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RESEARCH ARTICLE

Impact of Shifting Cultivation on Human Health at Lengpui and the Adjoining Villages, Mizoram, India

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Abstract

Objective: Studying the impact of air pollution caused by jhum burning on human health in the study area. **Methods:** The health status study was done in the village communities in the study area by employing the methods of Participatory Rural Appraisal (PRA). Information was gathered through personal and group interviews with the local villagers, the village council members, the YMA office bearers, the health workers and nurses, and government employees of Hmunpui, Lengpui and Sihhmui village. **Findings:** The health effect of jhum burning on the villagers are not as serious as anticipated. The greatest number of cases reported are cough and cold and a few cases of bronchitis, asthma and sinusitis. However, when using data from the urban region, the number of patients reported is greater than in the suburban area, and there are more respiratory diseases than in the suburban area. **Novelty:** Deterioration of air quality, which is an alteration of atmospheric chemistry by pollutants from natural and anthropogenic sources, is of major global environmental concern today. The sources of deterioration of air quality in Mizoram is mainly due to shifting cultivation or slash and burn agriculture or jhum burning, one of the main form of agriculture and livelihood of the villagers. Large amounts of air pollutants are emitted during prescribed forest fires (jhum burning). Unlike wildfires, prescribed fires are intentionally ignited in order to maintain ecosystem health and minimize adverse impacts of long-term fire suppression while protecting property. However, jhum burning has resulted in many forms of pollution, directly and indirectly hampering the natural environment. The need to understand the effect of jhum burning and the consequences not only on soil but on air and human health is important.

Keywords: Air pollution; Human health; Jhum burning; Livelihood; Mizoram

1 Introduction

Though an agricultural state, the primitive method of shifting cultivation / jhuming is still practiced in Mizoram. Shifting cultivation and the Mizo culture are closely interrelated. It is claimed that jhum was started by the Mizo since the days they descended from the far east to the Lushai hills (now Mizoram) across Burma (Myanmar)[(1)]. Most types of forest encroachment involve clearing the land of trees and vegetation by burning and then cultivating it as long as it will produce crops [Figure 1]. Clearing the vegetation in the autumn allows for better decomposition, which increases productivity.

Fig 1. Shifting (jhum) cultivation practices in the study area

The right timing of burning is of utmost importance in jhumming. The timing is crucial in the sense that the felled trees and bamboos in the field are to be sufficiently dry so that it burns very well. Generally, most plots are fired by the 15th or 20th of March (as declared by the Village Council), depending on local weather conditions. The village elders from their traditional knowledge of cloud formation decide the suitable date for burning. Late burning as in April increases the risk of fire spreading to the surrounding dry vegetation, or early rain can upset drying and burning. If rain soaks the unburnt jhum land, ideal jhum cultivation is not possible[(2)].

In today's world, shifting cultivation is bad because it causes carbon emissions and thus contributes to climate change[(3)]. The transformations of swidden cultivation have a wide range of environmental consequences at the local and at global levels. The brown haze, caused by dust from barren soils (by indiscriminate deforesting) and the blue haze from agricultural burning along with large dust concentrations, has led to a new air pollution problem known as particulate and aerosol pollution[(4)].

Human health is affected by air pollution mainly due to the inhalation of gases and particulates during respiration[(5)].CO has a high affinity towards haemoglobin and reduces the oxygen-carrying capacity of the blood, leading to damage to the Central Nervous System. Asphyxiation is caused by CO_2while SO_2 causes irritation of the respiratory tract and cough, and NO_2 causes inflammation of the lungs[(6)]. Personal discomfort is characterized by eye irritation and respiratory difficulties associated with asthma, bronchitis, emphysema, sinusitis, cardiovascular damage and lung cancer, which are particularly associated with particulates[(7)]. Mizoram Pollution Control Board (MPCB)[(8)] states that air pollution in Mizoram is largely contributed by Agricultural activities.

Unlike wildfires, prescribed fires are intentionally ignited in order to maintain ecosystem health and minimize adverse impacts of long-term fire suppression while protecting property. However, jhum burning has resulted in many forms of pollution, directly and indirectly hampering the natural environment. The need to understand the effect of jhum burning and the consequences not only on soil, but on air and human health is important. A specific study on the impact of jhum cultivation on air and the health status of the affected areas has not been carried out before particularly with reference to Mizoram. And since, the research proposed area, Lengpui is where the airport, an important commercial centre of the state is situated. Therefore, scientific studies on the impacts of jhum burning on the proposed areas became important[(9)].

The State Government has launched programmes for the control of jhuming and the agricultural lands are being allotted to the farmers for taking up the permanent type of cultivation[(10)]. In order to understand issues centered on jhum and to come up with viable approaches to deal with the system and its issues, we have to first acknowledge that jhum is constantly and rapidly changing in the modern-day due to certain political-economic processes and we have to understand how these

forces are shaping the system and how these manifest themselves as a part of the socio-economic lives of the shifting cultivator farmers. We have to look at jhum from a wider perspective in trying to understand it: population pressure on land, market integration and policy interventions, rural-urban dynamics, food and livelihood security of the farmers, conservation of forest and biodiversity, land degradation concerns as well as the traditional and cultural values instilled within the society by shifting cultivation practice [11,12].

2 Methodology

2.1 Study area

The study was carried out in and around Lengpui Airport (360m asl), 42 kms approx, from Aizawl, the capital city of Mizoram, India. The adjacent villages around the airport include Sairang (80m asl), Sihhmui (120m asl) and Hmunpui (840m asl) [Figure 2]. Shifting cultivation is a common phenomenon in these villages. The study was also stretched to the area that is not affected by jhum (control) which is the Mizoram University campus (860m asl).

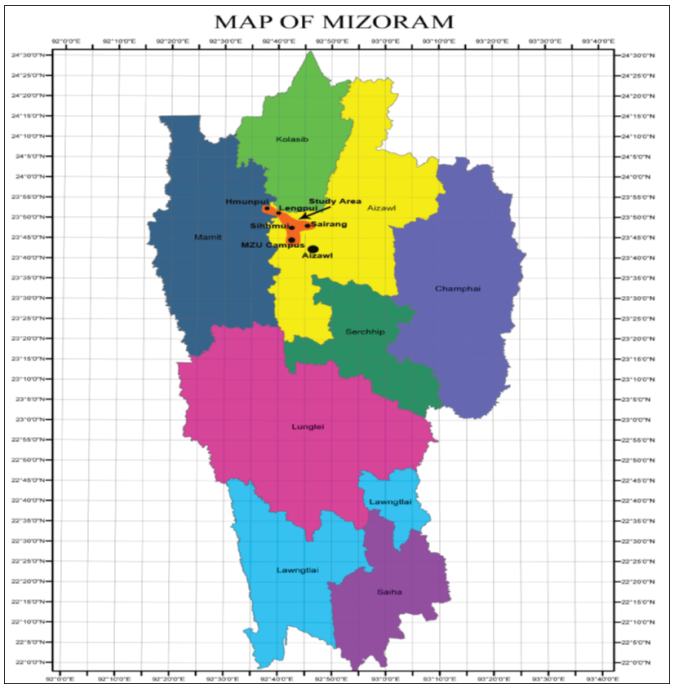

Fig 2. Map Showing Study Sites

2.2 Methods

The methodology included data gathering from urban and suburban locations over numerous years, integrating air quality monitoring data, health surveys, and medical records analysis to evaluate the influence of changing farming on human health outcomes.

3 Result and Discussion

3.1 Effect of jhum on human health

Table 1 shows the different diseases caused by jhum burning on the three villages, the data are recorded/collected during jhum burning which is from January to June of 2010 and 2011. Ranks are given on the basis of fixed scoring which is done out of ten and data are obtained from mutual sharing, questionnaires and records from the Primary Health Sub-Centre and Community Health Centre of their respective village. There is one Health Sub-Centre (HSC) at Hmunpui, One Community Health Centre and Primary Health Sub-Centre at Lengpui and one Primary Health Sub-Centre at Sairang. The Primary Health Sub-Centres

Table 1. Different diseases caused by jhum related air pollution on human and the number of people affected (scoring out of 10)

Sl. No.	Diseases	No of people affected		
		Hmunpui	Lengpui	Sairang
1.	Cough	***	********	***
2.	Cold	********	*****	**
3.	Sinusoities	*	**	***
4.	Emphysema	-	-	-
5.	Heart disease	-	-	-
6.	Lung Cancer	-	-	-
7.	Asthma	*	**	**
8.	Bronchitis	***	****	***

are looked after by one or two Health workers while the Community Health Sub-Centre by three doctors. The greatest number of diseases reported/ recorded are cough and cold and a few cases of bronchitis.

Keeping in mind the limitations of the sources of data obtained, jhum-related health impacts are not as serious as anticipated, rather, the effect of jhum on human health are fortunately mild cases. One of the village council members mention the discussion with the doctor stating that jhum burning does not affect much of human health since there are fewer cases reported during jhum burning. Reservations need to be made as these health problems are also related to air-borne diseases other than pollution made by jhum burning. The health effect of jhum burning on the villagers are not as serious as anticipated. The greatest number of cases reported are cough and cold and a few cases of bronchitis, asthma and sensuosities.

Table 2. Different diseases caused by jhum related air pollution on human and the number of people affected in urban area

Sl. No	Diseases	No. of Patients
1	Asthma	240
2	ARDS	620
3	COPD	954
4	Bronchitis	617
5	Bronchiolitis	98
6	Pneumonia	244
7	URTI	334
8	LRTI	616

Table 2 Shows the different diseases caused by air pollution, the data are recorded/collected from Civil Hospital, Aizawl for the past 2 years which is January to June of 2021 to 2022. It shows a detailed breakdown of the respiratory issues identified during the month of forest fires caused by jhum farming. The city's data revealed a significant number of patients with respiratory issues such as Asthma, Acute Respiratory Distress Syndrome (ARDS), Chronic Obstructive Pulmonary Disease (COPD), Bronchitis, Bronchiolitis, Pneumonia, Upper Respiratory Tract Infections (URTI), and Lower Respiratory Tract Infections (LRTI).

Patients in the metropolis had a broader spectrum of respiratory disorders than those on the periphery. This shows that the influence of jhum cultivation on air pollution, such as the production of smoke, particulate matter, and contaminants, is more evident in metropolitan areas. Furthermore, the degree of respiratory difficulties appears to be more severe among city patients, indicating a possible higher exposure to dangerous chemicals and a heightened risk to respiratory health.

3.2 Results of air quality monitoring

The results reveal that the average concentration of Respirable Suspended Particulate Matter and Carbon monoxide is quite high, while Nitrogen dioxide and Sulphur dioxide are very low as compared with the National Ambient Air Quality Standards (NAAQS) in Lengpui. Suspended Particulate Matter, however, was at par with NAAQS guidelines at Lengpui and is well within the permissible limits at MZU. These particulates and gas pollutants have proven pathological effects on human health; they also reduce visibility, and increase atmospheric turbidity besides these particulates are reported to have adverse effects on vegetation, animal, materials and buildings. A forest fire is reported to release maximum particulate matters which gets transported and diffuses within the atmosphere.

The SPM having an average concentration of 136.68 $\mu g/m^3$ (SE± 19.388) in the present study at Lengpui is comparatively high even though they are within the permissible limits while the RSPM exceeds the standard limits with the average concentration of 74.72 $\mu g/m^3$ (SE± 6.546) as compared to NAAQS standard of 60 $\mu g/m^3$. MZU Campus has a mean of 99.735$\mu g/m^3$ (SE± 4.423) SPM and 51.817$\mu g/m^3$ (SE± 2.318) RSPM. The pathological effects such as chronic bronchitis, bronchial asthma, emphysema and lung cancer are particularly associated with SPM. The size of the particles determines the site in the respiratory tract where they will deposit: PM_{10} particles deposit mainly in the upper respiratory tract while fine and ultra-fine particles are able to reach lung alveoli. RSPM (PM_{10}) can be inhaled through the upper respiratory airways and deposited in the lungs thus causing serious respiratory problems and in the long term an increased likelihood of respiratory death. They get retained in the respiratory system causing chronic respiratory diseases, cardiovascular damage, etc.

Pollutants release in the form of gases like NO_2 and SO_2 having 6.96 $\mu g/m^3$ (SE± 2.656) and 1.20 $\mu g/m^3$ (SE± 0.425) respectively are detected at Lengpui which are well below the limits of the standards while CO has an average concentration of 3.17mg/m^3 (SE± 0.5) which is above the permissible limits of NAAQS. Whereas MZU Campus has a mean concentration of 6.463 $\mu g/m^3$ (SE± 0.890) for NO_2, while SO_2 and CO have an average concentration of 0.853 $\mu g/m^3$ (SE± 129) and 1.456 mg/m^3 (SE± 0.231).

NO_2 causes inflammation of lung tissue and pulmonary edema, an accumulation of excessive fluid in the lungs. The main hazards of SO_2 on health are intense irritation, contribution to respiratory diseases and cardiac ailments. Significant relationships were found between this pollutant and bronchitis-like symptoms such as usual cough, sputum and breathlessness specifically in adults. Sulphur dioxide is an irritant gas, particularly for breathing apparatus. CO combines with the oxygen-carrying haemoglobin of the blood to form Carboxyhaemoglobin (COHb), it displaces oxygen and causes symptoms including death from asphyxiation, or lack of oxygen to the bloodstream and therefore to the brain. Carbon monoxide produces symptoms such as mild headaches, nausea and shortness of breath. Thus, jhum burning can have a very serious impact on society by deteriorating the health status of the local people. Air pollution directly influences every human activity and weather-sensitive economic sectors such as land, marine ecosystems, banking and insurance, health, food security, agriculture, water resources management, communication, tourism and recreation activities. There is a problem with flight scheduling and canceling because of the smoke caused by slash burning, specifically around the airport every year due to jhum burning. The variation in different air pollutants may be attributed to the quality and quantity of vegetation burned in that area.

4 Conclusion

The study highlights the major impact of jhum burning air pollution on human health, particularly in terms of respiratory disorders. The high quantities of Respirable Suspended Particulate Matter (RSPM) and Carbon Monoxide (CO), albeit within acceptable limits, signal possible dangers to respiratory health. Low levels of nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) indicate improved air quality in terms of these pollutants.

The study emphasizes the need for effective steps to reduce the negative consequences of jhum burning air pollution, such as the deployment of alternate farming practises and raising knowledge about the associated health concerns. The findings emphasize the significance of addressing pollutant concentrations and their pathological impacts on respiratory health, such as chronic bronchitis, bronchial asthma, and lung cancer.

Furthermore, the report highlights the larger environmental consequences of jhum burning, such as diminished visibility, increased air turbidity, and negative effects on flora, animals, materials, and structures. It emphasizes the difficulties faced by many industries, such as transportation and tourism, as a result of slash burning haze.

Overall, the report emphasizes the urgent need for comprehensive steps to reduce air pollution from jhum burning, safeguard human health, and conserve the environment. Implementing sustainable agricultural practises, strengthening air quality monitoring systems, and increasing public knowledge can all help to mitigate the negative consequences of jhum burning on both human health and the environment.

City regions have a higher prevalence and a broader spectrum of respiratory disorders than suburban settings. The findings emphasize the considerable impact of jhum burning air pollution on respiratory health, particularly in urban areas. It is critical to develop targeted interventions in urban settings to prevent negative consequences and protect persons' well-being. Promoting alternative agricultural practices and raising awareness about the associated health dangers are critical measures in tackling this issue. We may try to create healthier settings and reduce the burden of respiratory ailments caused by jhum burning by taking proactive actions.

4.1 Suggestions

1. Social and economic aspects need to be considered, pollution problems cannot be tackled by technology alone.

2. The formulation and enforcement of laws and regulations for the control strategy are a must as society cannot be governed without law.
3. Public awareness and education can be imparted through newspapers, journals, AIR, community meeting, etc.
4. Emissions and corresponding air quality impacts from prescribed fires can be reduced by adopting smoke reduction techniques and choosing better dispersion conditions for burning, as suggested by both U.S. Environmental Protection Agency (EPA) and U.S. Forest Service.
5. Jhum burning can have a very serious impact on society by deteriorating the health status of the local people and educating the community about the extent of its effect and recommending remedial measures.

5 Declaration

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