	35.98	88.33	13.93	176.12	27.78	95.35	15.04	46.09	7.27
Mawkdok	49.76	64.49	10.96	14.21	13.61	17.63	2.35	3.05	0.48	0.62
Mawkynrew	173.47	75.92	27.27	11.94	22.85	10.00	4.89	2.14	0.00	0.00
Mawkyrwat	111.62	43.66	42.28	16.54	59.06	23.10	35.74	13.98	6.94	2.71
Mawphlang	31.73	35.94	15.83	17.93	20.79	23.55	17.88	20.25	2.05	2.32
Mawryngkne	44.38	30.22	27.77	18.91	48.93	33.32	24.97	17.00	0.80	0.54
Mawshynrut	268.55	19.72	146.57	10.76	360.90	26.50	343.90	25.25	241.89	17.76
Mawsynram	393.89	69.43	77.77	13.71	77.76	13.71	15.95	2.81	1.95	0.34
Mawthadraishan	122.95	46.27	44.79	16.86	66.58	25.06	23.98	9.03	7.42	2.79
Mylliem	43.62	43.17	14.41	14.26	24.21	23.96	15.02	14.87	3.78	3.74
Nongstoin	358.15	44.28	143.96	17.80	215.11	26.59	73.00	9.02	18.64	2.30
Pynursla	294.67	79.03	44.49	11.93	29.91	8.02	3.77	1.01	0.00	0.00
Ranikor	261.07	37.87	89.12	12.93	170.50	24.73	112.19	16.27	56.58	8.21
Resubelpar	383.78	52.08	102.43	13.90	184.90	25.09	56.48	7.66	9.28	1.26
Rongara	282.05	57.82	65.93	13.52	100.39	20.58	37.40	7.67	1.99	0.41
Rongjeng	91.48	19.03	53.39	11.11	127.36	26.49	139.25	28.97	69.22	14.40
Rongram	185.33	35.31	97.11	18.50	165.23	31.48	71.74	13.67	5.52	1.05
Saipung	258.47	32.94	88.07	11.22	191.99	24.47	187.96	23.95	58.22	7.42
Samanda	205.65	38.13	78.40	14.53	178.86	33.16	61.45	11.39	15.03	2.79
Selsella	185.59	66.49	34.02	12.19	51.05	18.29	8.47	3.03	0.00	0.00
Shella_bho	257.49	83.93	29.53	9.62	17.52	5.71	2.26	0.74	0.00	0.00
Songsak	212.88	46.38	72.24	15.74	110.85	24.15	50.75	11.06	12.31	2.68
Thadlaskie	246.48	47.25	92.01	17.64	130.09	24.94	48.29	9.26	4.79	0.92
Tikrikilla	182.56	75.03	29.59	12.16	25.71	10.57	5.45	2.24	0.00	0.00
Umling	191.45	29.87	63.38	9.89	163.69	25.54	136.97	21.37	85.48	13.34
Umsning	192.24	22.64	98.12	11.56	232.52	27.39	201.08	23.69	125.02	14.73
Zikzak	296.93	81.43	43.75	12.00	22.02	6.04	1.97	0.54	0.00	0.00

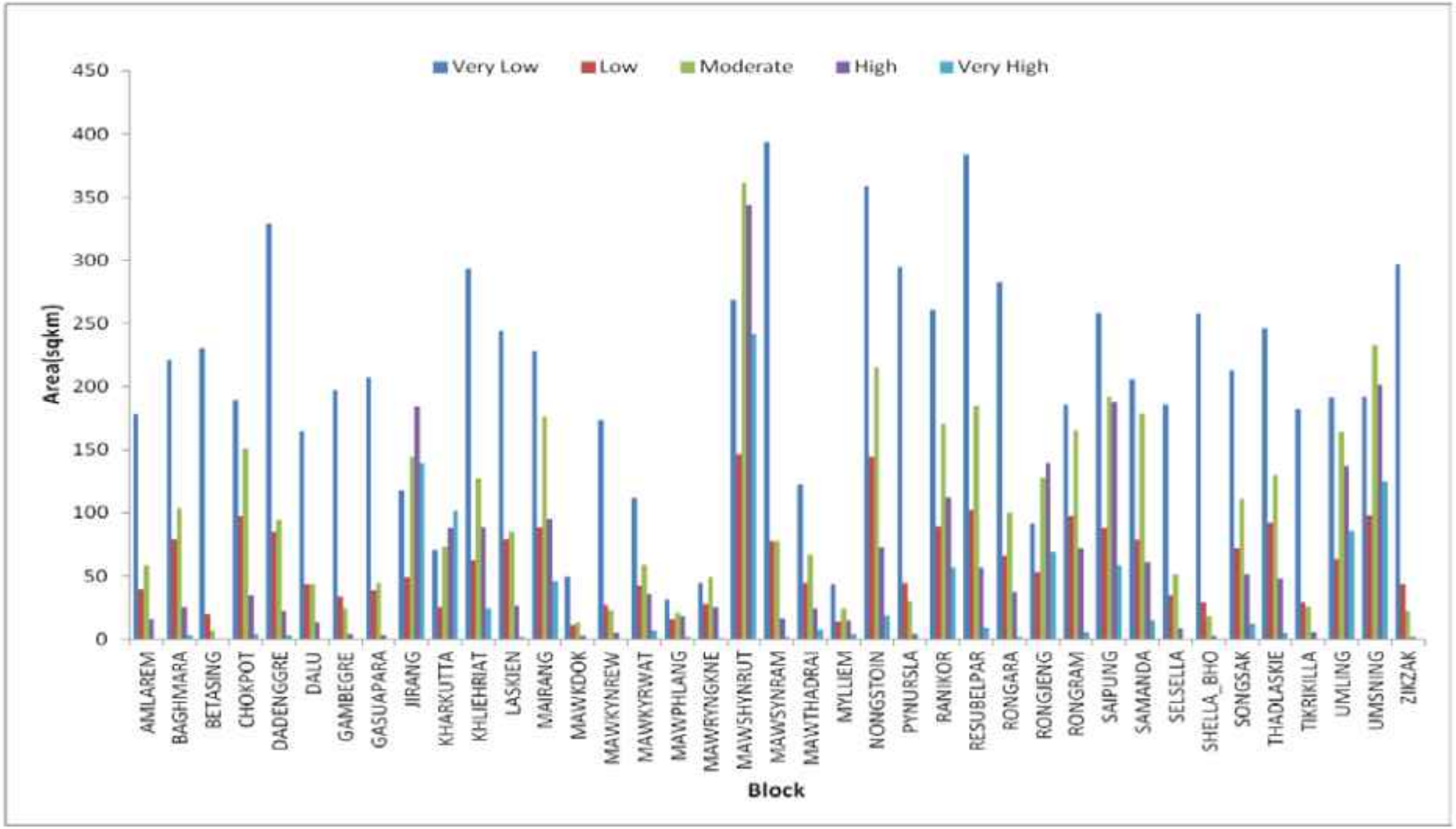


Figure 38. Block Wise Area of Different Forest Fire Prone Classes in Meghalaya

4.4. Forest Fire Vulnerability Analysis for different Forest Units (OBJECTIVE - II)

4.4.1. Government Owned Forest

Government owned reserve forest of the state comprise of Reserve Forest (RF) and Protected Forest (PF). Forest fire vulnerability analysis of all the reserve forest shows, Nongkhyllem RF has maximum area (13.56 km^2) under very high vulnerability class. However, Umsaw RF has the highest percent of (99.77%) of its total geographical under high and very high forest fire vulnerability class. About 90% of geographical area falls under high and very high vulnerability class for Umsaw RF, Dambu RF, Darugiri RF and Songsak RF. Saipung RF has lowest area (6.95 %) under high and very high vulnerability class. Umkhuti PF and Green Block PF have the highest area under high and very high vulnerability class i.e. 68.85% and 65.60% respectively. The spatial map of forest fire vulnerability for government owned forests is given in Figure 39. The area of different forest fire vulnerability classes for RFs and PFs are given in Table 8 and Figure 40. Forest fire vulnerability maps of all Reserve Forests, Protected Forests, Wildlife Sanctuaries, National Parks and Biosphere Reserve with a buffer of 500 m are given in **Annexure V.**

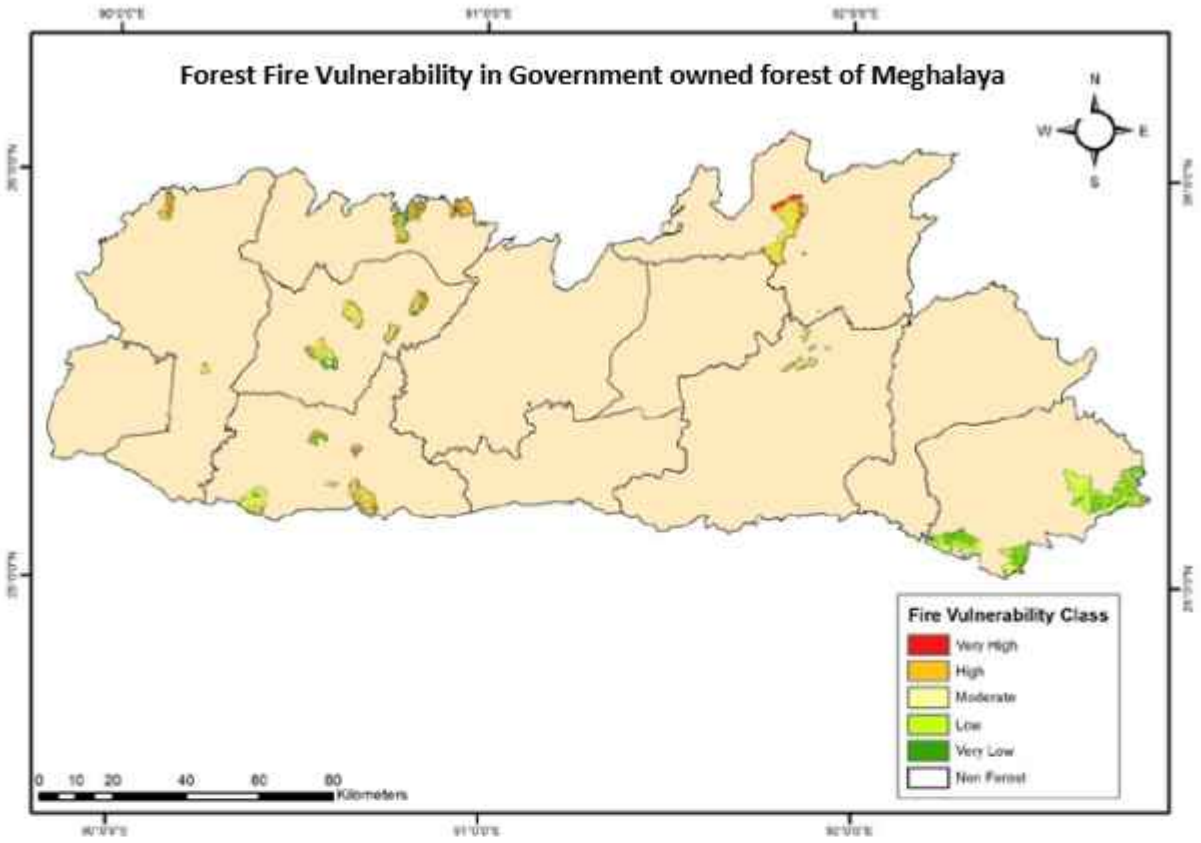


Figure 39. Forest Fire Vulnerability of government owned forest

Table 8. Forest Fire Vulnerability categories in government owned forests with a buffer zone of 500 m *(Area in Km²)*

Sl. No.	Reserve Forest	Very Low	Low	Moderate	High	Very High
1	Angratoli RF	2.570	5.554	10.633	11.073	3.219
	Angratoli RF Buffer	0.457	1.628	2.264	1.848	0.603
2	Baghmara RF	0.094	2.296	10.710	16.183	6.443
	Baghmara RF Buffer	0.134	1.223	2.840	3.279	1.712
3	Chimabangshi RF	0.272	1.381	4.387	6.437	3.942
	Chimabangshi RF Buffer	0.115	0.518	1.435	2.249	1.550
4	Dambu RF	0.004	0.162	1.242	5.345	8.003
	Dambu RF Buffer	0.080	0.456	1.352	2.536	2.895
5	Darugiri RF	0	0.056	0.375	3.242	5.731
	Darugiri RF Buffer	0.005	0.373	1.353	1.798	2.124
6	Dhima RF	0.120	1.137	3.152	5.401	4.239
	Dhima RF Buffer	0.052	0.213	1.063	2.310	1.868
7	Dibru Hill RF	0.864	2.687	4.738	4.193	1.340
	Dibru Hill RF Buffer	0.168	1.208	1.695	1.294	0.530

Sl. No.	Reserve Forest	Very Low	Low	Moderate	High	Very High
8	Dilma RF	0.009	0.144	0.830	1.363	0.554
	Dilma RF Buffer	0.017	0.260	0.834	0.939	0.331
9	Gittingiri RF	0.002	0.037	0.684	1.225	0.426
	Gittingiri RF Buffer	0.038	0.271	1.087	1.761	0.723
10	Ildek RF	0.003	0.067	0.358	0.782	0.744
	Ildek RF Buffer	0.008	0.068	0.382	0.632	0.490
11	Imangere RF	3.726	2.839	2.061	0.836	0.159
	Imangere RF Buffer	2.265	2.684	2.054	1.090	0.274
12	Narpuh RF Blk I	5.039	15.418	20.580	10.936	1.627
	Narpuh RF Blk I Buffer	2.861	4.887	5.629	3.830	1.065
13	Narpuh RF Blk II	2.574	10.455	13.199	6.617	1.484
	Narpuh RF Blk II Buffer	0.882	2.966	4.081	2.636	0.523
14	Nongkhyllem RF	0.241	9.713	30.591	33.656	13.568
	Nongkhyllem RF Buffer	0.239	3.328	7.418	9.478	7.388
15	Nongumiang RF	0.001	0.040	0.124	0.148	0.001
	Nongumiang RF Buffer	0.270	0.553	0.700	0.473	0.033
16	Rajasimla RF	0.104	0.966	3.394	6.675	5.839
	Rajasimla RF Buffer	0.025	0.184	0.564	1.036	0.741
17	Revak RF	0.001	0.099	1.063	2.086	1.516
	Revak RF Buffer	0.092	0.368	0.965	1.678	1.538
18	Riat Khwan RF	0.008	0.242	1.373	1.589	0.306
	Riat Khwan RF Buffer	0.374	0.634	1.164	1.200	0.249
19	Riat Laban RF	0.034	0.153	1.177	1.150	0.414
	Riat Laban RF Buffer	0.263	0.532	0.709	0.655	0.163
20	Rongrengre RF	0.014	1.337	4.202	9.445	10.523
	Rongrengre RF Buffer	0.007	0.384	1.847	3.105	3.544
21	Saipung RF	43.876	57.160	33.785	8.846	1.234
	Saipung RF Buffer	12.795	12.470	5.213	0.926	0.076
22	Shyrwat RF	0	0.015	0.106	0.184	0.069
	Shyrwat RF Buffer	0.025	0.086	0.451	0.448	0.138

Sl. No.	Reserve Forest	Very Low	Low	Moderate	High	Very High
23	Songsak RF	0.015	0.201	1.738	8.556	11.149
	Songsak RF Buffer	0.033	0.816	2.401	3.448	2.609
24	Tura-Hill RF	0.021	0.994	1.922	1.381	0.275
	Tura-Hill RF Buffer	0.057	1.112	1.621	1.372	1.029
25	Umsaw RF	0	0	0.001	0.178	0.224
	Umsaw RF Buffer	0.002	0.146	0.406	0.627	0.536
26	Green Block PF	0	0.002	0.055	0.087	0.020
	Green Block PF Buffer	0.009	0.033	0.312	0.409	0.092
27	Laitkor PF	0.020	0.071	0.928	1.141	0.249
	Laitkor PF Buffer	0.140	0.241	0.420	0.499	0.133
28	Short Round PF	0.001	0.004	0.224	0.339	0.083
	Short Round PF Buffer	0.012	0.023	0.054	0.065	0.017
29	Umkhuti PF	0.007	0.007	0.022	0.052	0.028
	Umkhuti PF Buffer	0.016	0.067	0.254	0.467	0.209
30	Upper-Shillong PF	0.031	0.208	1.347	1.651	0.460
	Upper-Shillong PF Buffer	0.163	0.499	1.697	1.435	0.428

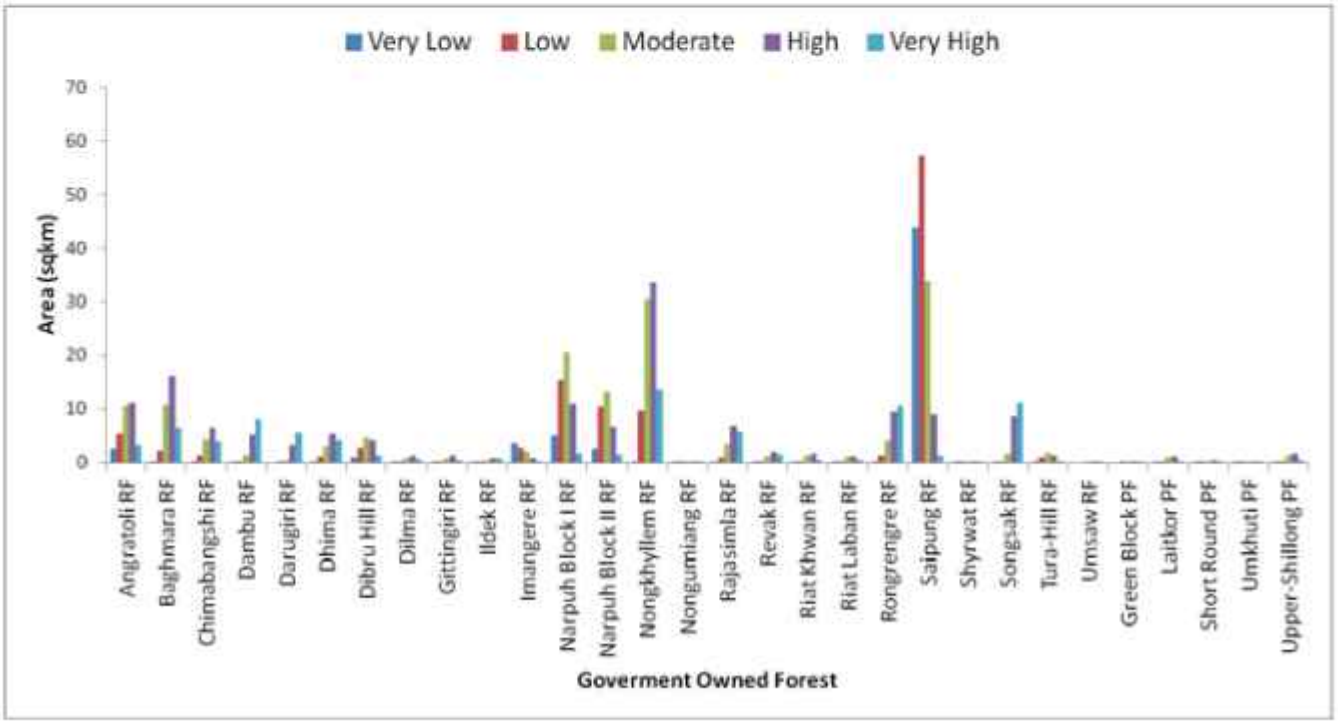


Figure 40. Forest Fire Vulnerability of Government Owned Forest

4.4.2. Protected Areas

Protected areas of the state comprise of Wildlife Sanctuaries, National Parks and Community reserves. Forest fire vulnerability analysis of all the Wildlife Sanctuaries shows, Nongkhyllem WLS has maximum area, 10.66 km^2 of forest cover falls under high and very high vulnerability class. However, Baghmara Pitcher Plant WLS has minimum area, 0.006 km^2 of forest cover falls under high and very high vulnerability class. The details of area under different vulnerability classes in the wildlife sanctuaries are given in Table 9. The spatial map of forest fire vulnerability for protected areas is given in Figure 41.

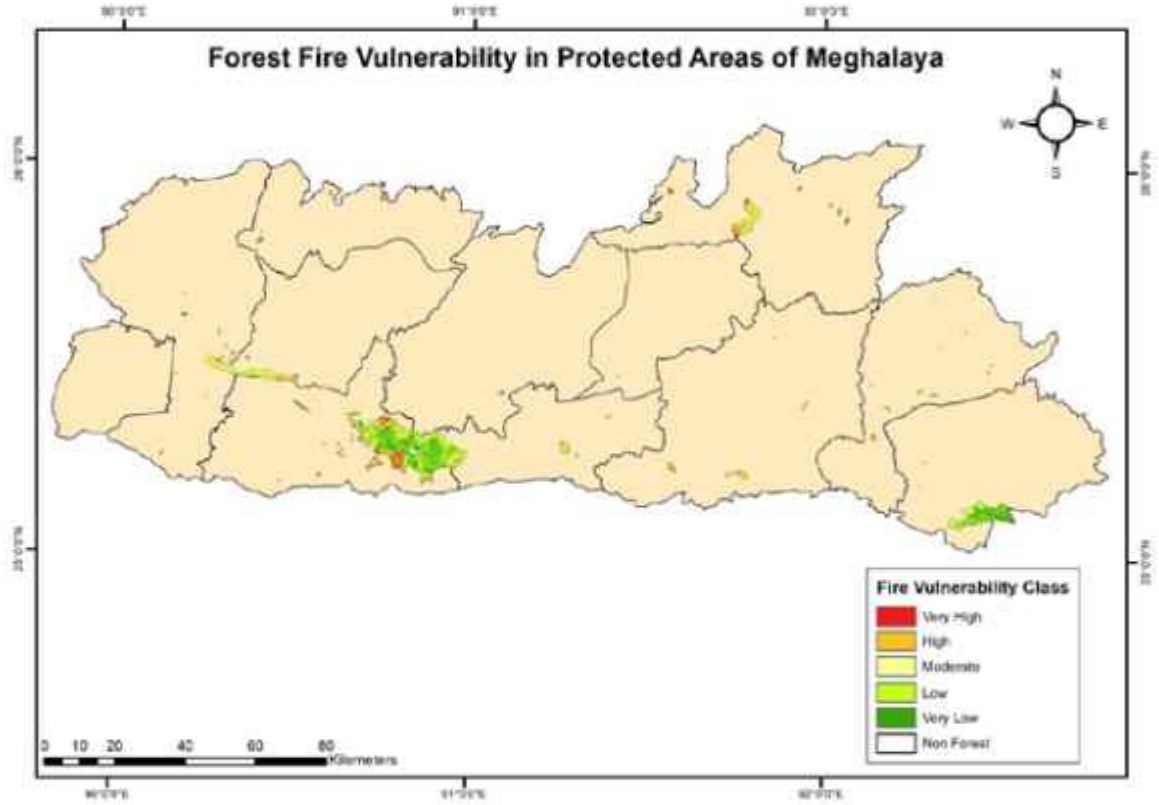


Figure 41. Forest Fire Vulnerability of Protected Areas in Meghalaya

Table 9. Forest Fire Vulnerability categories in Wildlife Sanctuaries with a buffer zone of 500 m *(Area in Km^2)*

Sl. No	Wildlife Sanctuary	Very Low	Low	Moderate	High	Very High
1	Narpuh WLS	18.209	23.490	16.650	6.775	0.770
	Narpuh WLS Buffer	1.726	2.481	3.871	3.188	0.565
2	Nongkhyllem WLS	0.392	8.154	15.715	9.258	1.417
	Nongkhyllem WLS Buffer	0.154	2.723	6.669	5.579	1.668
3	Siju WLS	0.114	1.511	2.273	1.121	0.095
	Siju WLS Buffer	0.224	1.134	1.819	1.272	0.179
4	Baghmara Pitcher Plant WLS	0	0	0.018	0.005	0.001
	Baghmara Pitcher Plant WLS Buffer	0.039	0.130	0.200	0.118	0.045

Balpakram National Park has more vulnerability to forest fire with 14.05 % under the high and very high vulnerability class than Nokrek National Park. The details of area under different vulnerability classes in the two National parks are given in Table 10. Vulnerability areas of WLSs and NPs are presented in Figure 42.

Table 10. Forest Fire Vulnerability categories in National Parks with a buffer zone of 500 m *(Area in Km²)*

Sl.No	National Park	Very Low	Low	Moderate	High	Very High
1	Balpakram NP	26.801	55.155	48.932	18.092	3.313
	Balpakram NP Buffer	5.997	16.103	18.845	12.133	3.285
2	Nokrek NP	4.064	18.029	17.442	4.855	0.059
	Nokrek NP Buffer	2.013	10.647	12.371	5.562	0.577

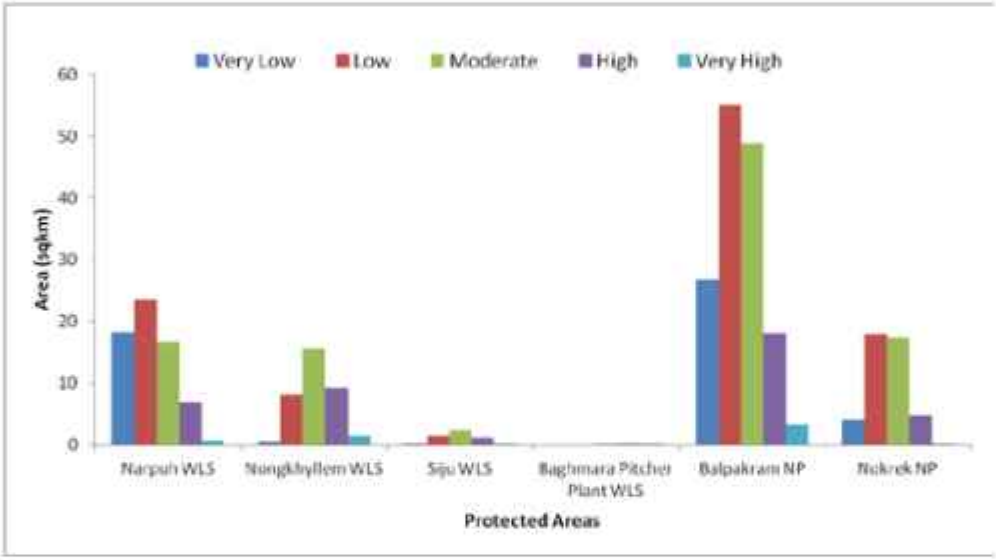


Figure 42. Forest Fire Vulnerability Area of Protected Areas

The 84 nos. of Community Reserve (CR) of the State comes under four different forest divisions i.e. Jaintia Hills Wildlife Division (JHWD), Khasi Hills Wildlife Division (KHWD), Balpakram National Park Division (BNPD) and Garo Hills Wildlife Division (GHWD). Community Reserve of Balpakram National Park Division followed by Garo Hills Wildlife Division, Jaintia Hills Wildlife Division and Khasi Hills Wildlife Division was found to be highly vulnerable to forest fire, with 41.40 %, 37.44%, 37.14%, and 33.36 % of forest area falls under high and very high vulnerability class.

Jaksongram CR of Balpakram National Park Division was highest vulnerable to forest fire with 99.97% of area under high and very high vulnerability class (Table 11). The total area of Selbagre CR of Garo Hills Wildlife Division was highest vulnerable to forest fire with 92.72% of area under high and very high vulnerability class (Table 12). Smaw Der Khli CR of Jaintia

Hills Wildlife Division was completely under high and very high vulnerability class (Table 13). Jirang CR of Khasi Hills Wildlife Division had more vulnerable to forest fire with 78.85% of area under high and very high vulnerability class (Table 14).

Table 11. Forest Fire Vulnerability categories in Community Reserves under BNPD with a buffer of 500 m *(Area in Km²)*

Sl. No	Community Reserve	Very Low	Low	Moderate	High	Very High
1	Aritakgre CR	0.461	0.113	0.024	0	0
	Aritakgre CR Buffer	1.870	0.849	0.196	0.003	0
2	Balsri Ading CR	0.001	0.013	0.058	0.105	0.053
	Balsri Ading CR Buffer	0.007	0.152	0.387	0.377	0.223
3	Chenggni CR	0.053	0.344	0.559	0.267	0.116
	Chenggni CR Buffer	0.563	1.058	0.943	0.572	0.126
4	Chimitap CR	0.218	0.662	0.828	0.138	0
	Chimitap CR Buffer	0.479	1.782	1.607	0.361	0.003
5	Dallenggittim CR	0.001	0.014	0.052	0.101	0.047
	Dallenggittim CR Buffer	0.048	0.219	0.400	0.503	0.340
6	Dambuk Attong CR	0.016	0.561	1.134	0.831	0.127
	Dambuk Attong CR Buffer	0.066	0.151	0.575	0.848	0.630
7	Dambuk Jongkol CR	0.008	0.600	1.378	1.113	0.129
	Dambuk Jongkol CR Buffer	0.066	0.769	1.929	2.077	0.568
8	Gokagre CR	0.002	0.005	0.033	0.089	0.038
	Gokagre CR Buffer	0.061	0.368	0.536	0.314	0.086
9	Halwa Ambeng CR	0.006	0.046	0.186	0.172	0.071
	Halwa Ambeng CR Buffer	0.033	0.220	0.562	0.564	0.144
10	Jaksongram CR	0	0	0	0.049	0.327
	Jaksongram CR Buffer	0.002	0.077	0.352	0.673	0.881
11	Karukol CR	0.004	0.059	0.087	0.075	0.037
	Karukol CR Buffer	0.107	0.457	0.671	0.508	0.194
12	Krem Longjiah CR	0.020	0.030	0.202	0.084	0
	Krem Longjiah CR Buffer	0.645	0.626	0.645	0.093	0
13	Lotnagar CR	0	0.001	0.019	0.060	0.036
	Lotnagar CR Buffer	0.009	0.113	0.122	0.050	0.021
14	Lum Matlang Raid Umket CR	0.020	0.008	0.161	0.197	0.007
	Lum Matlang Raid Umket CR Buffer	0.989	0.071	0.318	0.272	0.032
15	Matchirampat CR	0.005	0.015	0.106	0.081	0.021
	Matchirampat CR Buffer	0.030	0.379	0.658	0.686	0.304
16	Nikwatgre CR	0.002	0.015	0.041	0.047	0.034
	Nikwatgre CR Buffer	0.013	0.221	0.495	0.608	0.326
17	Rantangsora CR	0.003	0.021	0.036	0.033	0.010
	Rantangsora CR Buffer	0.174	0.387	0.242	0.199	0.220
18	Rongcheng CR	0.314	0.250	0.065	0	0
	Rongcheng CR Buffer	0.971	1.129	0.366	0.012	0
19	Ryntong Clan CR	0.021	0	0	0.029	0.095
	Ryntong Clan CR Buffer	0.491	0.000	0.068	0.393	0.693

Sl. No	Community Reserve	Very Low	Low	Moderate	High	Very High
20	Siju Duramong I CR	0	0.061	0.235	0.353	0.143
	Siju Duramong I CR Buffer	0.006	0.090	0.241	0.304	0.372
21	Siju Duramong II CR	0	0.030	0.394	0.834	1.104
	Siju Duramong II CR Buffer	0.074	0.426	1.032	1.302	0.439
22	Sonowa CR	0.131	0.324	0.533	0.560	0.222
	Sonowa CR Buffer	0.247	0.985	1.294	0.936	0.685
23	Taidang CR	0.034	0.287	0.300	0.095	0.001
	Taidang CR Buffer	0.221	0.956	0.970	0.531	0.099
24	Teptepa CR	0.130	0.467	0.542	0.328	0.030
	Teptepa CR Buffer	0.903	1.050	0.712	0.271	0.037
25	Upper Dosogre CR	0.003	0.039	0.108	0.072	0.003
	Upper Dosogre CR Buffer	0.128	0.447	0.610	0.318	0.014

Table 12. Forest Fire Vulnerability categories in Community Reserves under GHWD with a buffer of 500 m *(Area in Km²)*

Sl.No	Community Reserve	Very Low	Low	Moderate	High	Very High
1	Aruakgre CR	0.069	0.277	0.365	0.240	0.034
	Aruakgre CR Buffer	0.151	0.413	0.327	0.215	0.047
2	Aruakgre CR	0.008	0.0303	0.024	0.014	0
	Aruakgre CR Buffer	0.024	0.4234	0.349	0.424	0
3	Baladingre CR	0	0.058	0.129	0.066	0
	Baladingre CR Buffer	0.179	0.406	0.832	0.297	0.001
4	Bandarigre CR	0	0	0.001	0.004	0
	Bandarigre CR Buffer	0.004	0.110	0.283	0.308	0.069
5	Chandigre CR	0.184	0.157	0.025	0	0
	Chandigre CR Buffer	0.701	0.676	0.437	0.243	0.039
6	Chimanpara CR	0.011	0.042	0.017	0	0
	Chimanpara CR Buffer	0.147	0.035	0.011	0	0
7	Dankipara CR	0	0.004	0.009	0.005	0
	Dankipara CR Buffer	0.013	0.206	0.320	0.245	0.110
8	Daribokgre CR	0.001	0.267	0.818	0.582	0.043
	Daribokgre CR Buffer	0.178	1.028	1.516	0.885	0.088
9	Dumitdigre CR	0.001	0.008	0.156	0.382	0.152
	Dumitdigre CR Buffer	0.385	0.855	0.783	0.496	0.134
10	Dura Kalakgre CR	0.007	0.054	0.076	0.079	0.018
	Dura Kalakgre CR Buffer	0.036	0.353	0.988	1.356	0.370
11	Eman Asakgre CR	0.001	0.129	0.109	0.072	0.003
	Eman Asakgre CR Buffer	0.274	0.309	0.246	0.089	0.062
12	Kitmadamgre CR	0.021	0.165	0.265	0.175	0.080
	Kitmadamgre CR Buffer	0.107	0.423	0.804	0.725	0.275
13	Mandalgre CR	0.003	0.015	0.066	0.165	0.067
	Mandalgre CR Buffer	0.025	0.144	0.486	0.809	0.268
14	Mikadogre CR	0	0.001	0.007	0.004	0
	Mikadogre CR Buffer	0.007	0.106	0.274	0.297	0.146

Sl. No	Community Reserve	Very Low	Low	Moderate	High	Very High
15	Mongalgre CR	0.003	0.040	0.073	0.056	0.017
	Mongalgre CR Buffer	0.132	0.600	0.683	0.166	0.016
16	Resuhaluapara CR	0.025	0.135	0.191	0.127	0.021
	Resuhaluapara CR Buffer	0.620	0.818	0.551	0.291	0.049
17	Rongalgre CR	0.001	0.039	0.079	0.032	0
	Rongalgre CR Buffer	0.028	0.397	0.603	0.359	0.050
18	Rongma Paromgre CR	0	0.008	0.052	0.178	0.355
	Rongma Paromgre CR Buffer	0	0.055	0.520	0.830	0.749
19	Rongma Rekmangre CR	0	0.043	0.218	0.433	0.480
	Rongma Rekmangre CR Buffer	0.060	0.435	0.948	1.062	0.877
20	Sakalgre CR	0.042	0.446	0.581	0.131	0
	Sakalgre CR Buffer	0.297	1.241	1.642	0.390	0
21	Sasatgre CR	0	0.041	0.253	0.250	0.019
	Sasatgre CR Buffer	0.101	0.481	0.608	0.671	0.096
22	Selbagre CR	0	0	0.015	0.081	0.105
	Selbagre CR Buffer	0	0.006	0.164	0.862	1.103
23	Thokpara CR	0.064	0.160	0.080	0	0
	Thokpara CR Buffer	0.854	0.859	0.342	0	0
24	Rewak Watregittim CR	0.063	0.087	0.019	0.005	0
	Rewak Watregittim CR Buffer	0.482	0.628	0.203	0.085	0
25	Rewak Daburam CR	0.029	0.037	0.031	0.008	0
	Rewak Daburam CR Buffer	0.374	0.613	0.383	0.153	0

Table 13. Forest Fire Vulnerability categories in Community Reserves under JHWD with a buffer of 500 m *(Area in Km^2)*

Sl.No	Community Reserve	Very Low	Low	Moderate	High	Very High
1	Ka Khlaw Umthalong CR	0	0.005	0.008	0.005	0.006
	Ka Khlaw Umthalong CR Buffer	0.240	0.358	0.201	0.053	0.021
2	Ka Khloo Blai Lyngdoh Sein Raij Mynso CR	0	0	0.001	0.004	0.002
	Ka Khloo Blai Lyngdoh Sein Raij Mynso CR Buffer	0.009	0.071	0.110	0.124	0.033
3	Ka Khloo Langdoh Kur Pyrtuh CR	0.002	0.002	0.058	0.065	0.013
	Ka Khloo Langdoh Kur Pyrtuh CR Buffer	0.105	0.285	0.344	0.327	0.118
4	Ka Khloo Pohblai Mooshutia CR	0.014	0.039	0.068	0.077	0.013
	Ka Khloo Pohblai Mooshutia CR Buffer	0.148	0.195	0.167	0.116	0.013
5	Ka Khloo Thangbru Sula Lynter Sein Raij Mynso CR	0	0	0.009	0.016	0.004
	Ka Khloo Thangbru Sula Lynter Sein Raij Mynso CR Buffer	0.017	0.111	0.295	0.315	0.116
6	Ka Khloo Thangbru Umsymphu CR	0.005	0.012	0.026	0.030	0.012
	Ka Khloo Thangbru Umsymphu CR Buffer	0.044	0.099	0.095	0.064	0.016
7	Ka Krem Labit Umkyrpong CR	0.008	0.018	0.015	0.007	0.001

Sl. No	Community Reserve	Very Low	Low	Moderate	High	Very High
	Ka Krem Labit Umkyrpong CR Buffer	0.287	0.310	0.120	0.028	0.005
8	Ka Wah Umpatho CR	0.034	0.062	0.031	0.001	0
	Ka Wah Umpatho CR Buffer	1.316	0.287	0.084	0.008	0
9	Ka Lum Luwe CR	0.038	0.031	0.015	0	0
	Ka Lum Luwe CR Buffer	0.676	0.259	0.041	0.006	0
10	Khloo Blai Chyrmang Sein Raij Kongwasan Chyrmang Kmai CR	0	0	0.017	0.021	0.008
	Khloo Blai Chyrmang Sein Raij Kongwasan Chyrmang Kmai CR Buffer	0.028	0.117	0.222	0.164	0.052
11	Khloo Blai Ka Raij U Langdohionglang CR	0	0.005	0.052	0.073	0.020
	Khloo Blai Ka Raij U Langdohionglang CR Buffer	0.036	0.198	0.470	0.513	0.112
12	Khloo Blai Sein Raij Tuber CR	0.076	0.242	0.338	0.202	0.029
	Khloo Blai Sein Raij Tuber CR Buffer	0.450	0.497	0.370	0.245	0.057
13	Khloo Blai Langdoh Raij Raliang CR	0	0	0.006	0.013	0.009
	Khloo Blai Langdoh Raij Raliang CR Buffer	0.026	0.160	0.230	0.173	0.079
14	Khloo Khyllem Shrieh Mutong CR	0.002	0.002	0.004	0.002	0
	Khloo Khyllem Shrieh Mutong CR Buffer	0.027	0.037	0.072	0.042	0.009
15	Khloo Moopyai Wapung CR	0.019	0.062	0.245	0.080	0.013
	Khloo Moopyai Wapung CR Buffer	0.144	0.371	0.375	0.171	0.036
16	Smaw Der Khli CR	0	0	0	0.001	0.001
	Smaw Der Khli CR Buffer	0.050	0.126	0.148	0.248	0.250
17	Khloo Amrawan CR	0.100	0.109	0.326	0.476	0.251
	Khloo Amrawan CR Buffer	1.206	1.257	0.900	0.535	0.261
18	Ka Khloo Blai Ryngkaw Ka Sein Raij Khonshnong CR	0.007	0.010	0.159	0.252	0.114
	Ka Khloo Blai Ryngkaw Ka Sein Raij Khonshnong CR Buffer	0.075	0.448	0.839	0.779	0.286
19	Krem Iongjiah CR	0.066	0.128	0.139	0	0
	Krem Iongjiah CR Buffer	0.913	0.853	0.378	0	0

Table 14. Forest Fire Vulnerability categories in Community Reserves under KHWD with a buffer of 500 m *(Area in Km^2)*

Sl.No	Community Reserve	Very Low	Low	Moderate	High	Very High
1	Jirang CR	0.004	0.036	0.353	1.023	0.445
	Jirang CR Buffer	0.150	0.603	1.059	1.208	0.387
2	Kpoh Eijah CR	0.001	0.003	0.037	0.076	0.017
	Kpoh Eijah CR Buffer	0.090	0.206	0.311	0.361	0.080
3	Law Lyngdoh CR	0	0.001	0.011	0.010	0.003
	Law Lyngdoh CR Buffer	0.021	0.065	0.080	0.075	0.026
4	Lawbah CR	0.074	0.240	0.689	0.863	0.357
	Lawbah CR Buffer	0.211	0.621	1.195	0.837	0.325
5	Lumjusong CR	0.083	0.411	0.478	0.273	0.046

Sl. No	Community Reserve	Very Low	Low	Moderate	High	Very High
	Lumjusong CR Buffer	0.506	1.061	0.715	0.220	0.032
6	Lumkohkriah CR	1.070	1.881	1.708	0.863	0.155
	Lumkohkriah CR Buffer	1.418	2.074	1.295	0.542	0.049
7	Miewsyiar CR	0.004	0.141	0.279	0.211	0.214
	Miewsyiar CR Buffer	0.134	0.490	0.726	0.688	0.440
8	Nongsangu CR	0.008	0.182	0.334	0.264	0.118
	Nongsangu CR Buffer	0.134	0.982	1.083	0.386	0.070
9	Pdahkyndeng CR	0.126	0.295	0.243	0.069	0
	Pdahkyndeng CR Buffer	0.615	0.944	0.678	0.202	0.001
10	Phudja-Ud CR	0.072	0.346	0.512	0.166	0.003
	Phudja-Ud CR Buffer	0.426	0.704	0.474	0.152	0.008
11	Raid Nongbri CR	0.110	0.225	0.176	0.148	0.029
	Raid Nongbri CR Buffer	0.400	0.809	0.539	0.249	0.041
12	Rngibah CR	0.084	0.154	0.293	0.219	0.040
	Rngibah CR Buffer	1.064	0.920	0.665	0.508	0.086
13	Ryngud CR	0.094	0.524	1.467	1.626	1.253
	Ryngud CR Buffer	0.106	0.888	1.702	2.076	1.289
14	Thangkharang CR	0.008	0.131	0.240	0.214	0.144
	Thangkharang CR Buffer	0.071	0.514	0.773	0.769	0.245
15	Umsum CR	0.081	0.084	0.062	0.037	0.002
	Umsum CR Buffer	0.414	0.611	0.465	0.218	0.019

4.4.3. Biosphere Reserve

The only biosphere reserve of the state Nokrek Biosphere Reserve is also on the verge of forest fire vulnerability with 30.24%, 21.62% under high and very high vulnerability class respectively. The details of area under different vulnerability classes of the BR presented in Table 15.

Table 15. Forest Fire Vulnerability categories of Biosphere Reserve with a buffer of 500 m *(Area in Km²)*

Sl.No	Biosphere Reserve	Very Low	Low	Moderate	High	Very High
1	Nokrek Biosphere Reserve	26.55	116.14	194.68	211.96	151.60
	Nokrek Biosphere Reserve Buffer	1.62	7.46	11.97	11.02	5.79

4.4.4. Eco-Sensitive Zone

Out of four Eco-sensitive Zone (ESZ) of the state, BNP-SIJU ESZ is proposed one and other three are notified Eco-sensitive Zones. The Nongkhyllem ESZ and Nokrek ESZ are maximum vulnerable to forest fire with 52.26% and 34.55% respectively of forest cover under high and very high vulnerability class. The spatial map of Eco-sensitive Zones with vulnerability classes is shown in Figure 43. The details of area under different vulnerability classes of the ESZ presented in Table 16 and Figure 44.

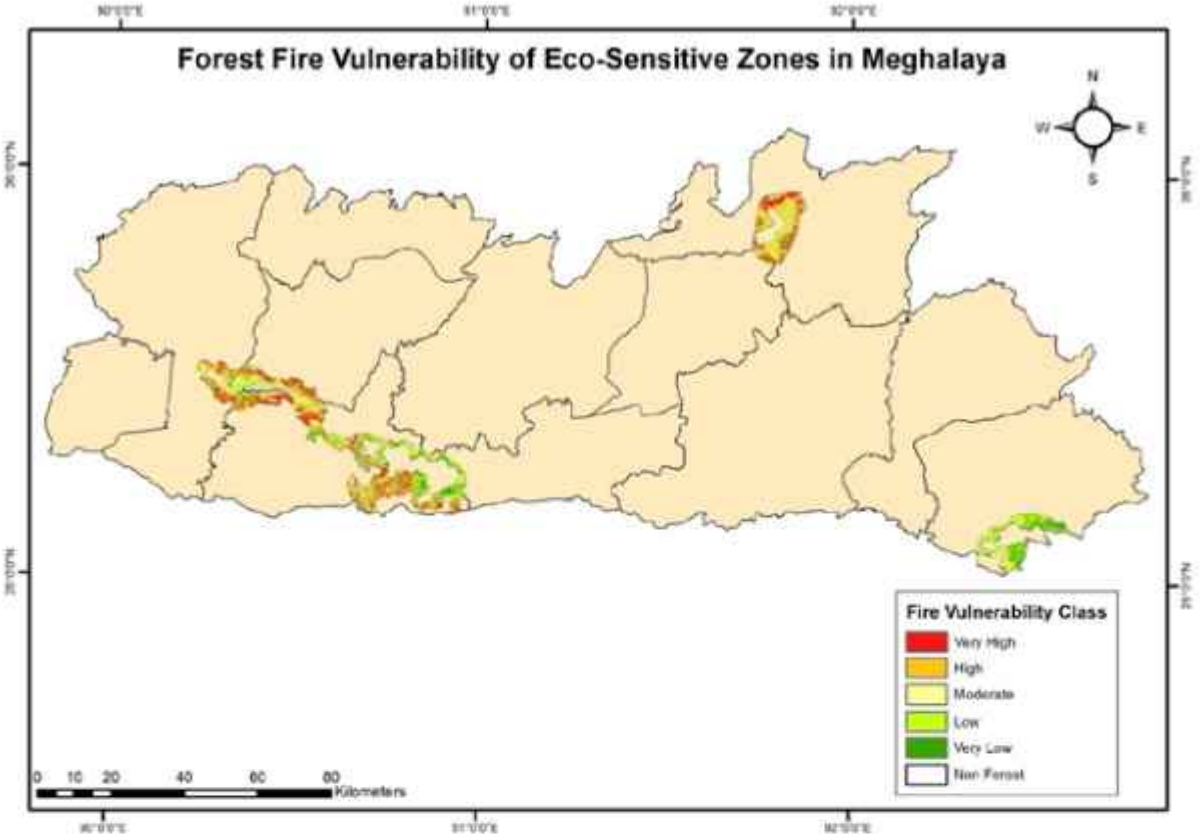


Figure 43. Forest Fire Vulnerability Area of Eco-Sensitive Zones in Meghalaya

Table 16. Forest Fire Vulnerability categories of Eco sensitive Zones with a buffer of 500 m *(Area in Km²)*

Sl. No	Ecosensitive Zones	Very Low	Low	Moderate	High	Very High
1	BNP SIJU ESZ (Proposed)	59.63	54.02	64.86	73.46	52.86
	BNP SIJU ESZ Buffer	5.42	14.30	21.87	19.16	6.98
2	Narpuh ESZ (Notified)	39.70	52.17	24.24	3.09	0
	Narpuh ESZ Buffer	3.96	5.53	7.17	6.23	2.39
3	Nokrek ESZ (Notified)	21.93	25.56	51.38	75.02	56.22
	Nokrek ESZ Buffer	2.36	6.93	10.70	14.90	13.12
4	Nongkhyllem WLS ESZ (Notified)	13.04	17.19	39.46	54.99	36.16
	Nongkhyllem WLS ESZ Buffer	0.66	3.09	6.28	8.53	7.24

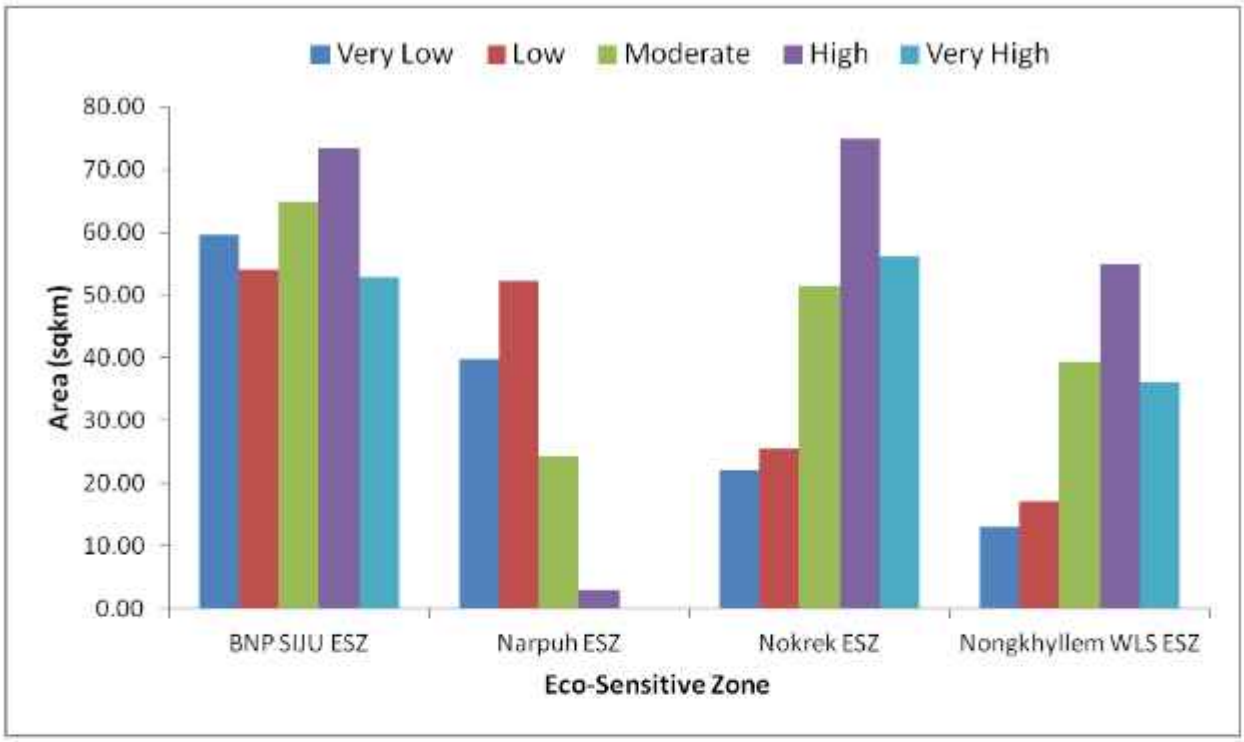


Figure 44. Areas of Different Forest Fire Vulnerability Classes in Ecosensitive Zones

4.4.5. Sacred Groves

The selected Sacred Groves (SG) of Khasi and Jaintia Hills have taken for this study, out of which 17 sacred groves are vulnerable to forest fire with more than 80% of its geographical area under high and very high vulnerability class. The Lawkyntang Umkyrsan SG was extremely affected by forest fire with 100 % area under high and very high vulnerability class. The details of area under different vulnerability classes of the BR presented in Table 17.

Table 17. Areas of Different Forest Fire Vulnerability categories in Sacred Groves of Khasi and Jaintia Hills *(Area in Km²)*

Sl.No	Sacred Groves	Very Low	Low	Moderate	High	Very High
1	Ka Khloo Blai Lyngdoh Sein Raij Mynso SG	0	0	0.001	0.004	0.002
	Ka Khloo Blai Lyngdoh Sein Raij Mynso SG Buffer	0.011	0.097	0.191	0.187	0.048
2	Ka Khloo Langdoh Kur Pyrtuh SG	0.002	0.002	0.058	0.065	0.013
	Ka Khloo Langdoh Kur Pyrtuh SG Buffer	0.105	0.285	0.344	0.327	0.118
3	Ka Khloo Thangbru Sula Lynter Sein Raij Mynso SG	0	0	0.009	0.016	0.004
	Ka Khloo Thangbru Sula Lynter Sein Raij Mynso SG Buffer	0.014	0.085	0.214	0.253	0.101
4	Khlaw Blai Moopassah SG	0	0	0.002	0.003	0.001
	Khlaw Blai Moopassah SG Buffer	0.032	0.144	0.336	0.284	0.067
5	Khlaw Blai Niam Kmai Pohpyrda SG	0	0.009	0.011	0.004	0
	Khlaw Blai Niam Kmai Pohpyrda SG Buffer	0.034	0.202	0.270	0.150	0
6	Khlaw Blai Pohmurang SG	0	0	0.003	0.008	0.004
	Khlaw Blai Pohmurang SG Buffer	0.019	0.137	0.166	0.088	0.019

Sl.No	Sacred Groves	Very Low	Low	Moderate	High	Very High
7	Khlaw Blai Raij Niam Tyrsha SG	0	0.001	0.003	0.001	0
	Khlaw Blai Raij Niam Tyrsha SG Buffer	0.070	0.265	0.310	0.137	0
8	Khlaw Blai Ryngkaw Khonchnong SG	0	0.035	0.127	0.244	0.134
	Khlaw Blai Ryngkaw Khonchnong SG Buffer	0.022	0.164	0.481	0.652	0.239
9	Khlaw Blai Shyllong SG	0	0	0	0	0
	Khlaw Blai Shyllong SG Buffer	0.004	0.018	0.045	0.073	0.032
10	Khlaw Raid Raitong SG	0.295	0.211	0.034	0	0
	Khlaw Raid Raitong SG Buffer	1.053	1.251	0.436	0	0
11	Khlieh Shnong Ingkhrong SG	0.002	0.005	0.013	0.023	0.012
	Khlieh Shnong Ingkhrong SG Buffer	0.166	0.356	0.244	0.041	0.006
12	Khlieh Shnong Sohra Mawphon SG	0.004	0.009	0.028	0.050	0.014
	Khlieh Shnong Sohra Mawphon SG Buffer	0.368	0.546	0.397	0.014	0.007
13	Khlo Blai Lyngdoh SG	0	0	0.006	0.013	0.008
	Khlo Blai Lyngdoh SG Buffer	0.026	0.162	0.232	0.174	0.080
14	Khlo Pohpuja Khlo Kyngtang SG	0	0.002	0.001	0	0
	Khlo Pohpuja Khlo Kyngtang SG Buffer	0.003	0.023	0.033	0.038	0.015
15	Khloo Blai Chyrmang Sein Raij Kong Wasan SG	0	0	0.022	0.025	0.010
	Khloo Blai Chyrmang Sein Raij Kong Wasan SG Buffer	0.030	0.128	0.238	0.169	0.052
16	Khloo Blai Ka Raij U Langdohionglang SG	0	0.005	0.052	0.073	0.020
	Khloo Blai Ka Raij U Langdohionglang SG Buffer	0.036	0.198	0.470	0.513	0.112
17	Khloo Blai Sein Raij Tuber SG	0.074	0.238	0.335	0.199	0.028
	Khloo Blai Sein Raij Tuber SG Buffer	0.452	0.501	0.374	0.247	0.057
18	Khloo Poh Blai Mooshutia SG	0.014	0.040	0.068	0.077	0.013
	Khloo Poh Blai Mooshutia SG Buffer	0.176	0.259	0.231	0.161	0.024
19	Khloo Thang Bru Umsymphu SG	0.005	0.011	0.025	0.030	0.012
	Khloo Thang Bru Umsymphu SG Buffer	0.017	0.034	0.032	0.019	0.006
20	Khongsit Mawlum SG	0.007	0.023	0.050	0.064	0.010
	Khongsit Mawlum SG Buffer	0.156	0.524	0.602	0.496	0.114
21	Kmawanrum Khlar SG	0	0	0.001	0.003	0
	Kmawanrum Khlar SG Buffer	0.028	0.065	0.087	0.084	0.023
22	Kullai Langsngun Lawadong Lawkur SG	0.032	0.042	0.074	0.126	0.024
	Kullai Langsngun Lawadong Lawkur SG Buffer	0.566	0.373	0.205	0.087	0.023
23	Kur Myrthong SG	0.020	0.072	0.168	0.159	0.060
	Kur Myrthong SG Buffer	0.041	0.185	0.275	0.232	0.025
24	Kyntoit Diengsiar Mawlong SG	0	0	0.002	0.003	0.004
	Kyntoit Diengsiar Mawlong SG Buffer	0	0.003	0.142	0.322	0.360
25	Kyntoit Mawriang Mawlong SG	0	0	0.002	0.001	0
	Kyntoit Mawriang Mawlong SG Buffer	0.001	0.011	0.082	0.042	0.009
26	Kyntoit Nongduh Mawlong SG	0	0	0	0	0.002
	Kyntoit Nongduh Mawlong SG Buffer	0	0.006	0.036	0.224	0.149
27	Laitkynsew Mawkdar SG	0	0	0.011	0.014	0.012

Sl.No	Sacred Groves	Very Low	Low	Moderate	High	Very High
	Laitkynsew Mawkdar SG Buffer	0.011	0.048	0.190	0.452	0.321
28	Law Adong Kohlu Khyrdop Mawlieh	0	0	0.006	0.003	0
	Law Adong Kohlu Khyrdop Mawlieh Buffer	0.105	0.194	0.276	0.198	0.024
29	Law Adong Law Pjaih Laitryngew SG	0.005	0.005	0.010	0.016	0.012
	Law Adong Law Pjaih Laitryngew SG Buffer	0.309	0.323	0.167	0.054	0.019
30	Law Adong Of Laitkynsew At Lumlaitdihum	0.002	0.001	0.015	0.024	0.001
	Law Adong Of Laitkynsew At Lumlaitdihum SG Buffer	0.085	0.154	0.128	0.095	0.012
31	Law Adong Synrang Sahum SG	0.001	0.004	0.006	0	0
	Law Adong Synrang Sahum SG Buffer	0.364	0.374	0.149	0.020	0.006
32	Law Adong Tad Latom At Swer SG	0.001	0.001	0.092	0.066	0.008
	Law Adong Tad Latom At Swer SG Buffer	0.063	0.151	0.262	0.296	0.051
33	Law Adong Tyrjut,Raid Nongkhlieng SG	0.002	0.010	0.022	0.071	0.022
	Law Adong Tyrjut,Raid Nongkhlieng SG Buffer	0.323	0.617	0.296	0.081	0.004
34	Law Adong Wah Shadsngi Nongmadan SG	0	0	0	0	0
	Law Adong Wah Shadsngi Nongmadan SG Buffer	0.014	0.011	0.003	0	0
35	Law Ing Blei Lyngdoh Nonglynkin SG	0.004	0.012	0.021	0	0
	Law Ing Blei Lyngdoh Nonglynkin SG Buffer	0.013	0.059	0.082	0.040	0.006
36	Law Kyntang Mukertilla Raid Mukertilla SG	0	0.005	0.005	0.019	0.033
	Law Kyntang Mukertilla Raid Mukertilla SG Buffer	0	0.007	0.024	0.162	0.244
37	Law Kyntang Of Smti Philo SG	0	0.002	0.004	0.003	0
	Law Kyntang Of Smti Philo SG Buffer	0.014	0.058	0.193	0.237	0.158
38	Law Lyngdoh Lait Raid Mawkhap SG	0	0.012	0.023	0.013	0
	Law Lyngdoh Lait Raid Mawkhap SG Buffer	0.190	0.320	0.465	0.182	0.008
39	Law Lyngdoh Law Adong At Nonglynkin SG	0.001	0.009	0.010	0.001	0
	Law Lyngdoh Law Adong At Nonglynkin SG Buffer	0.016	0.055	0.078	0.029	0.004
40	Law Lyngdoh Lawadong Kur Lai Kynja SG	0	0.001	0.031	0.056	0.032
	Law Lyngdoh Lawadong Kur Lai Kynja SG Buffer	0.058	0.200	0.206	0.035	0.006
41	Law Lyngdoh Lyngiong SG	0.034	0.094	0.153	0.199	0.040
	Law Lyngdoh Lyngiong SG Buffer	0.139	0.267	0.286	0.216	0.043
42	Law Lyngdoh Raid Wahkhen SG	0	0.003	0.007	0.009	0
	Law Lyngdoh Raid Wahkhen SG Buffer	0.214	0.350	0.230	0.131	0.010
43	Law Lyngdoh Rngaid SG	0.002	0.003	0.005	0.005	0
	Law Lyngdoh Rngaid SG Buffer	0.020	0.024	0.048	0.067	0.005
44	Law Lyngdoh Sawkpoh Wanniang SG	0.001	0.004	0.017	0.009	0.001
	Law Lyngdoh Sawkpoh Wanniang SG Buffer	0.021	0.072	0.118	0.077	0.015
45	Law Lyngdoh Shillong Maw SG	0	0	0.002	0.001	0
	Law Lyngdoh Shillong Maw SG Buffer	0.035	0.156	0.330	0.166	0.060
46	Law Pyllun Kur Iawphniaw Mawsaw SG	0.004	0.022	0.110	0.163	0.036
	Law Pyllun Kur Iawphniaw Mawsaw SG Buffer	0.081	0.209	0.269	0.222	0.055

Sl.No	Sacred Groves	Very Low	Low	Moderate	High	Very High
47	Law Saw Symber SG	0.038	0.043	0.059	0.029	0.002
	Law Saw Symber SG Buffer	0.011	0.029	0.024	0.012	0.004
48	Lawadong Dohling SG	0.136	0.158	0.186	0.119	0.023
	Lawadong Dohling SG Buffer	0.185	0.390	0.483	0.272	0.043
49	Lawadong Iapmoit SG	0.008	0.008	0.002	0	0
	Lawadong Iapmoit SG Buffer	0.153	0.187	0.107	0.021	0.007
50	Lawadong Iawkait At Laitryngew SG	0.001	0.002	0.003	0	0
	Lawadong Iawkait At Laitryngew SG Buffer	0.178	0.193	0.127	0.058	0.030
51	Lawadong Kliar Umrem SG	0.002	0.003	0.006	0.011	0.005
	Lawadong Kliar Umrem SG Buffer	0.184	0.322	0.212	0.045	0.019
52	Lawadong Kshaid SG	0.010	0.009	0.001	0	0
	Lawadong Kshaid SG Buffer	0.261	0.292	0.174	0.046	0.024
53	Lawadong Laitkynsew Lumlaitdihum SG	0	0.003	0.056	0.098	0.015
	Lawadong Laitkynsew Lumlaitdihum SG Buffer	0.034	0.088	0.454	0.702	0.294
54	Lawadong Laitmawpat SG	0.007	0.025	0.119	0.114	0.023
	Lawadong Laitmawpat SG Buffer	0.057	0.110	0.204	0.089	0.016
55	Lawadong Law Madan At Mawmluh SG	0.001	0.034	0.047	0.022	0
	Lawadong Law Madan At Mawmluh SG Buffer	0.089	0.174	0.437	0.772	0.174
56	Lawadong Lawarliang SG	0.002	0.003	0.019	0.031	0.011
	Lawadong Lawarliang SG Buffer	0.411	0.467	0.185	0.034	0.017
57	Lawadong Lawlung Nongshlem SG	0.009	0.038	0.131	0.175	0.023
	Lawadong Lawlung Nongshlem SG Buffer	0.383	0.669	0.583	0.437	0.079
58	Lawadong Mawsawa SG	0.001	0.004	0.044	0.059	0.021
	Lawadong Mawsawa SG Buffer	0.177	0.199	0.408	0.485	0.096
59	Lawadong Niangblah SG	0.010	0.025	0.044	0.090	0.013
	Lawadong Niangblah SG Buffer	0.191	0.448	0.222	0.127	0.014
60	Lawadong Nongsynrieh SG	0	0	0.023	0.032	0.007
	Lawadong Nongsynrieh SG Buffer	0.014	0.070	0.248	0.293	0.059
61	Lawadong Of Mawtneng SG	0.028	0.161	0.279	0.183	0.043
	Lawadong Of Mawtneng SG Buffer	0.338	0.629	0.581	0.546	0.203
62	Lawadong Phud Synrang SG	0.001	0.002	0.004	0.004	0.001
	Lawadong Phud Synrang SG Buffer	0.322	0.344	0.155	0.042	0.020
63	Lawadong Sangriang SG	0	0.006	0.010	0.058	0
	Lawadong Sangriang SG Buffer	0.087	0.479	0.151	0.209	0
64	Lawadong Sawkpoh Kur Nonglang SG	0.011	0.047	0.065	0.027	0.005
	Lawadong Sawkpoh Kur Nonglang SG Buffer	0.010	0.036	0.275	0.468	0.111
65	Lawadong Sohmyndong SG	0.280	0.471	0.210	0.031	0.007
	Lawadong Sohmyndong SG Buffer	0.716	1.130	0.773	0.203	0.045
66	Lawadong Suidnoh SG	0.004	0.004	0.003	0	0
	Lawadong Suidnoh SG Buffer	0.044	0.096	0.106	0.021	0.001
67	Lawadong Them U Mud SG	0	0.004	0.005	0.001	0
	Lawadong Them U Mud SG Buffer	0.247	0.245	0.095	0.009	0.003

Sl.No	Sacred Groves	Very Low	Low	Moderate	High	Very High
68	Lawadong Thymmai Laitryngew SG	0.003	0.002	0.002	0.002	0.002
	Lawadong Thymmai Laitryngew SG Buffer	0.109	0.119	0.089	0.045	0.025
69	Lawadong Wah Marobinat SG	0.001	0.003	0.003	0.004	0.001
	Lawadong Wah Marobinat SG Buffer	0.108	0.282	0.167	0.109	0.011
70	Lawadong Wah Rangmuh SG	0.002	0.017	0.007	0	0
	Lawadong Wah Rangmuh SG Buffer	0.225	0.364	0.234	0.138	0.050
71	Lawadong Wah SG	0	0.002	0.055	0.125	0.013
	Lawadong Wah SG Buffer	0.008	0.015	0.088	0.225	0.043
72	Lawadong Wah Um Sohphie SG	0.001	0.006	0.006	0.007	0.004
	Lawadong Wah Um Sohphie SG Buffer	0.311	0.415	0.196	0.014	0.002
73	Lawadong Wahingbah SG	0.010	0.011	0.005	0.001	0
	Lawadong Wahingbah SG Buffer	0.367	0.377	0.170	0.064	0.027
74	Lawadong Wahsier Swer SG	0.005	0.038	0.127	0.087	0.008
	Lawadong Wahsier Swer SG Buffer	0.513	0.720	0.380	0.144	0.013
75	Lawkyntang Blai Raij Niwakmai SG	0.001	0.003	0.001	0	0
	Lawkyntang Blai Raij Niwakmai SG Buffer	0.274	0.369	0.212	0.004	0
76	Lawkyntang Lyngdoh Mawnai SG	0.019	0.093	0.074	0.016	0
	Lawkyntang Lyngdoh Mawnai SG Buffer	0.332	0.367	0.198	0.036	0
77	Lawkyntang Mawbang SG	0	0	0	0	0
	Lawkyntang Mawbang SG Buffer	0.005	0.031	0.124	0.094	0.073
78	Lawkyntang Nongrim Khien Bsap Raij Mawlieh SG	0	0	0.006	0.005	0.001
	Lawkyntang Nongrim Khien Bsap Raij Mawlieh SG Buffer	0.004	0.011	0.097	0.121	0.009
79	Lawkyntang Of Tken Muker Raid Mukertilla SG	0	0.001	0.003	0.003	0.007
	Lawkyntang Of Tken Muker Raid Mukertilla SG Buffer	0	0.010	0.046	0.236	0.540
80	Lawkyntang Raid Nongpoh SG	0.001	0.065	0.141	0.194	0.082
	Lawkyntang Raid Nongpoh SG Buffer	0.021	0.192	0.464	0.485	0.282
81	Lawkyntang Ryngkew Swer SG	0.001	0.006	0.025	0.070	0.021
	Lawkyntang Ryngkew Swer SG Buffer	0.044	0.099	0.255	0.222	0.027
82	Lawkyntang Umkyrsan SG	0	0	0	0.001	0.002
	Lawkyntang Umkyrsan SG Buffer	0	0	0.041	0.309	0.437
83	Lawkyrphei SG	0	0	0	0	0
	Lawkyrphei SG Buffer	0.010	0.031	0.091	0.185	0.041
84	Lawlyngdoh Erbamon SG	0	0	0.001	0.001	0
	Lawlyngdoh Erbamon SG Buffer	0.011	0.052	0.079	0.033	0.029
85	Lawlyngdoh Kharai Raid Nongkhlieng SG	0	0	0.009	0.008	0.002
	Lawlyngdoh Kharai Raid Nongkhlieng SG Buffer	0.059	0.162	0.389	0.328	0.095
86	Lawlyngdoh Mawlot Phyllut SG	0.007	0.032	0.067	0.041	0
	Lawlyngdoh Mawlot Phyllut SG Buffer	0.155	0.248	0.132	0.052	0.002
87	Lawlyngdoh Synrynew SG	0	0.002	0.006	0.001	0
	Lawlyngdoh Synrynew SG Buffer	0.001	0.018	0.078	0.097	0.052

Sl.No	Sacred Groves	Very Low	Low	Moderate	High	Very High
88	Long Bong Raliang Dolloiship SG	0.001	0.007	0.008	0.002	0
	Long Bong Raliang Dolloiship SG Buffer	0.013	0.076	0.095	0.034	0
89	Lumniang Law Lyngdoh Of Kur Myrthong SG	0.982	0.251	0.070	0	0
	Lumniang Law Lyngdoh Of Kur Myrthong SG Buffer	2.264	0.487	0.172	0	0
90	Lynching SG	0.009	0.013	0.039	0.056	0.012
	Lynching SG Buffer	0.035	0.100	0.117	0.064	0.012
91	Mawbrai SG	0	0	0	0	0
	Mawbrai SG Buffer	0.001	0.013	0.058	0.062	0.047
92	Mawhiang SG	0.035	0.073	0.100	0.032	0.008
	Mawhiang SG Buffer	0.076	0.100	0.149	0.080	0.013
93	Mawlynnu 11 SG	0.002	0.001	0	0	0
	Mawlynnu 11 SG Buffer	0.052	0.157	0.213	0.141	0.036
94	Mawlynnu Khlieh Weiloi SG	0	0	0	0	0
	Mawlynnu Khlieh Weiloi SG Buffer	0.005	0.011	0.073	0.069	0.016
95	Mawlynnu Mawksan SG	0.013	0.054	0.074	0.009	0.001
	Mawlynnu Mawksan SG Buffer	0.020	0.073	0.130	0.151	0.046
96	Mawranglang SG	0	0.001	0.009	0.038	0.015
	Mawranglang SG Buffer	0.009	0.034	0.116	0.193	0.052
97	Mawtangor SG	0	0	0.013	0.017	0.002
	Mawtangor SG Buffer	0.027	0.083	0.257	0.281	0.068
98	Mawteibah SG	0.034	0.143	0.189	0.119	0.007
	Mawteibah SG Buffer	0.083	0.281	0.426	0.161	0.013
99	Myllep Klo Blai Raijkhonchnong SG	0	0.006	0.047	0.041	0.018
	Myllep Klo Blai Raijkhonchnong SG Buffer	0.068	0.280	0.331	0.185	0.094
100	Mynthiang Khlo Kyntang SG	0	0.002	0.001	0	0
	Mynthiang Khlo Kyntang SG Buffer	0.161	0.306	0.254	0.078	0
101	Nongrimbah Lawadong Mawlangwir SG	0.023	0.022	0.154	0.092	0.015
	Nongrimbah Lawadong Mawlangwir SG Buffer	0.020	0.050	0.132	0.225	0.093
102	Nongsiej Bisap SG	0	0.002	0.020	0.021	0.007
	Nongsiej Bisap SG Buffer	0.006	0.022	0.086	0.071	0.010
103	Nongsiej Laitwir SG	0	0.003	0.065	0.062	0.018
	Nongsiej Laitwir SG Buffer	0.064	0.156	0.276	0.187	0.029
104	Nongsiej Nongdom Laitnamlang SG	0.011	0.013	0.048	0.054	0.003
	Nongsiej Nongdom Laitnamlang SG Buffer	0.153	0.299	0.417	0.343	0.057
105	Phlangwanbroi SG	0.007	0.029	0.027	0.009	0
	Phlangwanbroi SG Buffer	0.531	0.494	0.188	0.039	0
106	Pon Pyrnon Lawadong SG	0.011	0.029	0.032	0.023	0.001
	Pon Pyrnon Lawadong SG Buffer	0.099	0.194	0.238	0.194	0.021
107	Pynden Sakwang SG	0.002	0.008	0.012	0.006	0.003
	Pynden Sakwang SG Buffer	0.083	0.111	0.048	0.007	0.002
108	Rei Mission Law Adong SG	0.002	0.004	0.021	0.023	0.003

Sl.No	Sacred Groves	Very Low	Low	Moderate	High	Very High
	Rei Mission Law Adong SG Buffer	0.102	0.232	0.282	0.170	0.035
109	Ri Kaksem SG	0	0.005	0.030	0.047	0.002
	Ri Kaksem SG Buffer	0.092	0.297	0.473	0.520	0.126
110	Ryngkaw Khonshnong SG	0	0	0	0.001	0
	Ryngkaw Khonshnong SG Buffer	0.022	0.199	0.608	0.896	0.373
111	Salar Lang SG	0	0.007	0.028	0.042	0.014
	Salar Lang SG Buffer	0.055	0.226	0.390	0.390	0.069
112	Synrai Hu SG	0.004	0.003	0.011	0.011	0.002
	Synrai Hu SG Buffer	0.013	0.037	0.164	0.171	0.051
113	The Jri Tyrkong Lawadong SG	0	0	0.017	0.052	0.031
	The Jri Tyrkong Lawadong SG Buffer	0.024	0.151	0.243	0.235	0.079
114	The Lawadong Sawktang SG	0	0.005	0.017	0.075	0.046
	The Lawadong Sawktang SG Buffer	0.113	0.278	0.578	0.774	0.139
115	The Lawadong Wahthlong SG	0.002	0.003	0.012	0.009	0.003
	The Lawadong Wahthlong SG Buffer	0.370	0.362	0.159	0.018	0.012
116	The Lawkyntang Mawsahep SG	0.001	0.003	0.009	0.002	0
	The Lawkyntang Mawsahep SG Buffer	0.271	0.264	0.289	0.069	0.004
117	The Lawkyntang Noh Ksiar SG	0	0	0	0	0
	The Lawkyntang Noh Ksiar SG Buffer	0	0.005	0.112	0.133	0.110
118	The Lawlyngdoh Kur Nongrem Khain Nongdait 2 SG	0	0	0.004	0.021	0.004
	The Lawlyngdoh Kur Nongrem Khain Nongdait 2 SG Buffer	0.006	0.022	0.042	0.049	0.009
119	The Lawlyngdoh Kur Nongrem Khain Nongdait SG	0.003	0.012	0.011	0.023	0.006
	The Lawlyngdoh Kur Nongrem Khain Nongdait SG Buffer	0.006	0.022	0.082	0.120	0.039
120	Twahsongparat SG	0.005	0.021	0.026	0.037	0.009
	Twahsongparat SG Buffer	0.044	0.126	0.333	0.132	0.019
121	Tyllong Um Kyrwiang SG	0.007	0.014	0.042	0.047	0.009
	Tyllong Um Kyrwiang SG Buffer	0.362	0.300	0.211	0.099	0.016
122	Tyrsad 2 SG	0.001	0.001	0.001	0	0
	Tyrsad 2 SG Buffer	0.012	0.050	0.043	0.001	0
123	Tyrsad SG	0.014	0.046	0.023	0	0
	Tyrsad SG Buffer	0.016	0.062	0.050	0.005	0
124	Umiong SG	0.162	0.166	0.514	0.768	0.178
	Umiong SG Buffer	2.218	1.763	0.879	0.169	0.010
125	Umwai Mawlong Kynrem SG	0.014	0.010	0.044	0.010	0.001
	Umwai Mawlong Kynrem SG Buffer	0.129	0.183	0.328	0.418	0.087
126	Umwai Mawlong SG	0	0	0.001	0.008	0.004
	Umwai Mawlong SG Buffer	0.001	0.031	0.145	0.359	0.205
127	Umwai Nurbah SG	0	0	0.001	0.010	0.008
	Umwai Nurbah SG Buffer	0	0.006	0.066	0.243	0.186
128	Umwai Village Mawthoh SG	0	0	0.024	0.005	0.001
	Umwai Village Mawthoh SG Buffer	0.046	0.156	0.379	0.408	0.118

129	Wah Mawthang Soh Khyllung SG	0	0	0	0.002	0.001
	Wah Mawthang Soh Khyllung SG Buffer	0.011	0.039	0.158	0.398	0.227
130	Wah Umthlong SG	0.001	0.003	0.001	0.002	0
	Wah Umthlong SG Buffer	0.354	0.328	0.115	0.007	0.001

4.5. Assessment of Forest Fire Prone Classes in Forest Units (OBJECTIVE - II)

4.5.1. Government Owned Forest

Government owned reserve forest of the state comprise of Reserve Forest (RF) and Protected Forest (PF). Forest fire vulnerability analysis of all the reserve forest shows, Saipung RF has maximum area (12.79 km^2) under very high fire prone category. There is no protected forest under very high fire prone class is but Upper Shillong PF is moderately prone to forest fire than others. However, Laitkor PF is the safest protected forest to fire with no forest cover under forest fire. The spatial map of forest fire prone for government owned forest is given in Figure 45. The area under different RF and PF is presented in Table 18 and Figure 46. Forest fire prone area maps of all Reserve Forests, Protected Forests, Wildlife Sanctuaries, National Parks and Biosphere Reserve with a buffer of 500 m are given in **Annexure VI.**

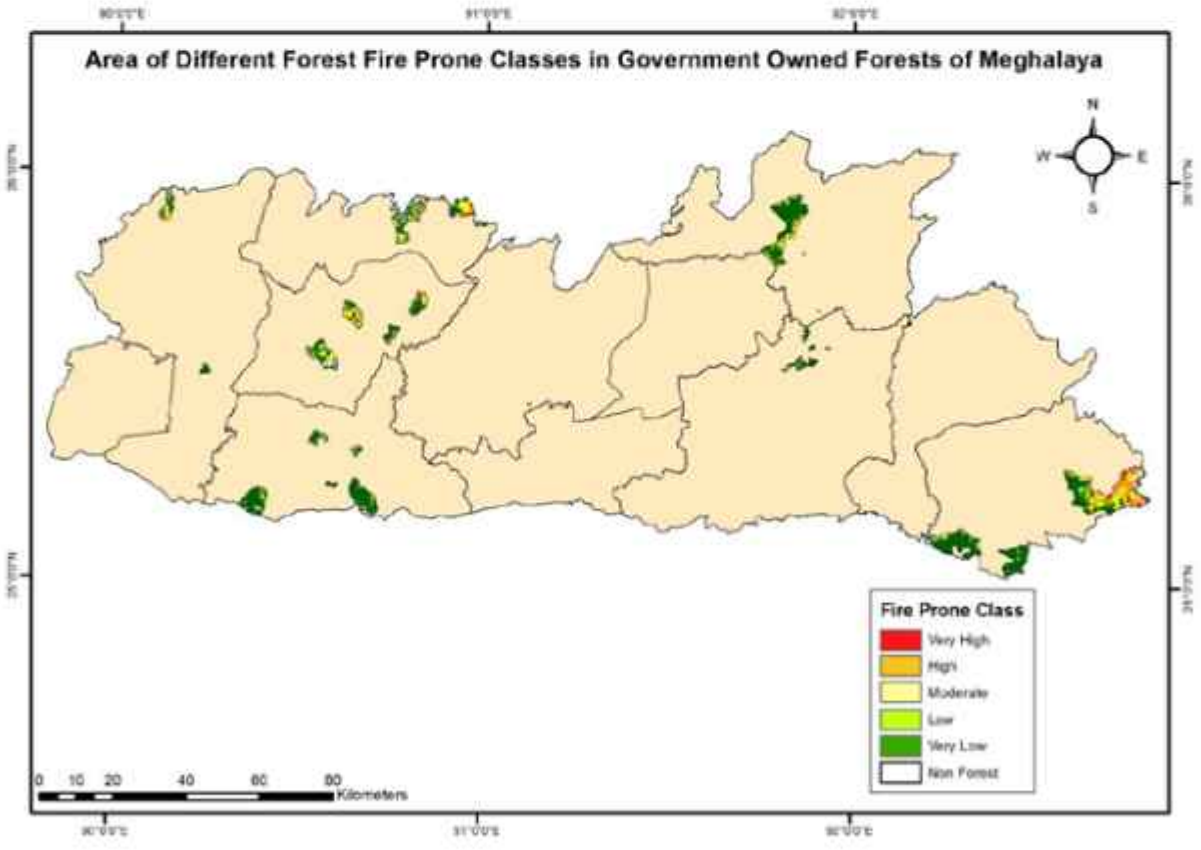


Figure 45. Area of Different Forest Fire Prone Classes in Government Owned Forest

Table 18. Forest Fire Prone Classes in Government Owned Forest with a buufer of 500 m

(Area in Km²)

Sl. No	Government Owned Forest	Very Low	Low	Moderate	High	Very High
1	Angratoli RF	31.17	2.02	1.84	0	0
	Angratoli RF Buffer	36.47	2.97	3.22	0	0
2	Baghmara RF	33.26	3.12	0.99	0	0
	Baghmara RF Buffer	42.34	4.28	1.00	0	0
3	Chimabangshi RF	10.32	4.26	3.31	0.78	0
	Chimabangshi RF Buffer	13.54	6.07	5.39	0.97	0
4	Dambu RF	9.91	1.05	3.37	1.50	0.84
	Dambu RF Buffer	11.50	2.03	6.45	3.47	1.89
5	Darugiri RF	6.17	2.56	0.17	1.10	0
	Darugiri RF Buffer	8.23	3.45	1.53	3.21	0.49
6	Dhima RF	5.95	5.53	1.04	2.38	0.86
	Dhima RF Buffer	7.49	6.72	1.74	4.19	1.65
7	Dibru Hill RF	7.80	2.92	3.56	0.89	0
	Dibru Hill RF Buffer	11.74	4.30	4.64	0.94	0
8	Dilma RF	3.02	0.07	0.08	0	0
	Dilma RF Buffer	4.98	0.39	0.55	0	0
9	Gittingiri RF	2.18	0	0.22	0	0
	Gittingiri RF Buffer	5.55	0	1.05	0	0
10	Ildek RF	1.28	0.88	0.03	0	0
	Ildek RF Buffer	2.61	1.29	0.34	0	0
11	Imangere RF	6.48	2.61	0.85	0	0
	Imangere RF Buffer	12.41	5.37	1.89	0	0
12	Narpuh Blk I RF	47.31	4.58	3.09	0	0
	Narpuh Blk I RF Buffer	62.53	7.00	6.70	0	0
13	Narpuh Blk II RF	32.03	2.76	0	0	0
	Narpuh Blk II RF Buffer	42.54	3.62	0	0	0
14	Nongkhyllem RF	65.26	10.60	11.15	2.25	0.08
	Nongkhyllem RF Buffer	77.21	15.75	18.70	6.71	2.49
15	Nongumiang RF	0.00	0.01	0.30	0	0
	Nongumiang RF Buffer	0.44	0.87	1.01	0	0
16	Rajasimla RF	3.62	1.59	8.06	1.61	2.57
	Rajasimla RF Buffer	4.38	1.93	8.53	1.62	4.21
17	Revak RF	2.12	2.09	0.75	0	0
	Revak RF Buffer	4.27	3.72	1.92	0	0
18	Riat Khwan RF	2.99	0.26	0.39	0	0
	Riat Khwan RF Buffer	5.44	1.28	1.15	0.11	0
19	Riat Laban RF	2.39	0.64	0	0	0
	Riat Laban RF Buffer	3.99	1.57	0.02	0	0
20	Rongrengre RF	17.17	4.96	7.86	0	0
	Rongrengre RF Buffer	24.45	6.94	10.26	0.08	0
21	Saipung RF	44.42	17.65	30.86	31.59	12.79
	Saipung RF Buffer	56.17	18.74	34.74	38.51	17.77
22	Shyrwat RF	0.38	0	0	0	0
	Shyrwat RF Buffer	1.64	0	0	0	0
23	Songsak RF	7.31	3.76	8.68	2.67	0.32
	Songsak RF Buffer	11.68	5.81	11.05	3.94	1.32
24	Tura-Hill RF	3.99	0.64	0	0	0
	Tura-Hill RF Buffer	8.22	1.94	0.03	0	0
25	Umsaw RF	0	0	0.41	0	0
	Umsaw RF Buffer	0.40	0	1.92	0.13	0

Sl. No	Government Owned Forest	Very Low	Low	Moderate	High	Very High
26	Green Block PF	0.17	0	0	0	0
	Green Block PF Buffer	1.29	0	0	0	0
27	Laitkor PF	2.50	0	0	0	0
	Laitkor PF Buffer	4.34	0	0	0	0
28	Short Round PF	0.71	0	0	0	0
	Short Round PF Buffer	0.98	0	0	0	0
29	Umkhuti PF	0.00	0.07	0.06	0	0
	Umkhuti PF Buffer	0.43	0.45	0.38	0	0
30	Upper-Shillong PF	1.93	1.69	0.40	0	0
	Upper-Shillong PF Buffer	4.72	3.50	0.97	0.03	0

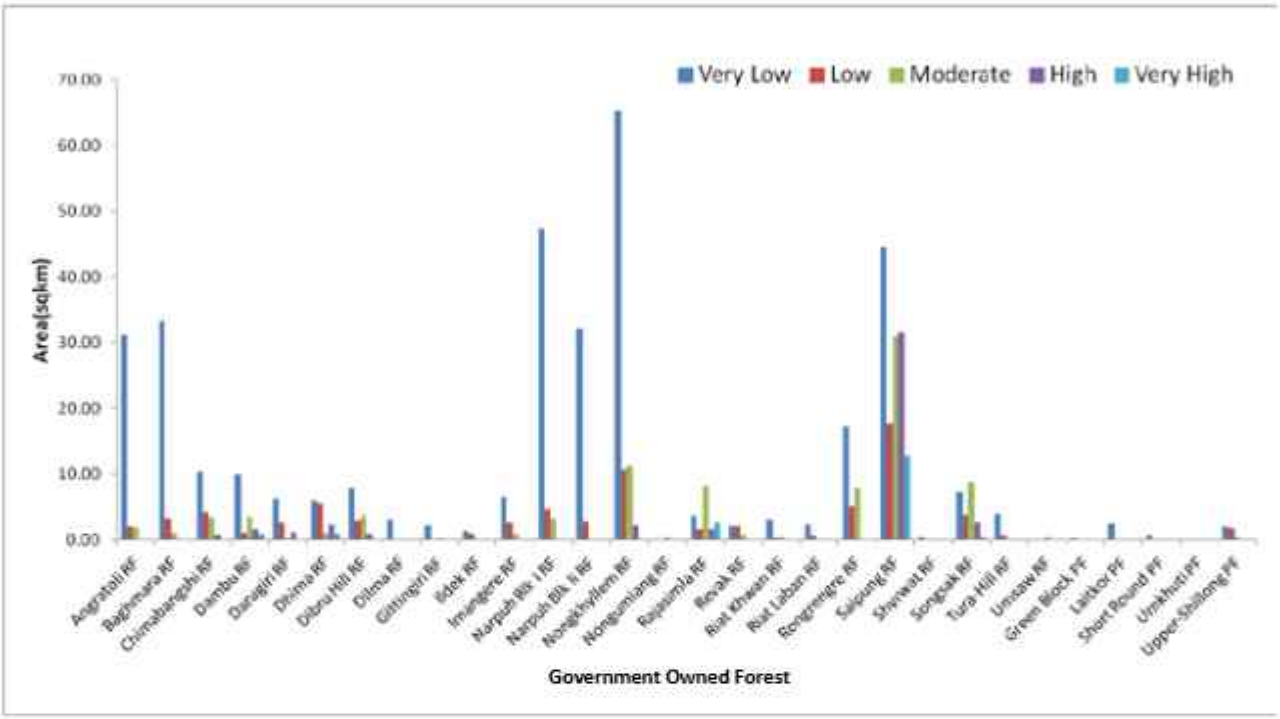


Figure 46. Area Under Different Forest Fire Prone Classes in Government Owned Forest of Meghalaya

4.5.2. Protected Areas

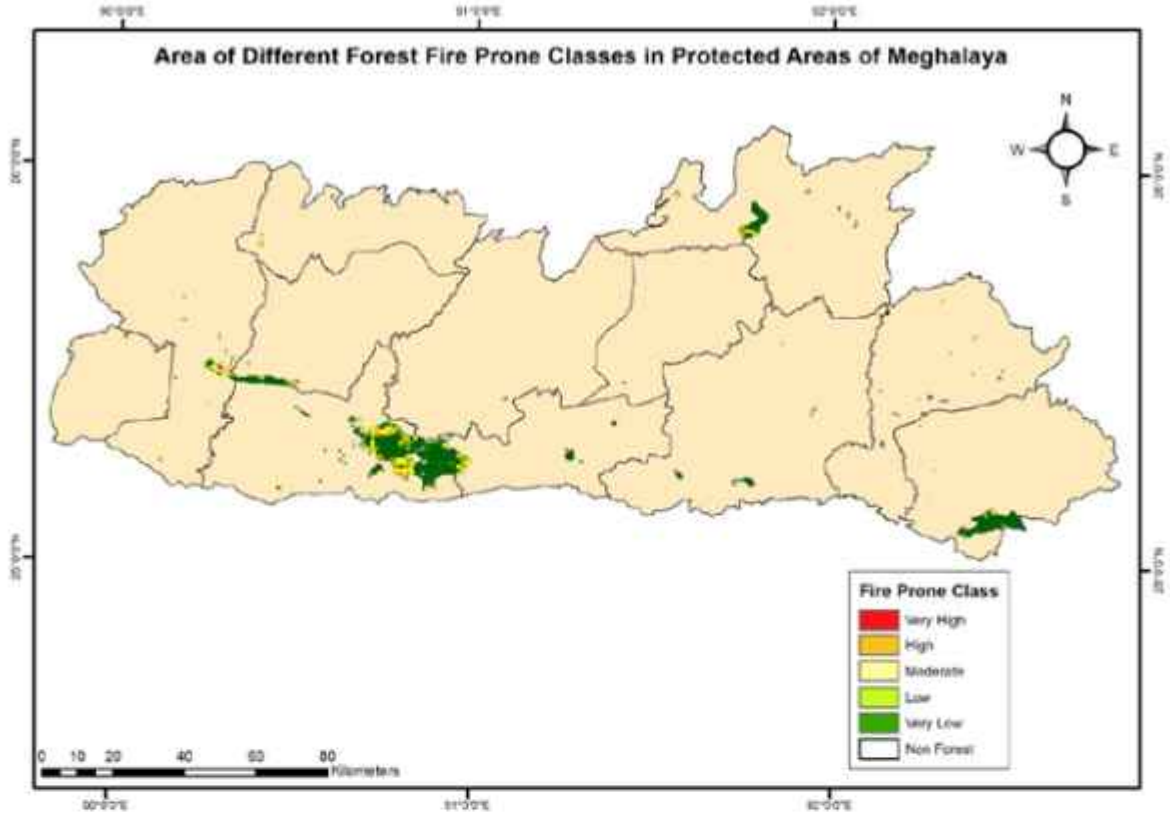


Figure 47. Area of Different Forest Fire Prone Classes of Protected Areas in Meghalaya

Protected areas of the state comprise of Wildlife Sanctuaries (WLS), National Parks (NP) and Community Reserves (CR). Forest fire prone analysis shows Nongkhyllem WLS is the only one with an area of 0.33 km^2 under very high prone class among the all-Wildlife Sanctuaries. Baghmara Pitcher Plant WLS is the safest one with no forest cover under high or very high fire prone class. The spatial map of forest fire prone for protected areas is shown in Figure 47. The details of area under different fire prone classes in the wildlife sanctuaries is presented in Table 19 and Figure 48.

Table 19. Forest Fire Prone Classes of Wildlife Sanctuaries with a buffer of 500 m

(Area in Km^2)

Sl.No	Wildlife Sanctuary	Very Low	Low	Moderate	High	Very High
1	Narpuh WLS	62.20	2.39	1.98	0	0
	Narpuh WLS Buffer	79.98	4.66	5.04	0.32	0
2	Nongkhyllem WLS	26.44	4.05	3.50	1.39	0.33
	Nongkhyllem WLS Buffer	38.45	5.25	5.76	2.10	1.49
3	Siju WLS	3.29	0	1.91	0.00	0
	Siju WLS Buffer	6.23	0	3.47	0.38	0
4	Baghmara Pitcher Plant WLS	0.02	0	0	0	0
	Baghmara Pitcher Plant WLS Buffer	0.46	0	0	0	0

Nokrek National Park is more threat to forest fire than Balpakram National Park with 1.24 km^2 under very high fire prone class. The details of area under different prone classes in the two National Parks are given in Table 20 and Figure 48.

Table 20. Forest Fire Prone Classes of National Parks with a buffer of 500 m

(Area in Km^2)

Sl.No	National Park	Very Low	Low	Moderate	High	Very High
1	Balpakram NP	129.89	11.46	9.80	3.77	0
	Balpakram NP Buffer	30.70	11.37	11.49	4.26	0
2	Nokrek NP	28.61	3.95	9.45	1.68	1.24
	Nokrek NP Buffer	45.02	7.48	15.96	5.69	2.29

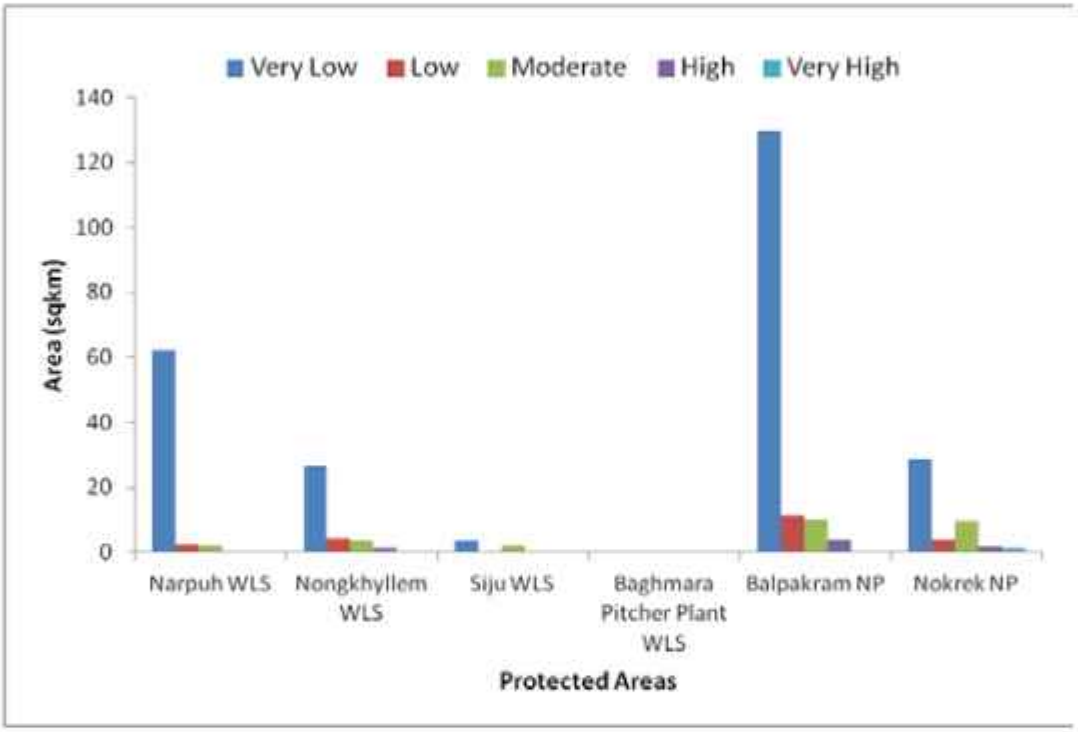


Figure 48. Area under different forest fire prone classes in protected areas of Meghalaya

The State under four different forest divisions i.e. Jaintia Hills Wildlife Division, Khasi Hills Wildlife Division, Balpakram National Park Division and Garo Hills Wildlife Division comprises with 84 nos. of Community Reserve (CR). Chenggni CR is the only community reserve of Balpakram National Park Division coming under very high fire prone class (Table 21). Out of 23 CR of Garo Hills Wildlife Division Sakalgre CR is highest fire prone than others coming under very high fire prone class (Table 22). Community Reserve of Jaintia Hills Wildlife Division is on safer side of fire prone with no CR under high and very high fire prone class (Table 23). Out of 15 Community Reserve of Khasi Hills Wildlife Division Sakalgre CR is the only CR under very high fire prone class (Table 24).

Table 21. Forest Fire Prone classes of Community Reserve under BNPD with a buffer of 500 m *(Area in Km²)*

Sl. No	Community Reserve	Very Low	Low	Moderate	High	Very High
1	Aritakgre CR	0.35	0.25	0	0	0
	Aritakgre CR Buffer	2.55	1.03	0	0	0
2	Balsri Ading CR	0.23	0	0	0	0
	Balsri Ading CR Buffer	1.60	0	0	0	0
3	Chenggni CR	0	0.29	0	1.05	0
	Chenggni CR Buffer	0	0.92	0.62	2.62	0.47
4	Chimitap CR	1.33	0.15	0.37	0	0
	Chimitap CR Buffer	3.46	1.10	1.55	0.01	0
5	Dallenggittim CR	0.04	0	0.18	0	0
	Dallenggittim CR Buffer	0.91	0.25	0.74	0	0
6	Dambuk Attong CR	2.49	0	0.20	0	0
	Dambuk Attong CR Buffer	5.38	0	1.74	0	0
7	Dambuk Jongkol CR	2.32	0	0.93	0	0
	Dambuk Jongkol CR Buffer	5.40	0	3.30	0	0
8	Gokagre CR	0.17	0	0	0	0
	Gokagre CR Buffer	1.38	0.41	0	0	0
9	Halwa Ambeng CR	0.22	0	0.26	0	0
	Halwa Ambeng CR Buffer	1.93	0.13	1.23	0	0
10	Jaksongram CR	0	0.38	0	0	0
	Jaksongram CR Buffer	0.12	1.65	0.46	0.37	0
11	Karukol Buffer	1.91	0.37	0	0	0
	Karukol CR	0.26	0	0	0	0
12	Krem Longjiah CR	0.01	0	0.32	0	0
	Krem Longjiah CR Buffer	0.89	0	0.68	0.29	0.15
13	Lotnagar CR	0.01	0.10	0	0	0
	Lotnagar CR Buffer	0.74	0.91	0	0	0
14	Lum Matlang Raid Umket CR	0.38	0	0.01	0	0
	Lum Matlang Raid Umket CR Buffer	1.43	0	0.26	0.00	0
15	Matchirampat CR	0.20	0	0.04	0	0
	Matchirampat CR Buffer	1.52	0	0.87	0	0
16	Nikwatgre CR	0.02	0.13	0	0	0
	Nikwatgre CR Buffer	0.73	1.13	0.01	0	0
17	Rantangsora Buffer	0.31	0	0.54	0.69	0
	Rantangsora CR	0.01	0	0.07	0.03	0
18	Rongcheng CR	0.25	0.40	0	0	0
	Rongcheng CR Buffer	1.35	1.80	0	0	0
19	Ryntong Clan CR	0	0.02	0	0.12	0
	Ryntong Clan CR Buffer	0	0.64	0.01	0.99	0
20	Siju Duramong I CR	0	0.04	0.76	0	0
	Siju Duramong I CR Buffer	0.20	0.75	2.81	0	0
21	Siju Duramong II CR	1.31	0.88	0.36	0	0

Sl. No	Community Reserve	Very Low	Low	Moderate	High	Very High
	Siju Duramong II CR Buffer	3.95	1.00	1.77	0	0
22	Sonowa CR	1.25	0.42	0.12	0	0
	Sonowa CR Buffer	4.40	1.00	1.17	0	0
23	Taidang CR	0	0.65	0.08	0.01	0
	Taidang CR Buffer	0.27	2.02	0.88	0.44	0
24	Teptepa Buffer	3.21	0.83	0.31	0.70	0
	Teptepa CR	0.98	0.26	0	0.26	0
25	Upper Dosogre CR	0.23	0	0	0	0
	Upper Dosogre CR Buffer	1.91	0	0	0	0

Table 22. Forest Fire Prone classes of Community Reserve under GHWD with a buffer of 500 m

(Area in Km²)

Sl. No	Community Reserve	Very Low	Low	Moderate	High	Very High
1	Aruakgre CR	0	0	0.76	0.25	0
	Aruakgre CR Buffer	0	0.49	2.51	0.81	0
2	Aruakgre I CR	0	0.06	0	0	0
	Aruakgre I CR Buffer	0	1.19	0.12	0	0
3	Baladingre CR	0	0	0.24	0.01	0
	Baladingre CR Buffer	0	0.01	1.54	0.54	0
4	Bandarigre CR	0.01	0	0	0	0
	Bandarigre CR Buffer	0.98	0	0	0	0
5	Chandigre CR	0	0	0.25	0.12	0
	Chandigre CR Buffer	0.16	0	0.83	1.59	0
6	Chimanpara CR	0	0	0.03	0.04	0
	Chimanpara CR Buffer	0	0.39	0.41	0.55	0
7	Dankipara CR	0.02	0	0	0	0
	Dankipara CR Buffer	1.09	0.02	0	0	0
8	Daribokgre CR	0.06	0	0.27	1.40	0
	Daribokgre CR Buffer	1.23	0	1.34	3.55	0
9	Dumitdigre CR	0.09	0.05	0.57	0	0
	Dumitdigre CR Buffer	0.93	0.81	1.73	0	0
10	Dura Kalakgre CR	0	0	0.06	0.19	0
	Dura Kalakgre CR Buffer	0.04	0	1.80	3.07	0
11	Eman Asakgre CR	0.32	0	0	0	0
	Eman Asakgre CR Buffer	1.77	0.51	0	0	0
12	Kitmadamgre CR	0	0	0.69	0.02	0
	Kitmadamgre CR Buffer	0	0.30	2.29	0.65	0
13	Mandalgre CR	0	0	0	0.33	0
	Mandalgre CR Buffer	0	0	0.77	1.52	0
14	Mikadogre CR	0	0.01	0	0	0
	Mikadogre CR Buffer	0.39	0.54	0.03	0	0
15	Mongalgre CR	0.19	0	0	0	0
	Mongalgre CR Buffer	1.37	0.47	0	0.02	0

Sl. No	Community Reserve	Very Low	Low	Moderate	High	Very High
16	ResuHaluapara CR	0.50	0	0	0	0
	ResuHaluapara CR Buffer	2.66	0.21	0	0	0
17	Rongalgre CR	0.16	0	0	0	0
	Rongalgre CR Buffer	1.58	0	0.13	0	0
18	Rongma Paromgre CR	0.19	0.19	0.24	0	0
	Rongma Paromgre CR Buffer	1.88	0.92	1.32	0	0
19	Rongma Rekmangre CR	0.94	0.29	0	0	0
	Rongma Rekmangre CR Buffer	2.78	1.40	0.66	0	0
20	Sakalgre CR	0	0	0.96	0	0.26
	Sakalgre CR Buffer	0.02	0	3.34	0.14	1.35
21	Sasatgre CR	0.03	0	0.56	0	0
	Sasatgre CR Buffer	0.44	0.13	2.42	0	0
22	Selbagre CR	0.10	0	0.11	0	0
	Selbagre CR Buffer	1.45	0.04	1.35	0	0
23	Thokpara CR	0	0.16	0	0.14	0
	Thokpara CR Buffer	0	0.99	0.36	1.09	0
24	Rewak Watregittim CR	0.19	0	0	0	0
	Rewak Watregittim CR Buffer	1.417	0.001	0	0	0
25	Rewak Daburam CR	0.11	0	0	0	0
	Rewak Daburam CR Buffer	1.424	0.149	0	0	0

Table 23. Forest Fire Prone classes of Community Reserve under JHWD with a buffer of 500 m

(Area in Km²)

Sl.No	Community Reserve	Very Low	Low	Moderate	High	Very High
1	Ka Khlaw Umthalong CR	0	0	0	0	0
	Ka Khlaw Umthalong CR Buffer	0	0	0.12	0	0
2	Ka Khloo Blai Lyngdoh Sein Raij Mynso CR	0.01	0	0	0	0
	Ka Khloo Blai Lyngdoh Sein Raij Mynso CR Buffer	0.90	0	0	0	0
3	Ka Khloo Langdoh Kur Pyrtuh CR	0.14	0	0	0	0
	Ka Khloo Langdoh Kur Pyrtuh CR Buffer	1.25	0.26	0	0	0
4	Ka Khloo Pohblai Mooshutia CR	0.22	0	0	0	0
	Ka Khloo Pohblai Mooshutia CR Buffer	0.95	0.04	0	0	0
5	Ka Khloo Thangbru Sula Lynter Sein Raij Mynso CR	0.03	0	0	0	0
	Ka Khloo Thangbru Sula Lynter Sein Raij Mynso CR Buffer	0.85	0.28	0	0	0
6	Ka Khloo Thangbru Umsymphu CR	0.09	0	0	0	0
	Ka Khloo Thangbru Umsymphu CR Buffer	0.47	0	0	0	0
7	Ka Krem Labit Umkyrpong CR	0	0	0	0.05	0
	Ka Krem Labit Umkyrpong CR	0.05	0	0.09	0.83	0

	Buffer					
Sl. No	**Community Reserve**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
8	Ka Lum Luwe CR	0	0	0.09	0	0
	Ka Lum Luwe CR Buffer	0	0.33	0.95	0.01	0
9	Ka Wah Umpatho CR	0.05	0	0.07	0	0
	Ka Wah Umpatho CR Buffer	0.50	0	0.28	0.02	0
10	Khloo Blai Chyrmang Sein Raij Kongwasan Chyrmang Kmai CR	0.05	0	0	0	0
	Khloo Blai Chyrmang Sein Raij Kongwasan Chyrmang Kmai CR Buffer	0.58	0.01	0	0.12	0
11	Khloo Blai Ka Raij U LangdohIonglang CR	0.11	0.04	0	0	0
	Khloo Blai Ka Raij U LangdohIonglang CR Buffer	0.88	0.47	0.33	0	0
12	Khloo Blai Sein Raij Tuber CR	0.75	0.15	0	0	0
	Khloo Blai Sein Raij Tuber CR Buffer	1.83	0.60	0.01	0.16	0
13	Khloo Moopyai wapung CR	0.14	0.15	0.13	0	0
	Khloo Moopyai wapung CR Buffer	0.80	0.43	0.37	0	0
14	Khlow Blai Langdoh Kur Lyndoh Raij Raliang CR	0.03	0	0	0	0
	Khlow Blai Langdoh Kur Lyndoh Raij Raliang CR Buffer	0.87	0	0.02	0	0
15	Smaw Der Khli CR	0	0	0	0	0
	Smaw Der Khli CR Buffer	0	0.61	0.12	0	0
16	Khloo Amrawan CR	0.80	0	0	0	0
	Khloo Amrawan CR Buffer	0.970	0	0	0	0
17	Ka Khloo Blai Ryngkaw Ka Sein Raij Khonshnong CR	0.38	0.03	0.15	0	0
	Ka Khloo Blai Ryngkaw Ka Sein Raij Khonshnong CR Buffer	1.399	0.531	0.616	0	0
18	Krem Iongjiah CR	0.01	0	0.32	0	0
	Krem Iongjiah CR Buffer	0.901	0	1.005	0.293	0.148

Table 24. Forest Fire Prone classes of Community Reserve under KHWD with a buffer of 500 m

(Area in Km^2)

Sl. No	**Community Reserve Forest**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
1	Jirang CR	0	0	0.72	1.23	0
	Jirang CR Buffer	0.08	0.36	1.96	2.93	0.20
2	Khlyllem Shrieh Mutong Village CR	0.01	0	0	0	0
	Khlyllem Shrieh Mutong Village CR Buffer	0.27	0	0	0	0
3	Kpoh Eijah CR	0.14	0	0	0	0
	Kpoh Eijah CR Buffer	1.34	0	0	0	0
4	Law Lyngdoh CR	0.03	0	0	0	0
	Law Lyngdoh CR Buffer	0.43	0	0	0	0

Sl. No	Community Reserve Forest	Very Low	Low	Moderate	High	Very High
5	Lawbah CR	2.29	0	0	0	0
	Lawbah CR Buffer	4.72	0	0.91	0	0
6	Lumjusong CR	0	0	0	1.30	0
	Lumjusong CR Buffer	0	0	0.35	3.24	0.48
7	Lumkohkriah CR	4.96	0.34	0	0.22	0
	Lumkohkriah CR Buffer	8.34	0.97	0.06	0.86	0
8	Miewsyiar CR	0	0.85	0.01	0	0
	Miewsyiar CR Buffer	0.30	2.26	0.97	0	0
9	Nongsangu CR	0.28	0.33	0.36	0	0
	Nongsangu CR Buffer	1.40	0.85	1.60	0.35	0
10	Pdahkyndeng CR	0	0	0	0.61	0.14
	Pdahkyndeng CR Buffer	0	0	0.25	1.76	1.31
11	Phudja-Ud CR	0.87	0	0	0.25	0
	Phudja-Ud CR Buffer	2.05	0.13	0.20	0.59	0
12	Raid Nongbri CR	0.38	0.32	0	0	0
	Raid Nongbri CR Buffer	1.00	1.67	0	0.36	0
13	Rngibah CR	0.01	0.10	0.49	0.21	0
	Rngibah CR Buffer	0.38	0.96	2.10	0.68	0
14	Ryngud CR	5.20	0	0	0	0
	Ryngud CR Buffer	12.42	0	0	0	0
15	Thangkharang CR	0.39	0.37	0	0	0
	Thangkharang CR Buffer	2.53	0.79	0	0	0
16	Umsum CR	0.28	0	0	0	0
	Umsum CR Buffer	2.04	0	0	0.05	0

4.5.3. Biosphere Reserve

The only Biosphere Reserve of the state, Nokrek Biosphere Reserve is also prone to forest fire with 91.91 sqkm, 18.59 sqkm under high and very high fire prone classes respectively. The details of area under different vulnerability classes of the Biosphere Reserve presented in Table 25.

Table 25. Forest Fire Prone classes of Biosphere Reserve with a buffer of 500 m

(Area in Km²)

Sl.No	Biosphere Reserve	Very Low	Low	Moderate	High	Very High
1	Nokrek Biosphere Reserve	288.94	125.41	233.11	91.91	18.59
	Nokrek Biosphere Reserve Buffer	326.87	137.46	247.56	95.76	18.59

4.5.4. Eco-Sensitive Zone

Out of four Eco-sensitive Zone, BNP-SIJU ESZ is proposed one other three are notified Eco-sensitive Zone of the state. The Nokrek ESZ and Nongkhyllem ESZ have more prone to forest fire with 59.24 sqkm and 34.74 sqkm, respectively under high and very high fire prone class.

The spatial map of Eco-sensitive Zone with prone classes is shown in Figure 49. The details of area under different fire prone classes of the ESZ is given in Table 26 and Figure 50.

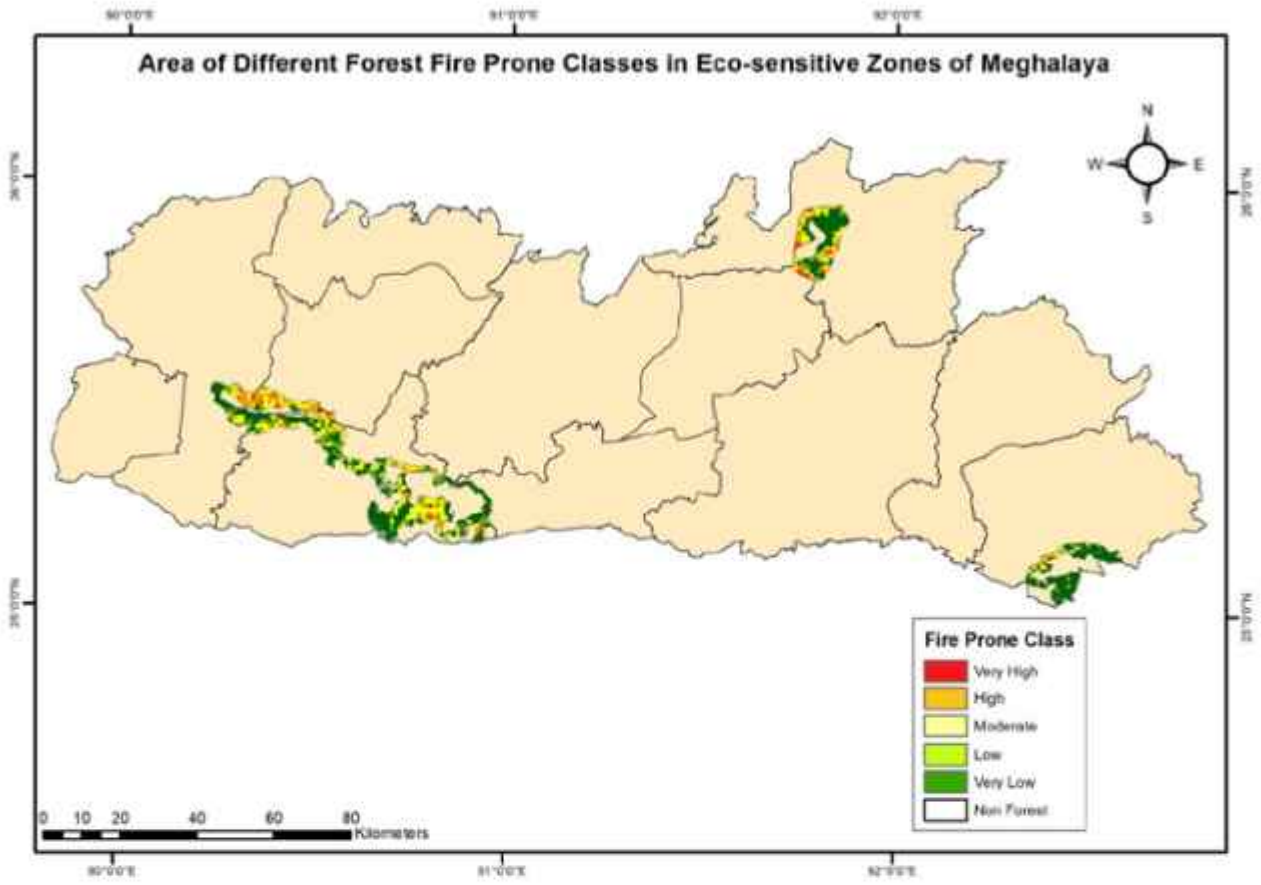


Figure 49. Forest Fire Prone Area Map of Eco-Sensitive Zone

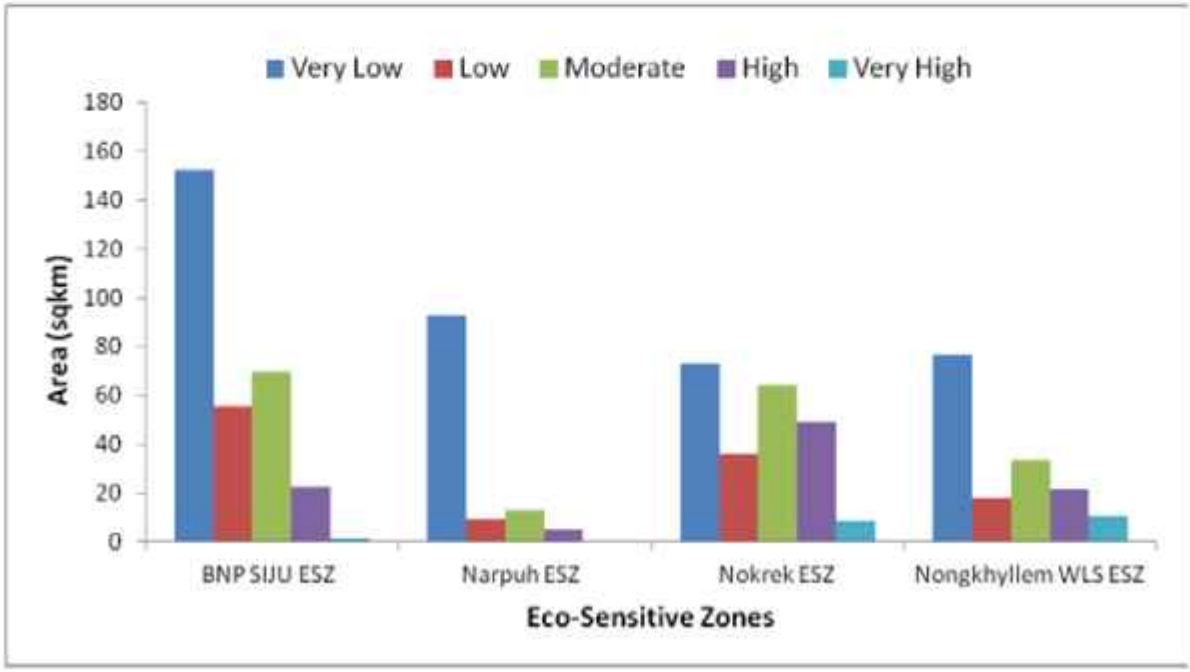


Figure 50. Area under different forest fire prone zone in wildlife sanctury forest of Meghalaya

Table 26. Forest Fire Prone classes of Eco sensitive Zone with a buffer of 500 m

(Area in Km²)

Sl.No	Ecosensitive Zones	Very Low	Low	Moderate	High	Very High
1	BNP SIJU ESZ - Proposed	152.40	55.64	69.81	22.64	1.73
	BNP SIJU ESZ Buffer	327.59	80.34	101.71	32.50	1.99
2	Narpuh ESZ - Notified	92.79	9.50	12.96	5.18	0.00
	Narpuh ESZ Buffer	172.66	14.48	17.59	7.05	0.32
3	Nokrek ESZ - Notified	73.26	36.11	63.93	49.24	8.64
	Nokrek ESZ Buffer	121.09	51.34	88.87	56.21	11.26
4	Nongkhyllem WLS ESZ - Notified	76.89	17.97	33.35	21.77	10.54
	Nongkhyllem WLS ESZ Buffer	106.43	23.90	43.39	33.47	17.77

4.5.5. Sacred Groves

Among the selected sacred groves of Khasi and Jaintia Hills, Khlaw Raid Raitong is only SG, extremely affected by forest fire under very high fire prone class. The details area under different fire prone classes of the SGs are in given Table 27.

Table 27. Forest Fire Prone classes of few Sacred Groves of Khasi and Jaintia Hills

(Area in Km²)

Sl. No	Sacred Groves	Very Low	Low	Moderate	High	Very High
1	Iong Bong Raliang Dolloiship SG	0.018	0	0	0	0
	Iong Bong Raliang Dolloiship SG Buffer	0.886	0	0	0.119	0
2	Ka Khloo Blai Lyngdoh Sein Raij Mynso SG	0.009	0	0	0	0
	Ka Khloo Blai Lyngdoh Sein Raij Mynso SG Buffer	0.898	0	0	0	0
3	Ka Khloo Langdoh Kur Pyrtuh SG	0.145	0	0	0	0
	Ka Khloo Langdoh Kur Pyrtuh SG Buffer	1.248	0.262	0	0	0
4	Ka Khloo Thangbru Sula Lynter Sein Raij Mynso SG	0.033	0	0	0	0
	Ka Khloo Thangbru Sula Lynter Sein Raij Mynso SG Buffer	0.849	0.279	0	0	0
5	Khlaw Blai Moopassah SG	0.004	0	0.002	0	0
	Khlaw Blai Moopassah SG Buffer	0.484	0	0.463	0.021	0
6	Khlaw Blai Niam Kmai Pohpyrda SG	0.025	0	0	0	0
	Khlaw Blai Niam Kmai Pohpyrda SG Buffer	1.095	0	0	0	0
7	Khlaw Blai Pohmurang SG	0.015	0	0	0	0
	Khlaw Blai Pohmurang SG Buffer	0.678	0	0	0	0
8	Khlaw Blai Raij Niam Tyrsha SG	0.005	0	0	0	0
	Khlaw Blai Raij Niam Tyrsha SG Buffer	0.850	0.001	0	0.065	0
9	Khlaw Blai Ryngkaw Khonchnong SG	0.377	0.033	0.148	0	0

Sl. No	Sacred Groves	Very Low	Low	Moderate	High	Very High
	Khlaw Blai Ryngkaw Khonchnong SG Buffer	1.402	0.528	0.618	0	0
10	Khlaw Blai Shyllong SG	0	0	0	0	0
	Khlaw Blai Shyllong SG Buffer	0.351	0	0.290	0	0
11	Khlaw Raid Raitong SG	0	0	0.149	0.102	0.293
	Khlaw Raid Raitong SG Buffer	0.134	0	0.795	1.261	1.336
12	Khlieh Shnong Ingkhrong SG	0.054	0	0	0	0
	Khlieh Shnong Ingkhrong SG Buffer	0.177	0	0.005	0	0
13	Khlieh Shnong Sohra Mawphon SG	0.046	0.028	0	0	0
	Khlieh Shnong Sohra Mawphon SG Buffer	0.060	0.038	0	0	0
14	Khlo Blai Lyngdoh SG	0.028	0	0	0	0
	Khlo Blai Lyngdoh SG Buffer	0.881	0	0.020	0	0
15	Khlo Pohpuja Khlo Kyngtang SG	0.003	0	0	0	0
	Khlo Pohpuja Khlo Kyngtang SG Buffer	0.559	0	0.120	0	0
16	Khloo Blai Chyrmang Sein Raij Kong Wasan SG	0.057	0	0	0	0
	Khloo Blai Chyrmang Sein Raij Kong Wasan SG Buffer	0.603	0.019	0	0.144	0
17	Khloo Blai Ka Raij U Langdohionglang SG	0.112	0.036	0.003	0	0
	Khloo Blai Ka Raij U Langdohionglang SG Buffer	0.882	0.471	0.329	0	0
18	Khloo Blai Sein Raij Tuber SG	0.740	0.149	0	0	0
	Khloo Blai Sein Raij Tuber SG Buffer	1.830	0.601	0.010	0.156	0
19	Khloo Poh Blai Mooshutia SG	0.217	0	0	0	0
	Khloo Poh Blai Mooshutia SG Buffer	0.955	0.044	0	0	0
20	Khloo Thang Bru Umsymphu SG	0.084	0	0	0	0
	Khloo Thang Bru Umsymphu SG Buffer	0.470	0	0	0	0
21	Khongsit Mawlum SG	0.017	0.074	0.065	0	0
	Khongsit Mawlum SG Buffer	1.216	0.119	0.821	0	0
22	Kmawanrum Khlar SG	0.003	0	0	0	0
	Kmawanrum Khlar SG Buffer	0.347	0	0	0	0
23	Kullai Langsngun Lawadong Lawkur SG	0.109	0.089	0	0	0
	Kullai Langsngun Lawadong Lawkur SG Buffer	0.204	0.243	0.016	0	0
24	Kur Myrthong SG	0.274	0.288	0	0	0
	Kur Myrthong SG Buffer	1.078	0.794	0	0	0
25	Kyntoit Diengsiar Mawlong SG	0.008	0	0	0	0
	Kyntoit Diengsiar Mawlong SG Buffer	0.885	0	0	0	0
26	Kyntoit Mawriang Mawlong SG	0.003	0	0	0	0
	Kyntoit Mawriang Mawlong SG Buffer	0.806	0	0	0	0
27	Kyntoit Nongduh Mawlong SG	0.002	0	0	0	0
	Kyntoit Nongduh Mawlong SG Buffer	0.832	0	0	0	0

Sl. No	Sacred Groves	Very Low	Low	Moderate	High	Very High
28	Laitkynsew Mawkdar SG	0.038	0	0	0	0
	Laitkynsew Mawkdar SG Buffer	1.112	0	0	0	0
29	Law Adong Kohlu Khyrdop Mawlieh	0	0.011	0	0	0
	Law Adong Kohlu Khyrdop Mawlieh Buffer	0.079	0.753	0	0	0
30	Law Adong Law Pjaih Laitryngew SG	0.017	0	0	0	0
	Law Adong Law Pjaih Laitryngew SG Buffer	0.091	0	0.012	0	0
31	Law Adong Of Laitkynsew At Lumlaitdihum SG	0.046	0	0	0	0
	Law Adong Of Laitkynsew At Lumlaitdihum SG Buffer	0.435	0	0.274	0	0
32	Law Adong Synrang Sahum SG Buffer	0.011	0	0	0	0
	Law Adong Tad Latom At Swer SG	0.001	0.173	0	0	0
33	Law Adong Tad Latom At Swer SG Buffer	0.479	0.554	0	0	0
	Law Adong Tyrjut Raid Nongkhlieng SG	0	0	0.126	0	0
34	Law Adong Tyrjut Raid Nongkhlieng SG Buffer	0.350	0.347	0.785	0	0
	Law Adong Wah Shadsngi Nongmadan SG Buffer	0.169	0	0	0	0
35	Law Ing Blei Lyngdoh Nonglynkin SG	0.038	0	0	0	0
	Law Ing Blei Lyngdoh Nonglynkin SG Buffer	0.278	0	0	0	0
36	Law Kyntang Mukertilla Raid Mukertilla SG	0.063	0	0	0	0
	Law Kyntang Mukertilla Raid Mukertilla SG Buffer	1.358	0	0	0	0
37	Law Kyntang Of Smti. Philo SG	0.010	0	0	0	0
	Law Kyntang Of Smti. Philo SG Buffer	0.734	0	0	0	0
38	Law Lyngdoh Lait Raid Mawkhap SG	0	0	0.049	0	0
	Law Lyngdoh Lait Raid Mawkhap SG Buffer	0.151	0	1.113	0	0
39	Law Lyngdoh Law Adong At Nonglynkin SG	0.020	0	0	0	0
	Law Lyngdoh Law Adong At Nonglynkin SG Buffer	0.217	0.012	0	0	0
40	Law Lyngdoh Lawadong Kur Lai Kynja SG	0.126	0	0	0	0
	Law Lyngdoh Lawadong Kur Lai Kynja SG Buffer	0.711	0	0	0	0
41	Law Lyngdoh Lyngiong SG	0.521	0	0	0	0
	Law Lyngdoh Lyngiong SG Buffer	1.533	0	0	0	0
42	Law Lyngdoh Raid Wahkhen SG	0.020	0	0	0	0
	Law Lyngdoh Raid Wahkhen SG Buffer	1.081	0.007	0.001	0	0
43	Law Lyngdoh Rngaid SG	0.016	0	0	0	0

Sl. No	Sacred Groves	Very Low	Low	Moderate	High	Very High
	Law Lyngdoh Rngaid SG Buffer	0.190	0	0.014	0	0
44	Law Lyngdoh Sawkpoh Wanniang SG	0.032	0	0	0	0
	Law Lyngdoh Sawkpoh Wanniang SG Buffer	0.388	0	0	0	0
45	Law Lyngdoh Shillong Maw SG	0.003	0	0	0	0
	Law Lyngdoh Shillong Maw SG Buffer	0.762	0	0.099	0	0
46	Law Pyllun Kur Iawphniaw Mawsaw SG	0	0.237	0.101	0	0
	Law Pyllun Kur Iawphniaw Mawsaw SG Buffer	0.250	0.572	0.266	0	0
47	Law Saw Symber SG	0.170	0	0	0	0
	Law Saw Symber SG Buffer	0.266	0	0	0	0
48	Lawadong Dohling SG	0.433	0.022	0	0	0
	Lawadong Dohling SG Buffer	1.646	0.203	0	0	0
49	Lawadong Iapmoit SG	0.007	0	0	0	0
	Lawadong Iapmoit SG Buffer	0.082	0	0.012	0	0
50	Lawadong Iawkait At Laitryngew SG Buffer	0.075	0	0.003	0	0
	Lawadong Kliar Umrem SG Buffer	0.194	0	0	0	0
51	Lawadong Kshaid SG	0.005	0	0	0	0
	Lawadong Kshaid SG Buffer	0.056	0	0.012	0	0
52	Lawadong Laitkynsew Lumlaitdihum SG	0.176	0	0	0	0
	Lawadong Laitkynsew Lumlaitdihum SG Buffer	2.605	0	0	0	0
53	Lawadong Laitmawpat SG	0.189	0.101	0	0	0
	Lawadong Laitmawpat SG Buffer	0.618	0.217	0	0	0
54	Lawadong Law Madan At Mawmluh SG	0.106	0	0	0	0
	Lawadong Law Madan At Mawmluh SG Buffer	1.632	0	0	0	0
55	Lawadong Lawarliang SG	0.047	0	0	0	0
	Lawadong Lawarliang SG Buffer	0.270	0.029	0.003	0	0
56	Lawadong Lawlung Nongshlem SG	0.413	0	0	0	0
	Lawadong Lawlung Nongshlem SG Buffer	2.168	0.104	0.014	0	0
57	Lawadong Mawsawa SG	0.131	0	0	0	0
	Lawadong Mawsawa SG Buffer	1.174	0	0	0	0
58	Lawadong Niangblah SG	0.057	0	0.127	0	0
	Lawadong Niangblah SG Buffer	0.645	0	0.603	0	0
59	Lawadong Nongsynrieh SG	0.063	0	0	0	0
	Lawadong Nongsynrieh SG Buffer	0.846	0	0	0	0
60	Lawadong Of Mawtneng SG	0	0.357	0.111	0.229	0
	Lawadong Of Mawtneng SG Buffer	0.441	0.886	1.109	0.831	0
61	Lawadong Phud Synrang SG Buffer	0.073	0	0	0	0
	Lawadong Sangriang SG	0.073	0	0	0	0

Sl. No	Sacred Groves	Very Low	Low	Moderate	High	Very High
62	Lawadong Sangriang SG Buffer	0.590	0.012	0	0	0
	Lawadong Sawkpoh Kur Nonglang SG	0.170	0	0	0	0
63	Lawadong Sawkpoh Kur Nonglang SG Buffer	1.183	0.029	0	0	0
	Lawadong Sohmyndong SG	0.026	0	0	0	0
64	Lawadong Sohmyndong SG Buffer	0.677	0.116	0	0	0
	Lawadong Suidnoh SG Buffer	0.118	0.213	0	0	0
65	Lawadong Them U Mud SG Buffer	0	0.011	0	0	0
	Lawadong Thymmai Laitryngew SG	0	0	0.003	0	0
66	Lawadong Thymmai Laitryngew SG Buffer	0.034	0	0.012	0	0
	Lawadong Wah Marobinat SG	0.011	0	0	0	0
67	Lawadong Wah Marobinat SG Buffer	0.616	0	0.134	0	0
	Lawadong Wah Rangmuh SG	0.006	0	0.020	0	0
68	Lawadong Wah Rangmuh SG Buffer	0.509	0.060	0.584	0	0
	Lawadong Wah SG	0.202	0	0	0	0
69	Lawadong Wah SG Buffer	2.163	0	0	0	0
	Lawadong Wah Um Sohphie SG	0	0.011	0	0	0
70	Lawadong Wah Um Sohphie SG Buffer	0.001	0.013	0	0	0
	Lawadong Wahingbah SG	0.001	0	0	0	0
71	Lawadong Wahingbah SG Buffer	0.096	0.001	0	0	0
	Lawadong Wahsier Swer SG	0.267	0.001	0	0	0
72	Lawadong Wahsier Swer SG Buffer	1.282	0.114	0.038	0	0
	Lawkyntang Blai Raij Niwakmai SG	0.005	0	0	0	0
73	Lawkyntang Blai Raij Niwakmai SG Buffer	0.864	0	0.052	0	0
	Lawkyntang Lyngdoh Mawnai SG	0.177	0	0.031	0	0
74	Lawkyntang Lyngdoh Mawnai SG Buffer	0.760	0.022	0.515	0	0
	Lawkyntang Mawbang SG Buffer	0.411	0	0	0	0
75	Lawkyntang Nongrim Khien Bsap Raij Mawlieh SG	0	0.012	0	0	0
	Lawkyntang Nongrim Khien Bsap Raij Mawlieh SG Buffer	0.156	0.431	0	0	0
76	Lawkyntang Of Tken Muker Raid Mukertilla SG	0.015	0	0	0	0
	Lawkyntang Of Tken Muker Raid Mukertilla SG Buffer	1.025	0	0	0	0
77	Lawkyntang Raid Nongpoh SG	0.248	0	0.287	0	0
	Lawkyntang Raid Nongpoh SG Buffer	1.147	0.081	1.054	0	0
78	Lawkyntang Ryngkew Swer SG	0	0.123	0	0	0
	Lawkyntang Ryngkew Swer SG Buffer	0.254	0.548	0	0	0
79	Lawkyntang Umkyrsan SG	0.003	0	0	0	0
	Lawkyntang Umkyrsan SG Buffer	0.917	0	0	0	0
80	Lawkyrphei SG Buffer	0.374	0	0	0	0

Sl. No	Sacred Groves	Very Low	Low	Moderate	High	Very High
81	Lawlyngdoh Erbamon SG	0.002	0	0	0	0
	Lawlyngdoh Erbamon SG Buffer	0.746	0	0	0	0
82	Lawlyngdoh Kharai Raid Nongkhlieng SG	0.019	0	0	0	0
	Lawlyngdoh Kharai Raid Nongkhlieng SG Buffer	1.080	0	0	0	0
83	Lawlyngdoh Mawlot Phyllut SG	0.147	0	0	0	0
	Lawlyngdoh Mawlot Phyllut SG Buffer	0.728	0.097	0	0	0
84	Lawlyngdoh Synrynew	0.009	0	0	0	0
	Lawlyngdoh Synrynew Buffer	0.928	0	0.051	0	0
85	Lumniang Law Lyngdoh Of Kur Myrthong SG	0	0.568	0.024	0	0
	Lumniang Law Lyngdoh Of Kur Myrthong SG Buffer	0	1.249	0.104	0.197	0
86	Lynching SG	0.103	0	0.028	0	0
	Lynching SG Buffer	0.269	0	0.223	0	0
87	Mawbrai SG Buffer	0.231	0	0	0	0
88	Mawhiang SG	0.057	0.198	0	0	0
	Mawhiang SG Buffer	0.633	0.253	0.033	0	0
89	Mawlynnu 11 SG	0.003	0	0	0	0
	Mawlynnu 11 SG Buffer	0.621	0	0	0	0
90	Mawlynnu Khlieh Weiloi SG Buffer	0.183	0	0	0	0
91	Mawlynnu Mawksan SG	0.134	0.020	0	0	0
	Mawlynnu Mawksan SG Buffer	0.538	0.425	0	0	0
92	Mawranglang SG	0	0	0.063	0	0
	Mawranglang SG Buffer	0	0.288	0.423	0	0
93	Mawtangor SG	0.004	0	0.028	0	0
	Mawtangor SG Buffer	0.174	0	0.595	0.075	0
94	Mawteibah SG	0.513	0.003	0	0	0
	Mawteibah SG Buffer	0.918	0.604	0	0	0
95	Myllep Klo Blai Raijkhonchnong SG	0.115	0	0	0	0
	Myllep Klo Blai Raijkhonchnong SG Buffer	1.381	0	0	0	0
96	Mynthiang Khlo Kyntang SG	0	0.003	0	0	0
	Mynthiang Khlo Kyntang SG Buffer	0.038	0.535	0.286	0	0
97	Nongrimbah Lawadong Mawlangwir SG	0.215	0.023	0.084	0	0
	Nongrimbah Lawadong Mawlangwir SG Buffer	0.863	0.055	0.105	0	0
98	Nongsiej Bisap SG	0	0	0.051	0	0
	Nongsiej Bisap SG Buffer	0.059	0.254	0.984	0.019	0
99	Nongsiej Laitwir SG	0	0	0.150	0.009	0
	Nongsiej Laitwir SG Buffer	0.169	0	1.021	0.332	0
100	Nongsiej Nongdom Laitnamlang SG	0.132	0	0	0	0
	Nongsiej Nongdom Laitnamlang SG Buffer	1.380	0.239	0.031	0	0

Sl. No	Sacred Groves	Very Low	Low	Moderate	High	Very High
101	Phlangwanbroi SG	0.083	0	0	0	0
	Phlangwanbroi SG Buffer	1.173	0	0.202	0	0
102	Pon Pyrnon Lawadong SG	0.099	0	0	0	0
	Pon Pyrnon Lawadong SG Buffer	0.598	0.065	0.223	0	0
103	Pynden Sakwang SG	0.030	0	0	0	0
	Pynden Sakwang SG Buffer	0.037	0.024	0	0	0
104	Rei Mission Law Adong SG	0.019	0.031	0	0	0
	Rei Mission Law Adong SG Buffer	0.567	0.314	0	0	0
105	Ri Kaksem SG	0.094	0	0	0	0
	Ri Kaksem SG Buffer	1.391	0.233	0	0	0
106	Ryngkaw Khonshnong SG	0.377	0.032	0.147	0	0
	Ryngkaw Khonshnong SG Buffer	1.400	0.528	0.618	0	0
107	Salar Lang SG	0.101	0	0	0	0
	Salar Lang SG Buffer	1.353	0	0	0	0
108	Synrai Hu SG	0.031	0	0	0	0
	Synrai Hu SG Buffer	0.572	0	0	0	0
109	The Jri Tyrkong Lawadong SG	0.101	0	0	0	0
	The Jri Tyrkong Lawadong SG Buffer	1.110	0	0.054	0	0
110	The Lawadong Sawktang SG	0.157	0	0	0	0
	The Lawadong Sawktang SG Buffer	1.888	0	0	0	0
111	The Lawadong Wahthlong SG Buffer	0.034	0	0.012	0	0
112	The Lawkyntang Mawsahep SG	0.011	0	0	0	0
	The Lawkyntang Mawsahep SG Buffer	0.615	0.076	0	0	0
113	The Lawkyntang Noh Ksiar SG Buffer	0.385	0	0	0	0
114	The Lawlyngdoh Kur Nongrem Khain Nongdait 2 SG	0.030	0	0	0	0
	The Lawlyngdoh Kur Nongrem Khain Nongdait 2 SG Buffer	0.170	0	0.019	0	0
115	The Lawlyngdoh Kur Nongrem Khain Nongdait SG	0.063	0	0	0	0
	The Lawlyngdoh Kur Nongrem Khain Nongdait SG Buffer	0.373	0	0	0	0
116	Twahsongparat SG	0.107	0	0	0	0
	Twahsongparat SG Buffer	0.665	0.117	0	0	0
117	Tyllong Um Kyrwiang SG	0.120	0	0	0	0
	Tyllong Um Kyrwiang SG Buffer	1.054	0.180	0	0	0
118	Tyrsad 2 SG	0.002	0	0	0	0
	Tyrsad 2 SG Buffer	0.214	0	0	0	0
119	Tyrsad SG	0.087	0	0	0	0
	Tyrsad SG Buffer	0.410	0	0	0	0
120	Umiong SG	0.362	0.675	0.257	0.002	0
	Umiong SG Buffer	1.324	0.754	0.315	0.007	0
121	Umwai Mawlong Kynrem	0.084	0	0	0	0
	Umwai Mawlong Kynrem Buffer	1.015	0.243	0	0	0

122	Umwai Mawlong SG	0.014	0	0	0	0
	Umwai Mawlong SG Buffer	1.033	0	0	0	0
123	Umwai Nurbah SG	0.020	0	0	0	0
	Umwai Nurbah SG Buffer	1.116	0	0	0	0
124	Umwai Village Mawthoh SG	0.030	0	0	0	0
	Umwai Village Mawthoh SG Buffer	1.166	0	0	0	0
125	Wah Mawthang Soh Khyllung SG	0.002	0.001	0	0	0
	Wah Mawthang Soh Khyllung SG Buffer	0.651	0.252	0	0	0

4.6. Burnt Area Analysis (2015-2021) (OBJECTIVE – III)

4.6.1. State Scenario

For the year 2015-2021 the burnt area analysis has been carried out for the months from November to May (except for the January, 2021 and May, 2021 due to non availability of cloud free satellite imagery). The burnt area analysis of different year is presented in Table 28 and Figure 51. The spatial map of burnt area in different years is presented in Figure 52.

Table 28. Burnt Area for the state of Meghalaya (2015-2021)

Year	Burnt Area (km^2)
2015	899.61
2016	706.39
2017	483.67
2018	375.64
2019	456.30
2020	1144.35
2021	477.13

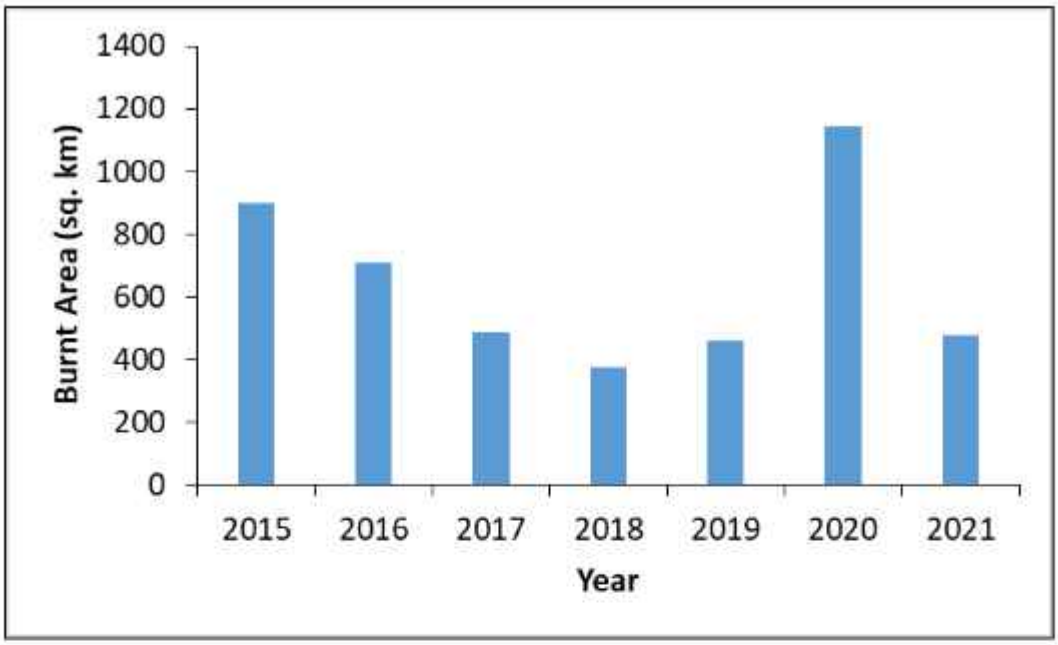


Figure 51. Year wise burnt area in Meghalaya

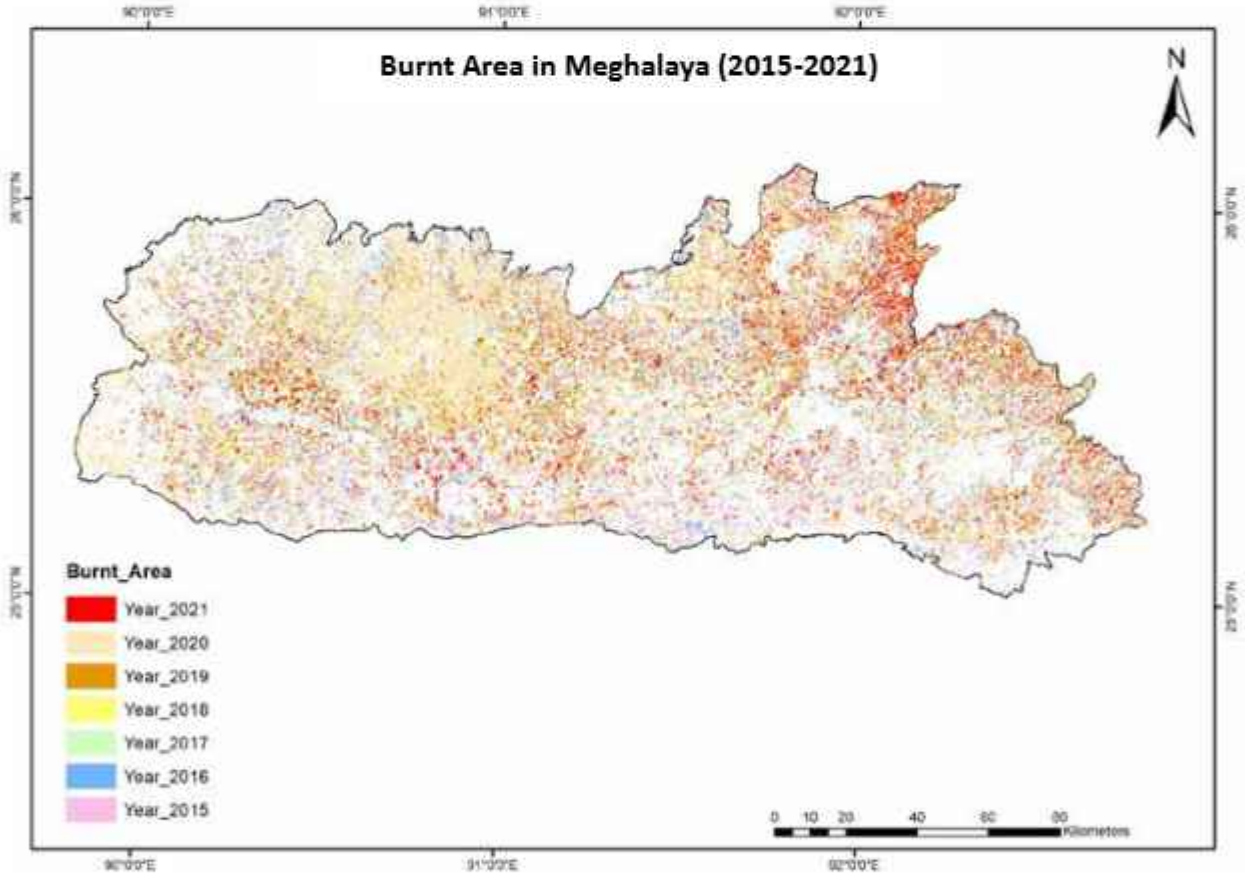


Figure 52. Burnt Area in Meghalaya (2015-2021)

4.6.2. District Scenario

District wise burnt area analysis shows, 2020 is the most forest fire occurrence year in between 2015-2020. With considering this study, West Khasi Hills district is more susceptible to forest fire ranked on top covering highest forest fire burnt area, while South

Wes Garo Hills district is less impacted to forest fire within the state. Ri Bhoi abd East Garo Hills district are also most affected to forest fire followed by West Khasi Hills district. The burnt area analysis of different year for all the district is presented in Table 31 and Figure 52. District-wise Forest fire burnt area maps are given in **Annexure VII.**

4.6.3. Block Scenario

Block wise burnt area analysis shows, Mawshynrut block is most susceptible to forest fire ranked on top covering highest forest fire burnt area, while Mawkdok block is less impacted to forest fire within the state. Ri Bhoi and East Garo Hills districts are also most affected to forest fire followed by West Khasi Hills district. The burnt area analysis of different year for all the blocks is presented in Table 32 and Figure 53. Block-wise Forest fire burnt area maps are given in **Annexure VIII.**

Table 29. District Wise Forest Fire Burnt Area in Meghalaya (2015-2021)

Districts	Year Wise Burnt Area (km^2)													
	2015		2016		2017		2018		2019		2020		2021	
	Area (km^2)	Area (%)	Area (km^2)	Area (%)	Area (km^2)	Area (%)	Area (km^2)	Area (%)	Area (km^2)	Area (%)	Area (km^2)	Area (%)	Area (km^2)	Area (%)
East Garo Hills	102.84	6.43	83.29	5.20	44.66	2.79	45.77	2.86	40.25	2.52	211.46	13.21	32.20	2.01
East Jaintia Hills	81.59	4.23	43.58	2.26	32.79	1.70	16.54	0.86	33.88	1.76	61.65	3.20	34.59	1.80
East Khasi Hills	90.52	3.15	41.14	1.43	24.01	0.84	18.47	0.64	33.33	1.16	47.75	1.66	36.66	1.28
Eastern West Khasi Hills	125.02	9.21	114.71	8.45	82.07	6.05	95.38	7.03	87.38	6.44	219.76	16.19	79.6	5.87
North Garo Hills	66.80	5.31	72.95	5.80	14.76	1.17	20.10	1.60	22.57	1.79	131.17	10.42	13.95	1.11
Ri-bhoi	118.35	5.02	84.90	3.60	94.32	4.00	29.53	1.25	83.65	3.54	136.31	5.78	101.83	4.32
South Garo Hills	74.58	3.99	49.45	2.65	32.37	1.73	28.83	1.54	28.86	1.54	51.30	2.75	28.01	1.50
South West Garo Hills	10.16	1.23	10.46	1.27	4.86	0.59	5.62	0.68	3.80	0.46	34.72	4.21	7.19	0.87
South West Khasi Hills	52.57	4.24	20.05	1.62	15.21	1.23	19.82	1.60	19.79	1.60	37.01	2.99	24.39	1.97
West Garo Hills	90.07	3.40	87.04	3.29	55.39	2.09	54.02	2.04	37.85	1.43	103.92	3.93	39.44	1.49
West Jaintia Hills	55.46	2.92	48.04	2.53	47.63	2.51	19.79	1.04	30.10	1.59	44.27	2.33	40.71	2.15
West Khasi Hills	31.65	1.22	50.76	1.96	35.61	1.38	21.78	0.84	34.86	1.35	65.02	2.51	38.57	1.49
Total	899.61		706.37		483.68		375.65		456.32		1144.34		477.14	

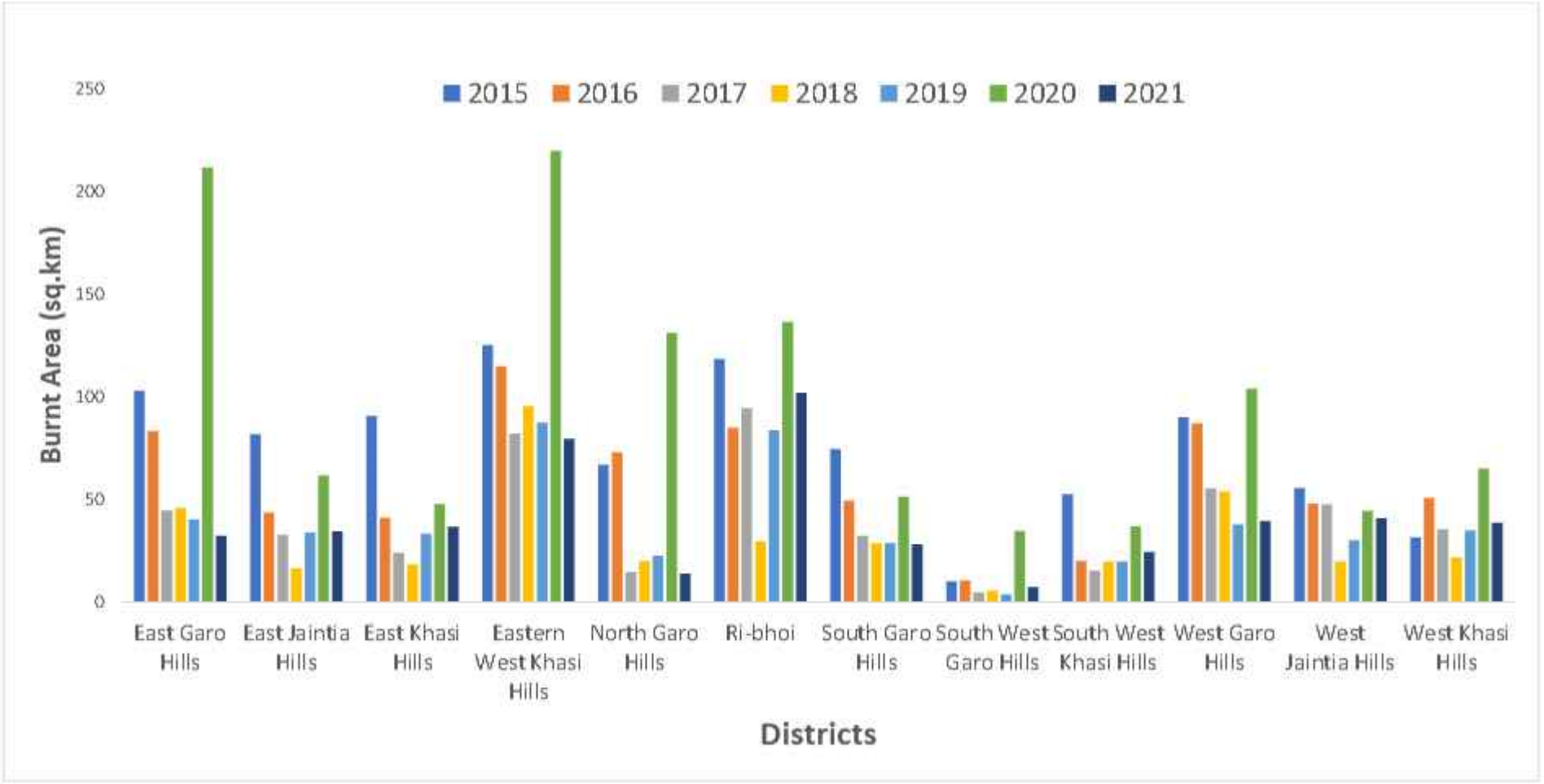


Figure 53. District wise burnt area in different years in Meghalaya

Table 30. Block Wise Burnt Area in Meghalaya

Block	Year Wise Burnt Area (km^2)													
	2015		2016		2017		2018		2019		2020		2021	
	Area (km^2)	Area (%)	Area (km^2)	Area (%)	Area (km^2)	Area (%)	Area (km^2)	Area (%)	Area (km^2)	Area (%)	Area (km^2)	Area (%)	Area (km^2)	Area (%)
Amlarem	17.95	3.96	4.24	0.94	2.32	0.51	3.24	0.72	4.26	0.94	6.14	1.36	3.19	0.70
Baghmara	19.20	3.94	14.62	3.00	8.55	1.75	10.74	2.20	7.38	1.51	15.28	3.14	6.59	1.35
Betasing	4.52	1.19	6.04	1.59	2.01	0.53	2.52	0.66	1.86	0.49	13.90	3.67	4.14	1.09
Chokpot	24.45	4.80	14.65	2.87	12.41	2.43	10.18	2.00	10.14	1.99	13.92	2.73	7.31	1.43
Dadenggre	19.81	3.43	17.05	2.95	8.76	1.52	8.11	1.40	6.85	1.19	15.80	2.74	6.59	1.14
Dalu	11.63	3.11	10.92	2.92	6.75	1.81	4.74	1.27	4.33	1.16	12.60	3.37	4.77	1.28
Gambegre	9.94	3.51	12.81	4.53	7.00	2.47	16.21	5.73	4.40	1.56	20.75	7.33	6.24	2.21
Gasuapara	15.36	4.40	8.88	2.54	5.03	1.44	2.89	0.83	5.02	1.44	11.09	3.18	3.47	0.99
Jirang	37.70	5.69	28.88	4.36	30.81	4.65	13.32	2.01	27.87	4.20	57.95	8.74	21.42	3.23
Kharkutta	26.61	6.69	35.51	8.93	5.22	1.31	6.48	1.63	7.74	1.95	50.80	12.77	5.57	1.40
Khliehriat	36.80	3.91	14.20	1.51	10.97	1.17	5.94	0.63	14.93	1.59	28.06	2.98	11.14	1.18
Laskien	19.10	3.18	16.60	2.77	23.35	3.89	5.97	1.00	9.64	1.61	17.94	2.99	16.64	2.77
Mairang	22.72	2.71	40.88	4.88	29.67	3.54	15.30	1.82	27.76	3.31	51.35	6.12	31.19	3.72
Mawkdok	5.50	2.99	1.64	0.89	1.25	0.68	1.33	0.72	1.33	0.72	2.08	1.13	2.37	1.29
Mawkynrew	8.07	1.98	4.15	1.02	2.43	0.60	1.04	0.26	1.98	0.49	4.01	0.99	2.80	0.69
Mawkyrwat	16.65	3.65	7.32	1.60	4.40	0.96	6.80	1.49	6.21	1.36	10.92	2.39	7.69	1.68
Mawphlang	3.92	1.90	3.73	1.81	3.58	1.73	3.38	1.64	6.95	3.37	6.03	2.92	5.24	2.54
Mawryngkneng	3.94	1.63	8.49	3.52	5.92	2.45	3.14	1.30	5.90	2.44	3.63	1.50	8.63	3.58
Mawshynrut	82.52	5.62	80.40	5.47	52.02	3.54	68.85	4.69	55.68	3.79	172.80	11.76	48.10	3.27
Mawsynram	37.40	4.51	12.39	1.50	4.66	0.56	6.87	0.83	7.72	0.93	17.09	2.06	8.44	1.02
Mawthadraishan	8.93	1.72	9.88	1.91	5.94	1.15	6.48	1.25	7.10	1.37	13.67	2.64	7.38	1.42
Mylliem	1.75	1.01	3.82	2.21	2.32	1.34	0.93	0.54	4.34	2.51	4.25	2.46	2.59	1.50
Nongstoin	42.50	3.80	34.31	3.07	30.05	2.69	26.53	2.37	31.70	2.84	46.96	4.20	31.50	2.82
Pynursla	14.88	3.46	3.19	0.74	1.79	0.42	0.75	0.17	2.52	0.59	4.51	1.05	3.59	0.83

Ranikor	35.92	4.59	12.74	1.63	10.81	1.38	13.02	1.66	13.57	1.73	26.09	3.33	16.70	2.13
Resubelpara	40.18	4.67	37.44	4.35	9.54	1.11	13.62	1.58	14.84	1.72	80.38	9.34	8.38	0.97
Rongara	15.57	2.98	11.30	2.17	6.37	1.22	5.02	0.96	6.32	1.21	11.01	2.11	10.65	2.04
Rongjeng	35.71	6.75	23.91	4.52	7.25	1.37	11.98	2.26	9.86	1.86	125.24	23.68	4.92	0.93
Rongram	33.23	5.81	31.26	5.47	26.20	4.58	18.26	3.19	15.11	2.64	31.22	5.46	15.99	2.80
Saipung	44.78	4.54	29.38	2.98	21.82	2.21	10.60	1.07	18.95	1.92	33.58	3.41	23.46	2.38
Samanda	27.31	4.68	30.06	5.15	23.89	4.09	20.59	3.53	19.47	3.34	29.58	5.07	20.26	3.47
Selsella	11.82	2.32	9.07	1.78	5.53	1.09	4.96	0.98	5.40	1.06	18.51	3.64	4.57	0.90
Shella Bholaganj	15.07	3.72	3.72	0.92	2.07	0.51	1.02	0.25	2.59	0.64	6.15	1.52	3.01	0.74
Songsak	39.81	8.17	29.32	6.02	13.53	2.78	13.20	2.71	10.92	2.24	56.63	11.62	7.02	1.44
Thadlaskien	18.40	2.18	27.20	3.22	21.95	2.60	10.57	1.25	16.20	1.92	20.19	2.39	20.87	2.47
Tikrikilla	3.64	1.09	5.94	1.78	1.15	0.35	1.75	0.53	1.76	0.53	5.04	1.51	1.28	0.38
Umling	42.06	5.96	17.57	2.49	22.49	3.19	3.68	0.52	16.63	2.36	38.25	5.42	23.95	3.39
Umsning	38.60	3.90	38.46	3.88	41.02	4.14	12.53	1.26	39.14	3.95	40.10	4.05	56.47	5.70
Zikzak	5.64	1.26	4.42	0.99	2.85	0.64	3.10	0.70	1.94	0.44	20.81	4.67	3.05	0.68

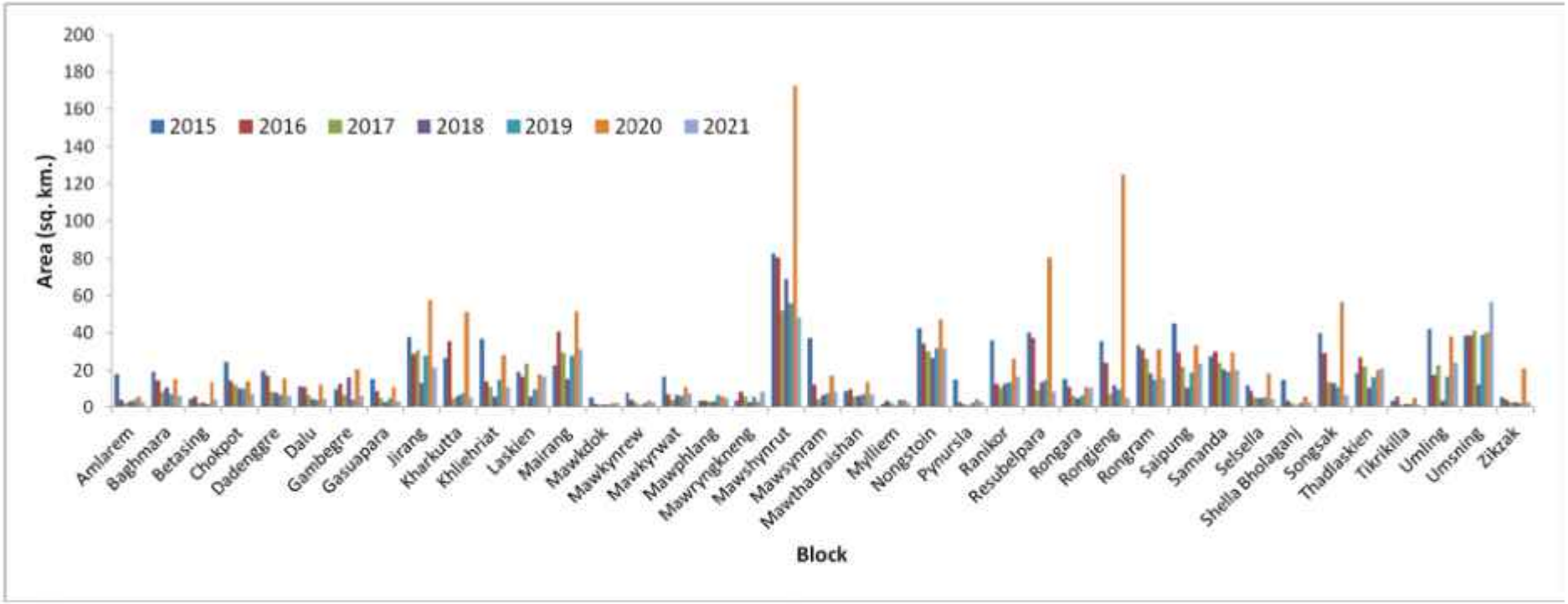


Figure 54. Block wise burnt area in different years in Meghalaya

4.7. Field Based Mobile App and Dashboard (OBJECTIVE – IV)

4.7.1. Forest fire App

The forest fire incident reporting App has been developed by NESAC under this project for ground-based fire information collection. The App has facility to collect information in online as well as offline mode. The App has provision to collect geo-coordinates, and other site details like name of district/block, village etc. The App has provision to collect the geographic information in both point as well as polygon format. The area under the polygon will be generated and displayed in the App. The forest fire related information like whether it is jhum fire/a non jhum fire, a new burned site or an old site, type of vegetation etc. A user can add the approximate burnt area for a specific forest fire region.

This App is available in google play store. It can be downloaded by any user and contribute to the collection of the forest fire information by uploading the forest fire incidents and burnt site of Meghalaya State. The layout of the App is given in Figure 55.



(a)



(b)

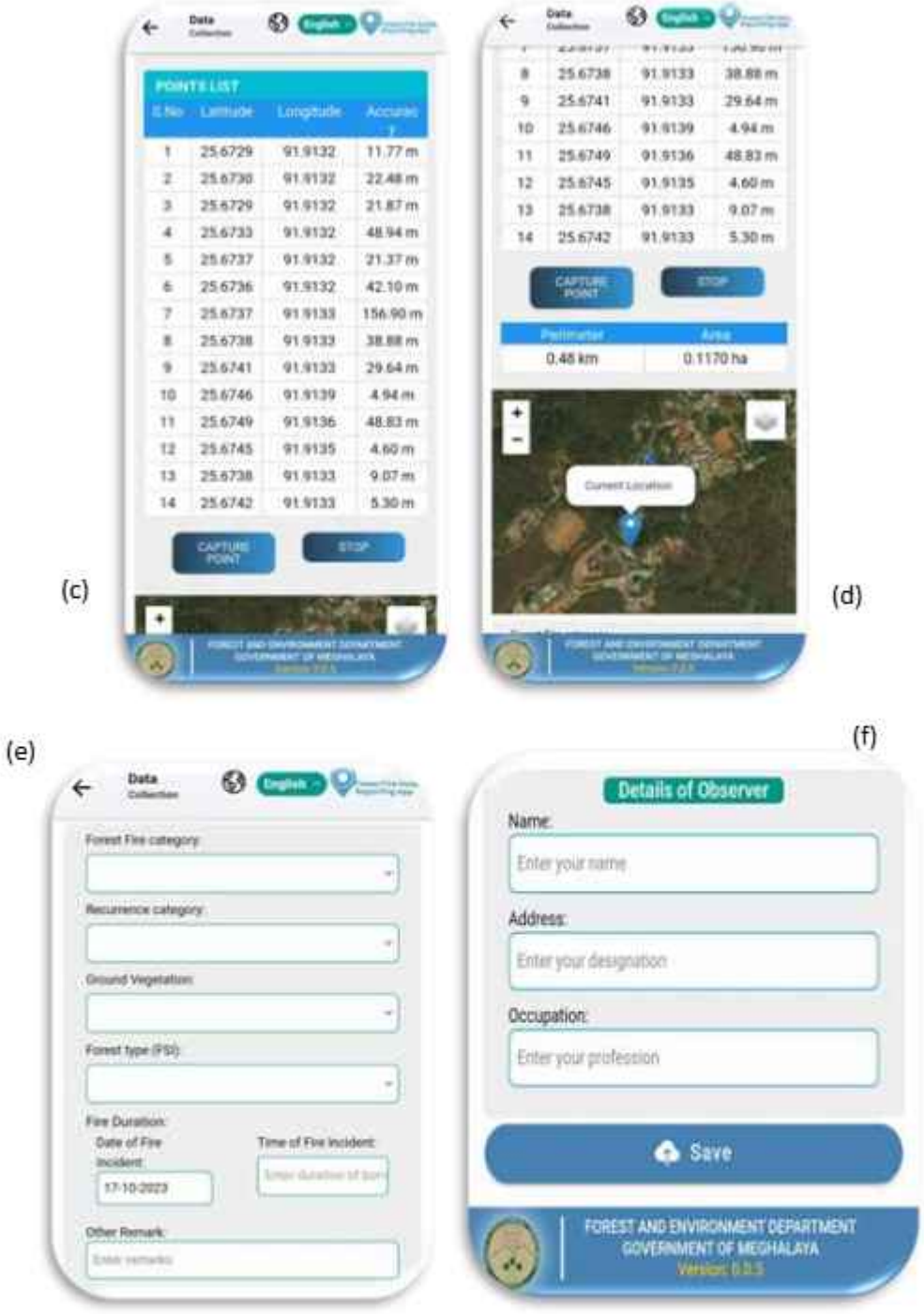
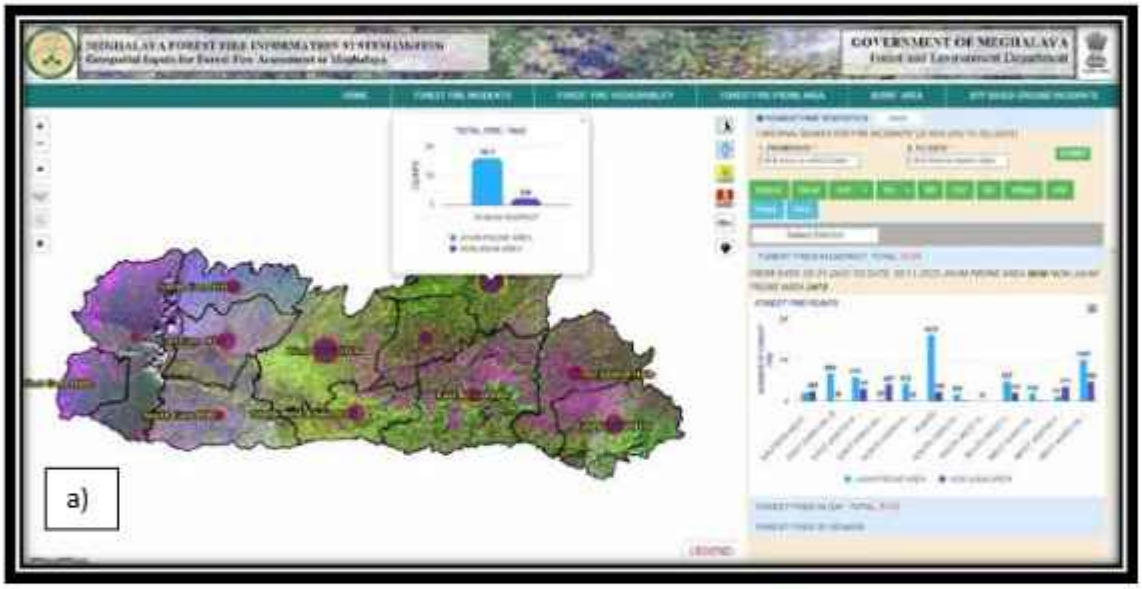


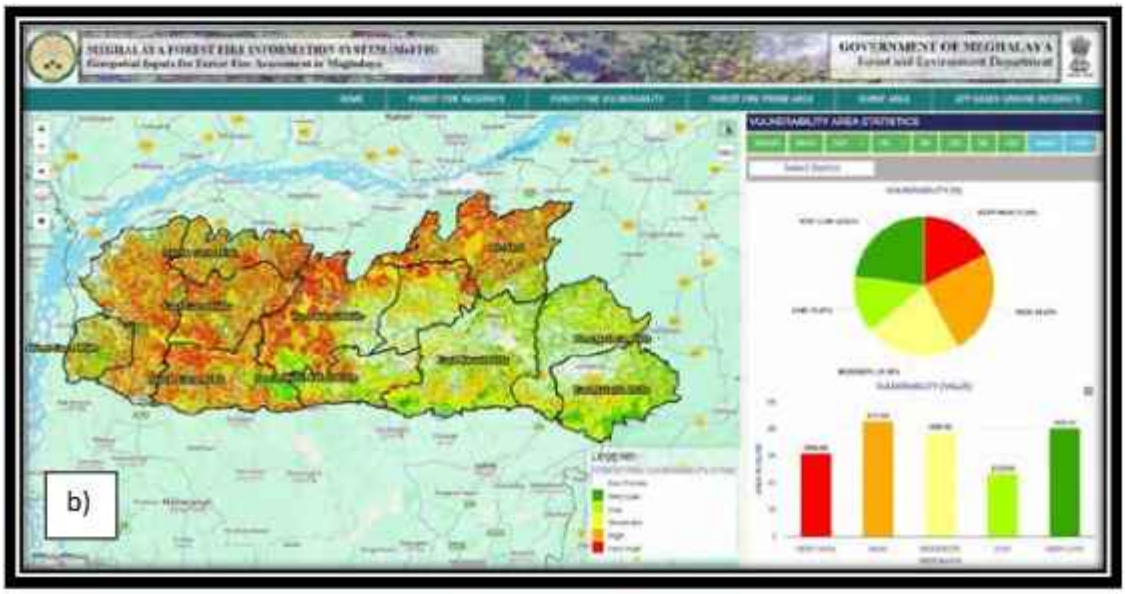
Figure 55. Snapshots of Mobile App (a) Landing Page (b) details of the location and option to capture burnt area (c) , (d) Location specific data of the recorded burnt area (e) details of vegetation and fire type (f) details of Observer and to save the record

4.7.2. Forest fire Dashboard

The Forest fire dashboard (Figure 56) is a single point window to get the forest fire information about entire Meghalaya. This dashboard contains the various thematic outputs generated under the project. The forest fire incidents generated by FSI can be regularly monitored in various administrative units. The forest fire vulnerability map and forest fire prone maps are also available in this dashboard. The users are given facility to use the area of

interest (forest boundaries) available in the dashboard, provide own shape file or draw own polygon to generate statistics on various themes available in the dashboard. The forest boundaries available in the dashboard are reserve forest, community forest, sacred groves, protected areas, state boundary, district boundary, block boundary. The statistics of the defined boundaries are generated in the form of graph upon selection or drawing the area of interest. The link to ISRO Bhuvan, Google maps, ESRI maps is also provided for better visualization. The user has the facility to view the various base maps like the road, settlement and waterbody, land use/land cover, shifting cultivation etc. This dashboard will help the decision makers to monitor the forest fire incidents during forest fire season and also generate statistics to the vulnerable and prone zones for taking appropriate mitigation measures. There is a dedicated section provided in this dashboard to visualize the ground-based forest fire information collected using the fire incident reporting app.





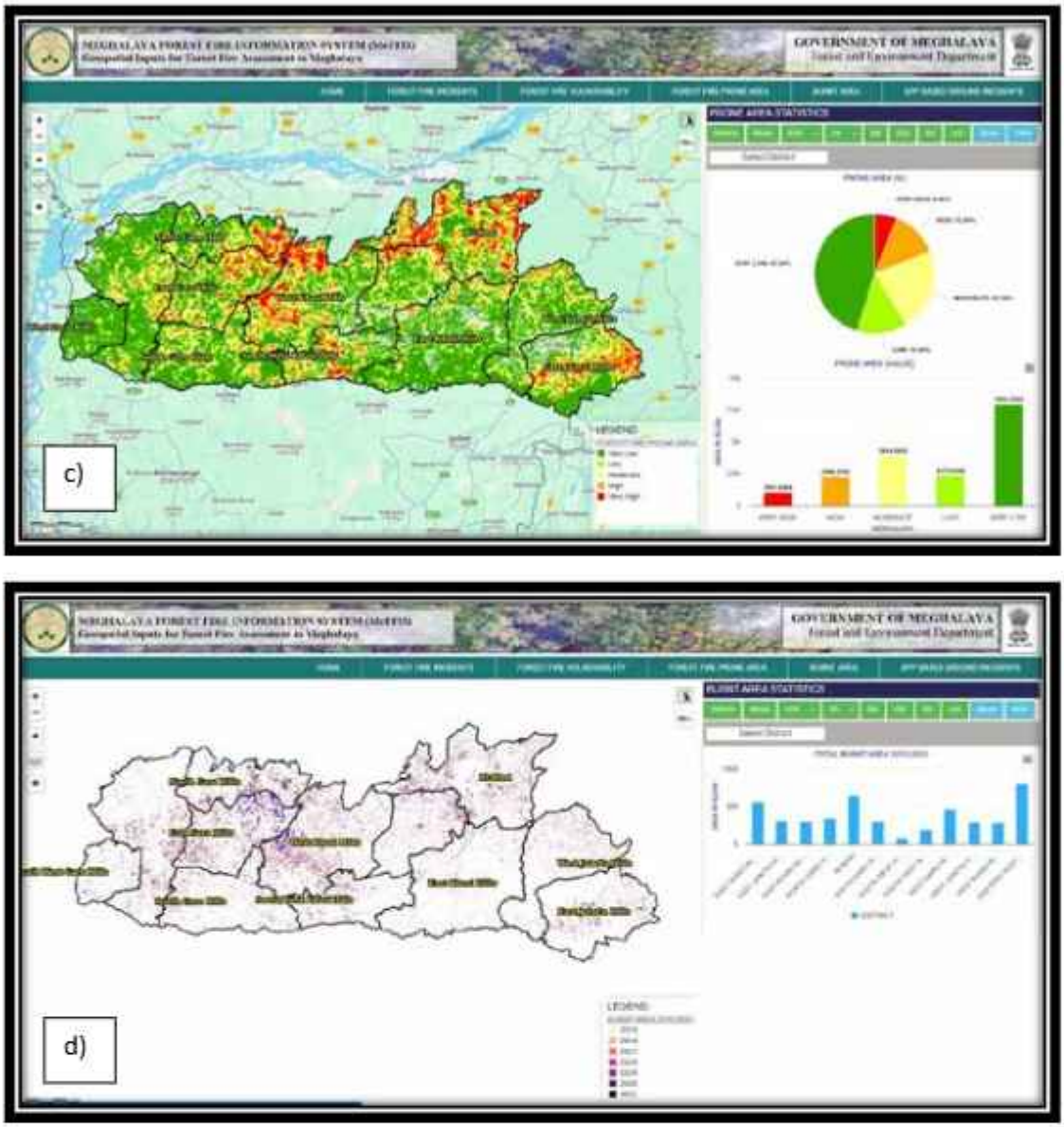


Figure 56. Screenshots of MFFIS Dashboard a) Forest Fire Incidents b) Forest Fire Vulnerability Area c) Forest Fire Prone Area of Meghalaya d) Burnt area assessment for the year 2015-2021

CHAPTER - 5

5. CONCLUSION AND RECOMMENDATIONS

5.1. Forest fires have significant adverse impact on growth and health of forests. It also contributes to global greenhouse gas emissions and can negatively affect public health and provision of ecosystem services from forests.

5.2. Drivers of forest fire in Meghalaya

In Meghalaya forests fires may be classified into two broad categories namely; intentional forest fires and accidental forest fires. As the name suggests, intentional forest fires are caused by intentional burning of forests and ground vegetation for a specific economic outcome.

5.2.1. Major drivers of the intentional forest fires in Meghalaya are as below:

i. Jhum/ shifting cultivation;
ii. Annual post-harvest burning of broomstick plantations to promote growth of better quality fresh broom sticks;
iii. Annual burning of grasslands to promote growth of fresh flush of more palatable grasses;
iv. Burning of dried lops and tops in freshly worked forests to prepare site for reforestation or other non-forestry uses;
v. Burning of the dried lops, tops other freshly felled ground vegetation to prepare sites for plantation of forestry, horticulture and agriculture crops;
vi. Burning of leaf litter in parks, gardens and residential areas; and
vii. Burning of undergrowth to facilitate easy collection of non-timber forest products (NTFPs).

5.2.2. Similarly, as the name suggests, accidental fires are caused accidently or unintentionally. Major drivers of accidental forest fires are as below:

i. Transfer or flying of sparks and other burning materials from adjoining intentional forest fires, camp sites, camp fires and human settlements;
ii. Throwing of burning bidies and cigarettes butts on forest floor;
iii. Burning of ground flora by cowboys and other village lads for fun;

iv. Sparks from the vehicle exhaust.

5.3. Strategy for Prevention, Minimization and Mitigation of Forest Fires

5.3.1. Intentional Forest Fires

The intentional forest fires can be controlled only by controlling their respective causes or reasons. Concerted and meaningful efforts are required to wean away people from shifting/jhum cultivation and broomstick plantations by promoting more ecologically prudent and environmentally sustainable livelihood options to the households presently engaged in these ecologically destructive activities. Similarly, current practices for management of grasslands need to be amended and modified to obviate the requirement of annual burning to promote regeneration of fresh flush of grasses. The current management practices and cost-norms for afforestation of freshly worked forests and afforestation of other areas need to amended and modified to obviate the need to clear and burn ground vegetation, lops and tops.

Appropriate policy framework prohibiting burning of leaf litter and other combustible materials in parks, gardens, residential and commercial areas needs to be put in place, adequately publicised and effectively implemented.

5.3.2. Accidental Forest Fires

The limited physical, financial and human resources available in the Forest and Environment and other Departments and agencies need to be utilised in a targeted, focussed, effective and efficient manner to prevent minimise and to mitigate accidental forest fires. During the fire season, these resources may be deployed in the areas highly vulnerable as well the areas highly prone to forest fires identified through this study. Effective measures are also required to be undertaken to reduce fire vulnerability and proneness of these areas by undertaking suitable measures. Appropriate measures may also be taken to restore the areas affected by forest fires.

Management of the accidental forest fires should be directed to the management of its source i.e. a thick contiguous layer of dry combustible litter. Management may include diversion, destruction and division of the litter.

Diversion of the litter may involve collection and use of litter for productive uses such as fuel (briquette), fiber (rope weaving), fertilizer (composting) and furnishings (filling for mattresses, pine cone handicrafts). Destruction may involve increasing the rate of decay of

the litter by improving moisture regime in forest floor by construction of check dams, contour trenches, interception trenches, and other moisture conservation structures; gradual replacement of conifer and deciduous species by evergreen species and periodic controlled burning of accumulated dry litter. Division includes fragmentation of the contiguous layer of the litter by construction and regular cleaning of conventional dry fire lines consisting of about three meters wide strips completely devoid of any litter or living vegetation and self-sustaining natural wet fire lines consisting of strips or shelterbelts of evergreen species at regular intervals.

Study reveals that moist deciduous forests are more vulnerable to fire incidents. Among the forests of different density classes, dense forests are witnessing maximum fire incidents. Dense moist deciduous forests are therefore highly susceptible for forest fire. In addition to fuel, topography also found to have significant impact on forest fires. Areas having 10 to 30 degree slope have witnessed largest number of fire incidents as such areas are preferred for the jhum cultivation. Since anthropogenic activities are the primary cause of forest fires in the state, areas located in close proximity of roads and settlements have shown high fire incidents. Highest numbers of fire incidents have been reported in areas located within a buffer of 500 m from the road.

Moist deciduous forest, dense forest, areas having slope from 10 to 30 degree and areas located within 500 m distance from roads and settlements should therefore be treated on priority for forest fire management activities.

As majority of forests in Meghalaya are owned by communities, clans and private individuals, forest fires cannot be controlled without active involvement of local communities. Regular awareness programs to need to be organised to make the people aware of adverse impacts of forest fires and the activities that may be undertaken to prevent, minimise and mitigate the adverse impacts of forest fires.

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Forest Fire Vulnerability Map for all Districts of Meghalaya

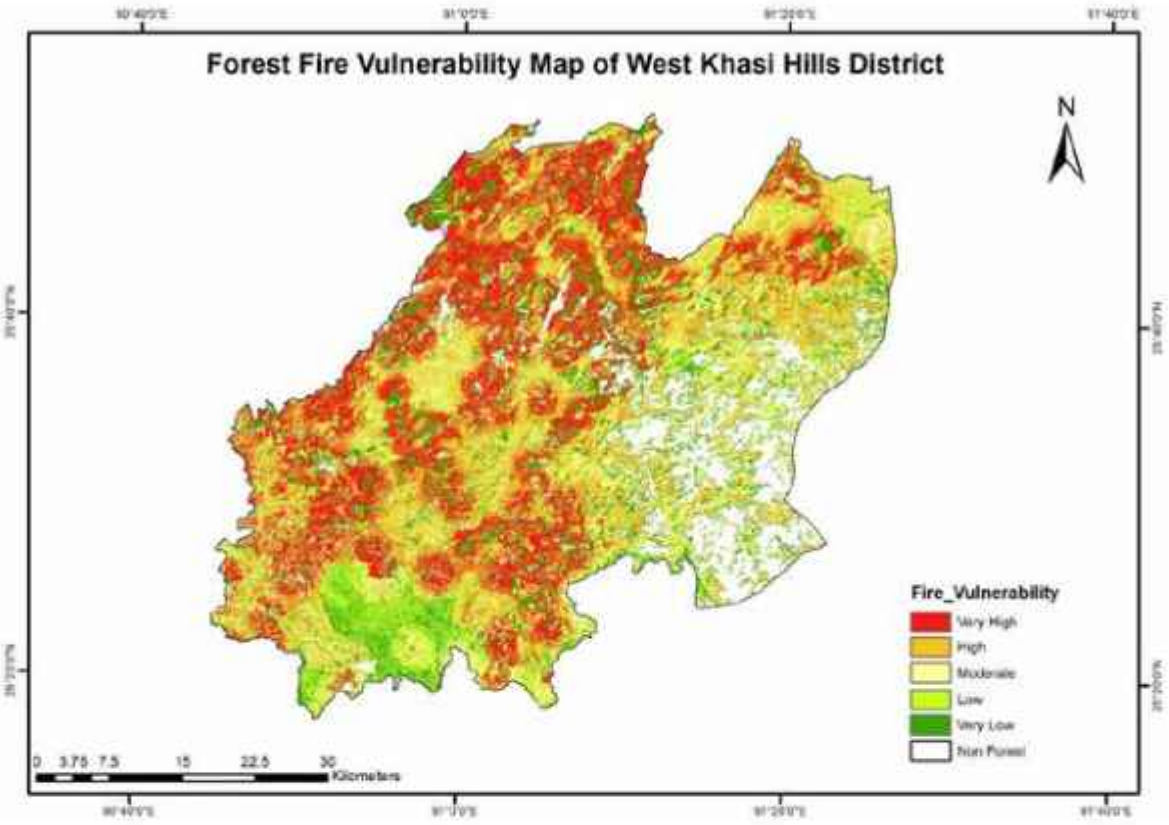


Figure 57. Forest Fire Vulnerability Map of West Khasi Hills District

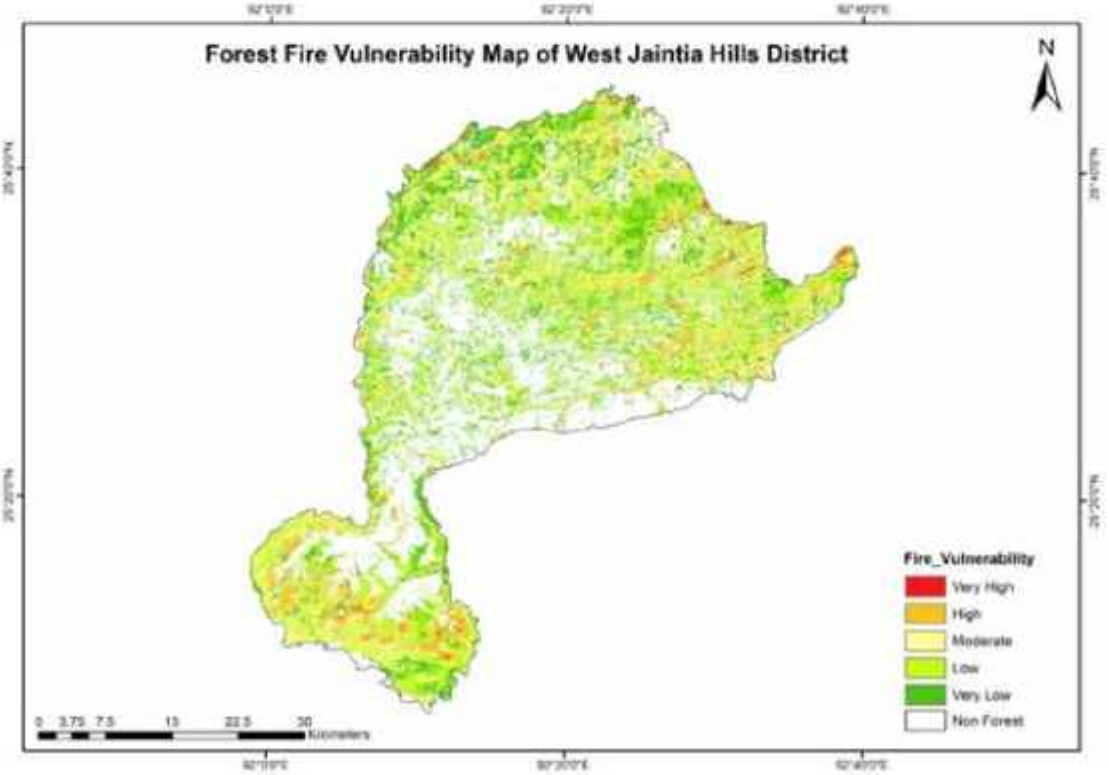


Figure 58. Forest Fire Vulnerability Map of West Jaintia Hills District

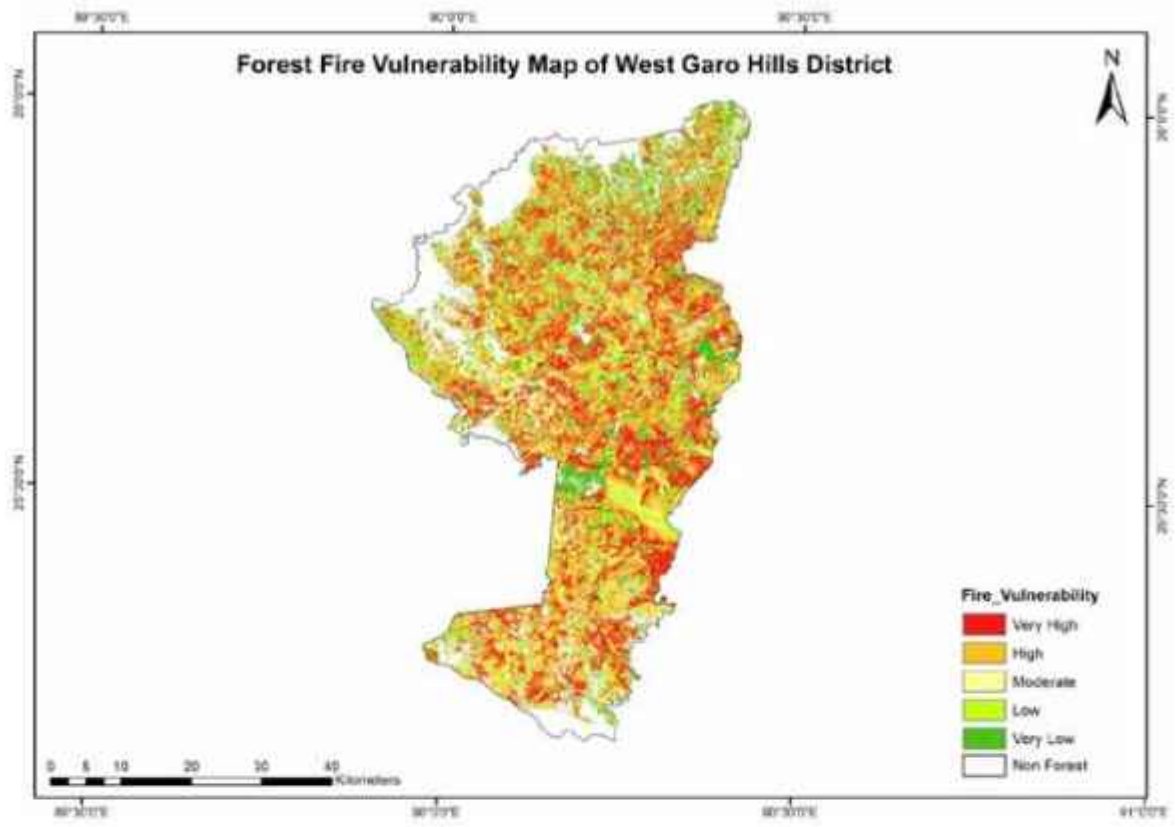


Figure 59. Forest Fire Vulnerability Map of West Garo Hills District

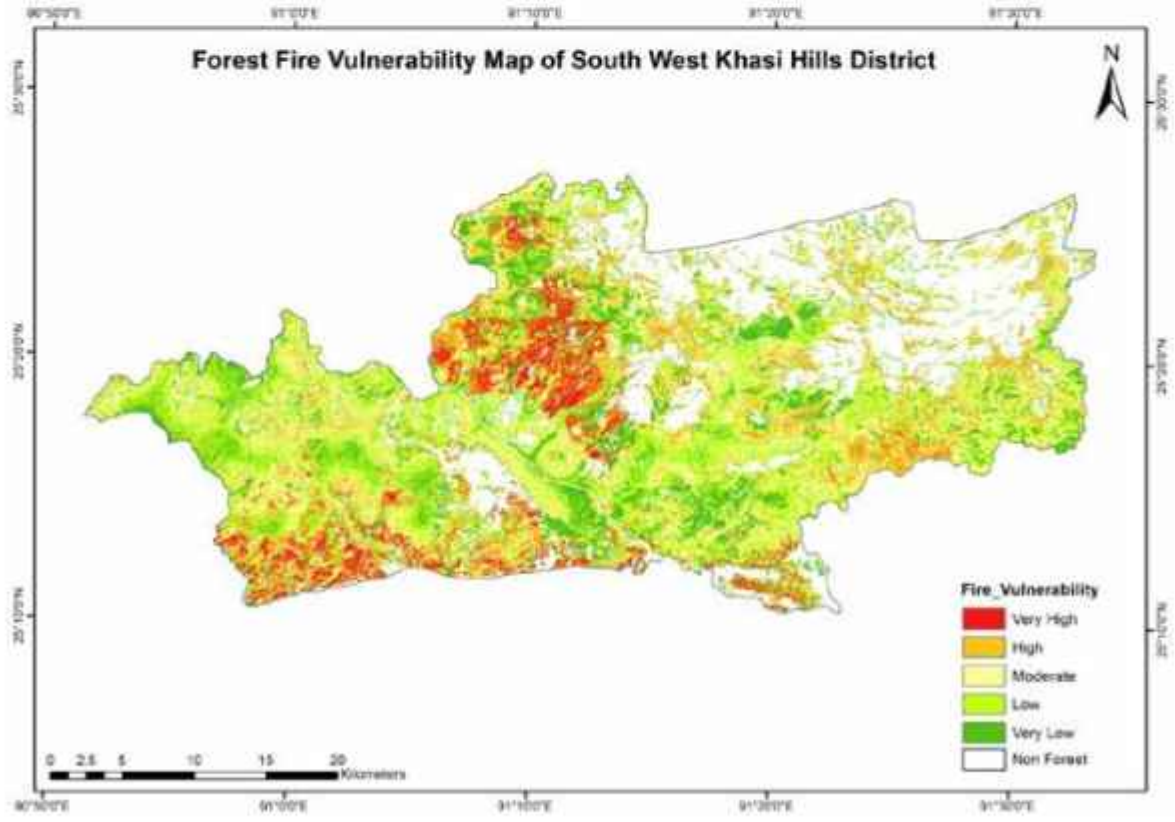


Figure 60. Forest Fire Vulnerability Map of South West Khasi Hills District

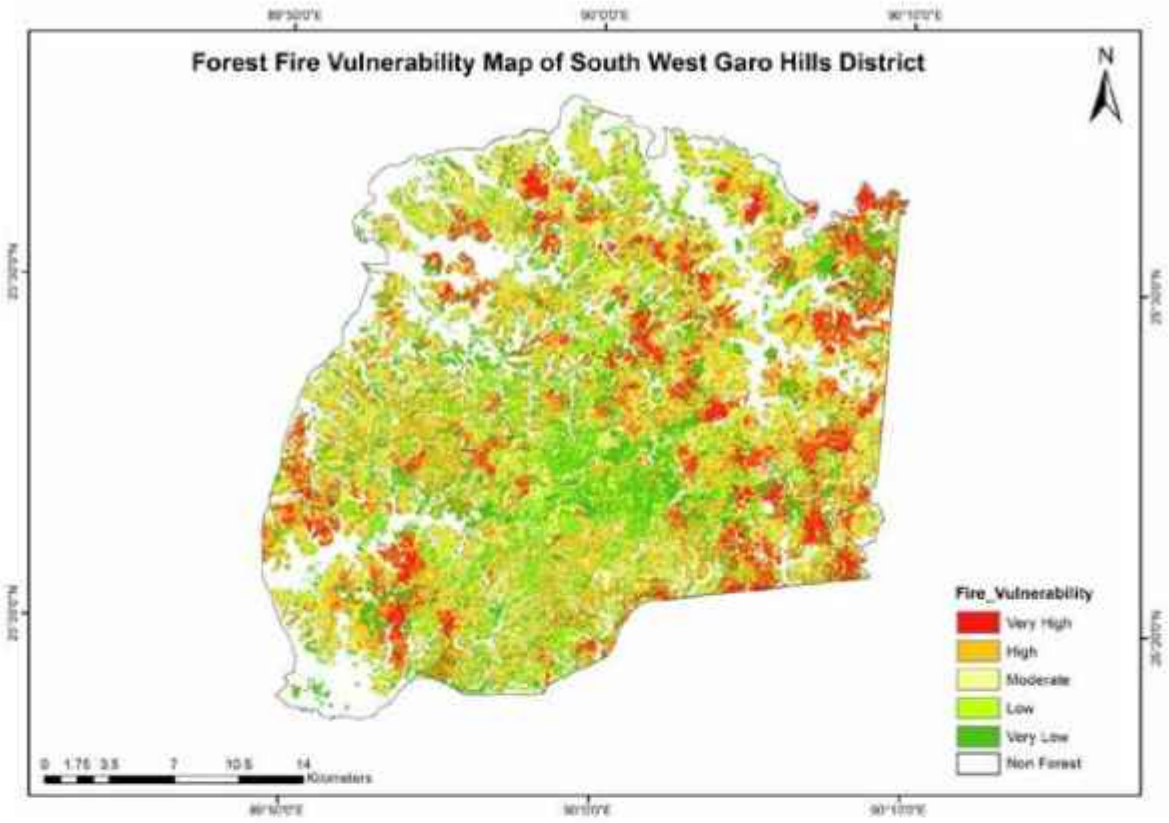


Figure 61. Forest Fire Vulnerability Map of South West Garo Hills District

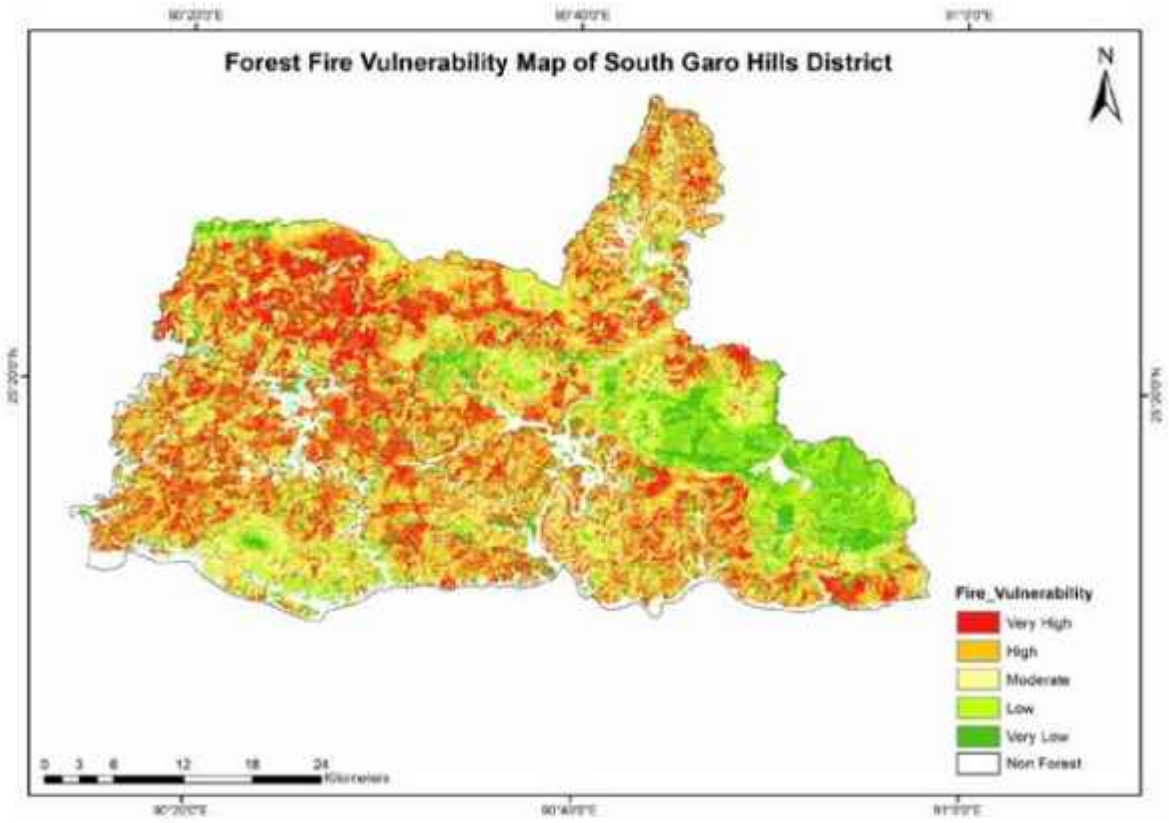


Figure 62. Forest Fire Vulnerability Map of South Garo Hills District

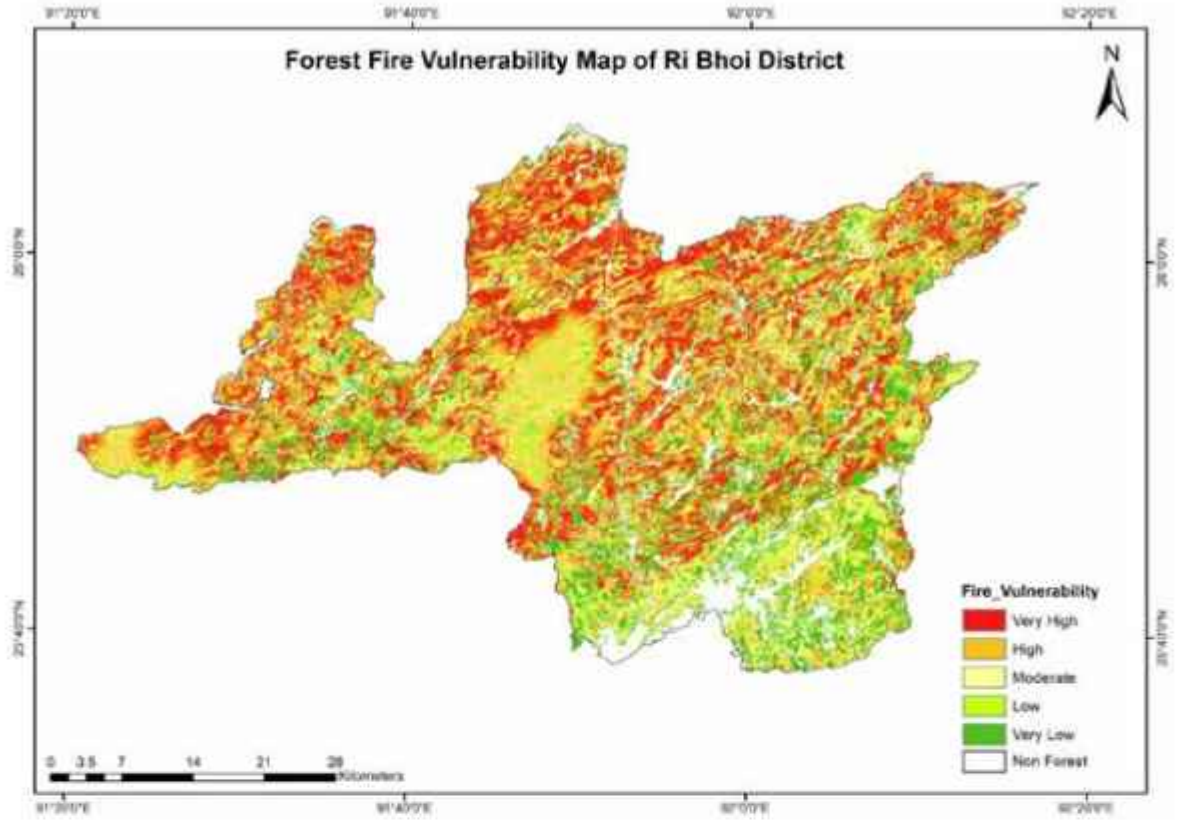


Figure 63. Forest Fire Vulnerability Map of Ri Bhoi District

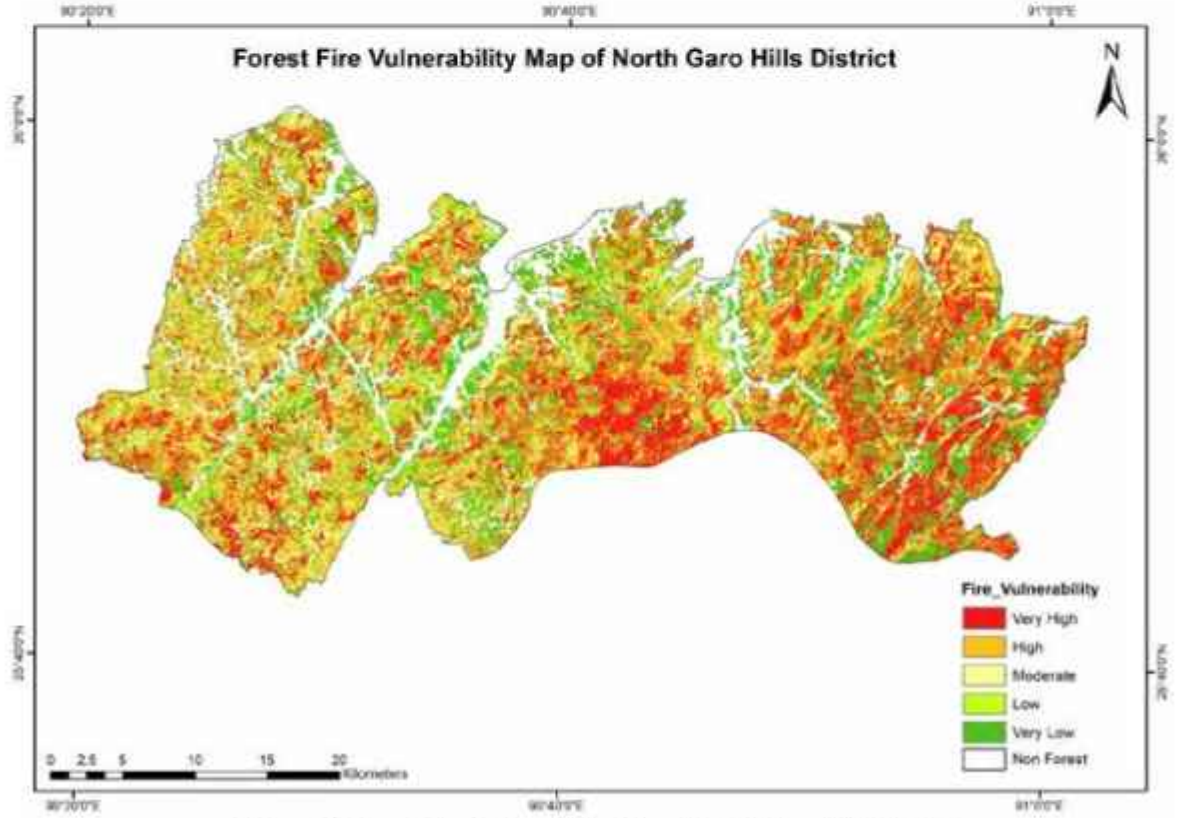


Figure 64. Forest Fire Vulnerability Map of North Garo Hills District

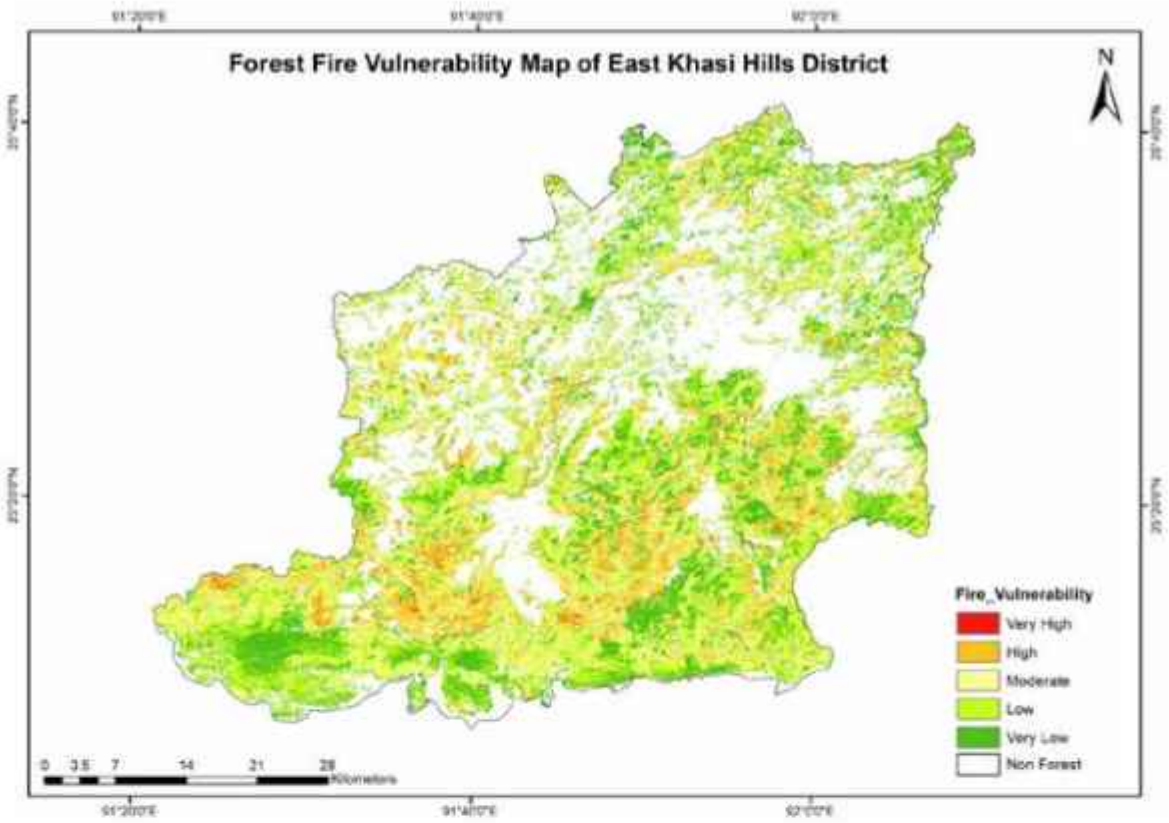


Figure 66. Forest Fire Vulnerability Map of East Khasi Hills District

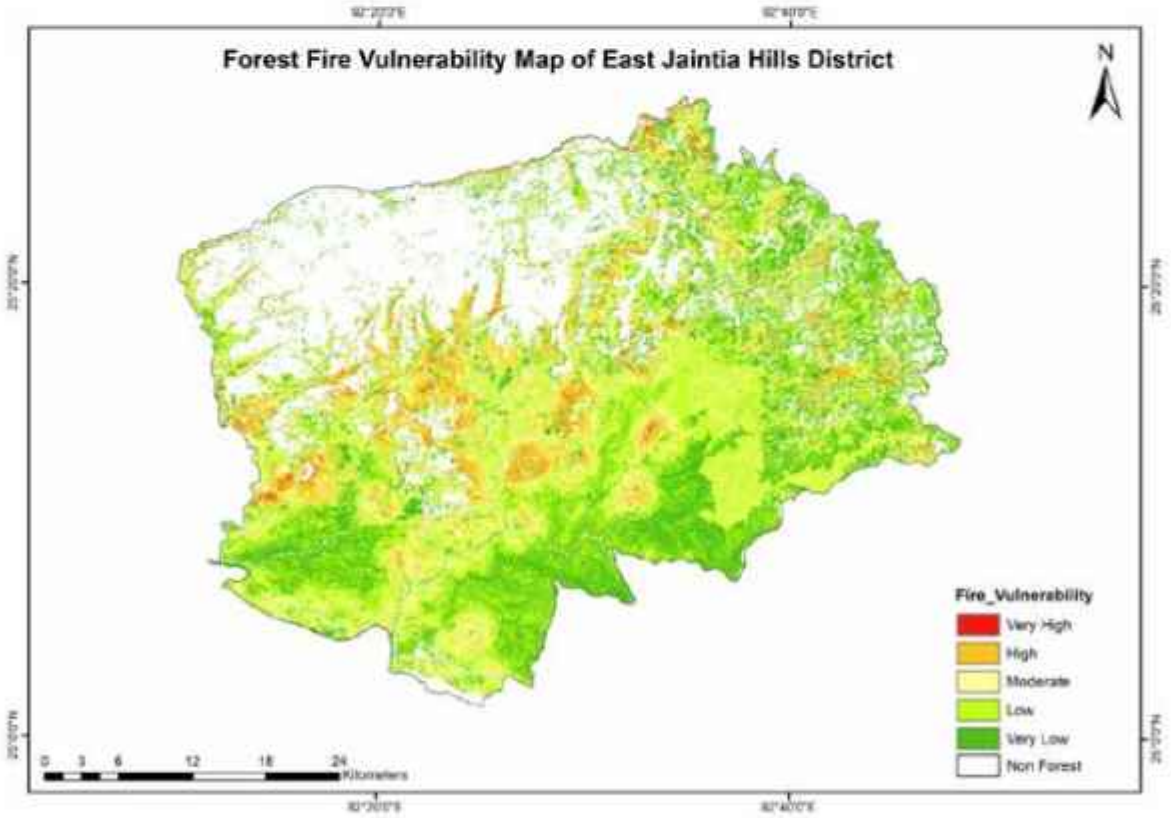


Figure 65. Forest Fire Vulnerability Map of East Jaintia Hills District

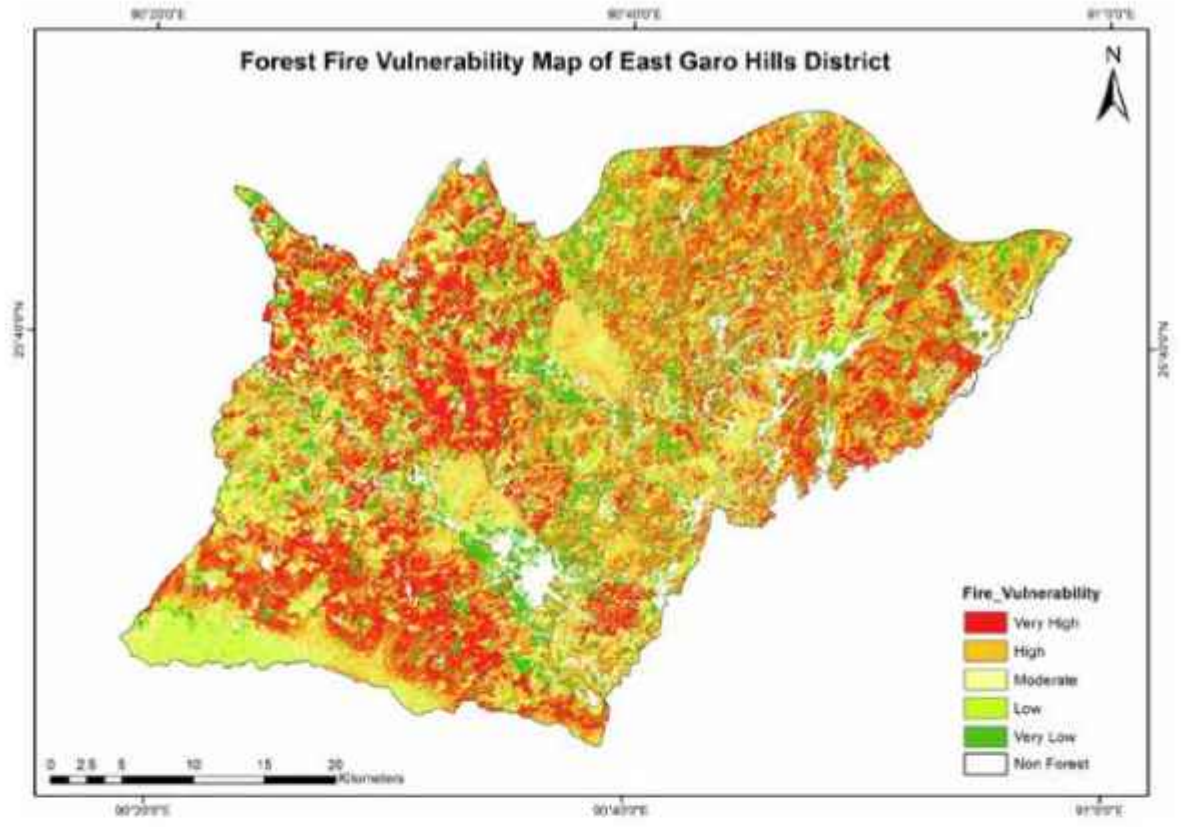


Figure 67. Forest Fire Vulnerability Map of East Garo Hills District

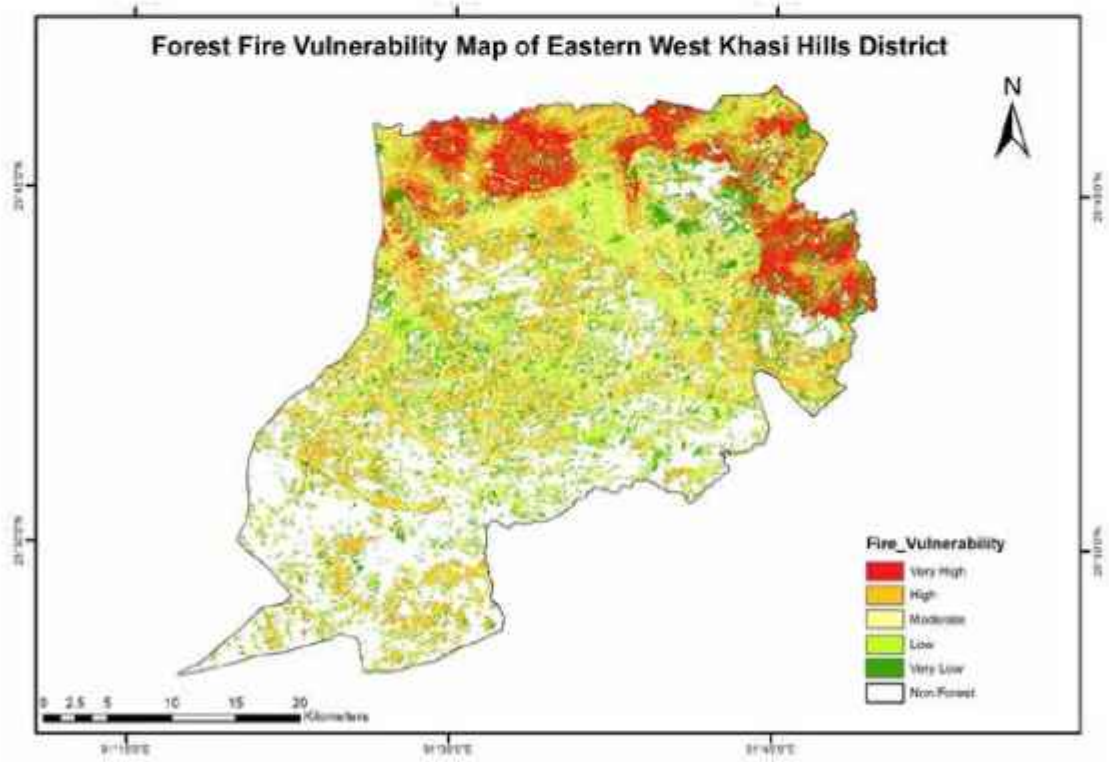


Figure 68.Forest Fire Vulnerability Map of Eastern West Khasi Hills District

Forest Fire Vulnerability Map for all Blocks of Meghalaya

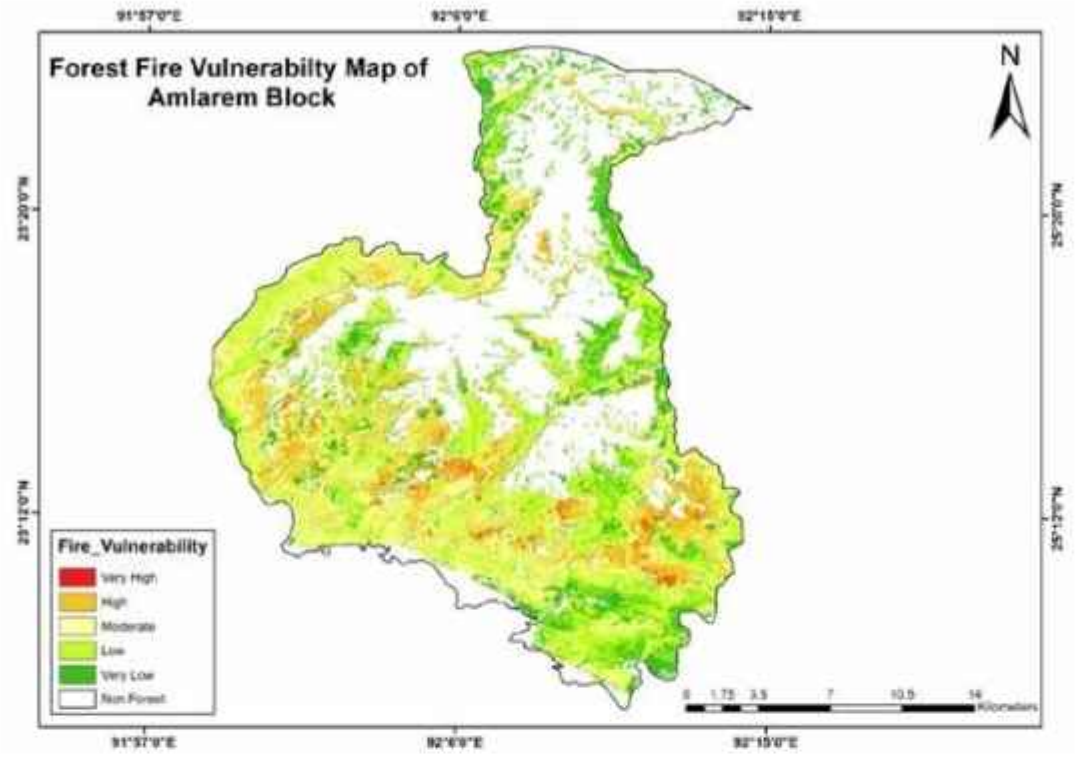


Figure 69. Forest Fire Vulnerability Map of Amlarem Block

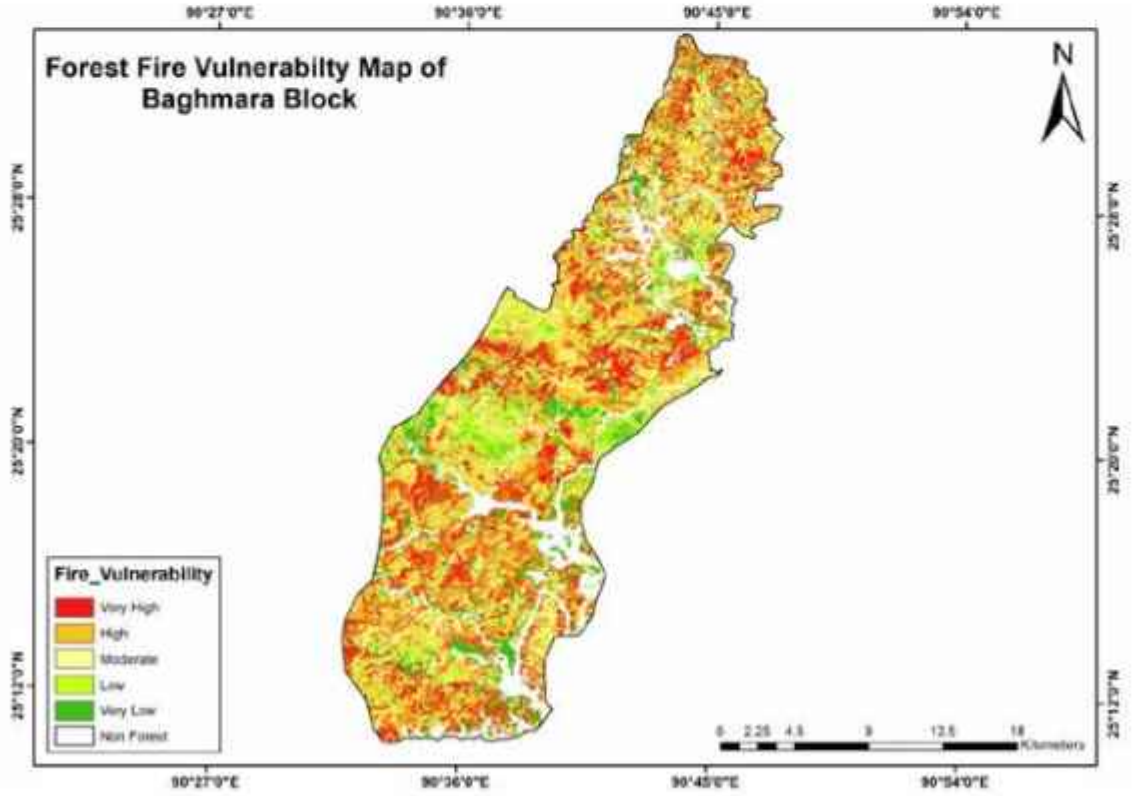


Figure 70. Forest Fire Vulnerability Map of Baghmara Block

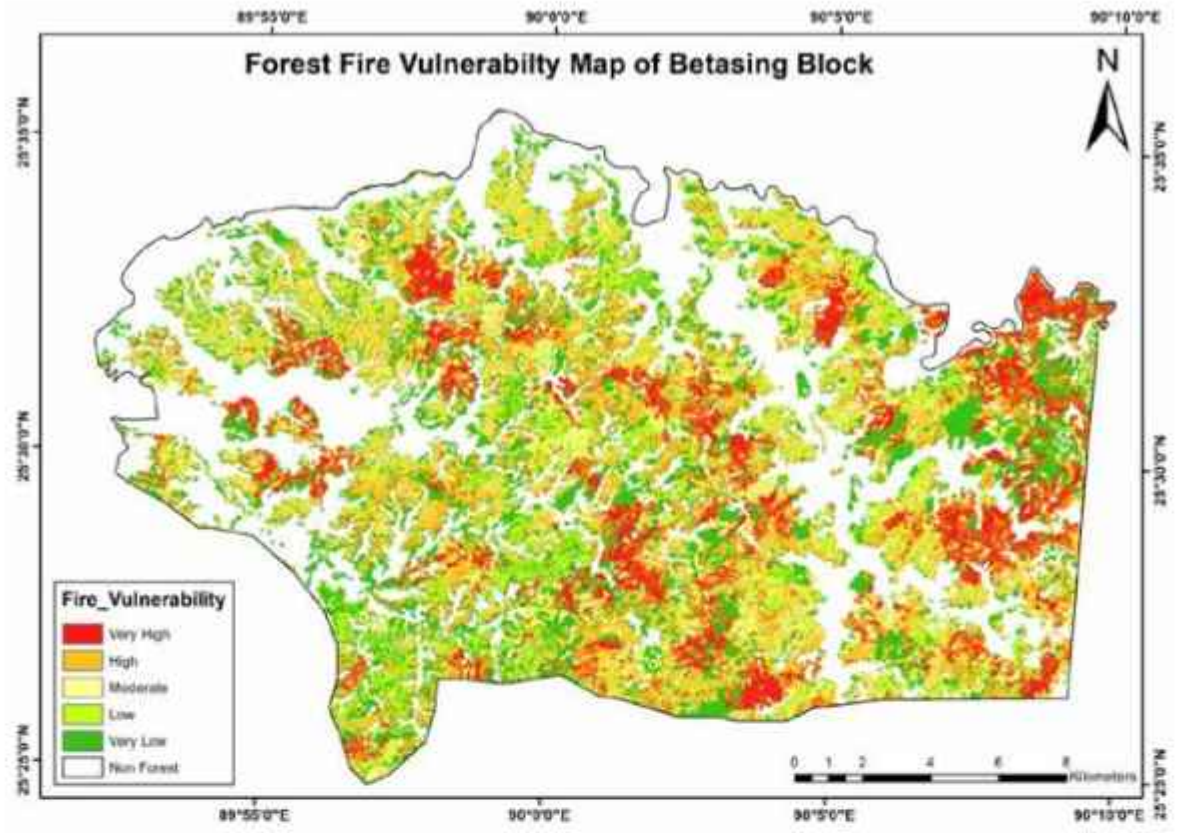


Figure 71. Forest Fire Vulnerability Map of Betasing Block

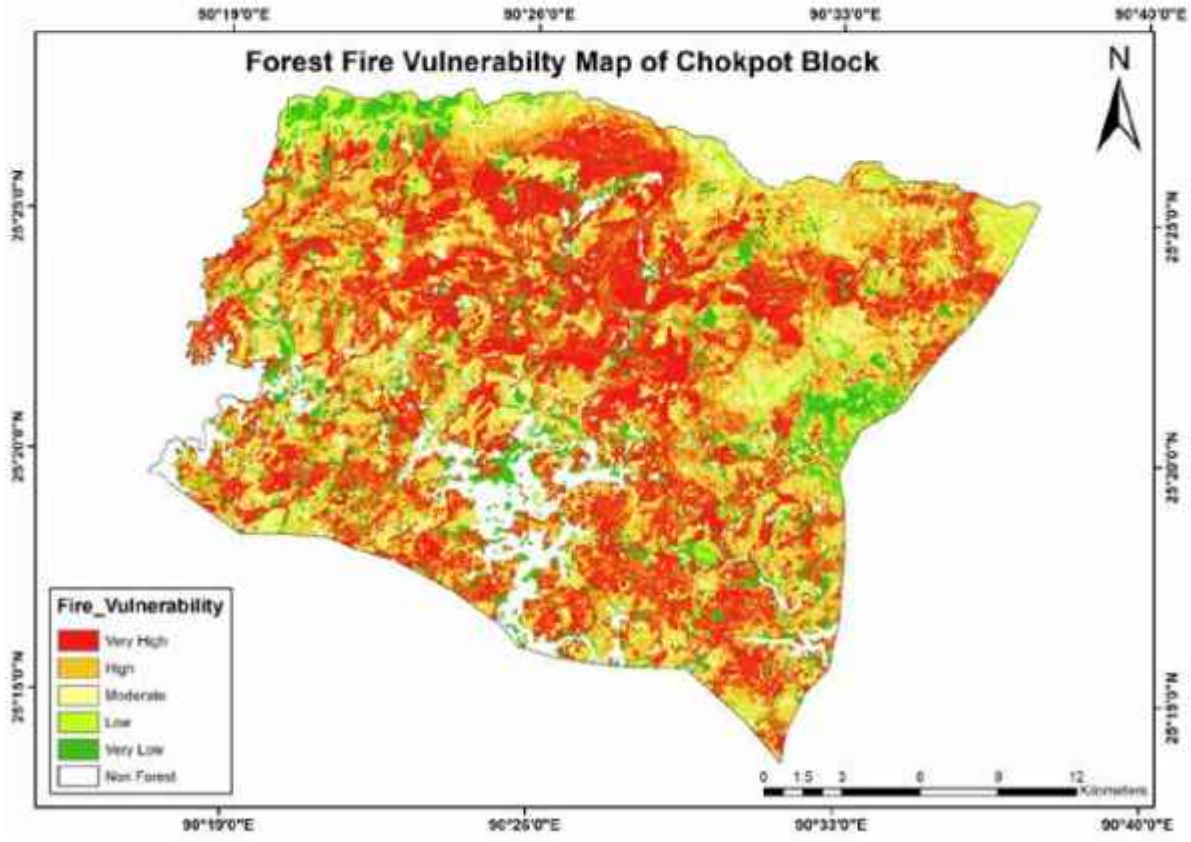


Figure 72. Forest Fire Vulnerability Map of Chokpot Block

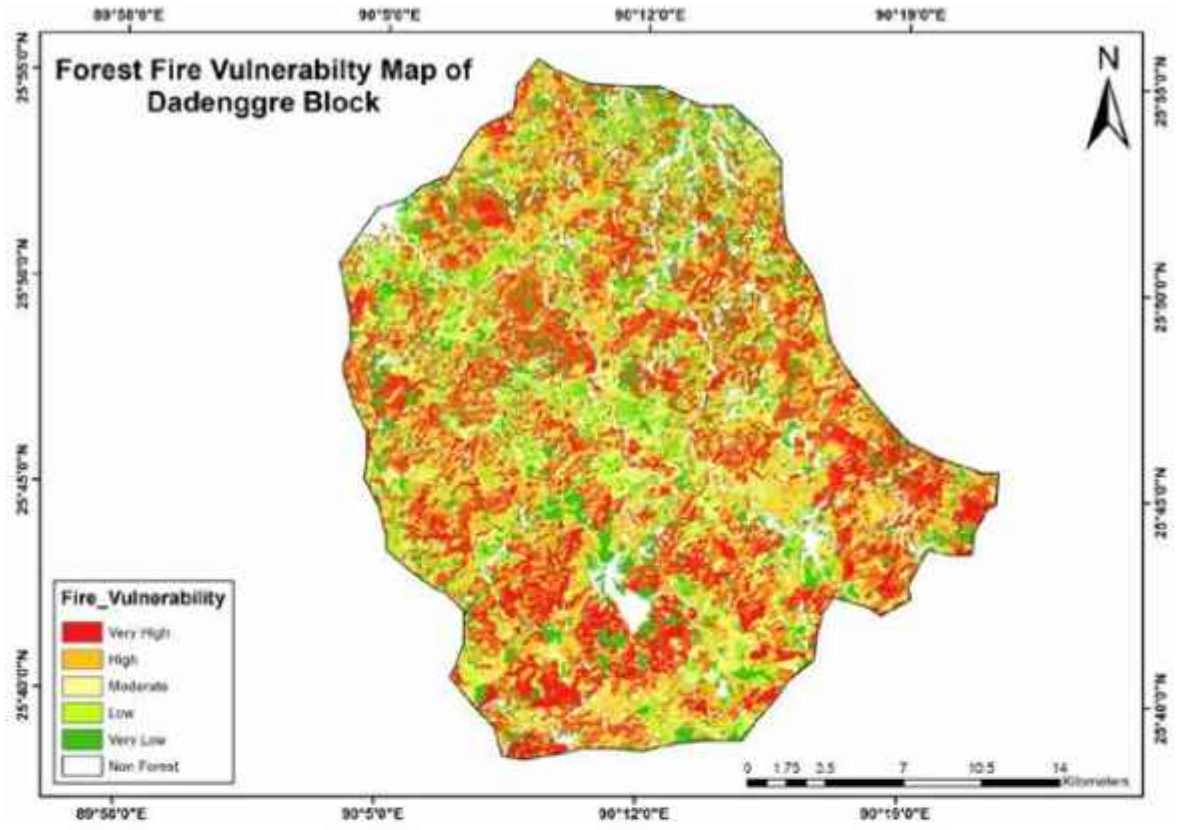


Figure 73. Forest Fire Vulnerability Map of Dadenggre Block

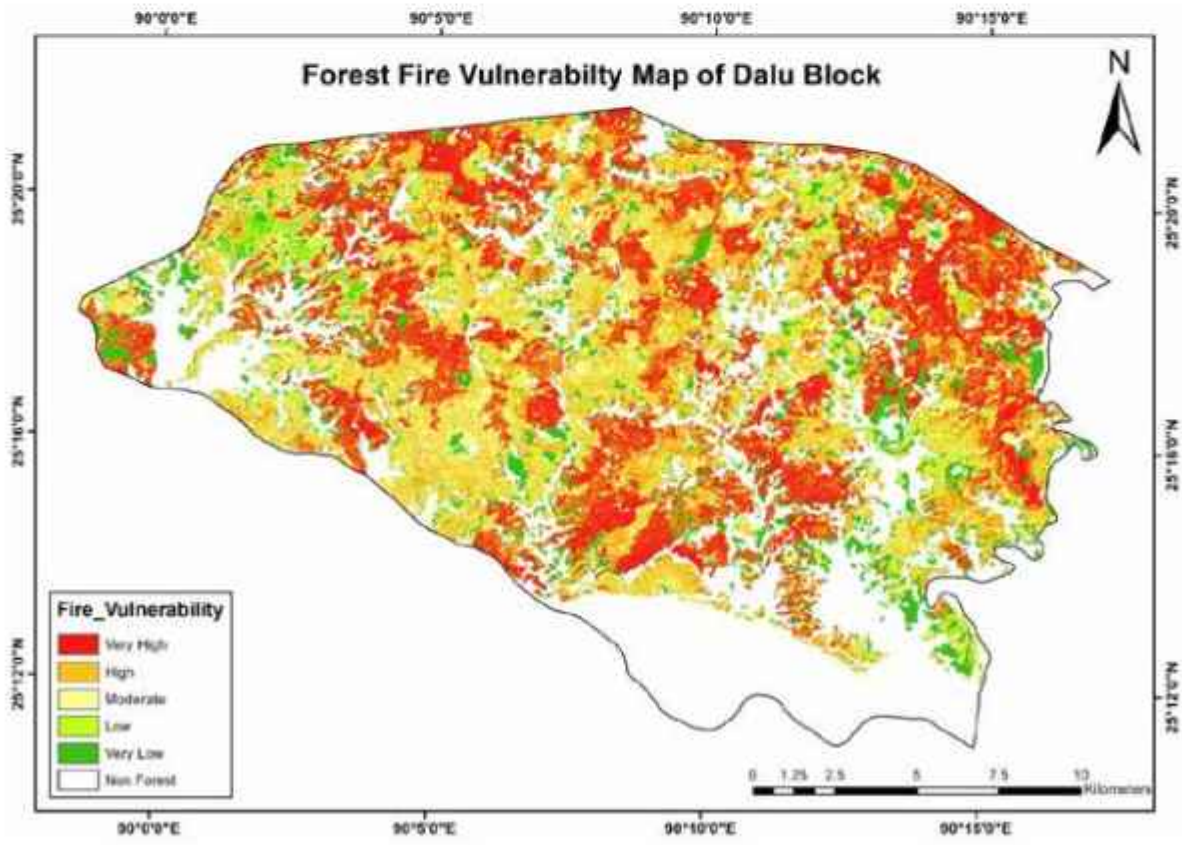


Figure 74. Forest Fire Vulnerability Map of Dalu Block

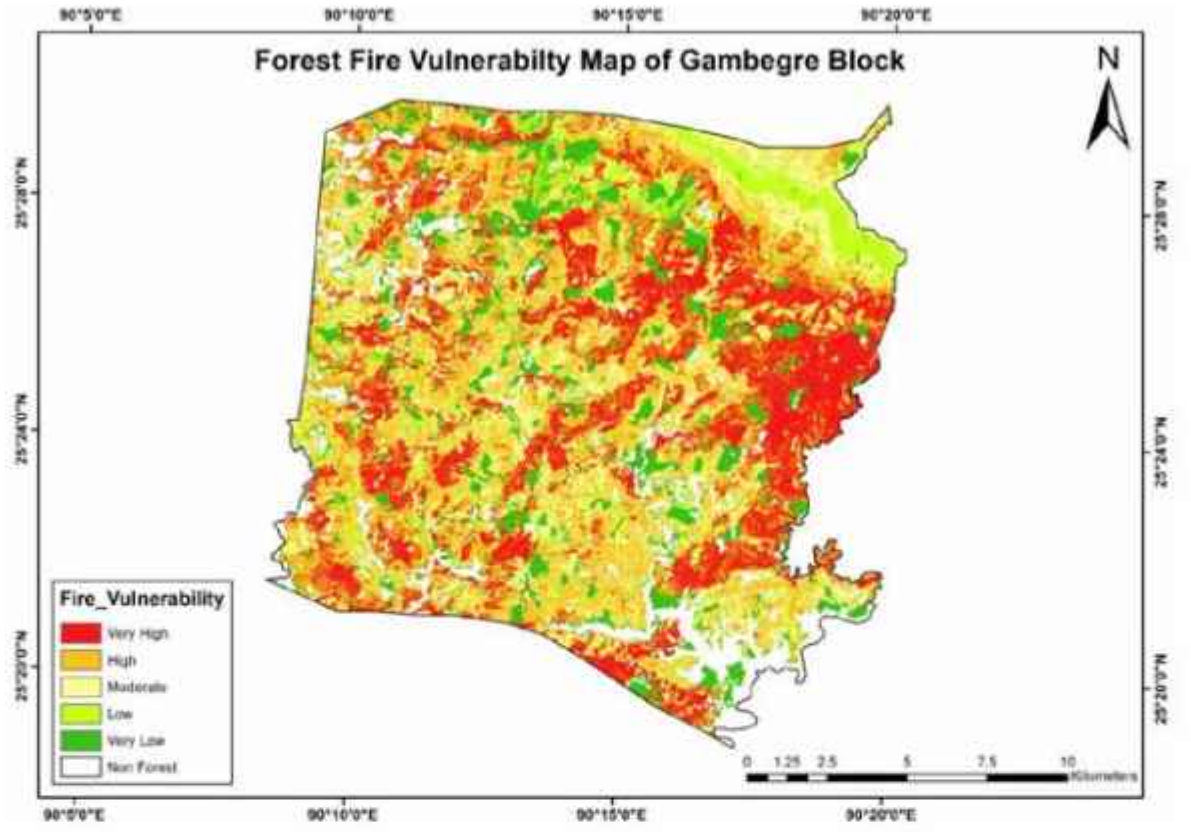


Figure 75. Forest Fire Vulnerability Map of Gambegre Block

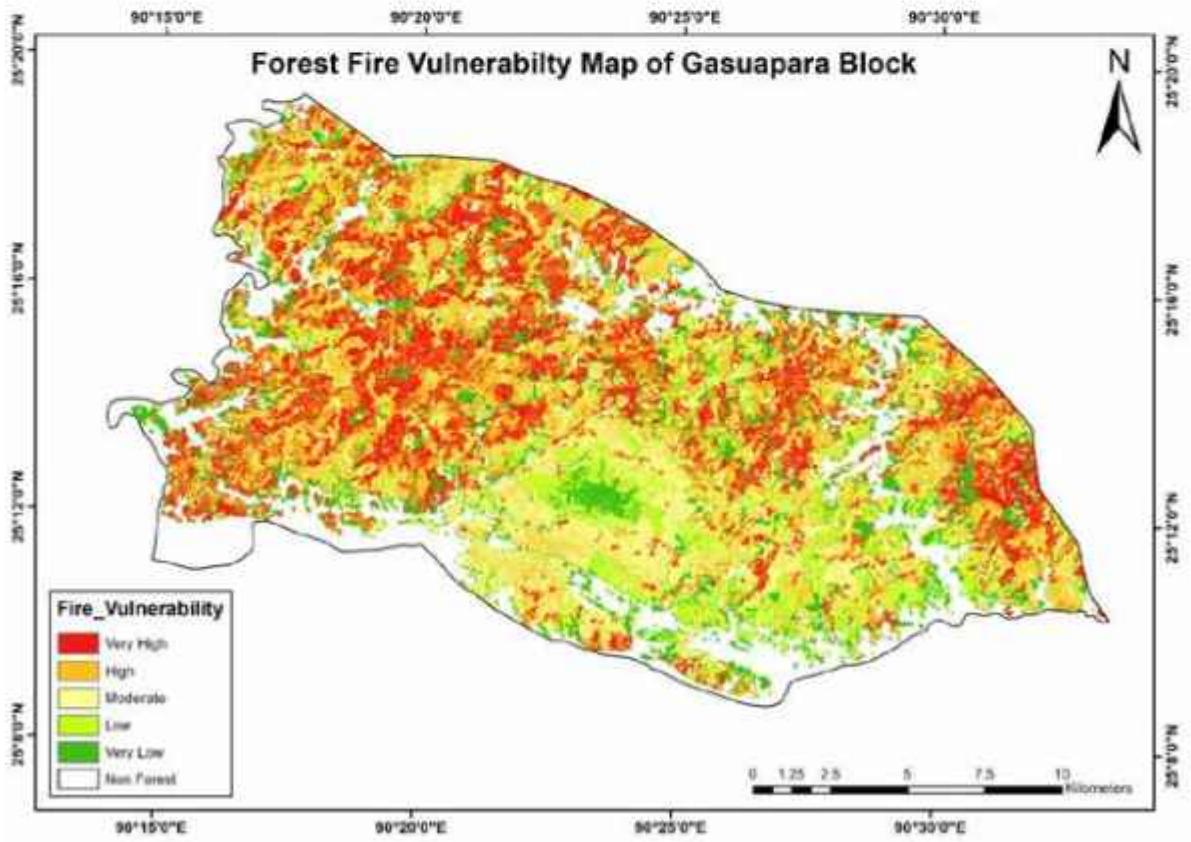


Figure 76. Forest Fire Vulnerability Map of Gasuapara Block

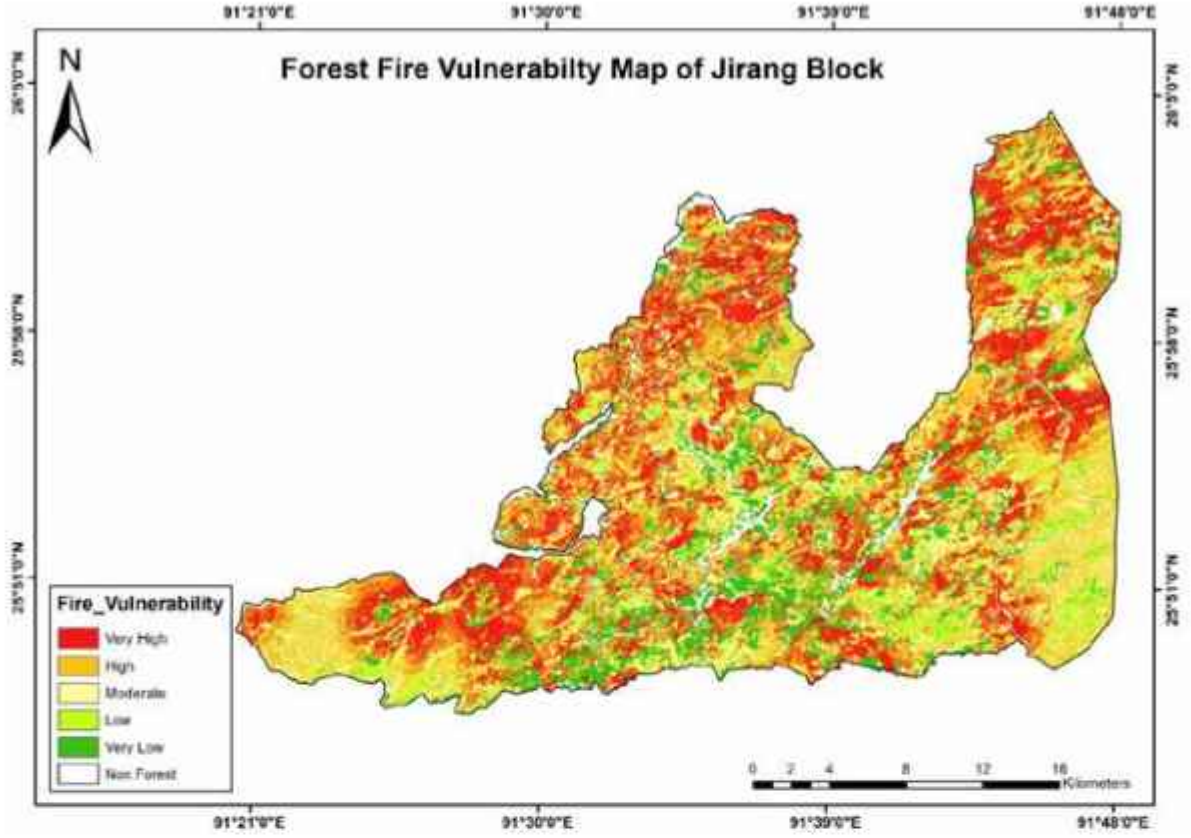


Figure 77. Forest Fire Vulnerability Map of Jirang Block

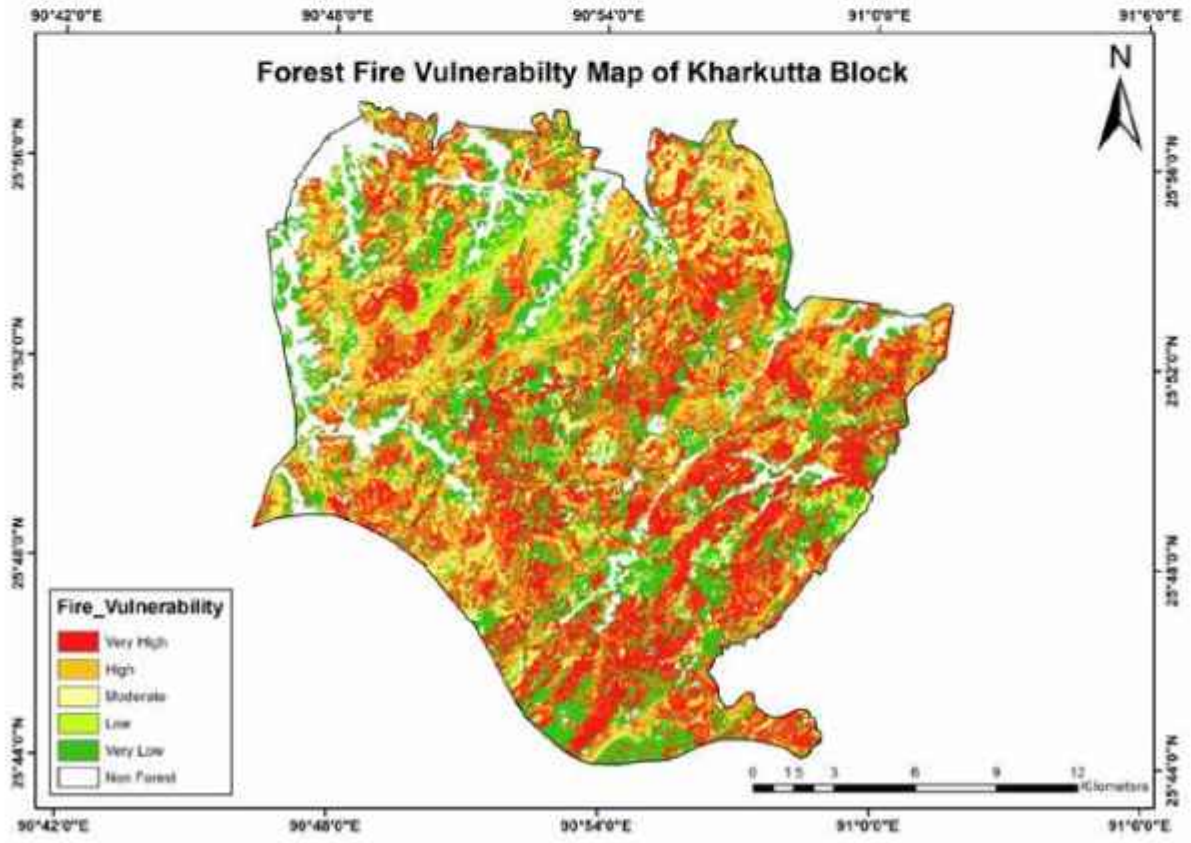


Figure 78. Forest Fire Vulnerability Map of Kharkutta Block

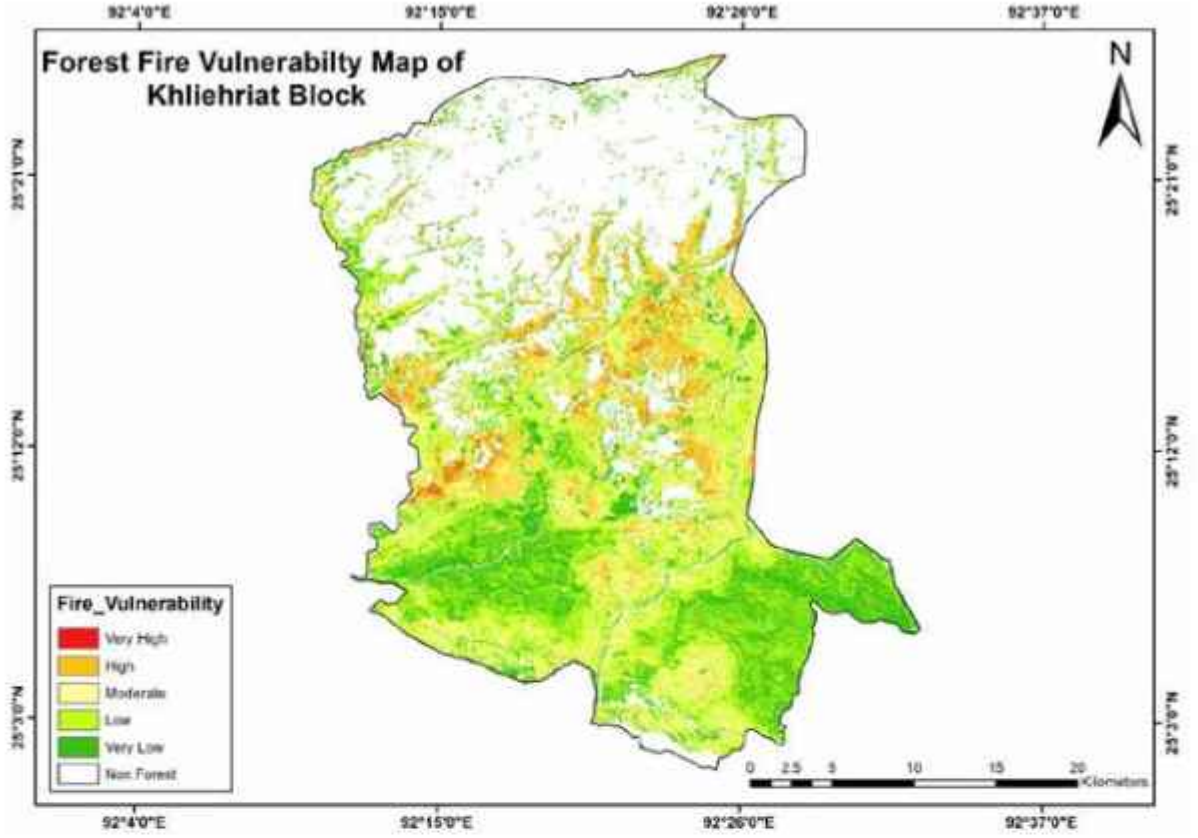


Figure 79. Forest Fire Vulnerability Map of Khliehriat Block

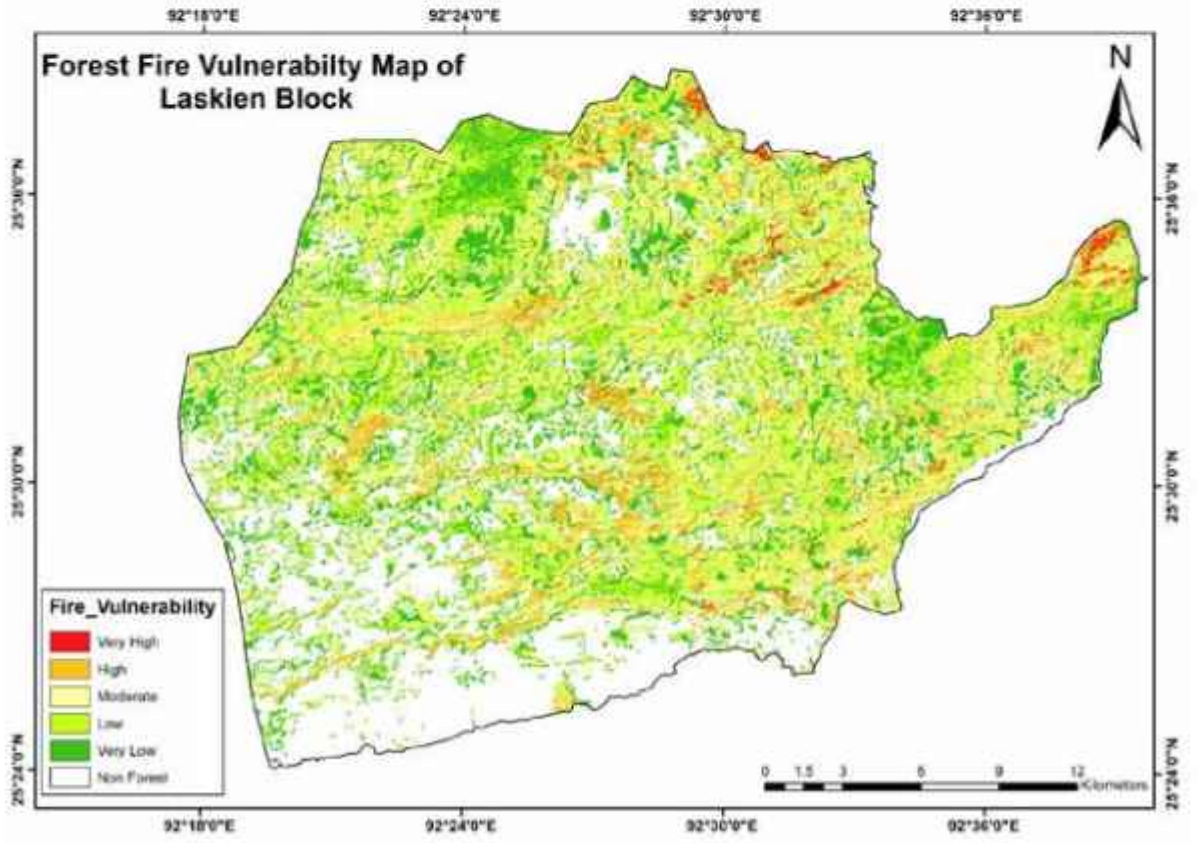


Figure 80. Forest Fire Vulnerability Map of Laskien Block

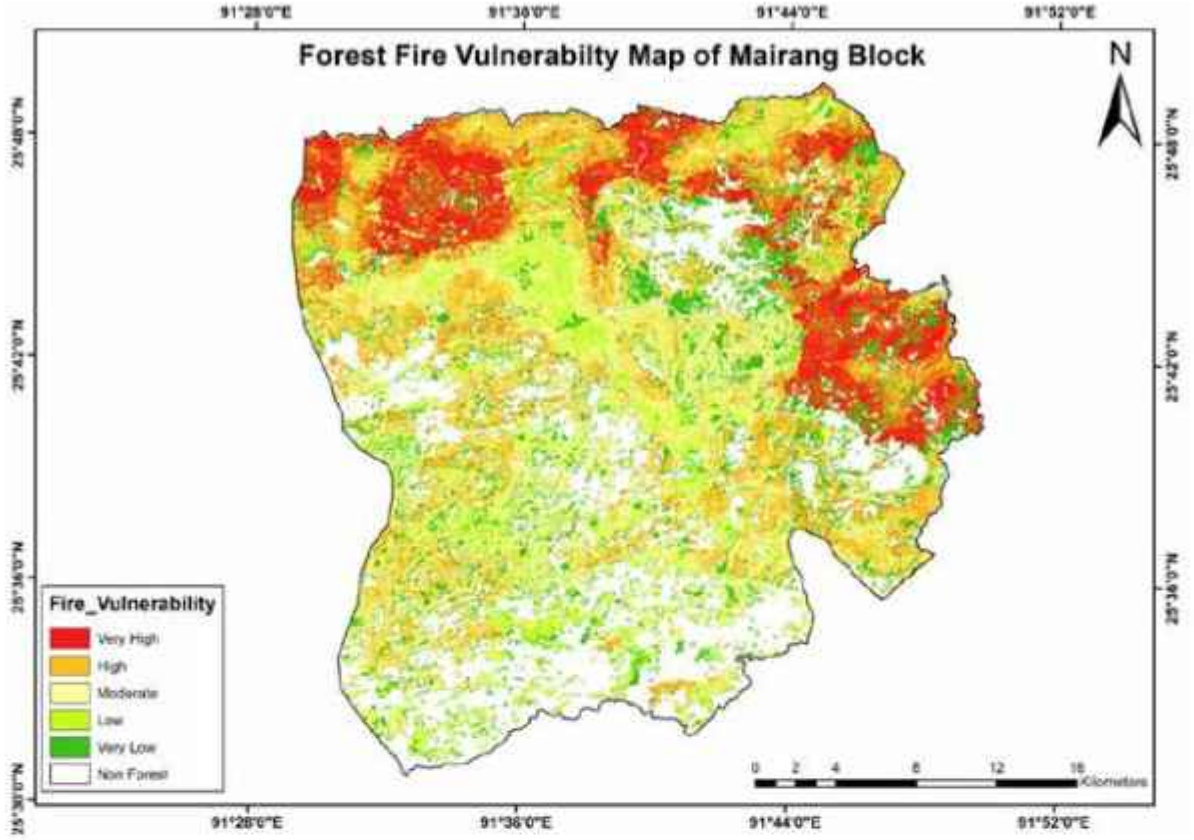


Figure 81. Forest Fire Vulnerability Map of Mairang Block

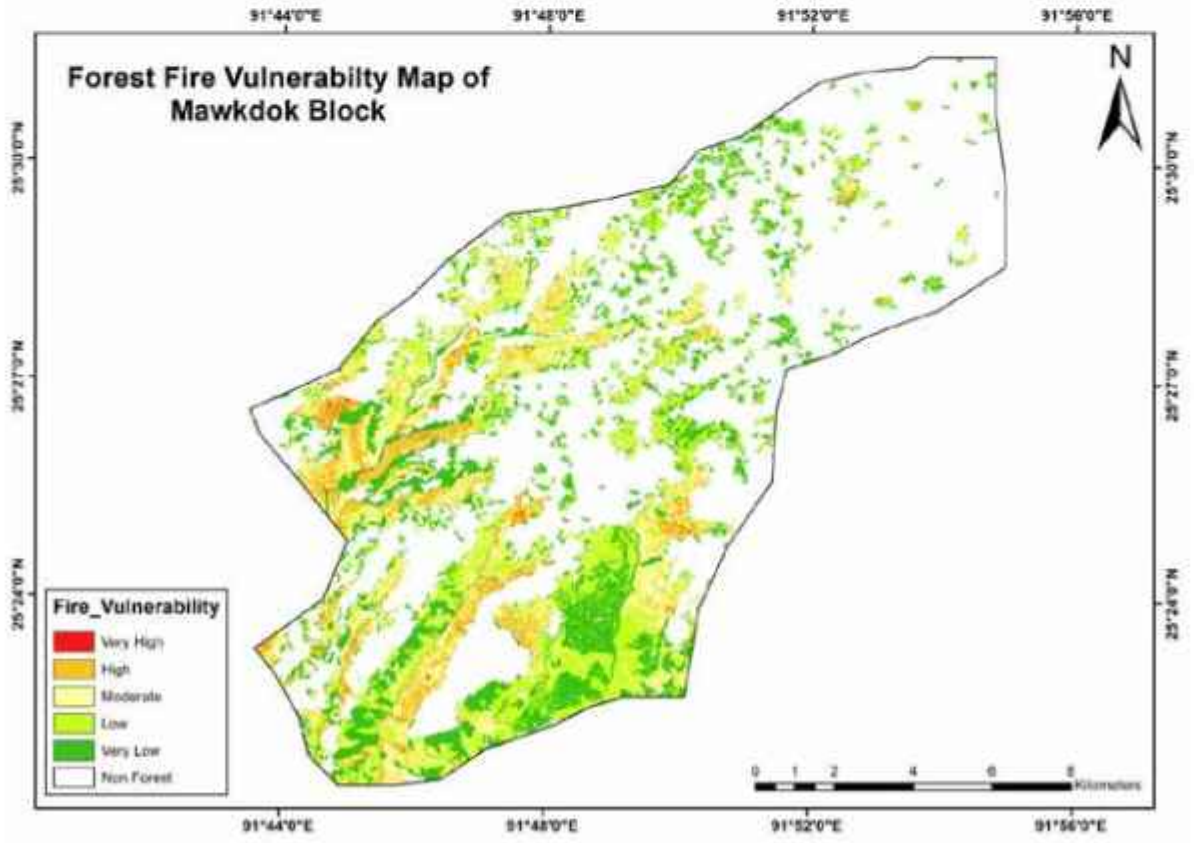


Figure 82. Forest Fire Vulnerability Map of Mawkdok Block

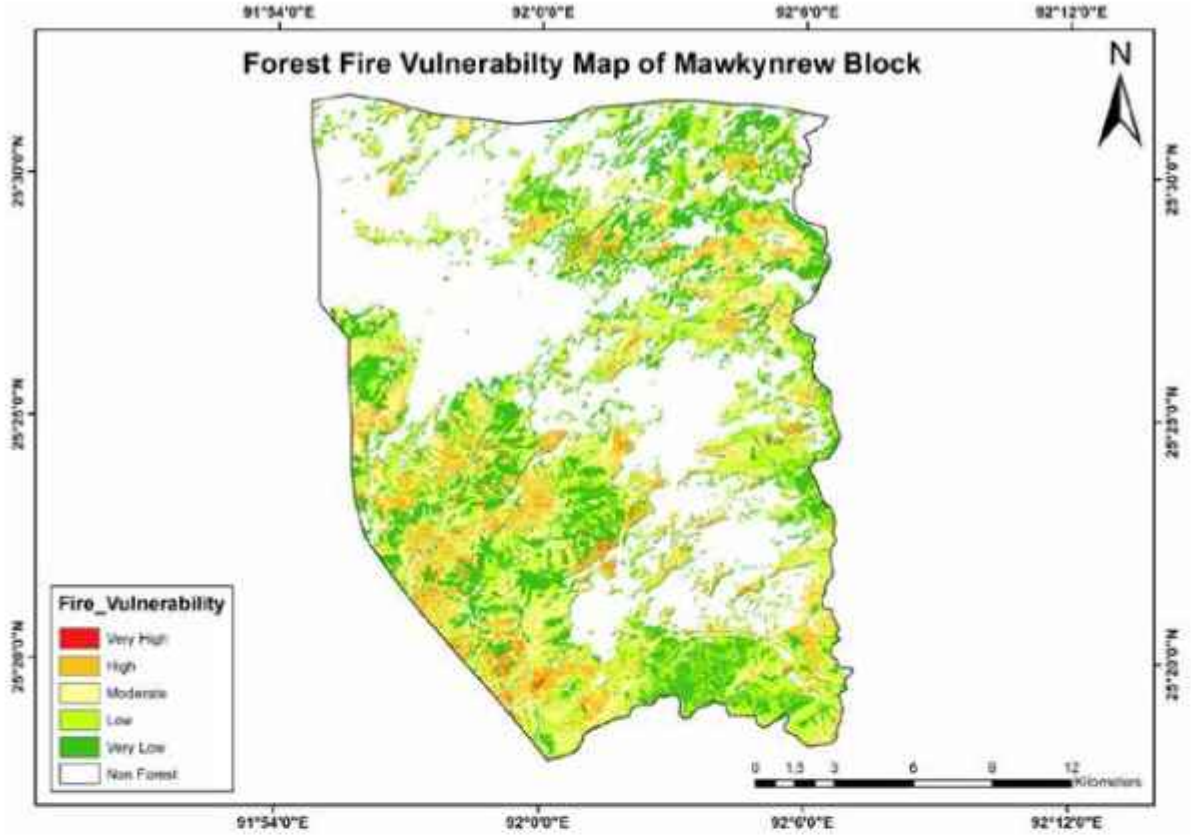


Figure 83. Forest Fire Vulnerability Map of Mawkynrew Block

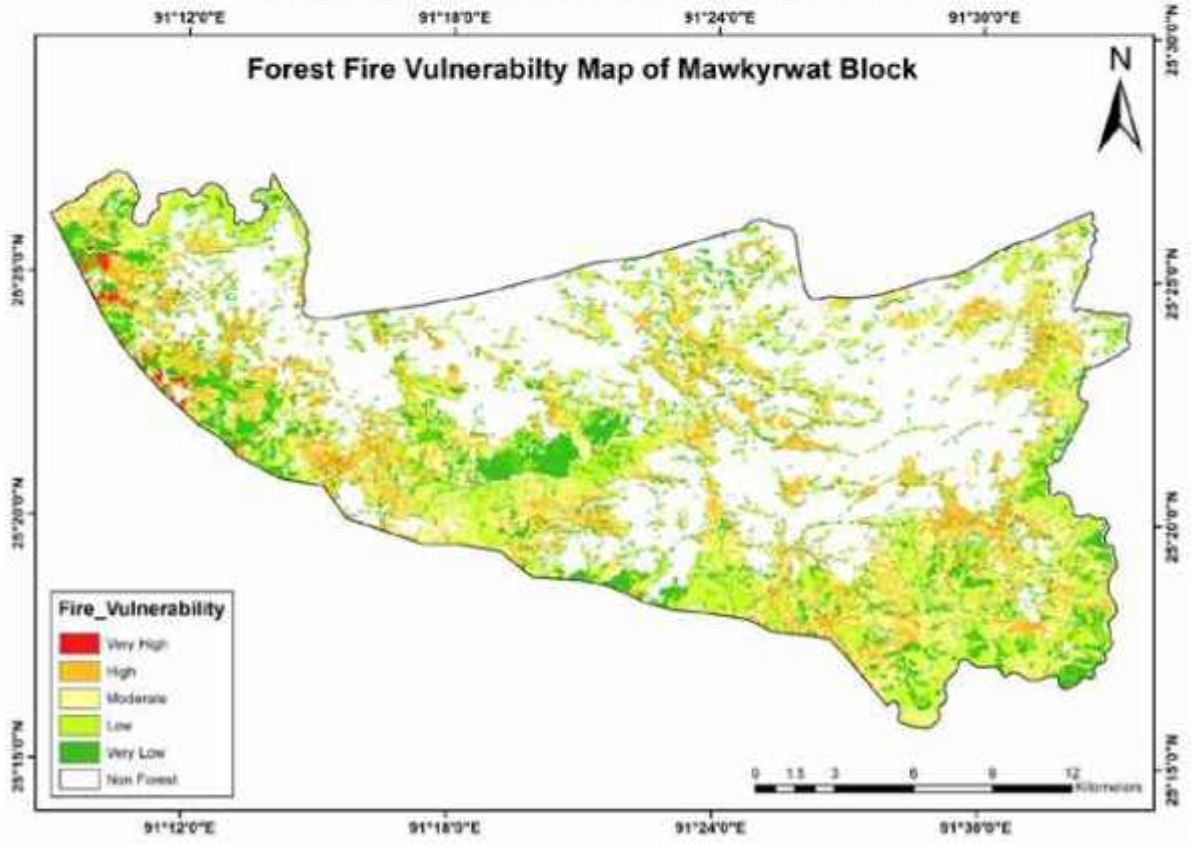


Figure 84. Forest Fire Vulnerability Map of Maawkyrwat Block

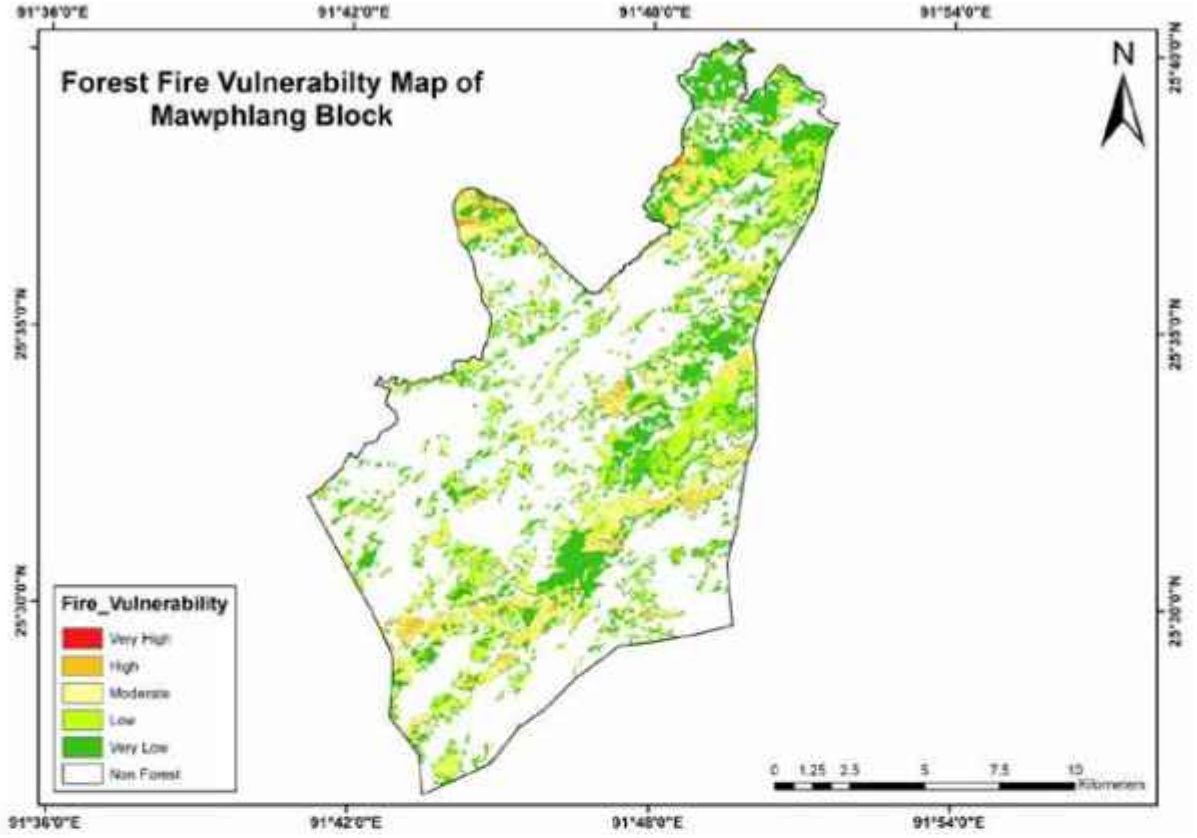


Figure 85. Forest Fire Vulnerability Map of Mawphlang Block

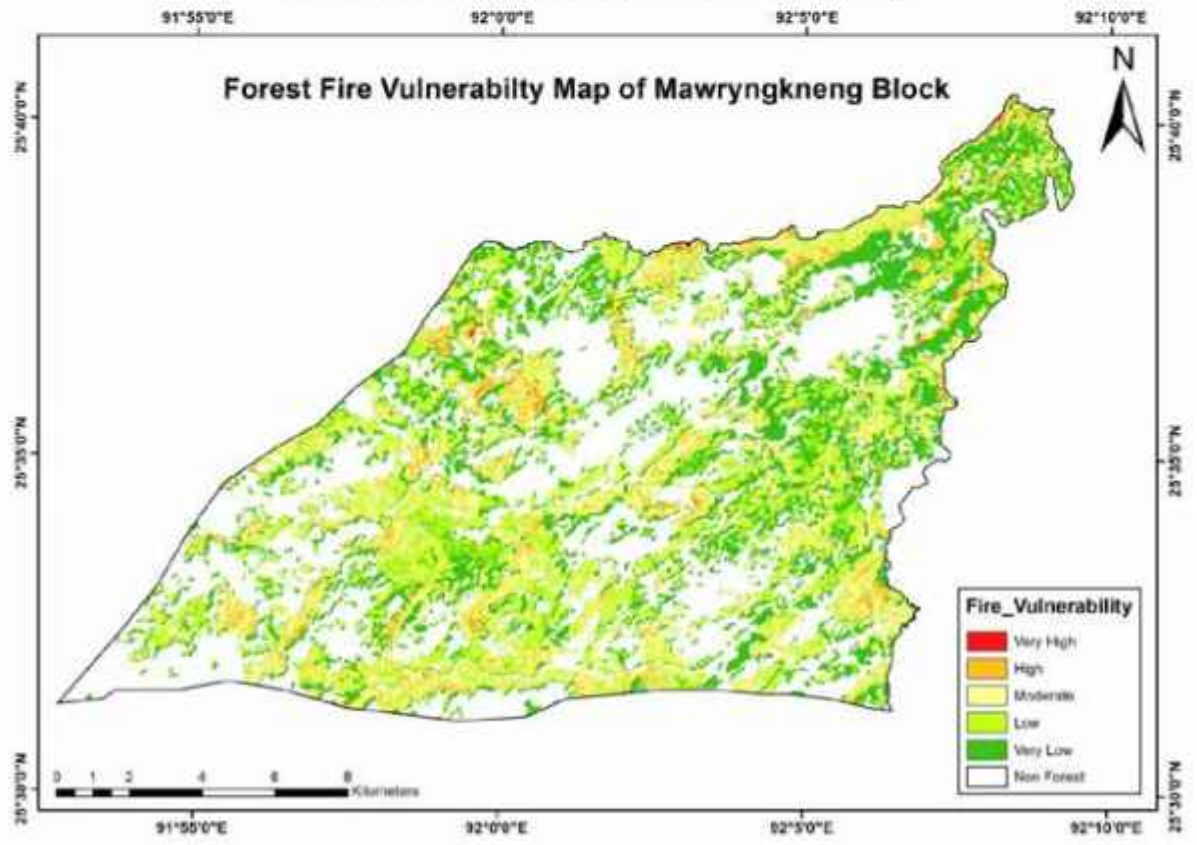


Figure 86. Forest Fire Vulnerability Map of Mawryngkneng Block

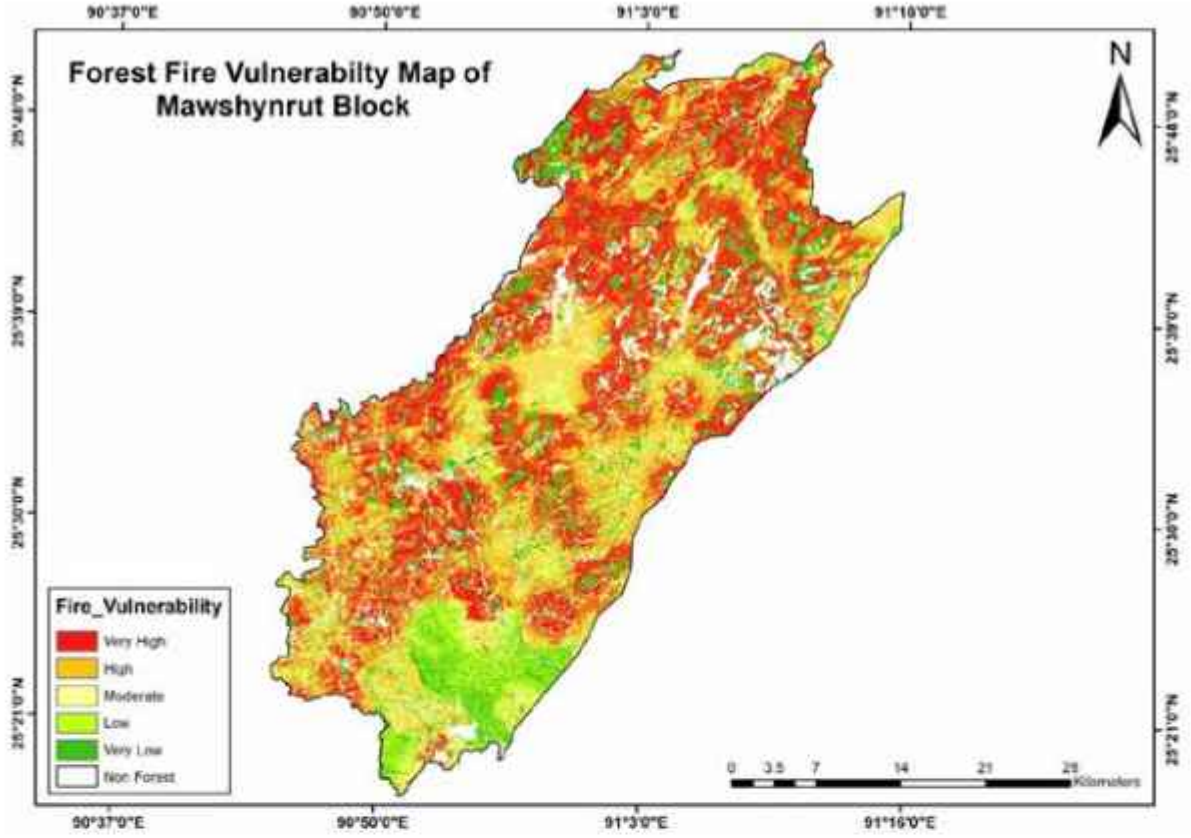


Figure 87. Forest Fire Vulnerability Map of Mawshynrut Block

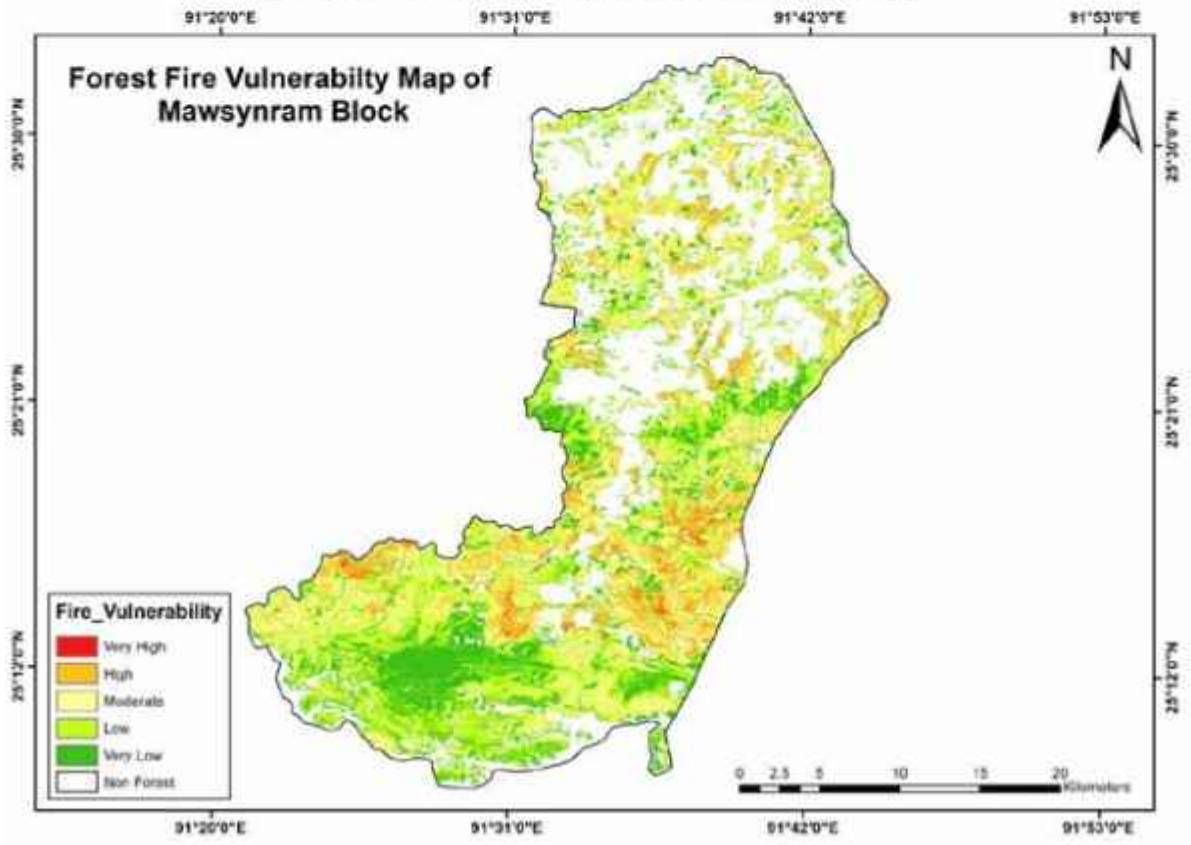


Figure 88. Forest Fire Vulnerability Map of Mawsynram Block

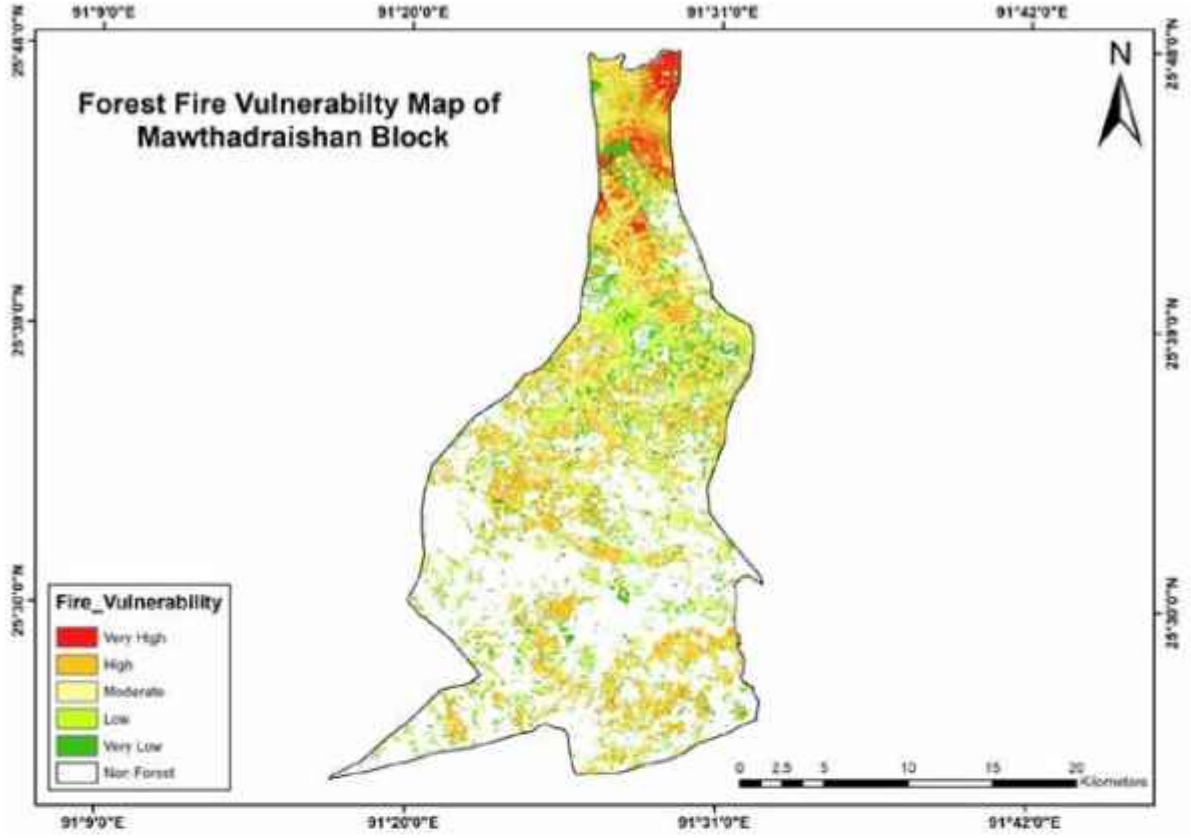


Figure 89. Forest Fire Vulnerability Map of Mawthadraishan Block

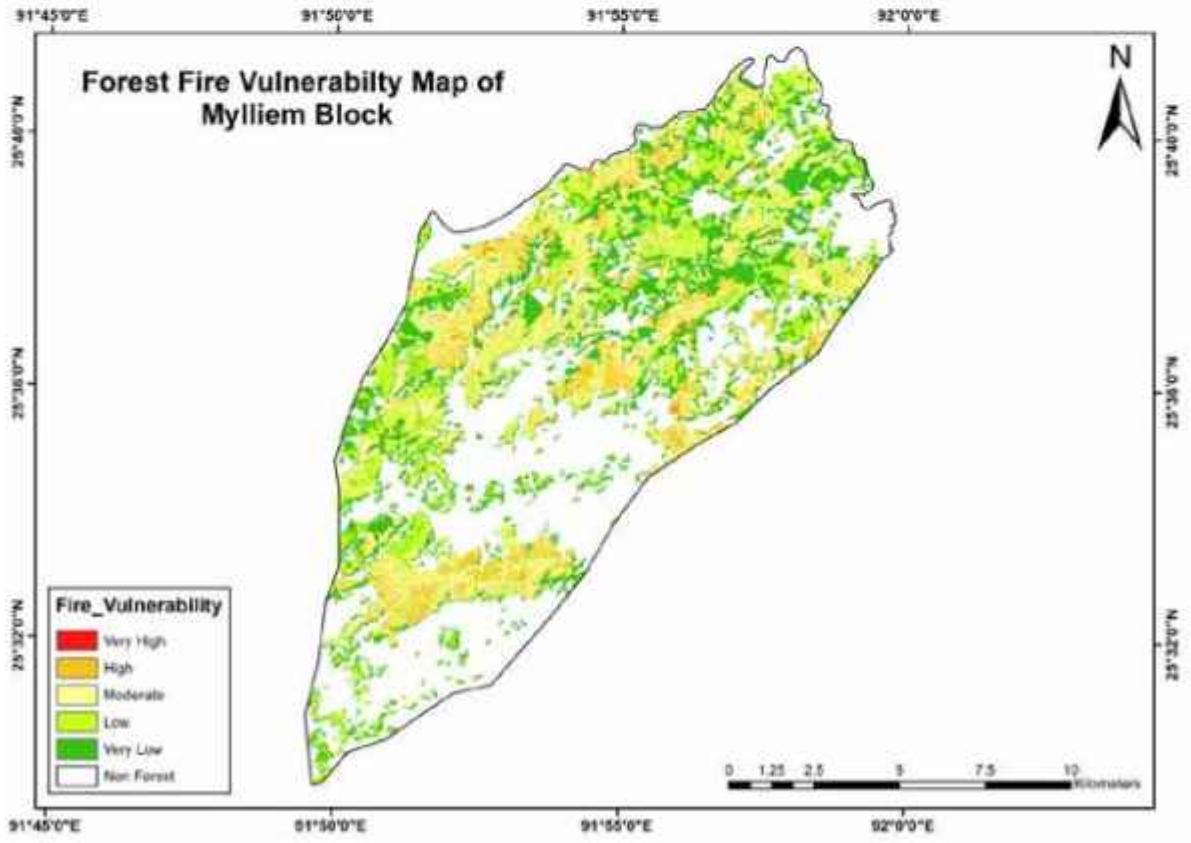


Figure 90. Forest Fire Vulnerability Map of Mylliem Block

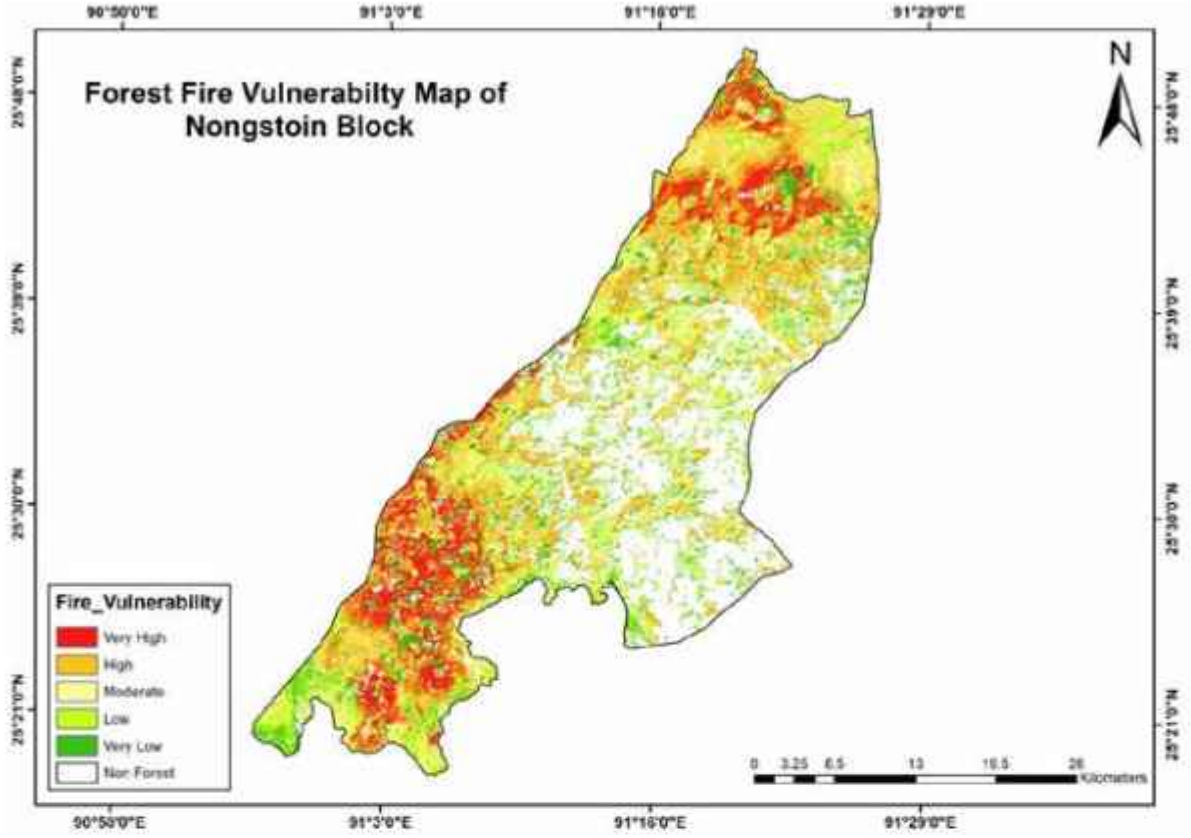


Figure 91. Forest Fire Vulnerability Map of Nongstoin Block

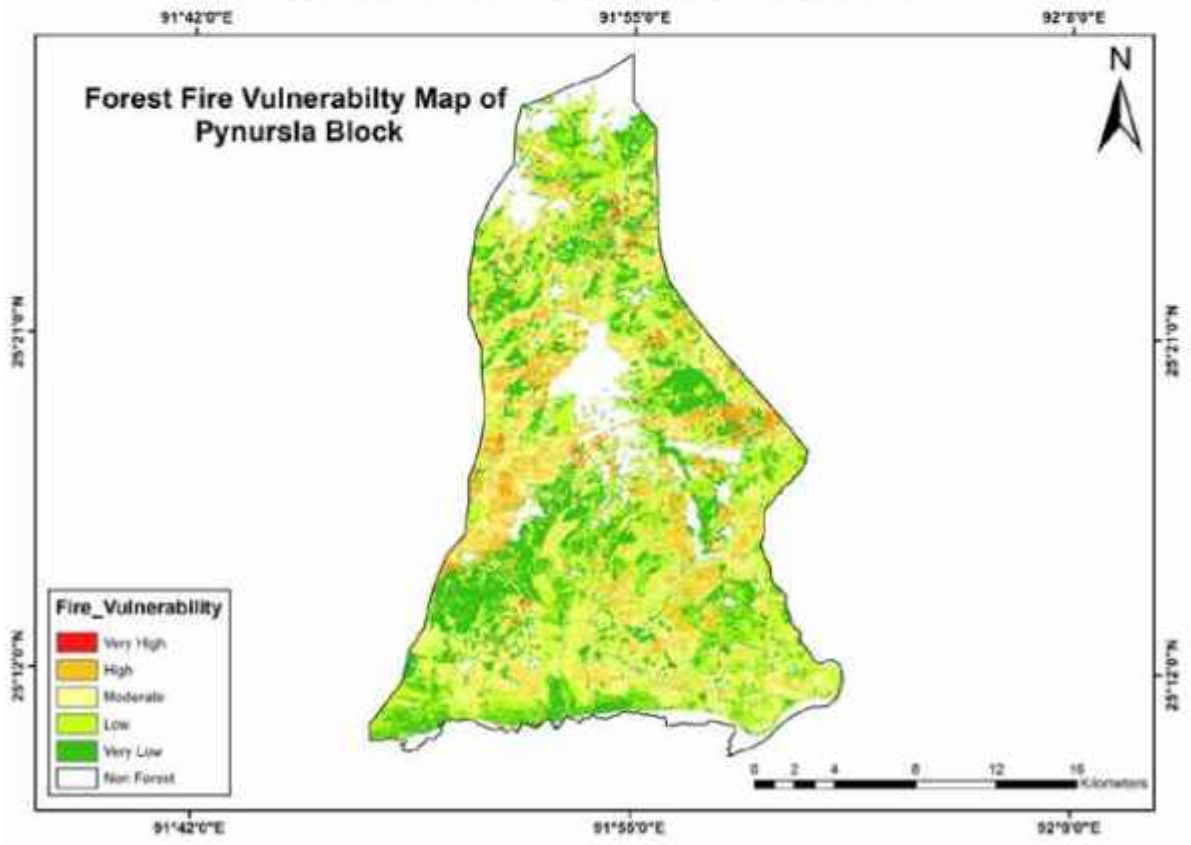


Figure 92. Forest Fire Vulnerability Map of Pynursla Block

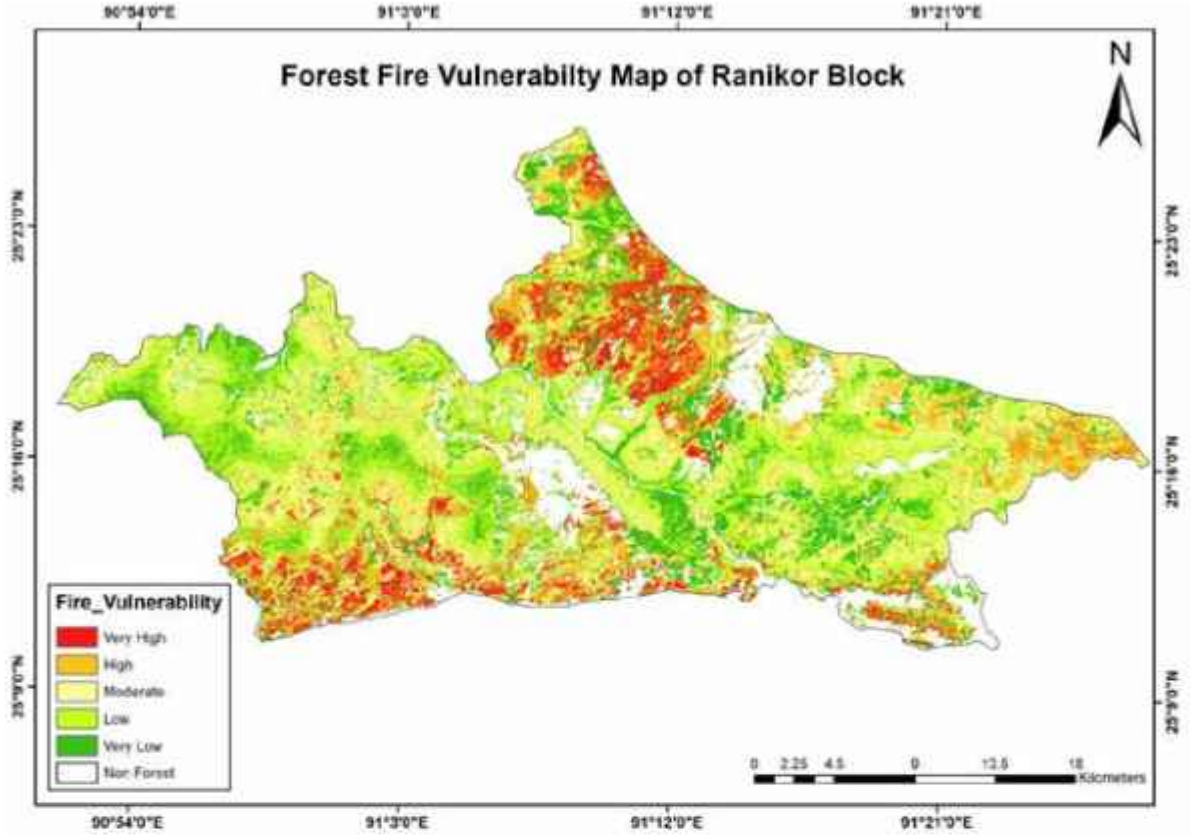


Figure 93. Forest Fire Vulnerability Map of Ranikor Block

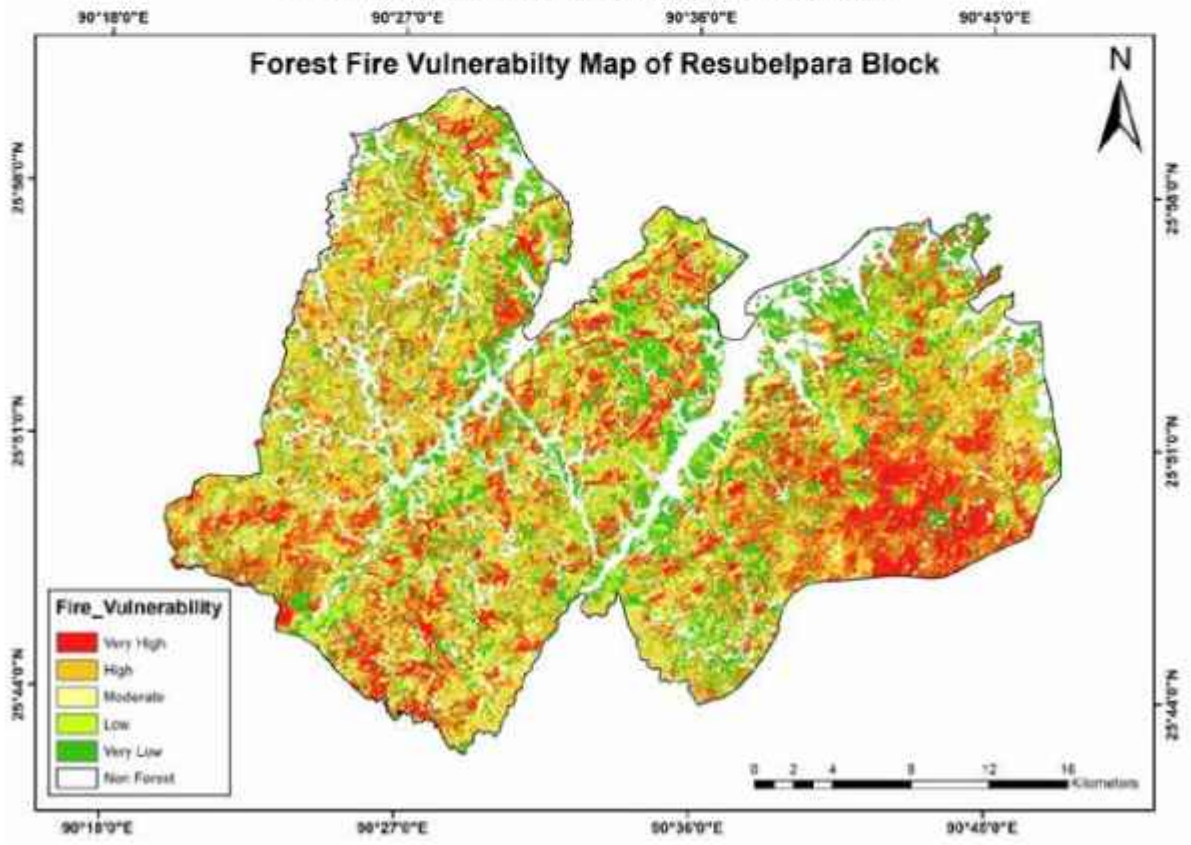


Figure 94. Forest Fire Vulnerability Map of Resubelpara Block

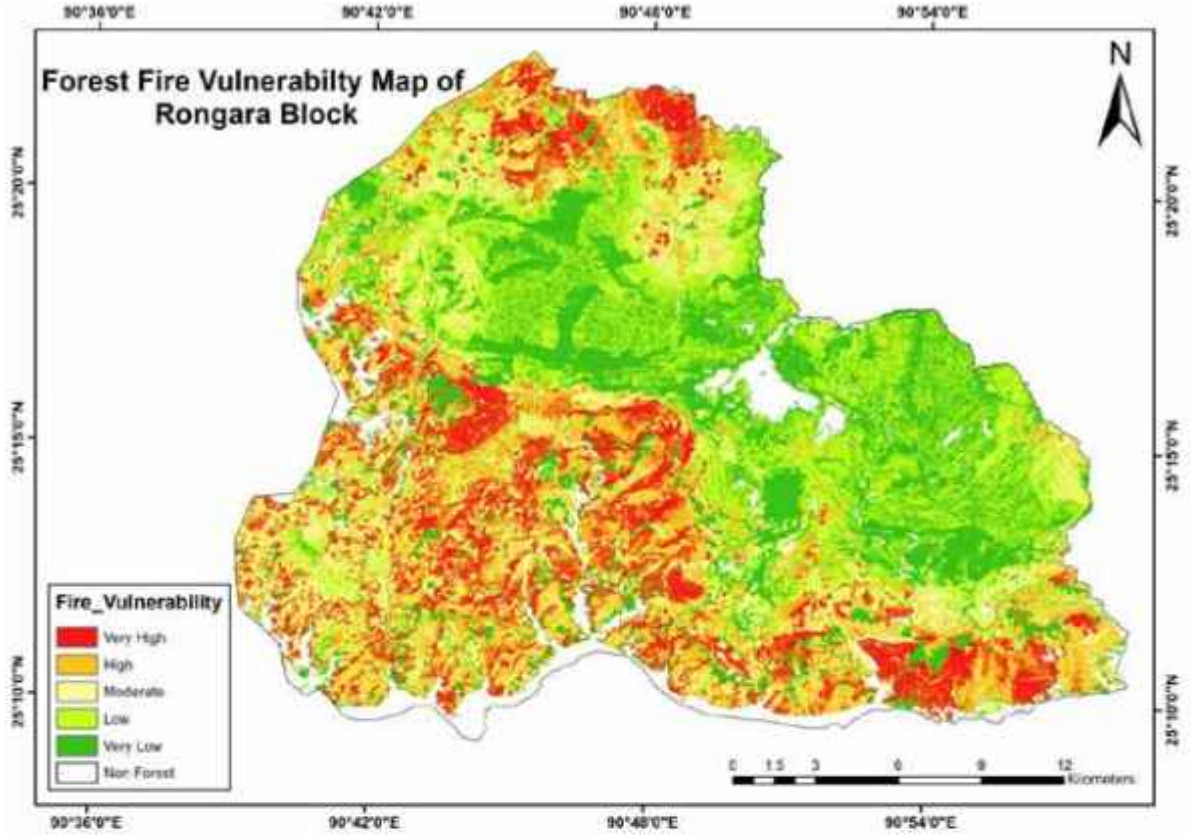


Figure 95. Forest Fire Vulnerability Map of Rongara Block

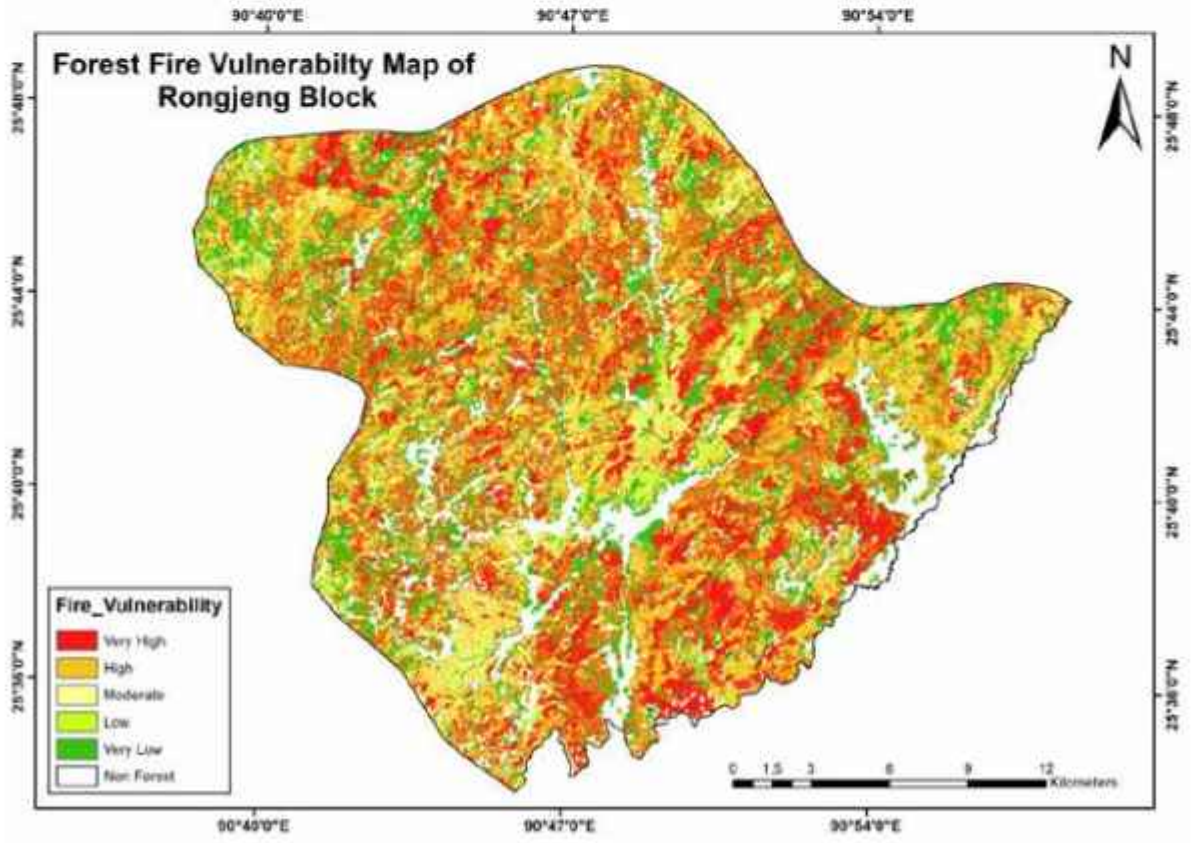


Figure 96. Forest Fire Vulnerability Map of Rongjeng Block

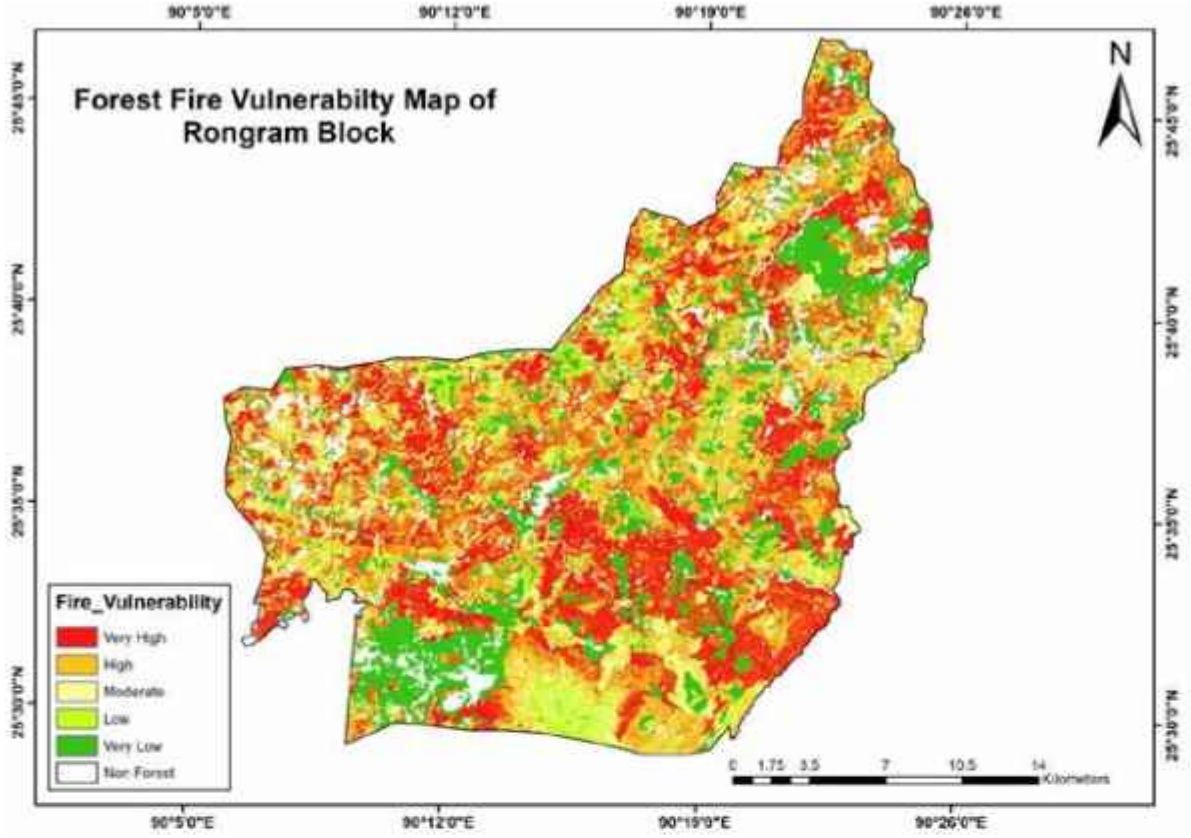


Figure 97. Forest Fire Vulnerability Map of Rongram Block

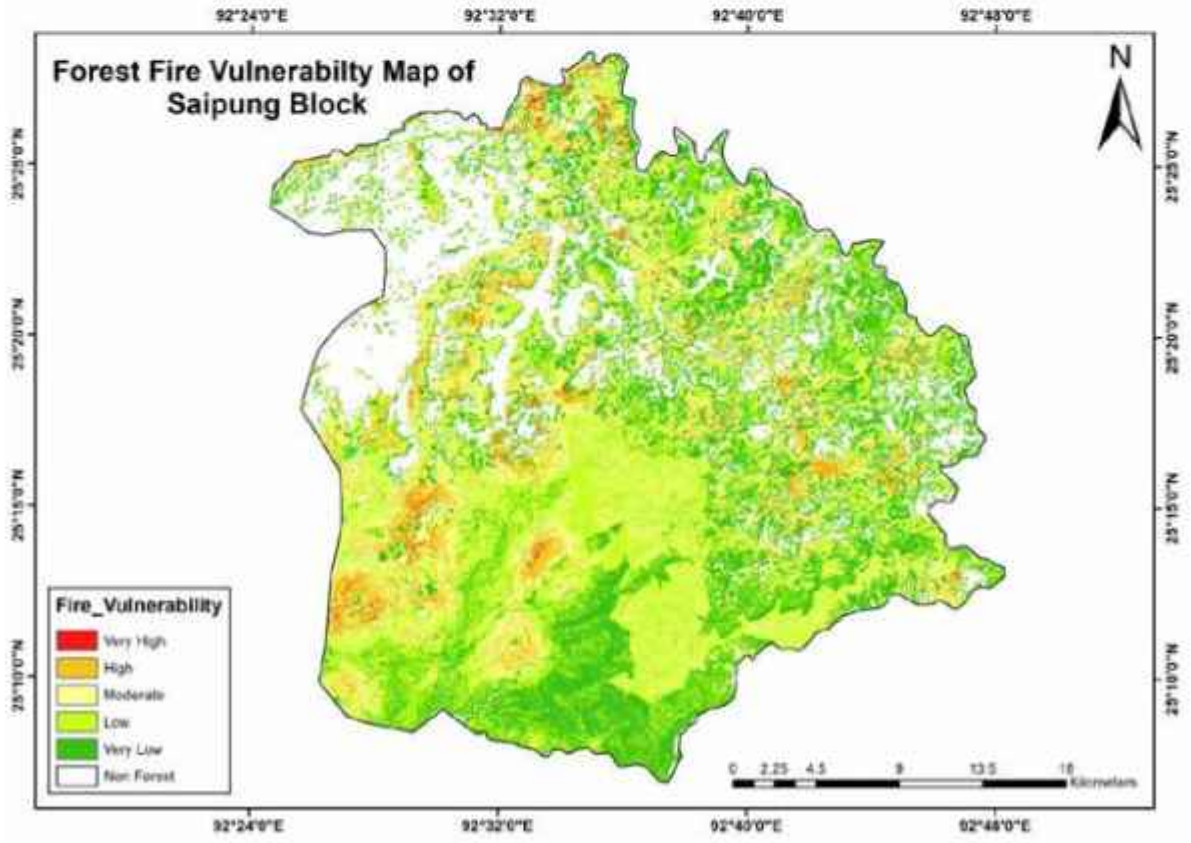


Figure 98. Forest Fire Vulnerability Map of Saipung Block

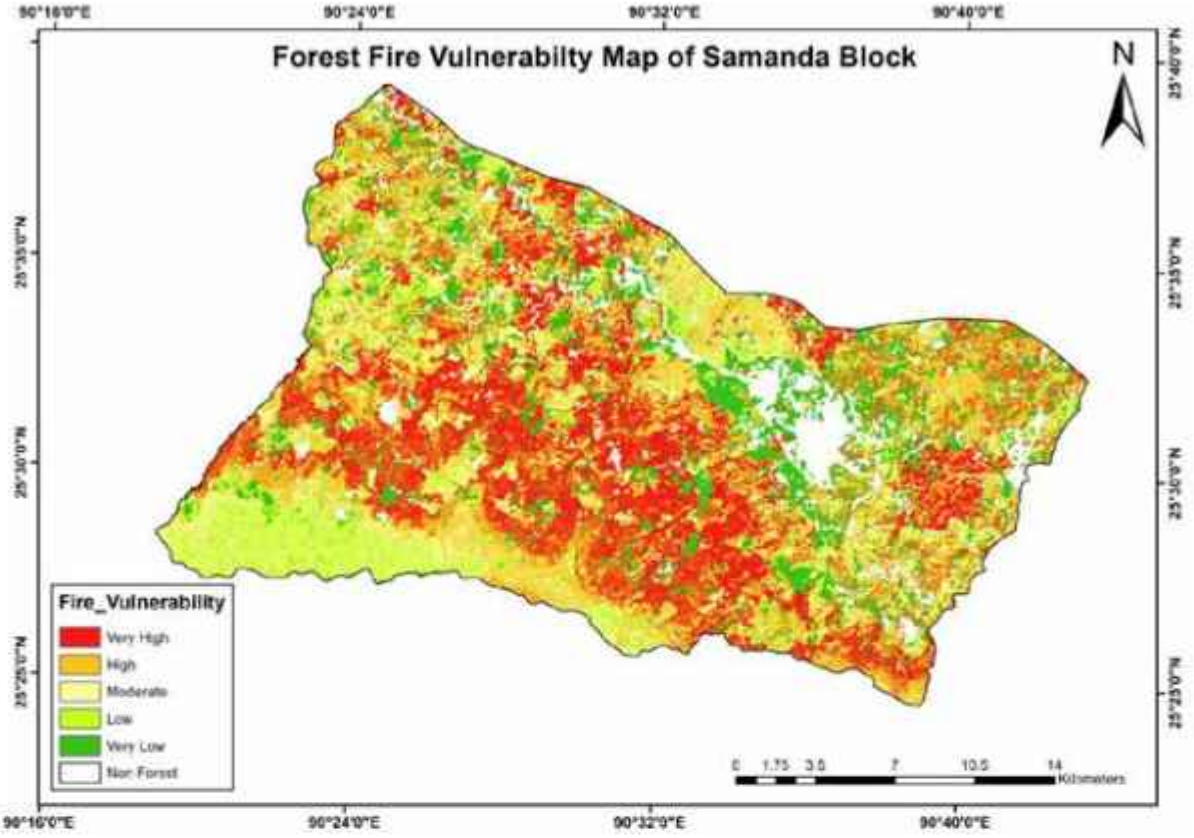


Figure 99. Forest Fire Vulnerability Map of Samanda Block

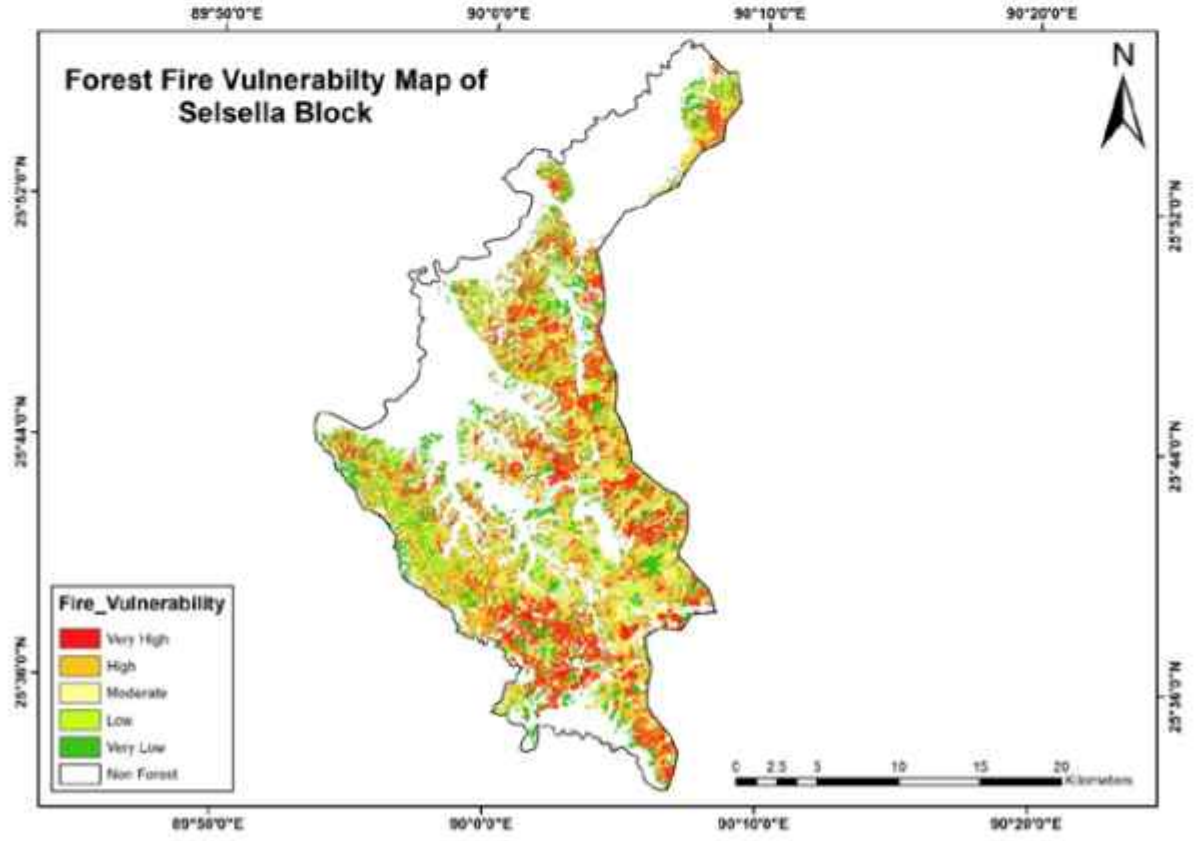


Figure 100. Forest Fire Vulnerability Map of Selsella Block

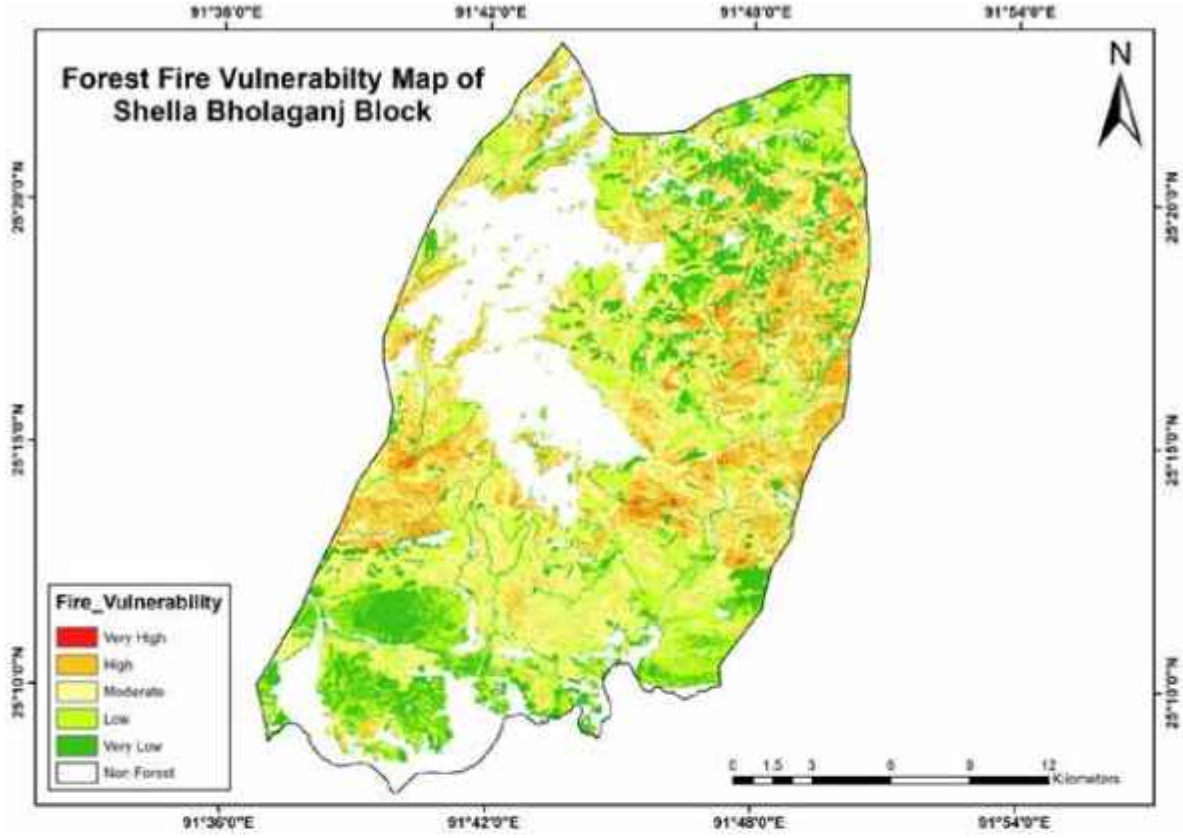


Figure 101. Forest Fire Vulnerability Map of Bholaganj Block

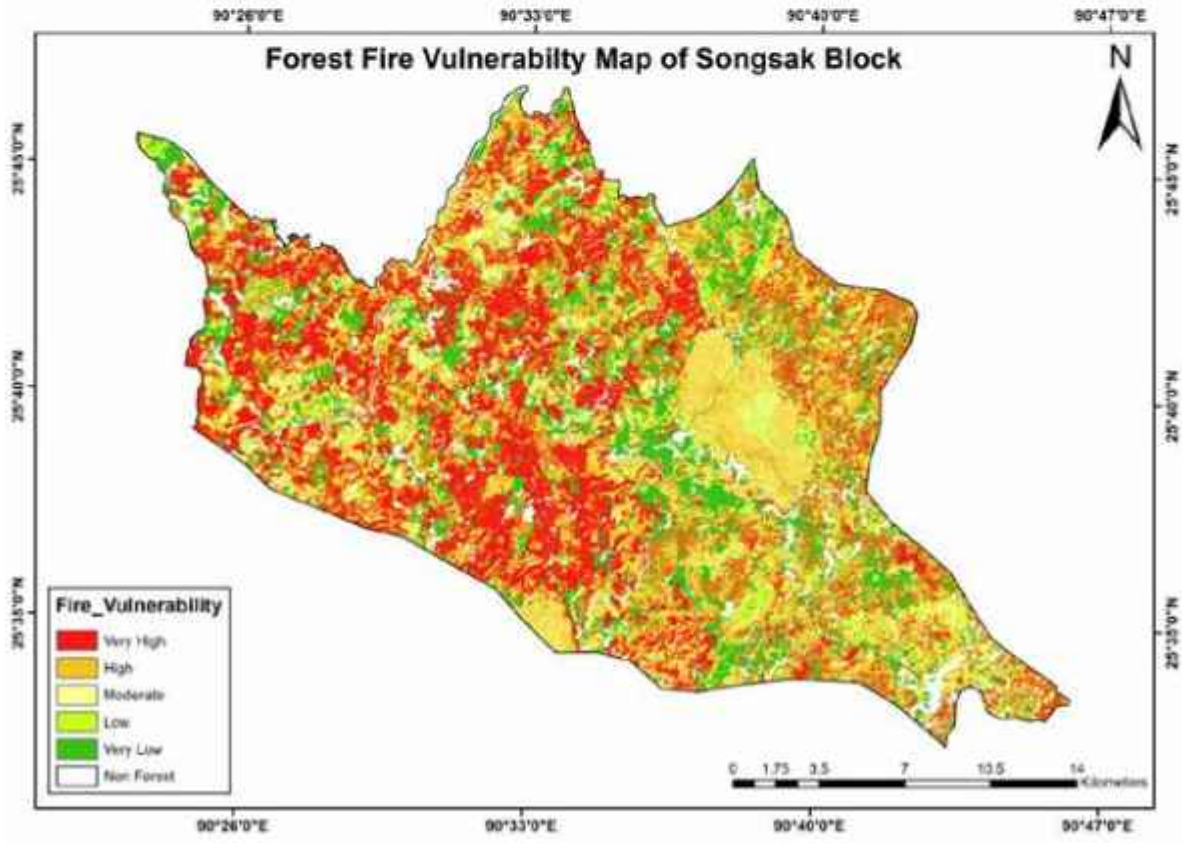


Figure 102. Forest Fire Vulnerability Map of Songsak Block

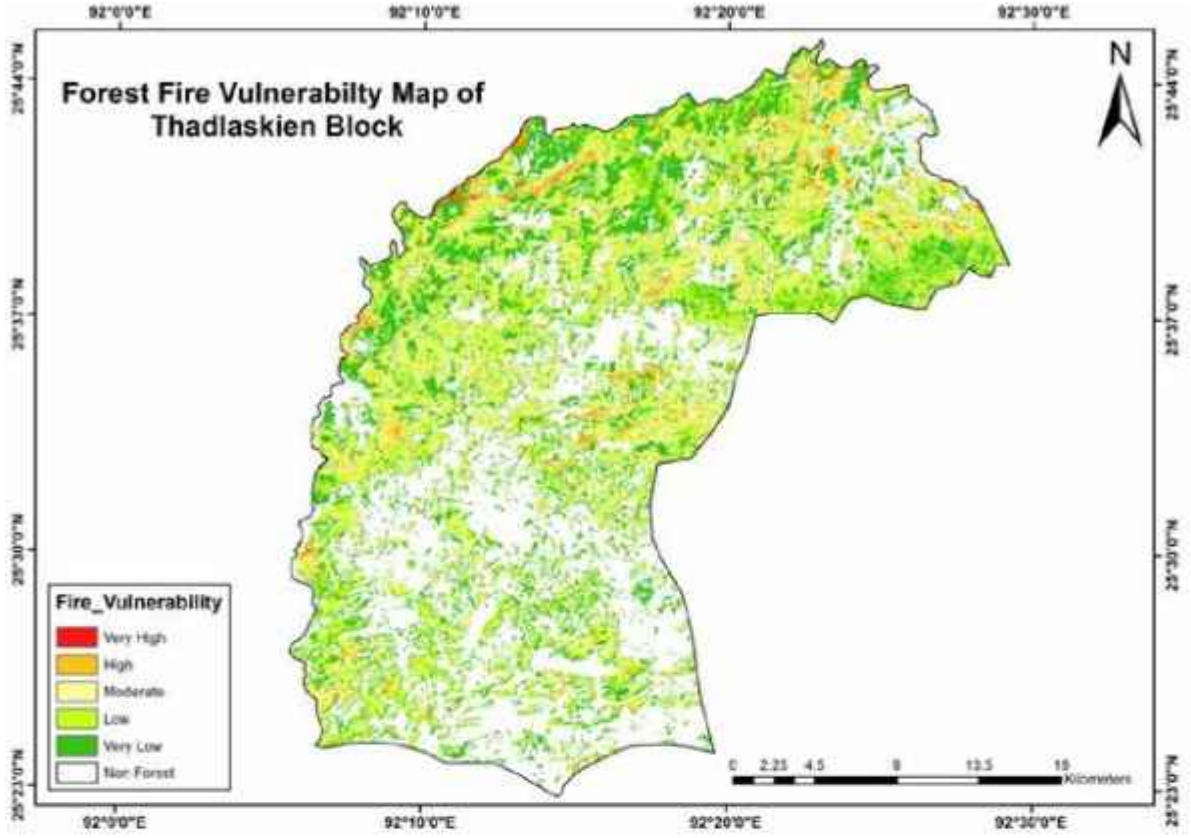


Figure 103. Forest Fire Vulnerability Map of Thadlaskien Block

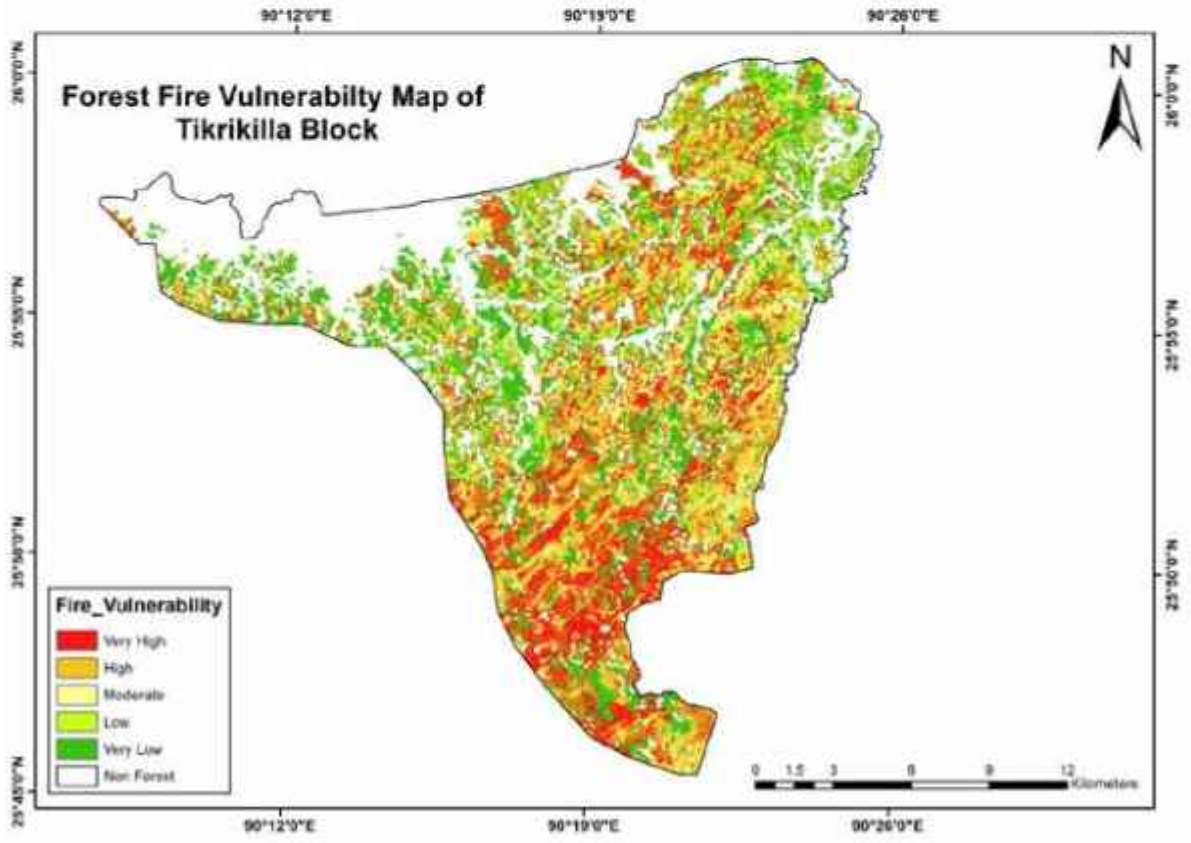


Figure 104. Forest Fire Vulnerability Map of Tikrikilla Block

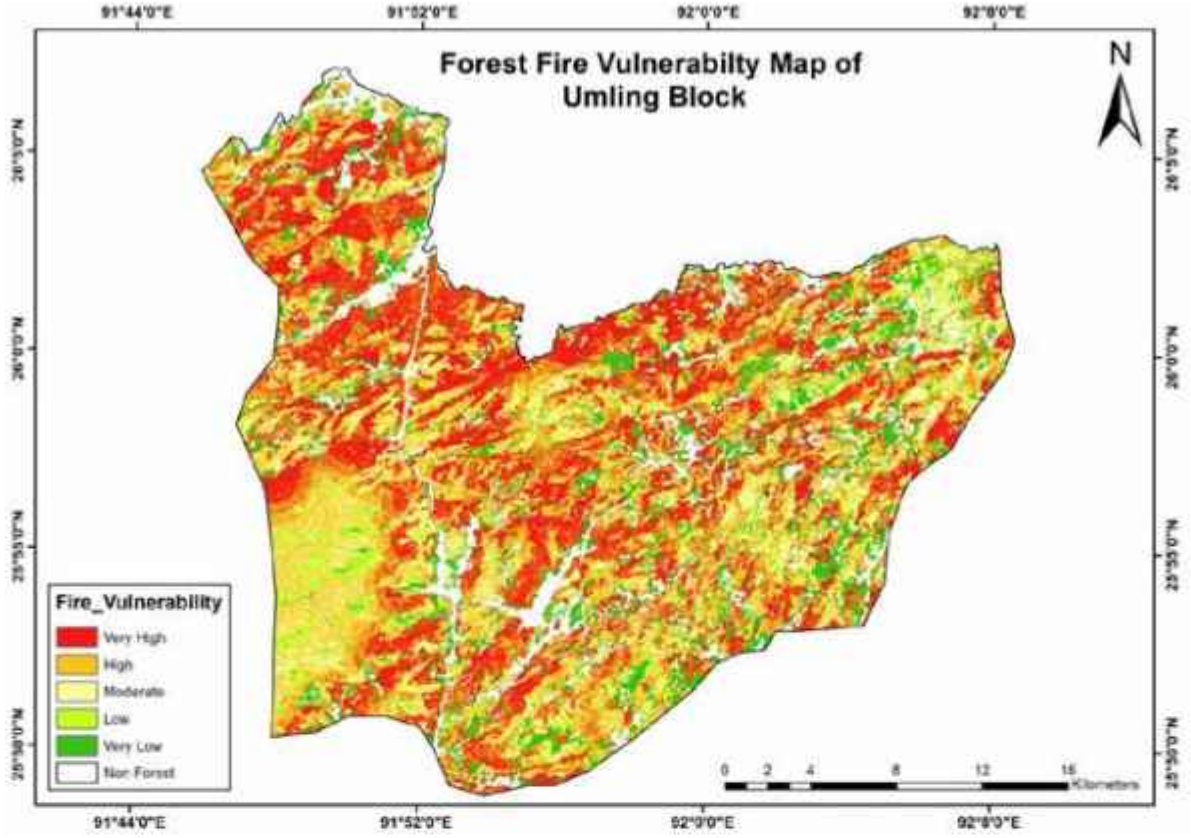


Figure 105. Forest Fire Vulnerability Map of Umling Block

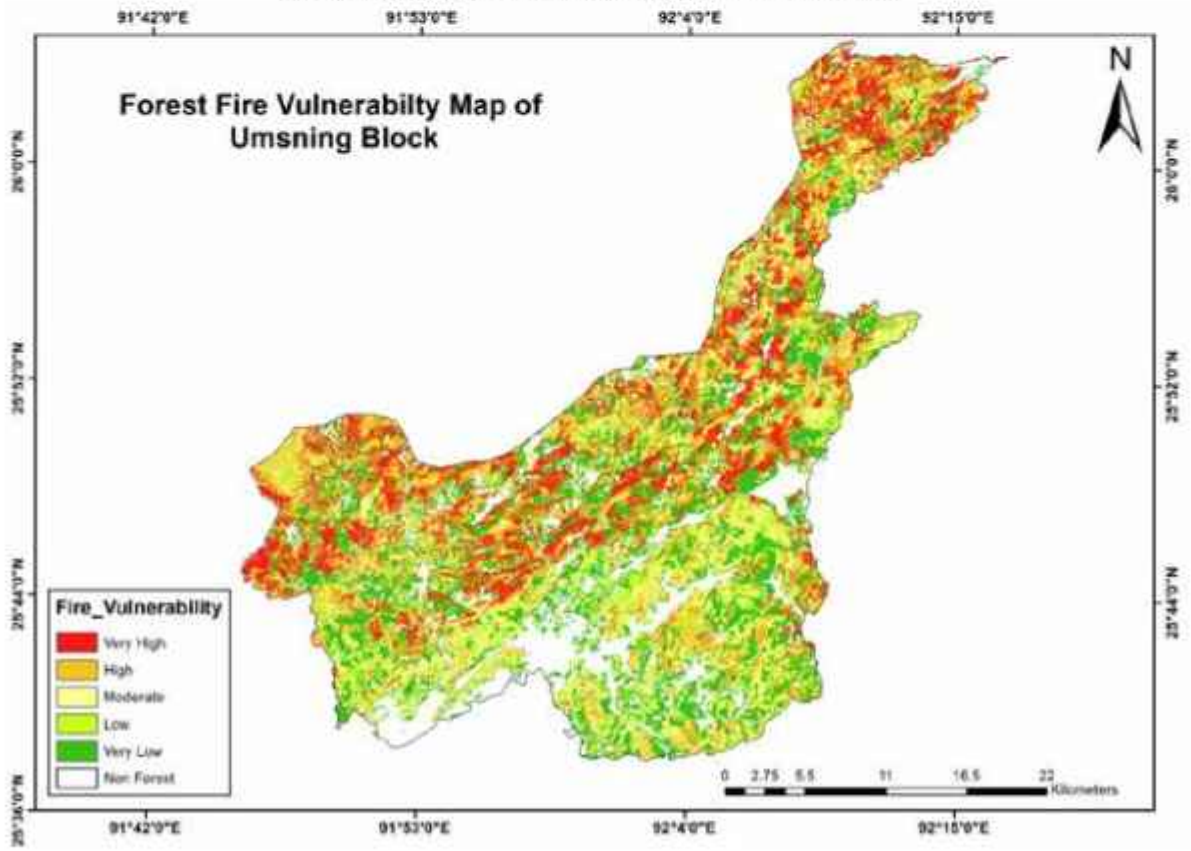


Figure 106. Forest Fire Vulnerability Map of Umsning Block

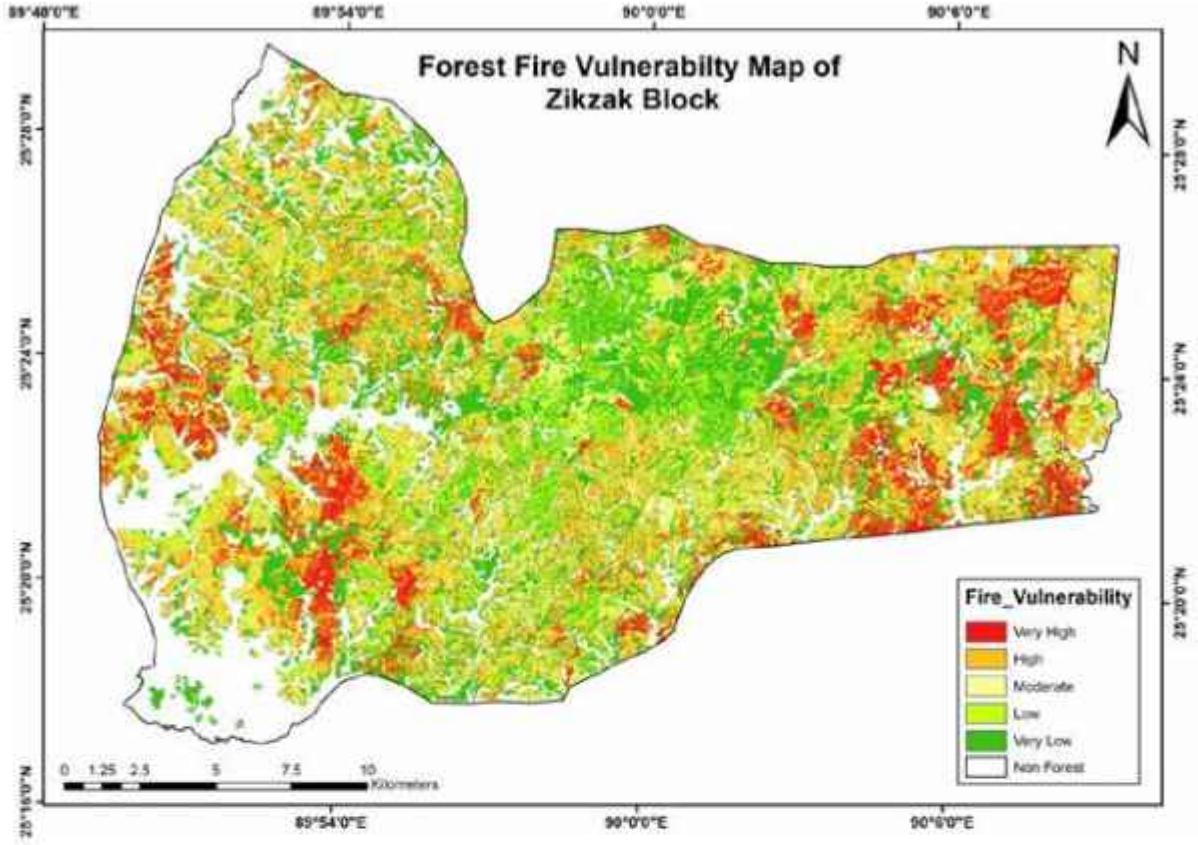


Figure 107. Forest Fire Vulnerability Map of Zikzak Block

Forest Fire Prone Map for all Districts of Meghalaya

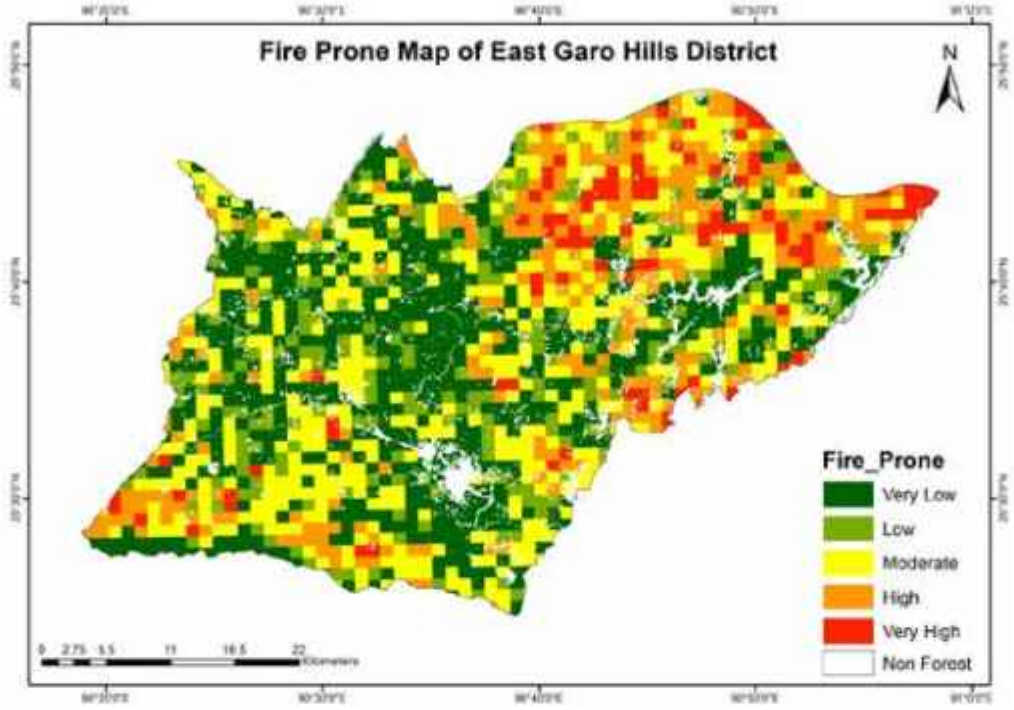


Figure 108. Forest Fire Prone Map of East Garo Hills District

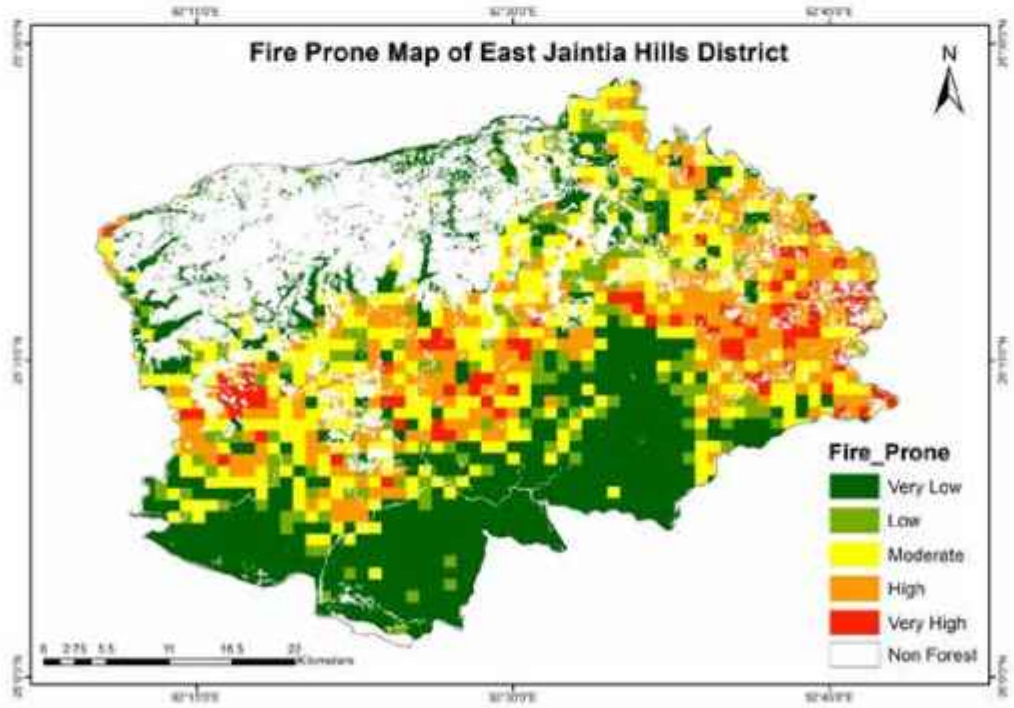


Figure 109. Forest Fire Prone Map of East Jaintia Hills District

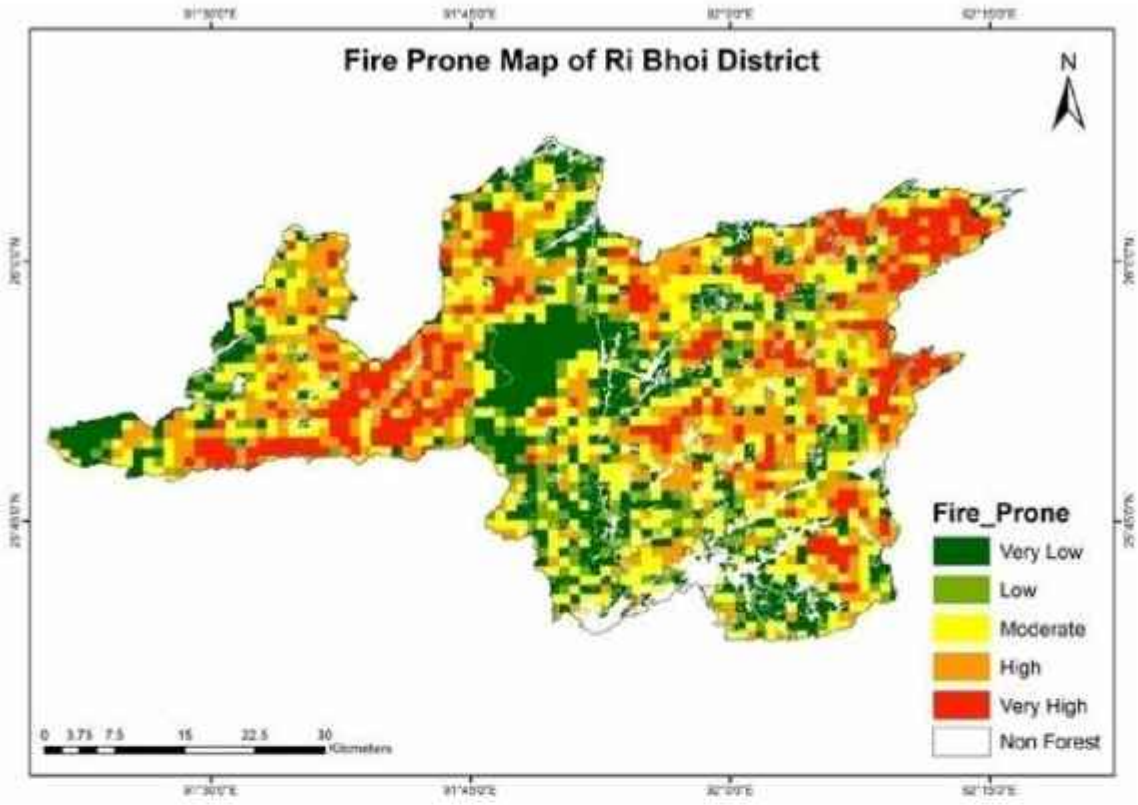


Figure 110. Forest Fire Prone Map of Ri Bhoi District

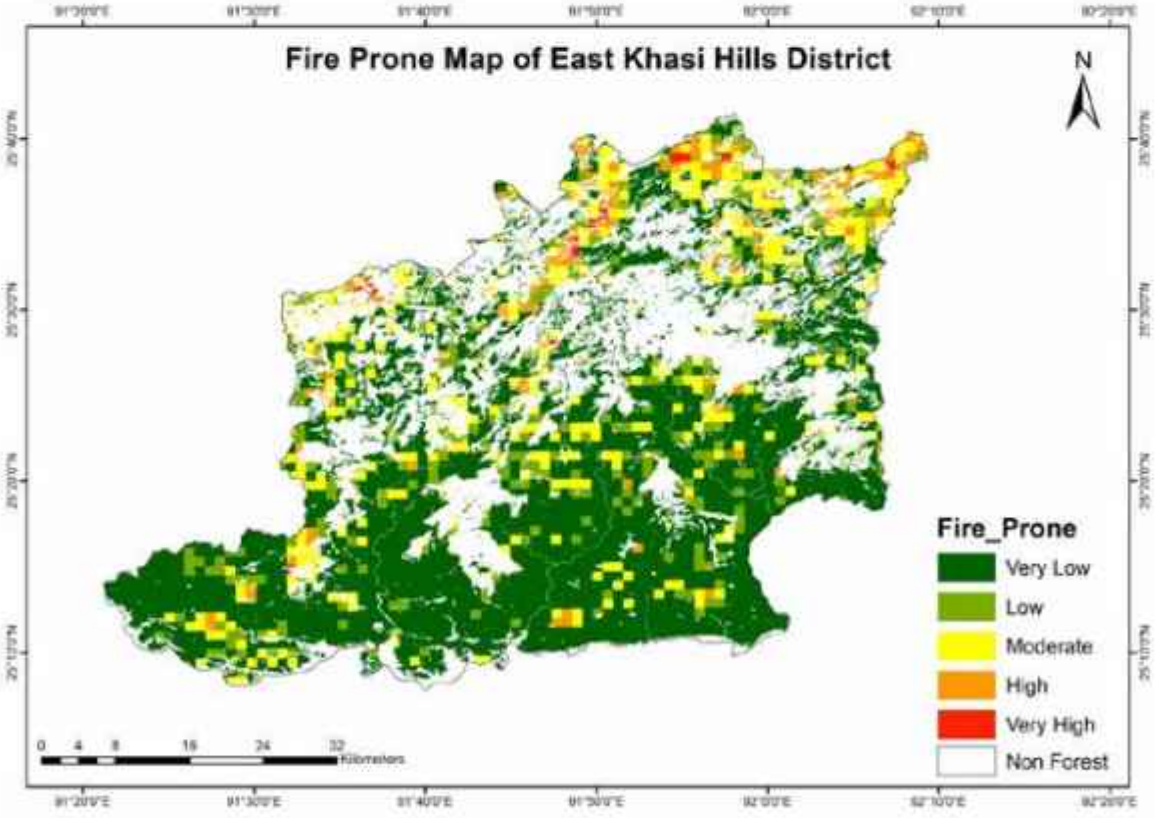


Figure 111. Forest Fire Prone Map of East Khasi Hills District

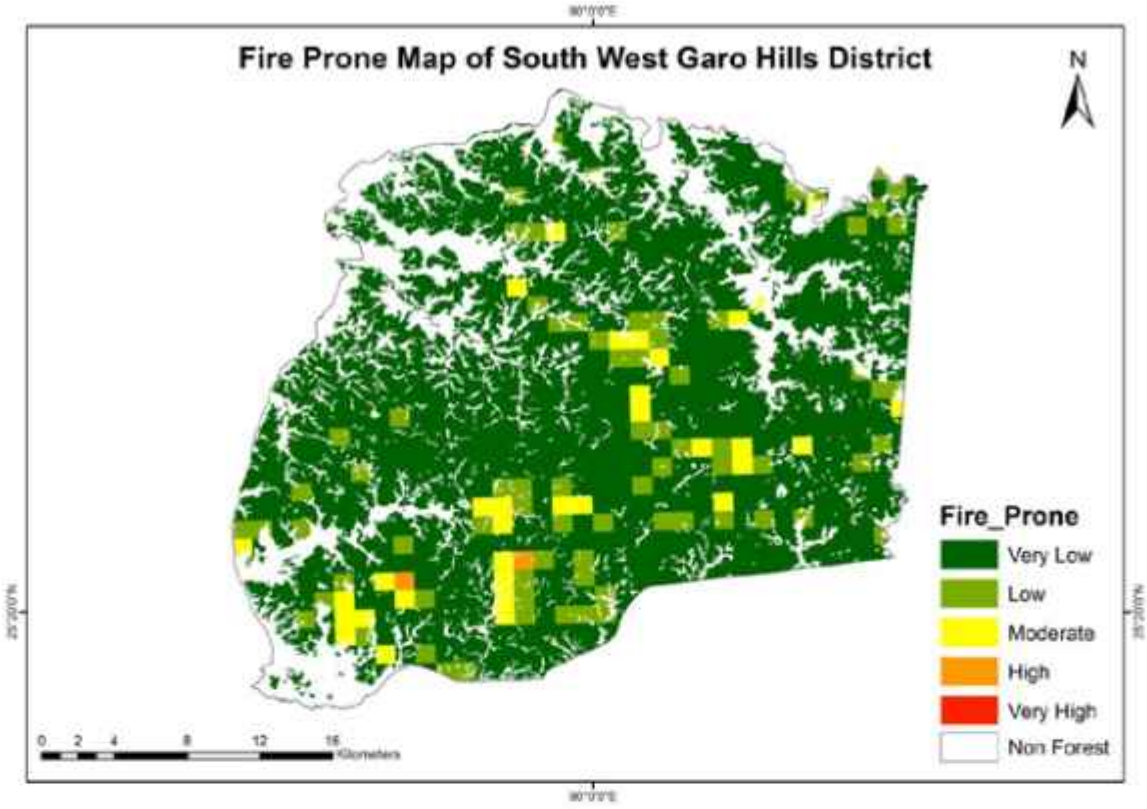


Figure 112. Forest Fire Prone Map of South West Garo Hills District

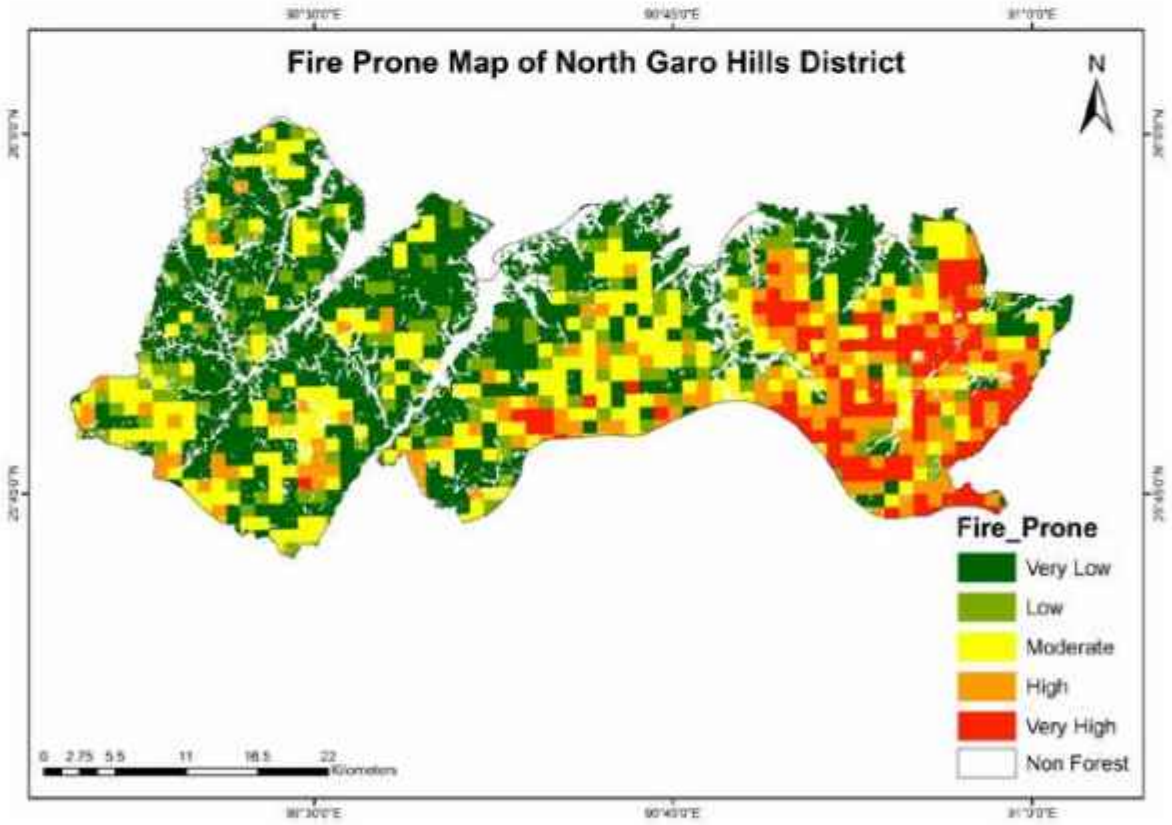


Figure 113. Forest Fire Prone Map of North Garo Hills District

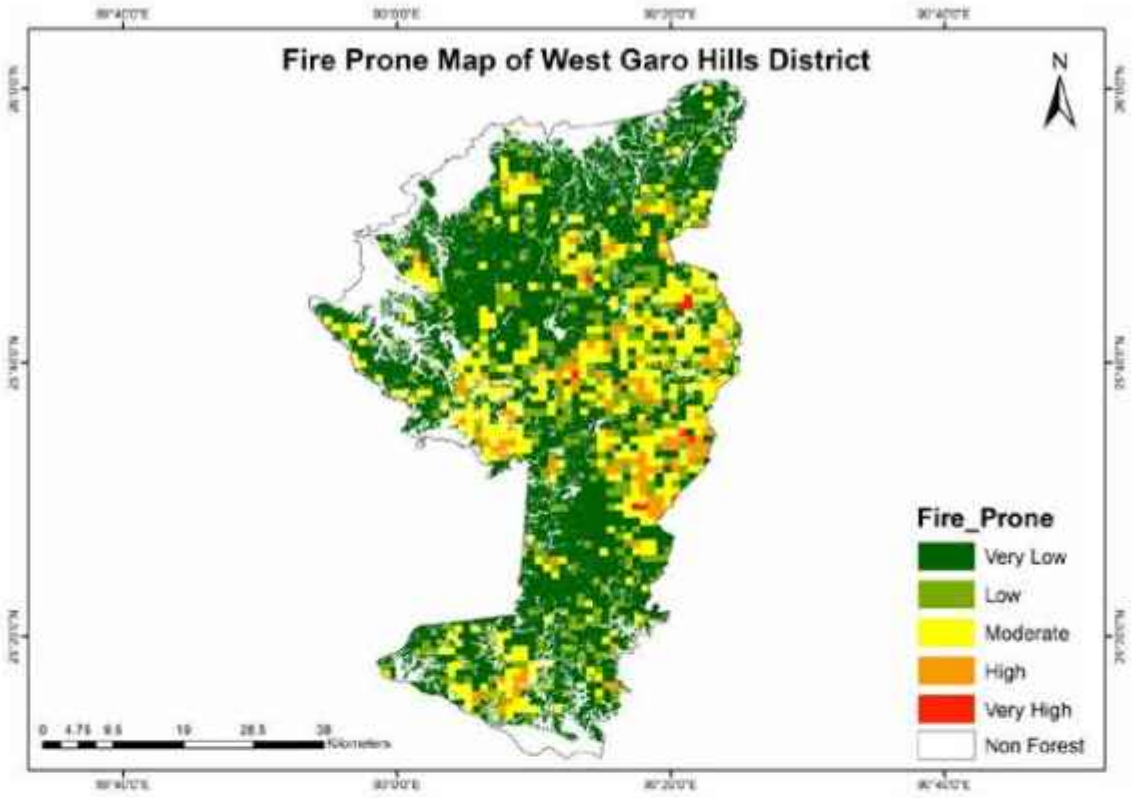


Figure 115. Forest Fire Prone Map of West Garo Hills District

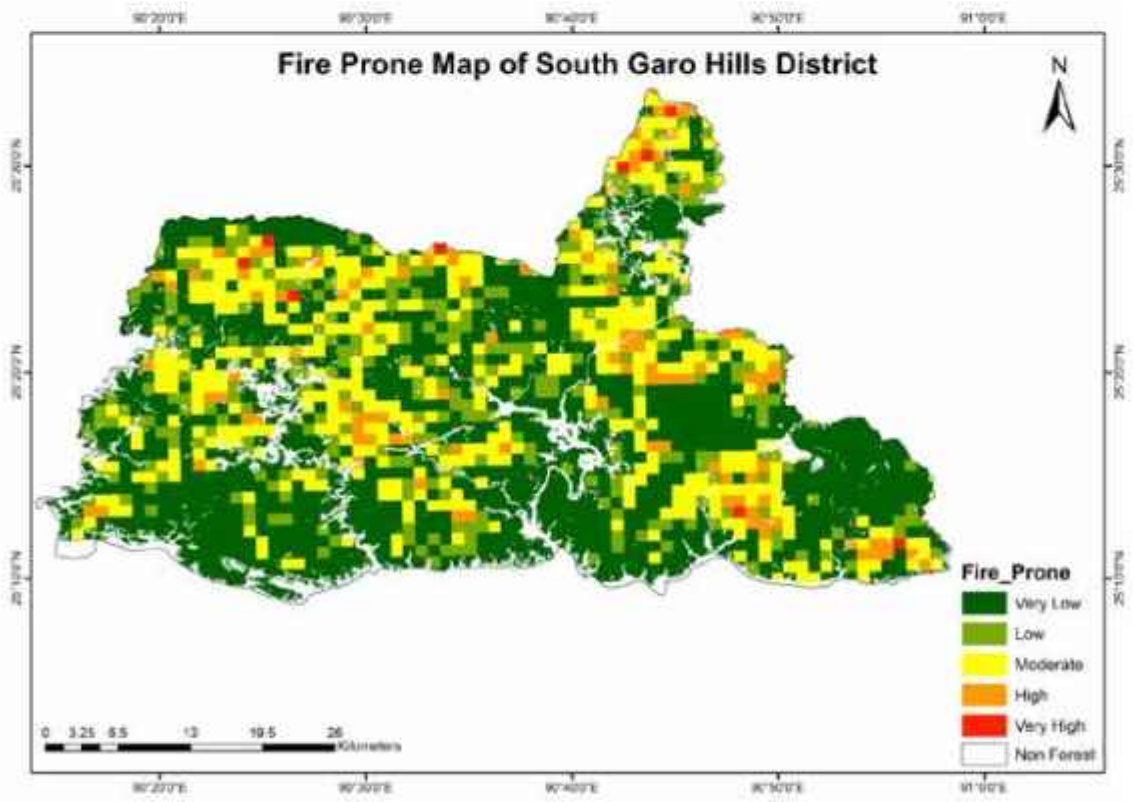


Figure 114. Forest Fire Prone Map of South Garo Hills District

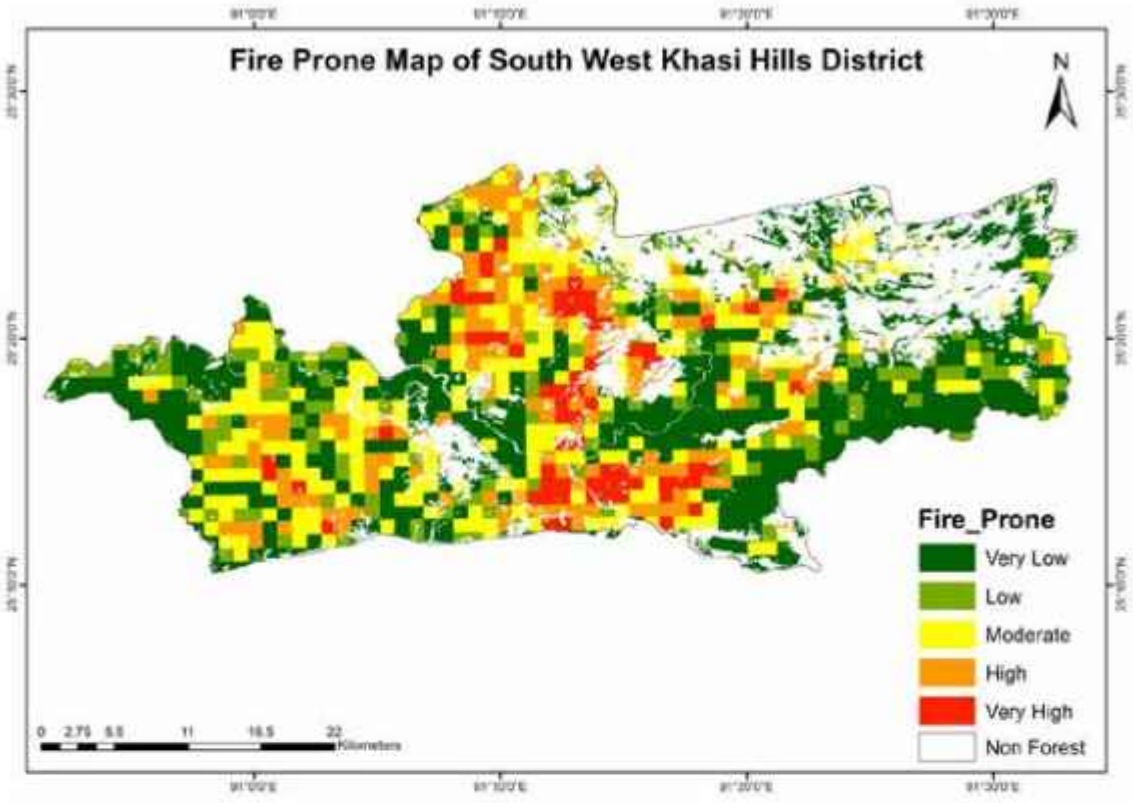


Figure 117. Forest Fire Prone Map of South West Khasi Hills District

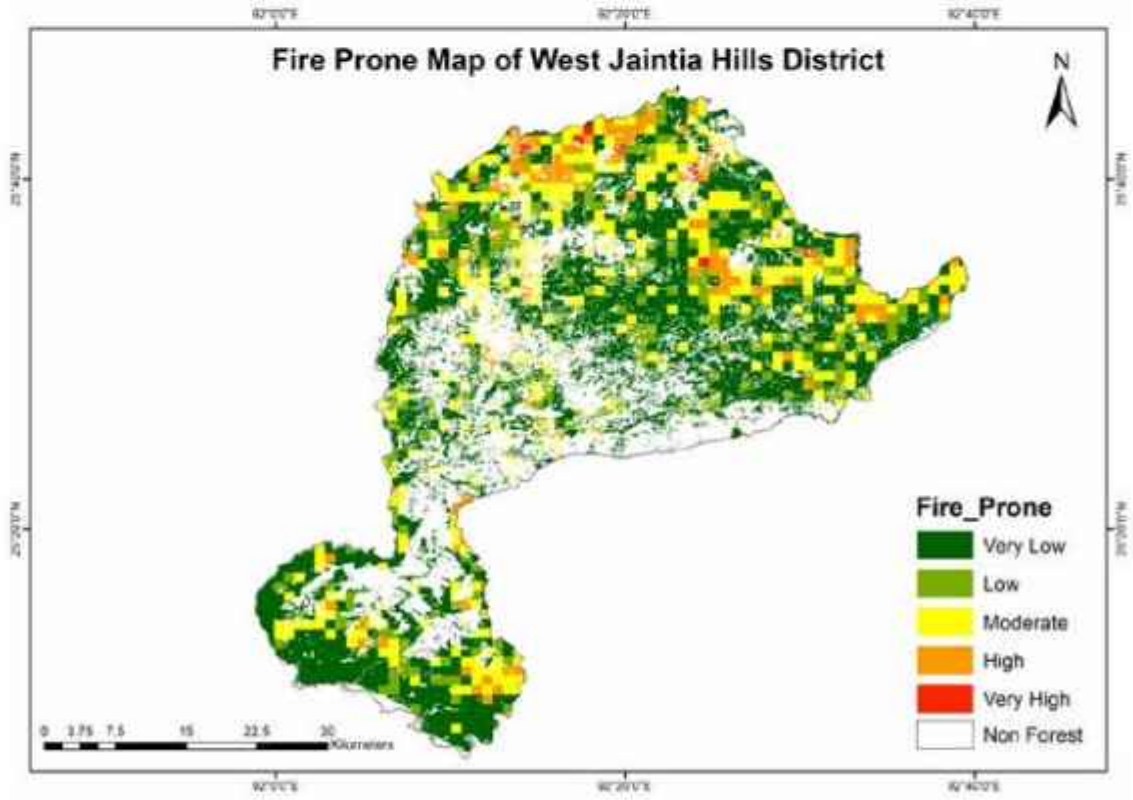


Figure 116. Forest Fire Prone Map of West Jaintia Hills District

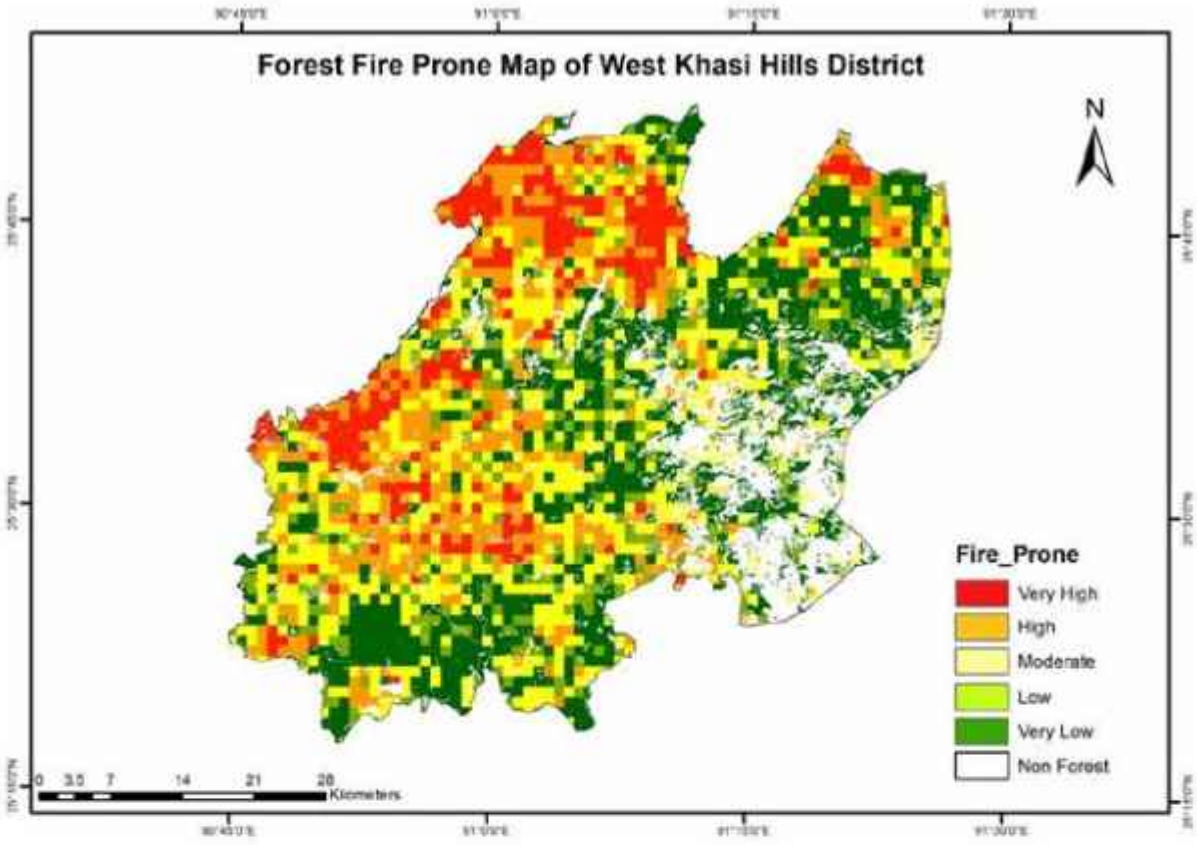


Figure 119. Forest Fire Prone Map of West Khasi Hills District

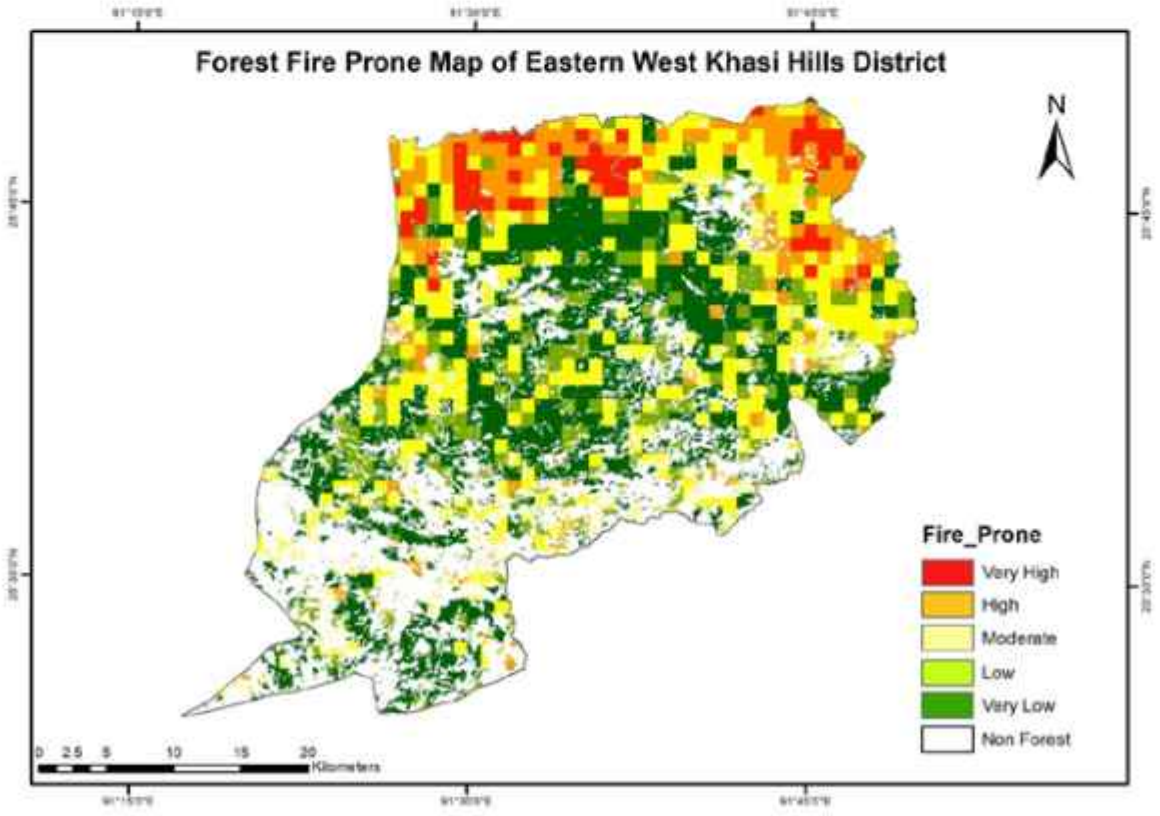


Figure 118. Forest Fire Prone Map of Eastern West Khasi Hills District

Forest Fire Prone Map for all Blocks of Meghalaya

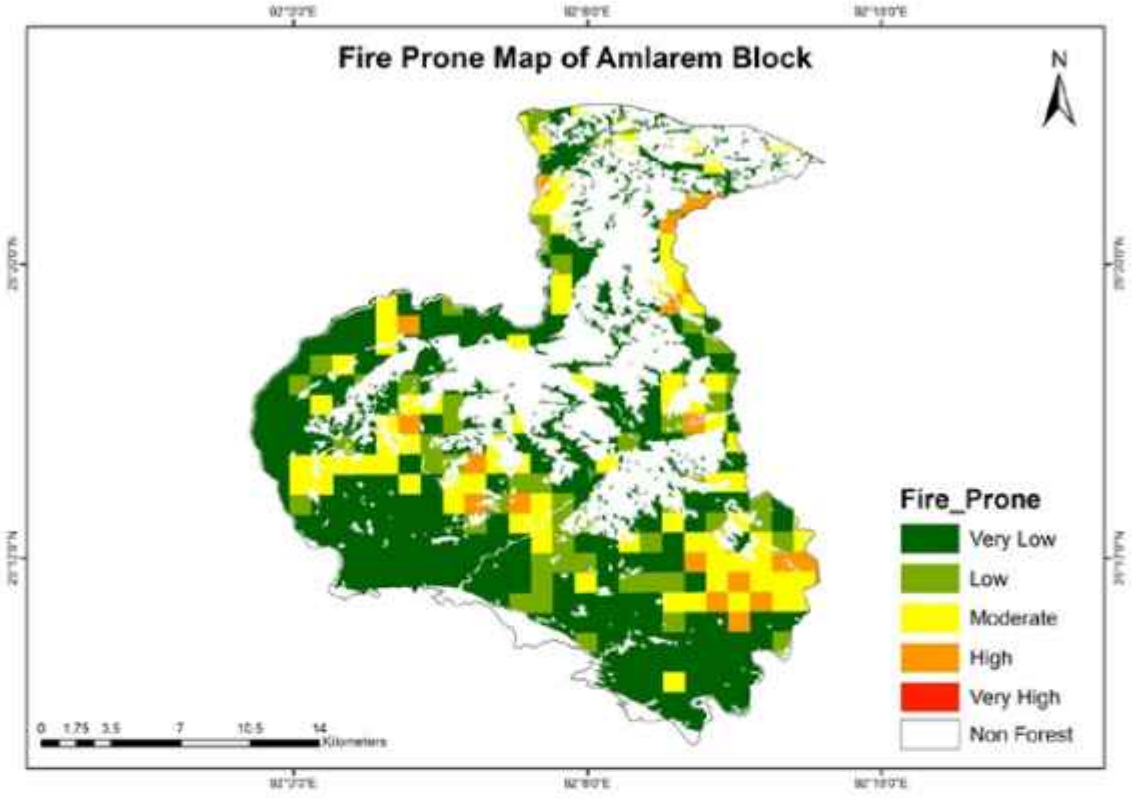


Figure 120. Forest Fire Prone Map of Amlarem Block

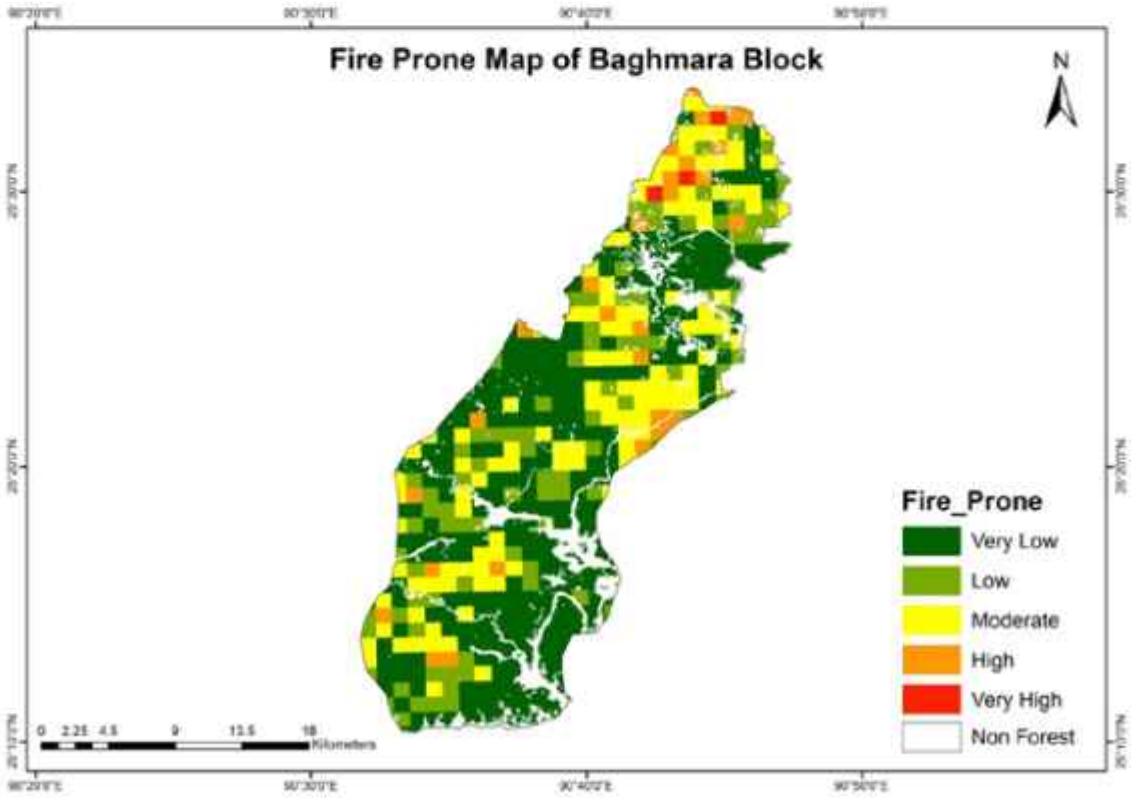


Figure 121. Forest Fire Prone Map of Baghmara Block

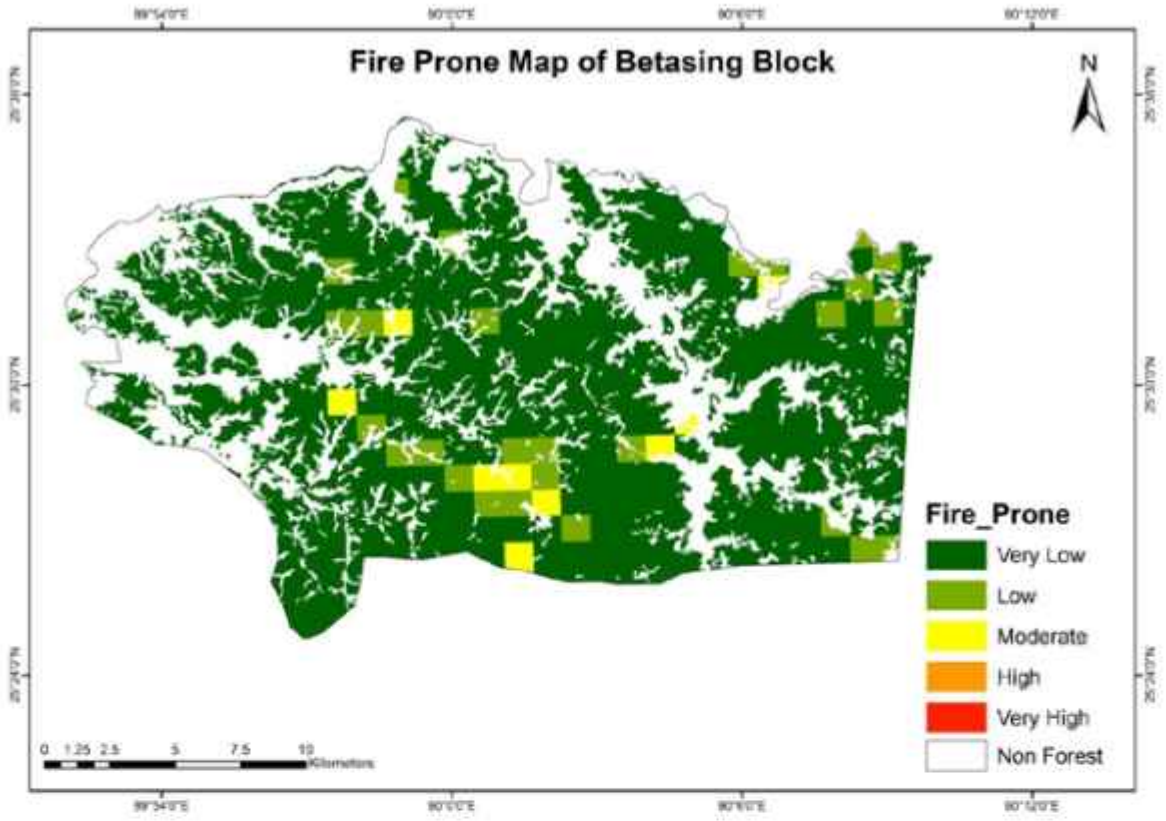


Figure 122. Forest Fire Prone Map of Betasing Block

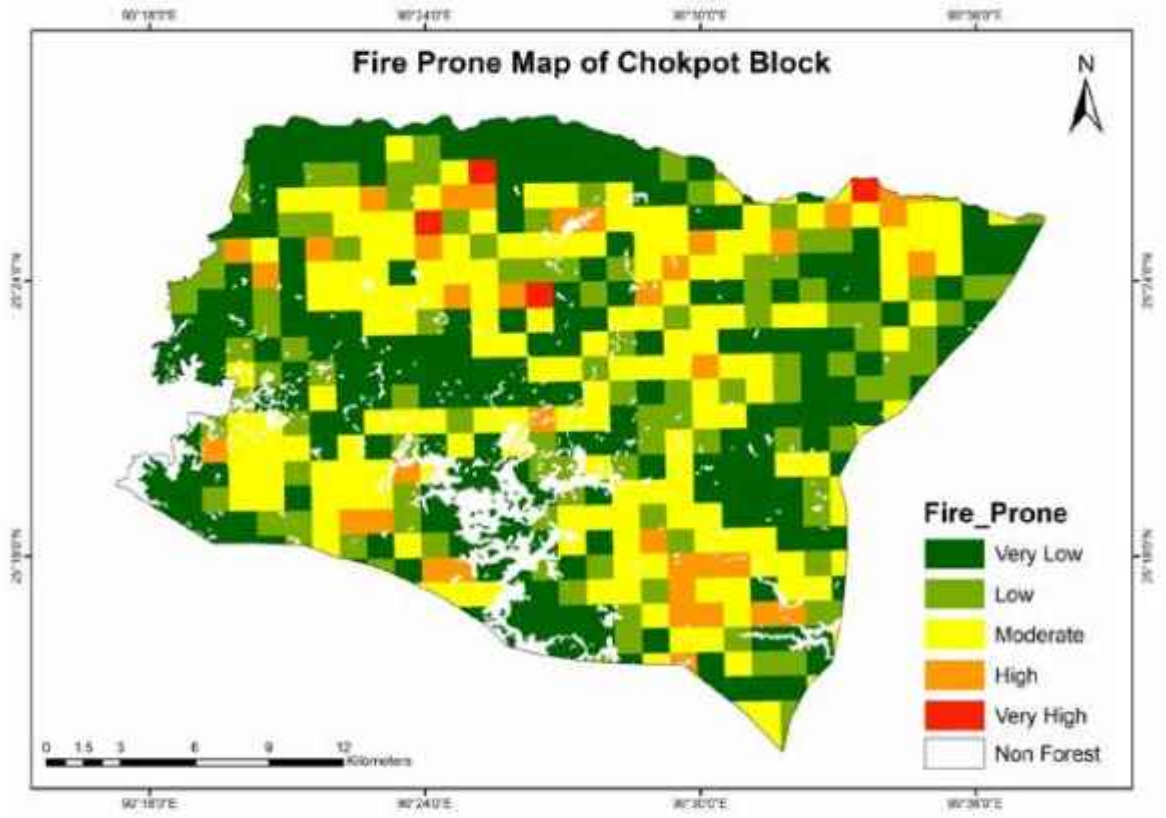


Figure 123. Forest Fire Prone Map of Chokpot Block

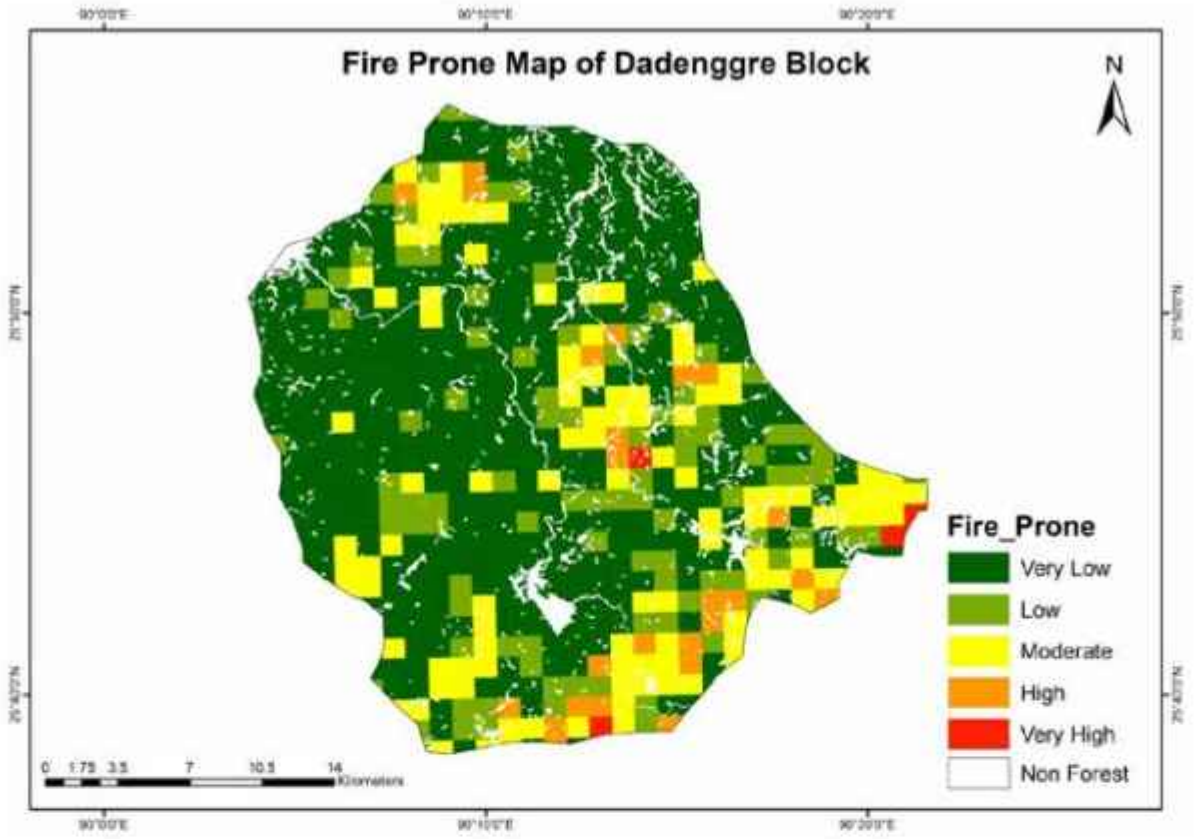


Figure 124. Forest Fire Prone Map of Dadenggre Block

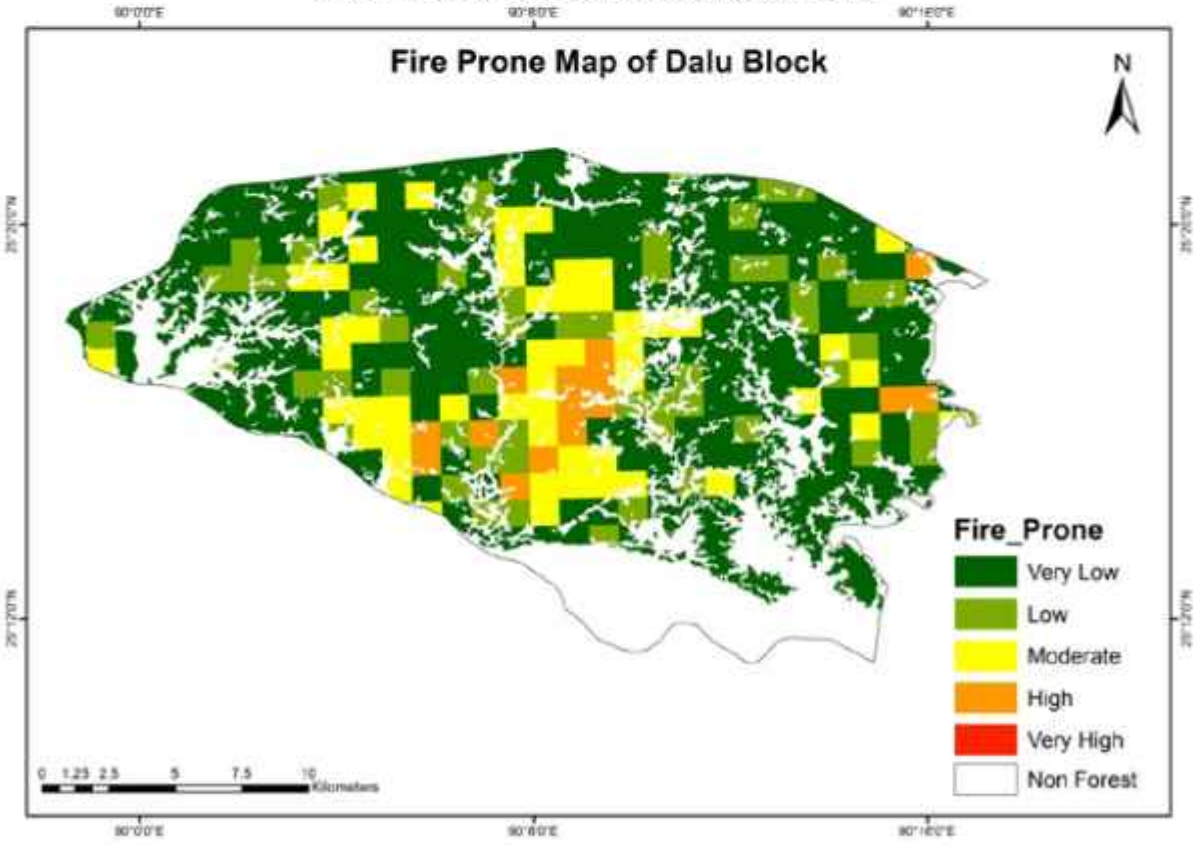


Figure 125. Forest Fire Prone Map of Dalu Block

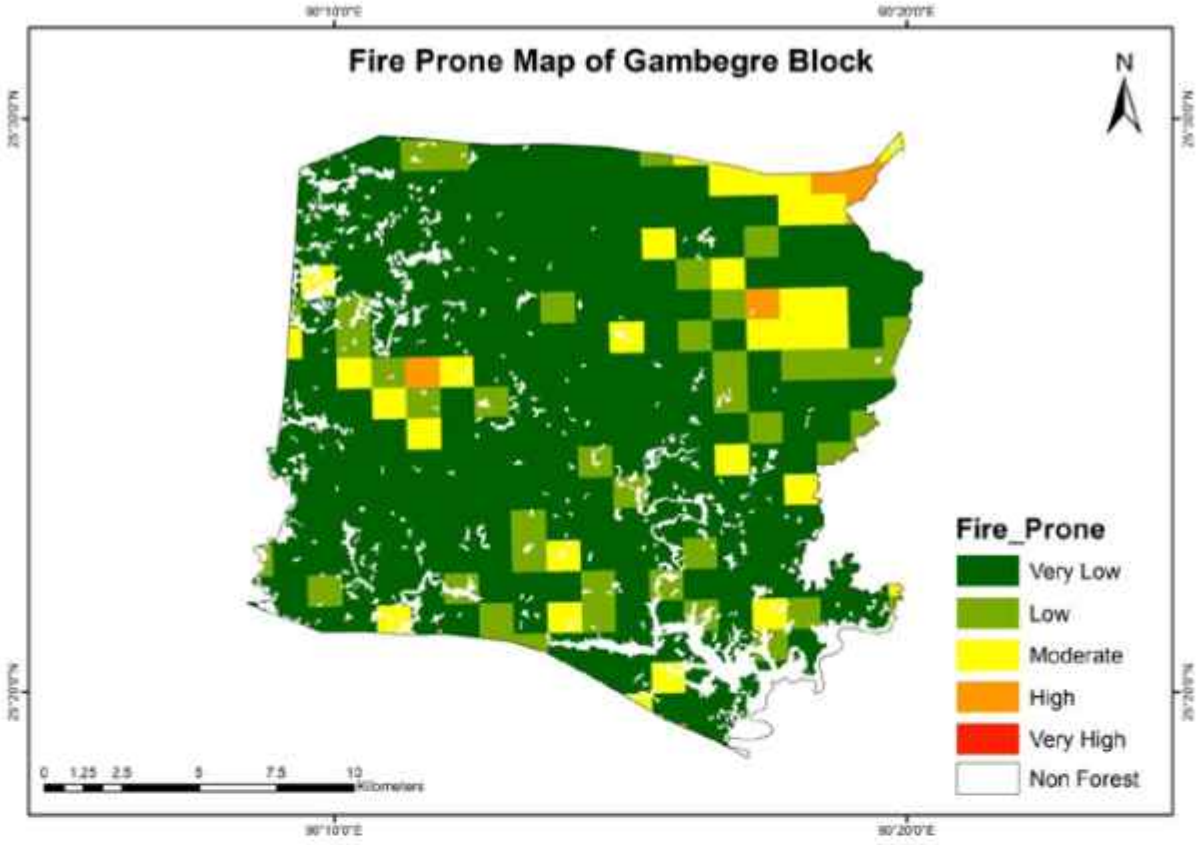


Figure 126. Forest Fire Prone Map of Gaambegre Block

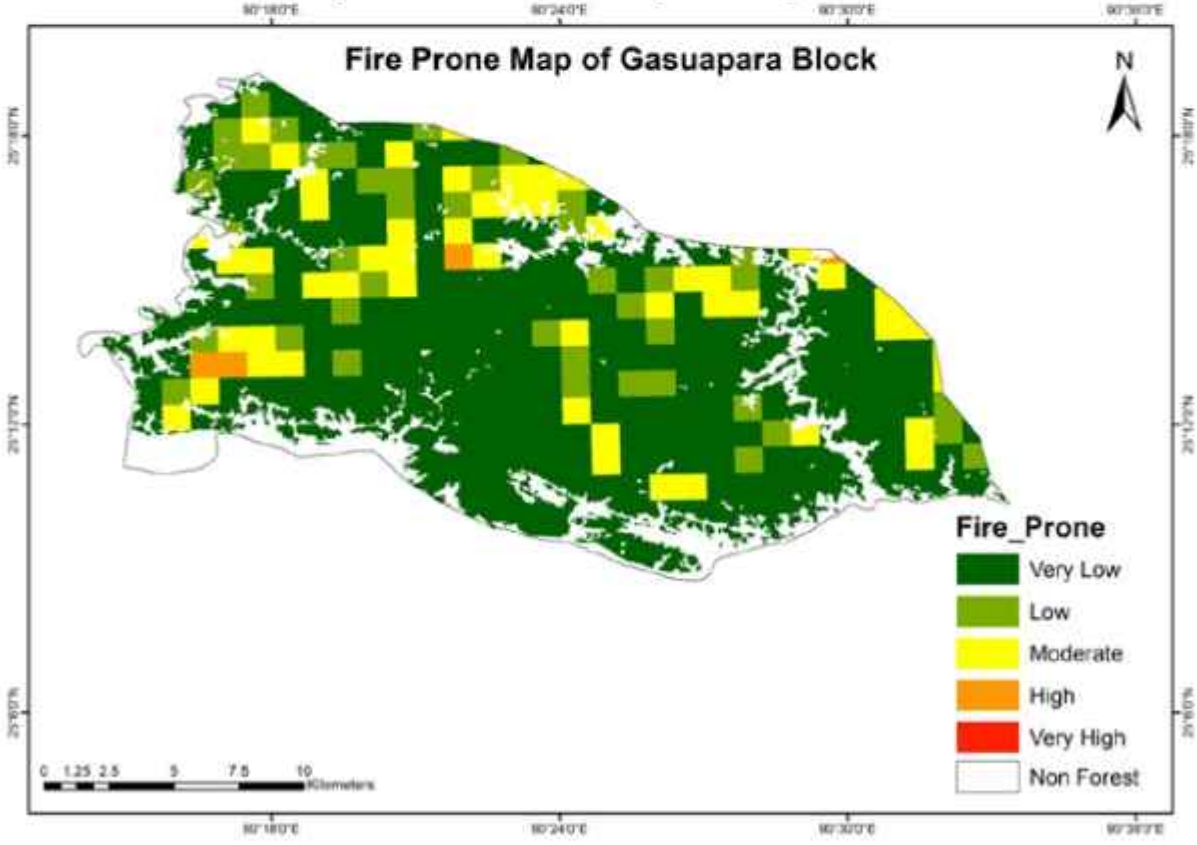


Figure 127. Forest Fire Prone Map of Gasuapara Block

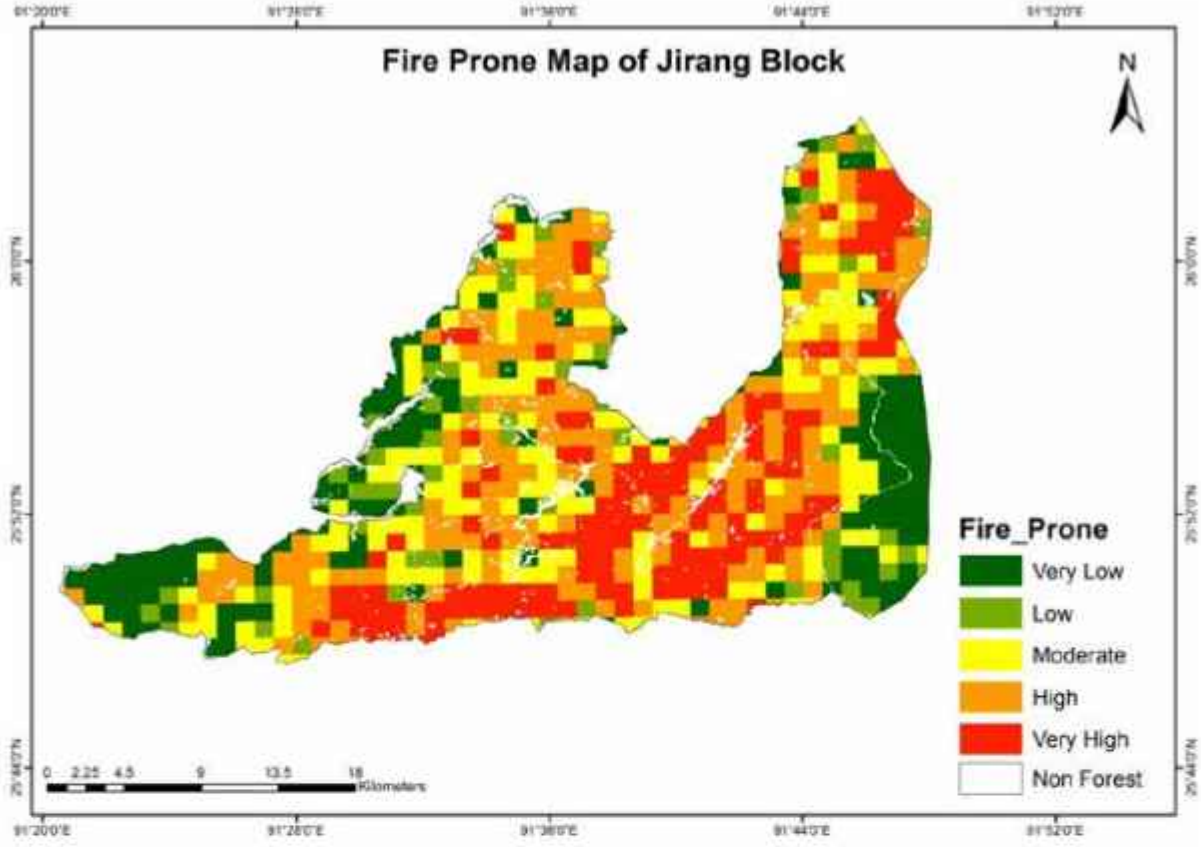


Figure 128. Forest Fire Prone Map of Jirang Block

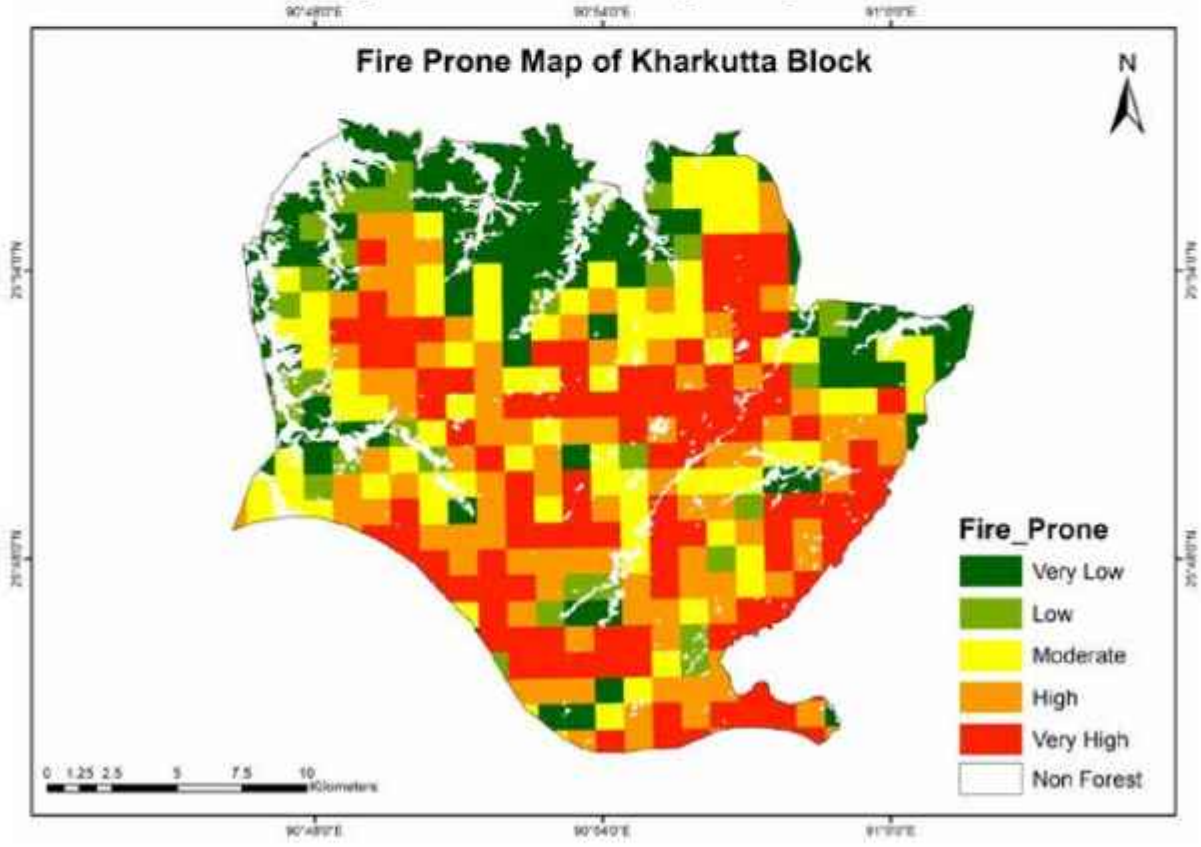


Figure 129. Forest Fire Prone Map of Kharkutta Block

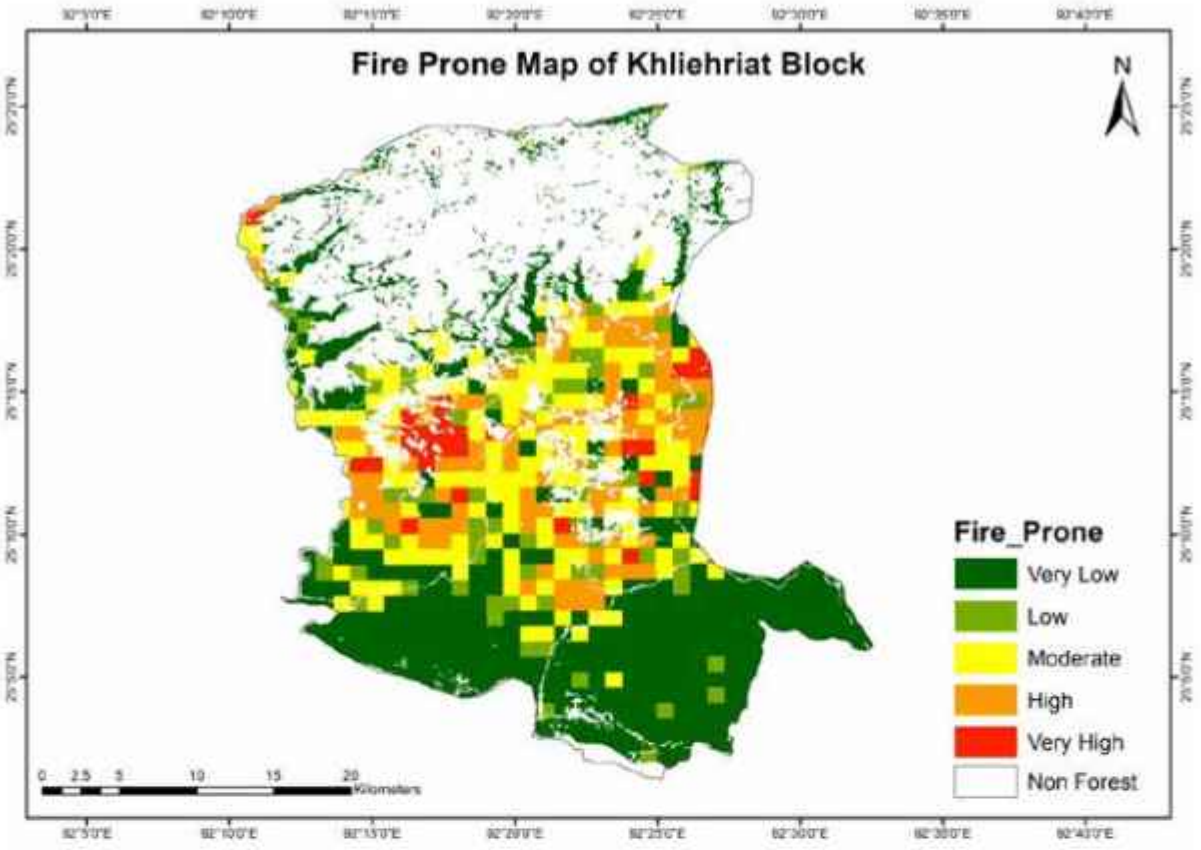


Figure 130. Forest Fire Prone Map of Khliehriat Block

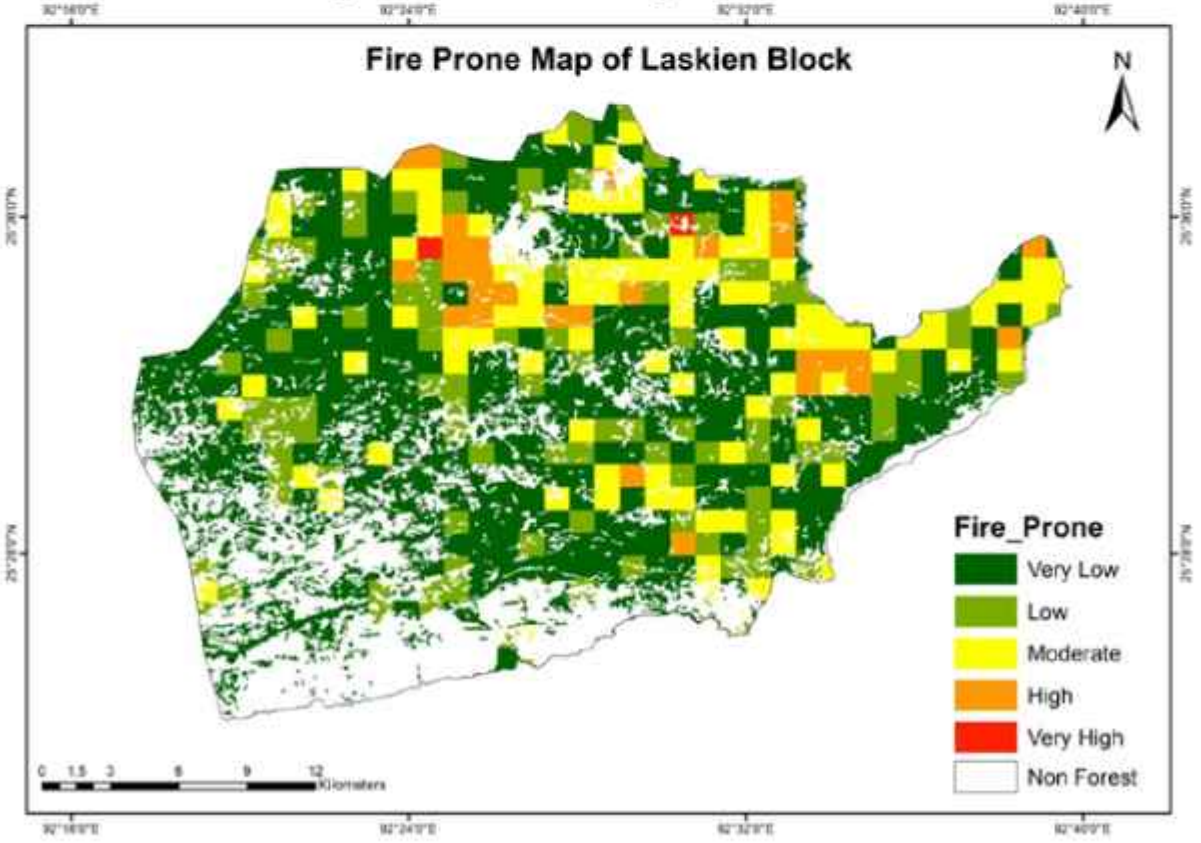


Figure 131. Forest Fire Prone Map of Laskien Block

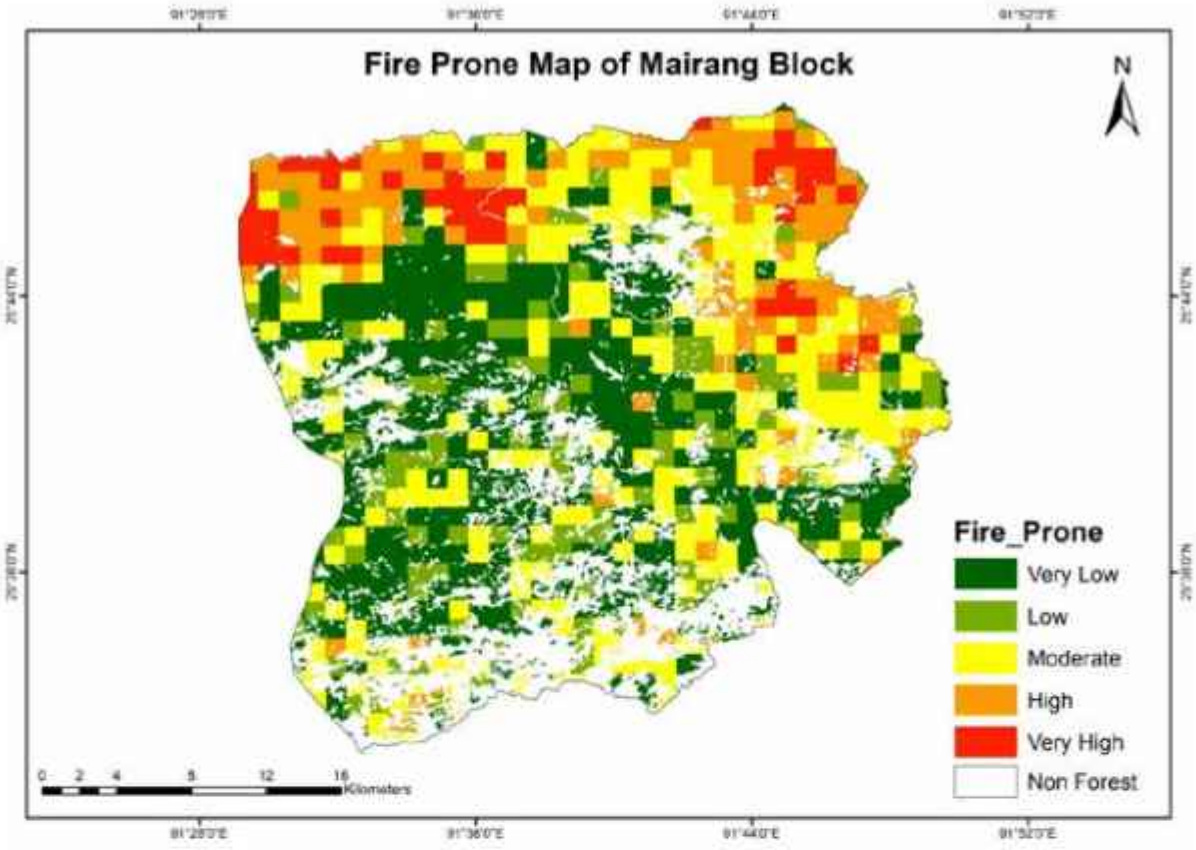


Figure 132. Forest Fire Prone Map of Mairang Block

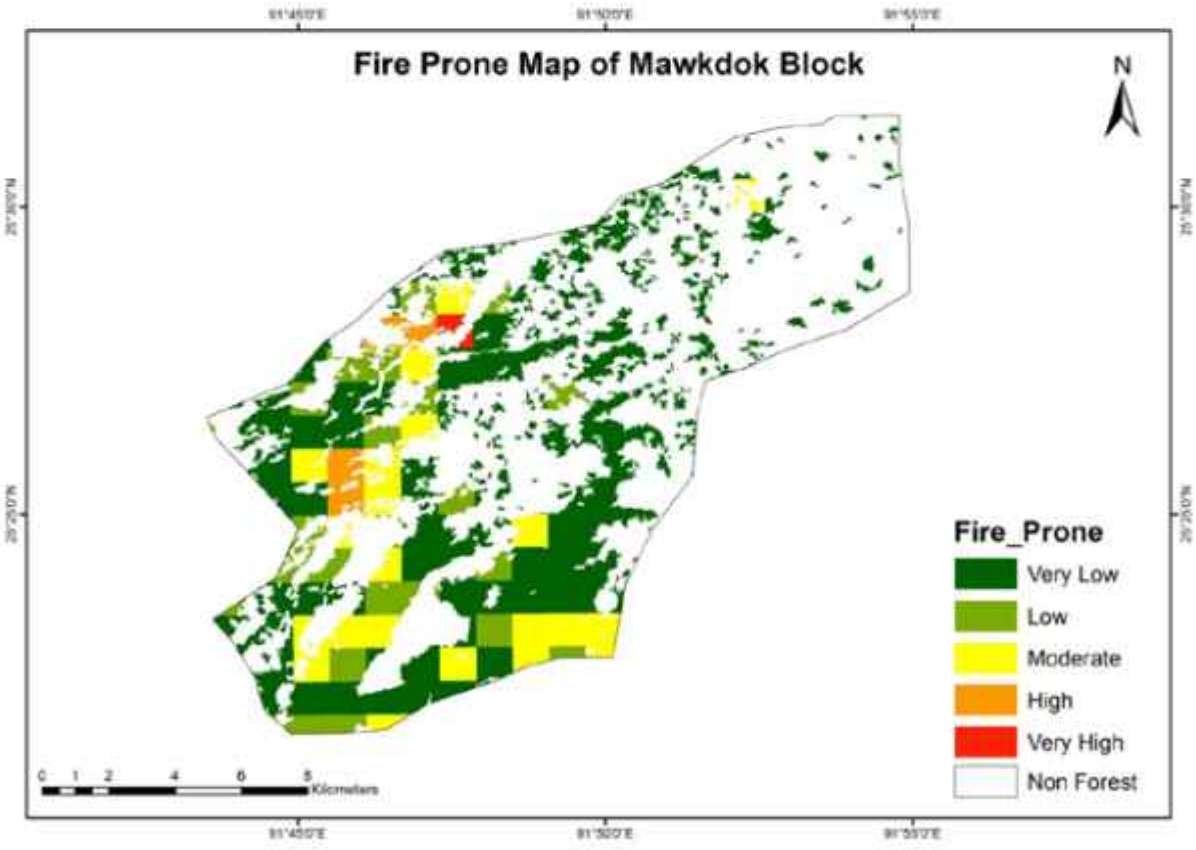


Figure 133. Forest Fire Prone Map of Mawkdok Block

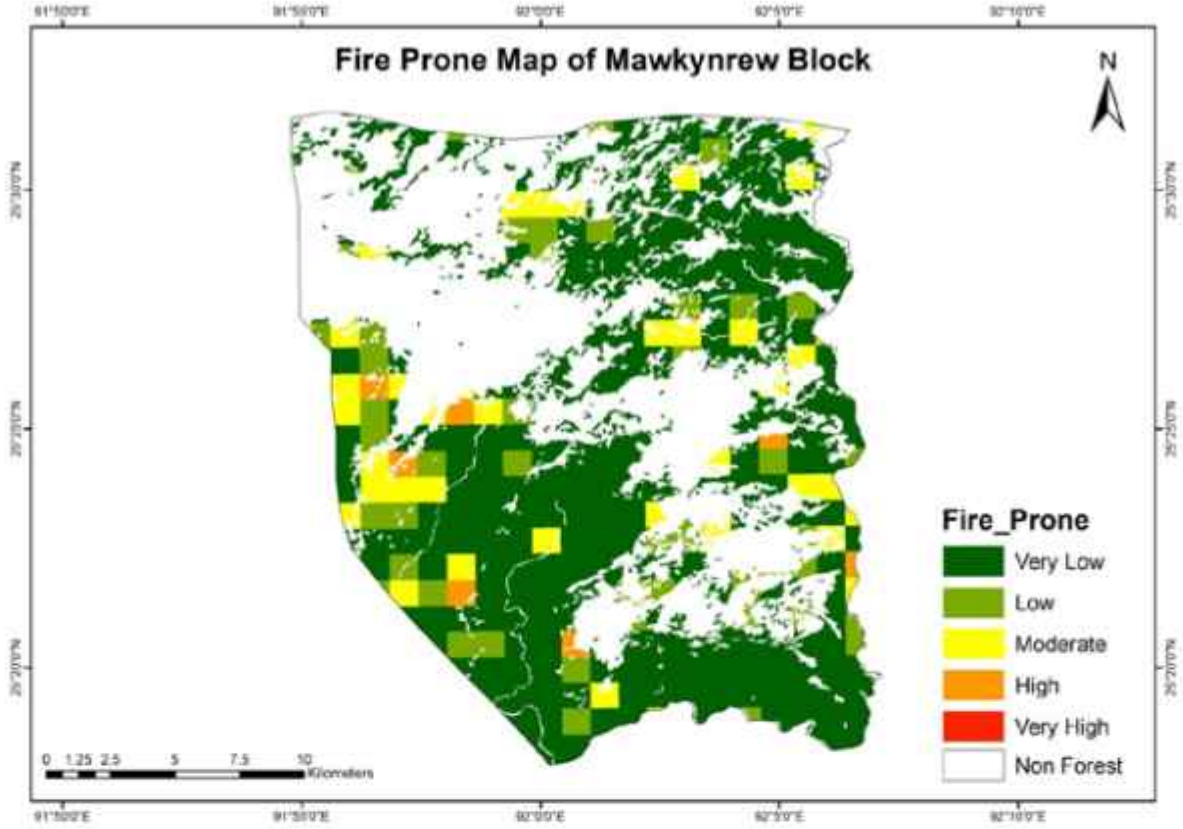


Figure 134. Forest Fire Prone Map of Mawkynrew Block

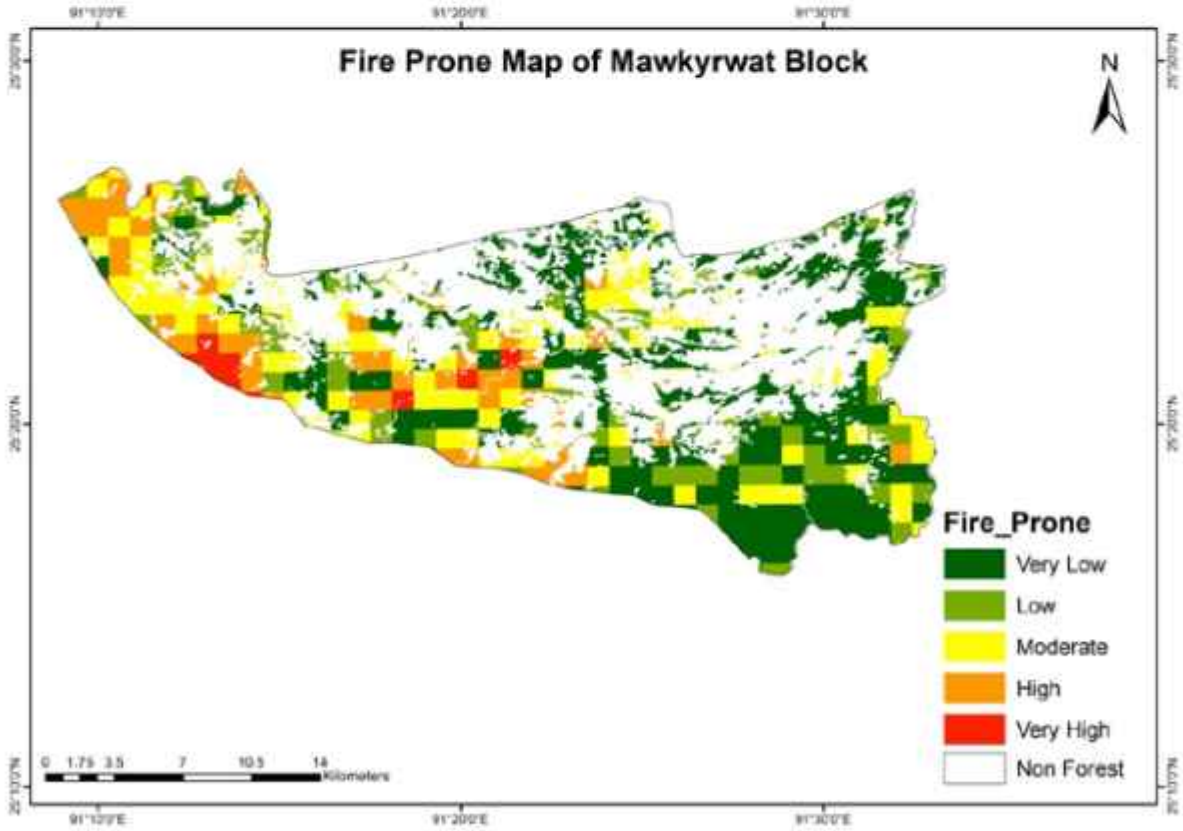


Figure 135. Forest Fire Prone Map of Mawkyrwat Block

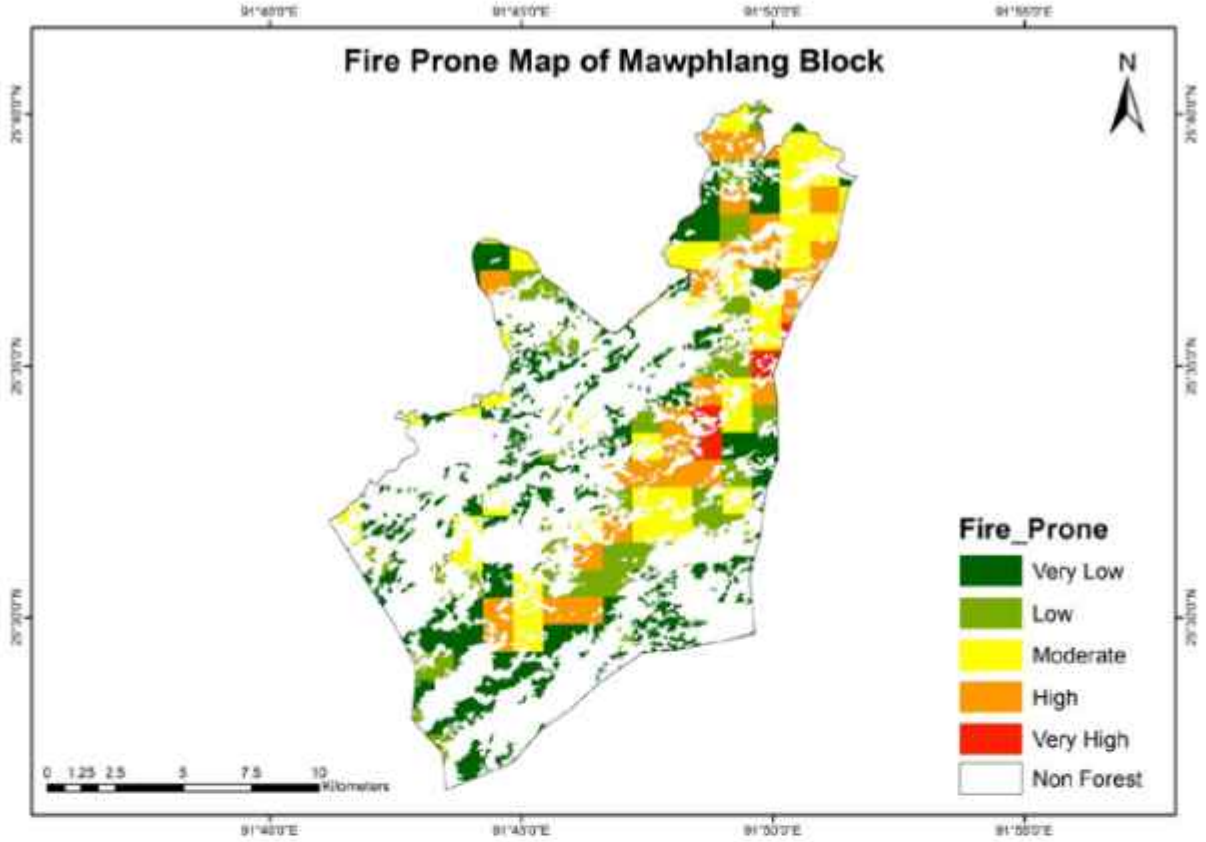


Figure 136. Forest Fire Prone Map of Mawphlang Block

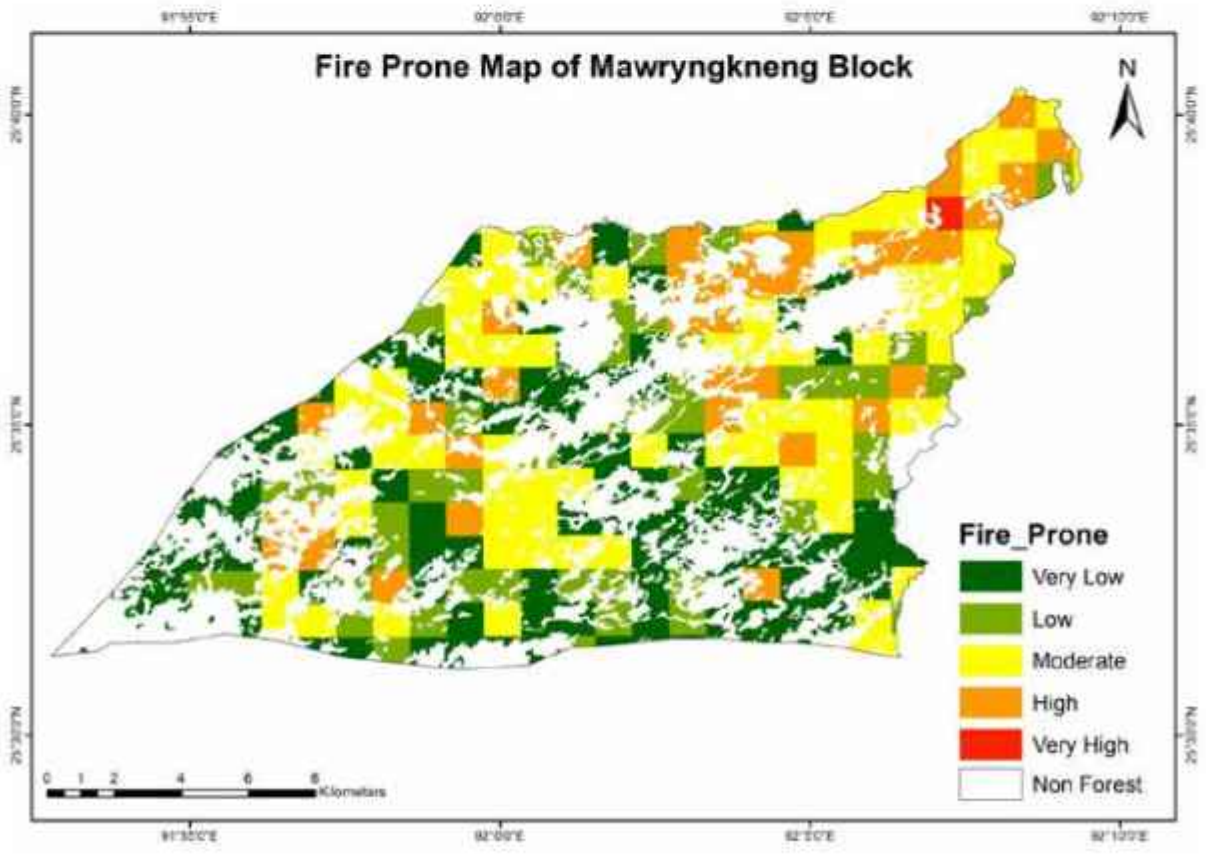


Figure 137. Forest Fire Prone Map of Mawryngkneng Block

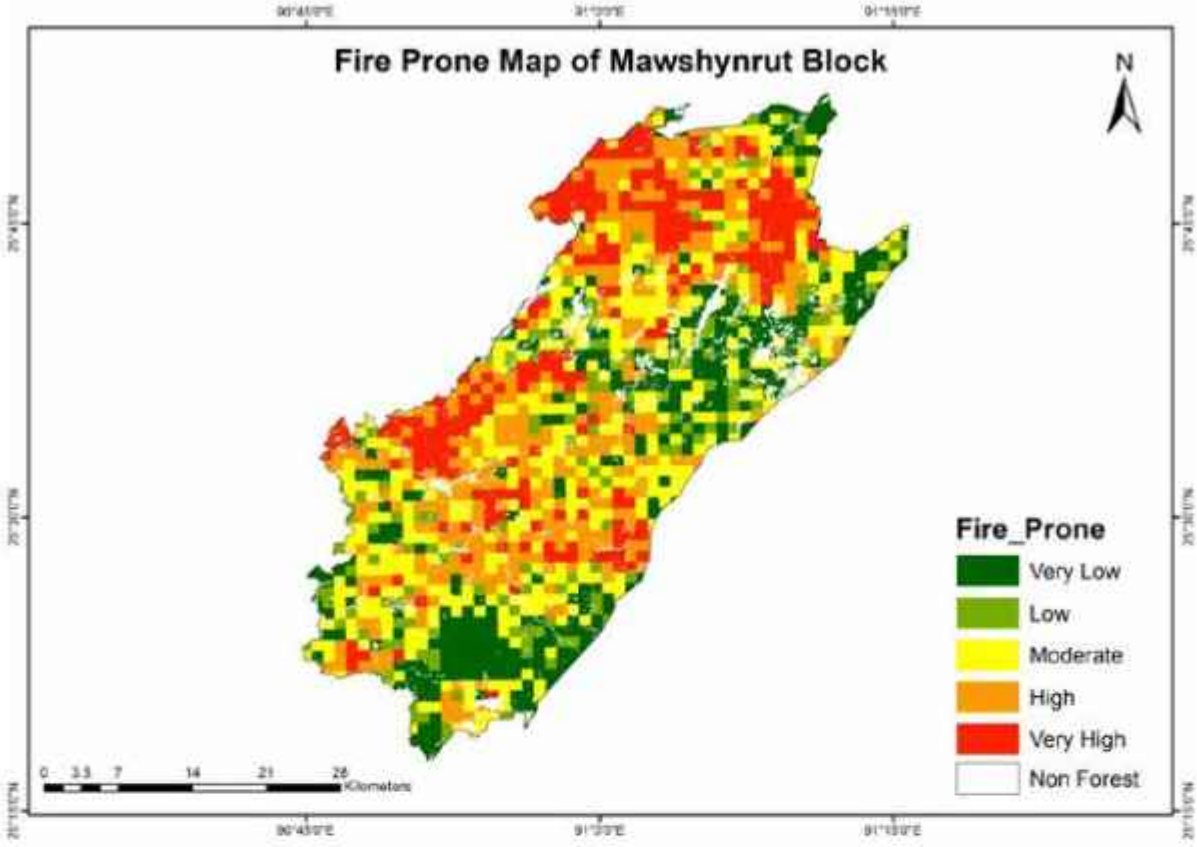


Figure 138. Forest Fire Prone Map of Mawshynrut Block

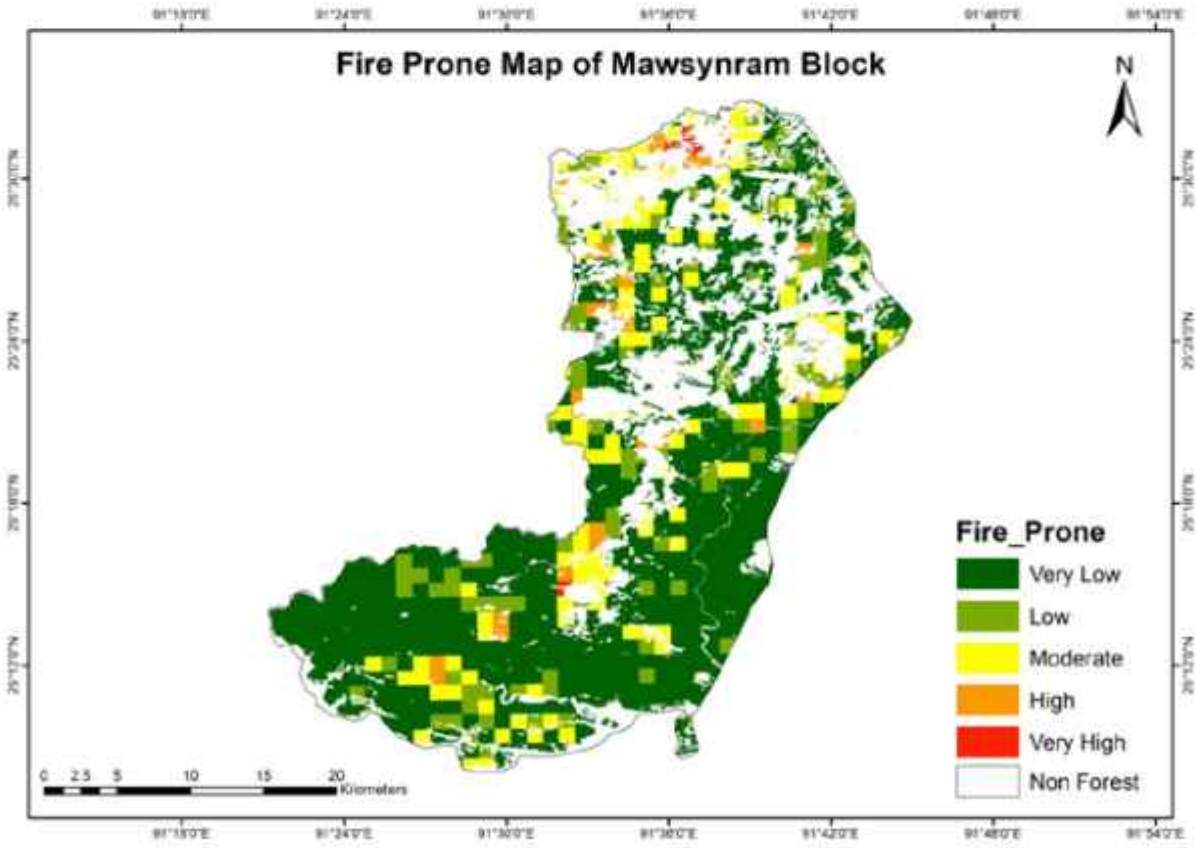


Figure 139. Forest Fire Prone Map of Mawsynram Block

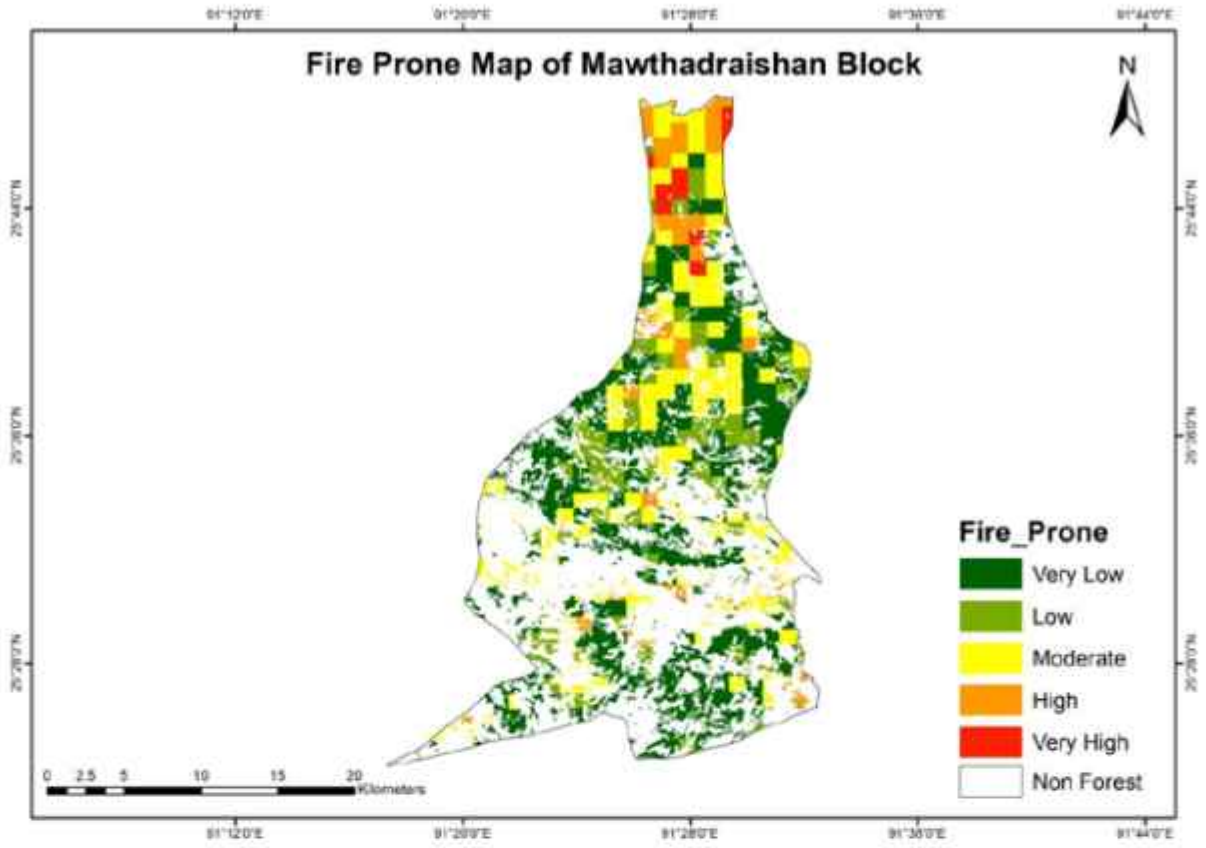


Figure 140. Forest Fire Prone Map of Mawthadraishan Block

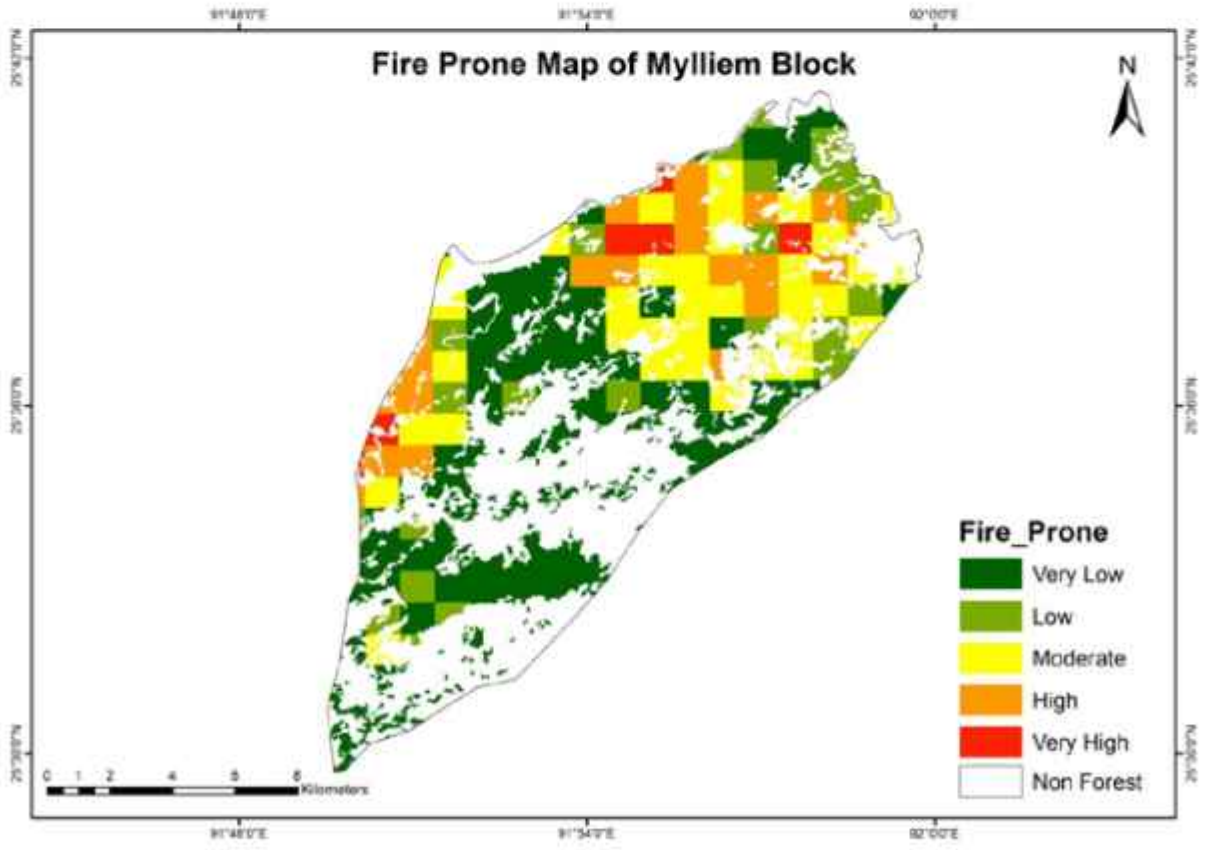


Figure 141. Forest Fire Prone Map of Myllie Block

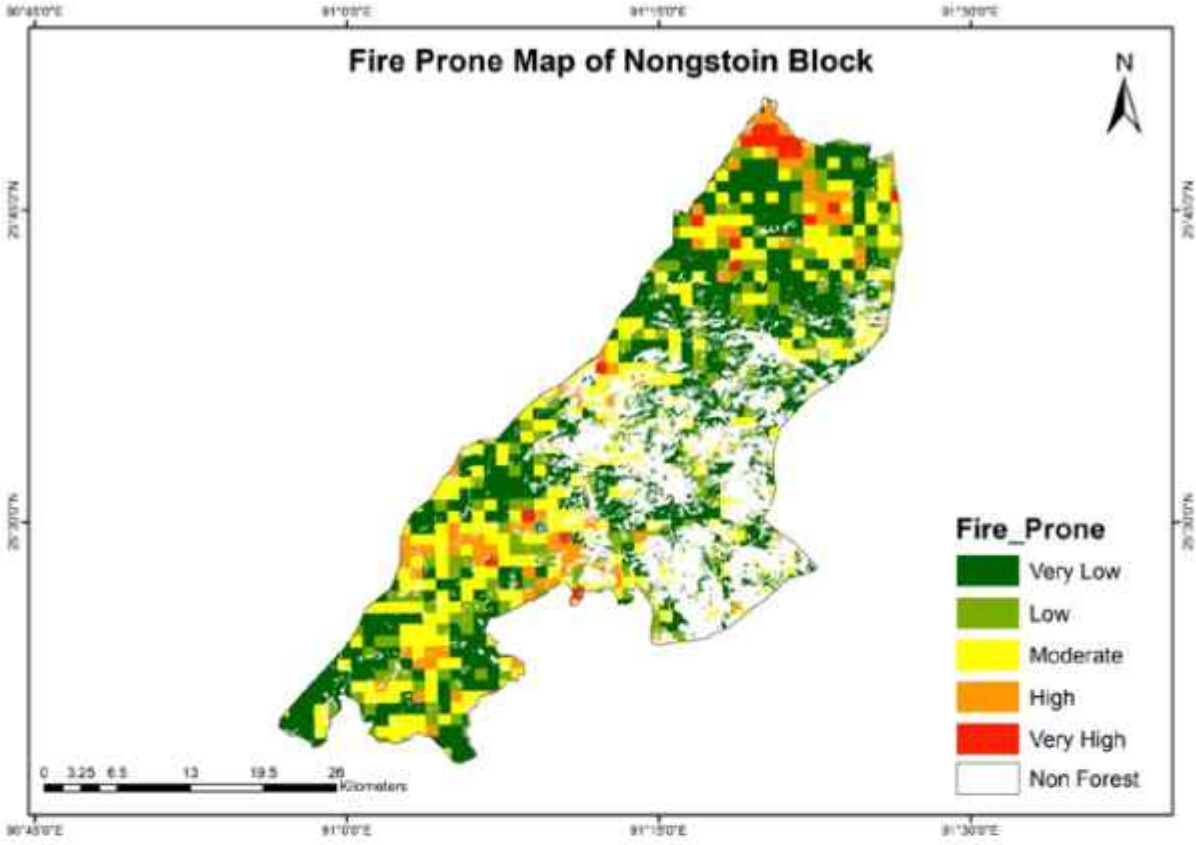


Figure 142. Forest Fire Prone Map of Nongstoin Block

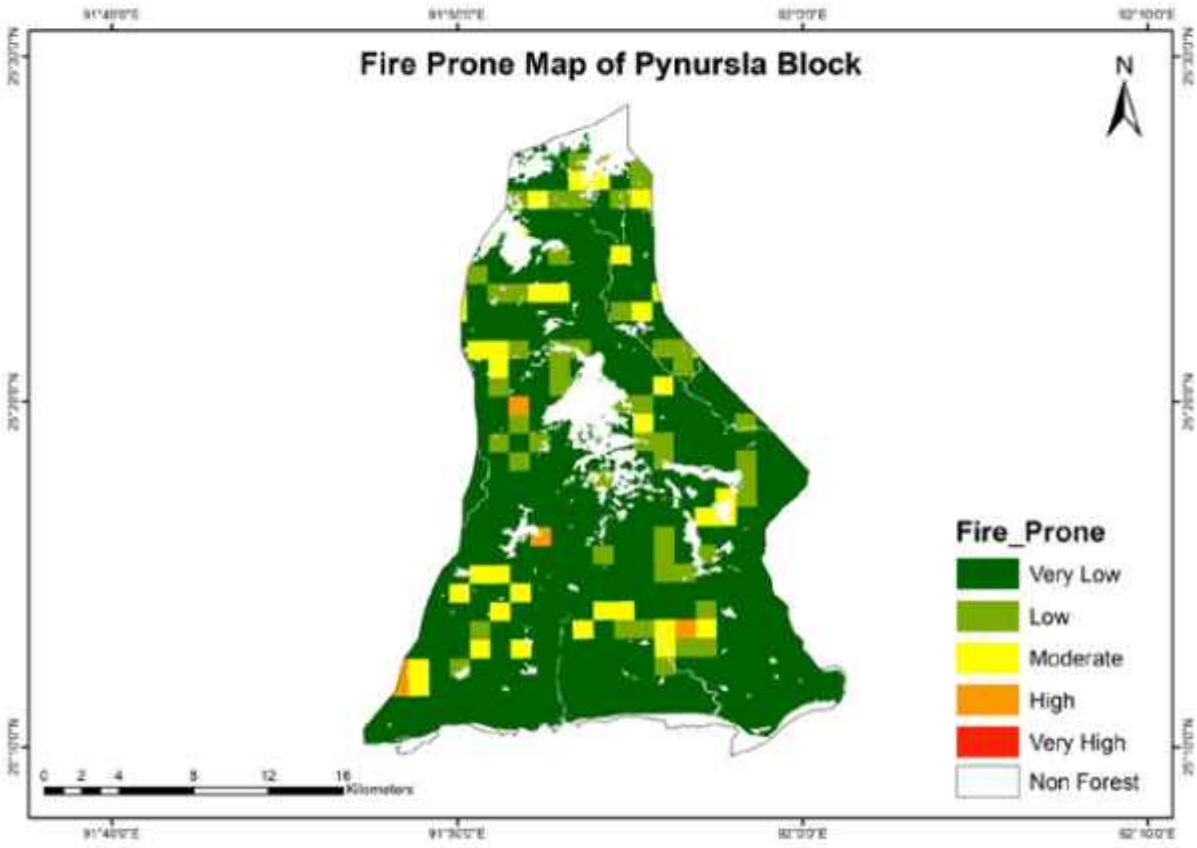


Figure 143. Forest Fire Prone Map of Pynursla Block

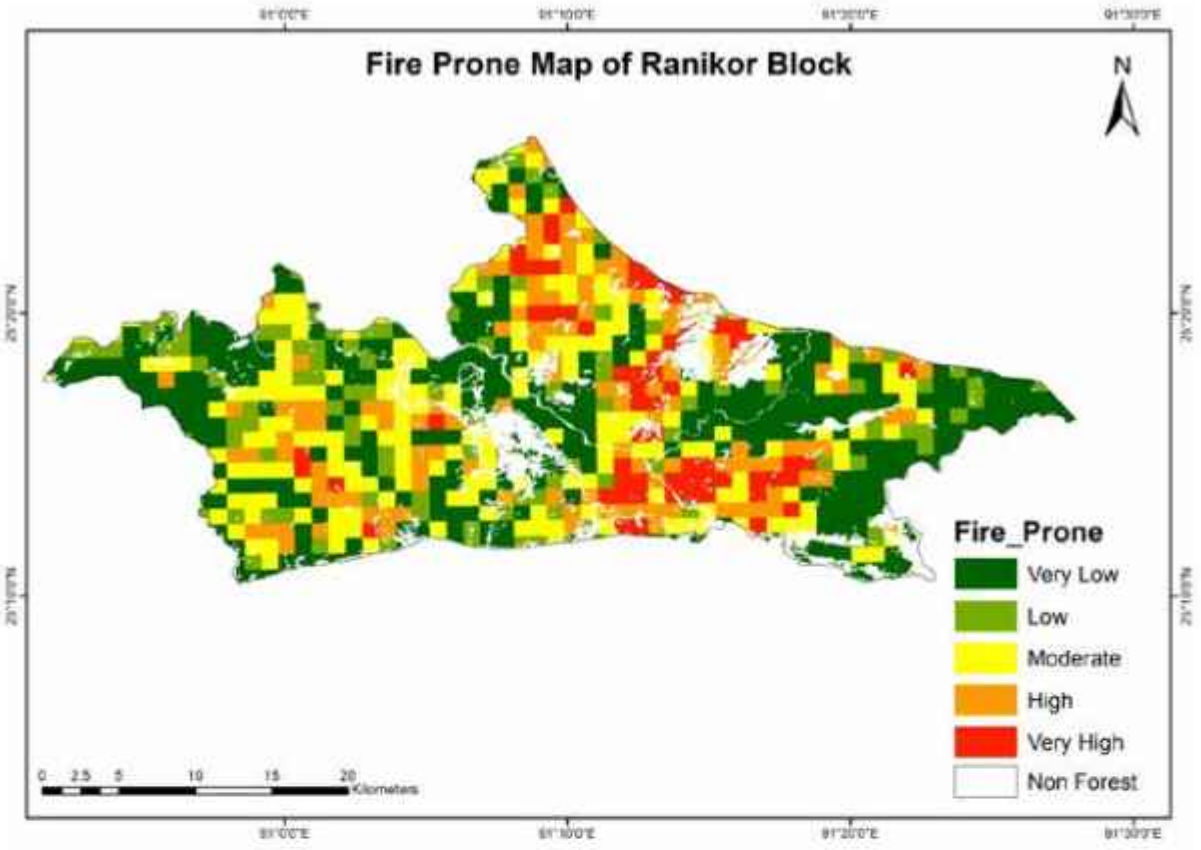


Figure 144. Forest Fire Prone Map of Ranikor Block

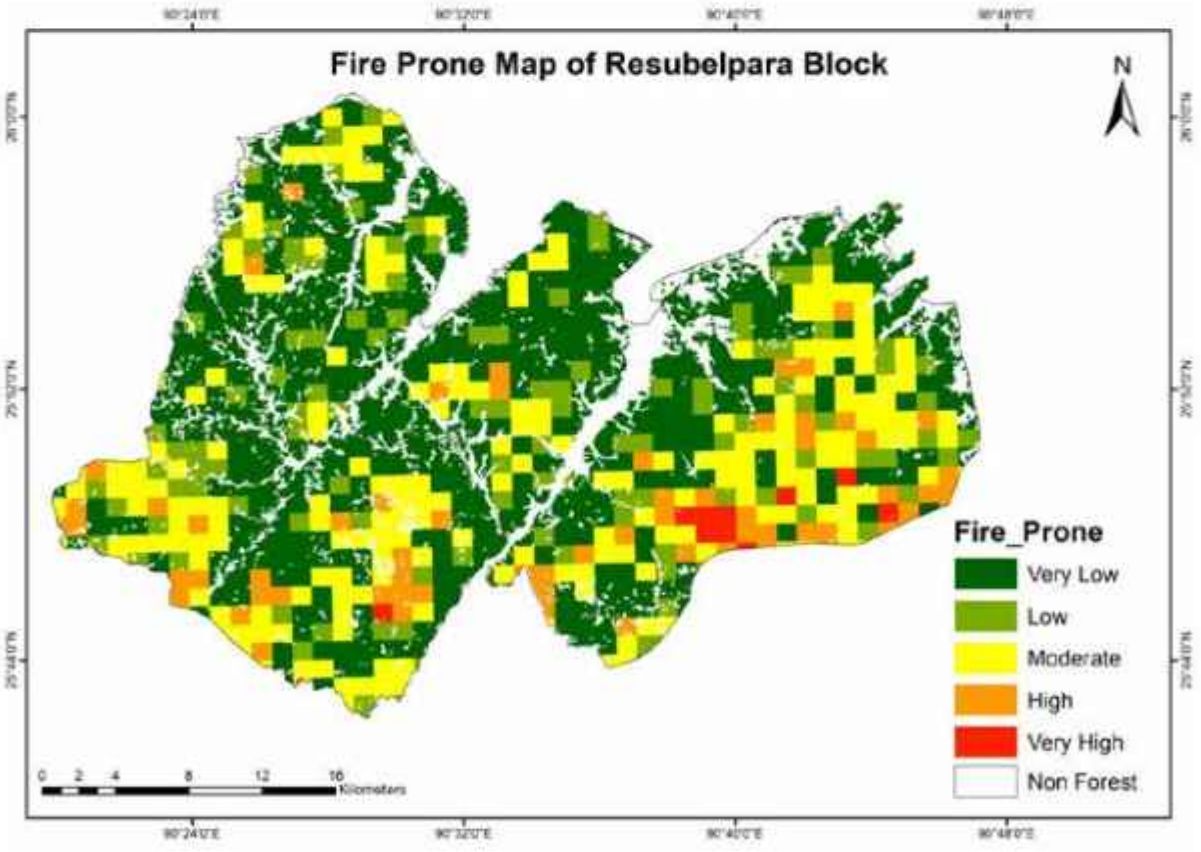


Figure 145. Forest Fire Prone Map of Resubelpara Block

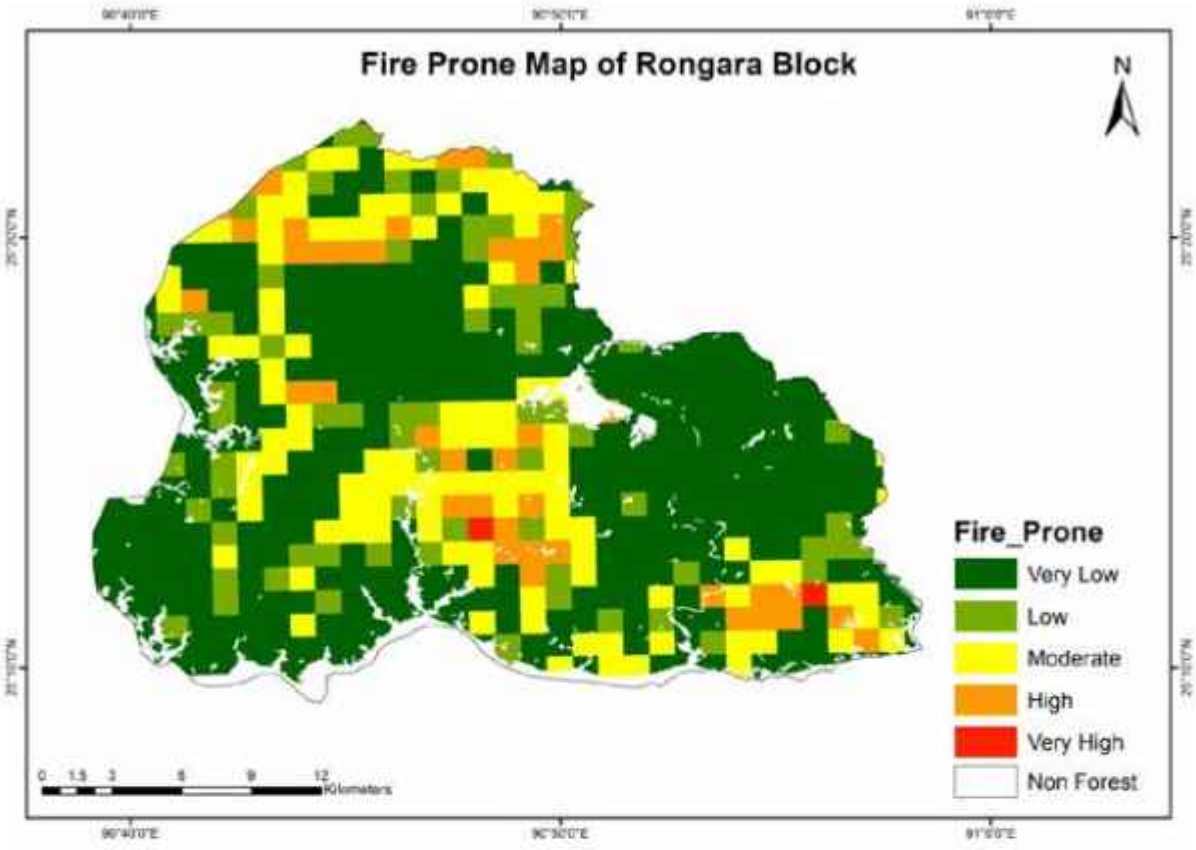


Figure 146. Forest Fire Prone Map of Rongara Block

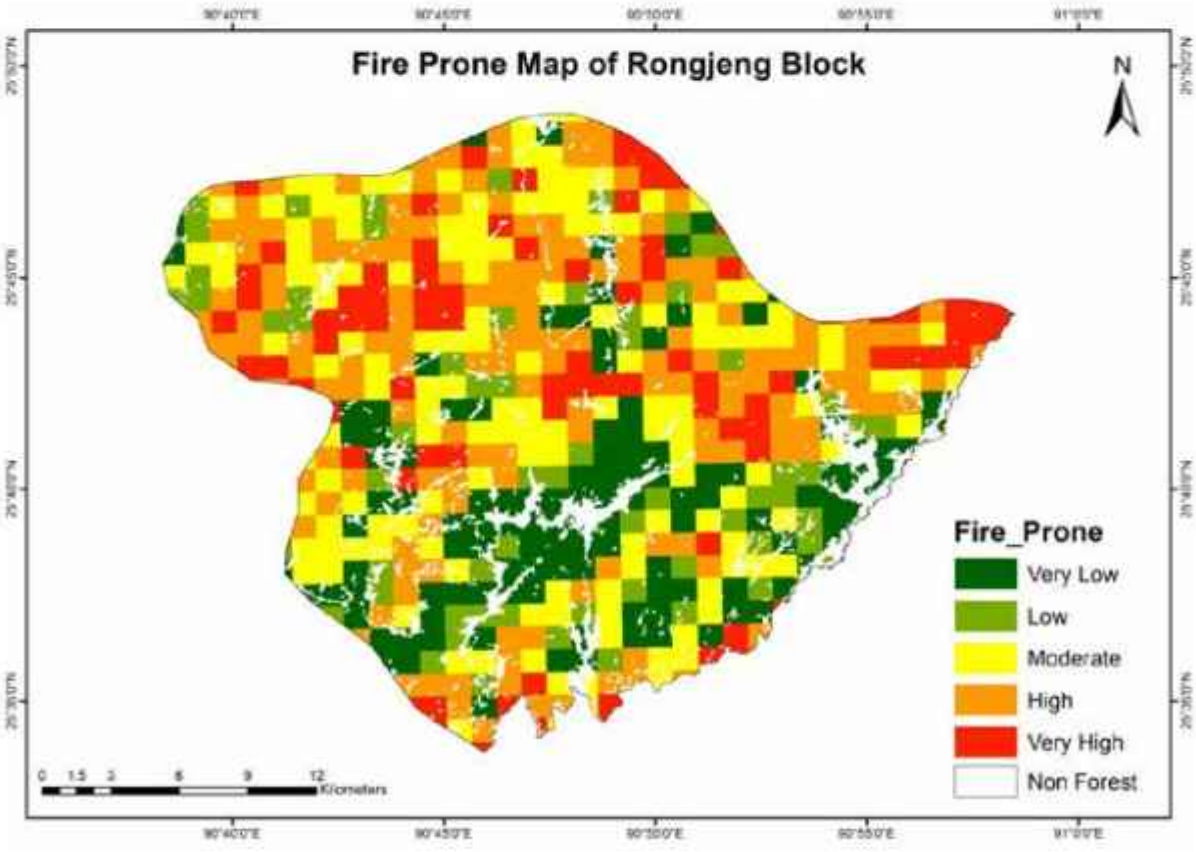


Figure 147. Forest Fire Prone Map of Rongjeng Block

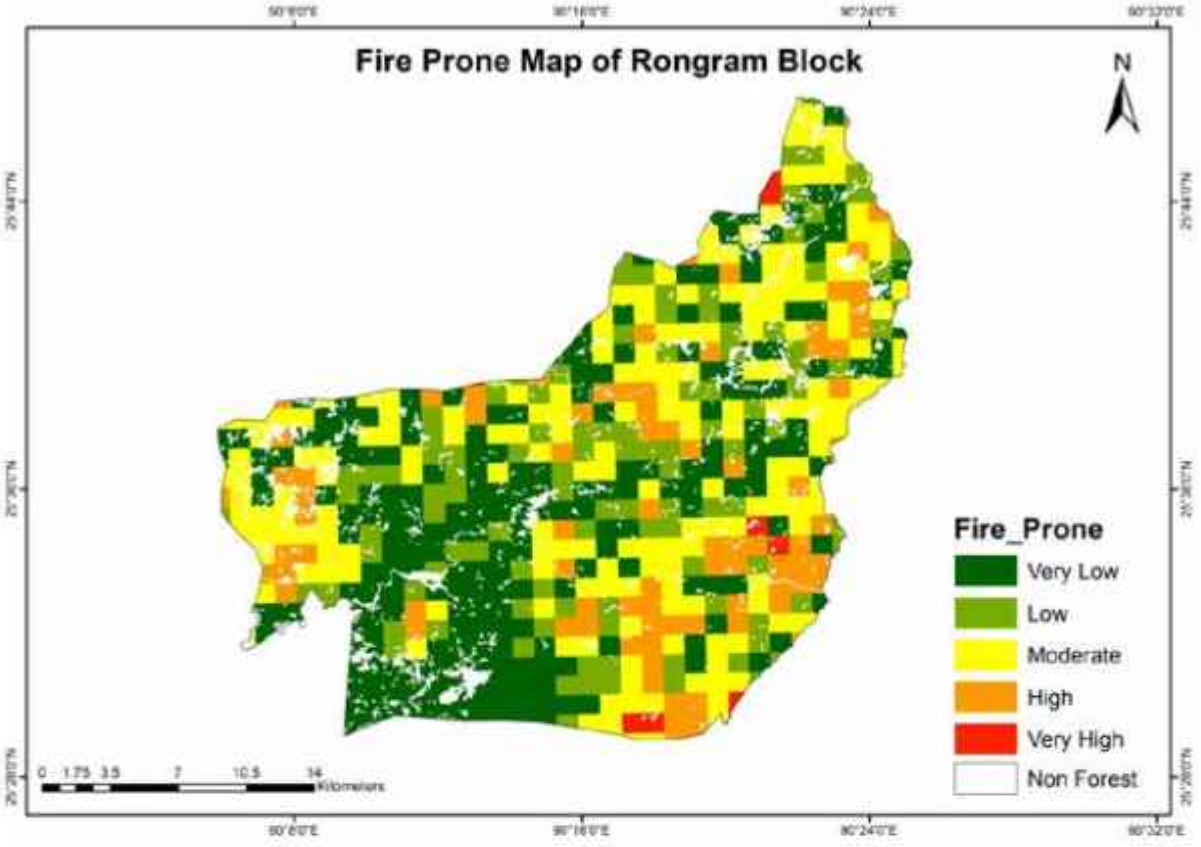


Figure 148. Forest Fire Prone Map of Rongram Block

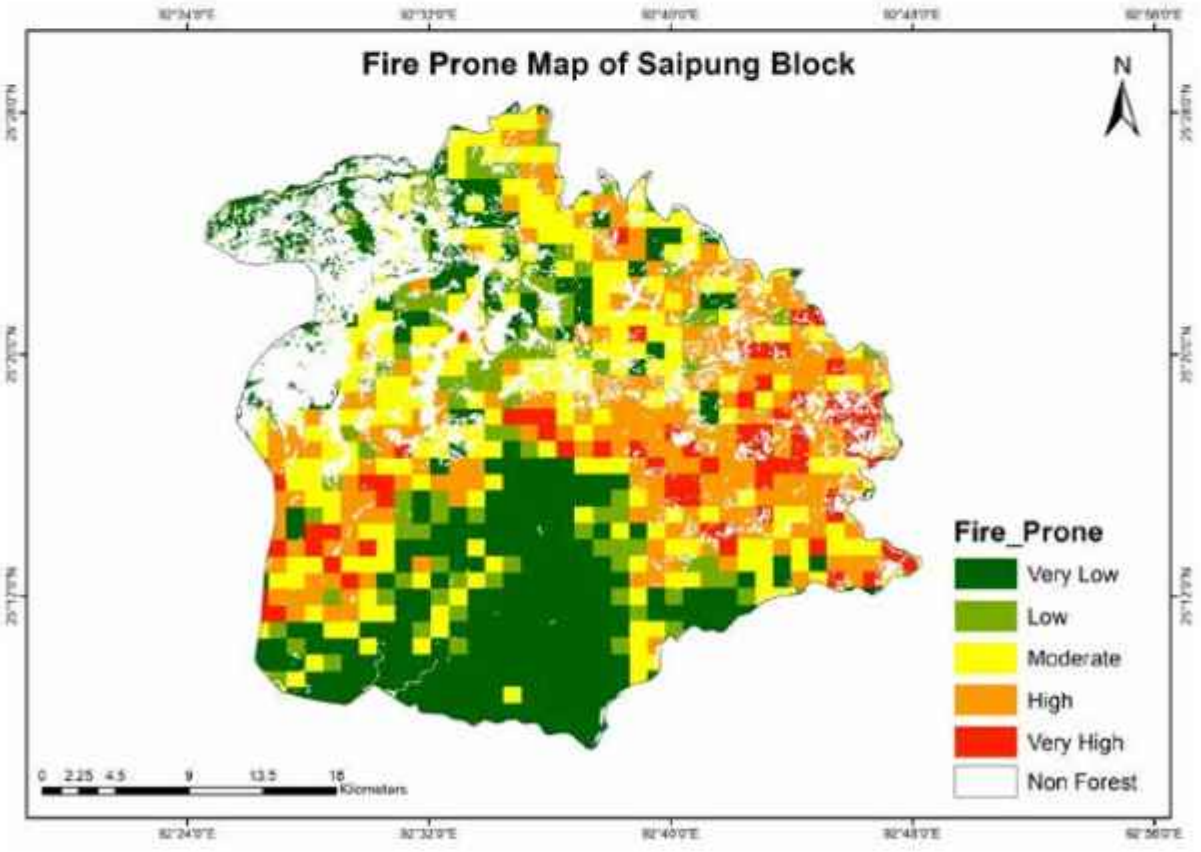


Figure 149. Forest Fire Prone Map of Saipung Block

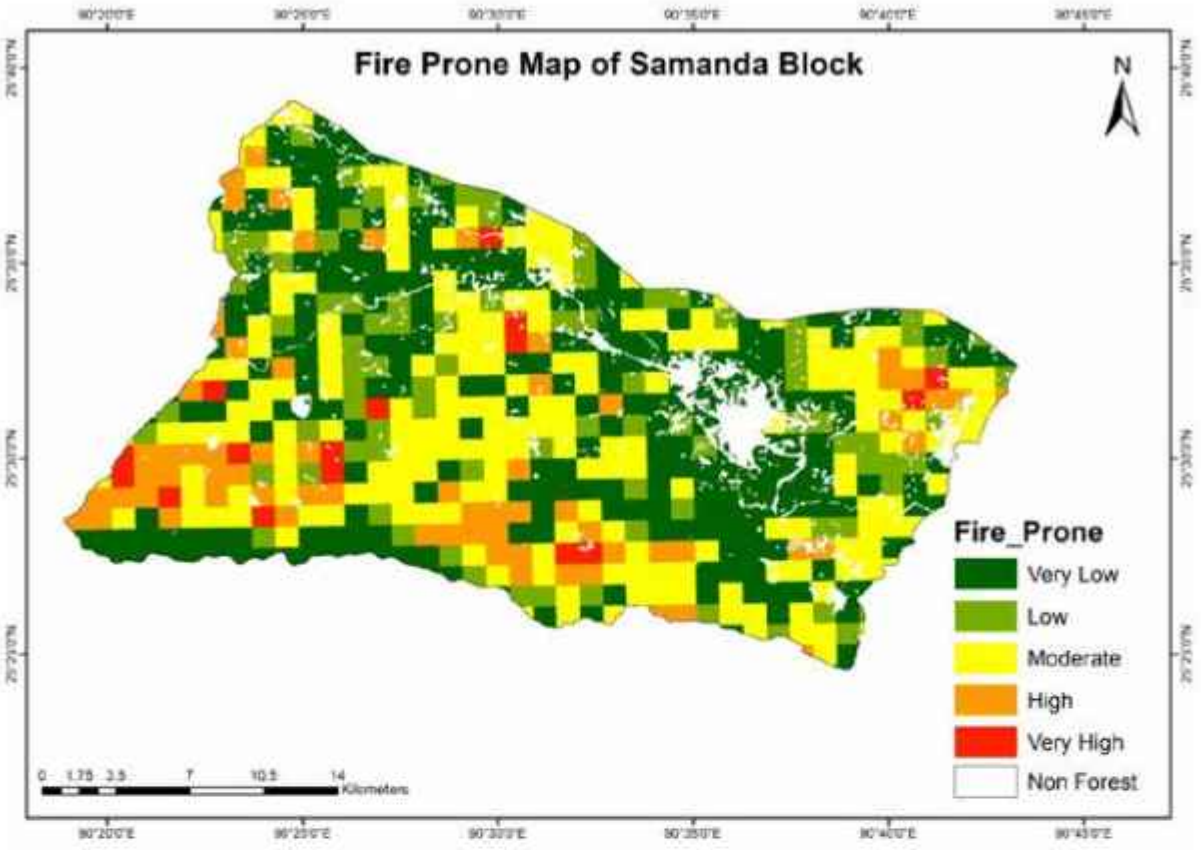


Figure 150. Forest Fire Prone Map of Samanda Block

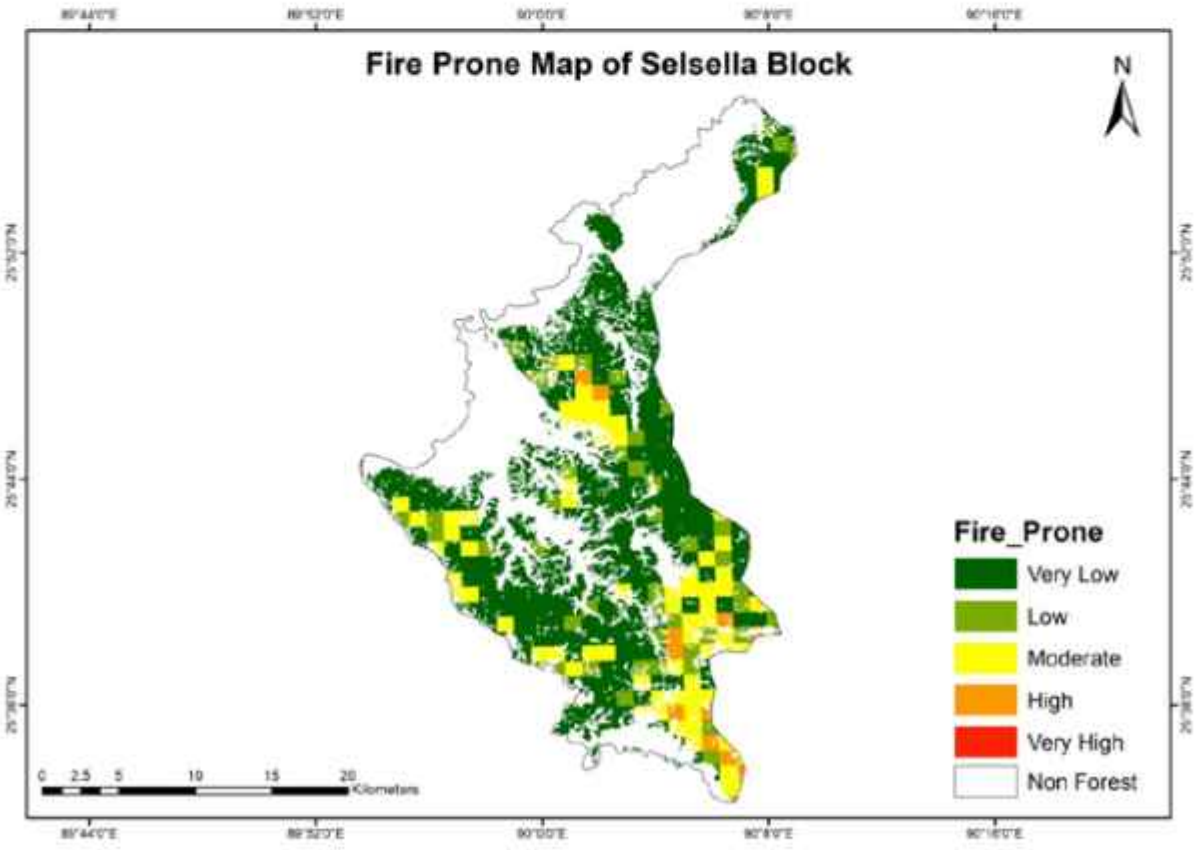


Figure 151. Forest Fire Prone Map of Selsella Block

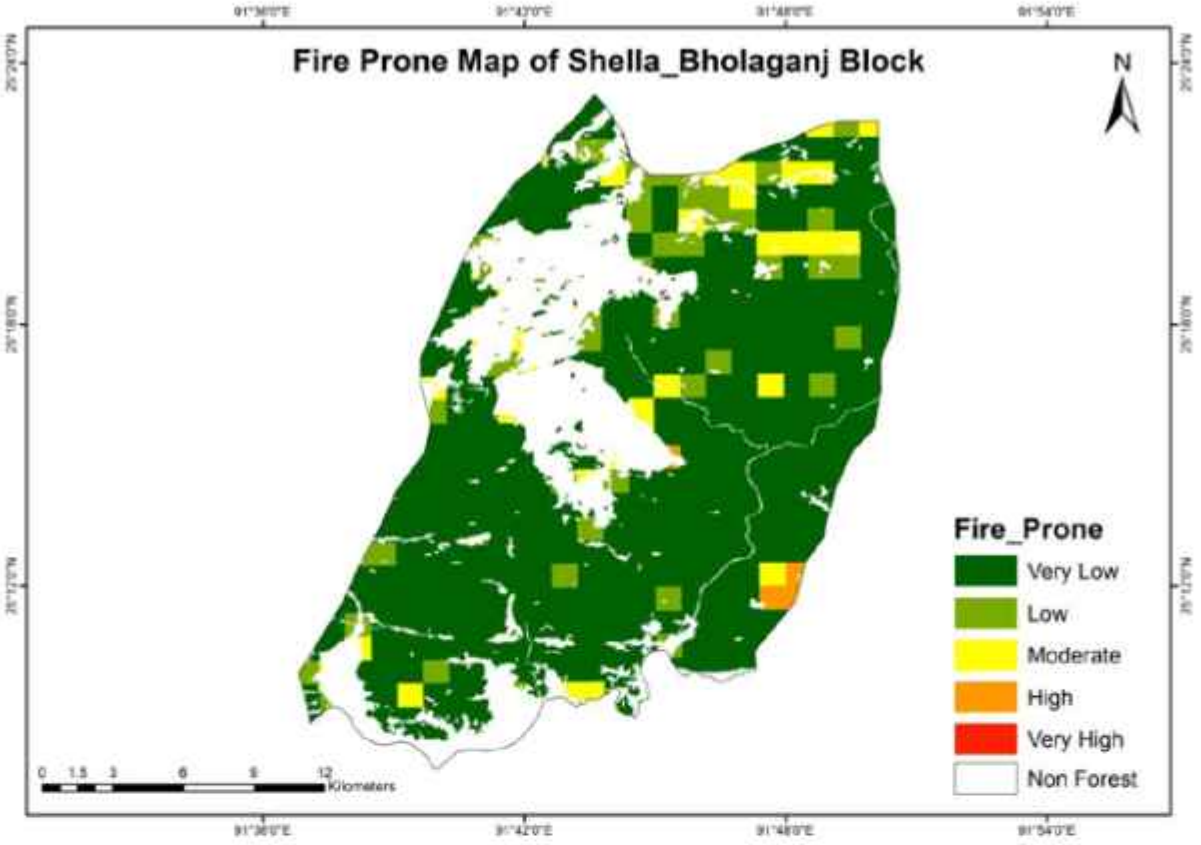


Figure 152. Forest Fire Prone Map of Shells_Bholaganj Block

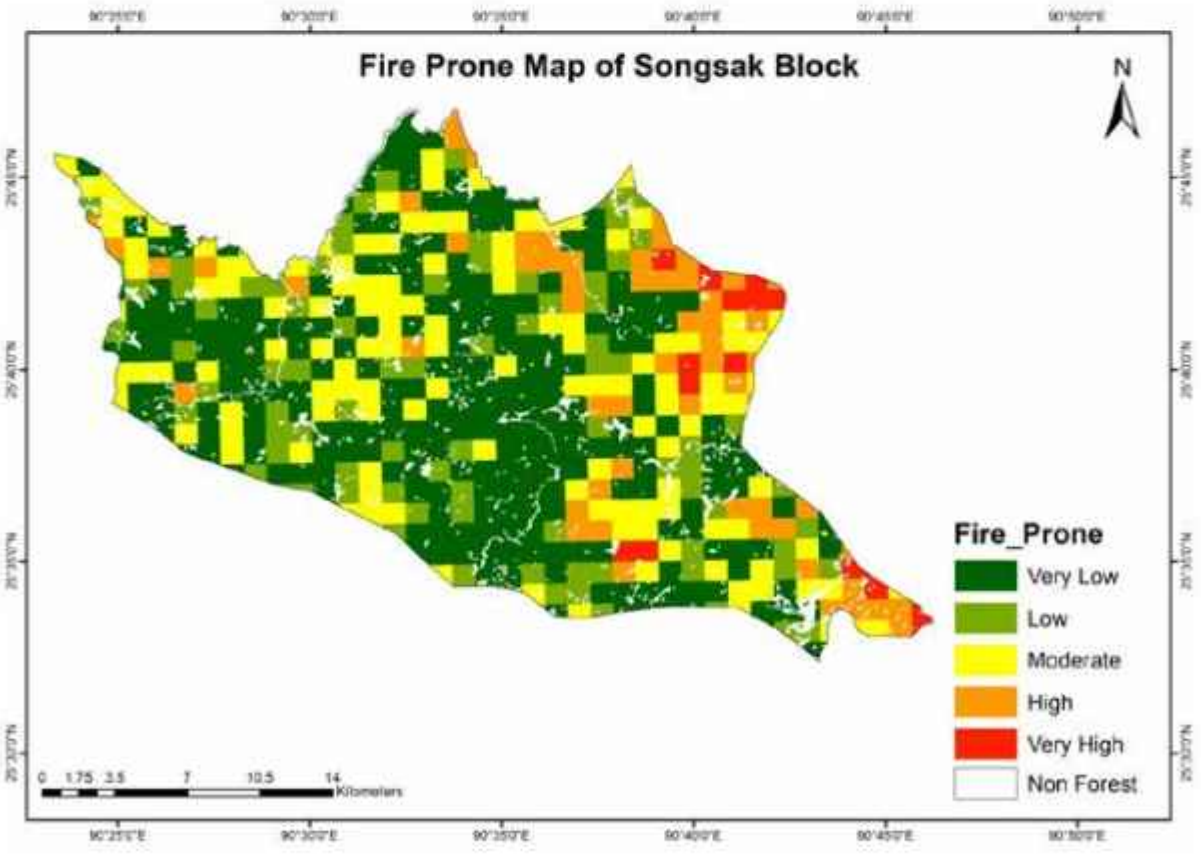


Figure 153. Forest Fire Prone Map of Songsak Block

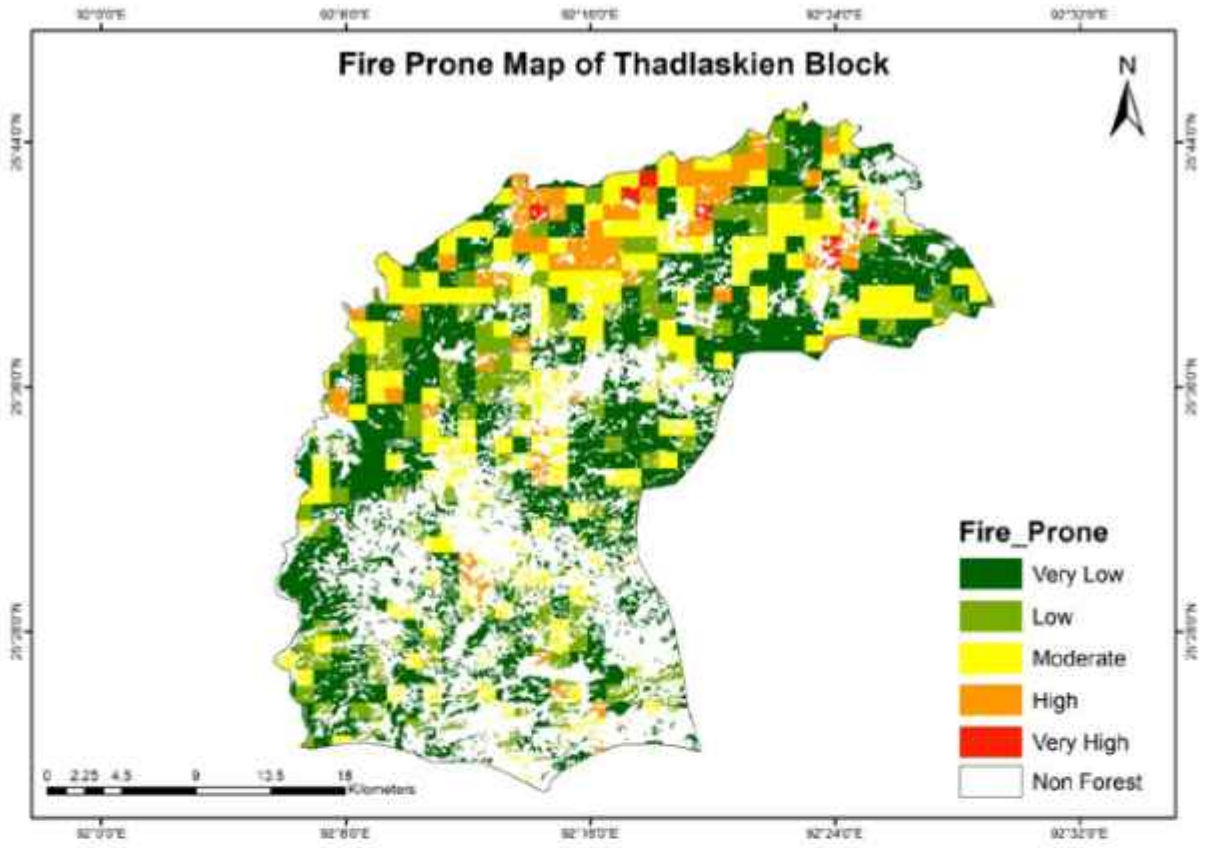


Figure 154. Forest Fire Prone Map of Thadlaskien Block

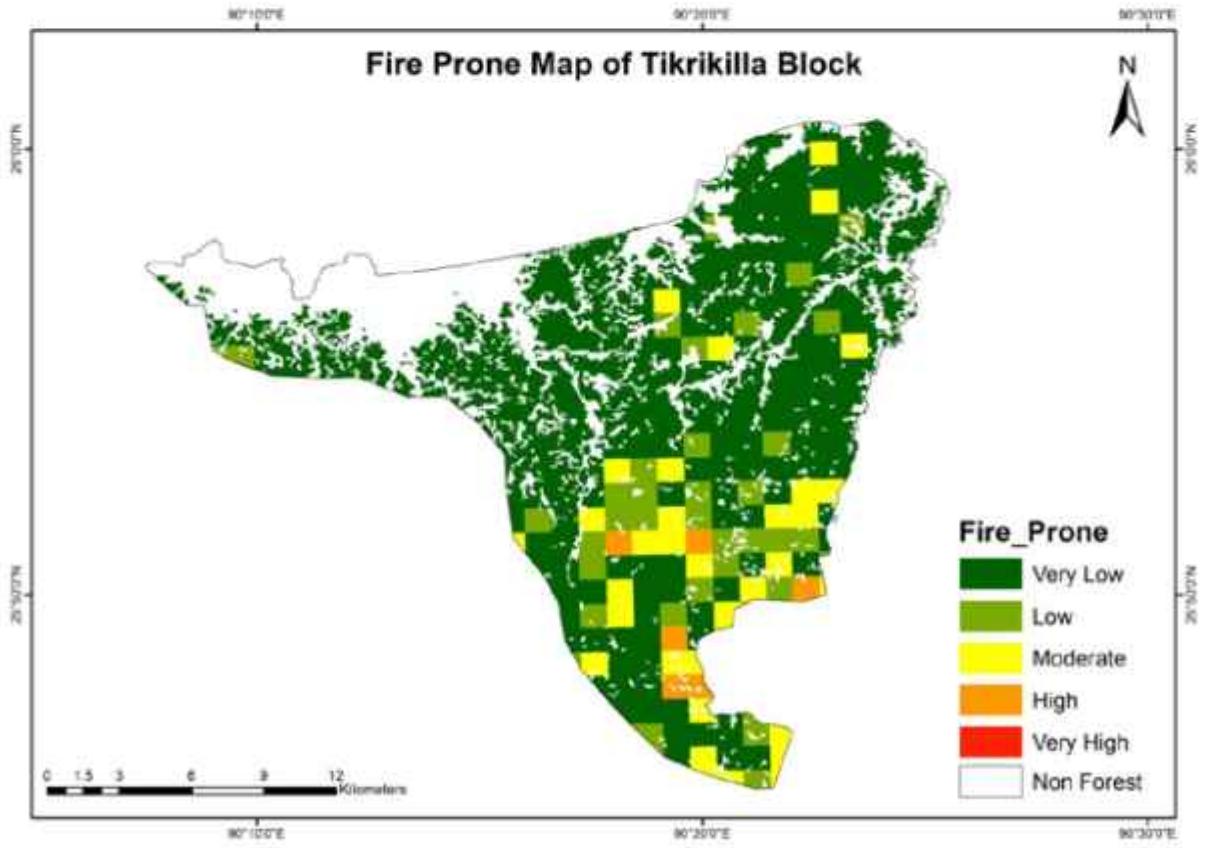


Figure 155. Forest Fire Prone Map of Tikrikilla Block

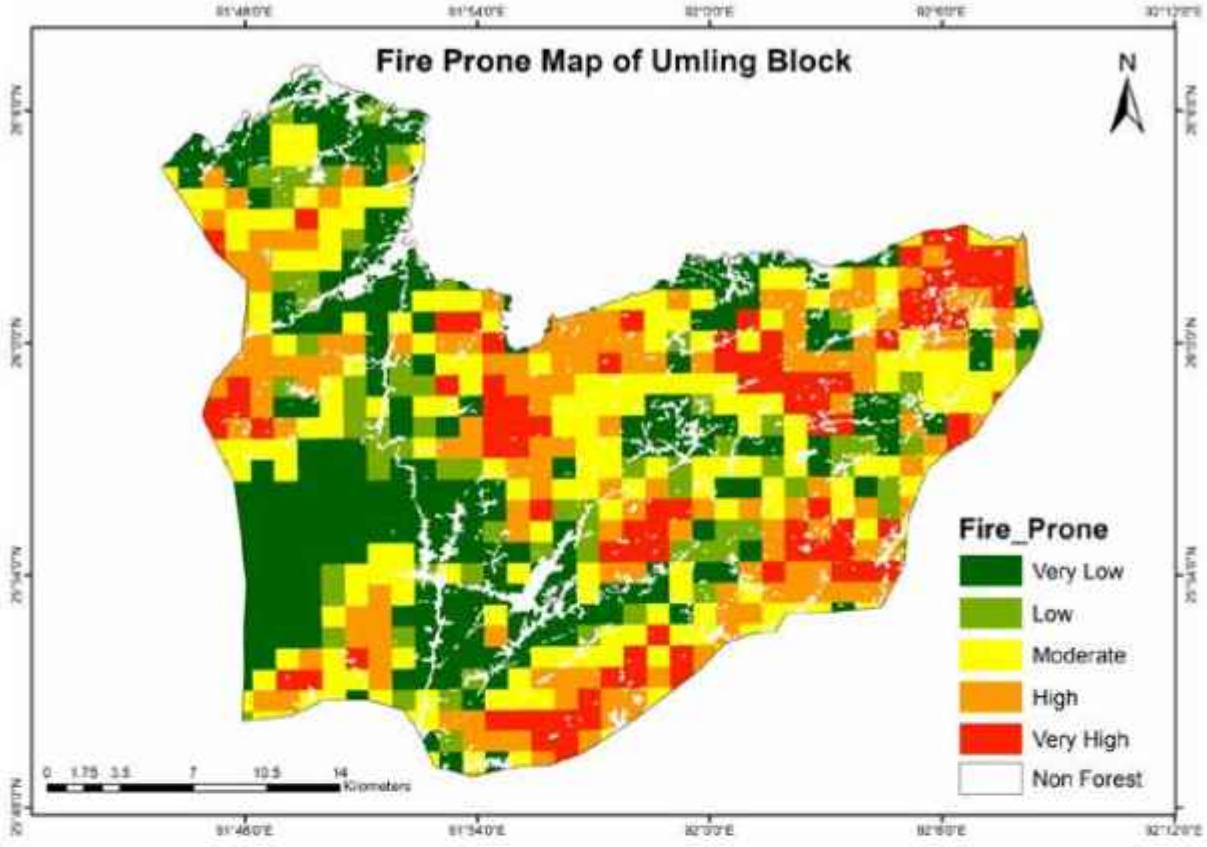


Figure 156. Forest Fire Prone Map of Umling Block

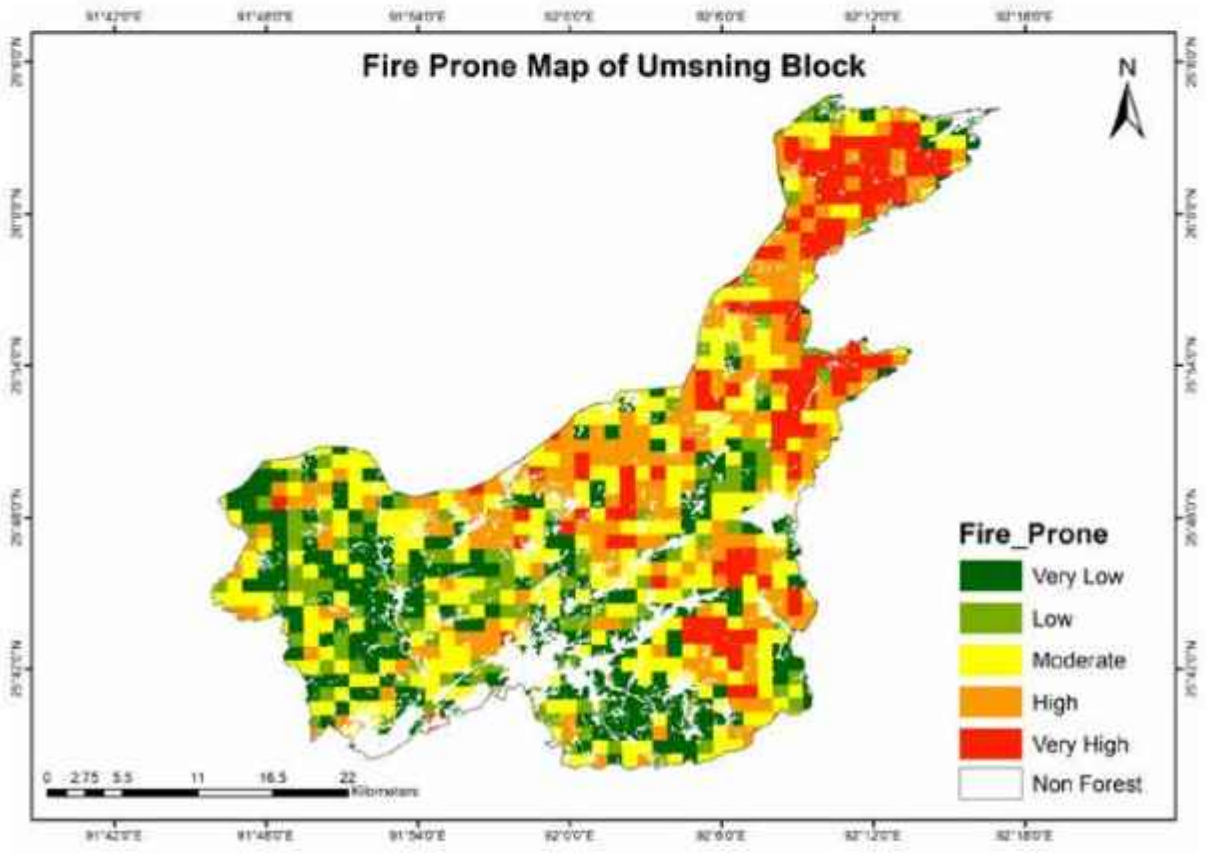


Figure 157. Forest Fire Prone Map of Umsning Block

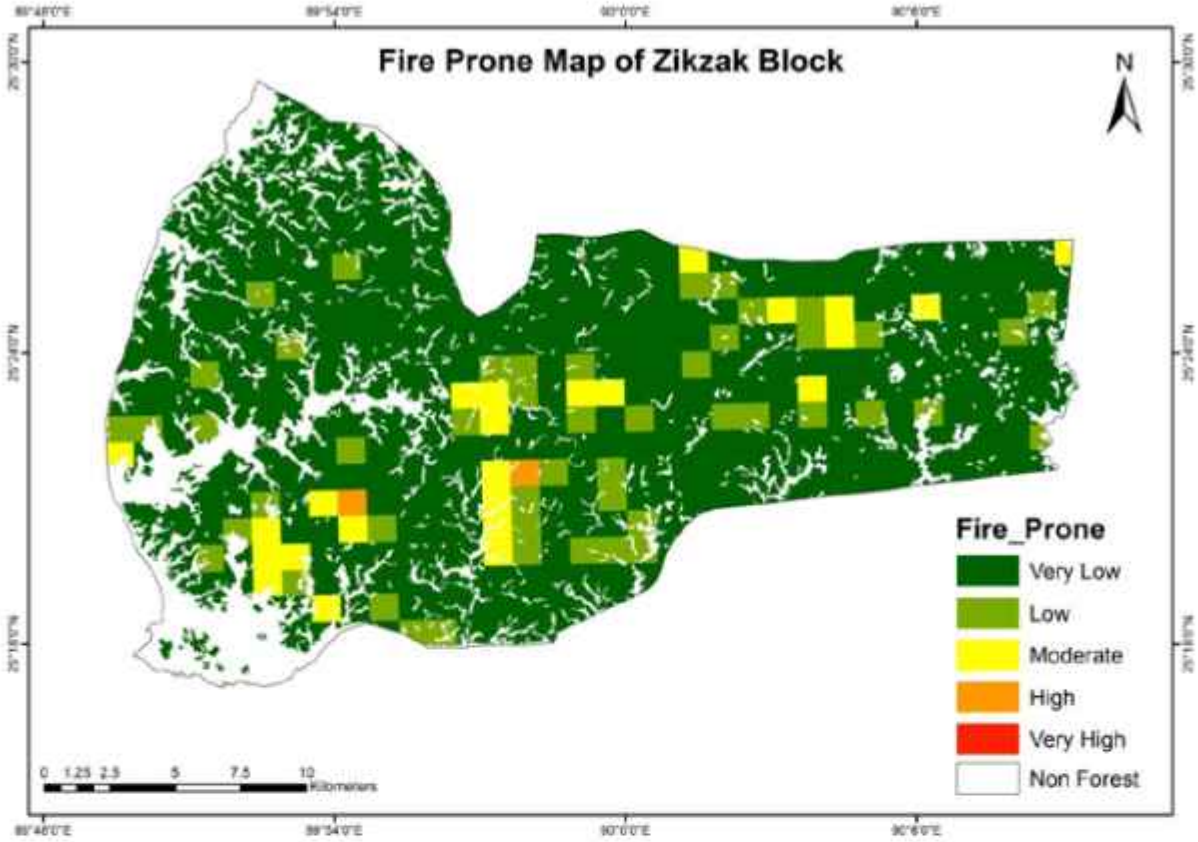


Figure 158. Forest Fire Prone Map of Zikzak Block

Forest Fire Vulnerability Map of Reserve Forest – Protected Forest – Wildlife Sanctuary – National Park-Biosphere Reserve of Meghalaya State

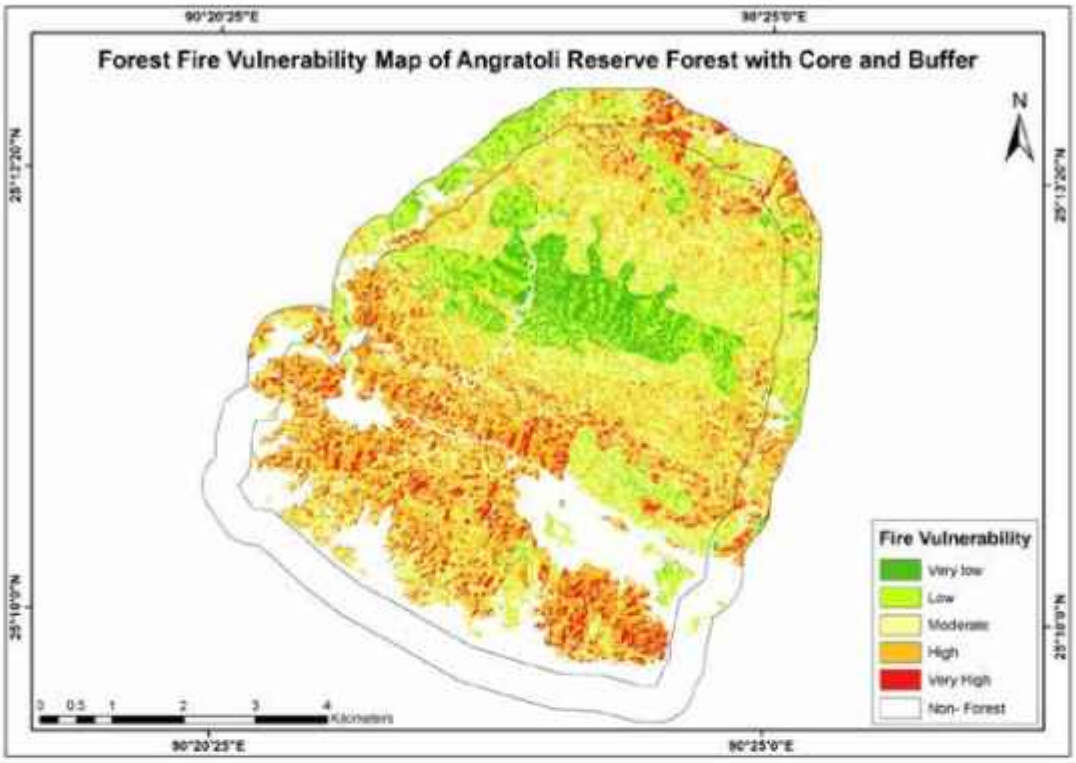


Figure 159. Vulnerability Map of Angratoli Reserve Forest

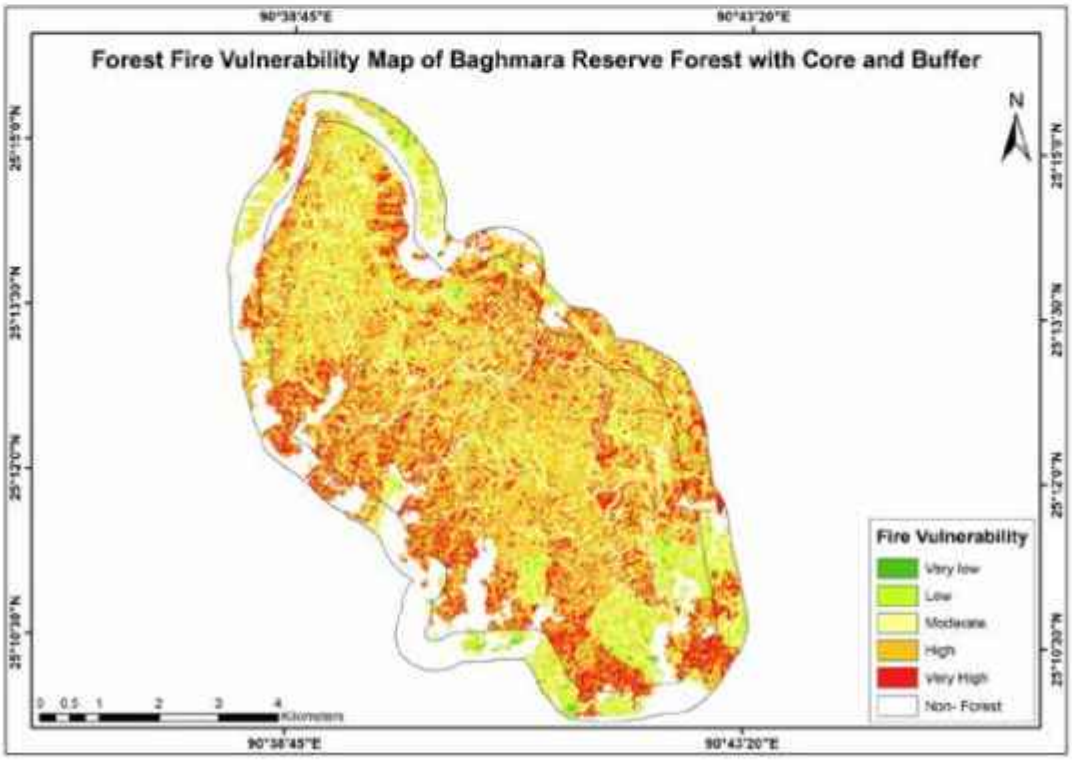


Figure 160. Vulnerability Map of Baghmara Reserve Forest

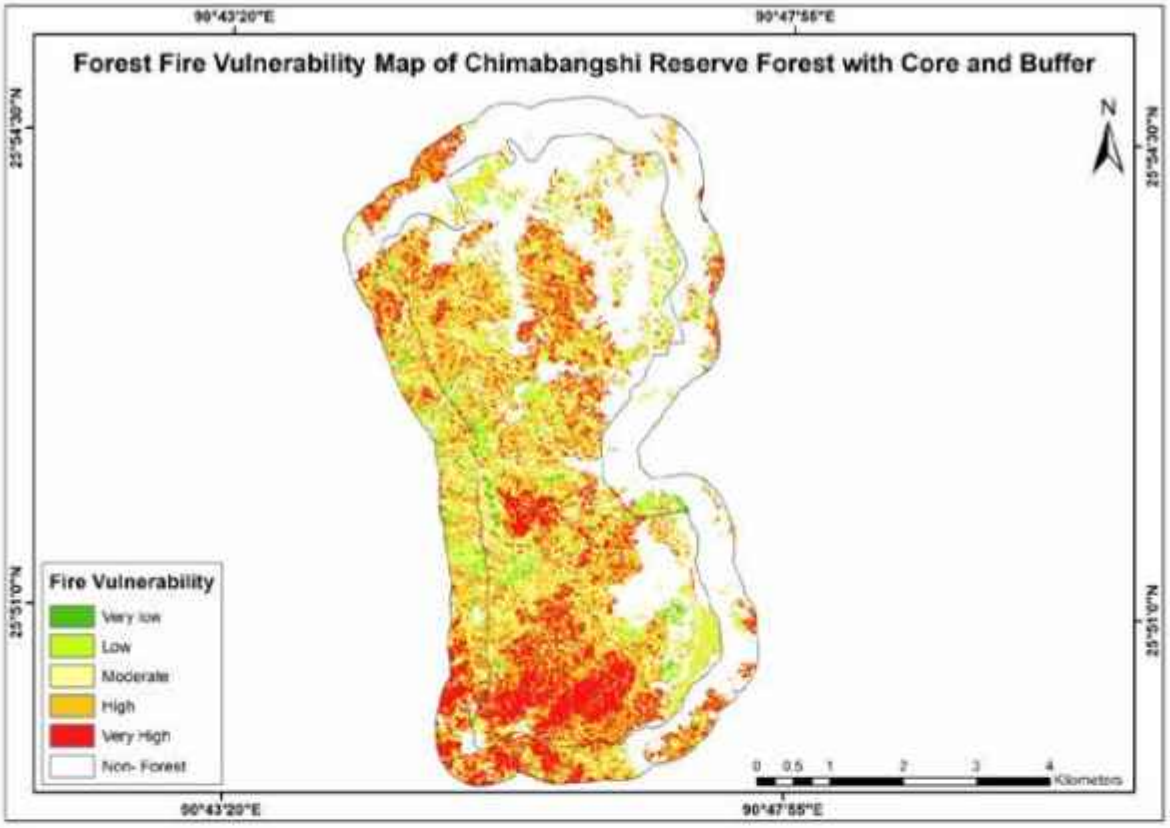


Figure 161. Vulnerability Map of Chimabangshi Reserve Forest

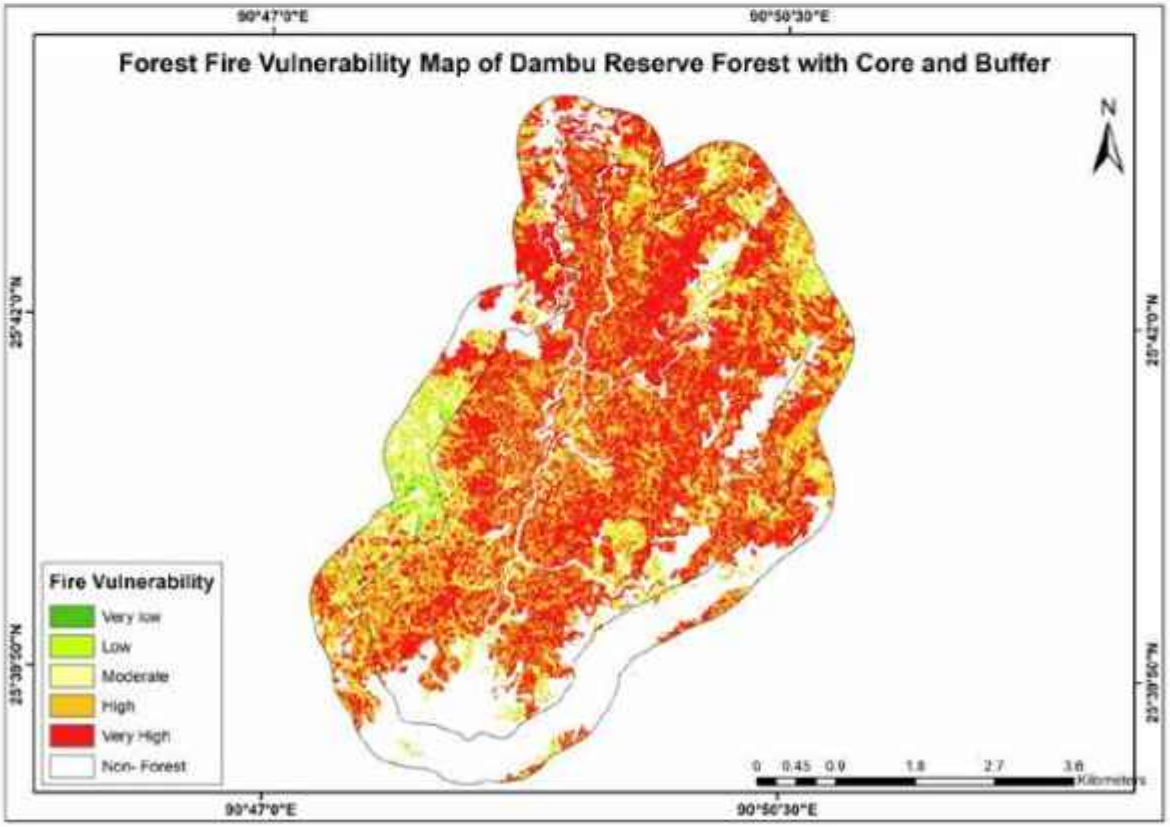


Figure 162. Vulnerability Map of Dambu Reserve Forest

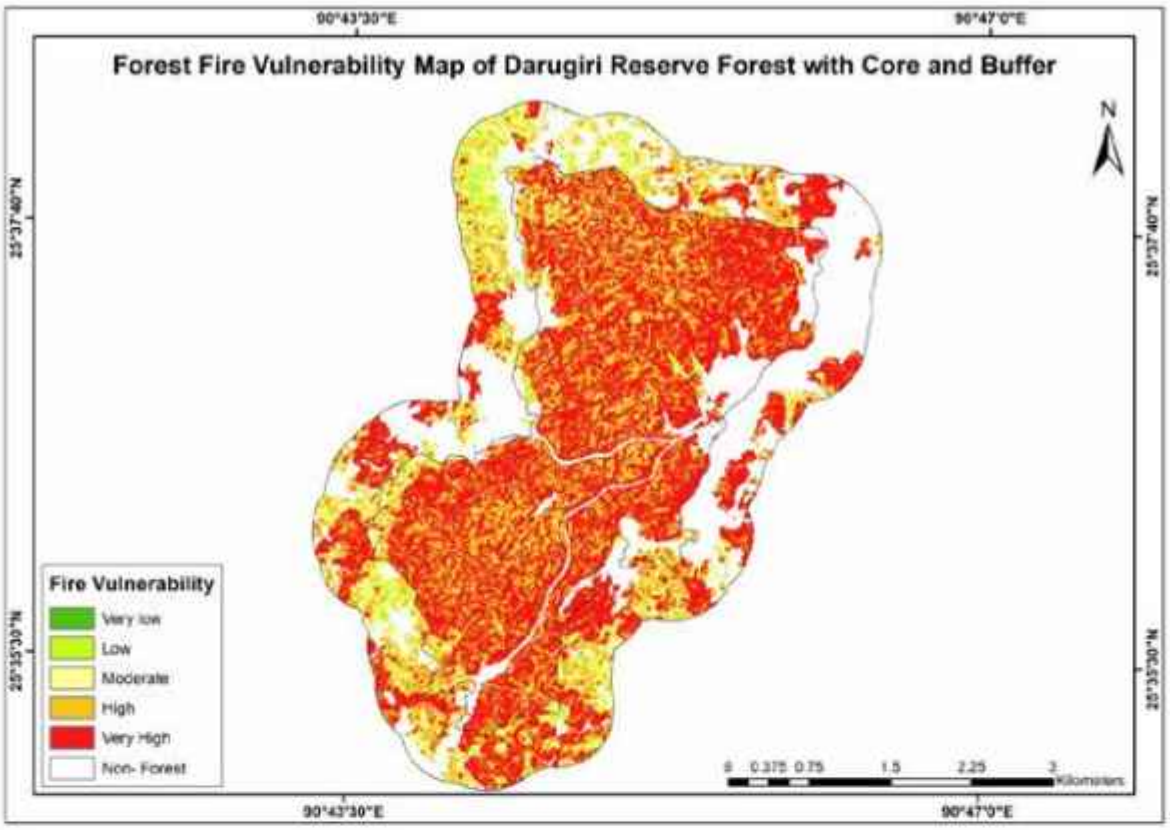


Figure 163. Vulnerability Map of Darugiri Reserve Forest

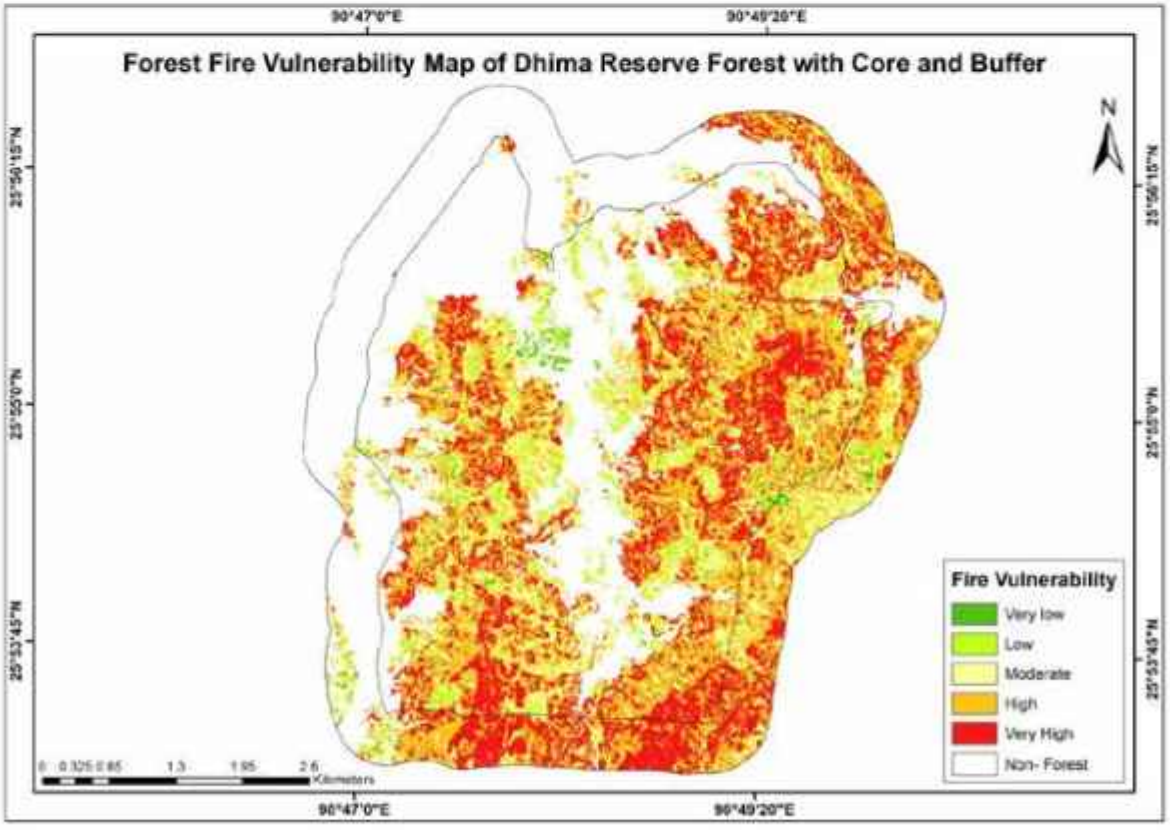


Figure 164. Vulnerability Map of Dhima Reserve Forest

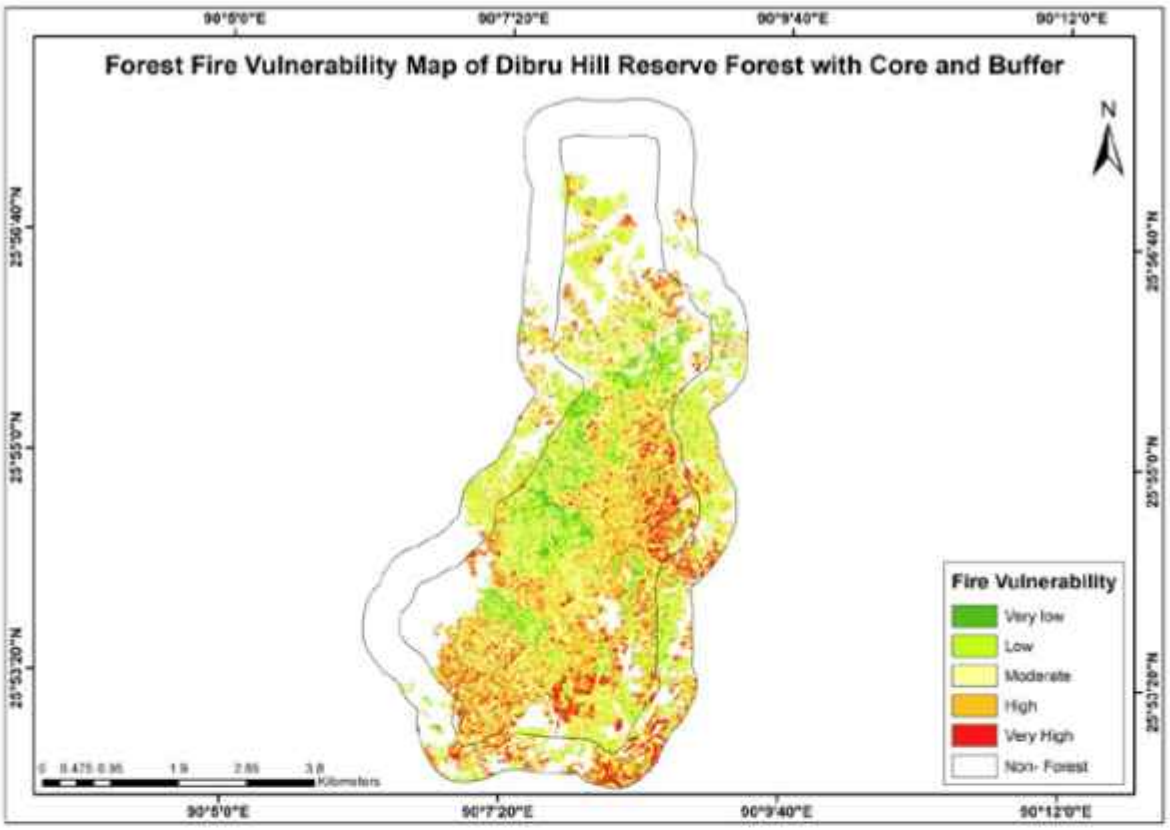


Figure 165. Vulnerability Map of Dibru Reserve Forest

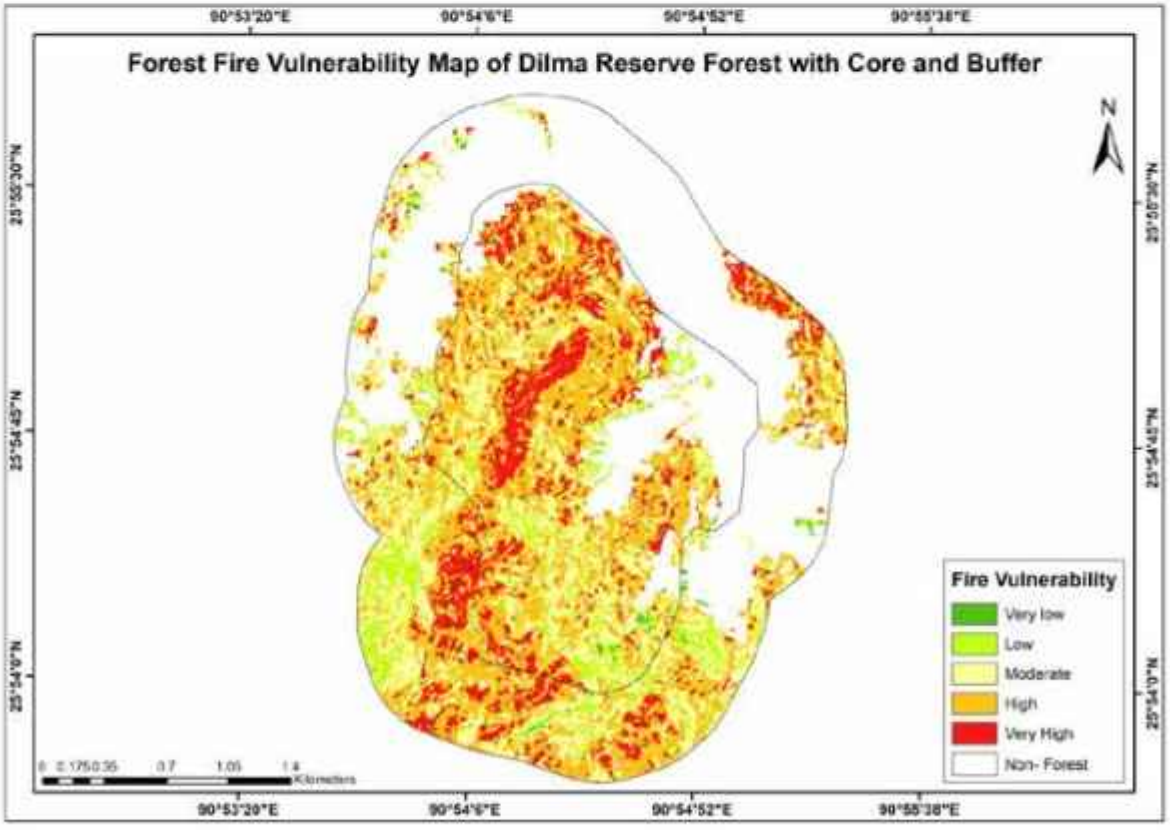


Figure 166. Vulnerability Map of Dilma Reserve Forest

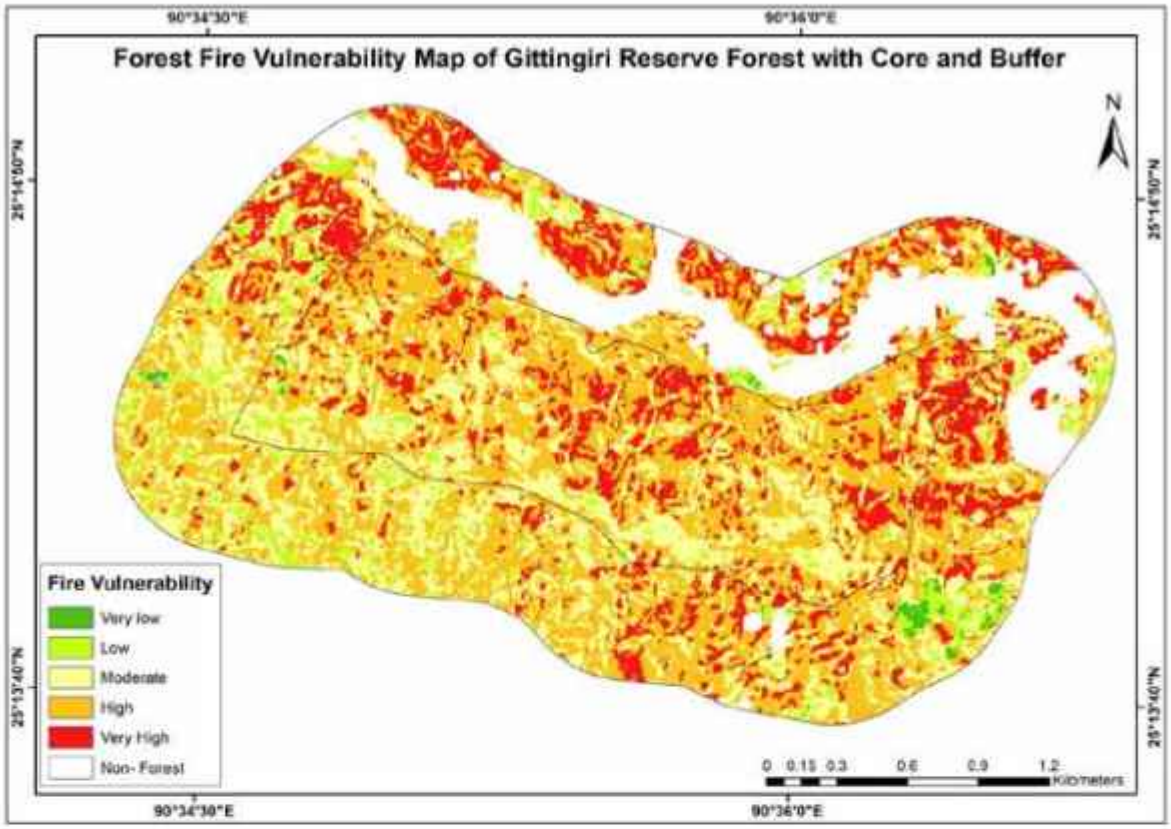


Figure 167. Vulnerability Map of Gittingiri Reserve Forest

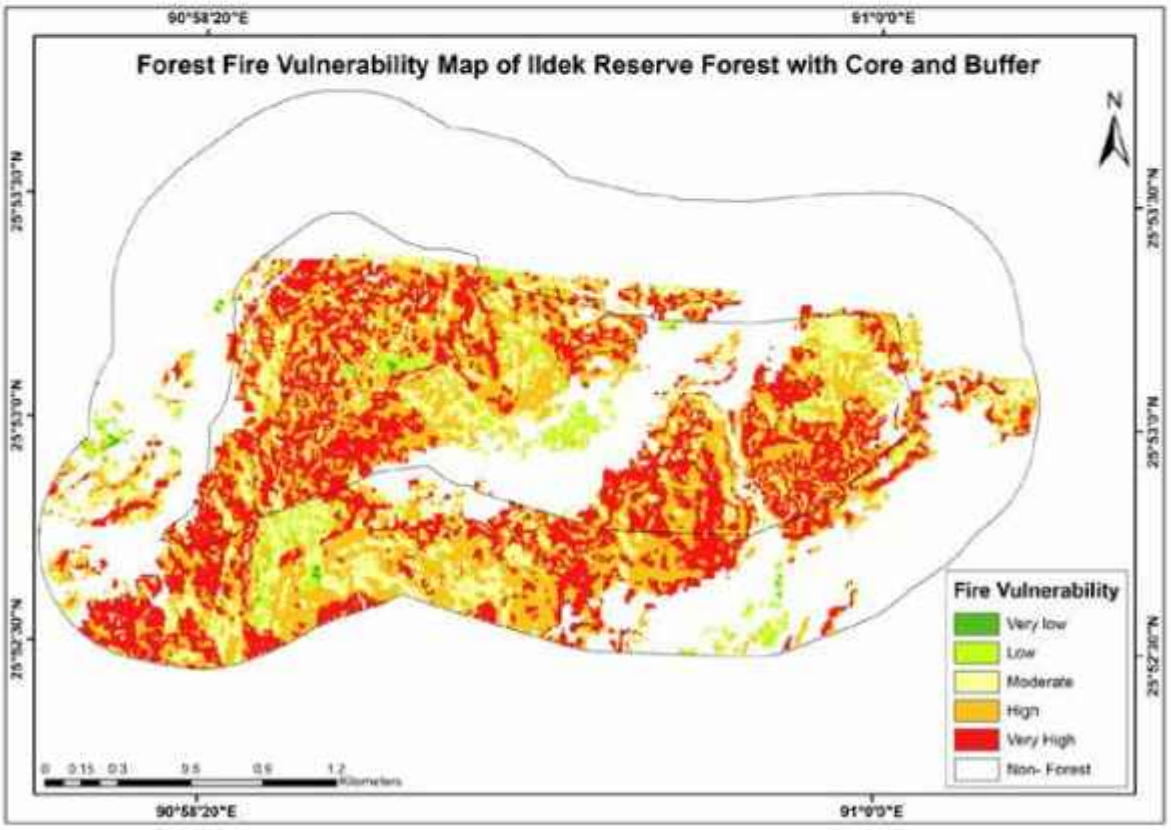


Figure 168. Fire Vulnerability Map of Ildek Reserve Forest

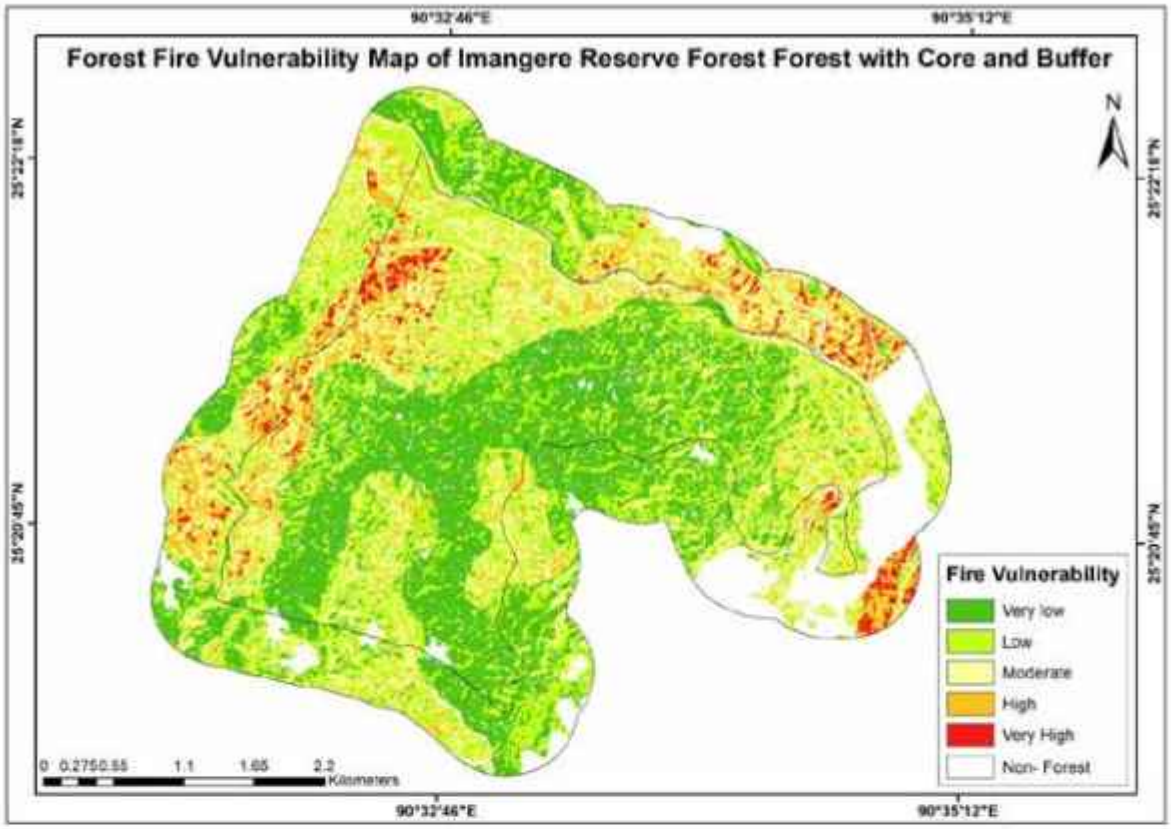


Figure 169. Fire Vulnerability Map of Imangere Reserve Forest

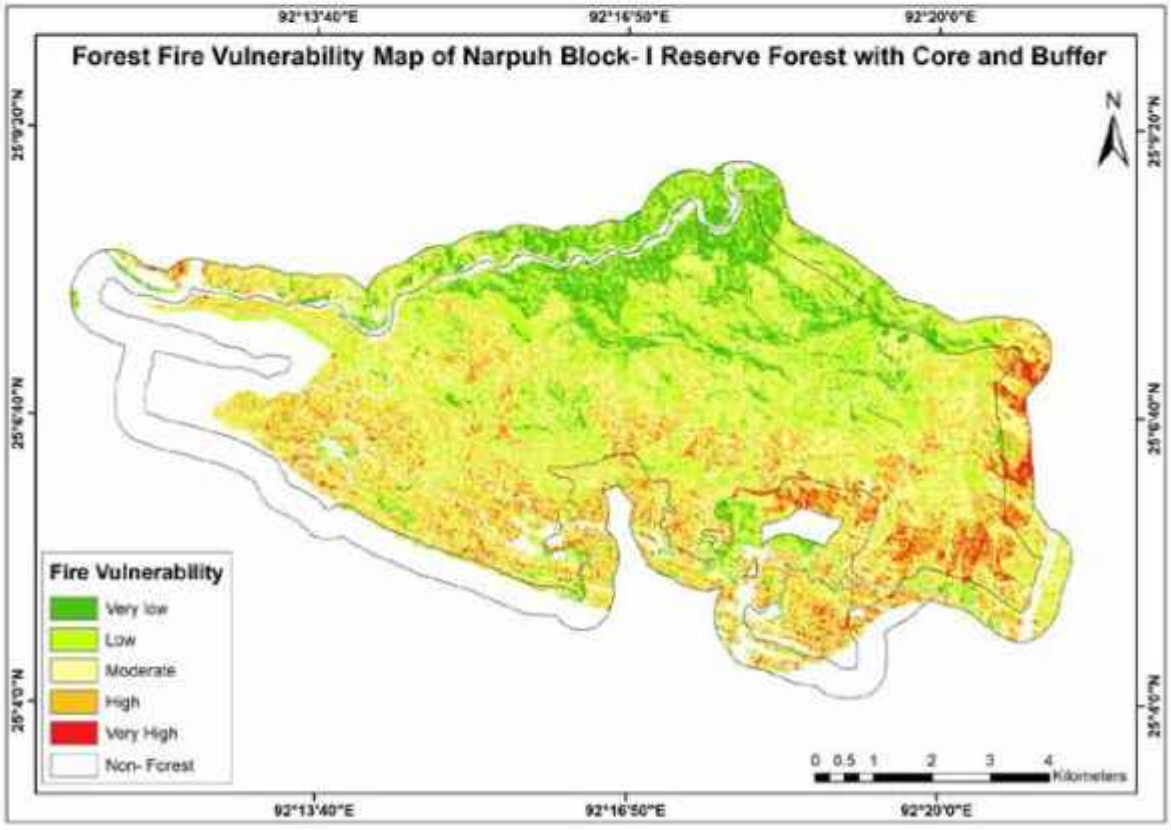


Figure 170. Fire Vulnerability Map of Narpuh Block I Reserve Forest

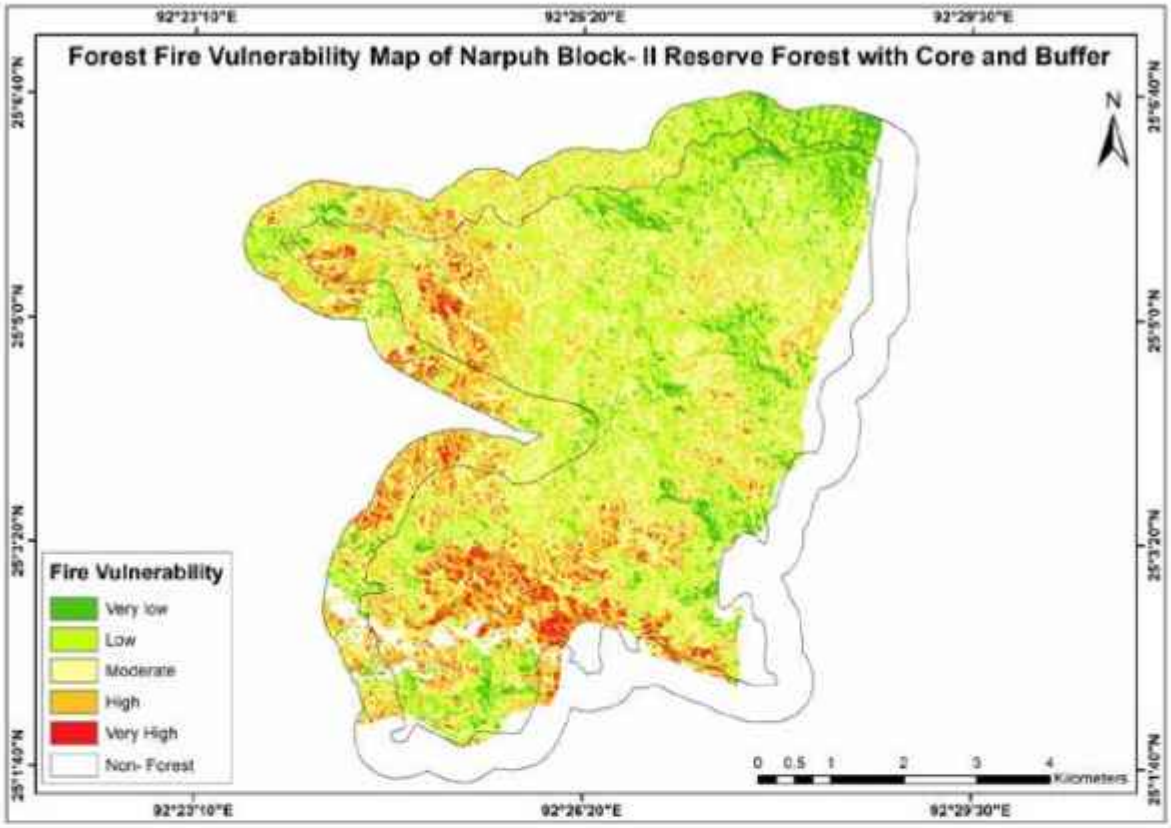


Figure 171. Forest Fire Vulnerability Map of Narpuh Block II Reserve Forest

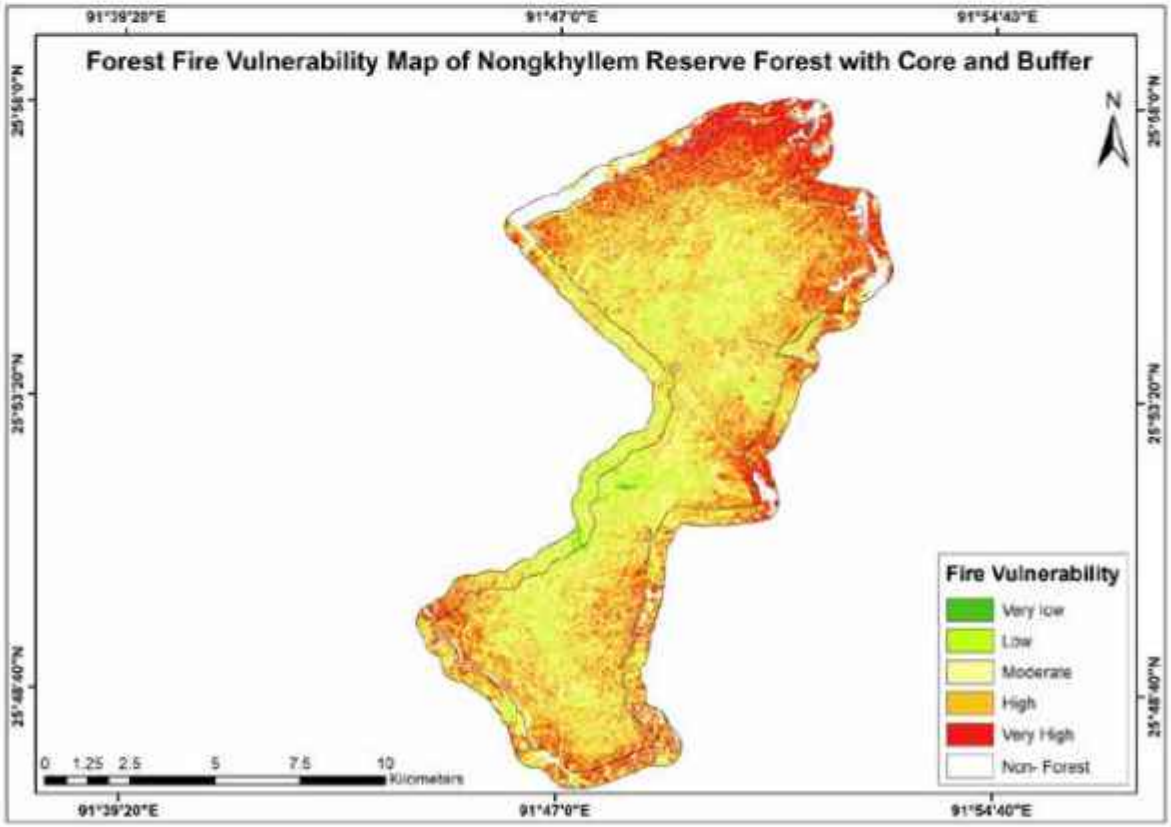


Figure 172. Forest Fire Vulnerability Map of Nongkhyllem Reserve Forest

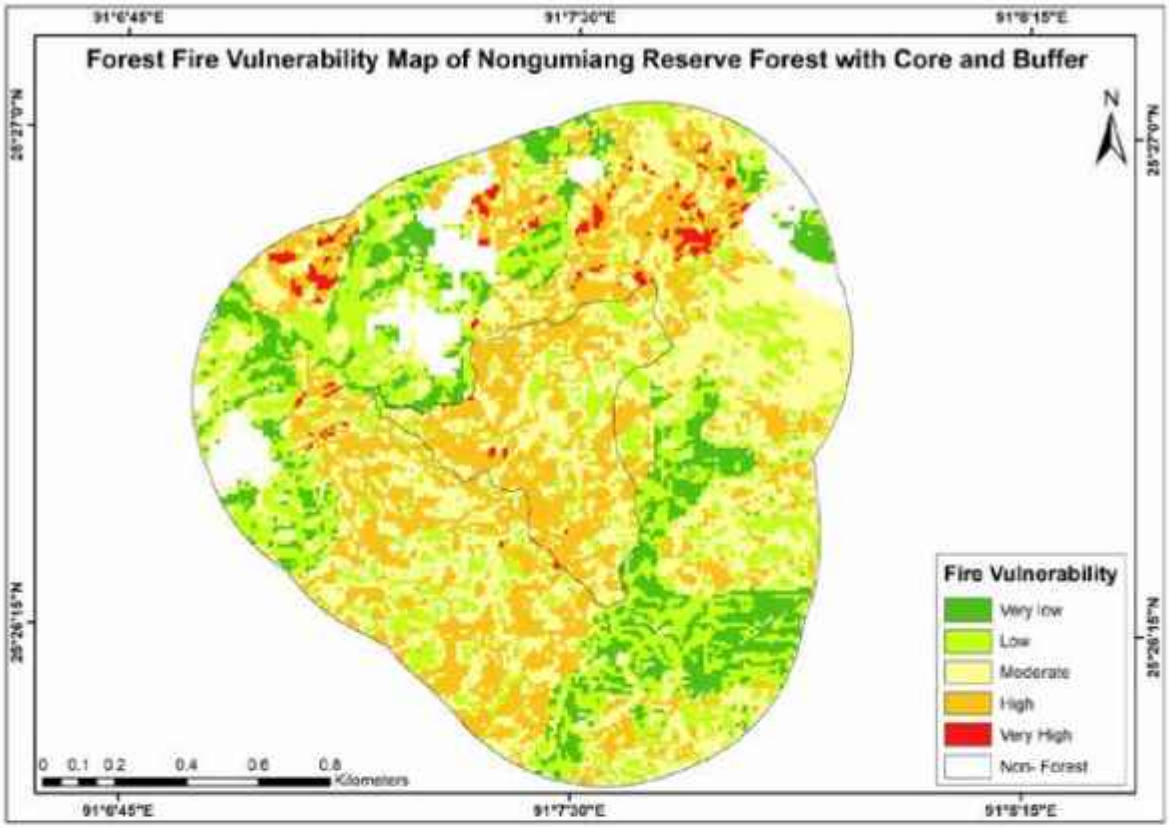


Figure 173. Forest Fire Vulnerability Map of Nongumiang Reserve Forest

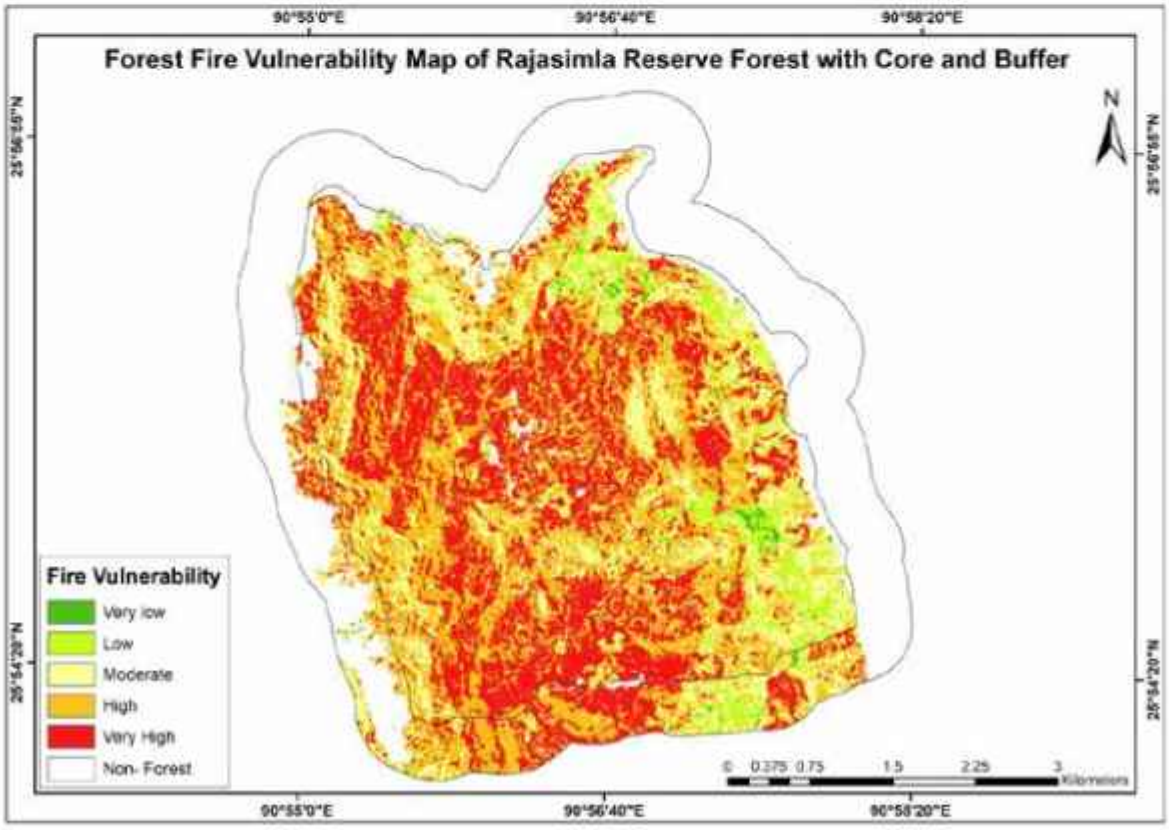


Figure 174. Forest Fire Vulnerability Map of Rajasimla Reserve Forest

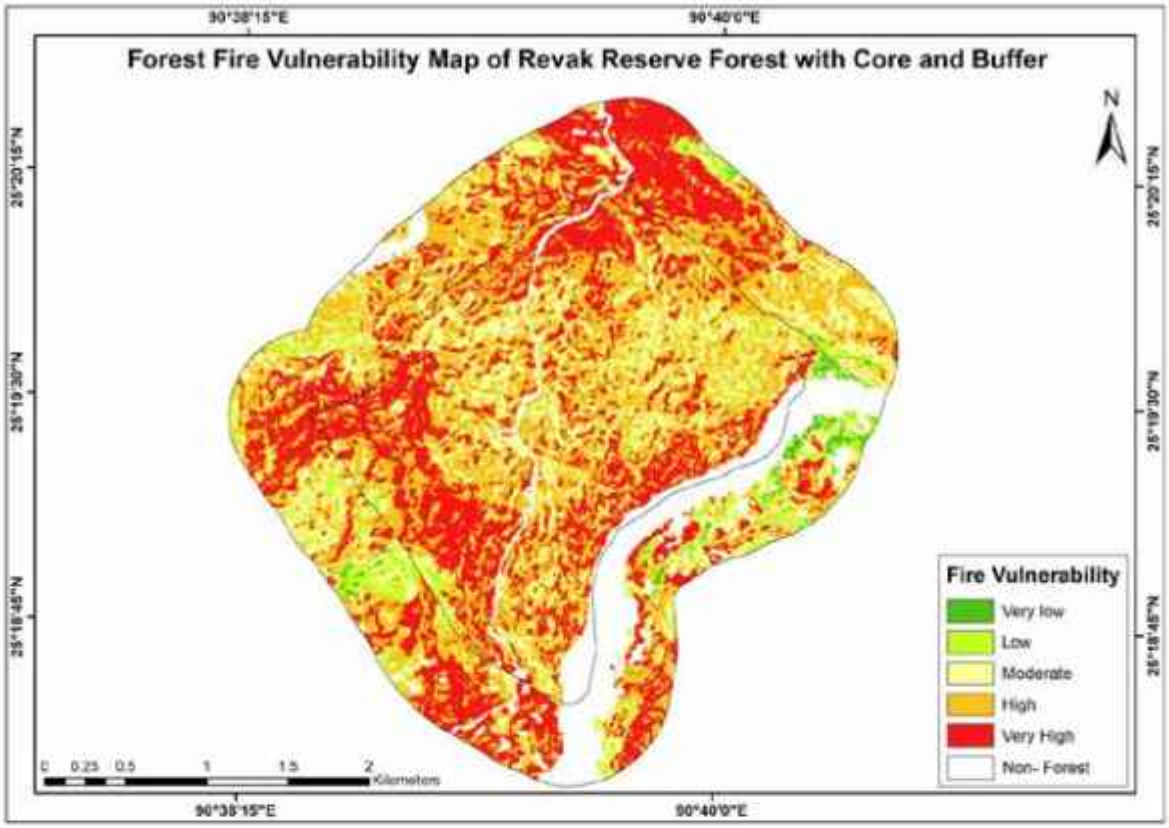


Figure 175. Forest Fire Vulnerability Map of Revak Reserve Forest

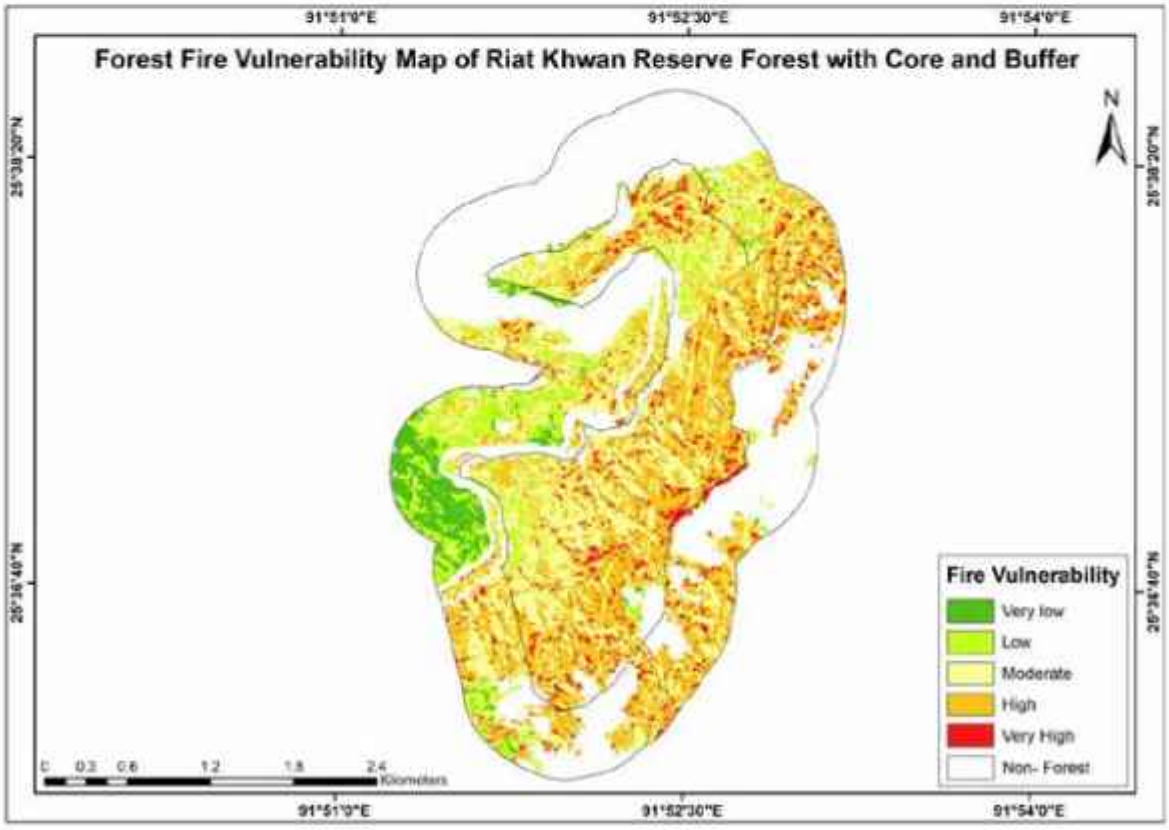


Figure 176. Forest Fire Vulnerability Map of Riat Khwan Reserve Forest

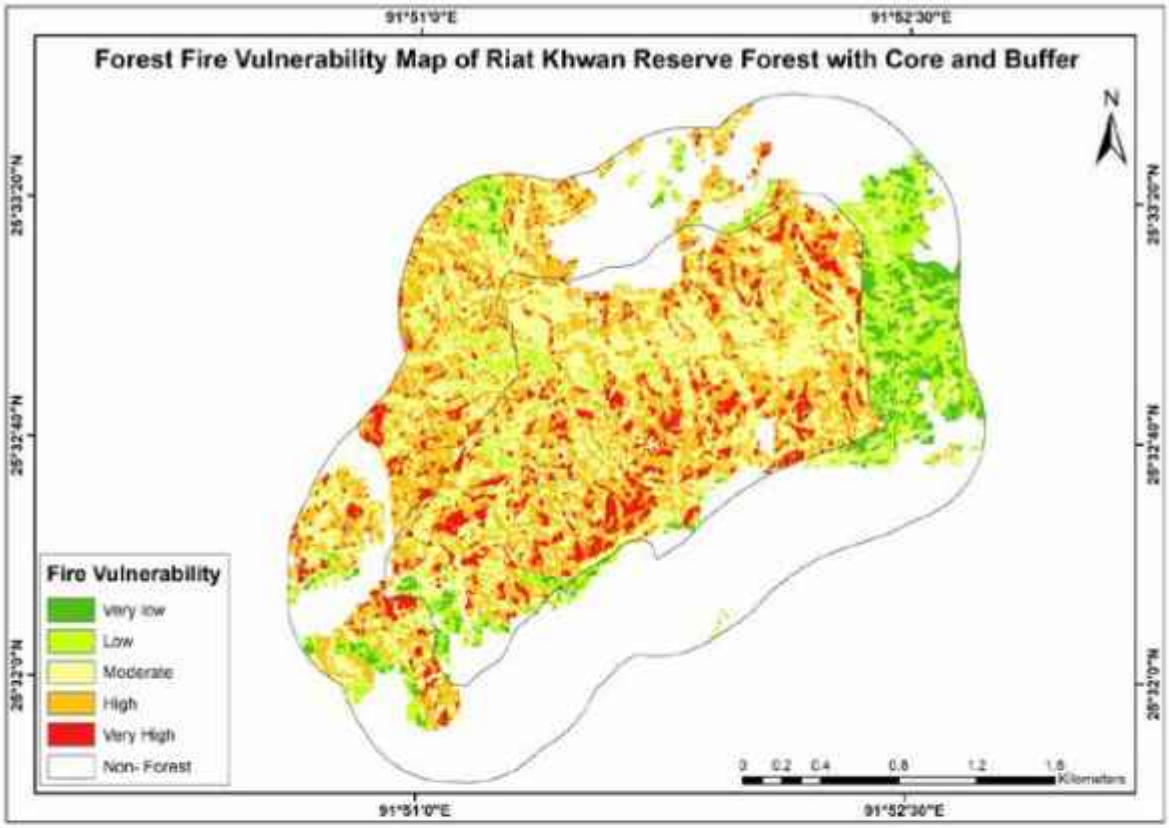


Figure 177. Forest Fire Vulnerability Map of Riat Laban Reserve Forest

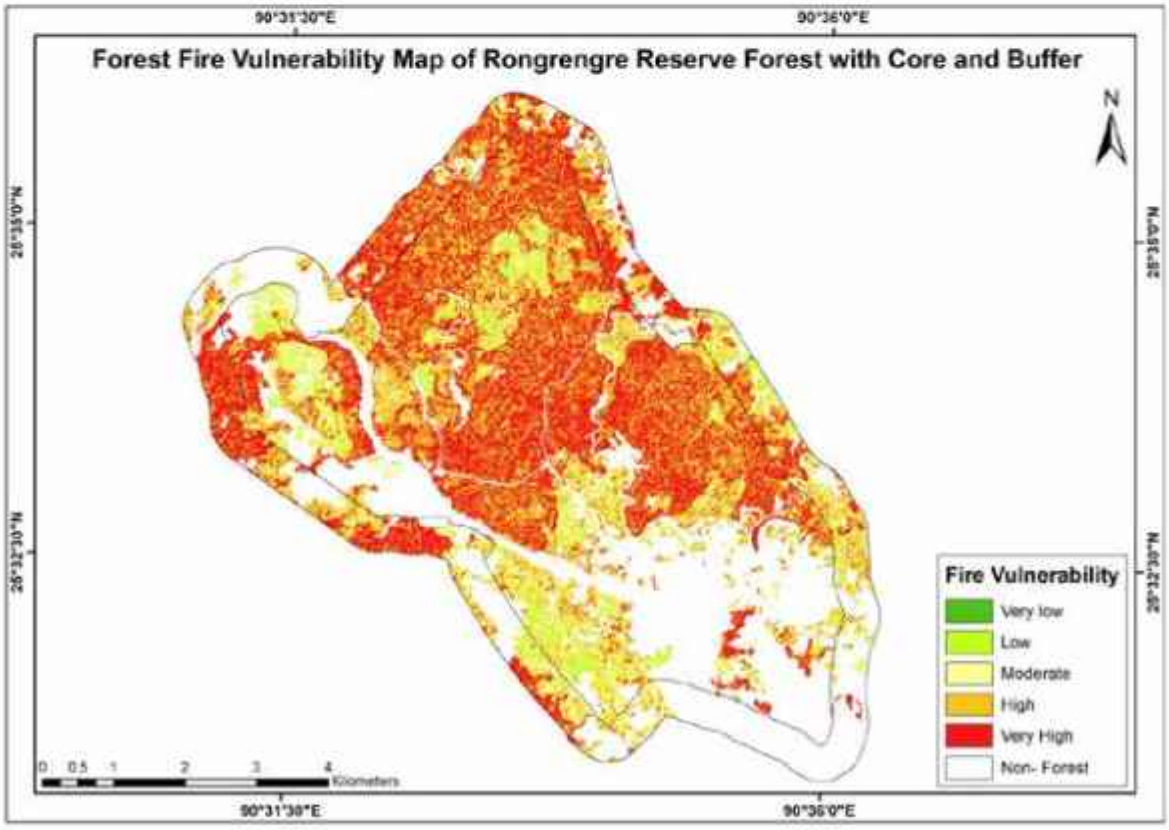


Figure 178. Forest Fire Vulnerability Map of Rongrengre Reserve Forest

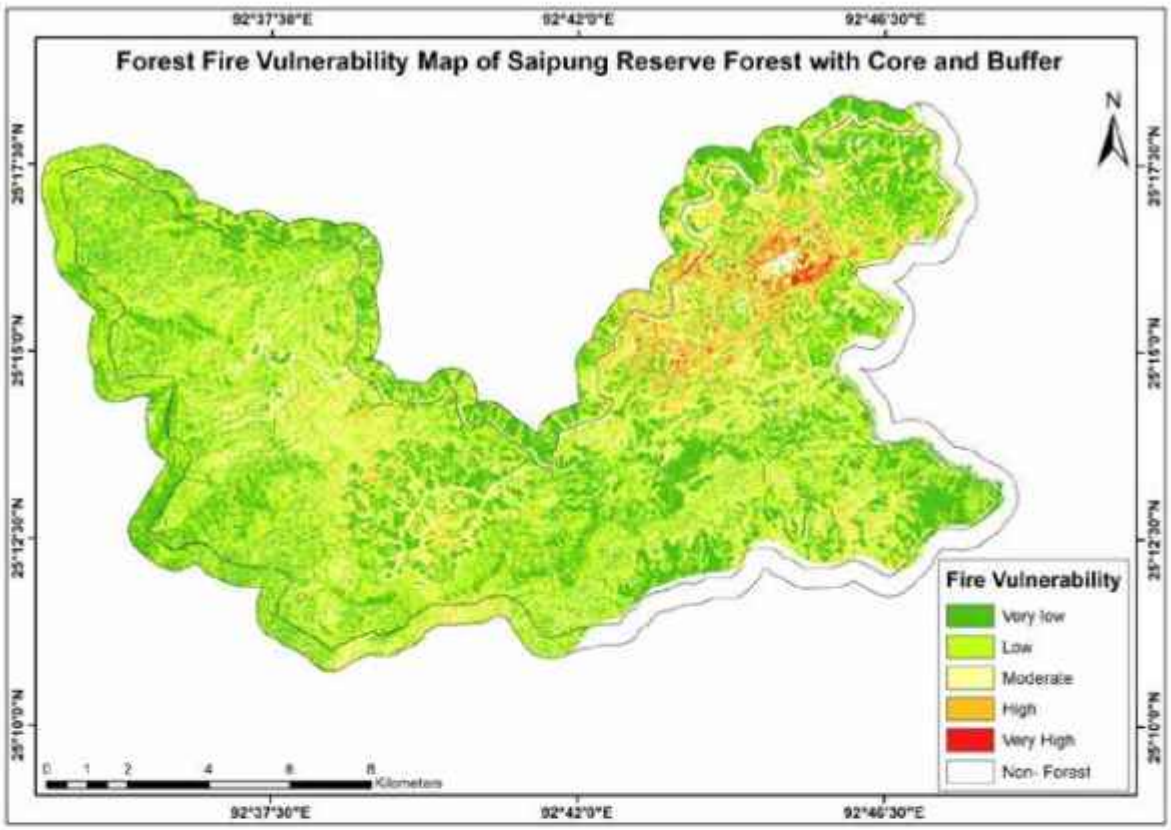


Figure 179. Forest Fire Vulnerability Map of Saipung Reserve Forest

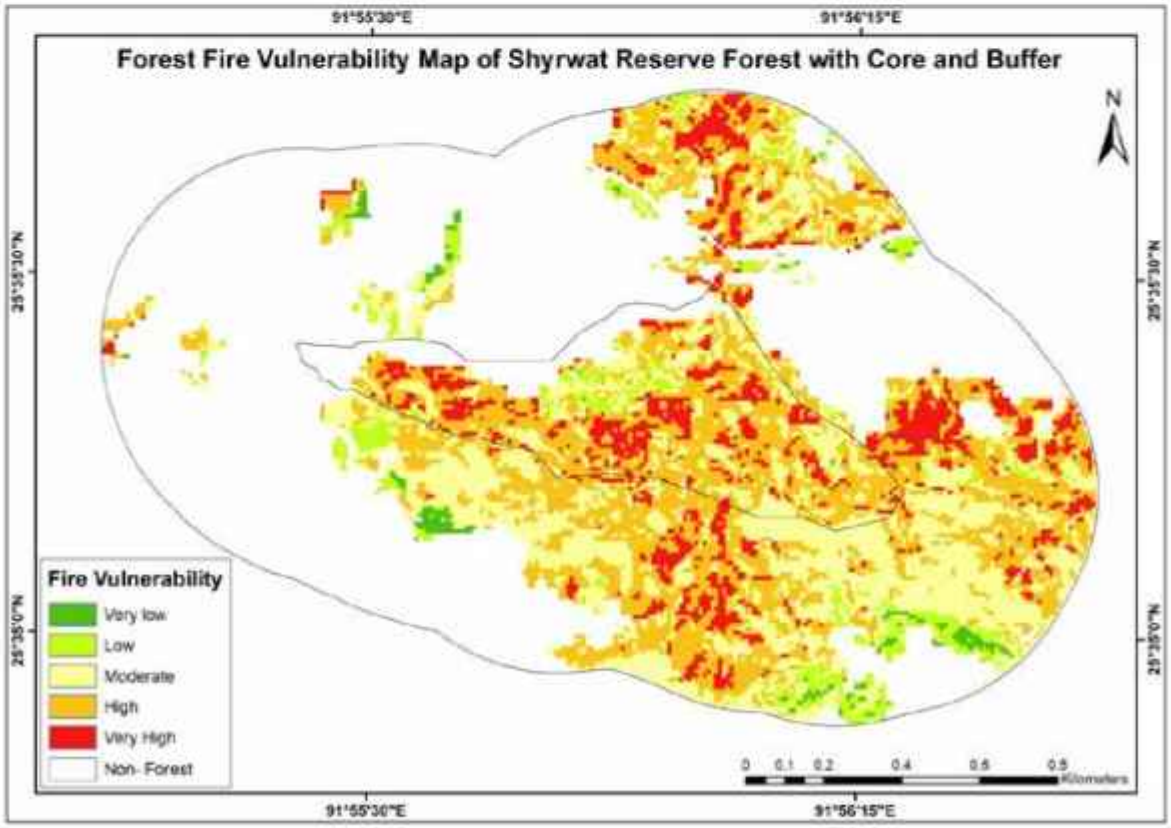


Figure 180. Forest Fire Vulnerability Map of Shyrwat Reserve Forest

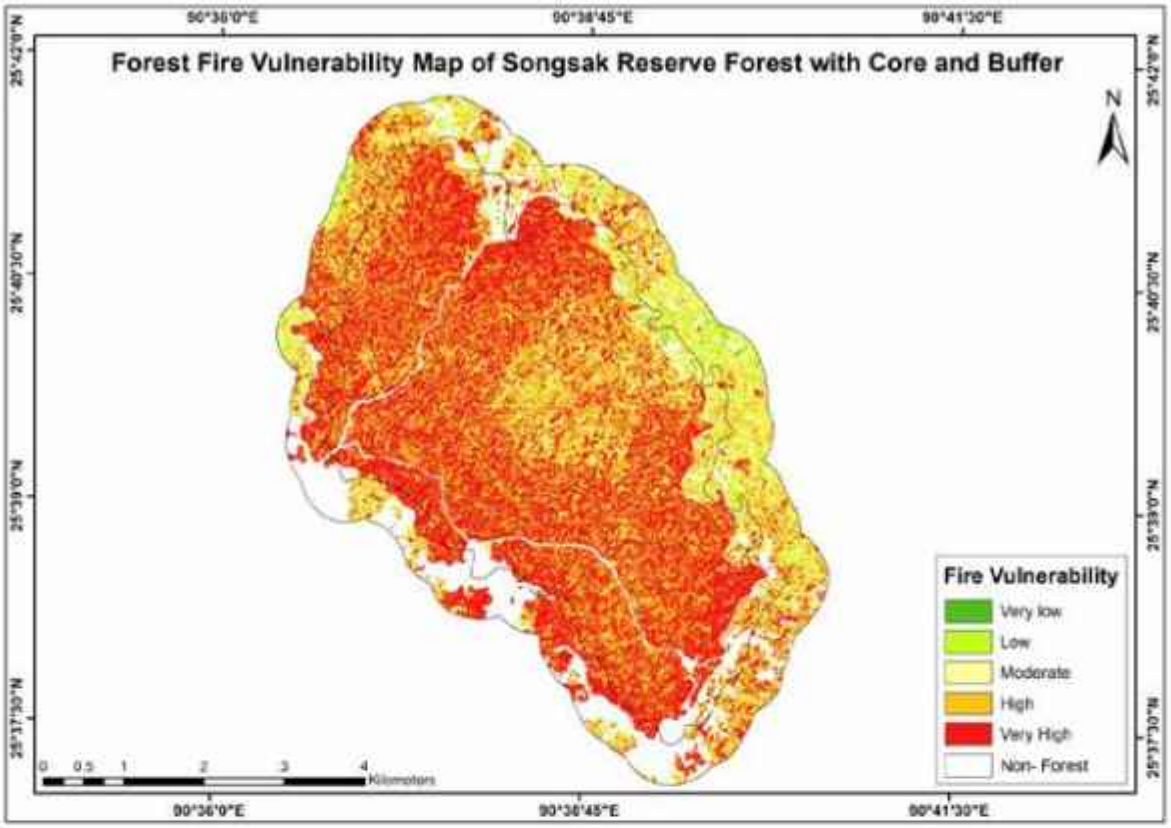


Figure 181. Forest Fire Vulnerability Map of Songsak Reserve Forest

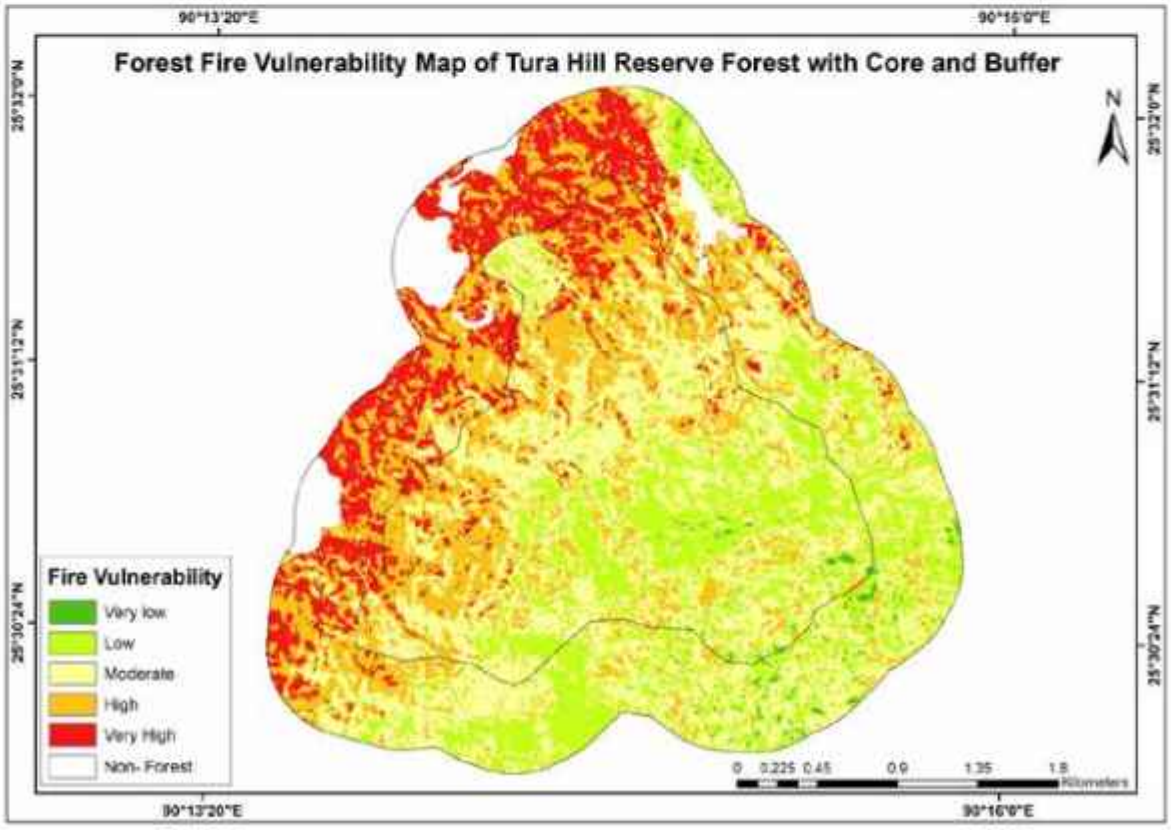


Figure 182. Forest Fire Vulnerability Map of Tura Hill Reserve Forest

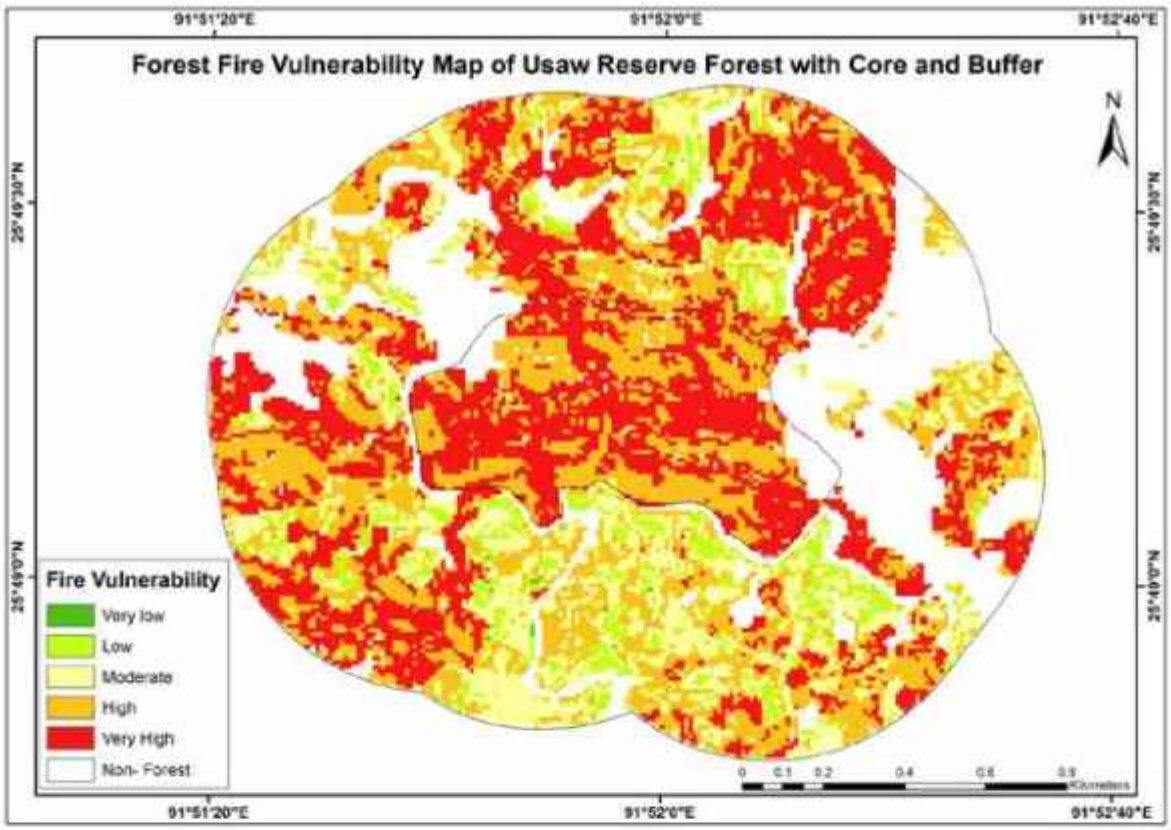


Figure 183. Forest Fire Vulnerability Map of Umsaw Reserve Forest

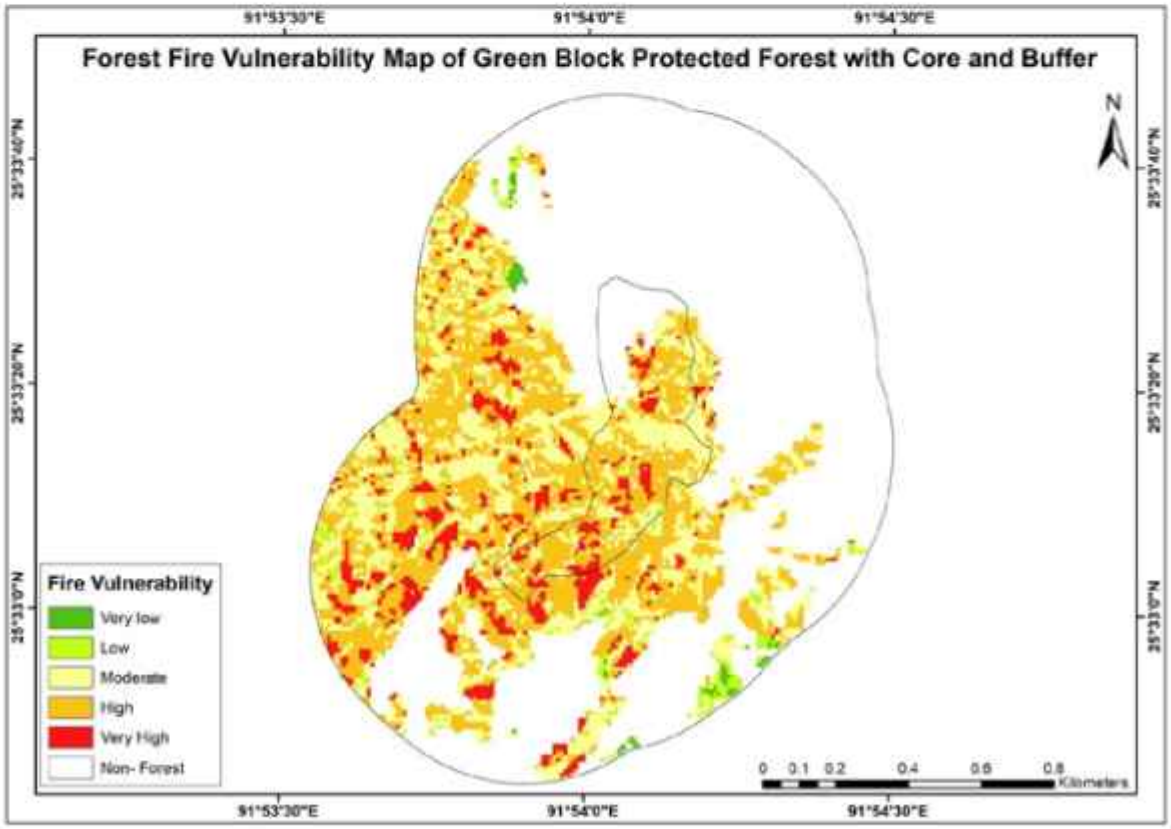


Figure 184. Forest Fire Vulnerability Map of Green Block Protected Forest

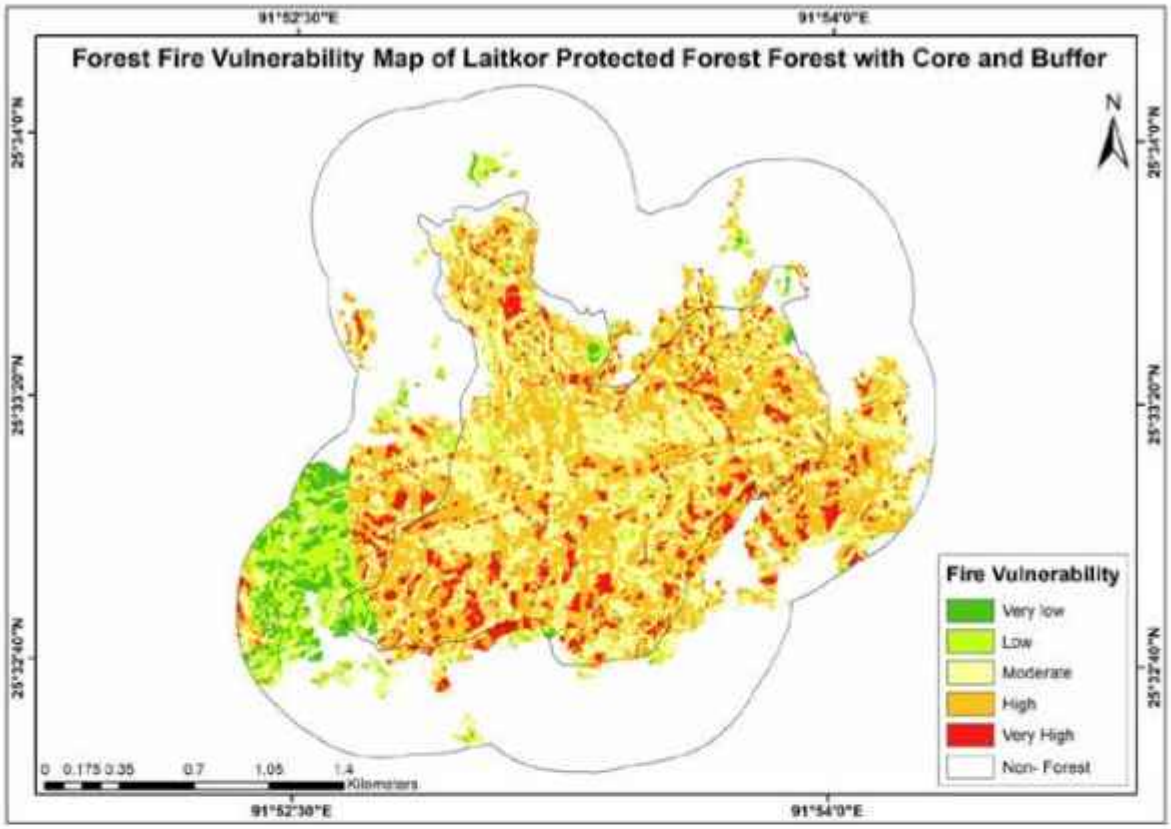


Figure 185. Forest Fire Vulnerability Map of Laitkor Protected Forest

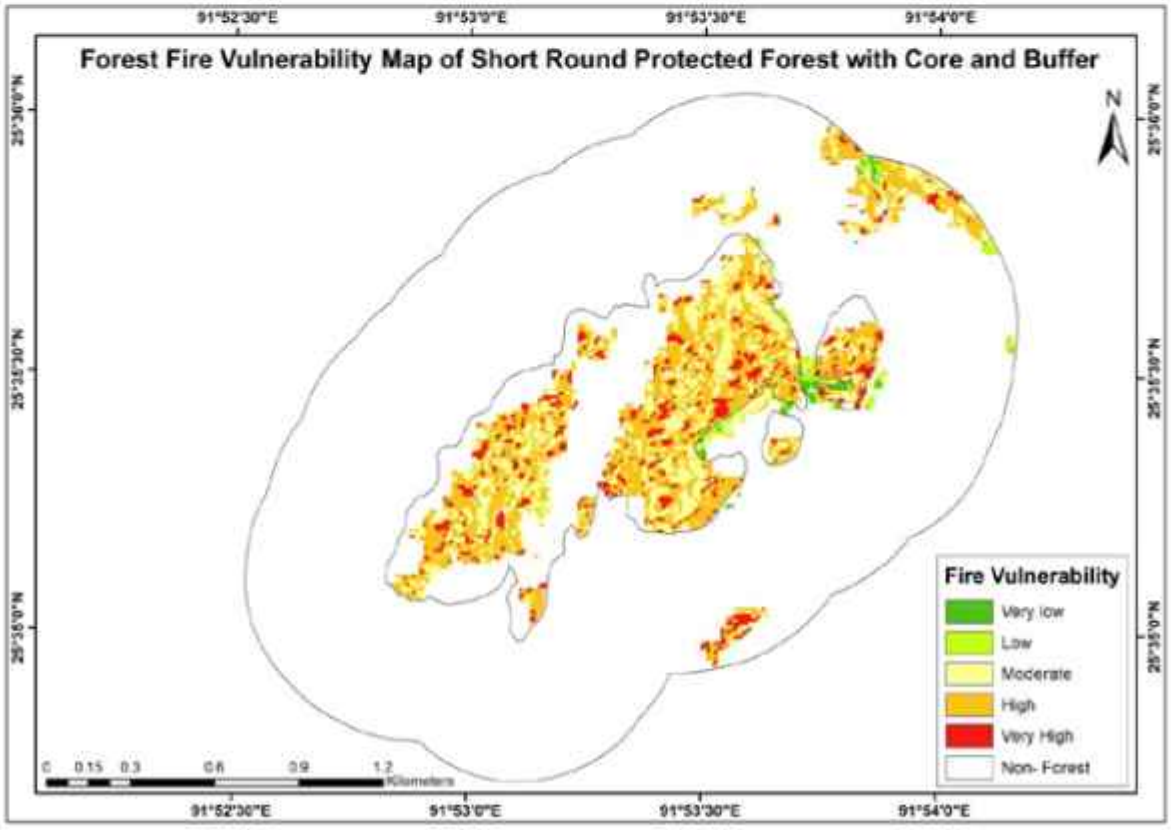


Figure 186. Forest Fire Vulnerability Map of Short Round Protected Forest

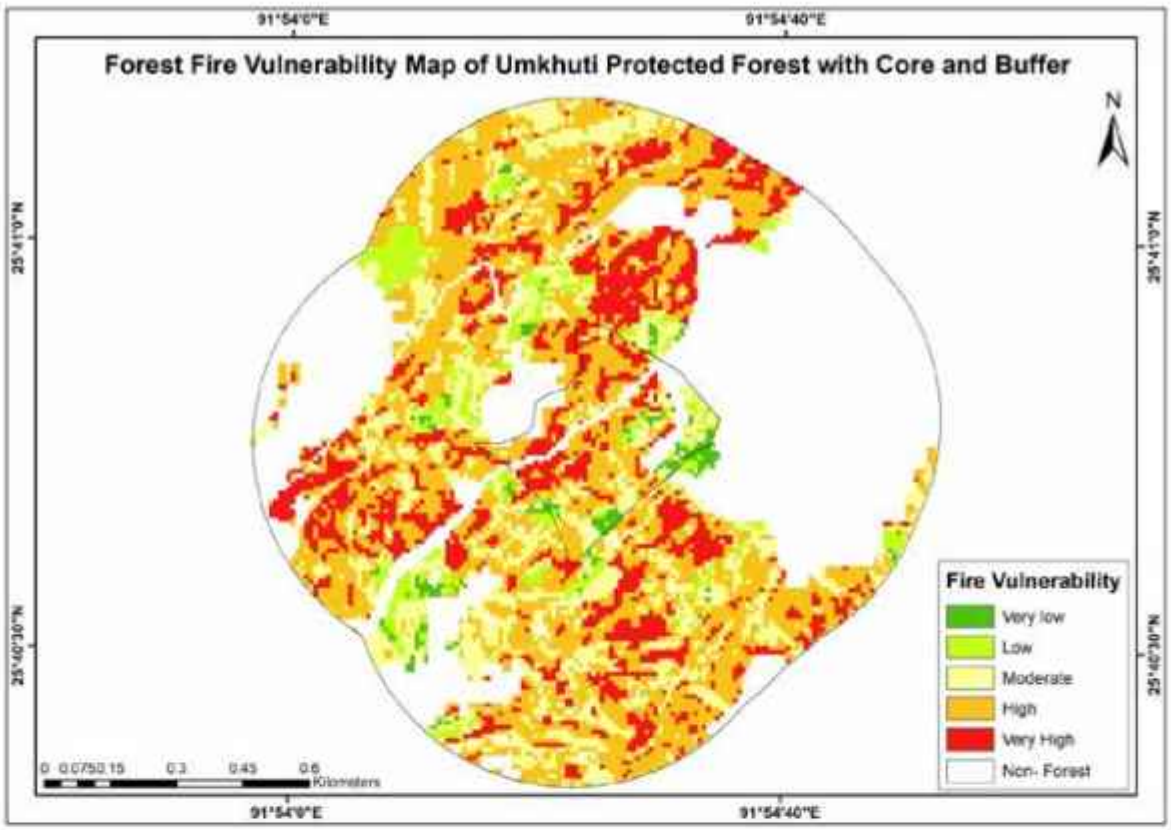


Figure 187. Forest Fire Vulnerability Map of Umkhuti Protected Forest

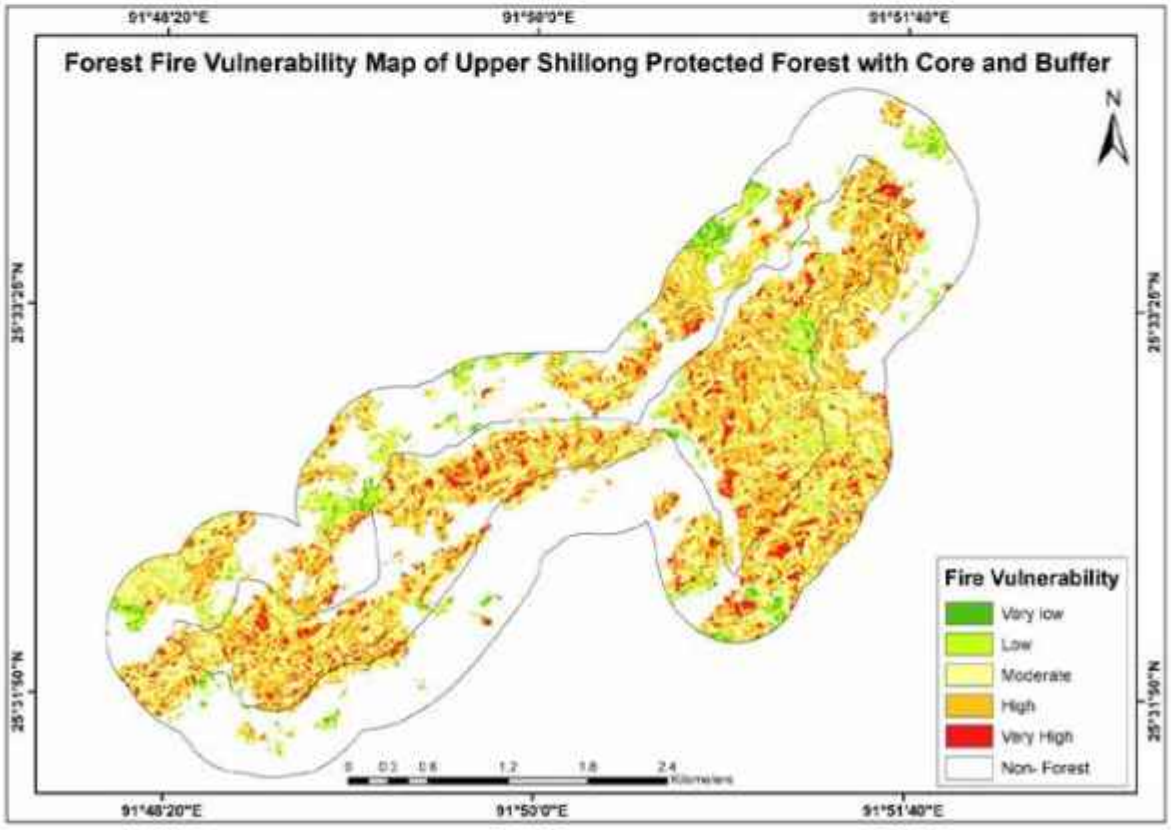


Figure 188. Forest Fire Vulnerability Map of Upper Shillong Protected Forest

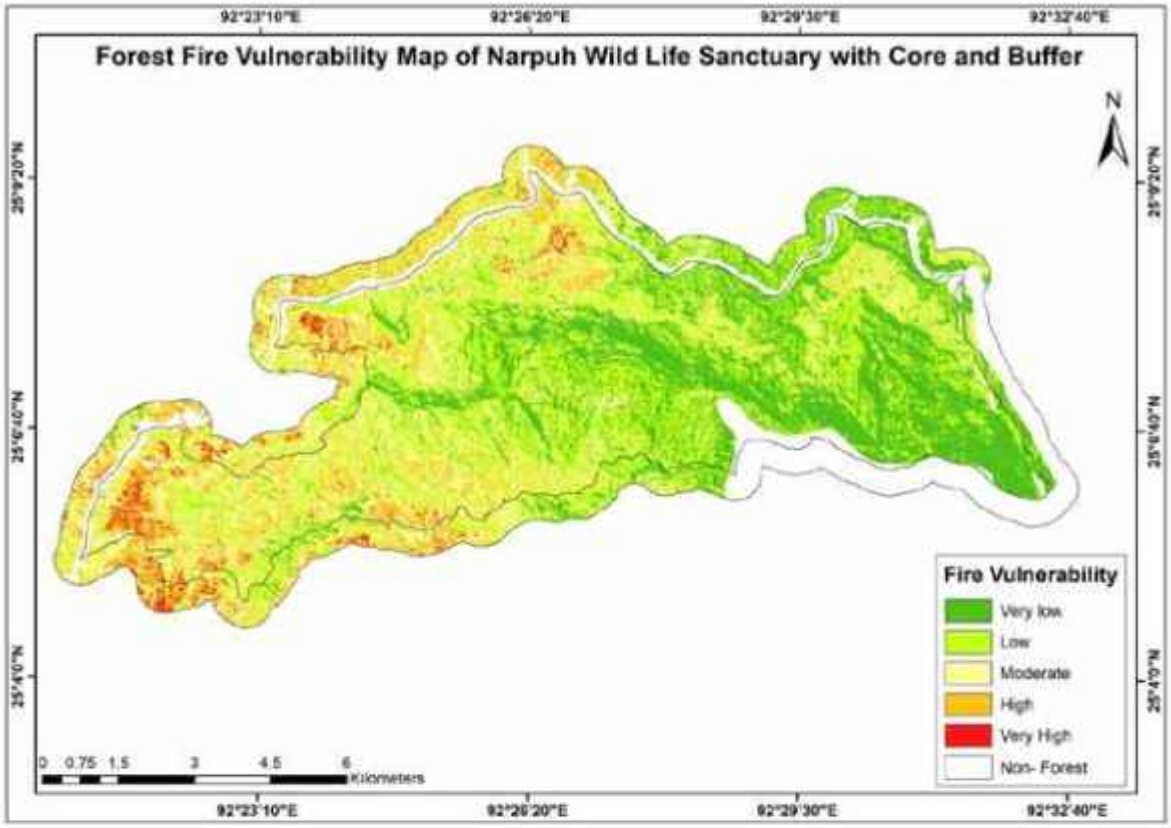


Figure 189. Forest Fire Vulnerability Map of Narpuh Wildlife Sanctuary

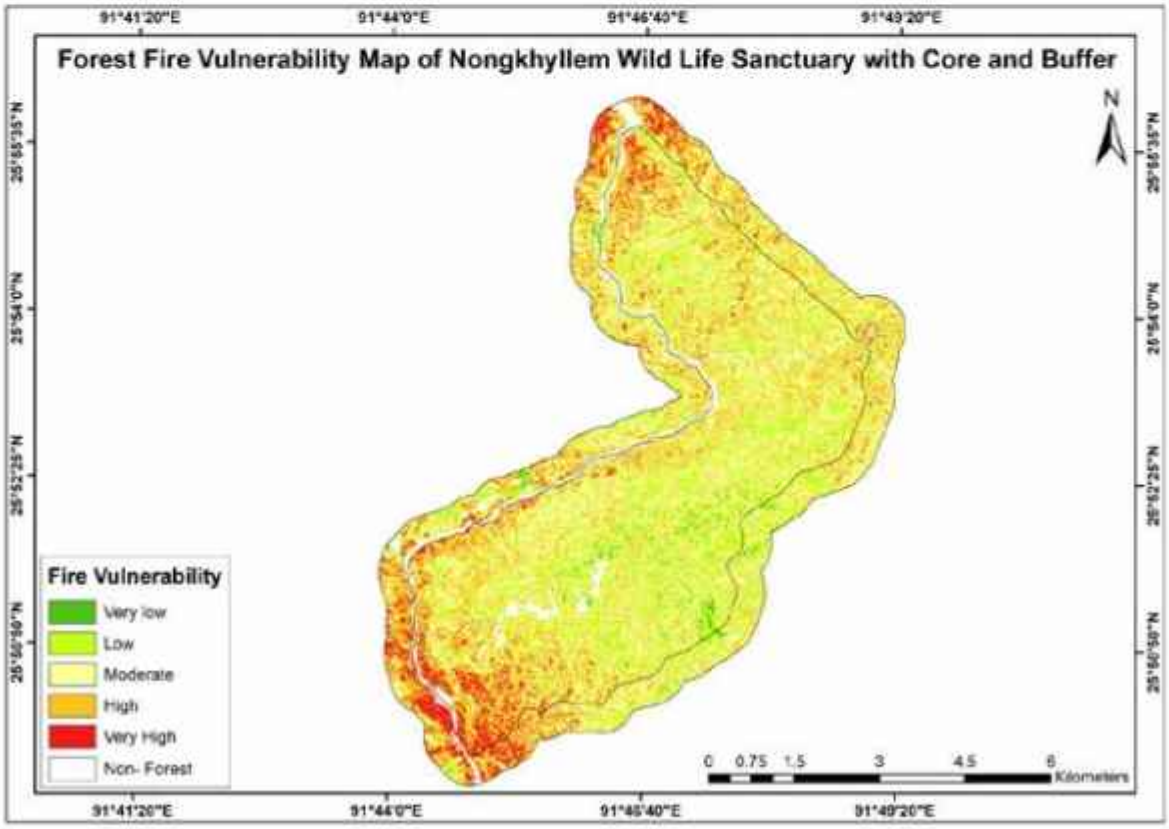


Figure 190. Forest Fire Vulnerability Map of Nongkhyllem Wildlife Sanctuary

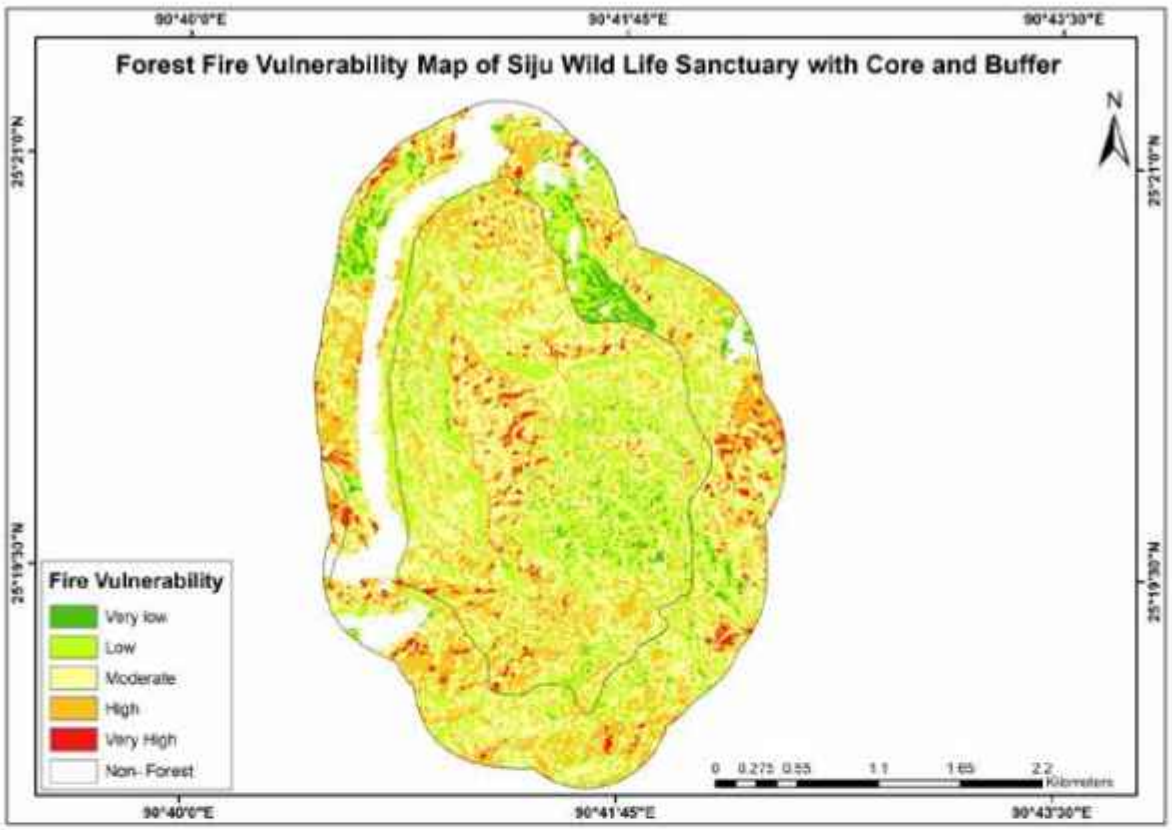


Figure 191. Forest Fire Vulnerability Map of Siju Wildlife Sanctuary

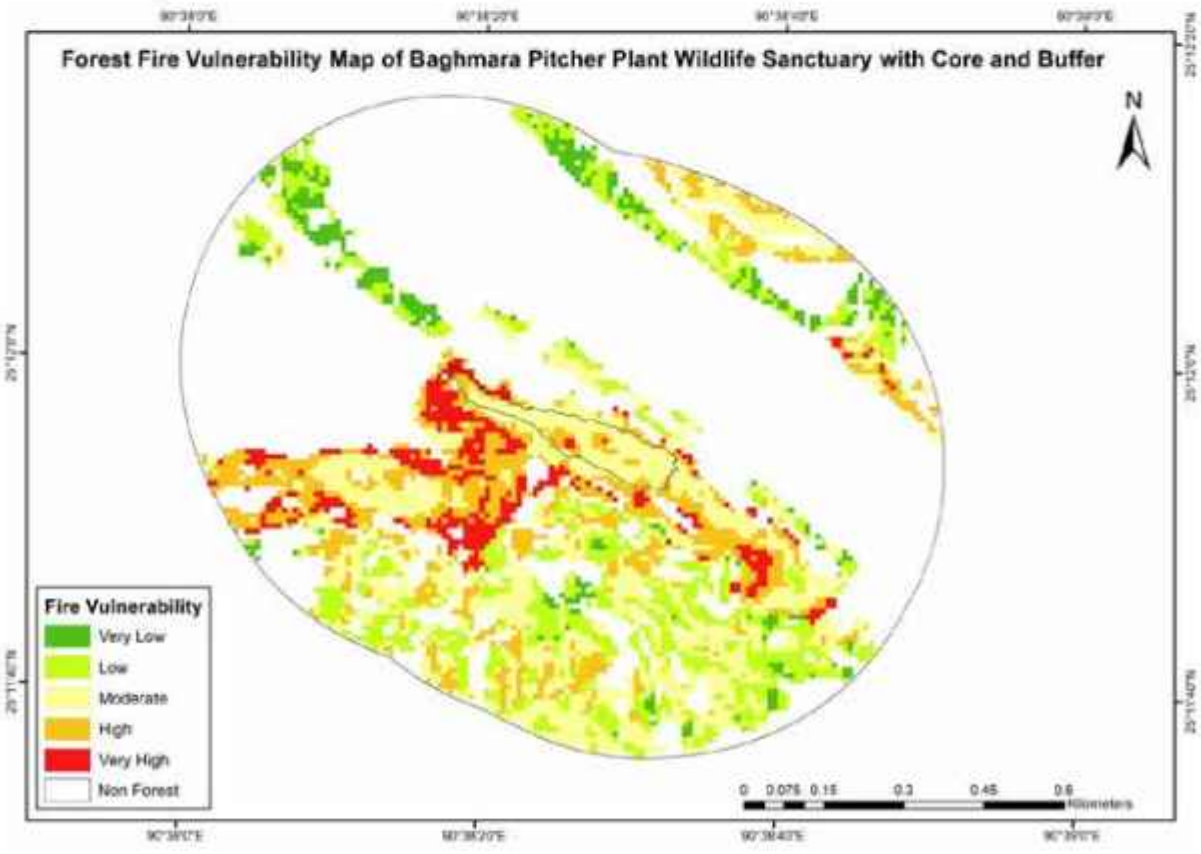


Figure 192. Forest Fire Vulnerability Map of Baghmara Pitcher Plant Wildlife Sanctuary

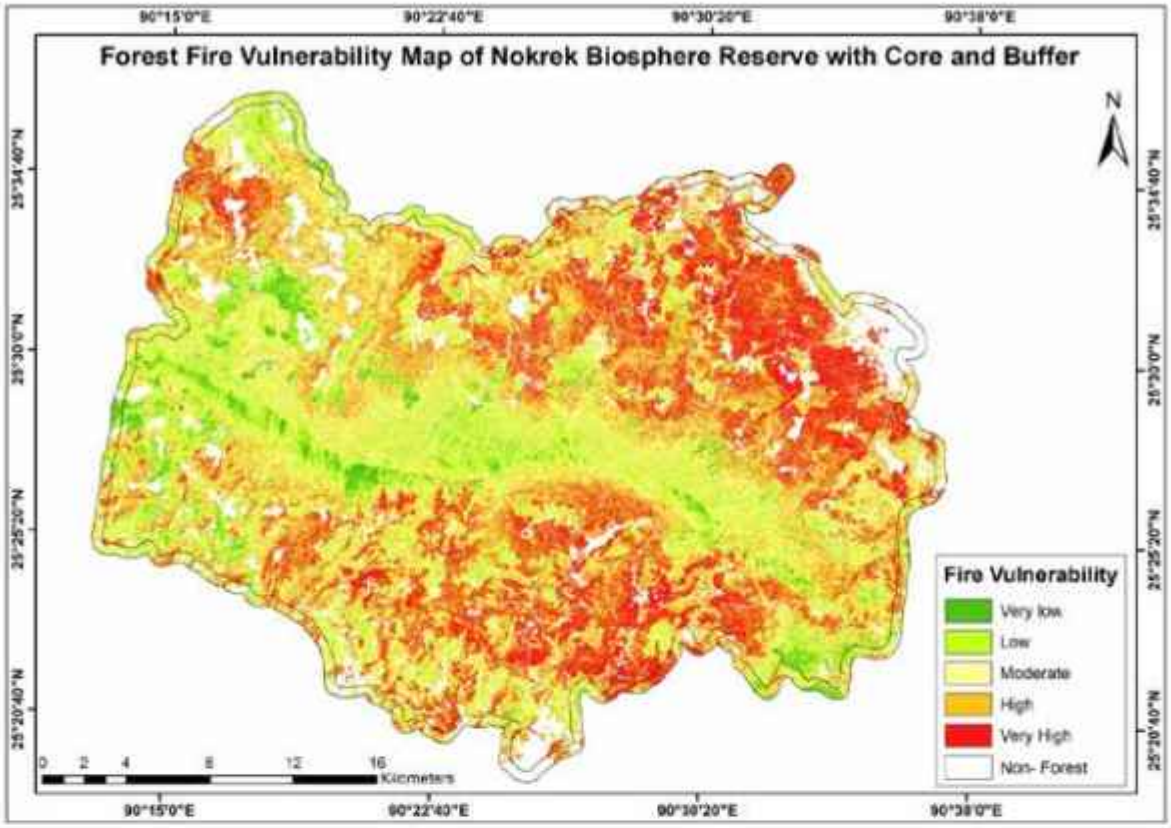


Figure 193. Forest Fire Vulnerability Map of Nokrek Biosphere Reserve

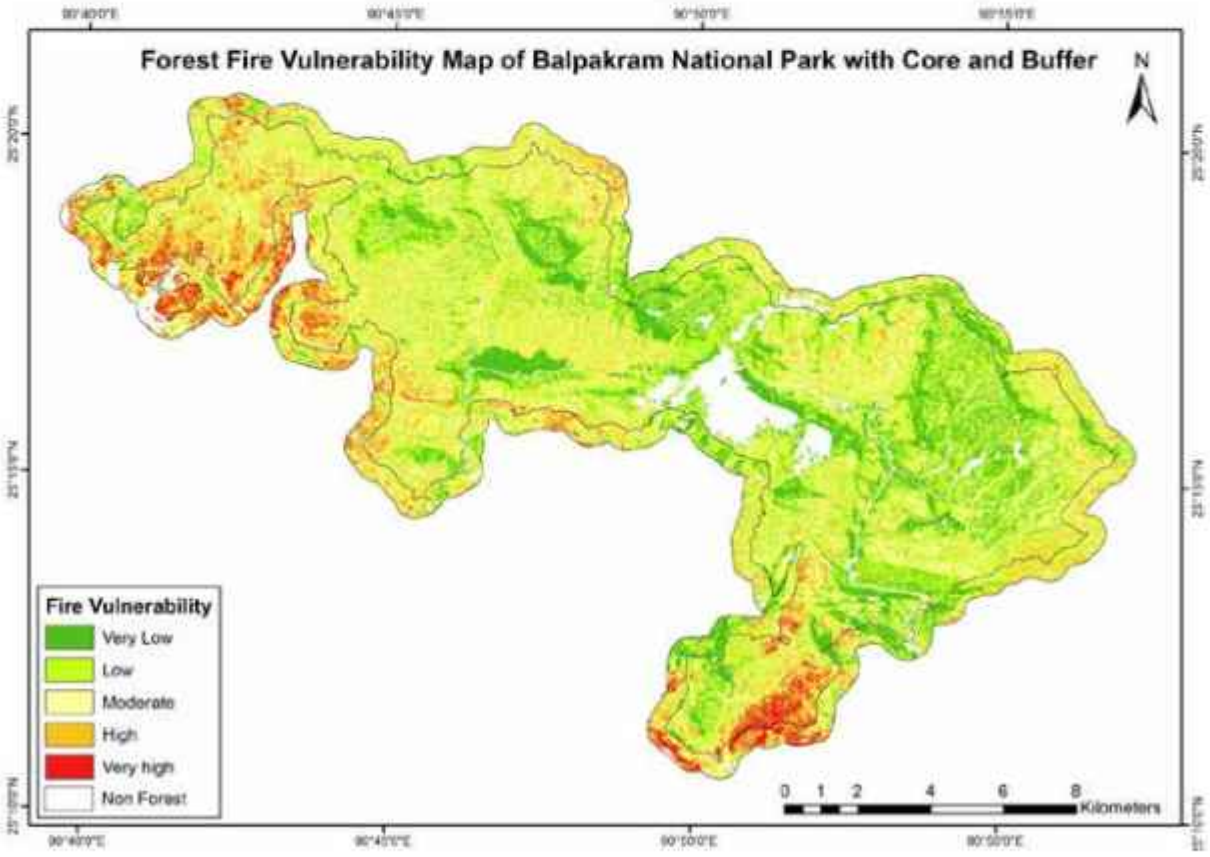


Figure 194. Forest Fire Vulnerability Map of Balpakram National Park

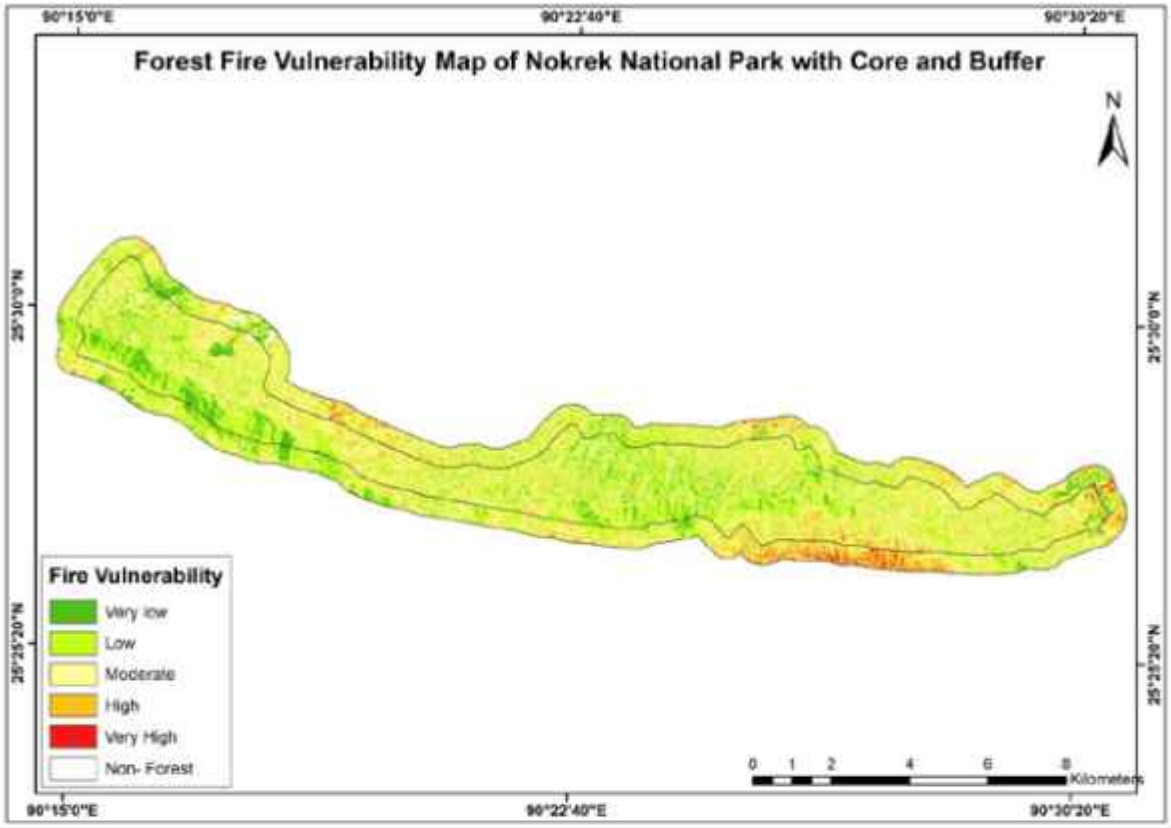


Figure 195. Forest Fire Vulnerability Map of Nokrek National Park

Forest Fire Prone Map of Reserve Forest – Protected Forest – Wildlife Sanctuary – National Park-Biosphere Reserve of Meghalaya State

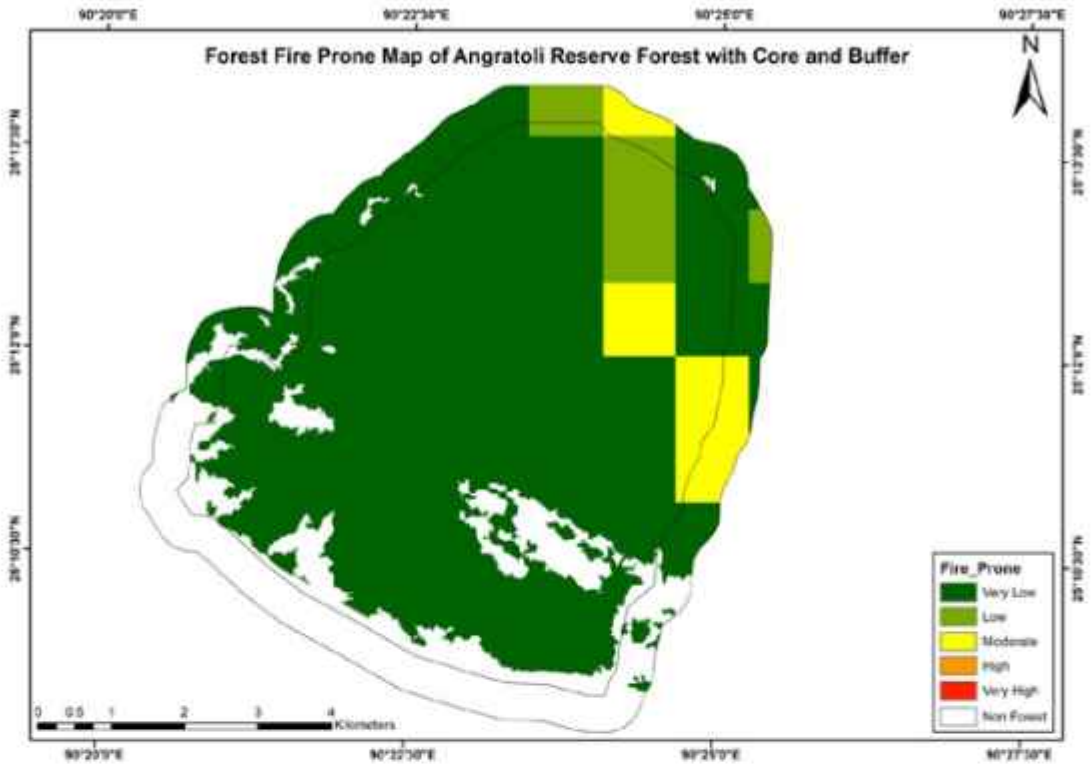


Figure 196. Forest Fire Prone Map of Angratoli Resrve Forest

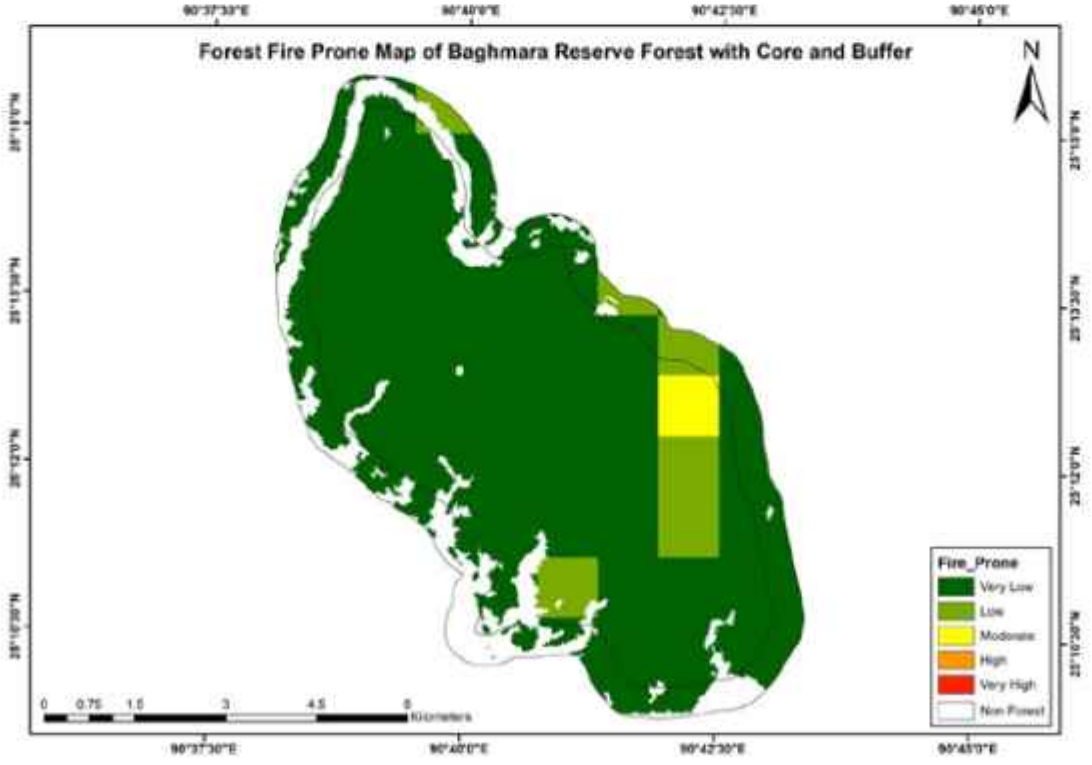


Figure 197. Forest Fire Prone Map of Baghmara Reserve Forest

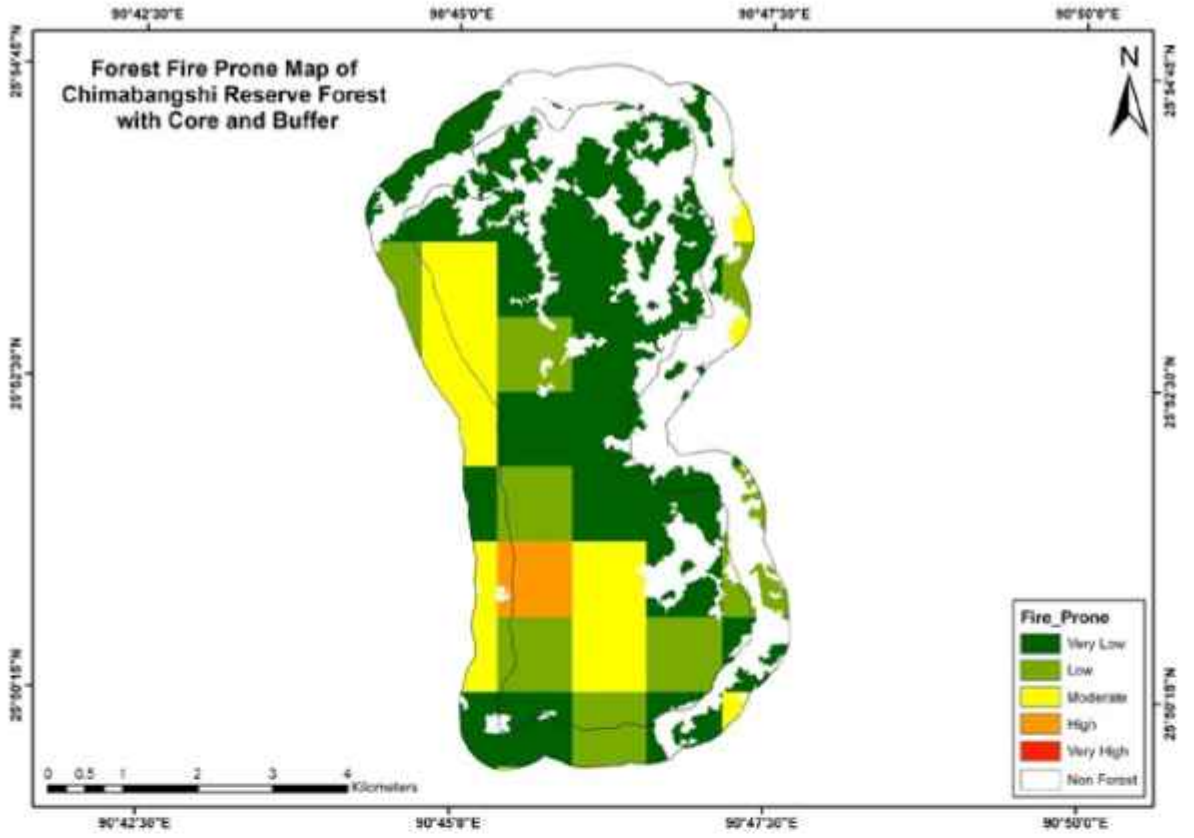


Figure 198. Forest Fire Prone Map of Chimabangshi Reserve Forest

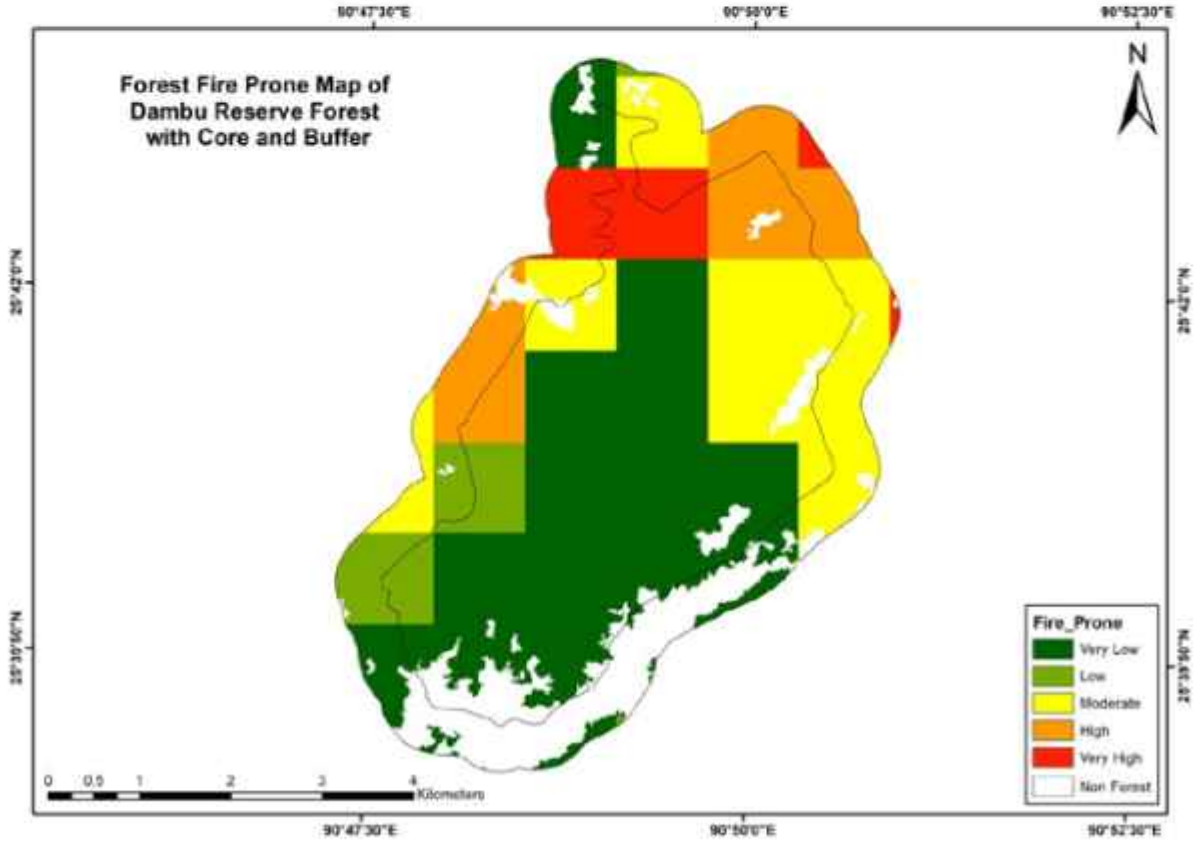


Figure 199. Forest Fire Prone Map of Dambu Reserve Forest

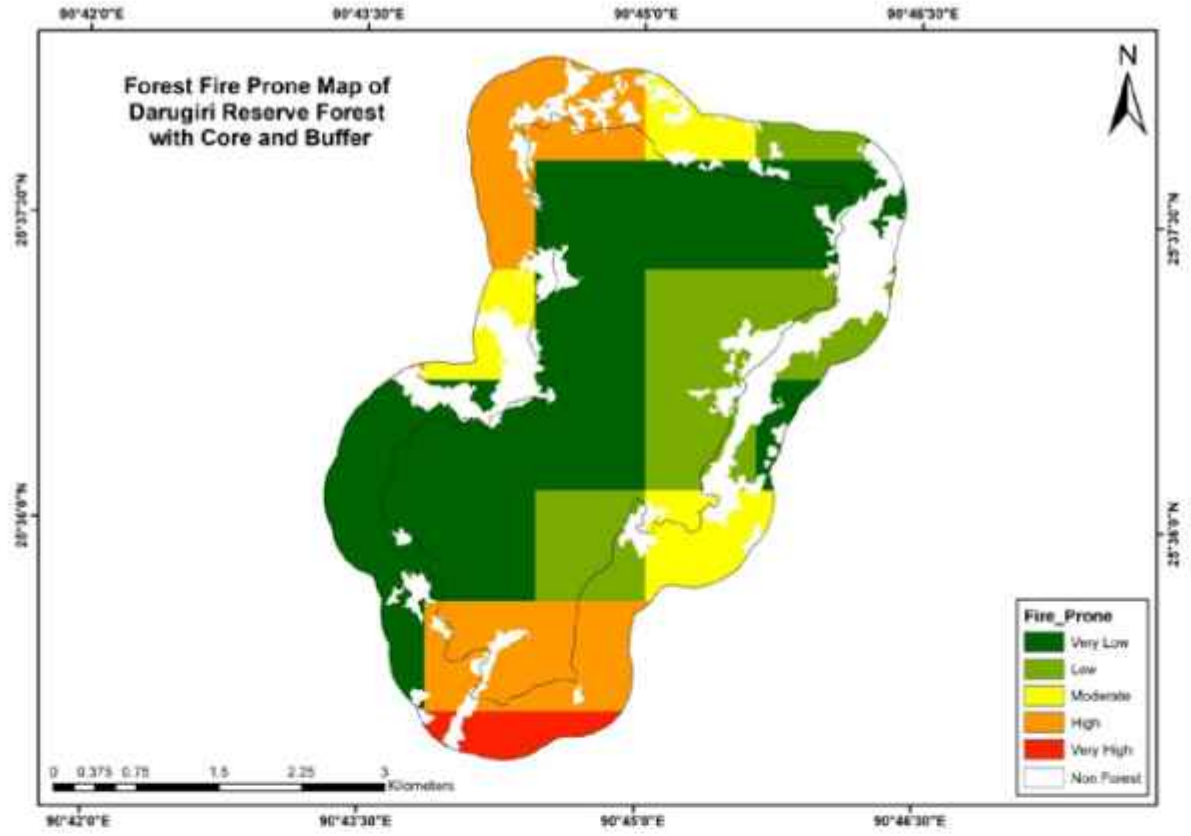


Figure 200. Forest Fire Prone Map of Darugiri Reserve Forest

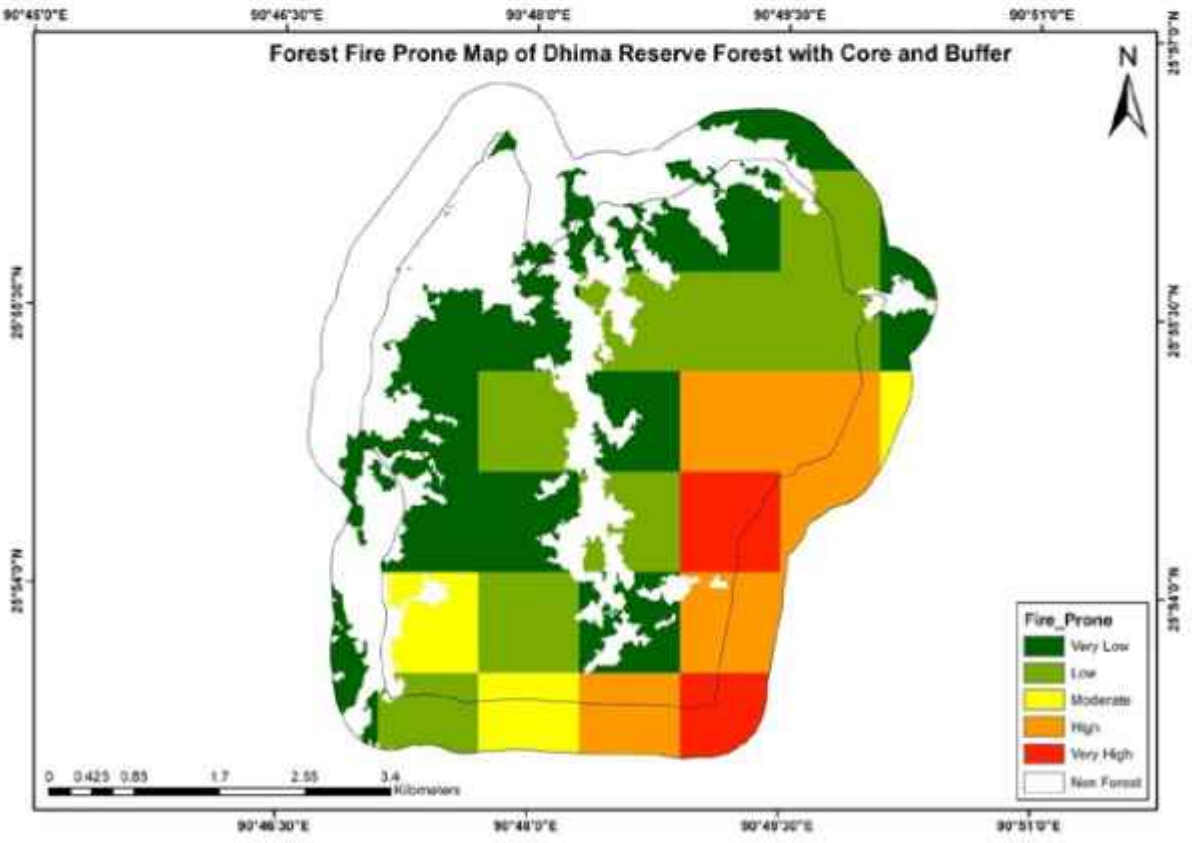


Figure 201. Forest Fire Prone Map of Dhima Reserve Forest

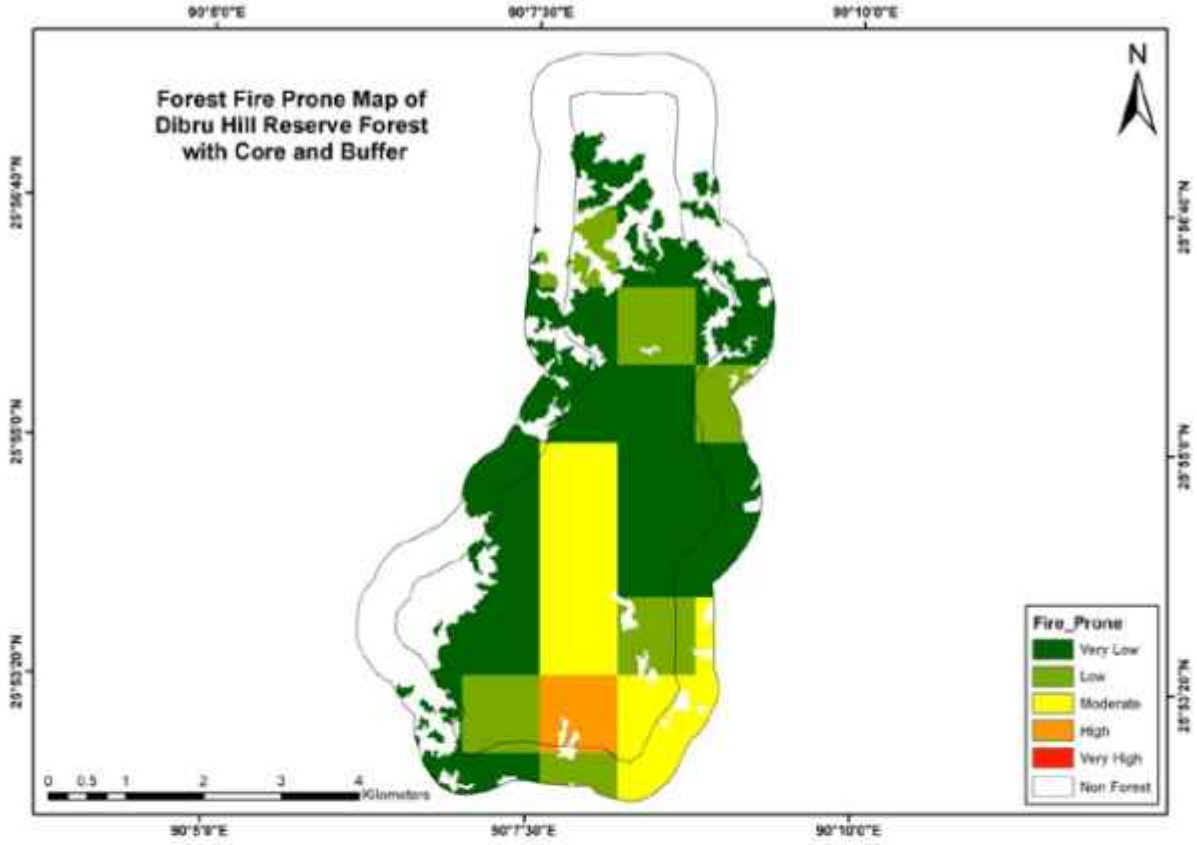


Figure 202. Forest Fire Prone Map of Dibru Hill Reserve Forest

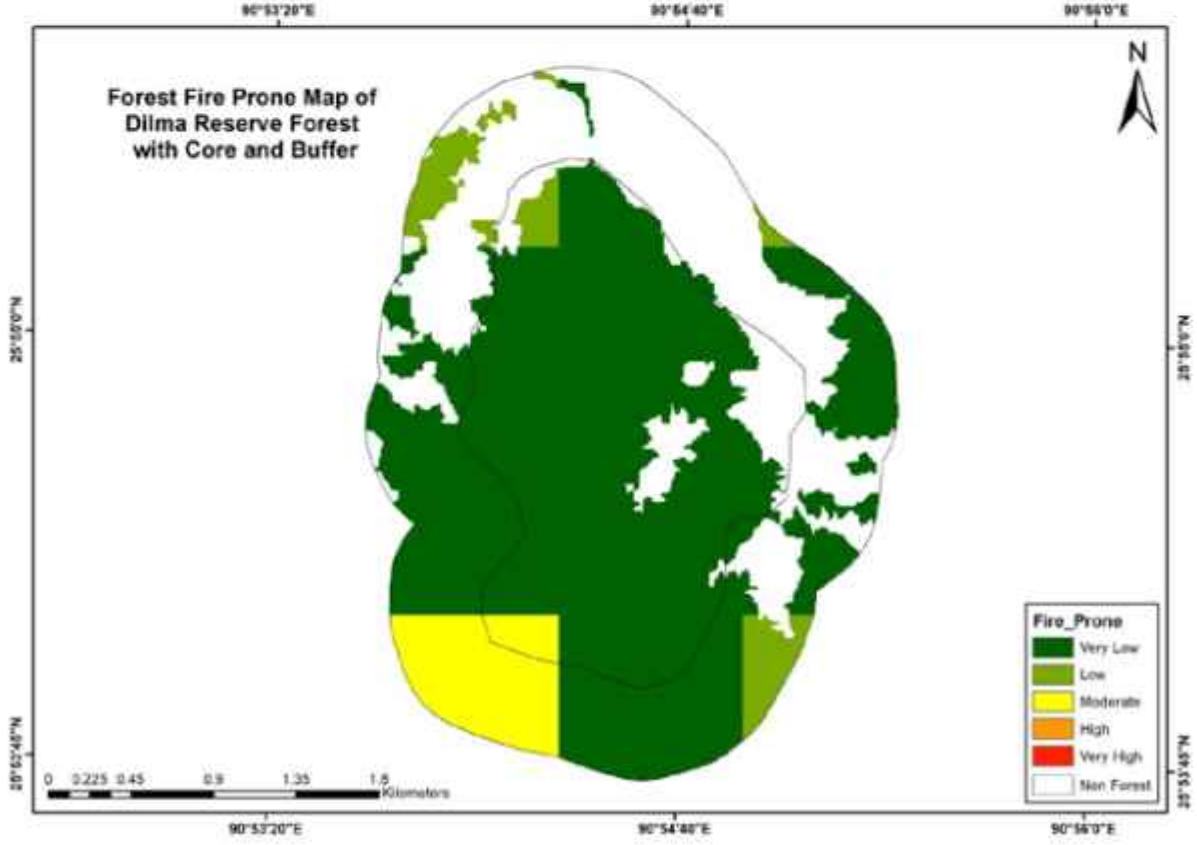


Figure 203. Forest Fire Prone Map of Dilma Reserve Forest

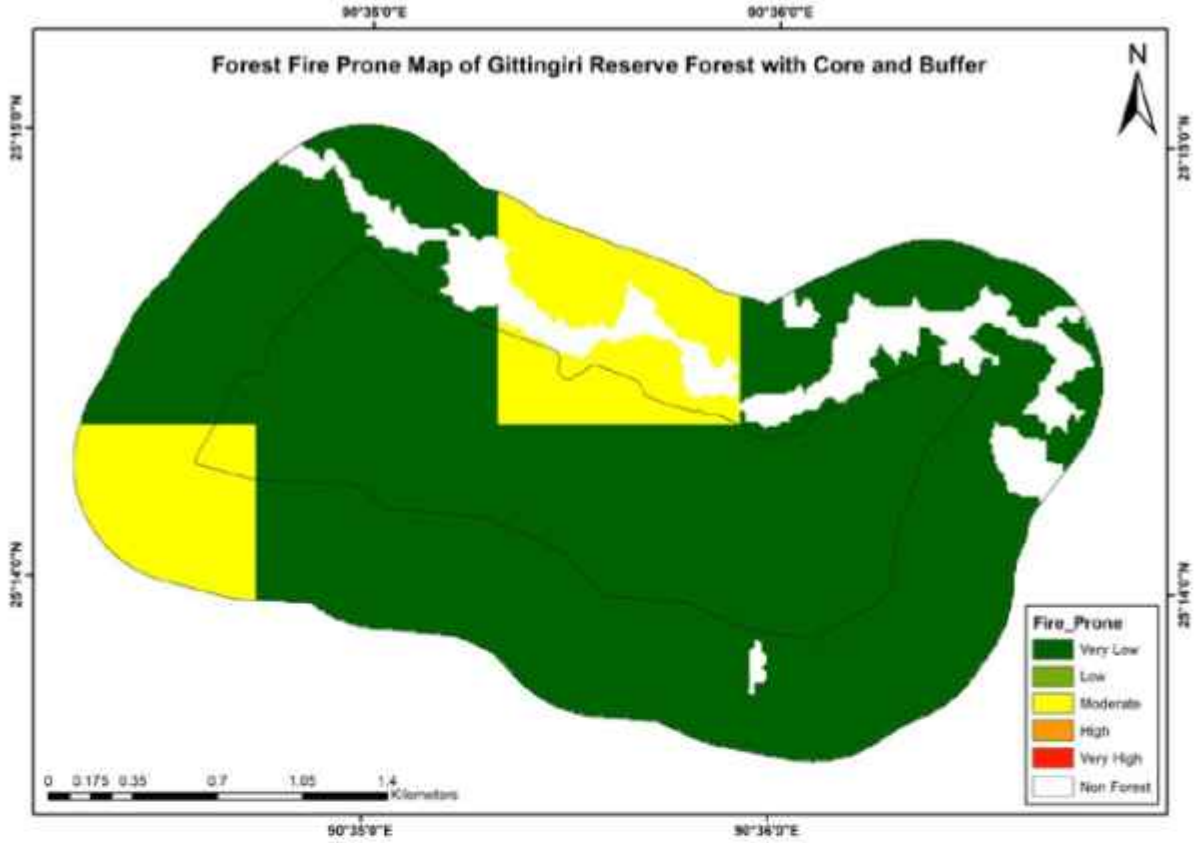


Figure 204. Forest Fire Prone Map of Gittingiri Reserve Forest

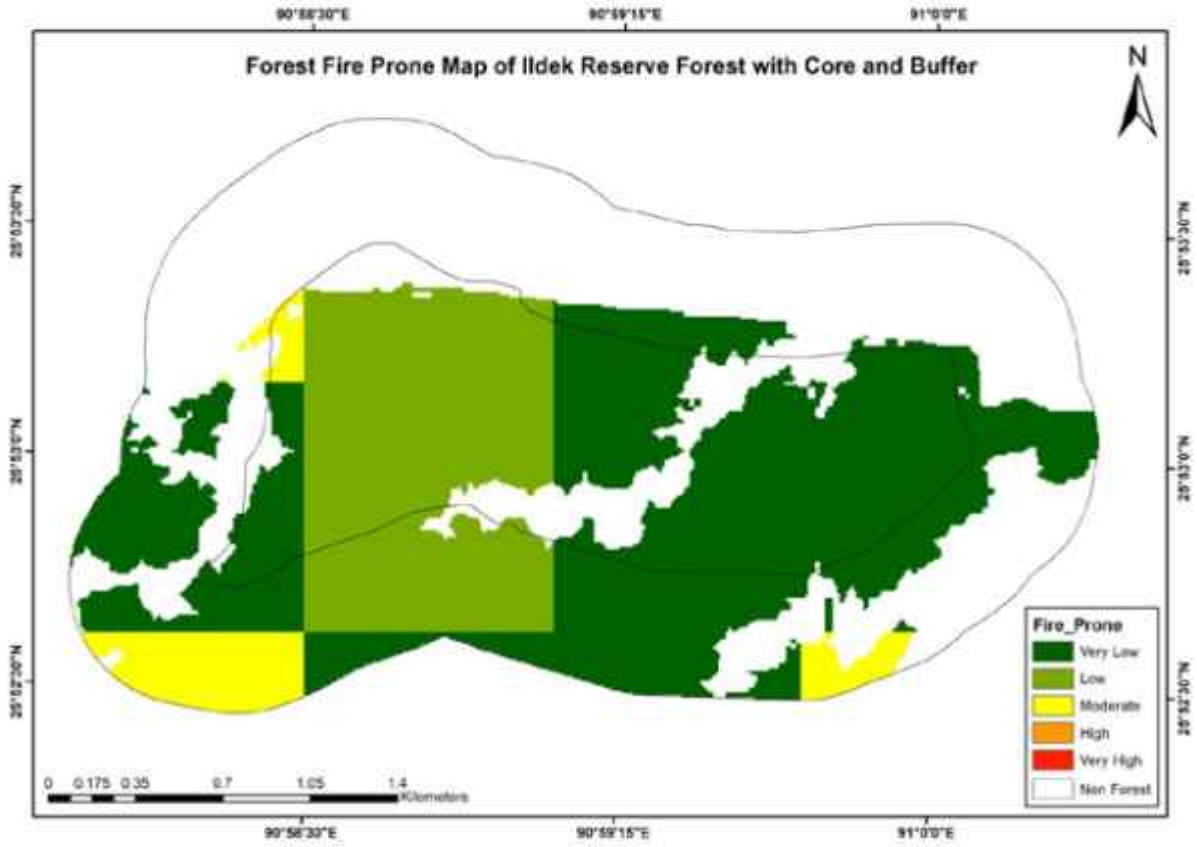


Figure 205. Forest Fire Prone Map of Ildek Reserve Forest

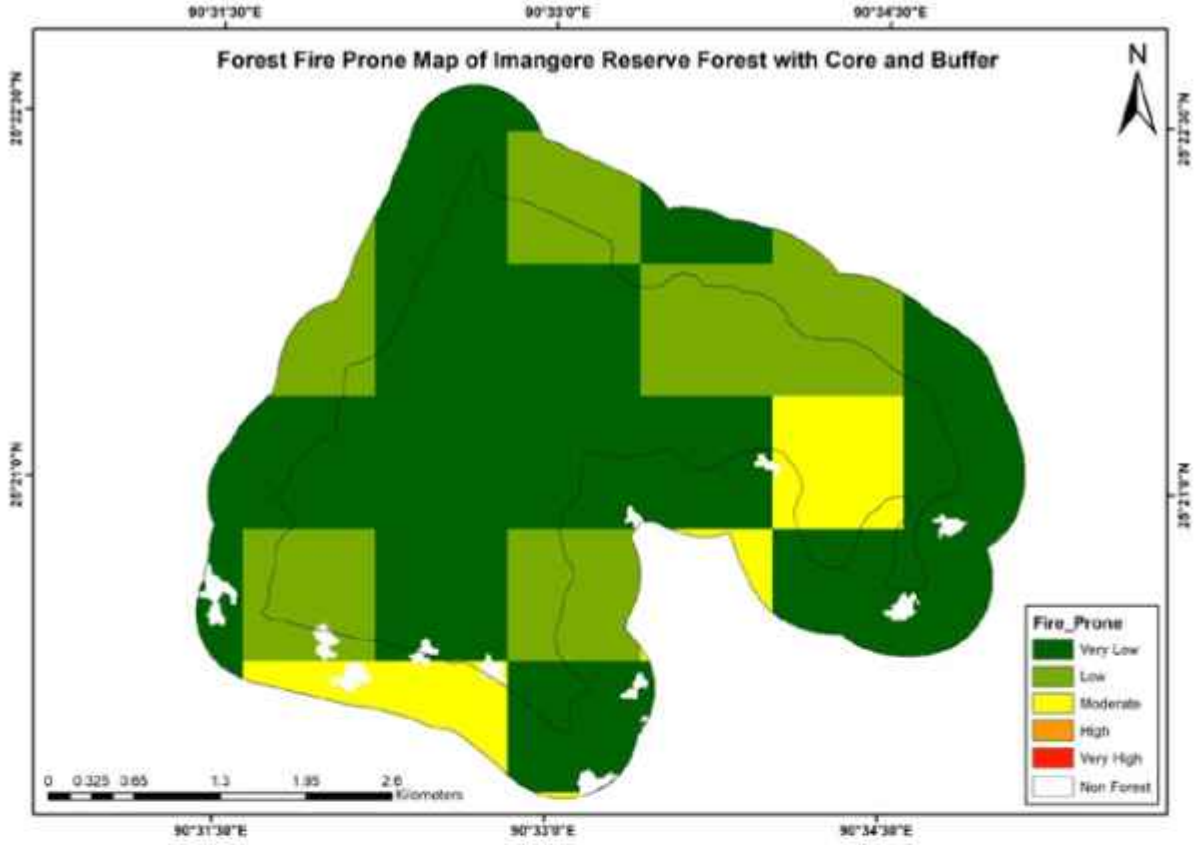


Figure 206. Forest Fire Prone Map of Imangere Reserve Forest

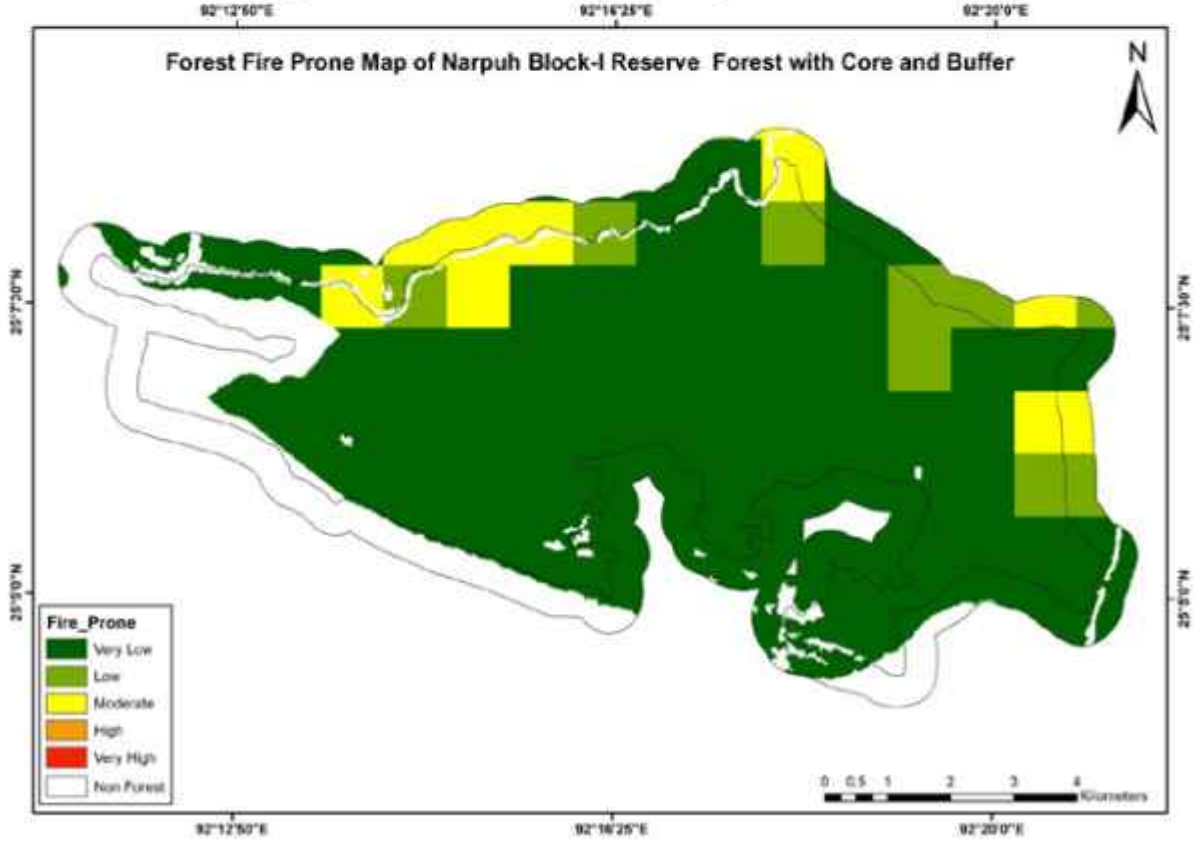


Figure 207. Forest Fire Prone Map of Narpuh Block-I Reserve Forest

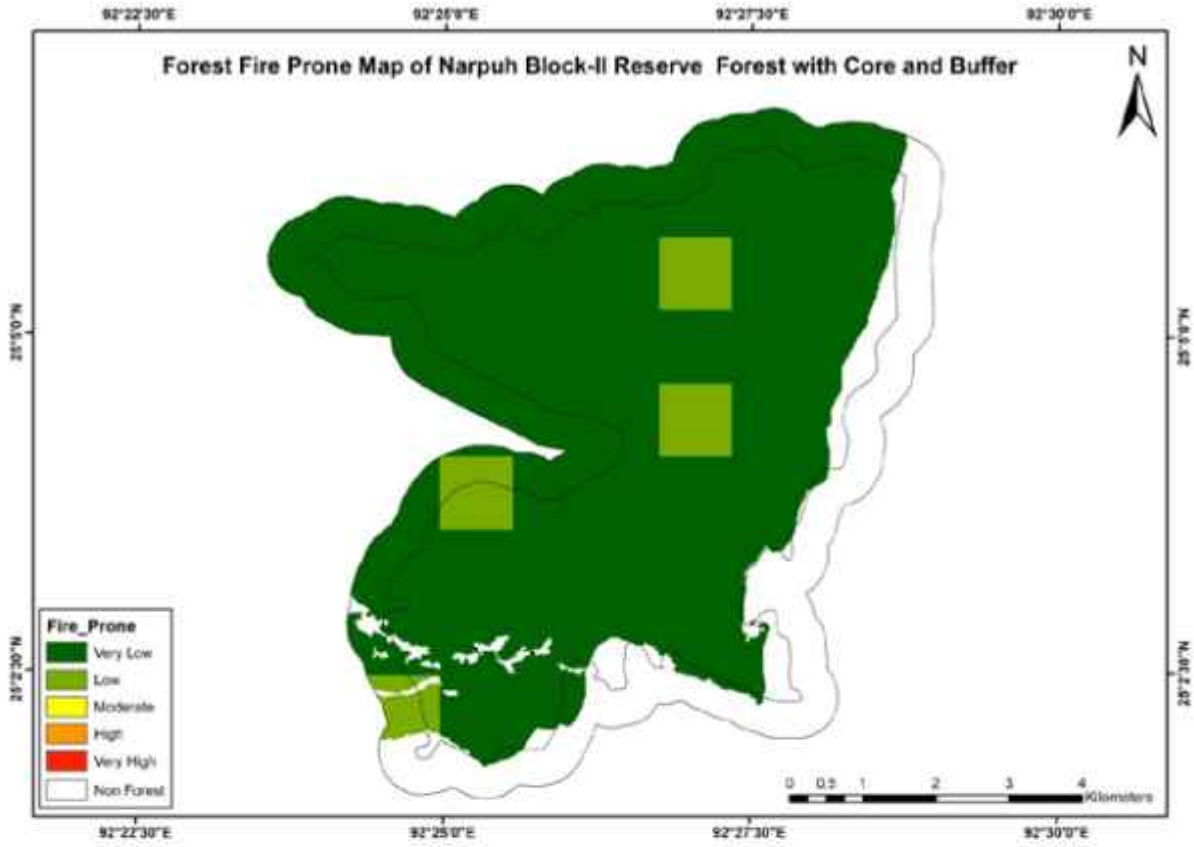


Figure 208. Forest Fire Prone Map of Narpuh Block-II Reserve Forest

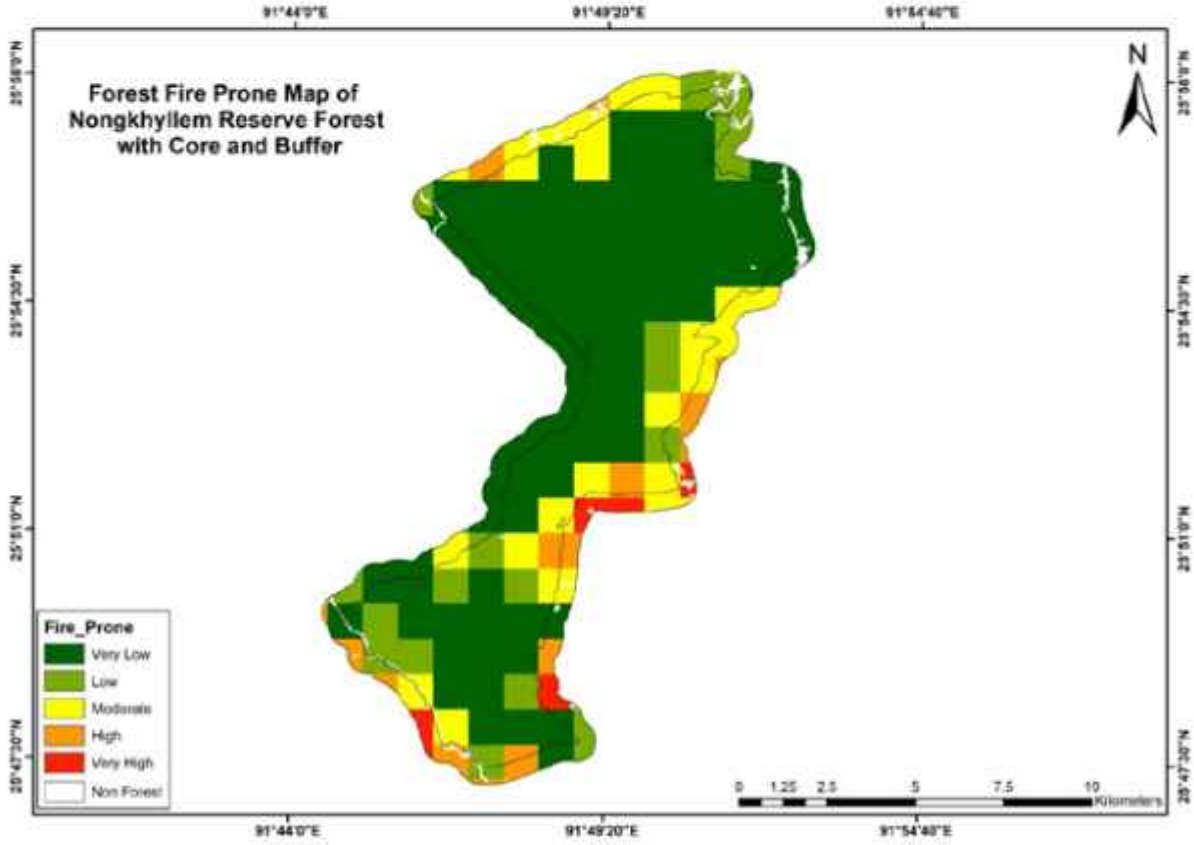


Figure 209. Forest Fire Prone Map of Nongkhyllem Reserve Forest

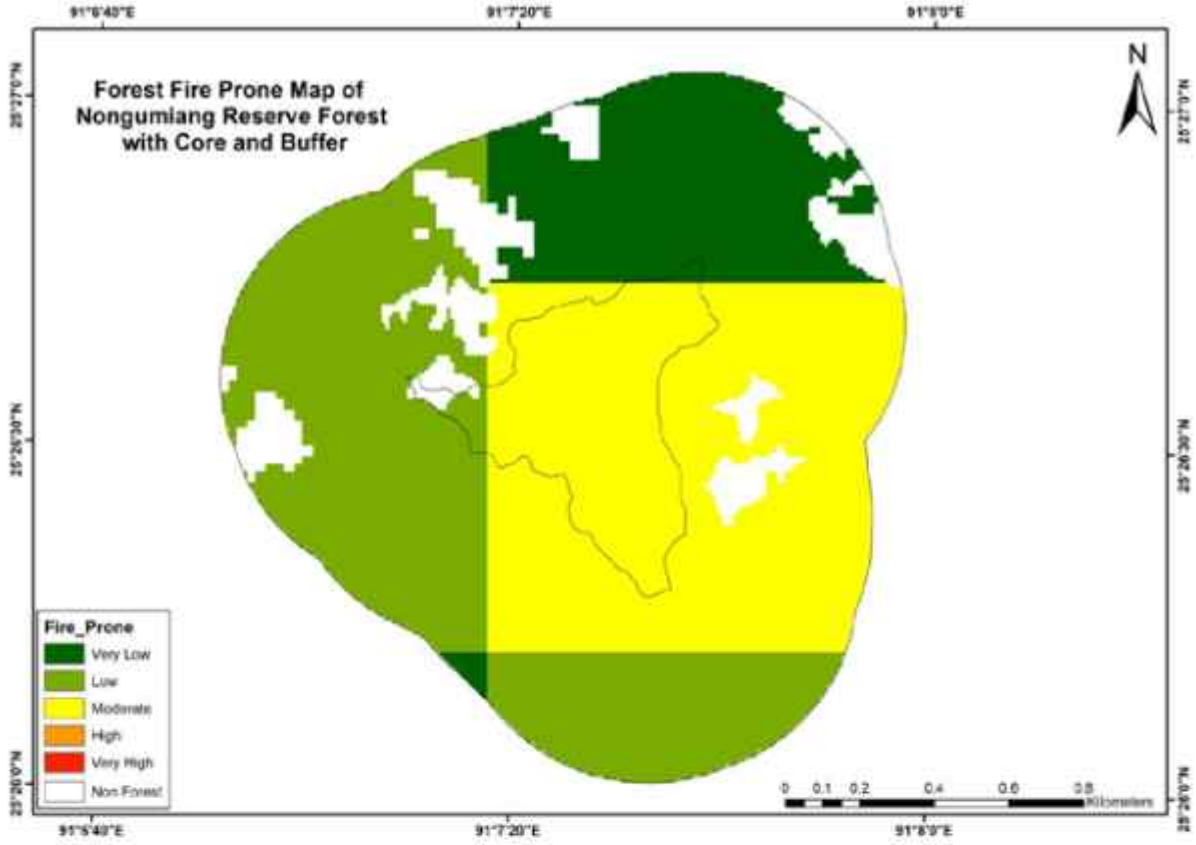


Figure 210. Forest Fire Prone Map of Nongumiang Reserve Forest

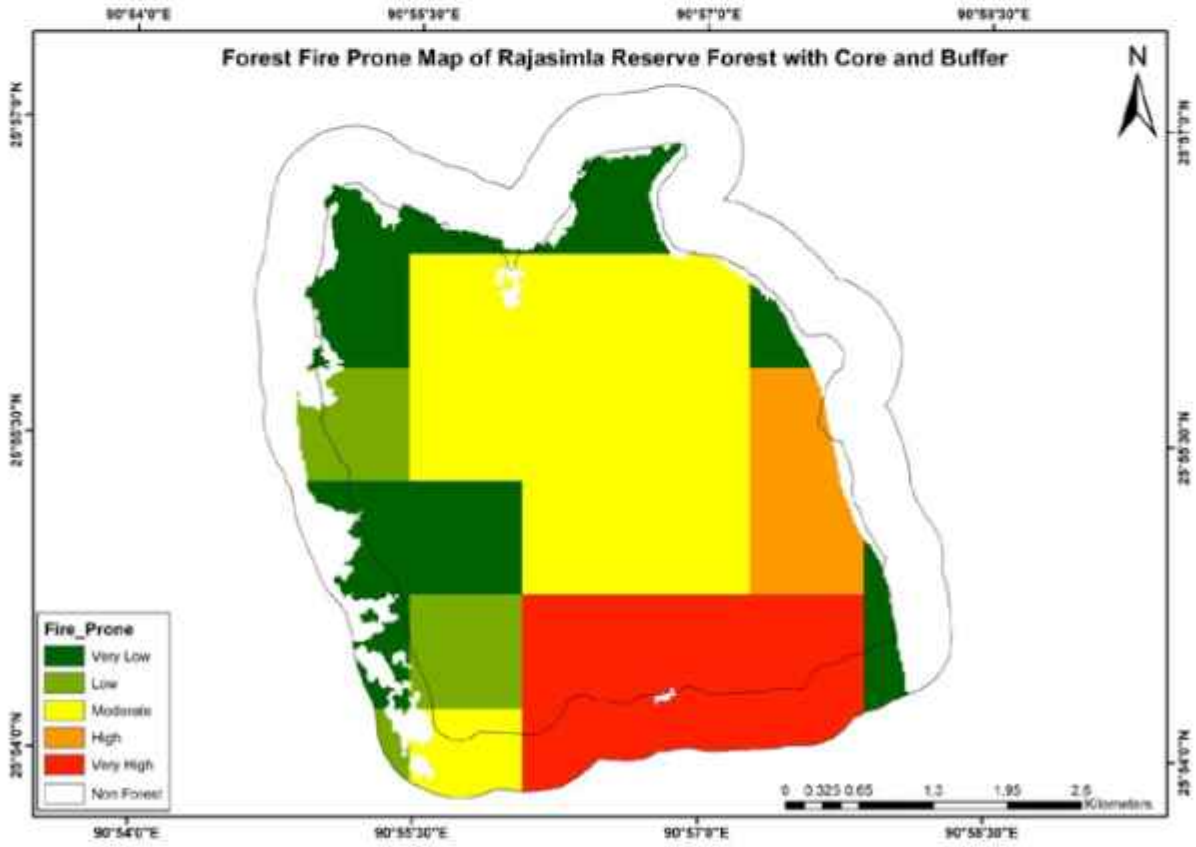


Figure 211. Forest Fire Prone Map of Rajasimla Reserve Forest

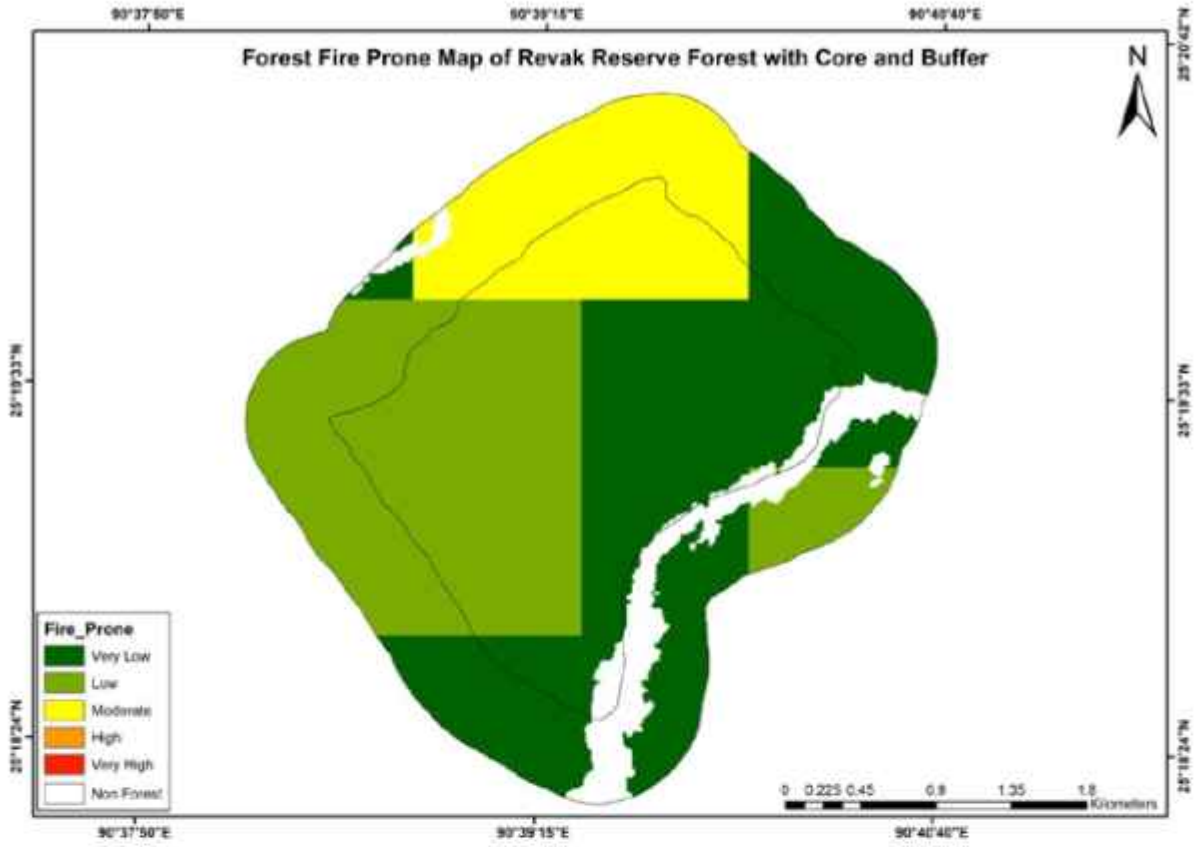


Figure 212. Forest Fire Prone Map of Revak Reserve Forest

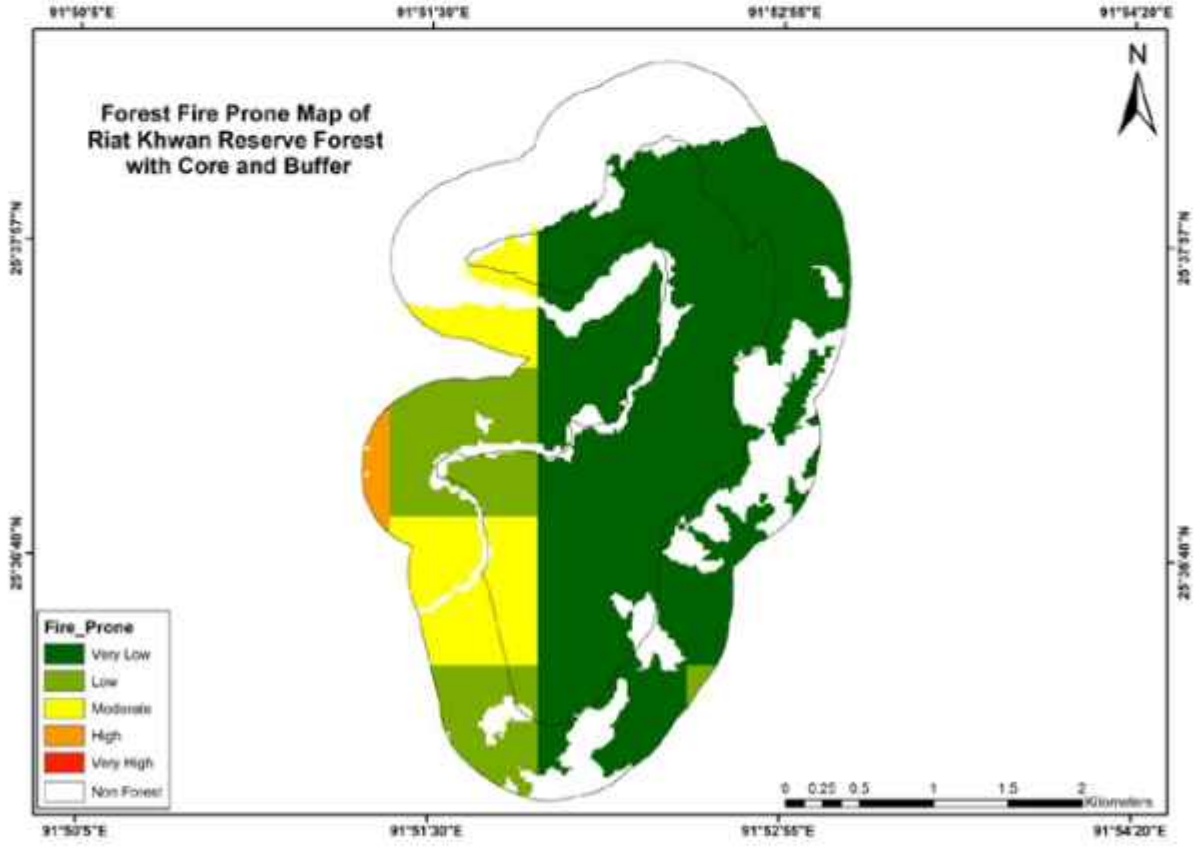


Figure 213. Forest Fire Prone Map of Riat Khwan Reserve Forest

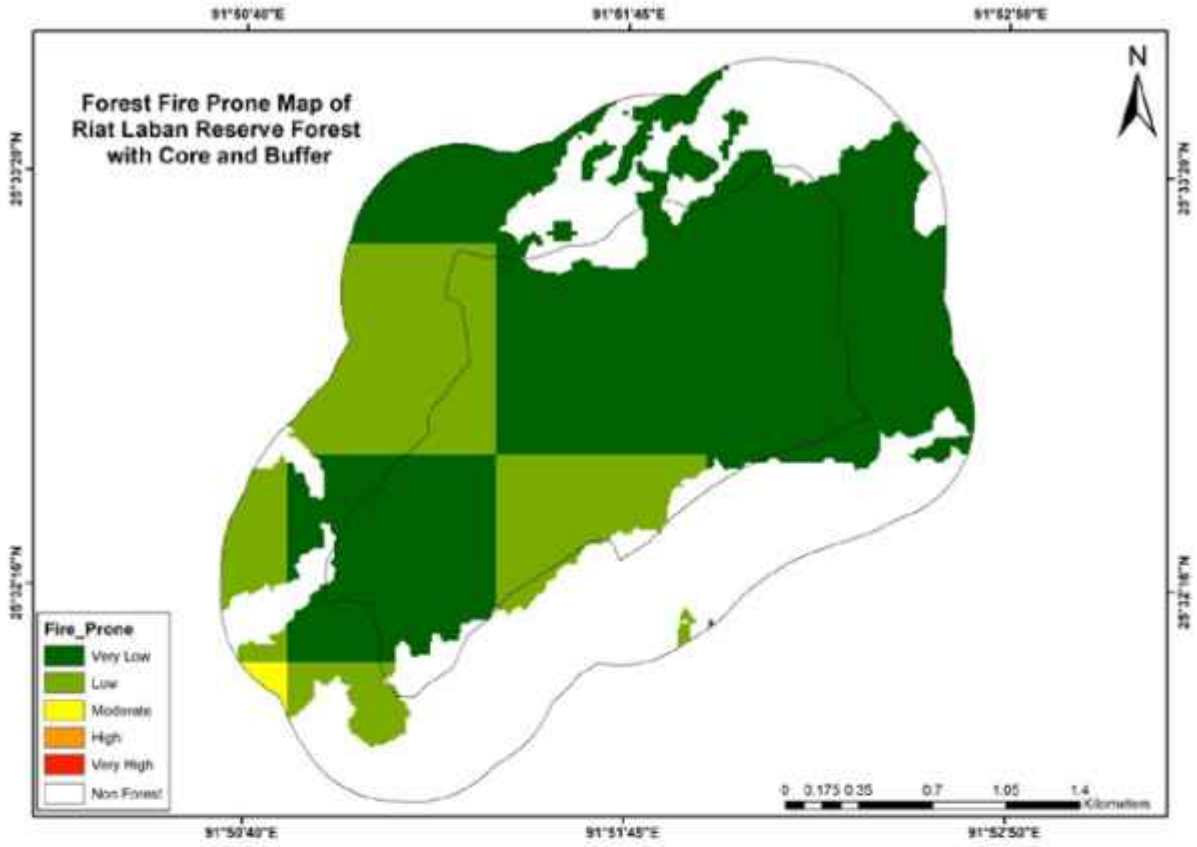


Figure 214. Forest Fire Prone Map of Riat Laban Reserve Forest

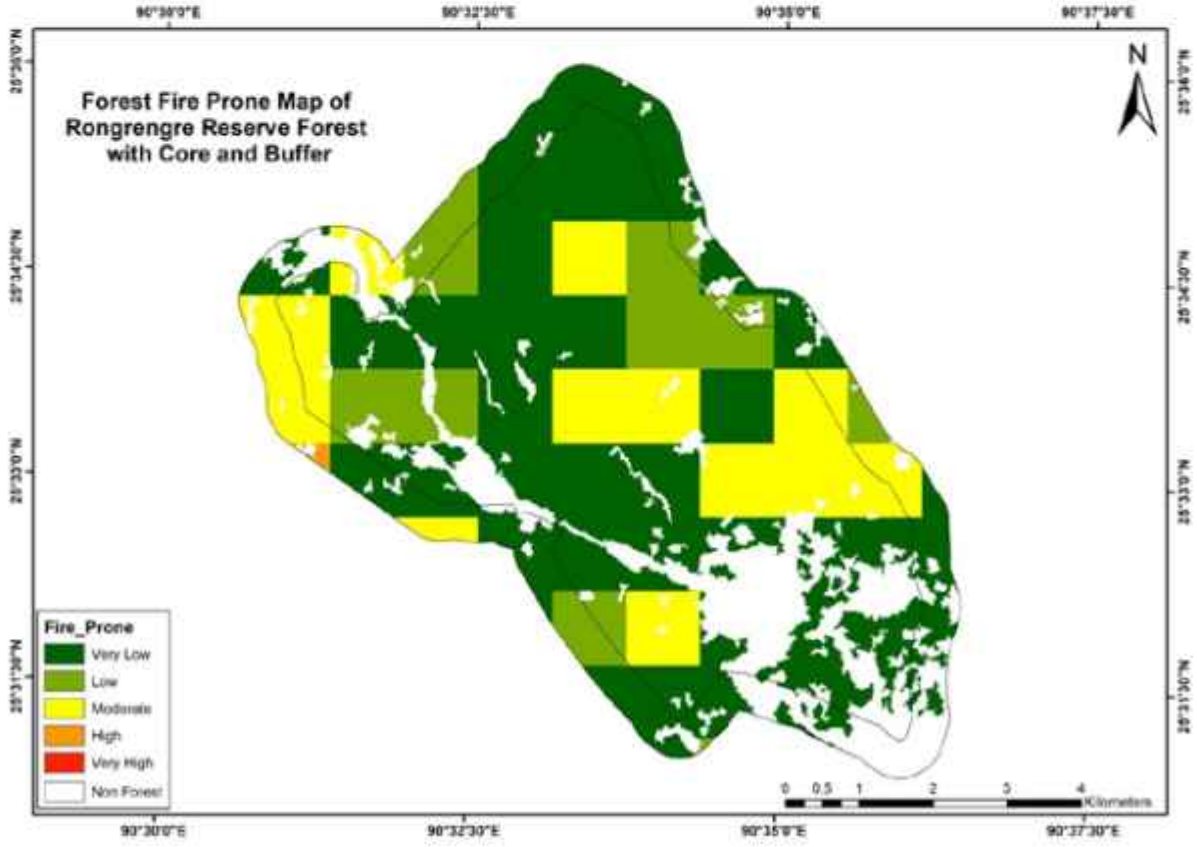


Figure 215. Forest Fire Prone Map of Rongrengre Reserve Forest

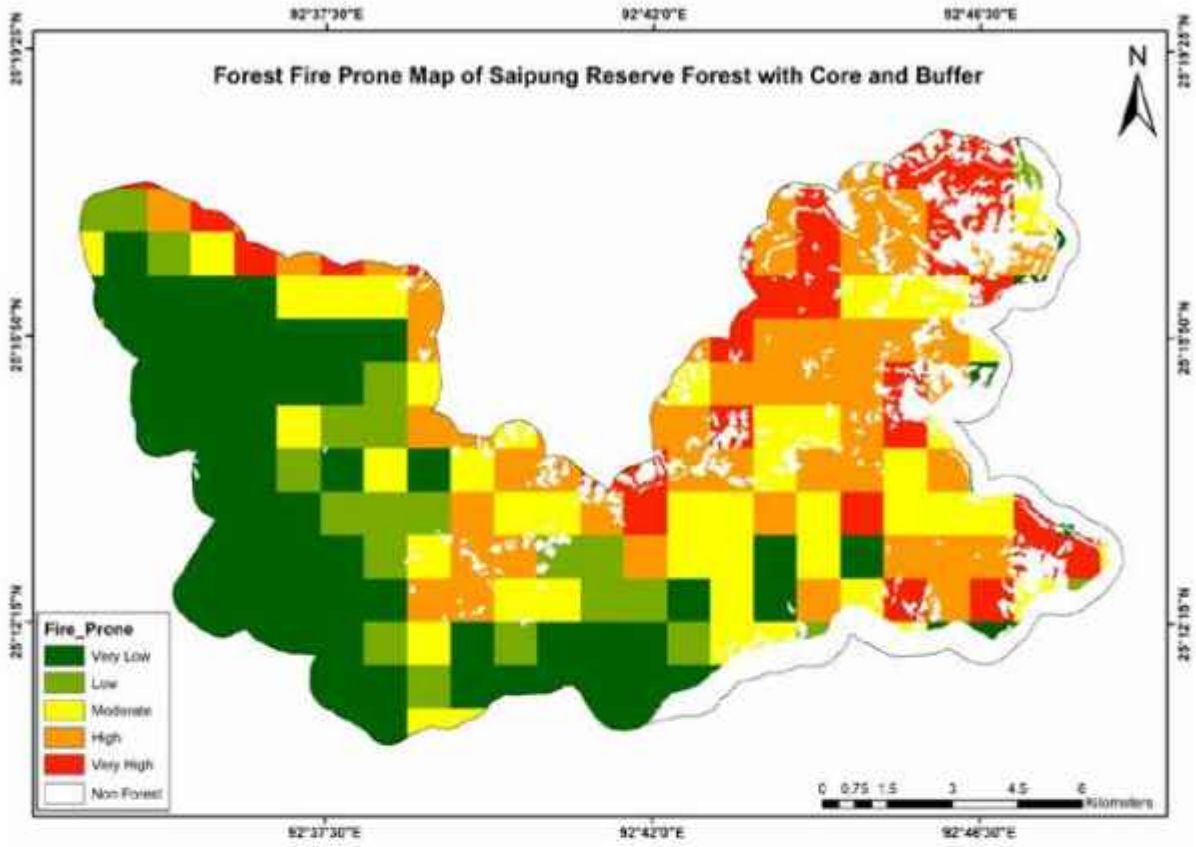


Figure 216. Forest Fire Prone Map of Saipung Reserve Forest

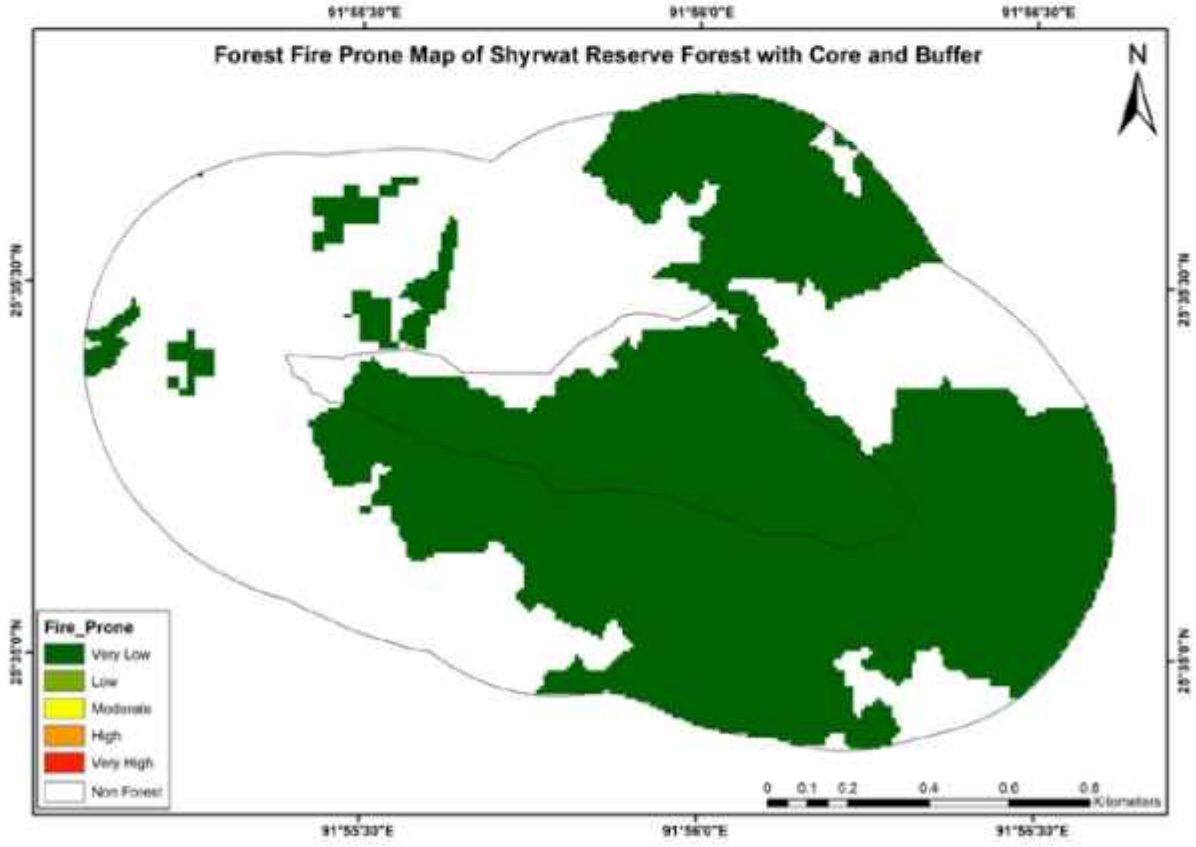


Figure 217. Forest Fire Prone Map of Shyrwat Reserve Forest

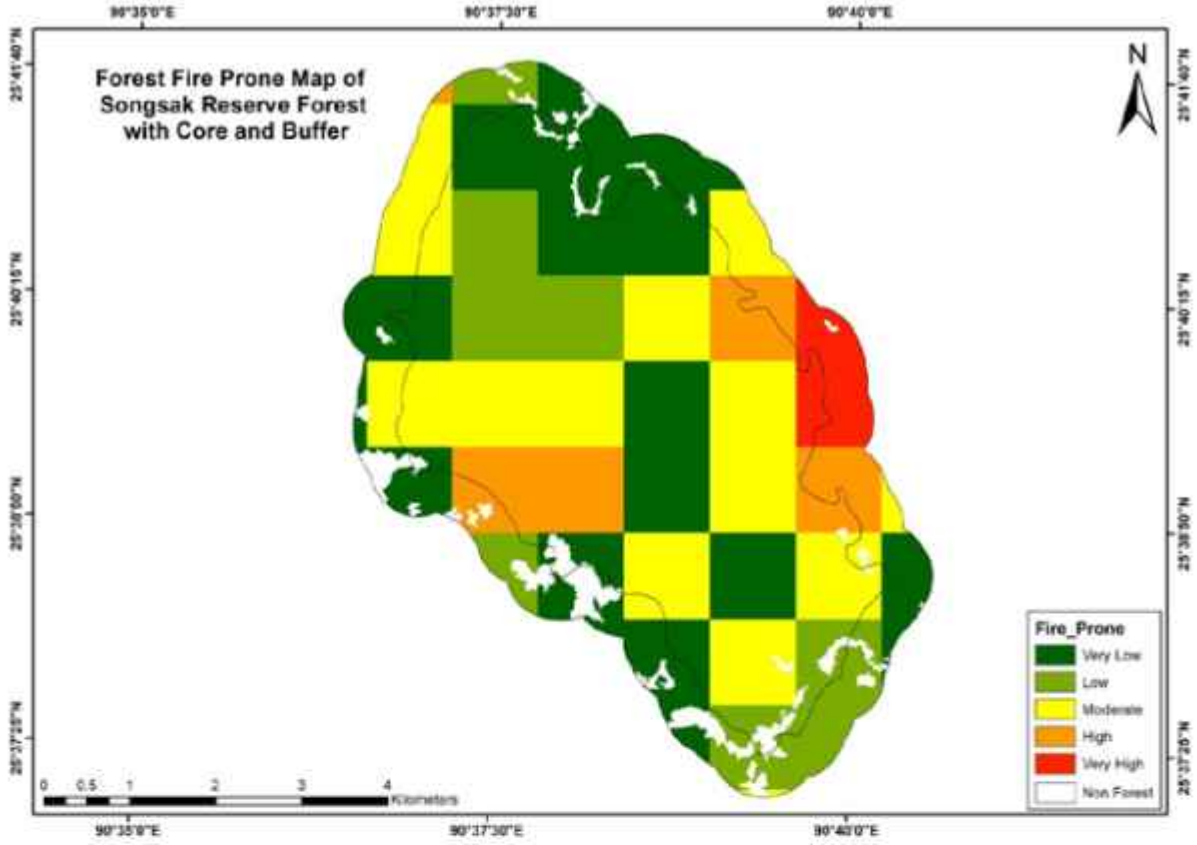


Figure 218. Forest Fire Prone Map of Songsak Reserve Forest

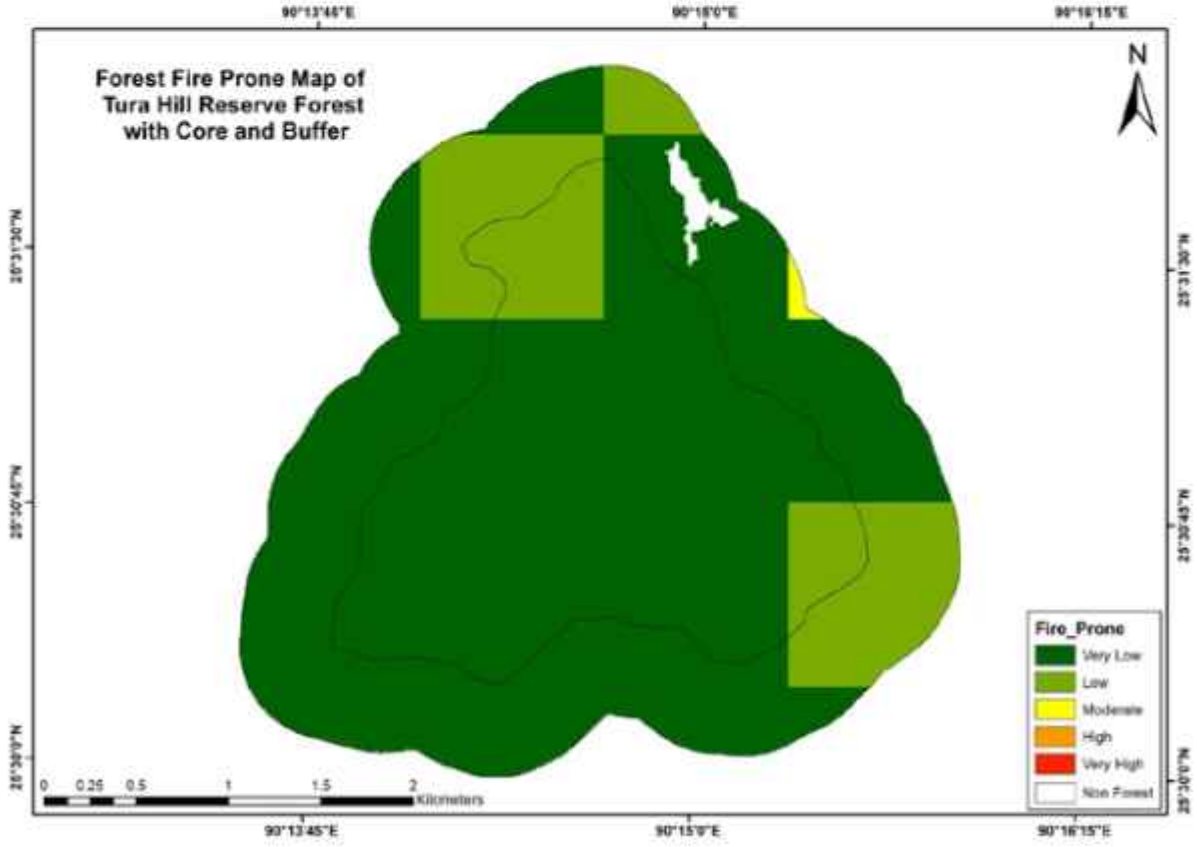


Figure 219. Forest Fire Prone Map of Tura Hill Reserve Forest

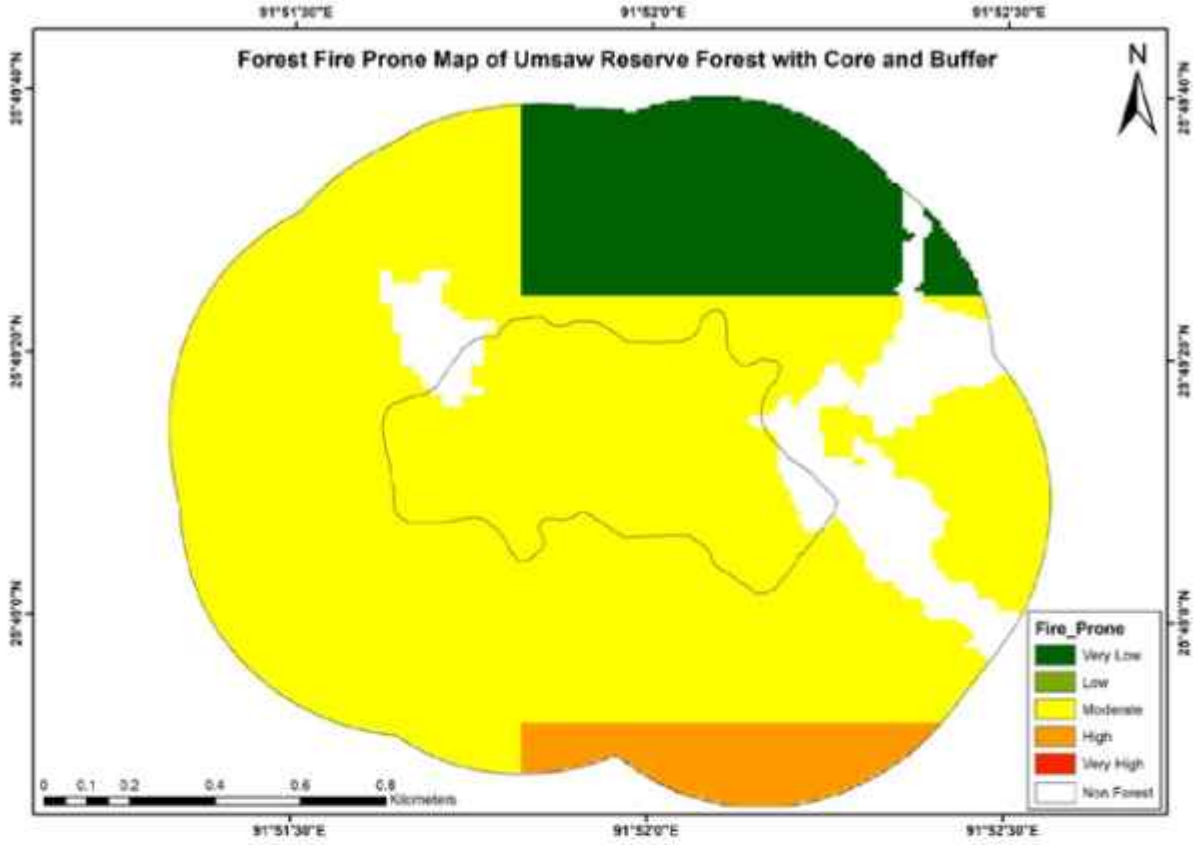


Figure 220. Forest Fire Prone Map of Umsaw Reserve Forest

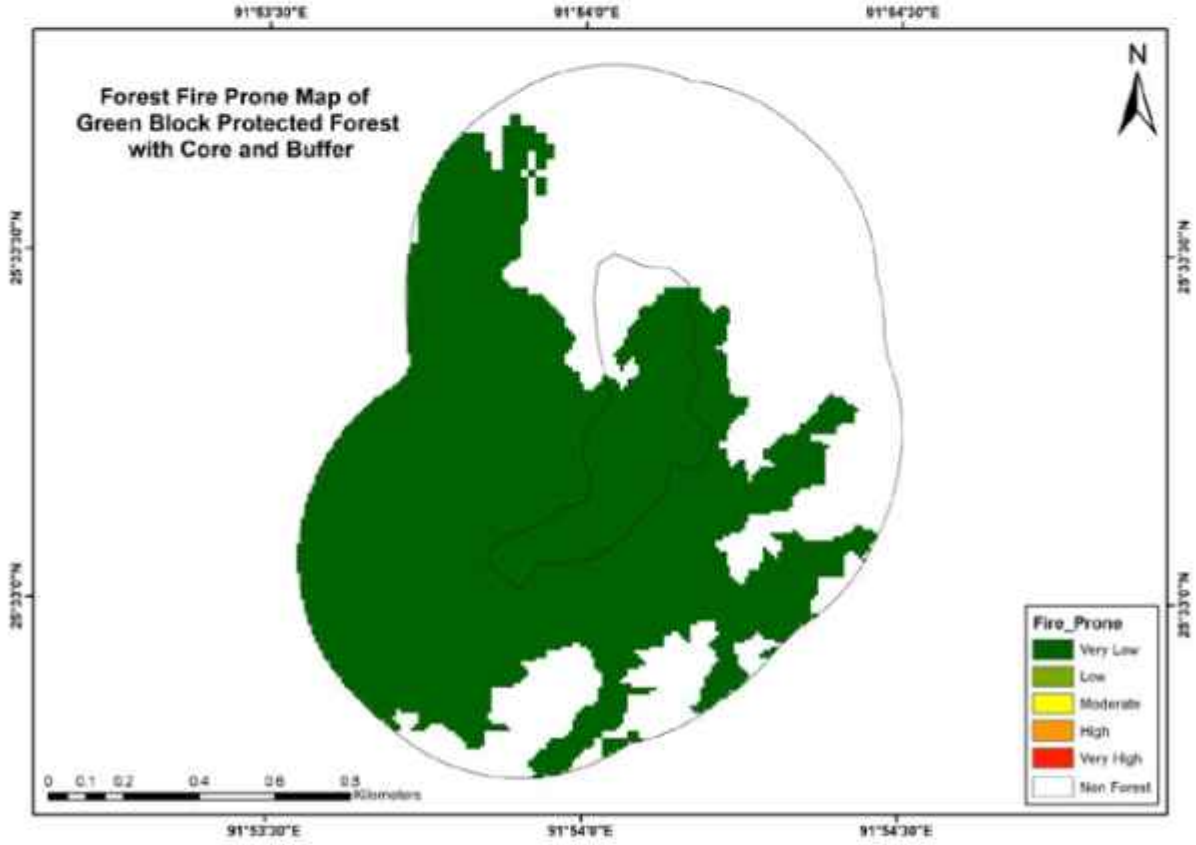


Figure 221. Forest Fire Prone Map of Green Block Protected Forest

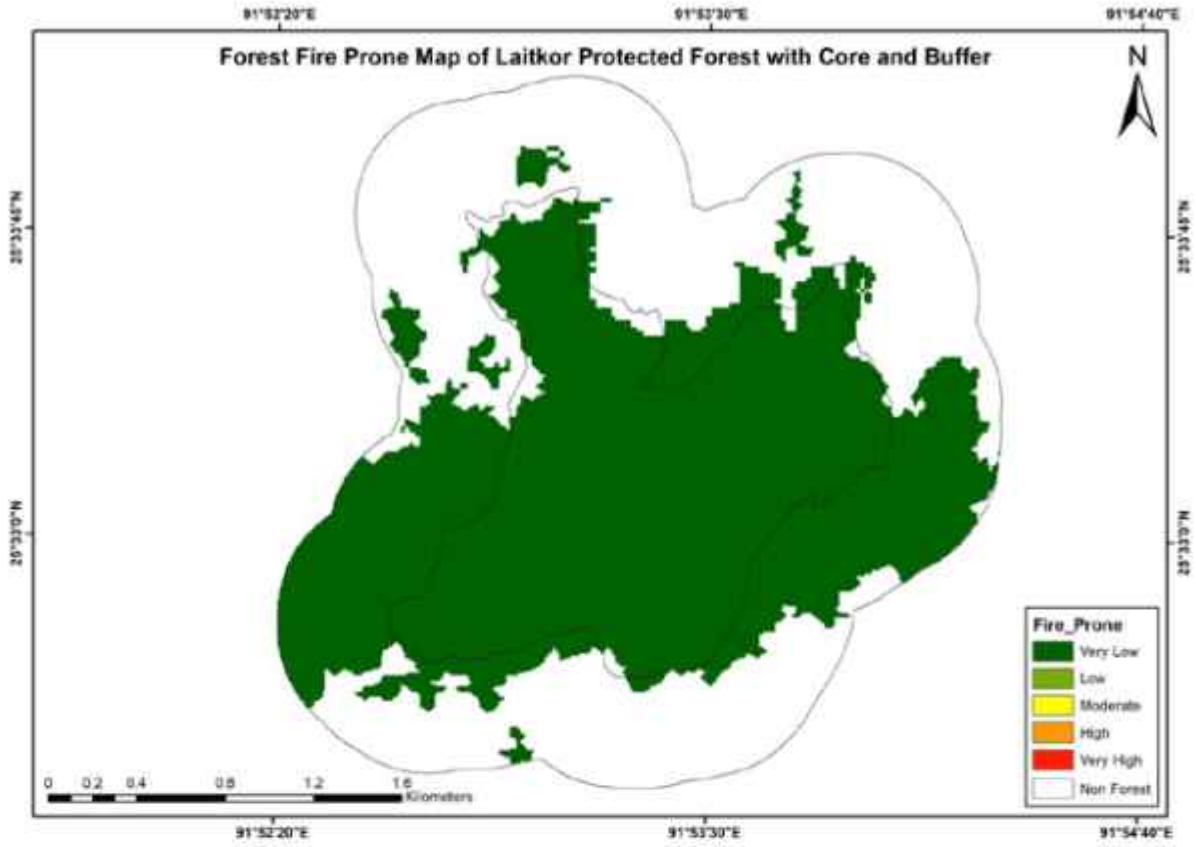


Figure 222. Forest Fire Prone Map of Laitkor Protected Forest

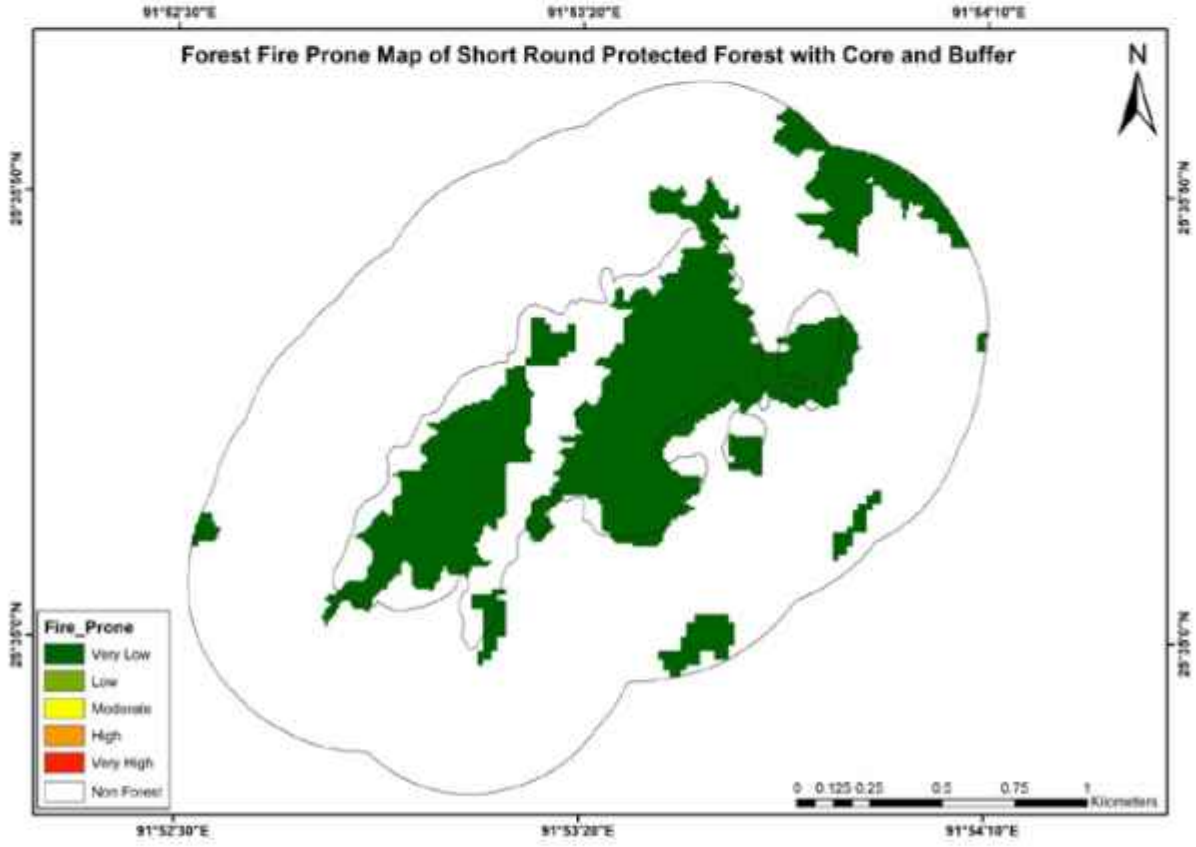


Figure 223. Forest Fire Prone Map of Short Round Protected Forest

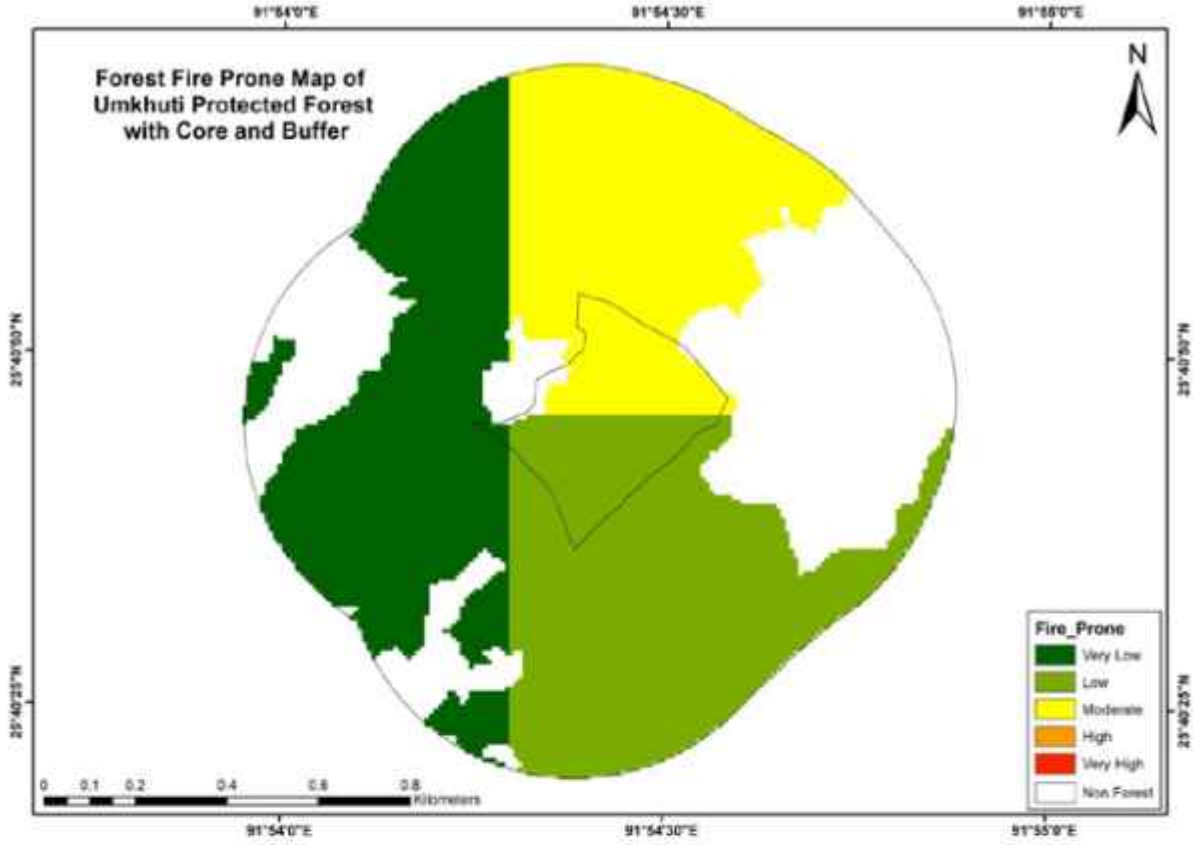


Figure 224. Forest Fire Prone Map of Umkhuti Protected Forest

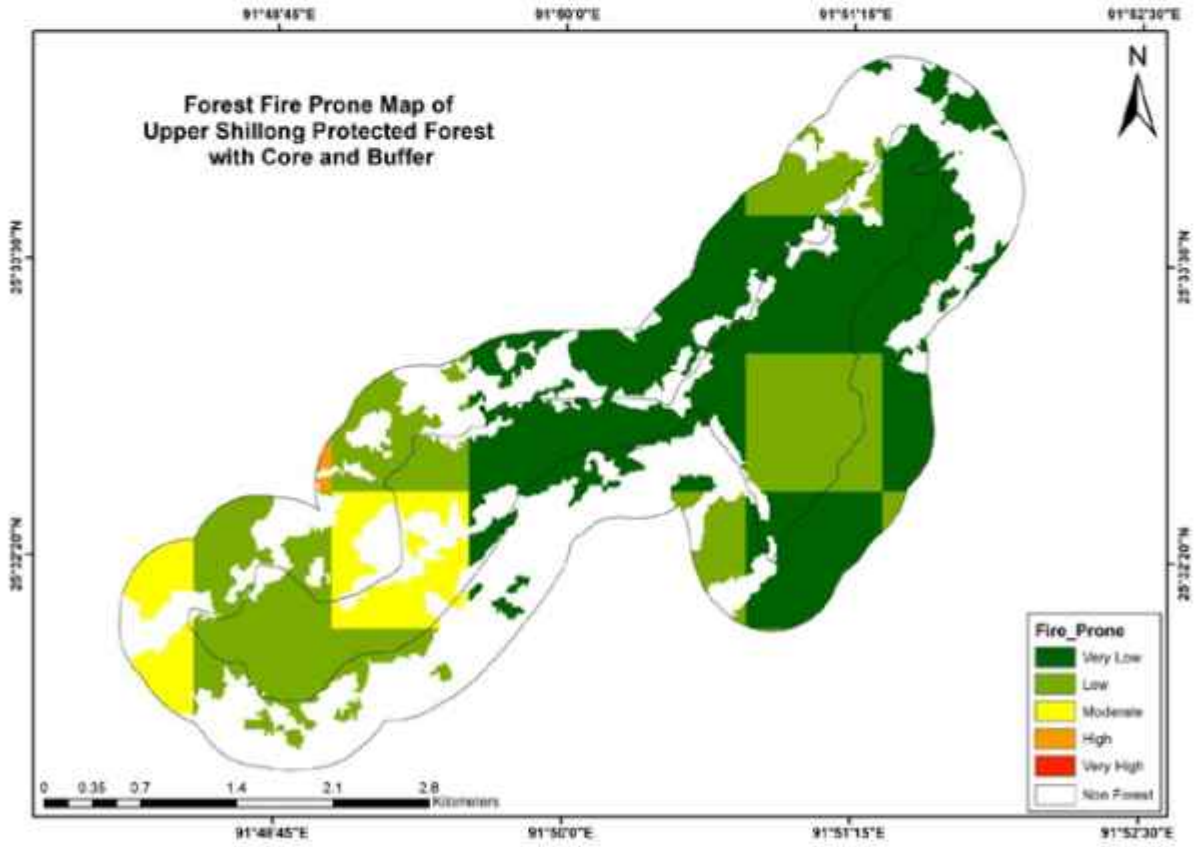


Figure 225. Forest Fire Prone Map of Upper Shillong Protected Forest

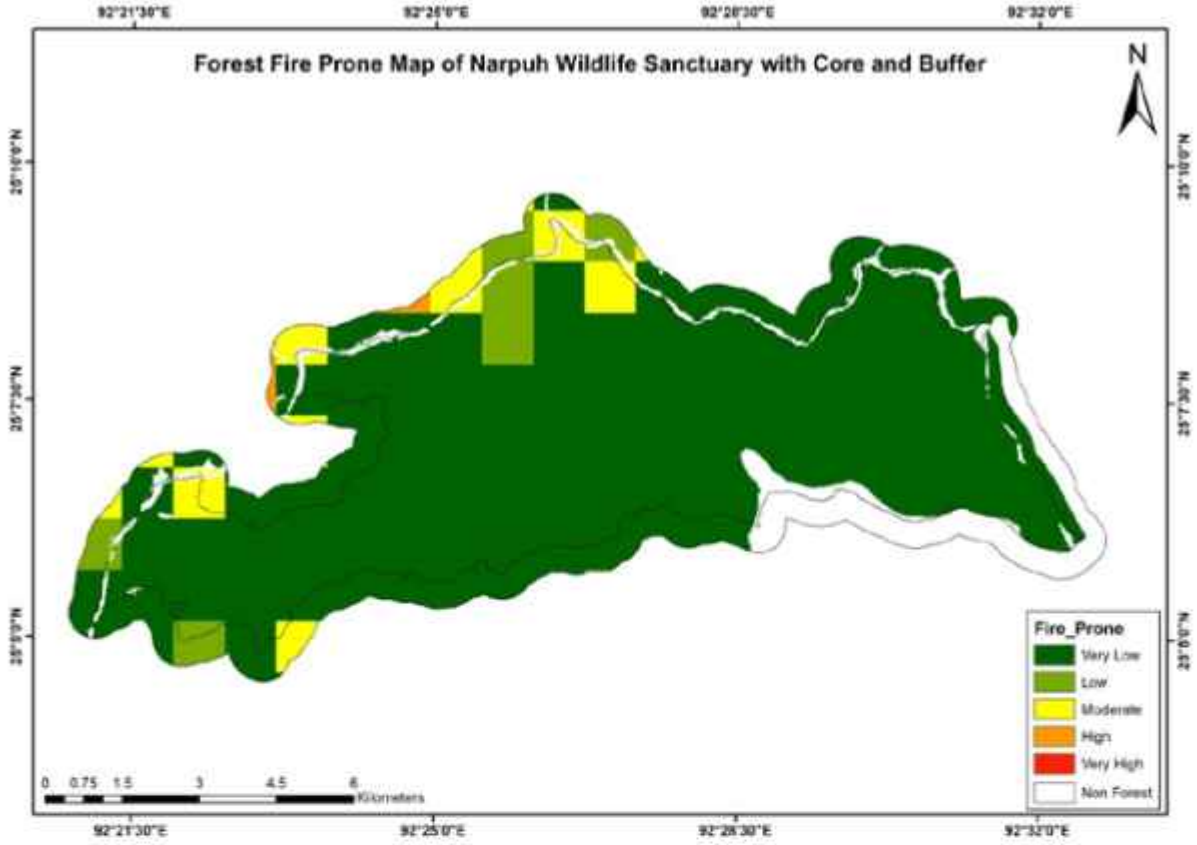


Figure 226. Forest Fire Prone Map of Narpuh Wildlife Sanctuary

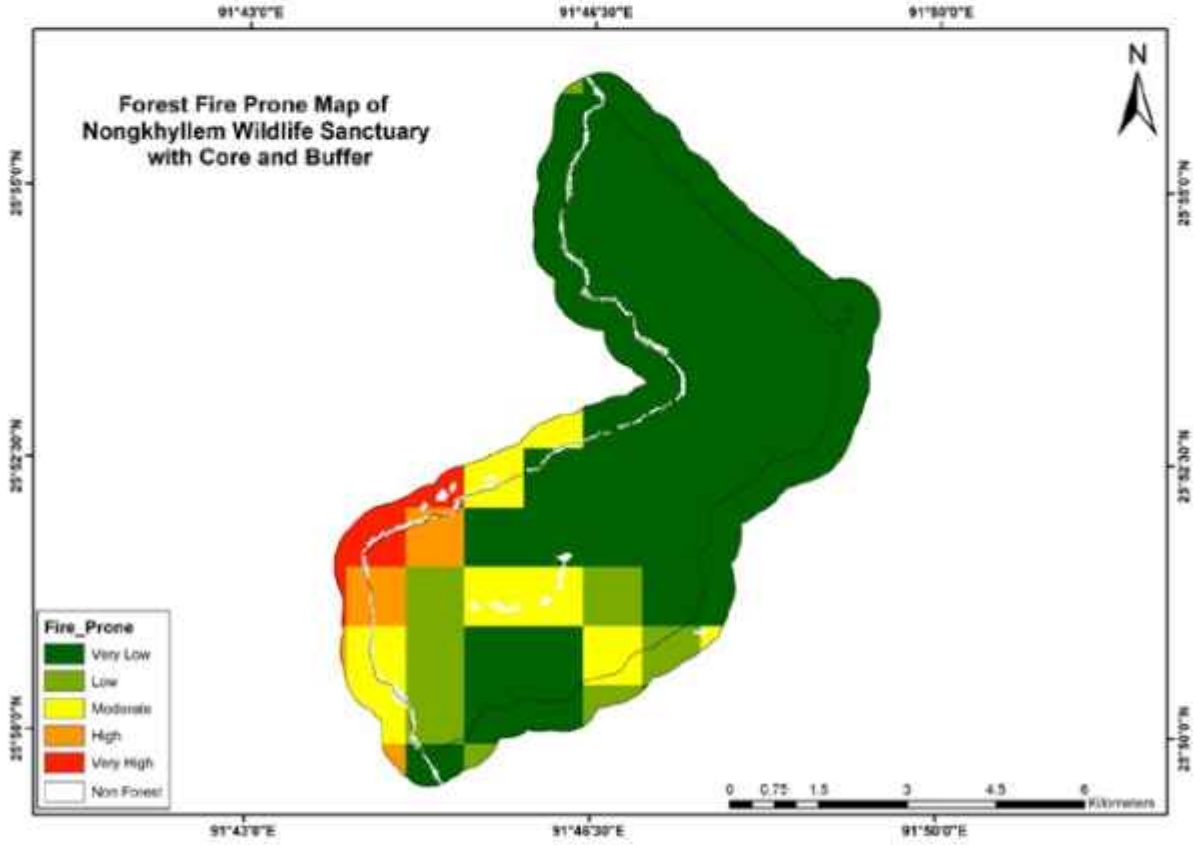


Figure 227. Forest Fire Prone Map of Nongkhyllem Wildlife Sanctuary

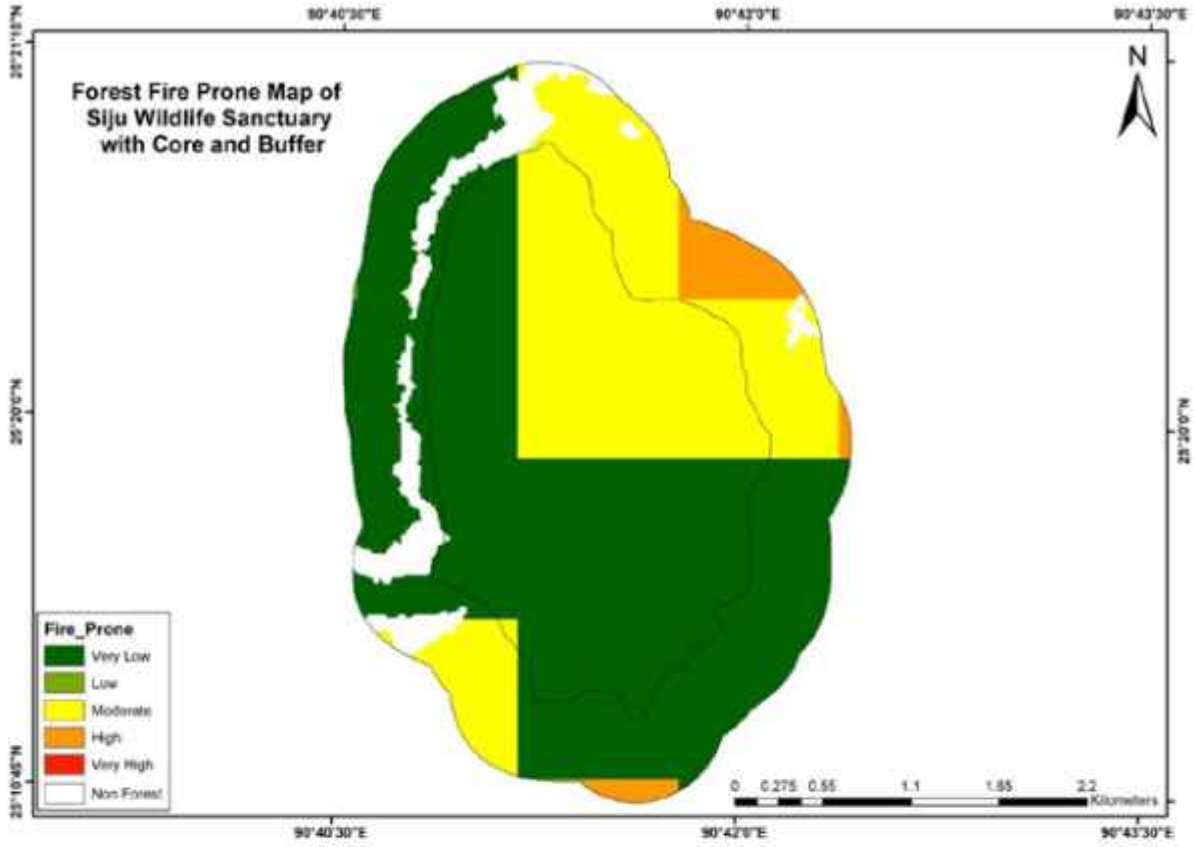


Figure 228. Forest Fire Prone Map of Siju Wildlife Sanctuary

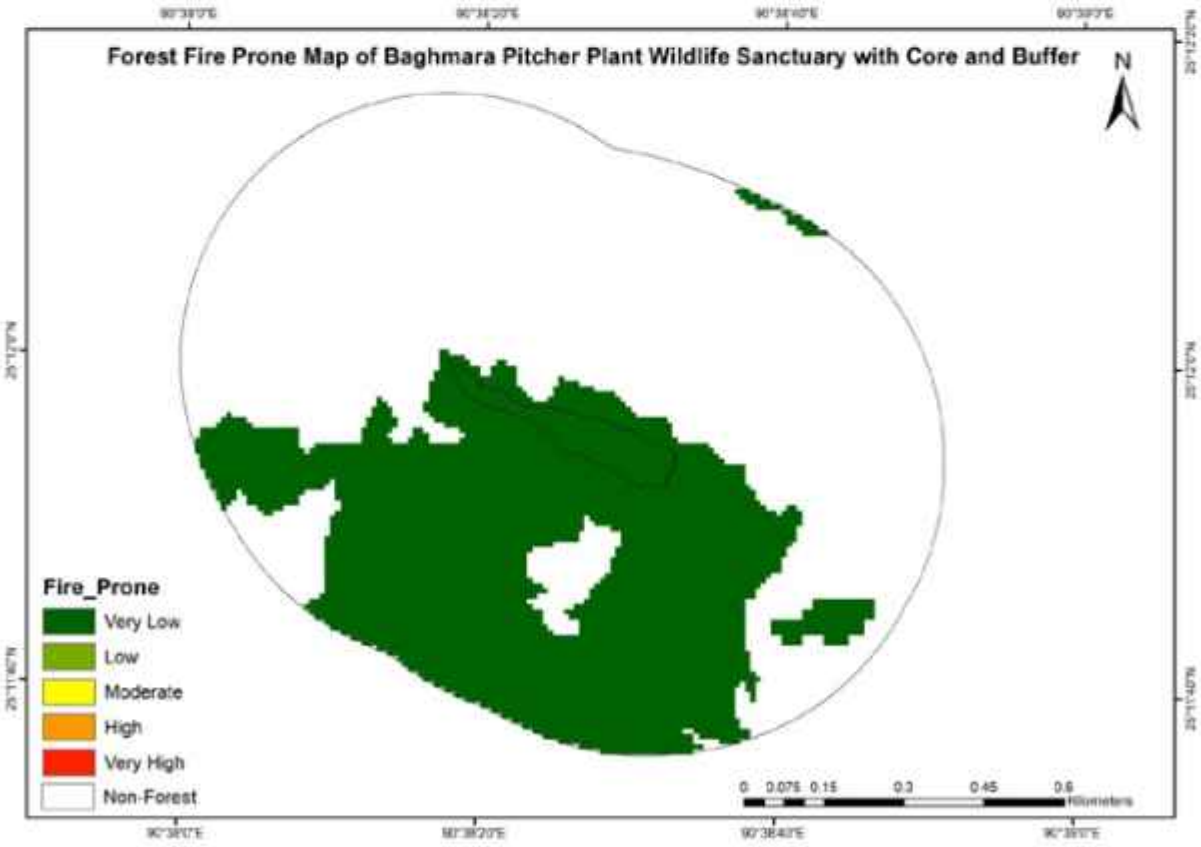


Figure 229. Forest Fire Vulnerability Map of Baghmara Pitcher Plant Wildlife Sanctuary

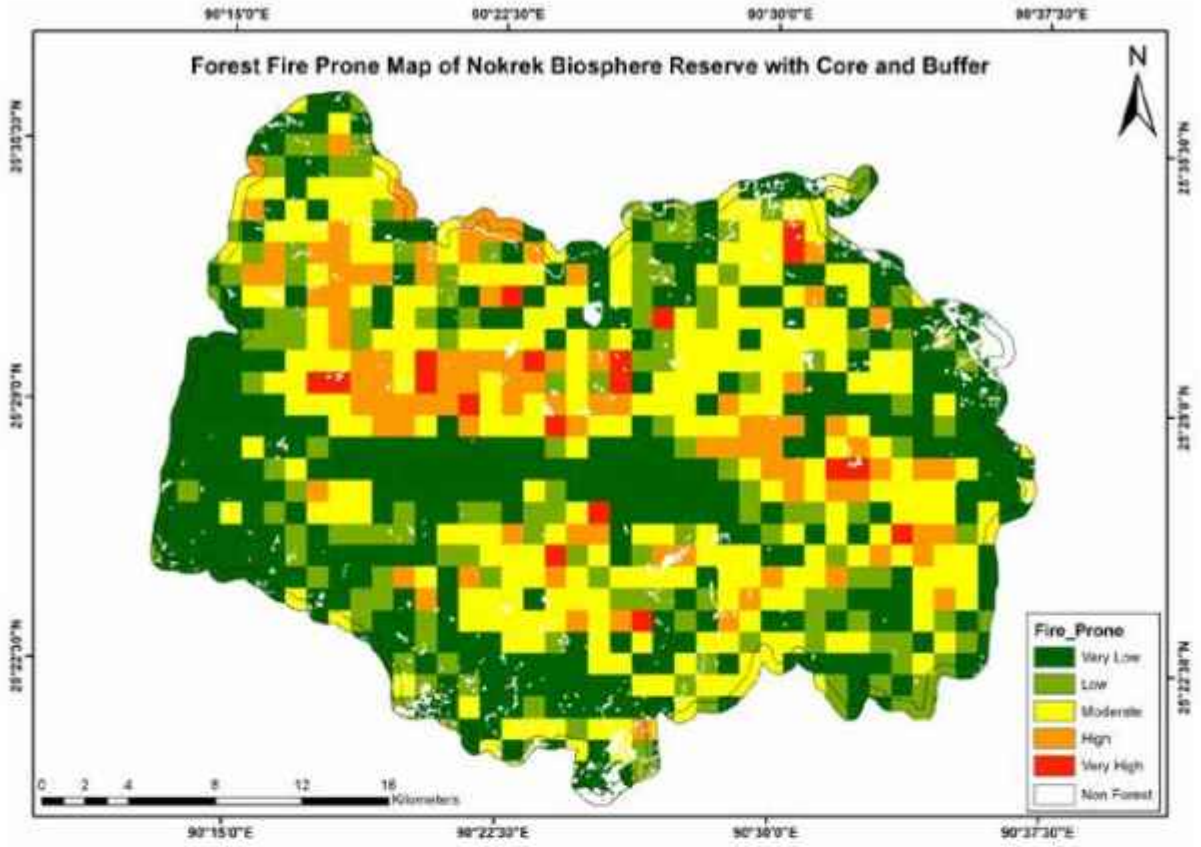


Figure 230. Forest Fire Prone Map of Nokrek Biosphere Reserve

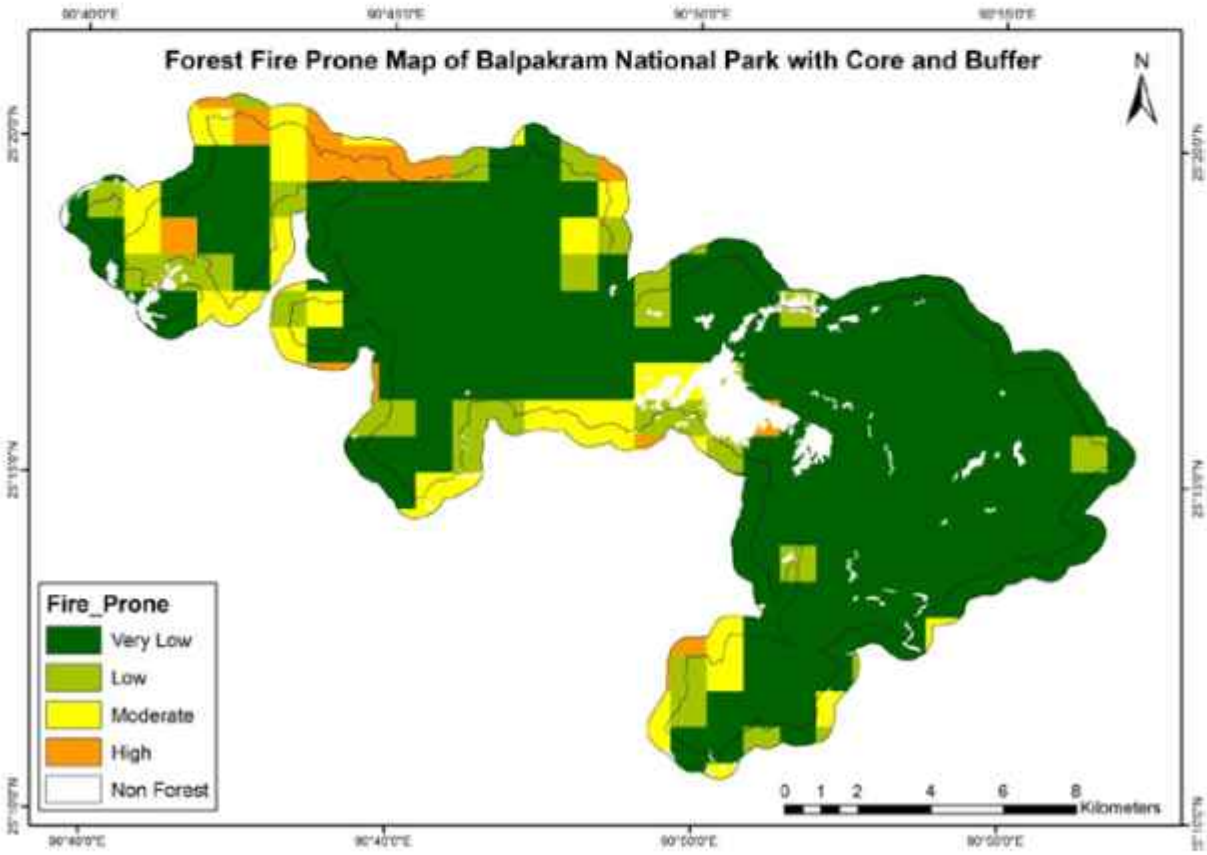


Figure 231. Forest Fire Prone Map of Balpakram National Park

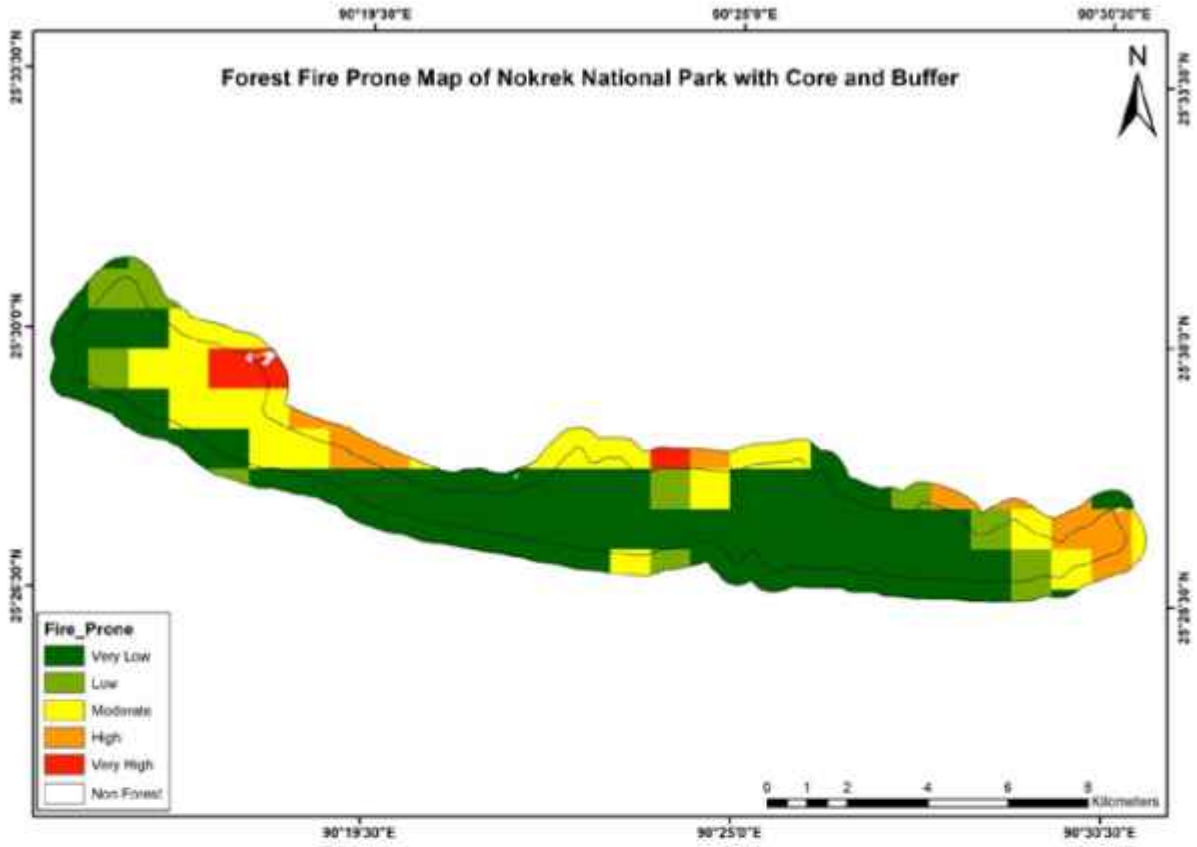


Figure 232. Forest Fire Prone Map of Nokrek National Park

Forest Fire Burnt Area Map of all Districts of Meghalaya (2015-2021)

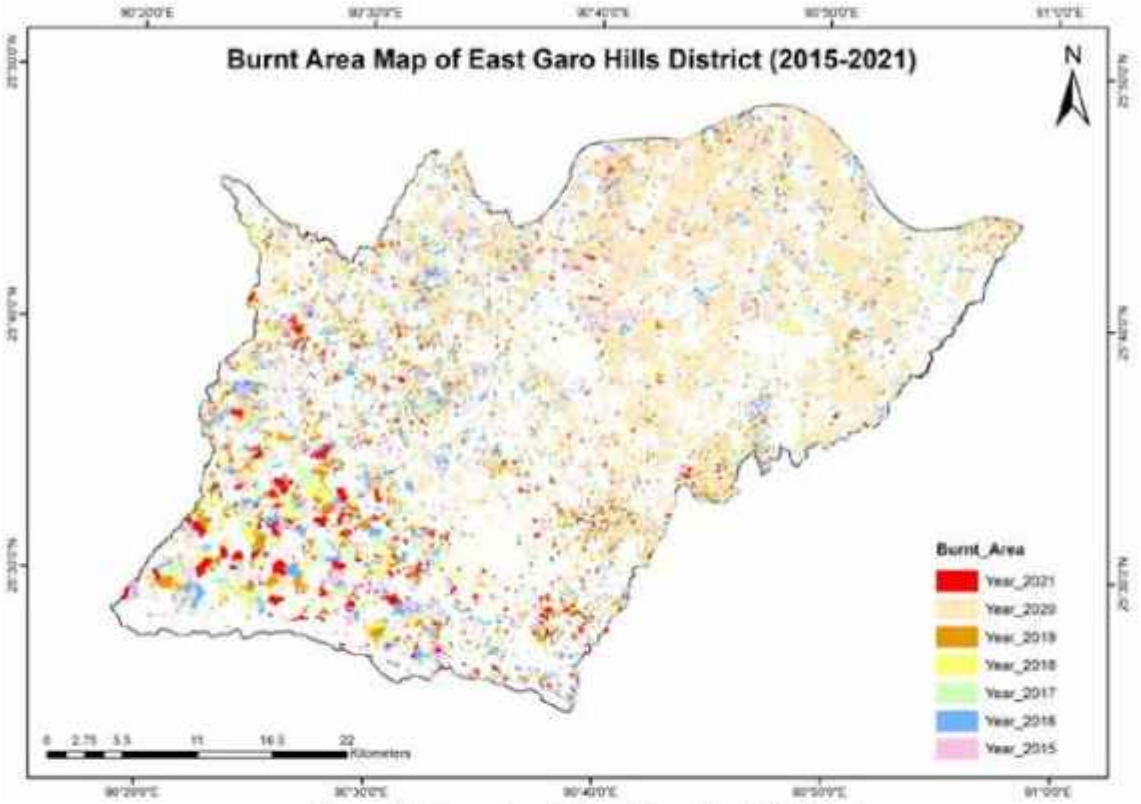


Figure 233. Burnt Area Map of East Garo Hills District

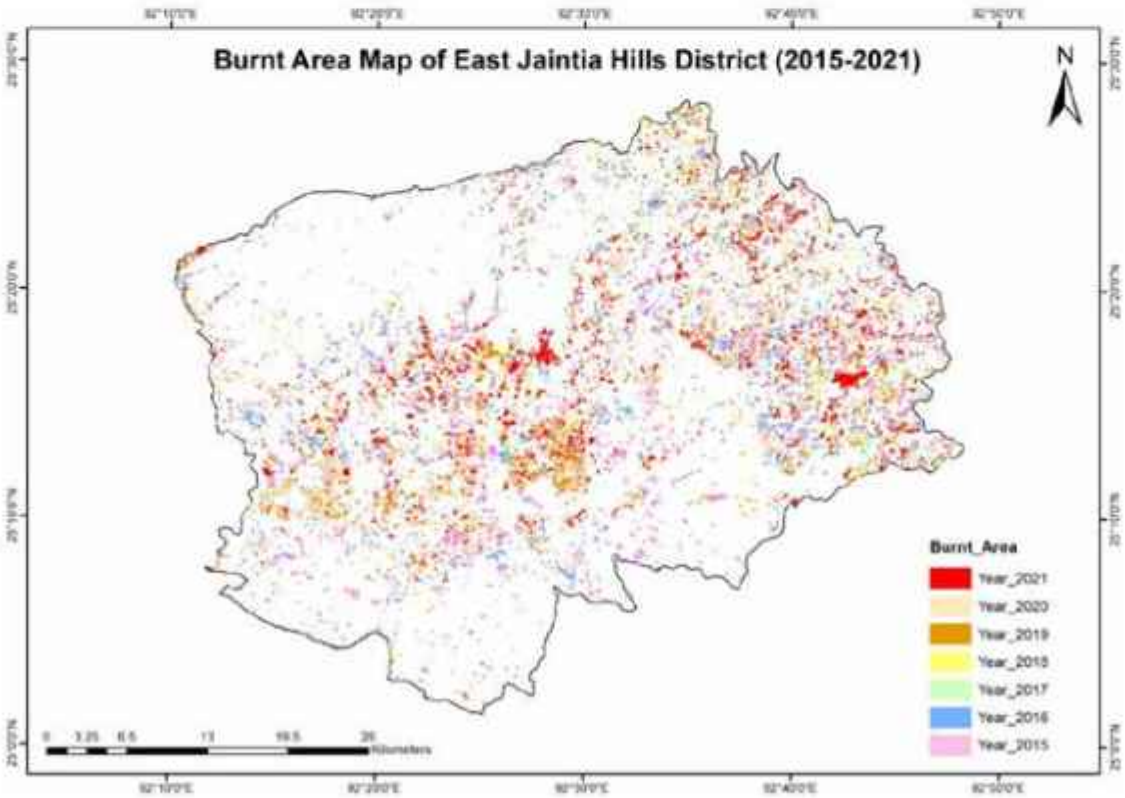


Figure 234. Burnt Area Map of East Jaintia Hills District

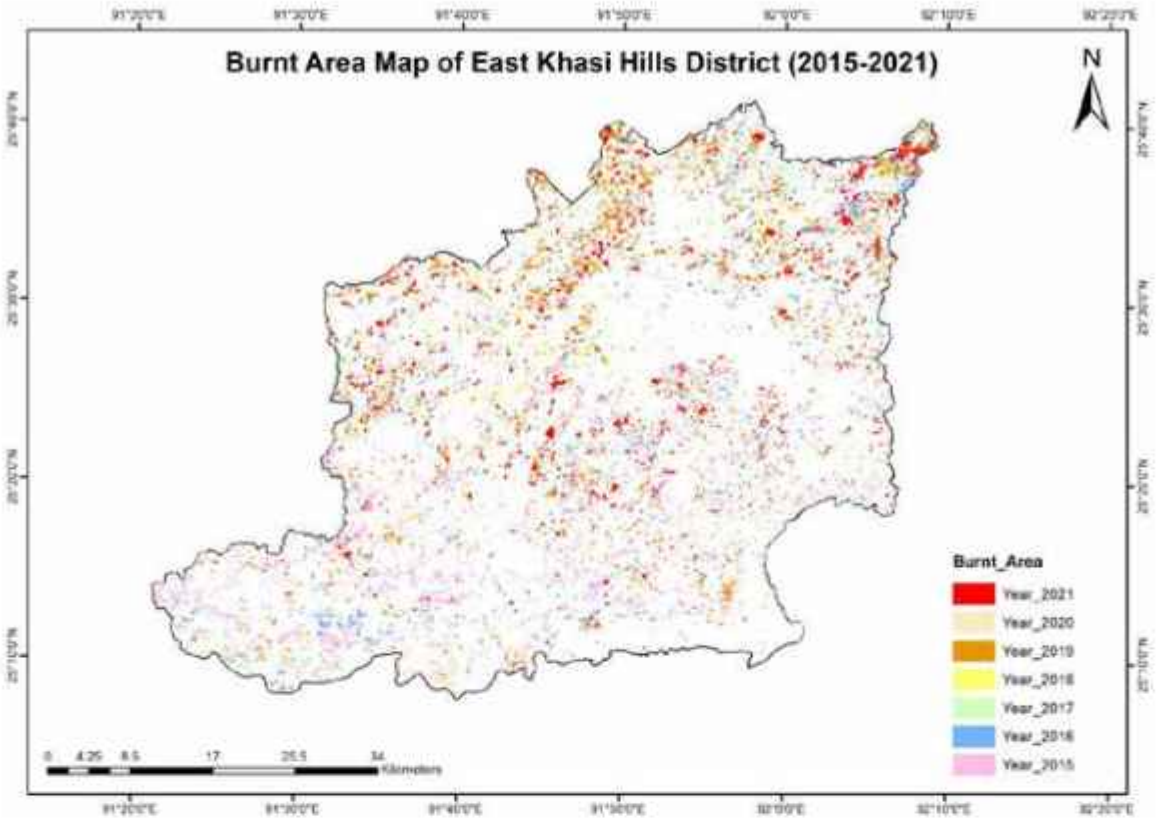


Figure 235. Burnt Area Map of East Khasi Hills District

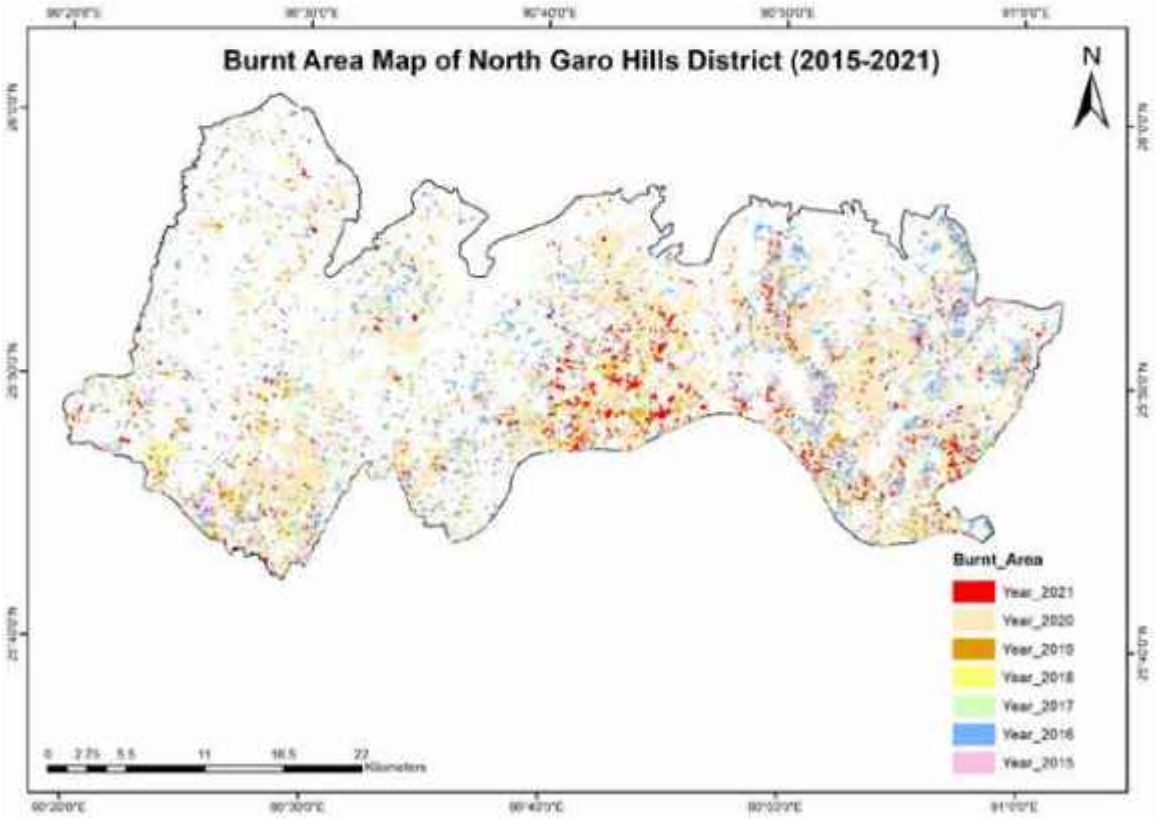


Figure 236. Burnt Area Map of North Garo Hills District

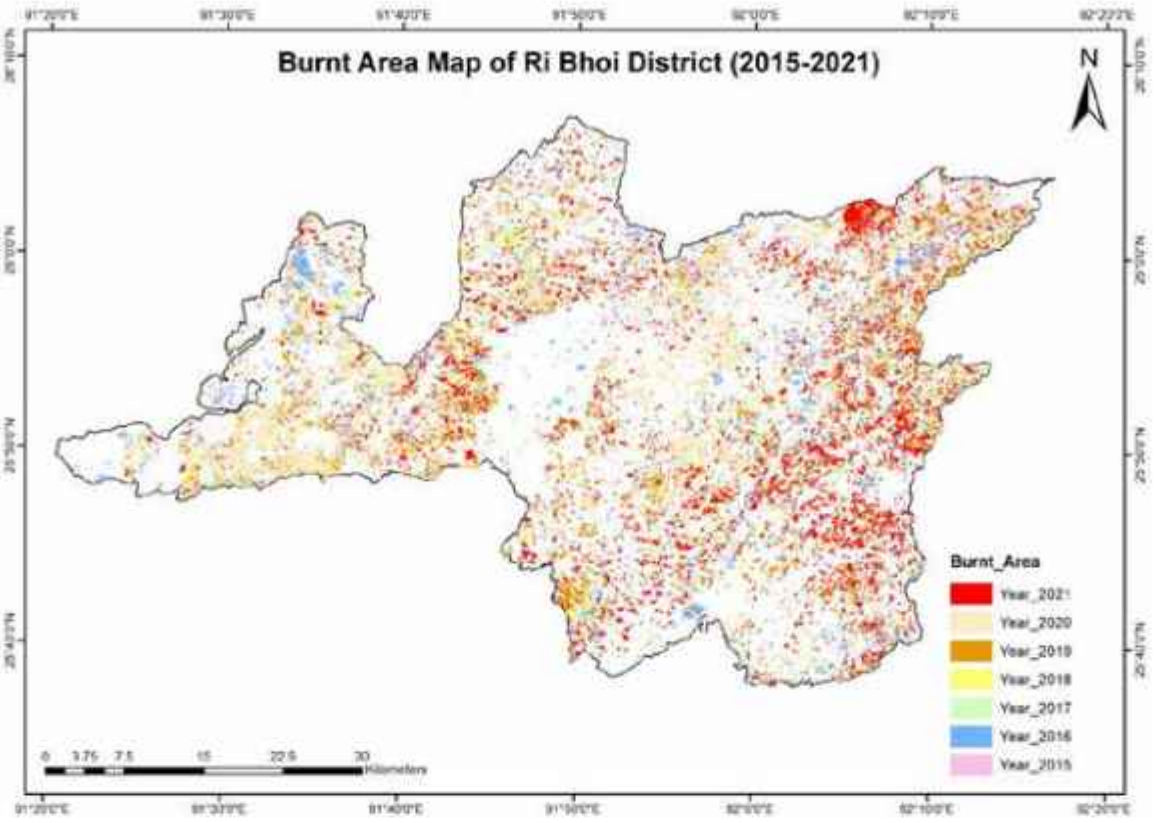


Figure 237. Burnt Area Map of Ri Bhoi District

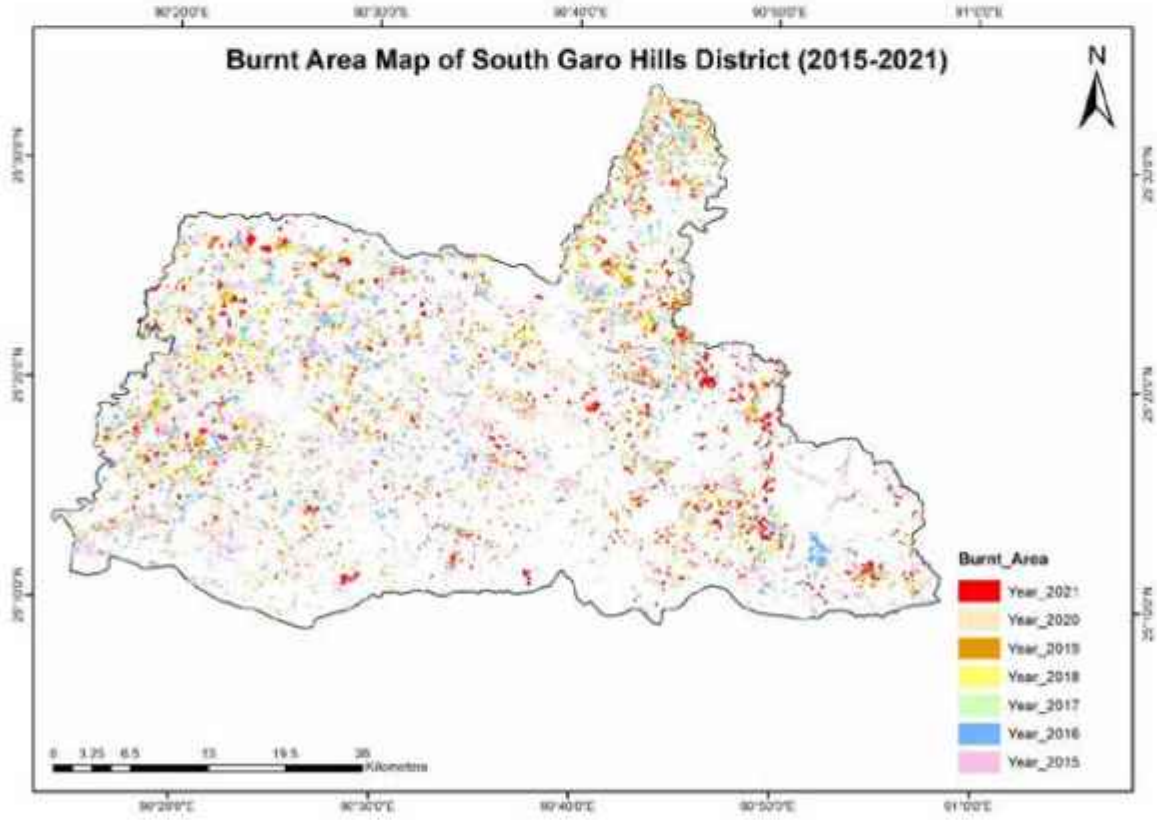


Figure 238. Burnt Area Map of South Garo Hills District

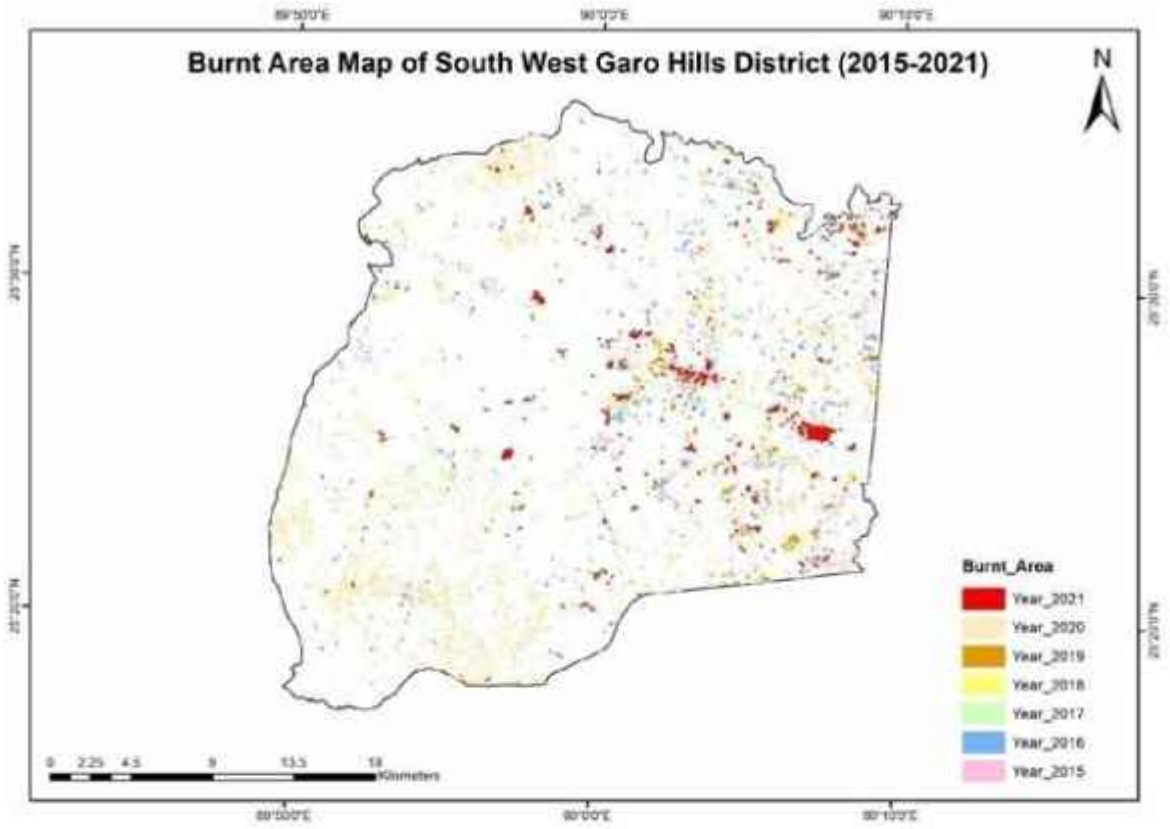


Figure 239. Burnt Area Map of South West Garo Hills District

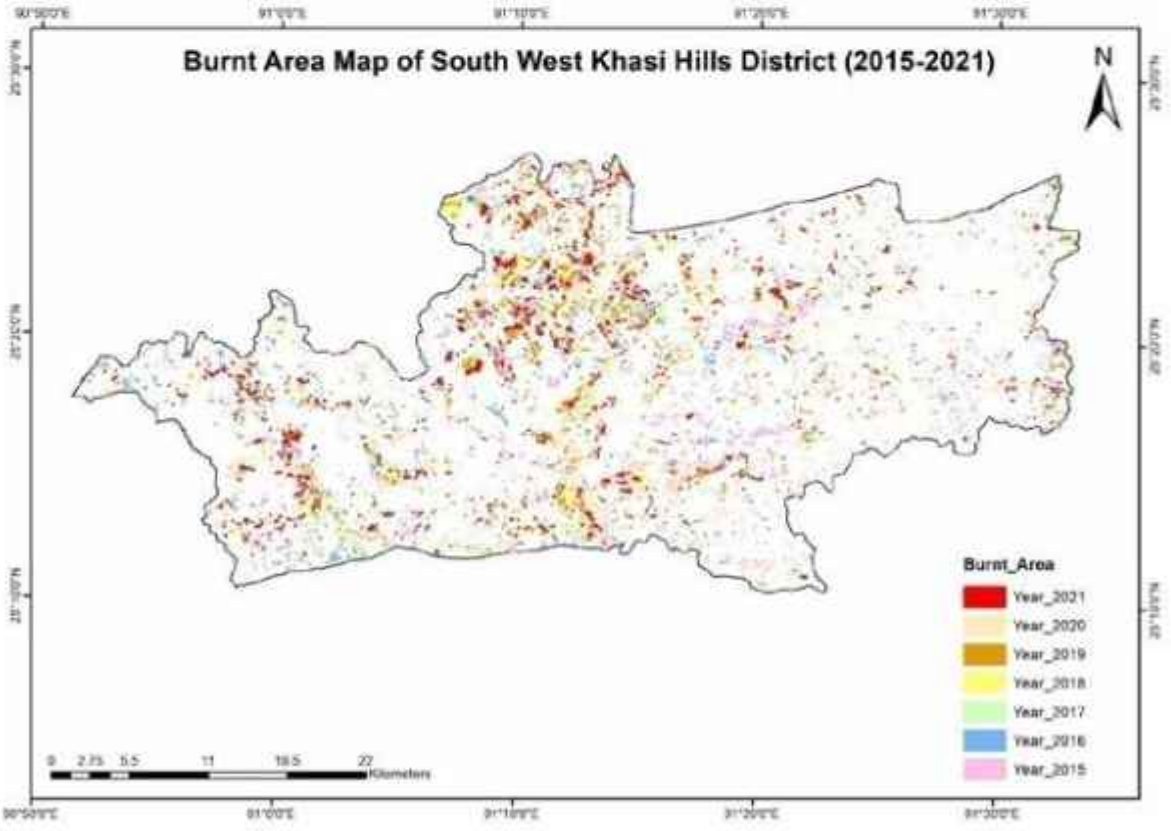


Figure 240. Burnt Area Map of South West Khasi Hills District

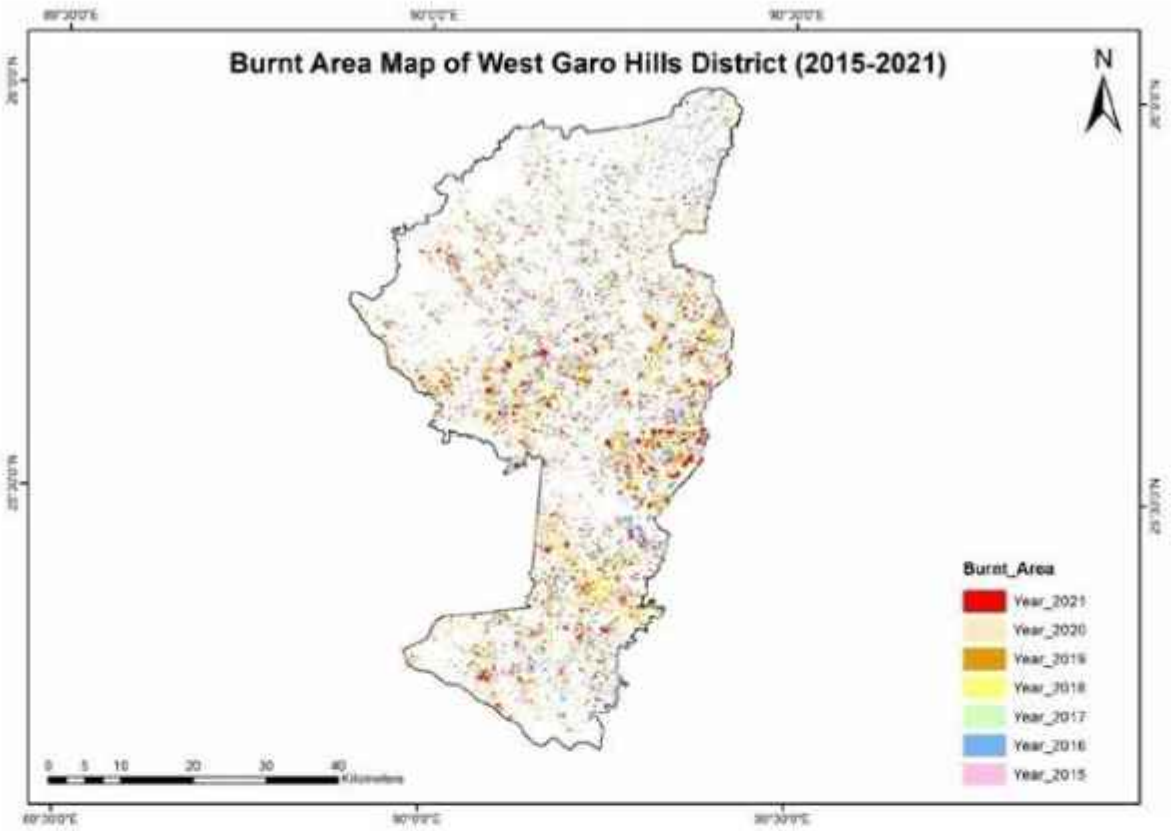


Figure 241. Burnt Area Map of West Garo Hills District

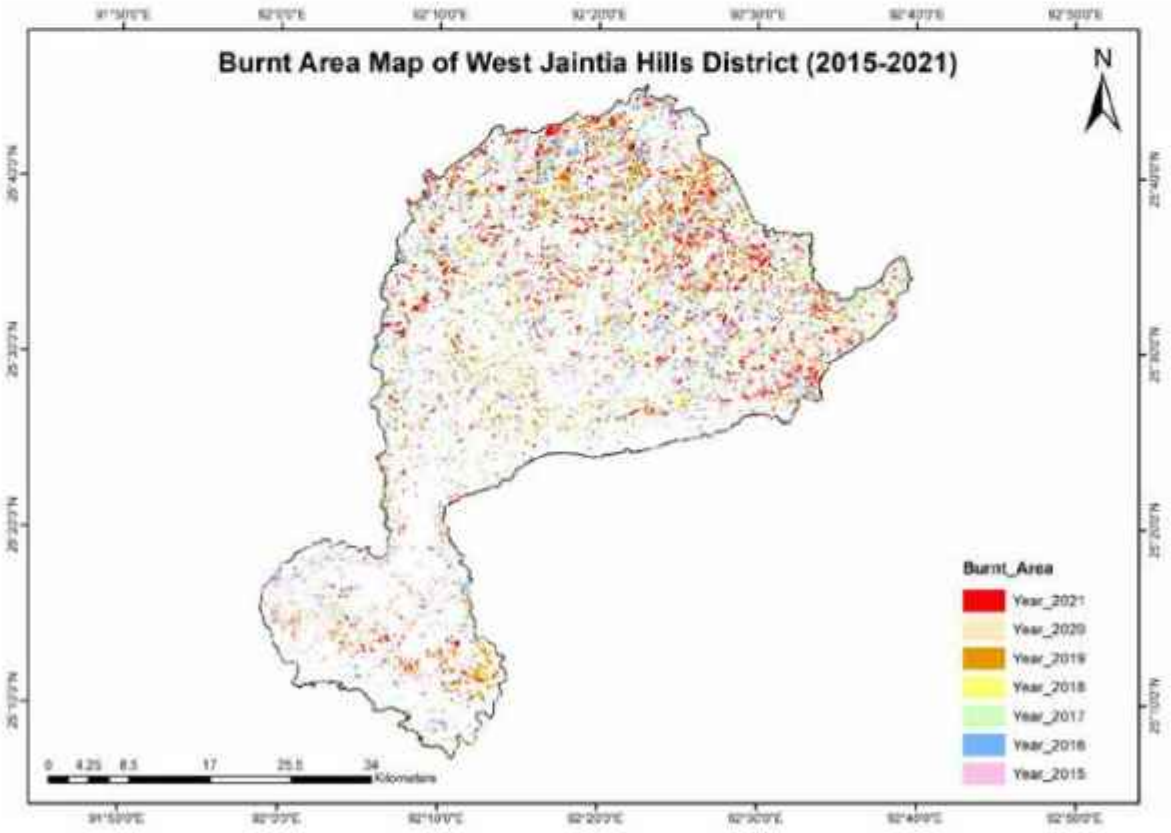


Figure 242. Burnt Area Map of West Jaintia Hills District

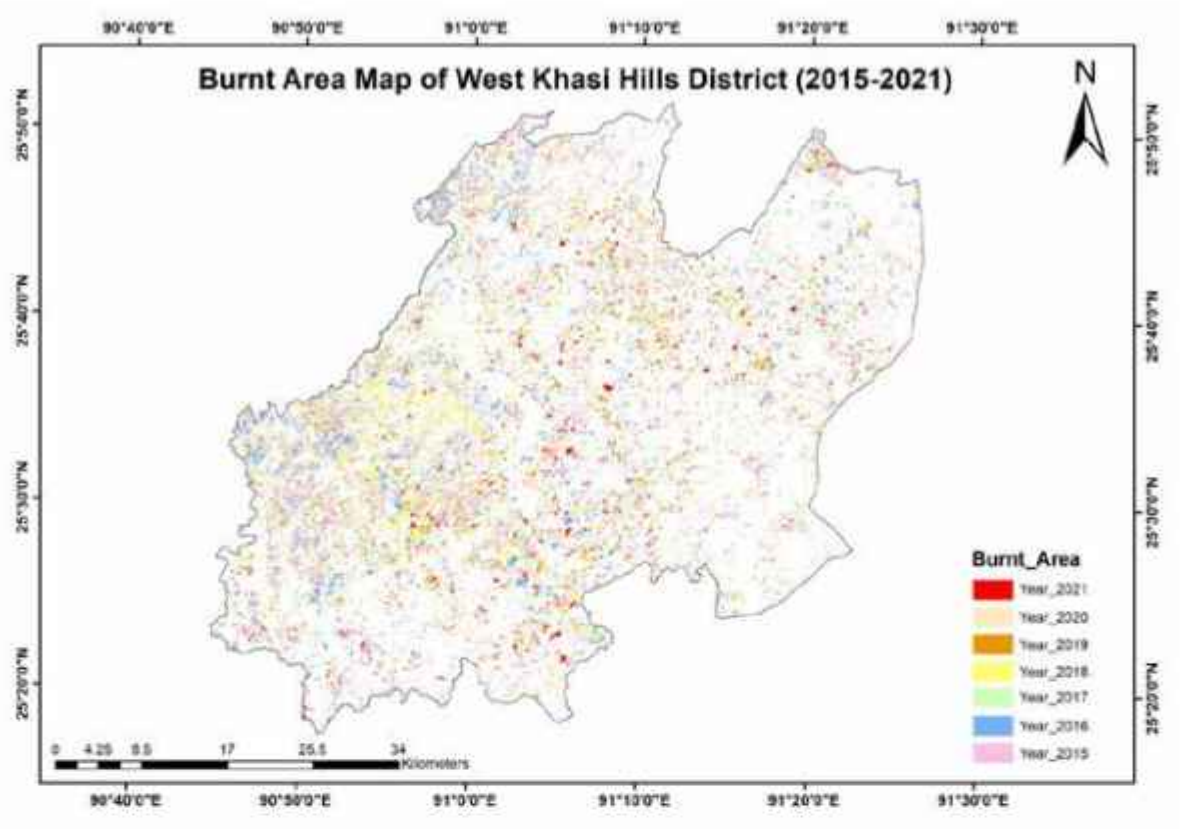


Figure 243. Burnt Area Map of West Khasi Hills District

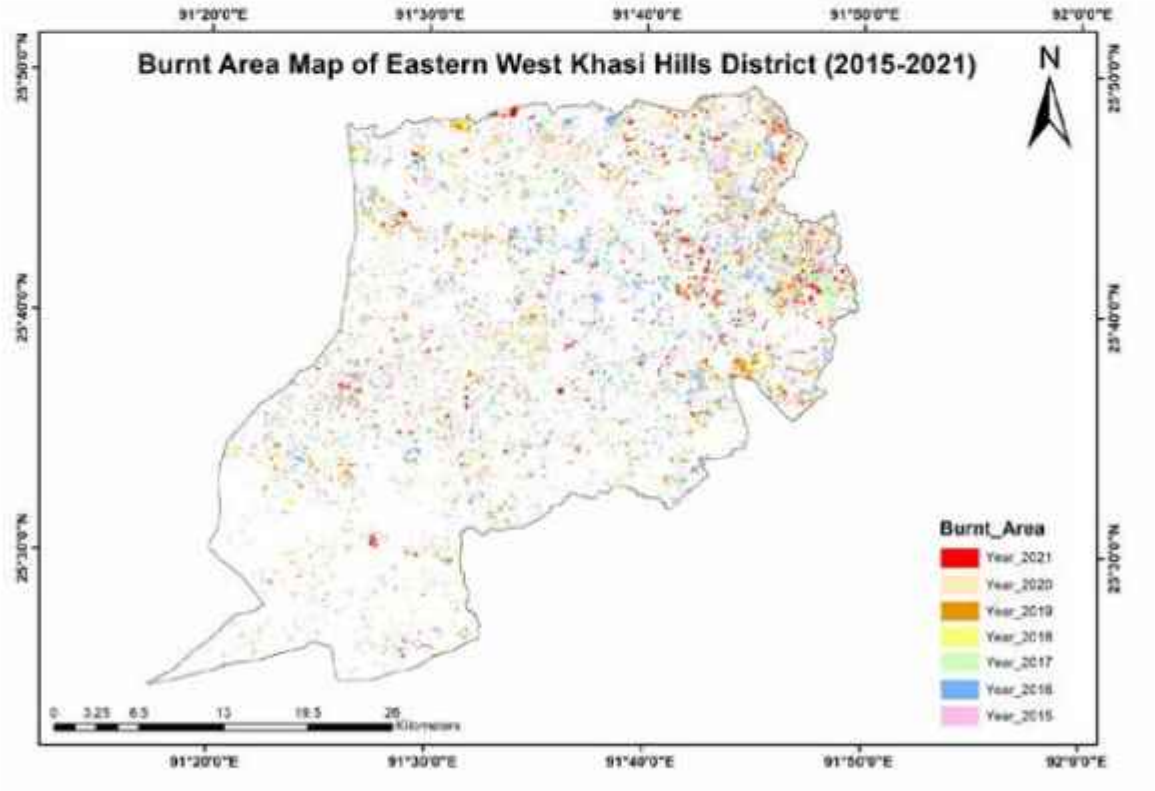


Figure 244. Burnt Area Map of Eastern West Khasi Hills District

Forest Fire Burnt Area Map of all Blocks of Meghalaya (2015-2021)

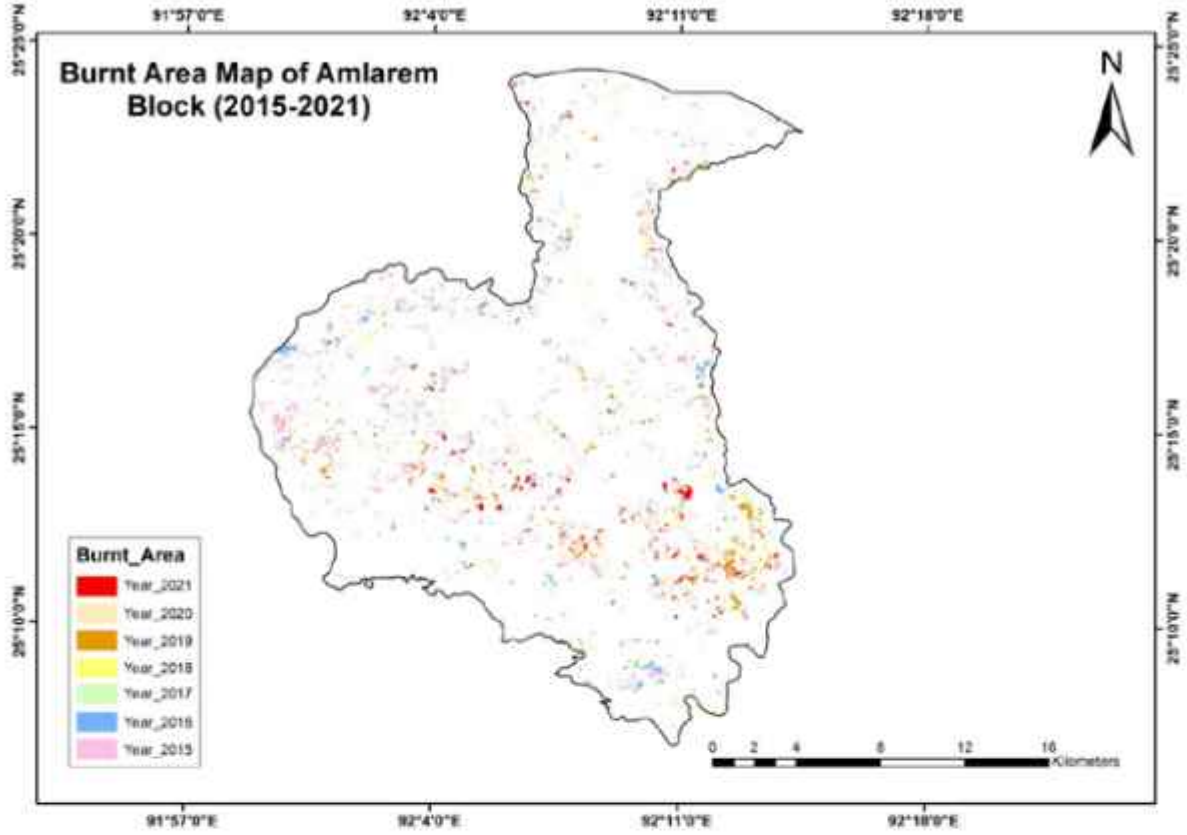


Figure 245. Burnt Area Map of Amlarem Block

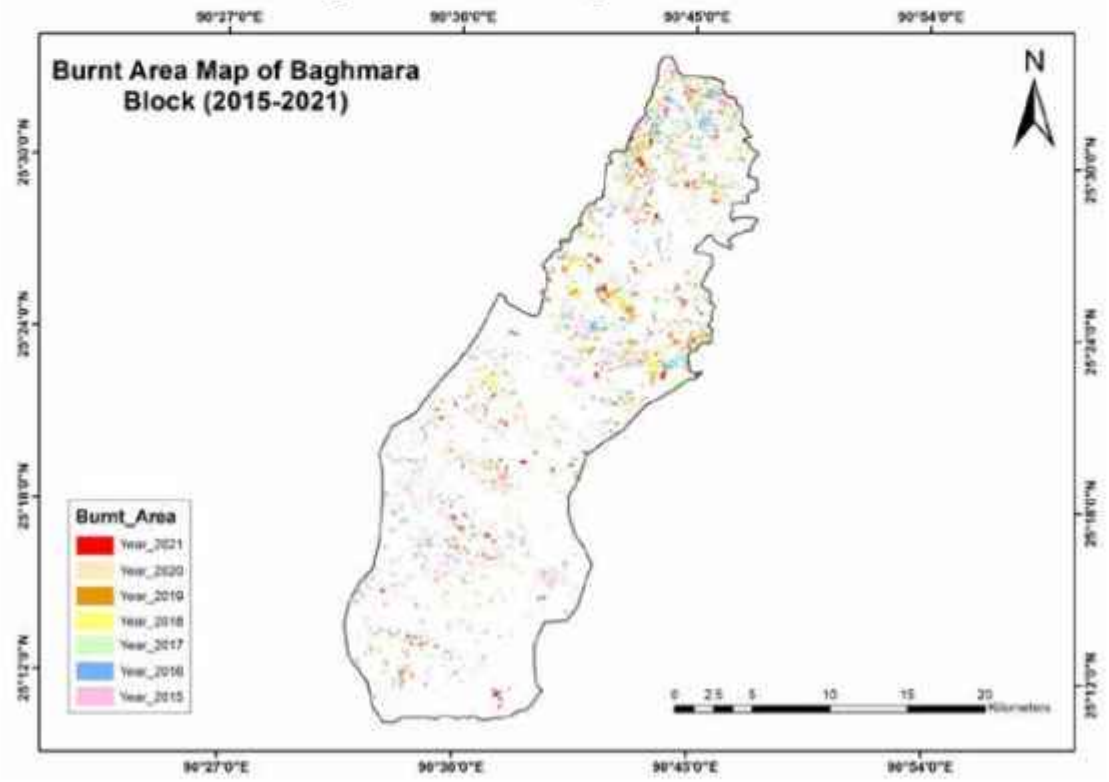


Figure 246. Burnt Area Map of Baghmara Block

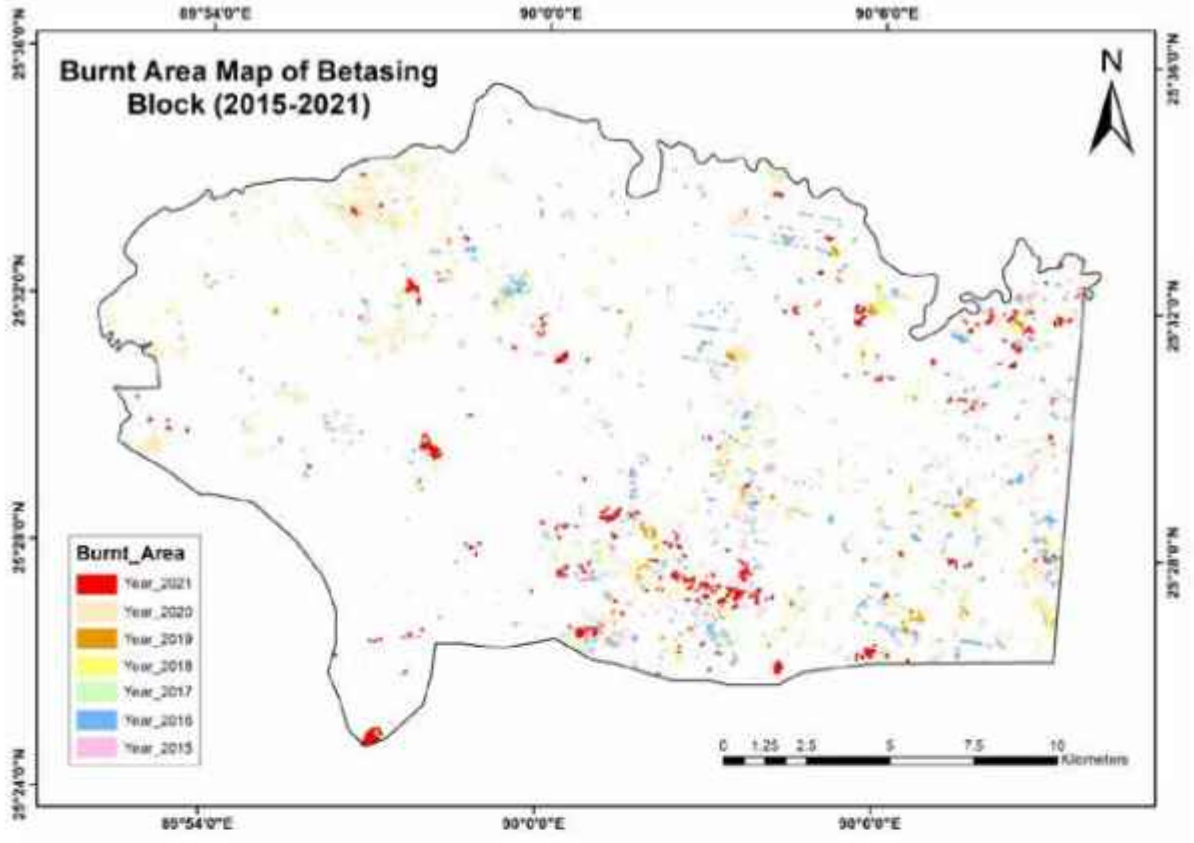


Figure 247. Burnt Area Map of Betasing Block

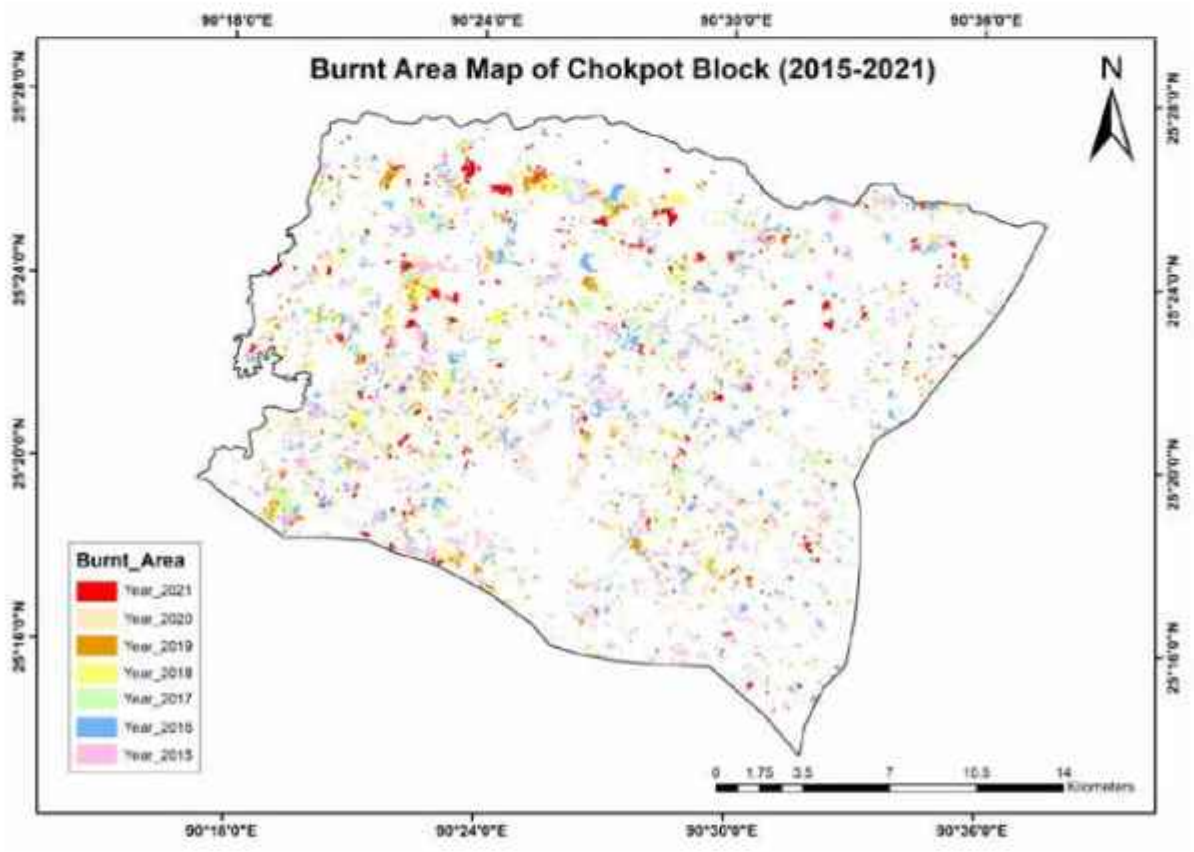


Figure 248. Burnt Area Map of Chokpot Block

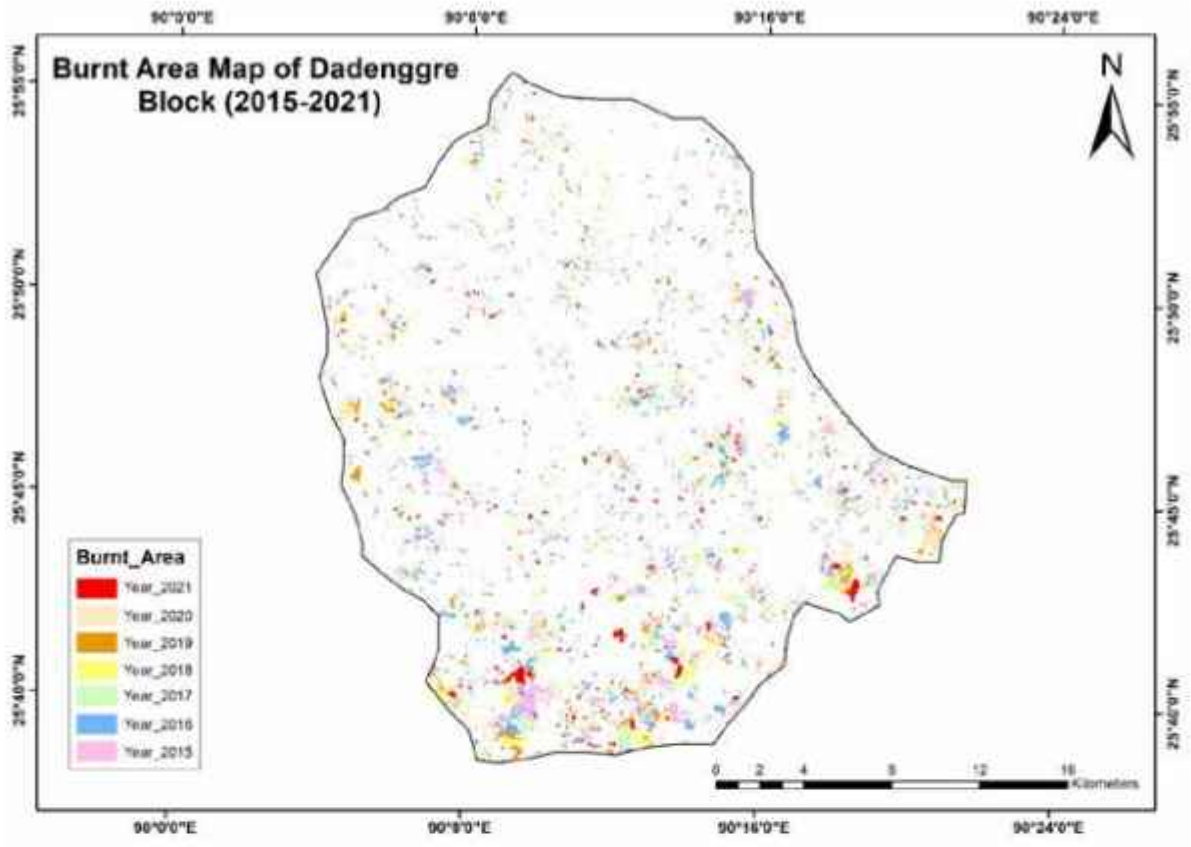


Figure 249. Burnt Area Map of Dadenggre Block

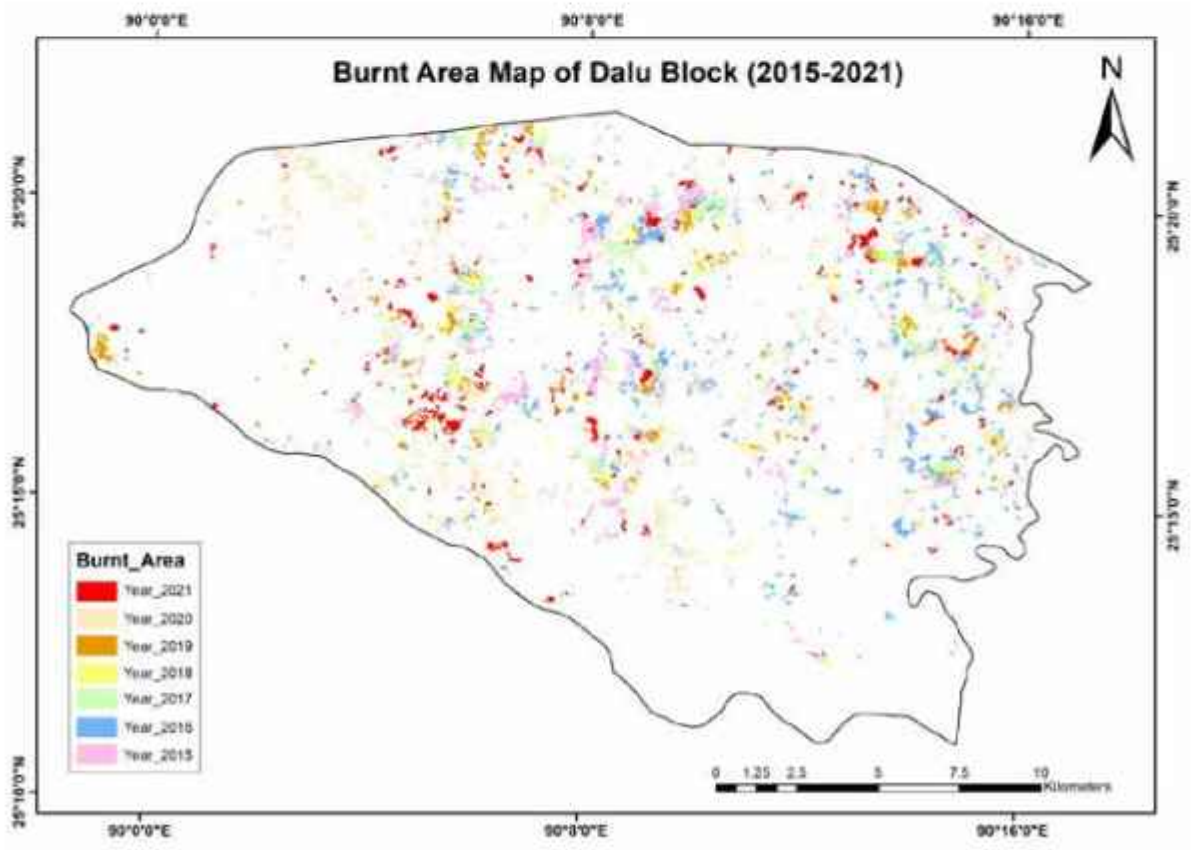


Figure 250. Burnt Area Map of Dalu Block

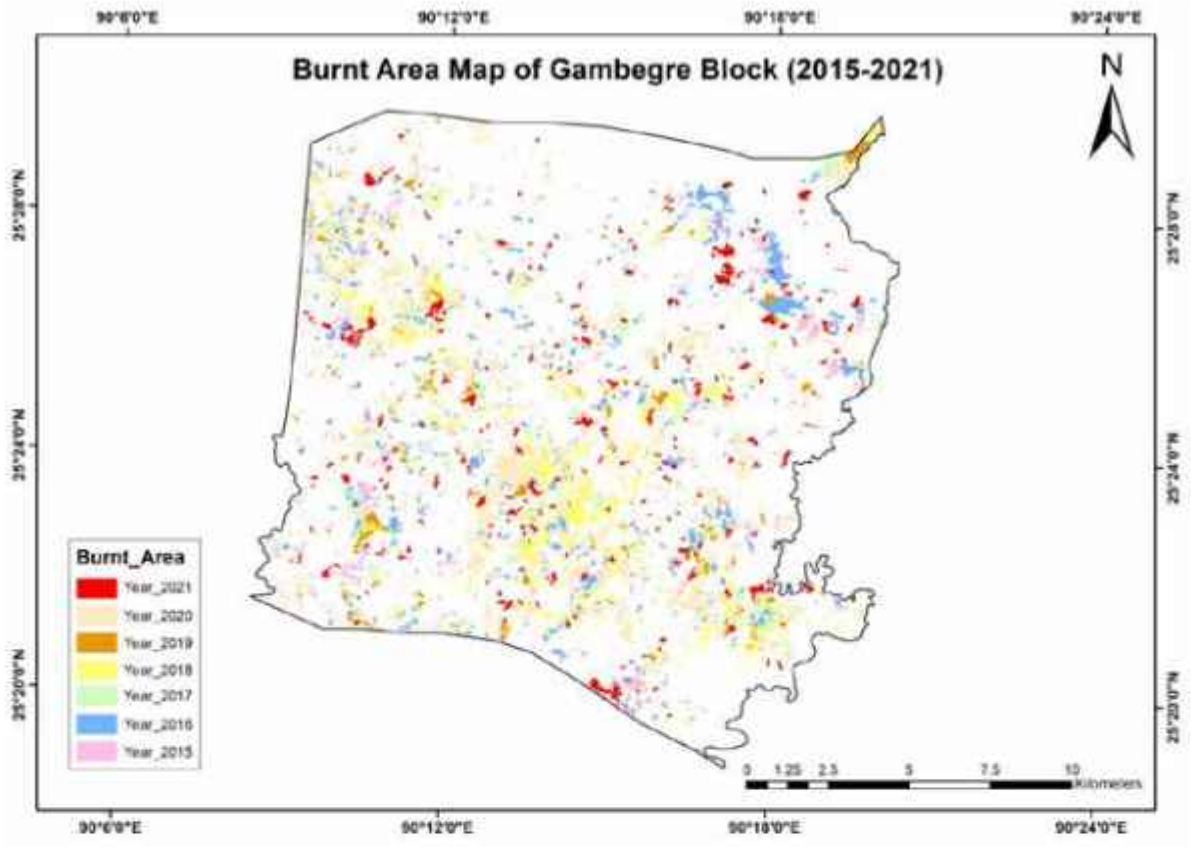


Figure 251. Burnt Area Map of Gambegre Block

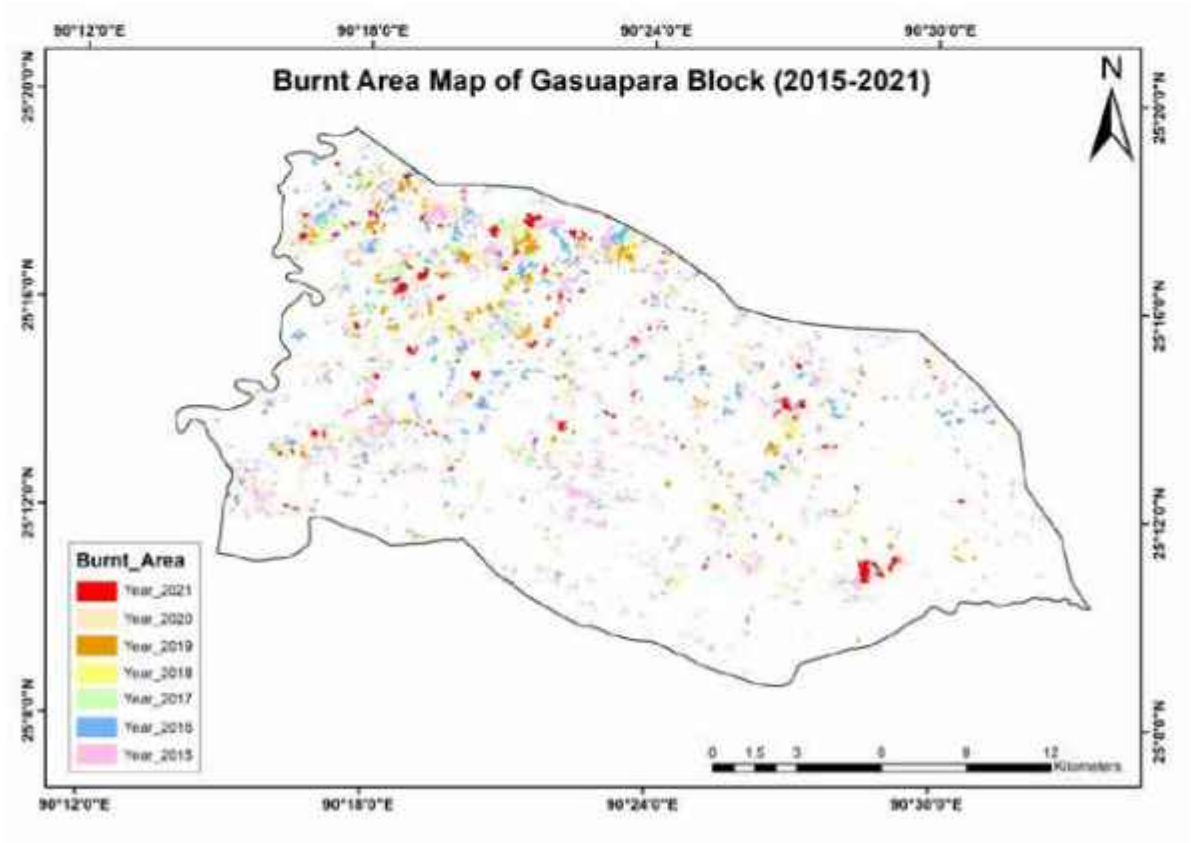


Figure 252. Burnt Area Map of Gasuapara Block

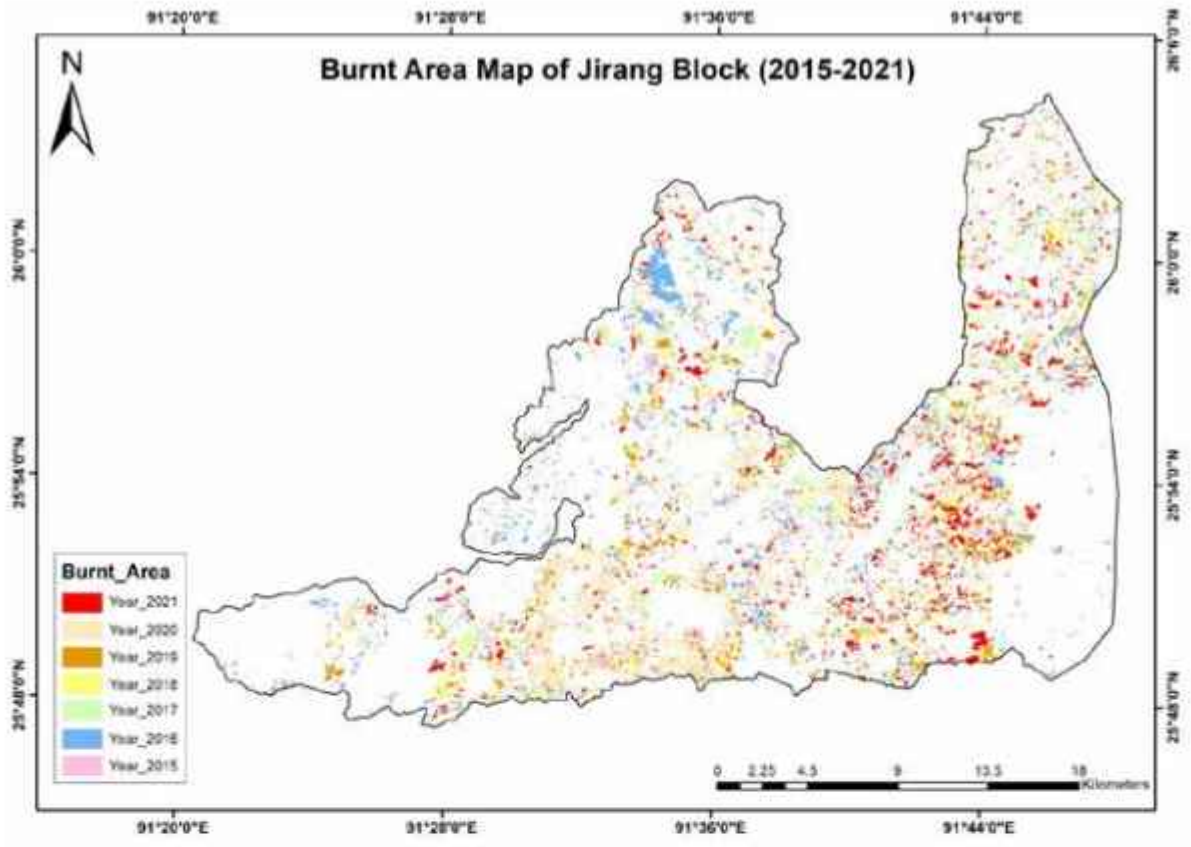


Figure 253. Burnt Area Map of Jirang Block

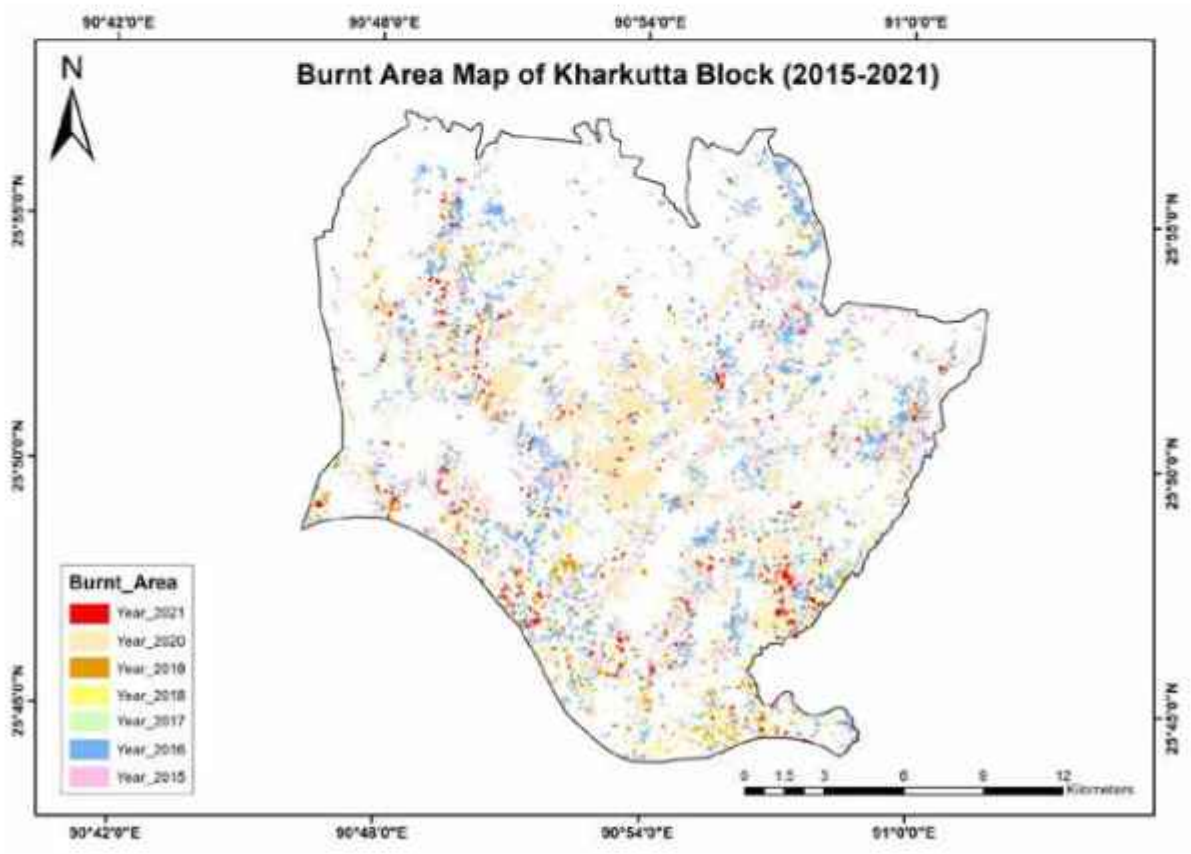


Figure 254. Burnt Area Map of Kharkutta Block

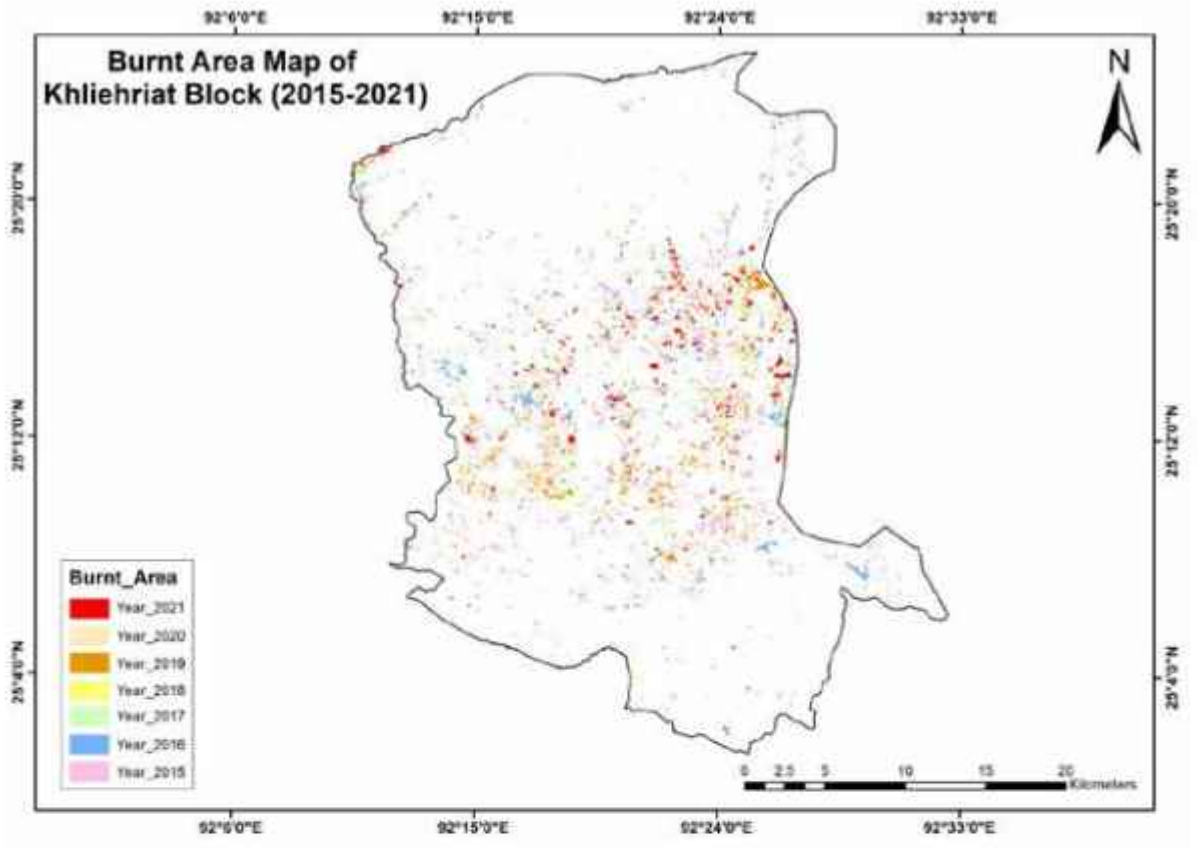


Figure 255. Burnt Area Map of Khliehriat Block

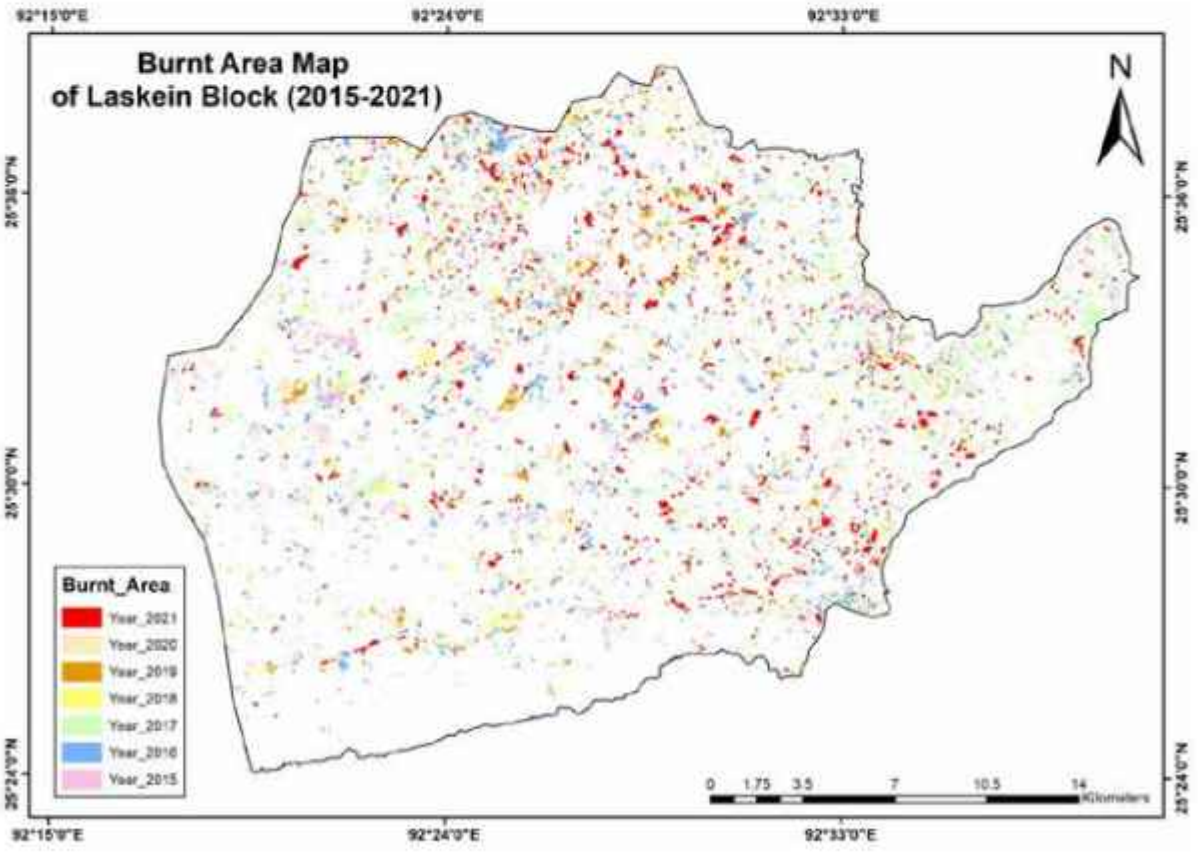


Figure 256. Burnt Area Map of Laskein Block

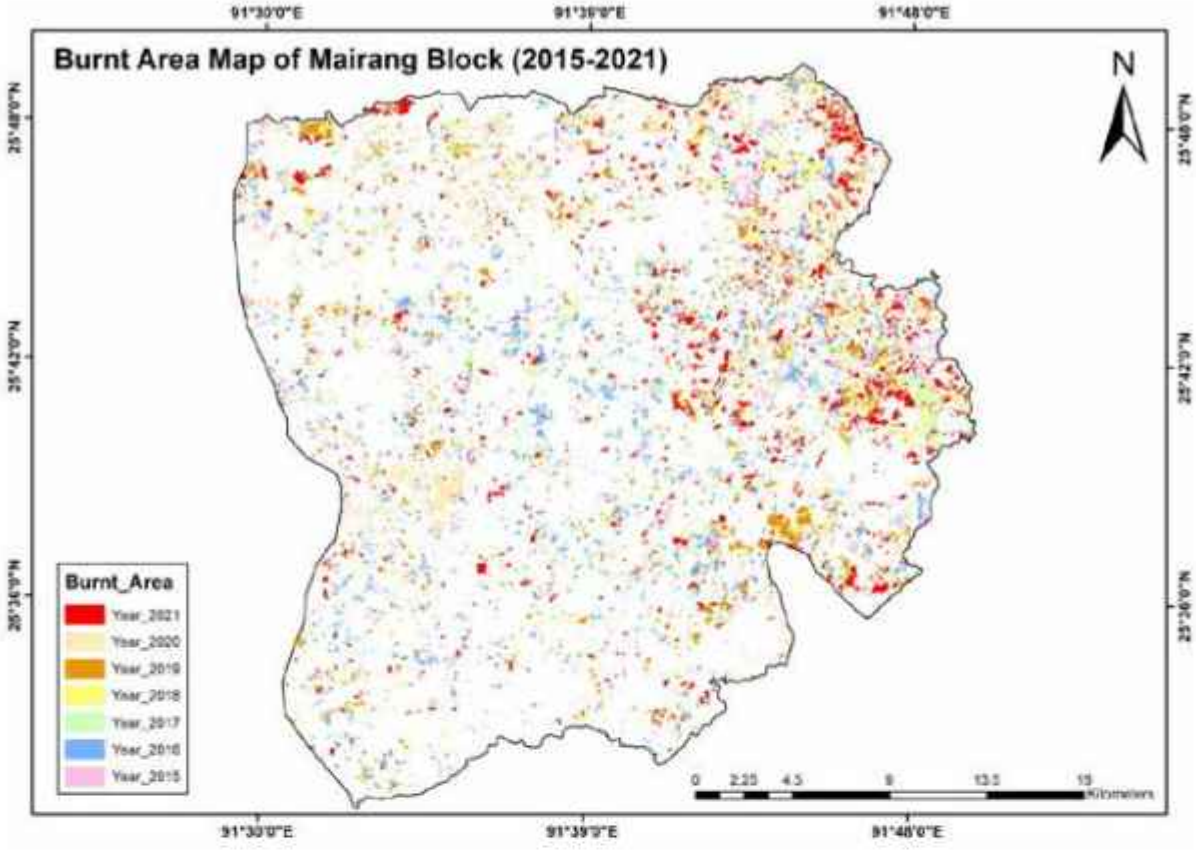


Figure 257. Burnt Area Map of Mairang Block

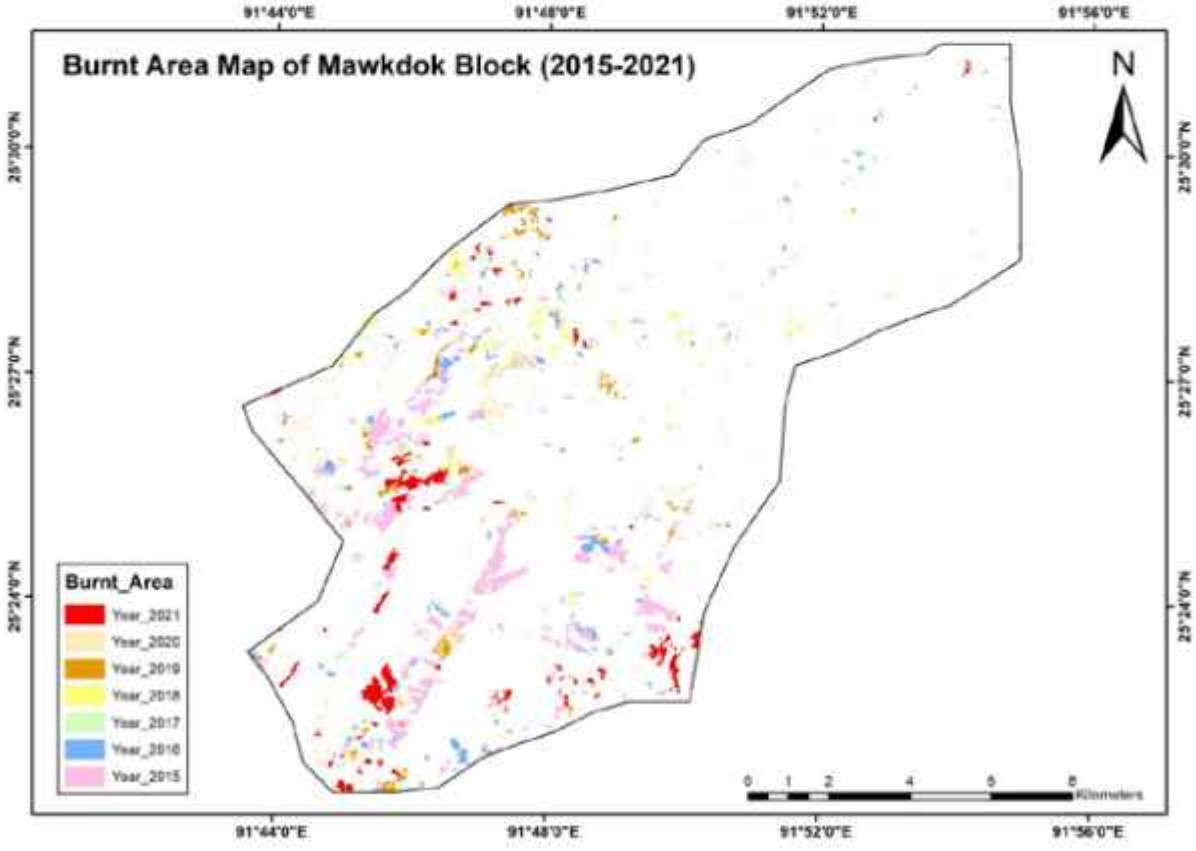


Figure 258. Burnt Area Map of Mawkdok Block

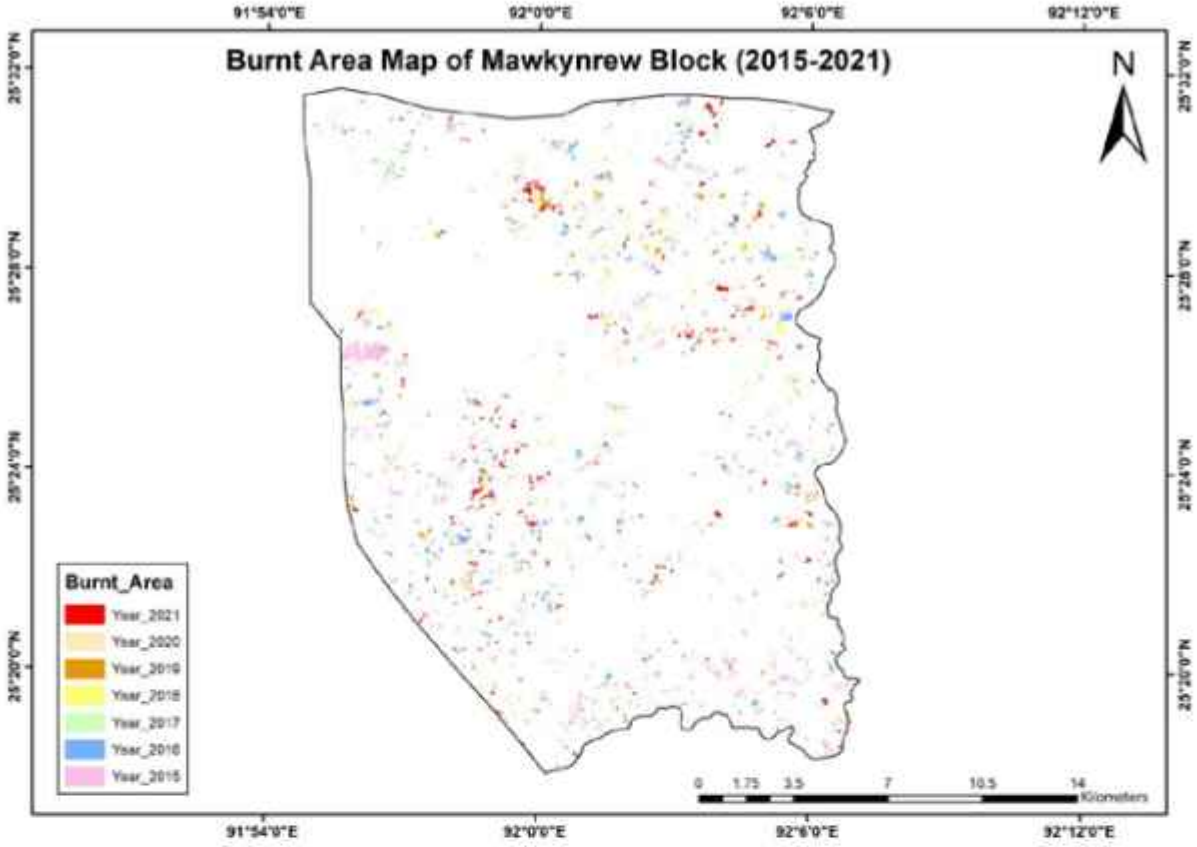


Figure 259. Burnt Area Map of Mawkynrew Block

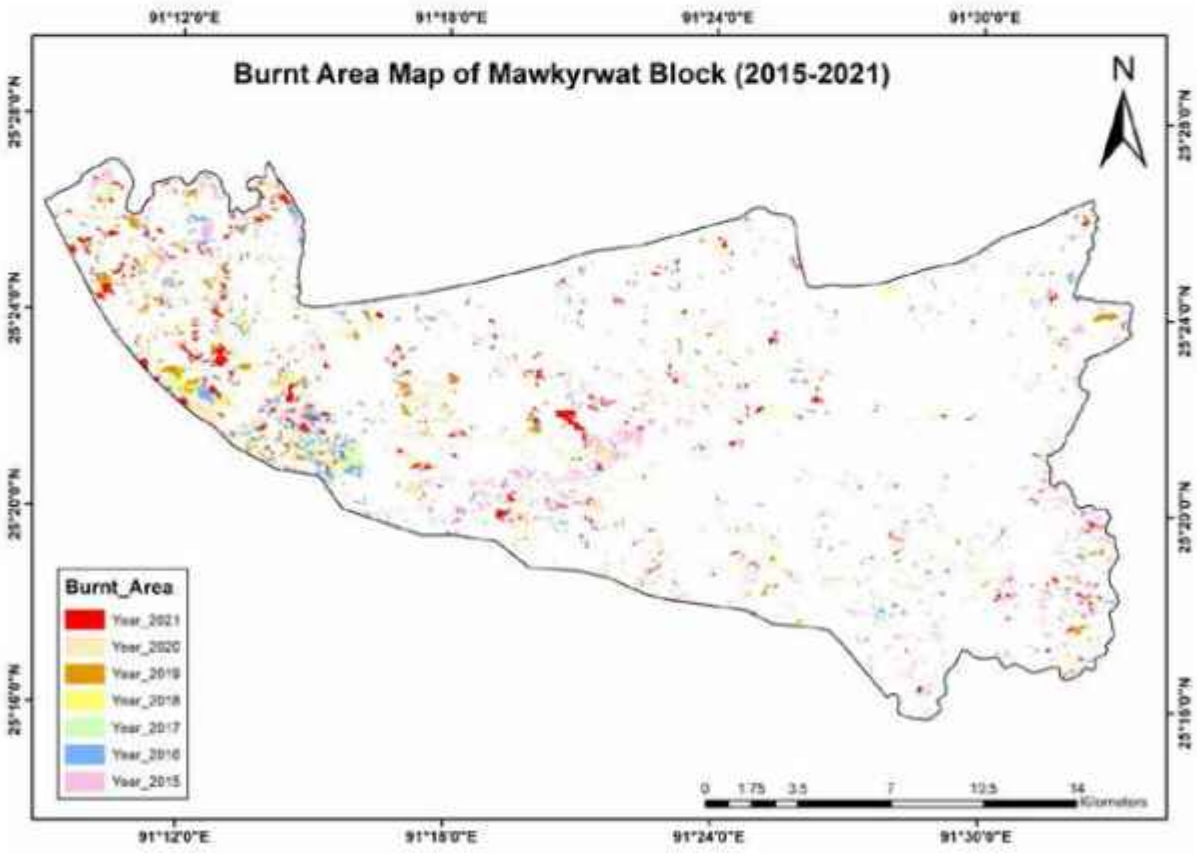


Figure 260. Burnt Area Map of Mawkyrwat Block

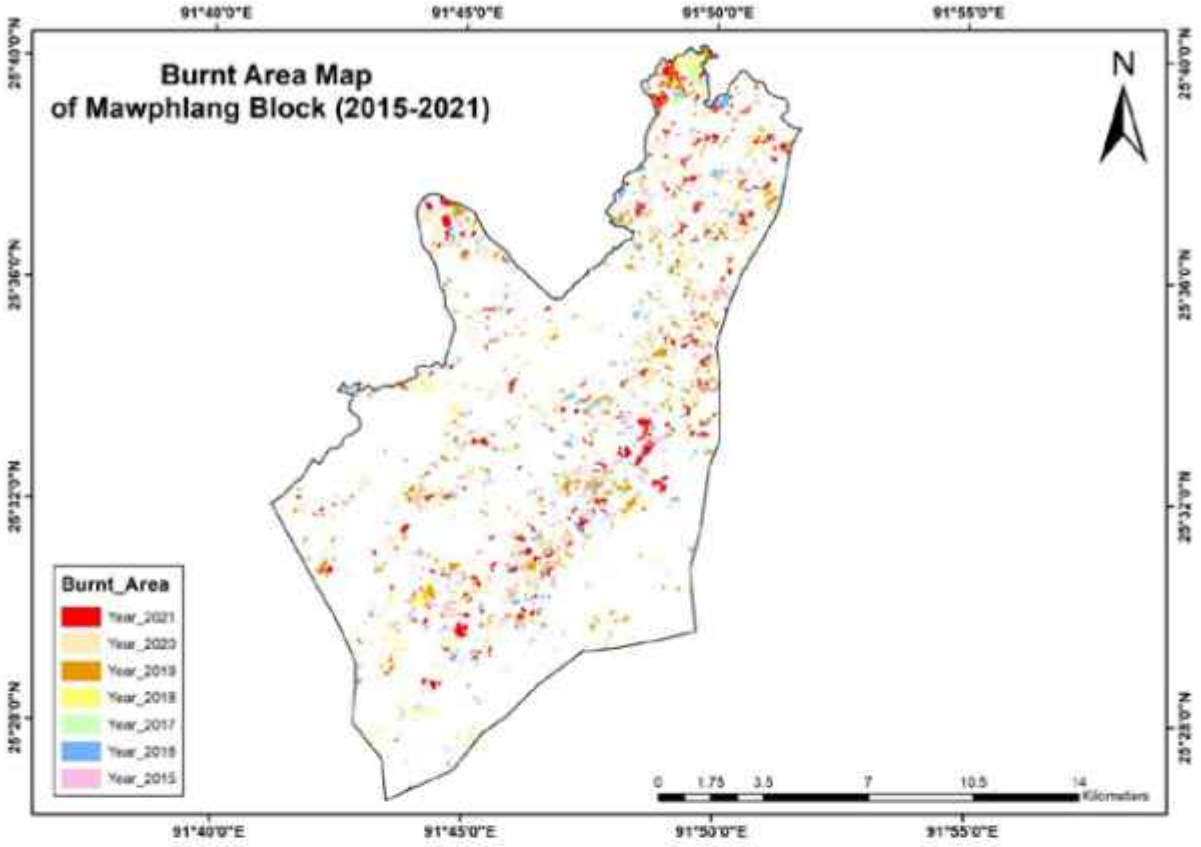


Figure 261. Burnt Area Map of Mawphlang Block

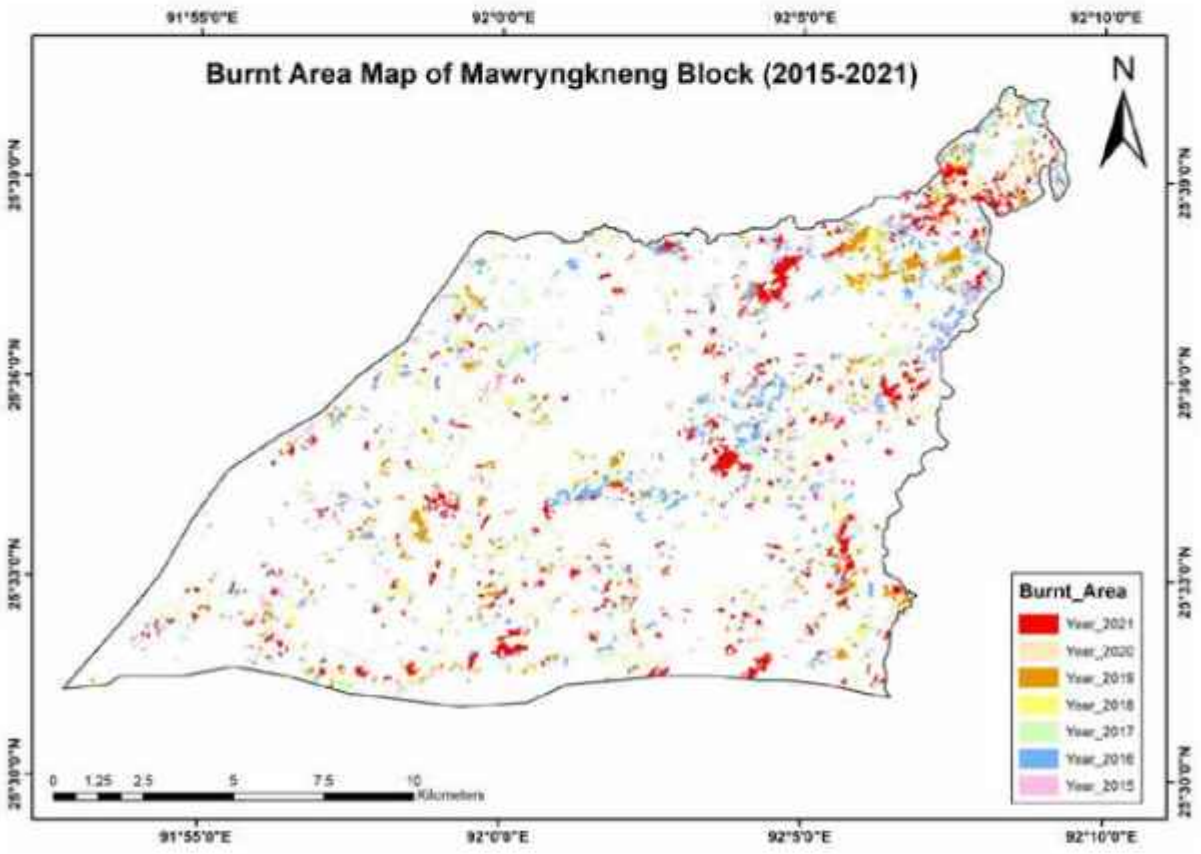


Figure 262. Burnt Area Map of Mawryngkneng Block

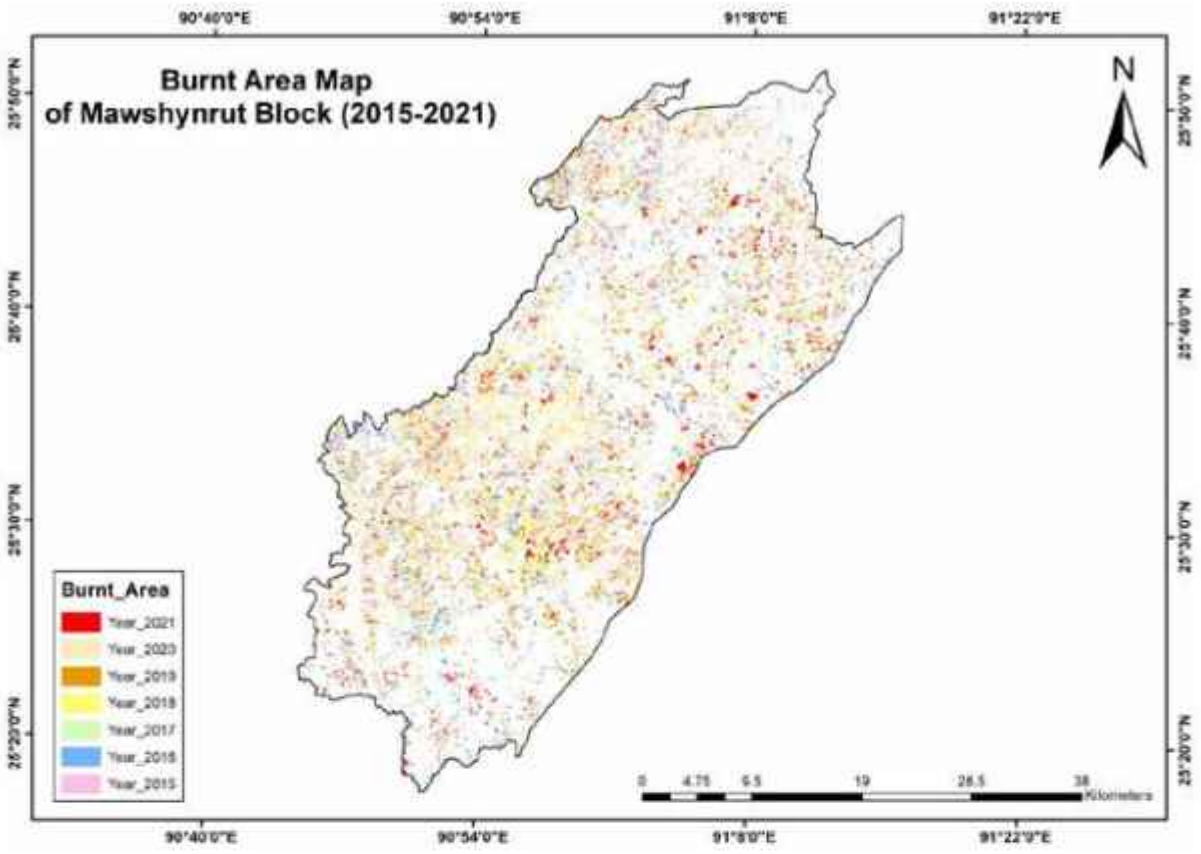


Figure 263. Burnt Area Map of Mawshynrut Block

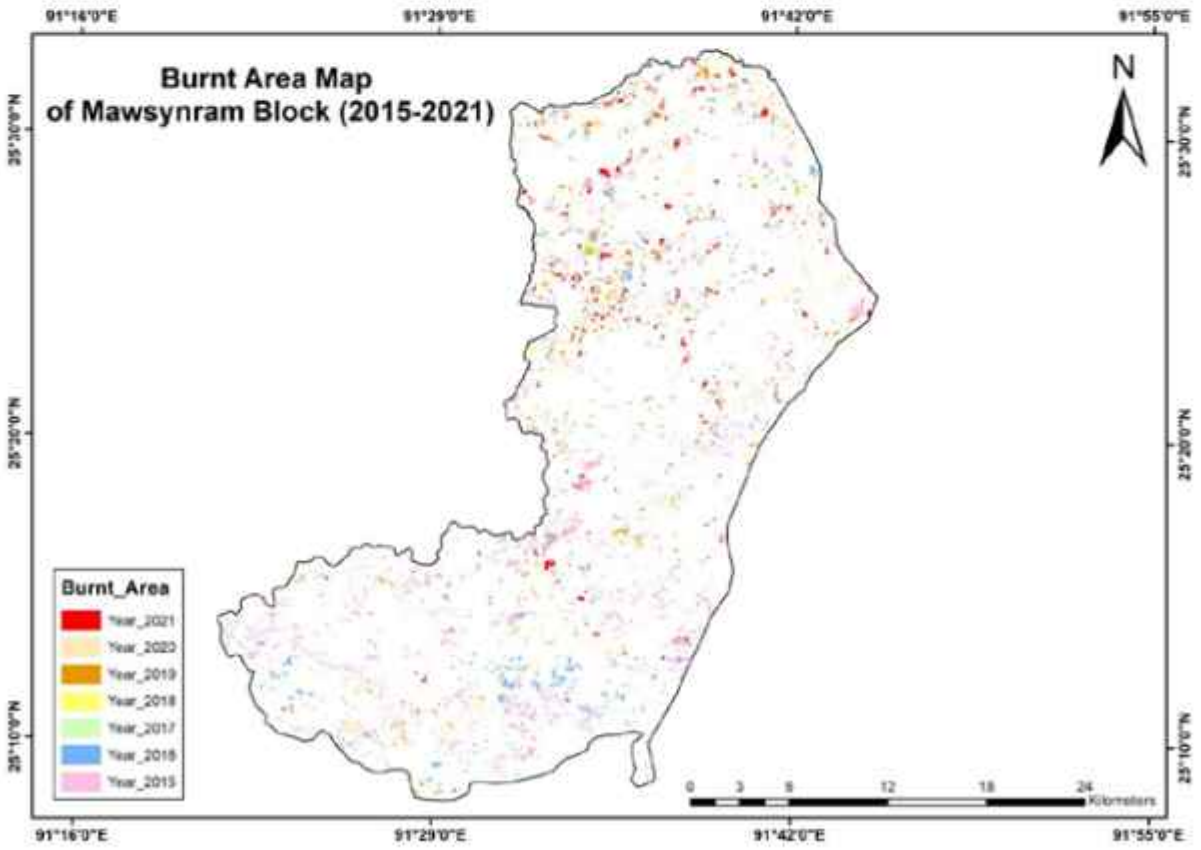


Figure 264. Burnt Area Map of Mawsynram Block

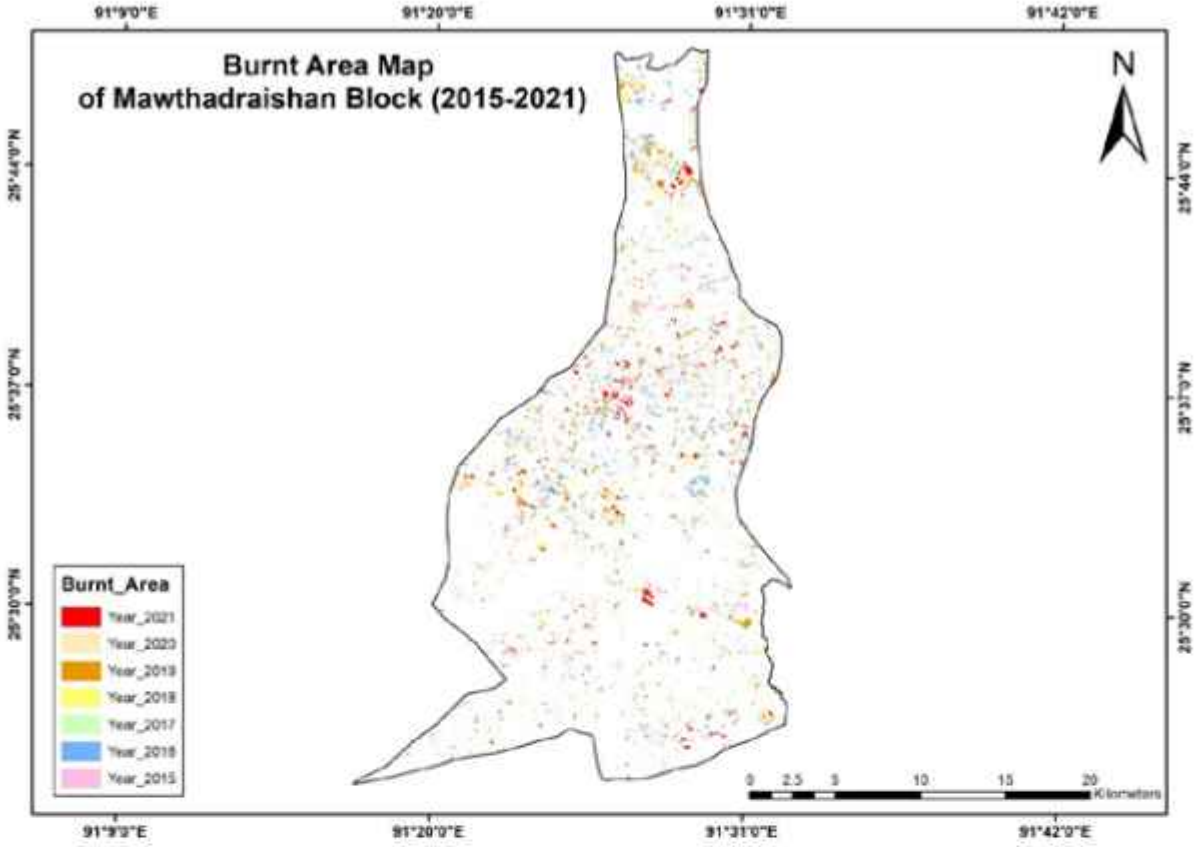


Figure 265. Burnt Area Map of Mawthadraishan Block

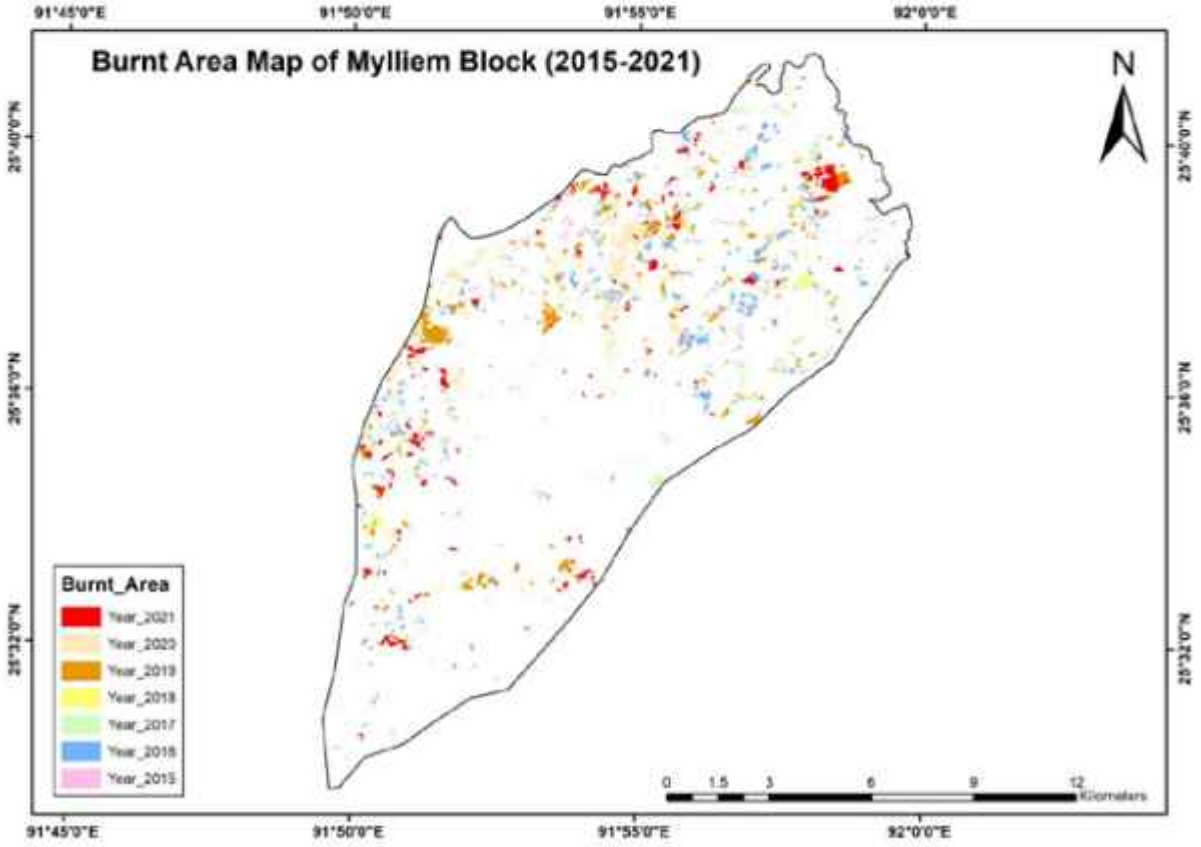


Figure 266. Burnt Area Map of Mylliem Block

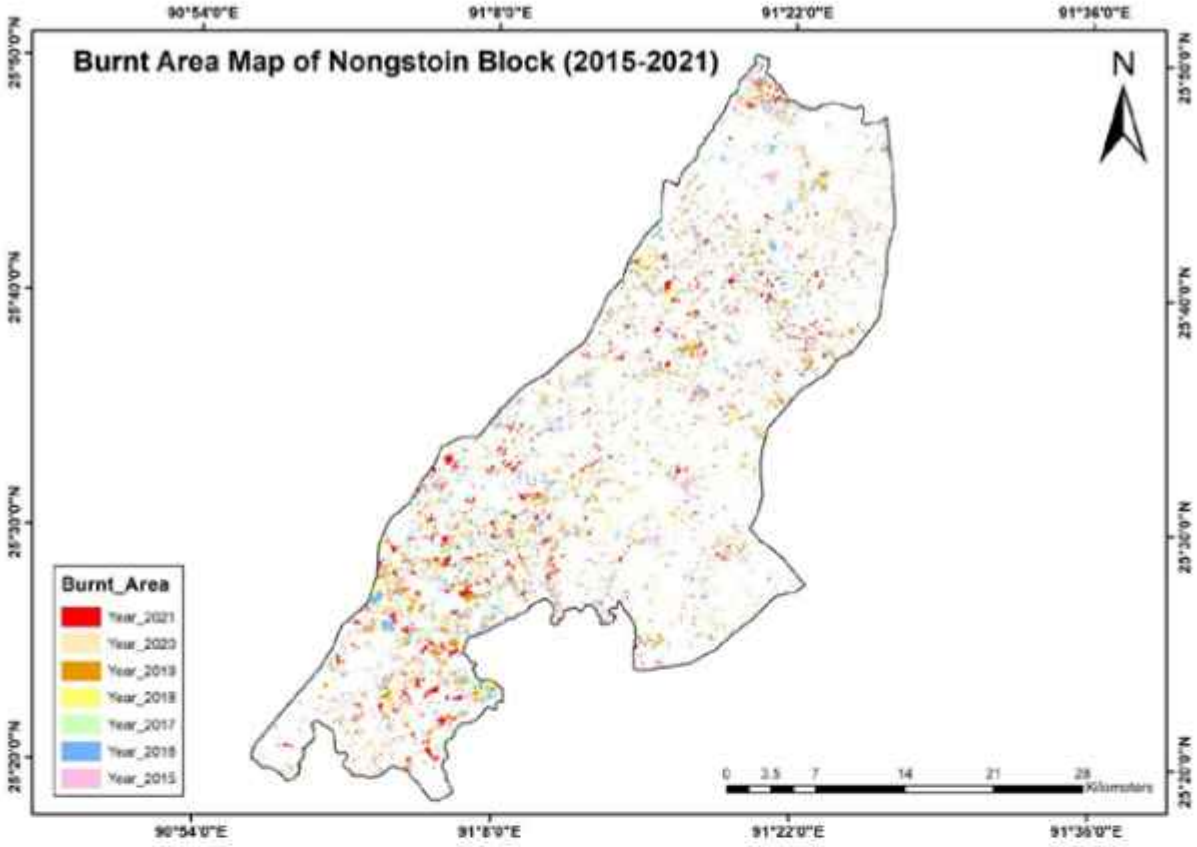


Figure 267. Burnt Area Map of Nongstoin Block

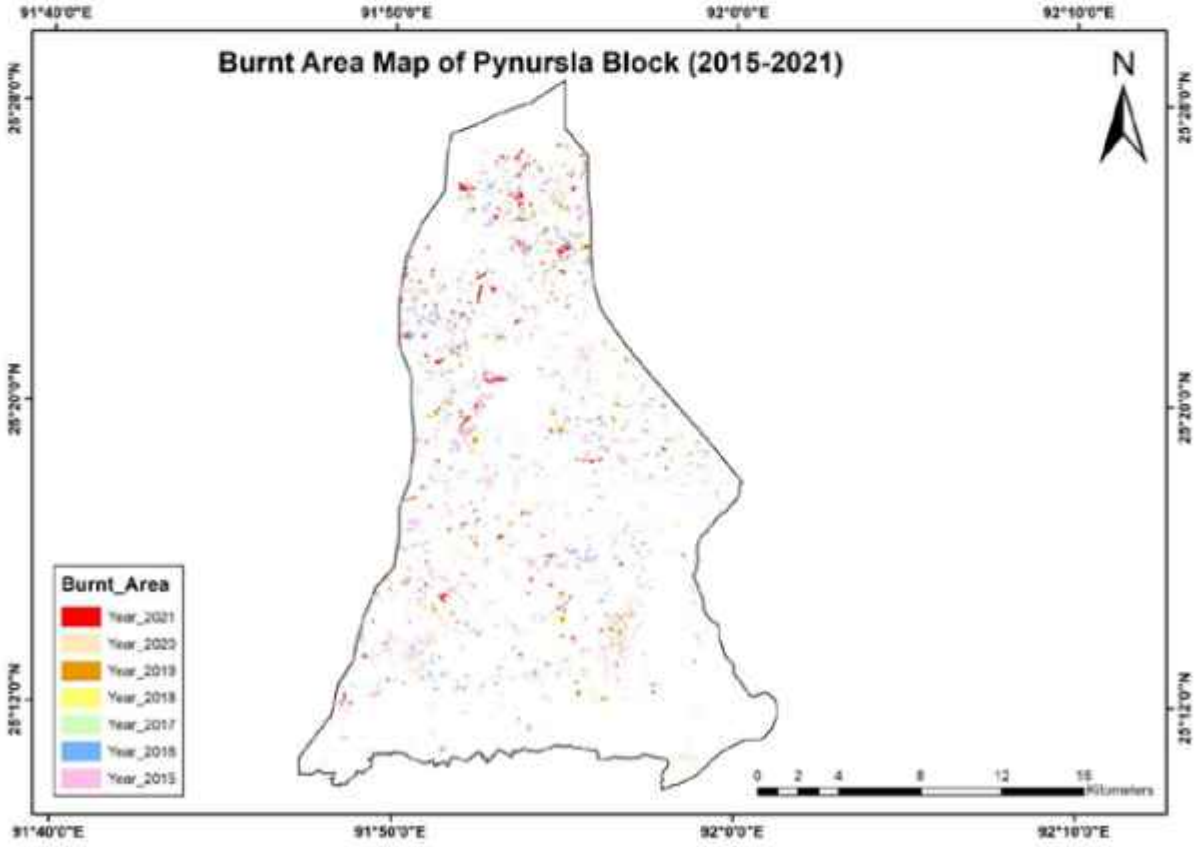


Figure 268. Burnt Area Map of Pynursla Block

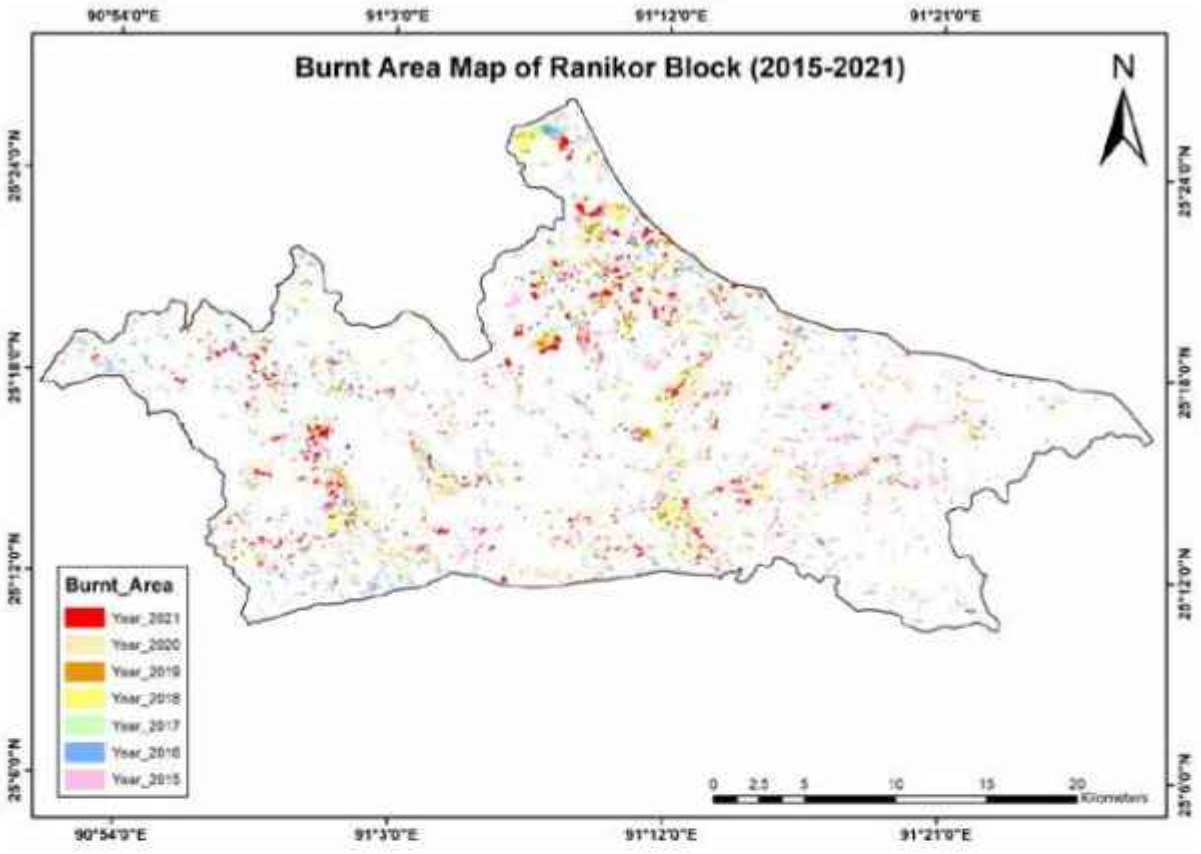


Figure 269. Burnt Area Map of Ranikor Block

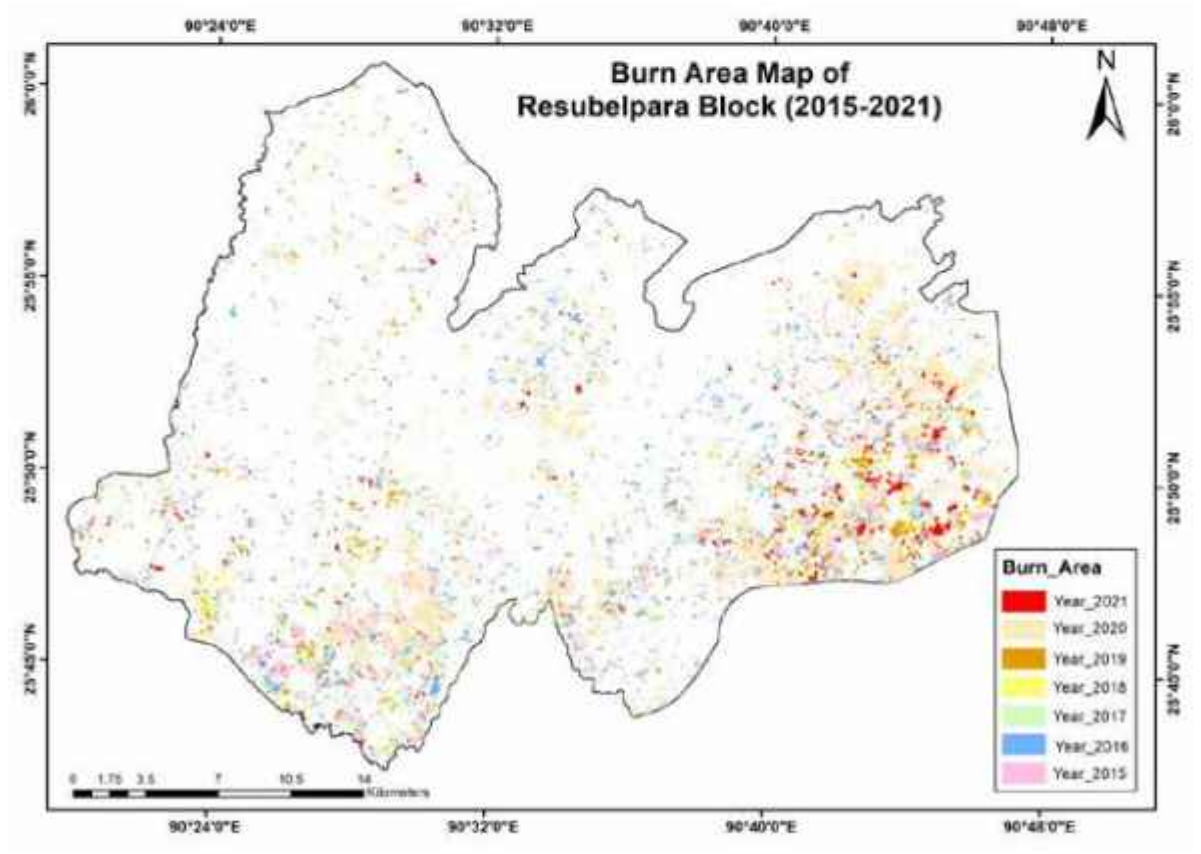


Figure 270. Burnt Area Map of Resubelpara Block

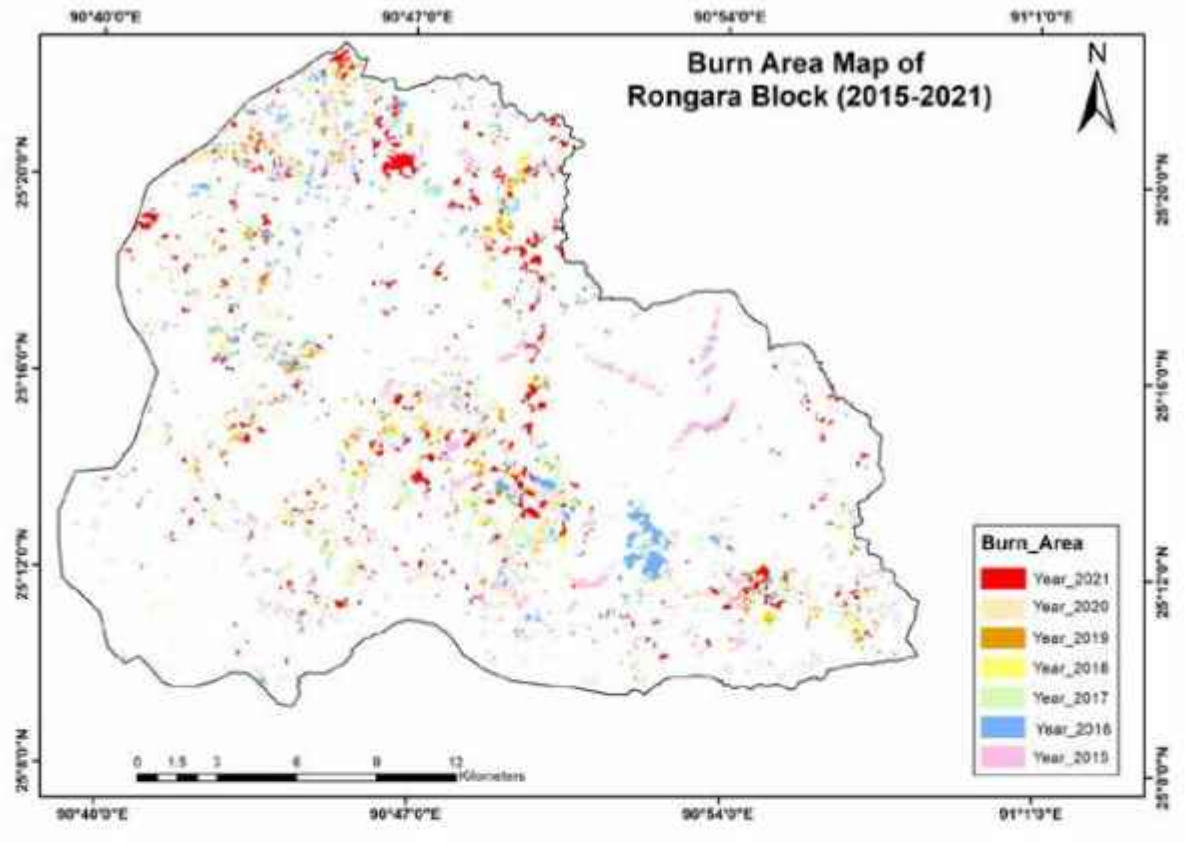


Figure 271. Burnt Area Map of Rongara Block

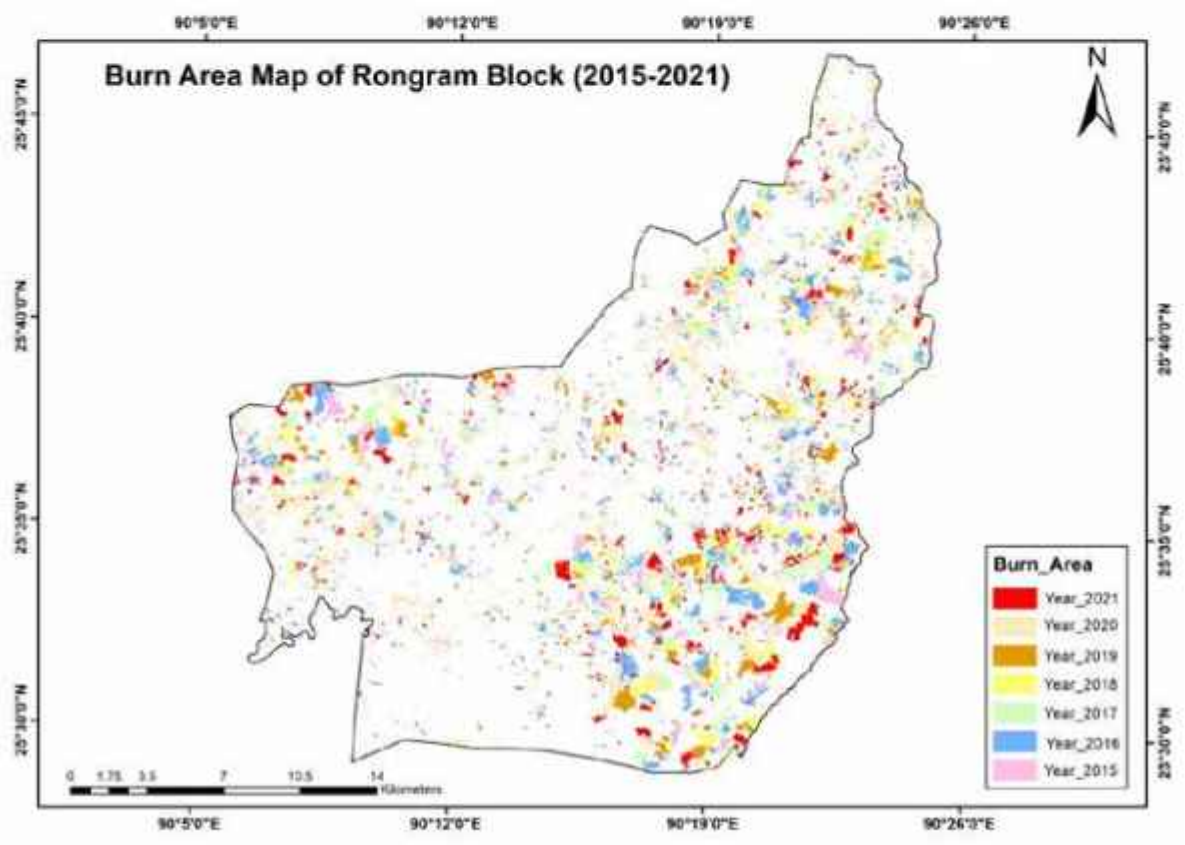


Figure 272. Burnt Area Map of Rongram Block

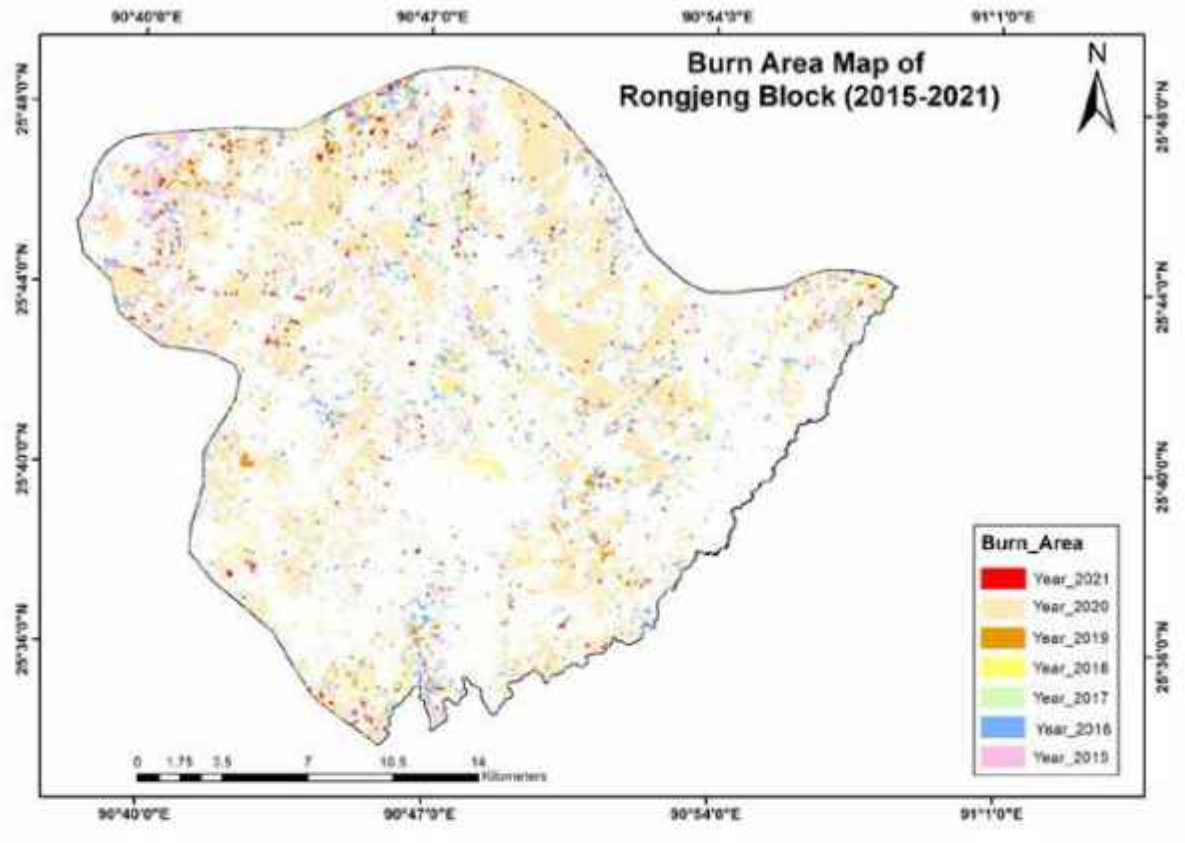


Figure 273. Burnt Area Map of Rongjeng Block

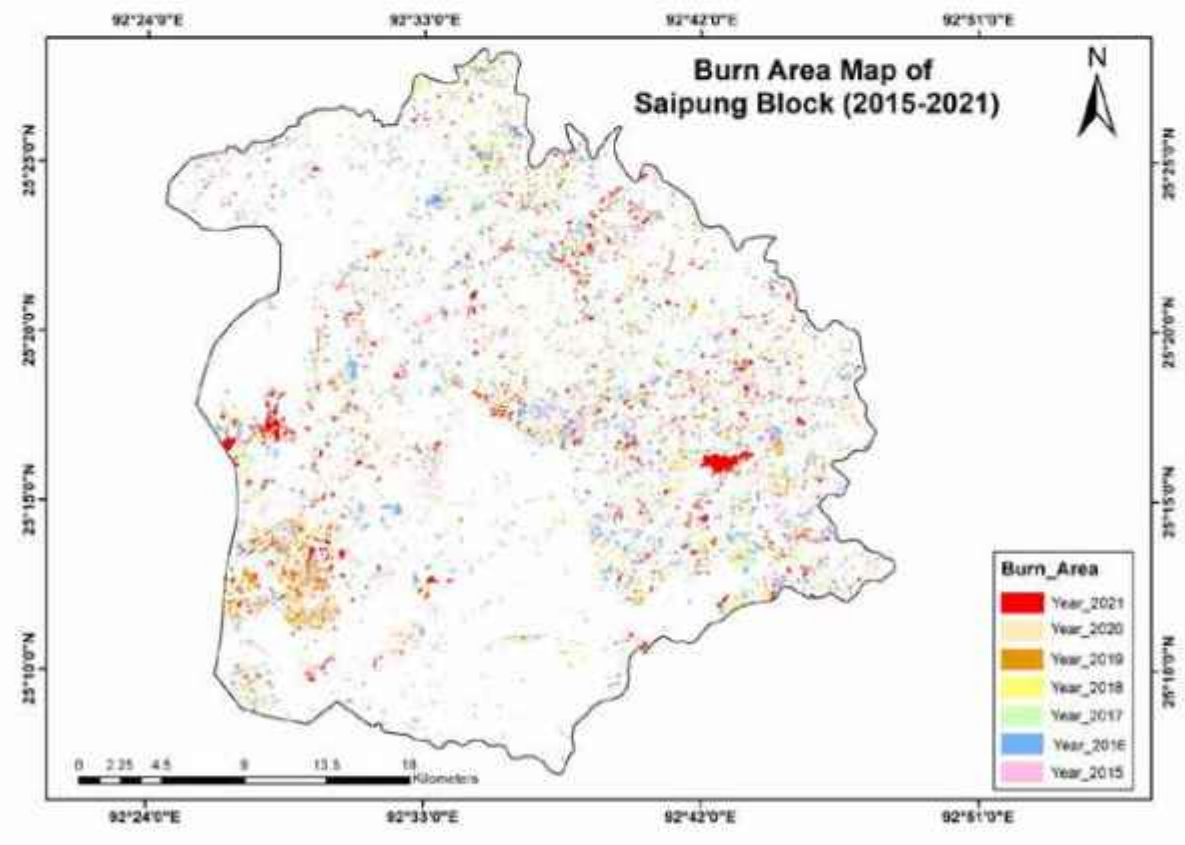


Figure 274. Burnt Area Map of Saipung Block

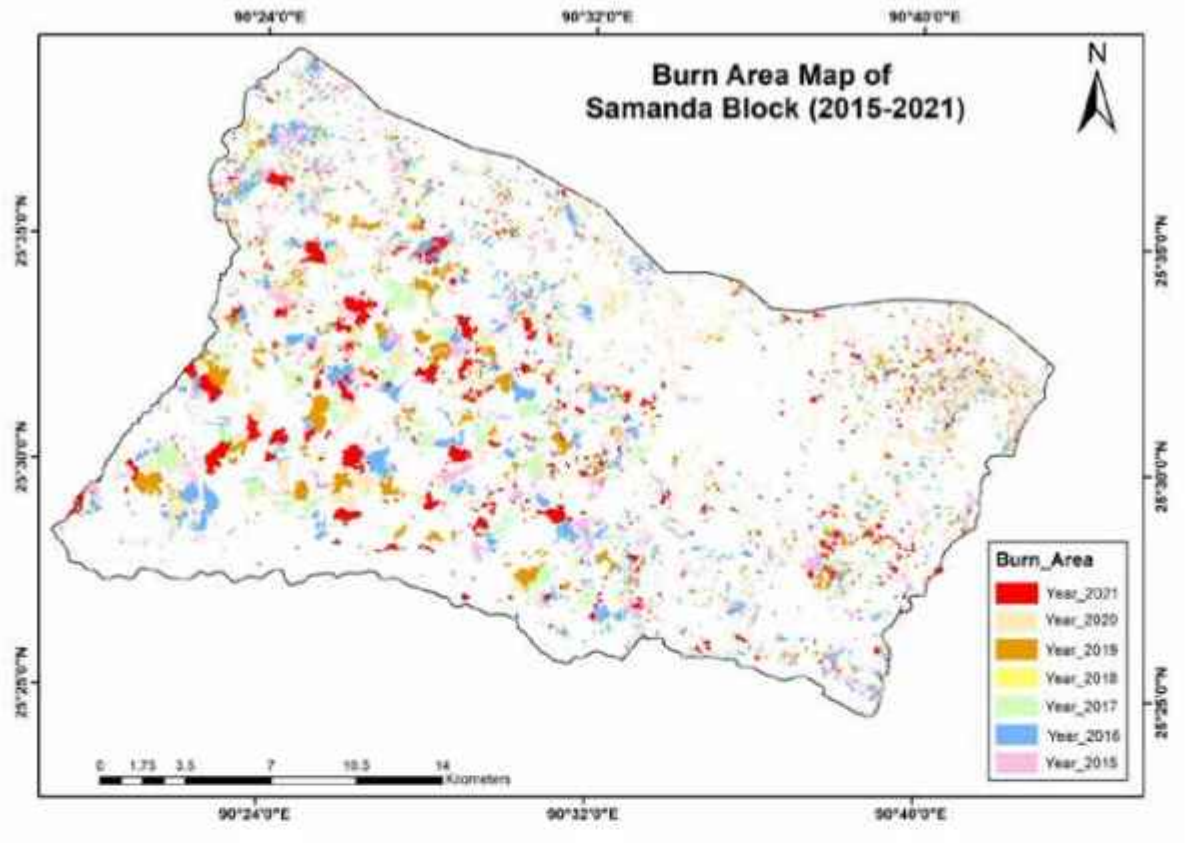


Figure 275. Burnt Area Map of Samanda Block

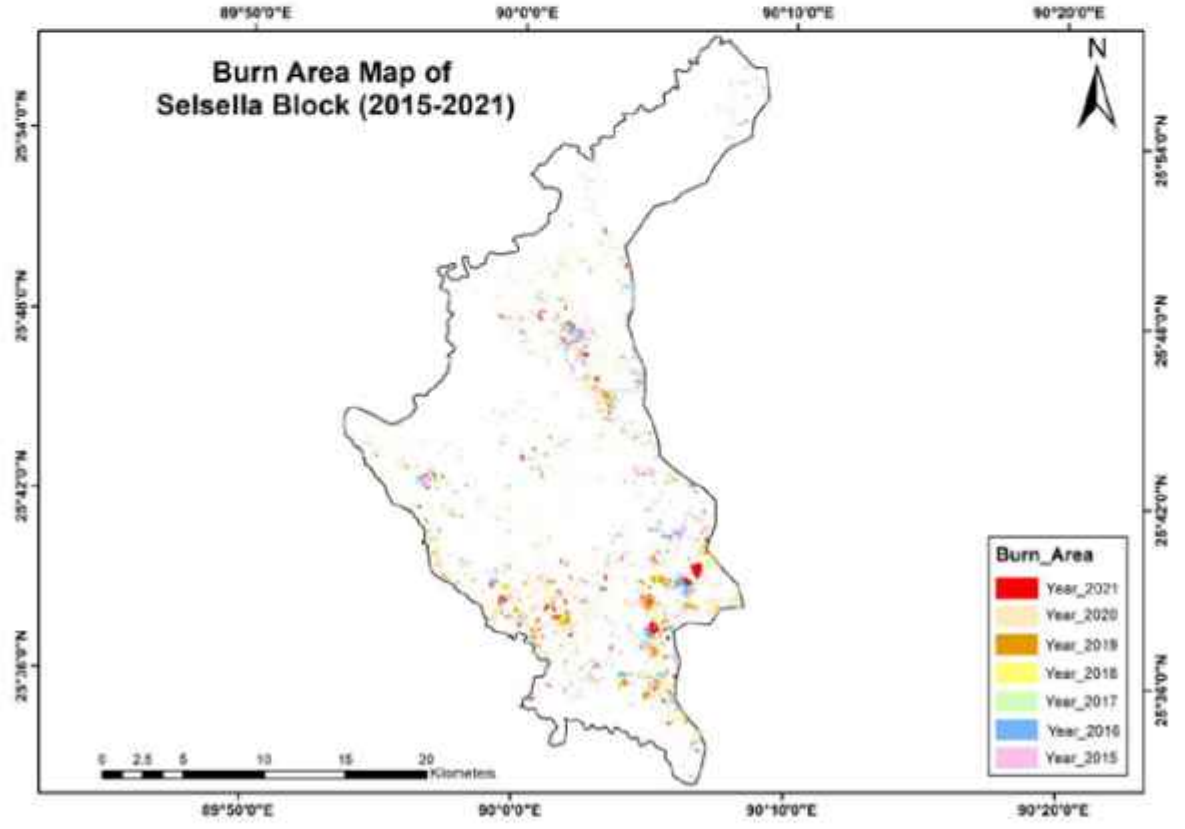


Figure 276. Burnt Area Map of Selsella Block

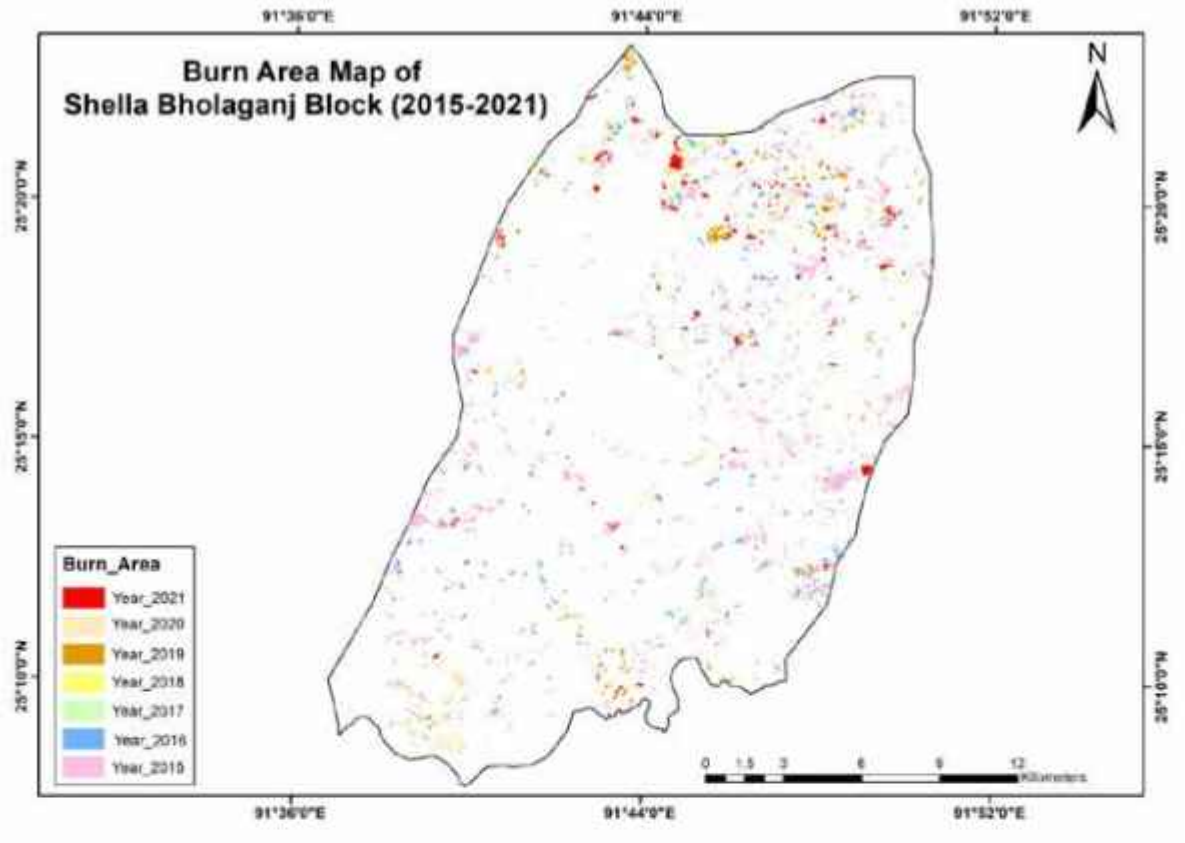


Figure 277. Burnt Area Map of Shella Bholaganj Block

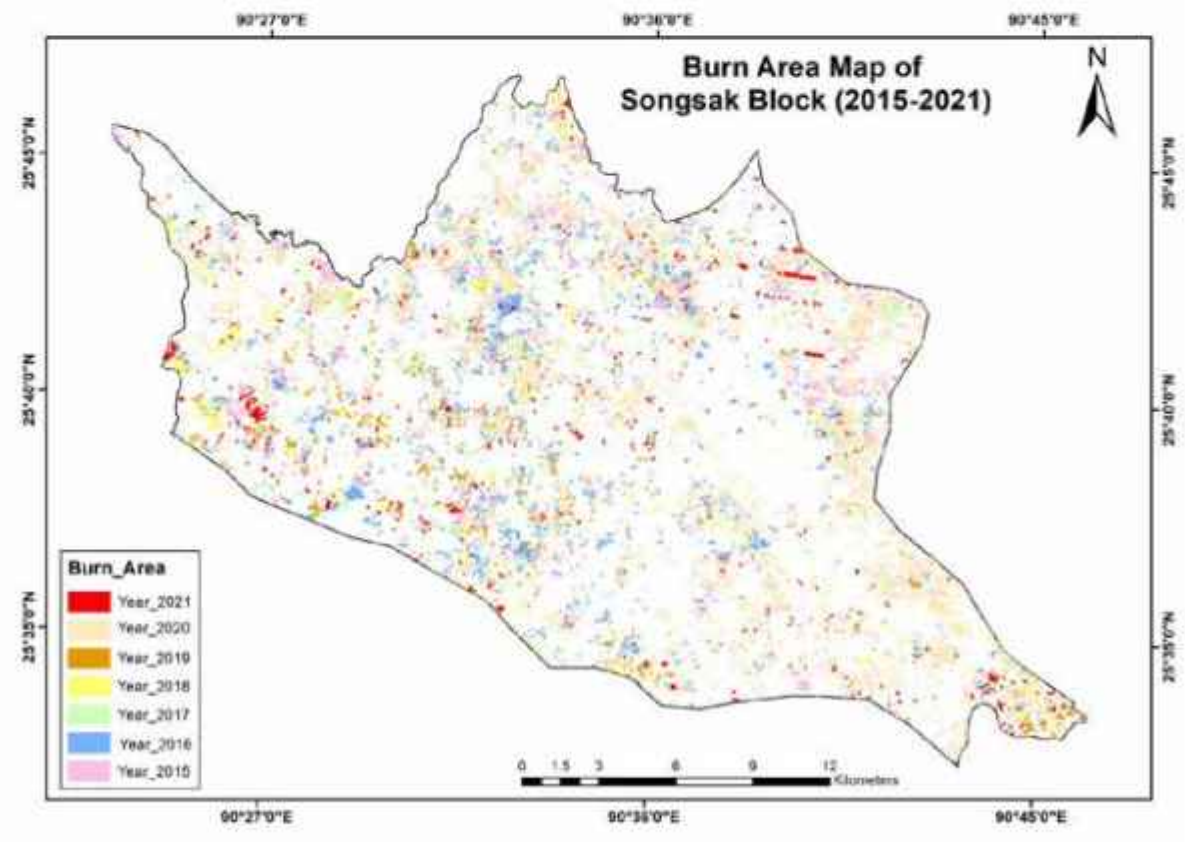


Figure 278. Burnt Area Map of Songsak Block

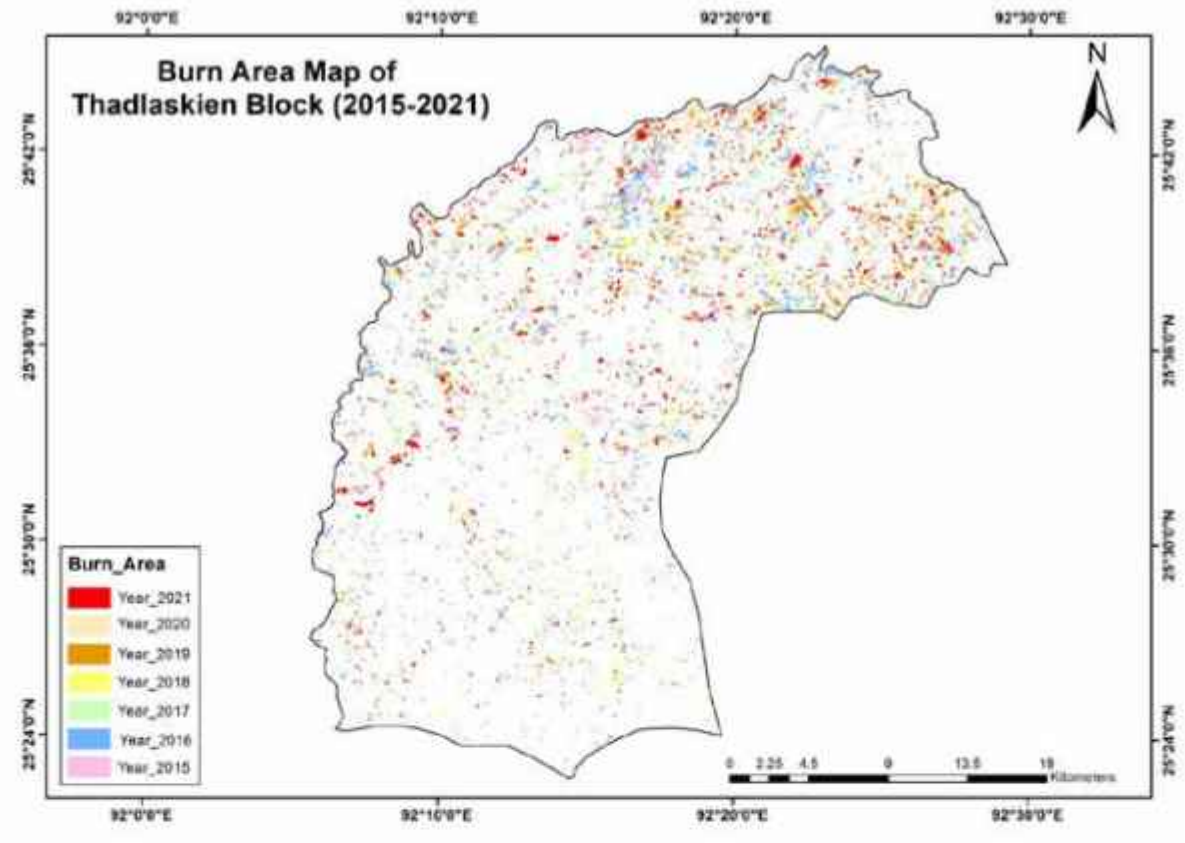


Figure 279. Burnt Area Map of Thadlaskien Block

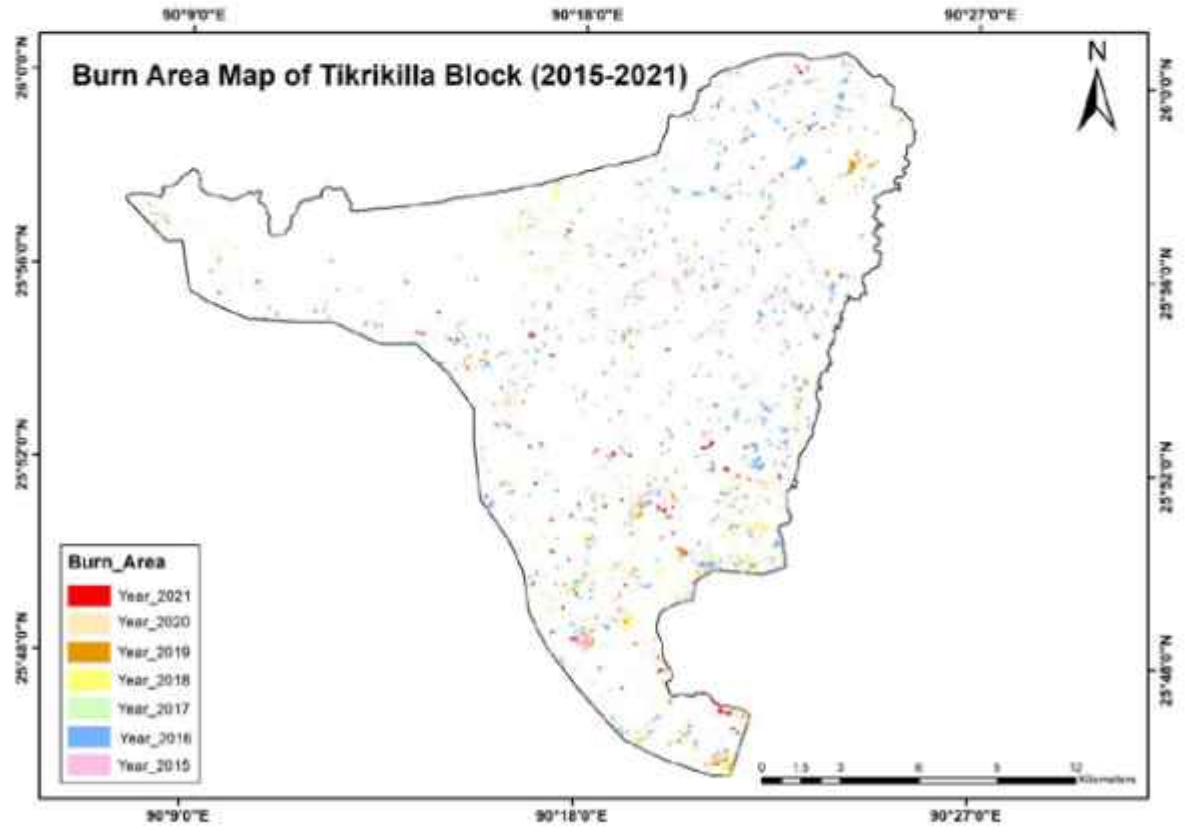


Figure 280. Burnt Area Map of Tikrikilla Block

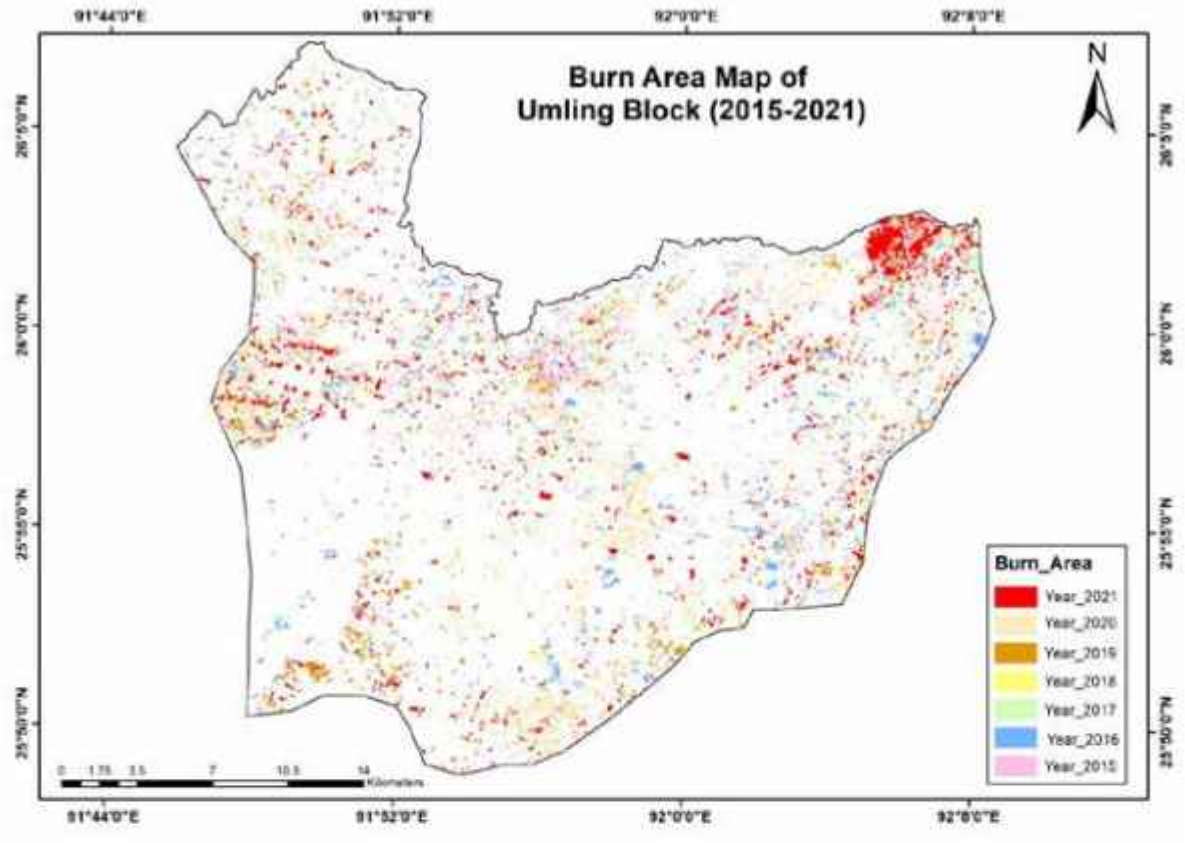


Figure 281. Burnt Area Map of Umling Block

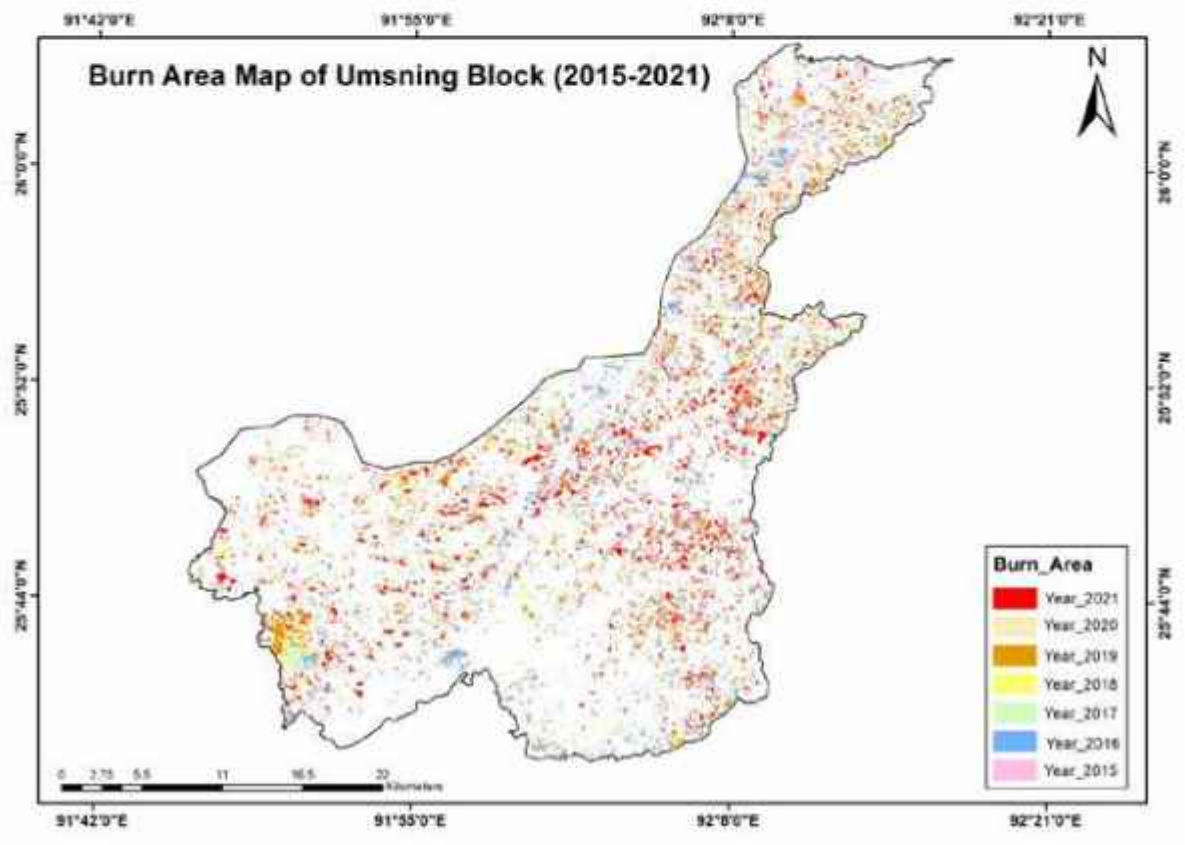


Figure 282. Burnt Area Map of Umsning Block

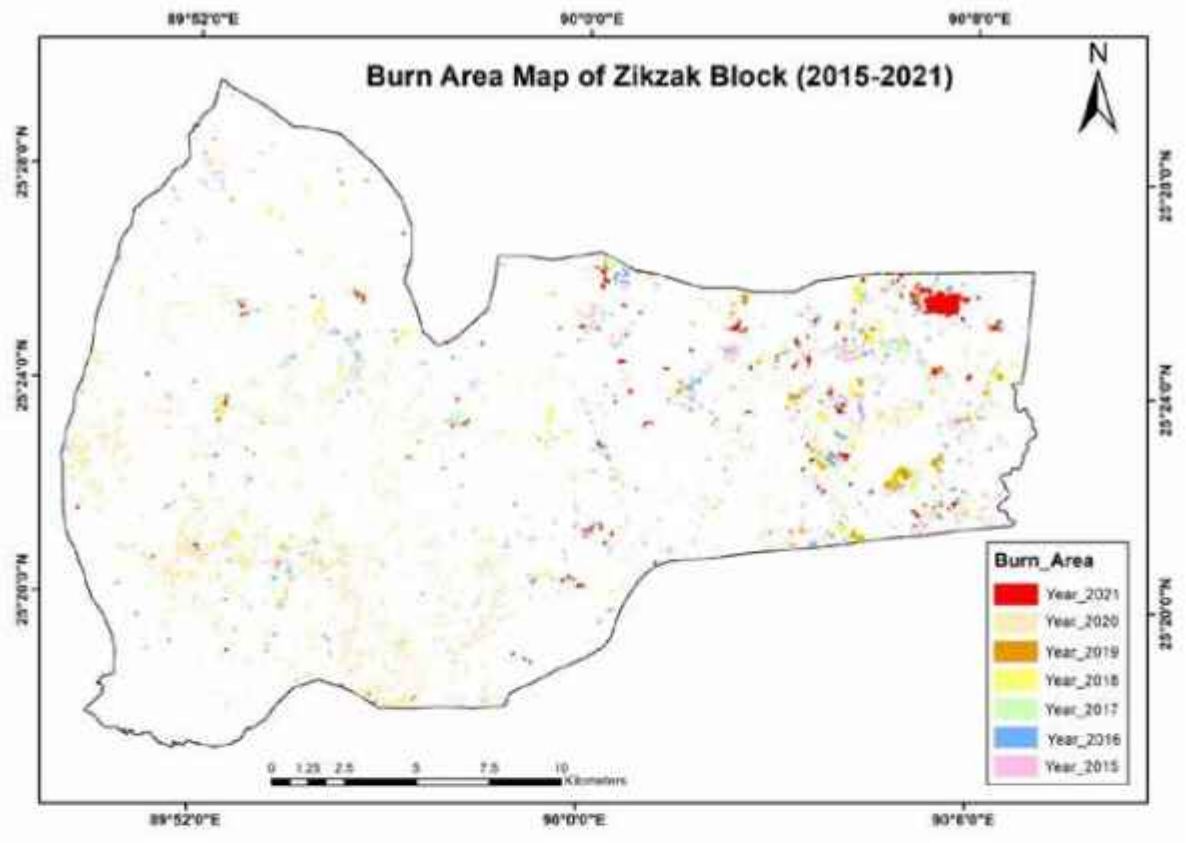
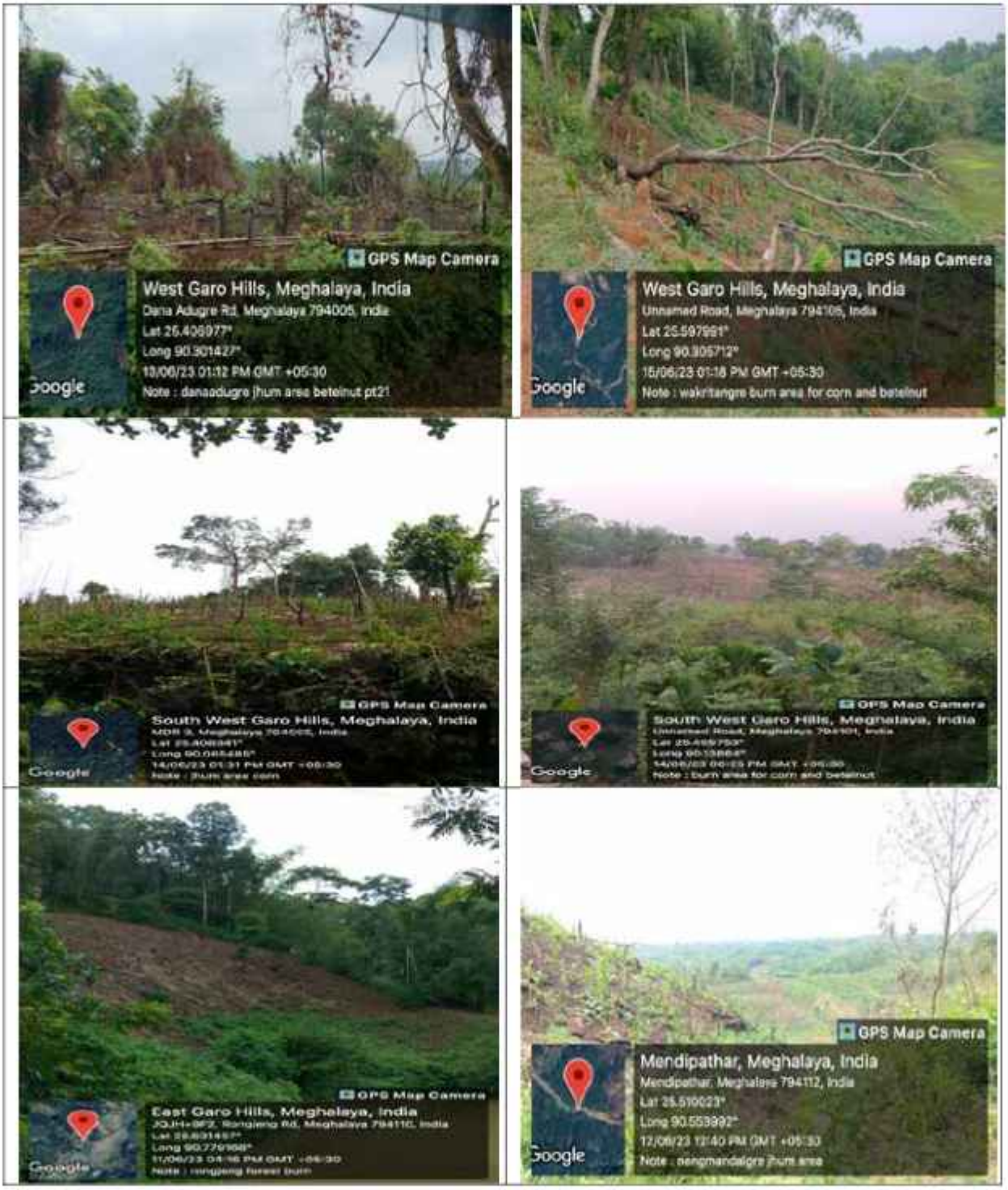


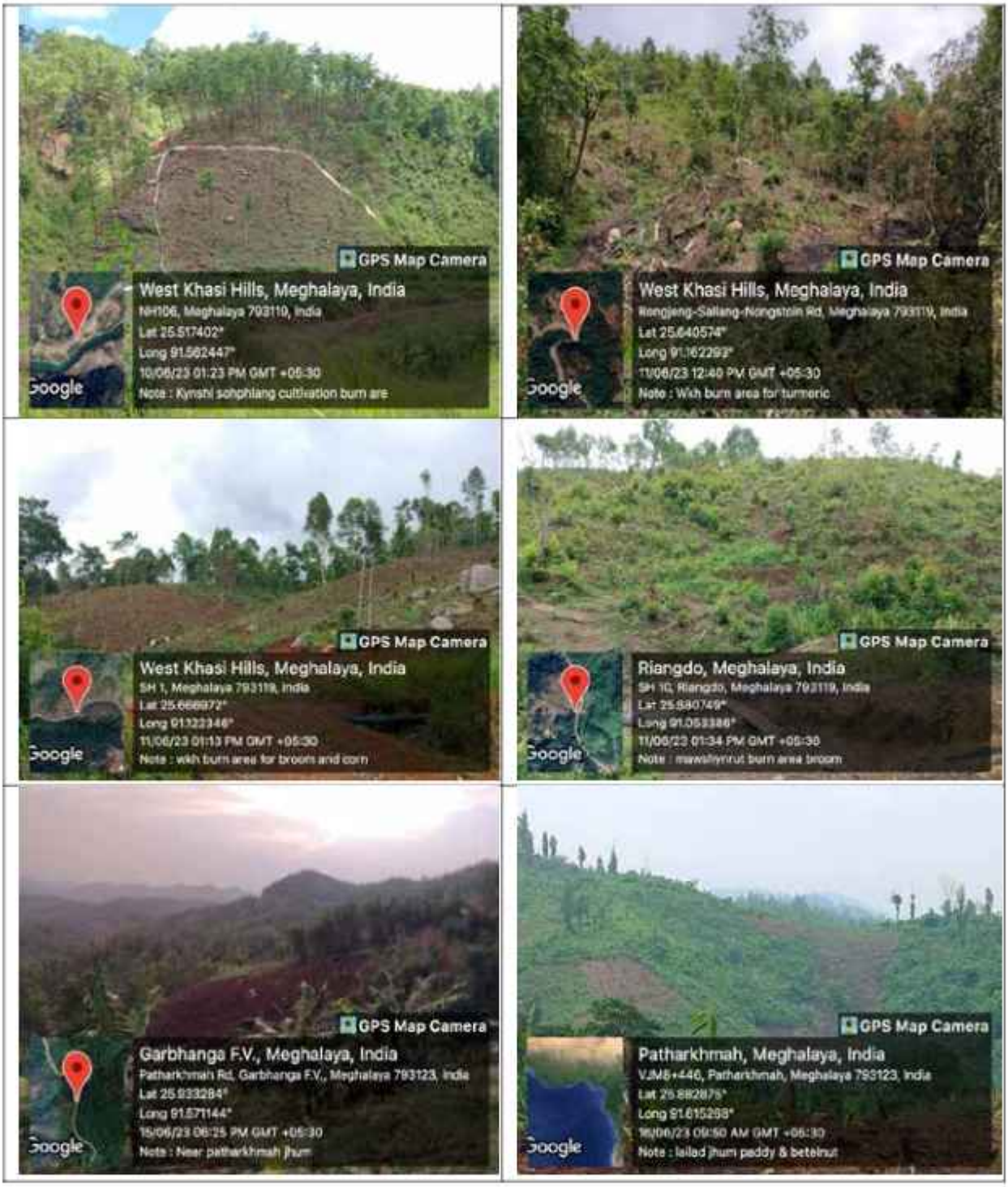
Figure 283. Burnt Area Map of Zikzak Block

Annexure-IX

Field Photographs



Field Photographs of Forest Fire



Field Photographs of Forest Fire



Dr. Kasturi Chakraborty is currently working as Scientist/Engineer 'SF' and Head, Forestry and Ecology Division at North Eastern Space Applications Centre (NESAC), Umiam, Meghalaya. She joined the organisation during the year 2002. Dr Kasturi completed her M.Sc. and M.Phil in Ecology and completed her PhD on forest and land use/ land cover dynamics using remote sensing and GIS. Presently, she is working on remote sensing applications in forestry and Ecology at NESAC. She has contributed as team member and team leader in several important forestry applications like ecosystem dynamics, forest working plan, forest change analysis at regional scale, land use land cover studies and so on. She has also completed assignments on wetland based projects. She has been in focal role in the National Wetland Inventory and Assessment project for whole North East Region (NER). She has brought out environmental change quantification and awareness through her research publications. She is recipient of ISRO, young scientist award and ISRO project team award.



Dr. Dhruval Bhavsar is a scientist at the Forestry and Ecology Division, North Eastern Space Applications Centre (NESAC), Department of Space, Umiam, Meghalaya. He obtained his Ph.D. and master's degree in forestry from Forest Research Institute (Deemed to be University), Dehradun. He has over 10 years of experience in the field of forest ecology, forest monitoring, and management using remote sensing and GIS. His primary expertise lies in imaging spectroscopy and microwave remote sensing. He has successfully completed various projects and authored publications related to forest loss monitoring, forest fire, species discrimination and distribution, forest biomass assessment, and carbon estimation.



Shri Harish Chandra Chaudhary is an Indian Forest Service Officer. He has more than 30 years of experience of working under the Government of India, the Government of Meghalaya, the Indian Council of Forestry Research and Education (ICFRE) and National Human Rights Commission. While working under the ICFRE for five years he was associated in planning and execution of several forestry research projects. While working under the Government of India for more than six years, he dealt the matters relating to the Forest (Conservation) Act, 1980 and the Green India Mission. Under the Government of Meghalaya, he has handled issues relating to forest management, protection, afforestation, wildlife and forestry research education and training. Currently, he is working as Principal Chief Conservator of Forest, Working Plan, Research and Training and District Council Affairs, Forest and Environment Department, Government of Meghalaya.



Shri Suraj Kumar Swain is a wildlife and forest researcher with a passion for conserving biodiversity and natural habitats, having a sound knowledge in the application of remote sensing and GIS for forest cover change analysis, land use and land cover studies. He obtained his M.Sc. degree in Biodiversity and Conservation of Natural Resources from the Central University of Odisha and pursuing his PhD from Mizoram University. His professional experience spans over six years, primarily focused on forest inventory and ecology in different parts of India. Currently, He is working as a Research Scientist at the NER-DRR, Forestry and Ecology Division, North Eastern Space Applications Centre (NESAC), Department of Space, Government of India.



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