



Impact of jhum burning on air quality and human health in Mizoram, India

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ABSTRACT

Deterioration of air quality, which is an alteration of atmospheric chemistry by pollutants from natural and anthropogenic sources is of major global environmental concerns 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.

Key words: Air pollution; human health; jhum burning; NAAQS; Mizoram.

INTRODUCTION

Shifting cultivation is regarded as the first step in transition from food gathering and hunting to food production. It is considered as a primitive form of agriculture and the cultivators are usually identified as hill tribes or mountain people and are regarded as backward, serving on subsistence economy.¹ Though an agricultural state, the primitive method of shifting cultiva-

tion/jhuming is still practiced in Mizoram. Shifting cultivation and the Mizo culture are closely inter-related. It is claimed that cutting jhum was started by the Mizo since the days they descended from the far east to the Lushai hills (now Mizoram) across Burma. The respite between the completion of the jungle clearing operation and the burning of jhum is the time when the joyous festival 'Chapchar kut' is celebrated.² According to Food and Agricultural Organization, it is defined as, "the custom of cultivating clearance scattered in the reservoir of natural vegetable (forest or grass or woodland)

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and of abandoning them as soon as the soil is exhausted and this includes in certain areas the customs of shifting homesteads in order to follow the cultivators, searching for new lands".³ 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 Air pollution is a serious threat to the diversity of life. The human health is affected by air pollution mainly due to inhalation of gases and particulates during respiration.⁵ Interaction among pollutants (mixture of gases and particulate matter) may result in effects that may be additive, synergistic or antagonistic. Pollutants effects are normally manifested in specific target organs or may also be indirect, the principal target organs or organ systems are the eyes and the respiratory and the cardiovascular systems.⁶ The National Health Survey reported over 14 million asthma or hay fever sufferers in the United States in 1964. Scientific information from cause-effect relationship studies at typical levels is of particular importance in addressing chronic exposures of humans to ambient pollutants.⁷

CO has high affinity towards haemoglobin and reduces oxygen carrying capacity of blood, leading to damage of central nervous system. Asphyxiation is caused by CO₂ while SO₂ causes irritation of the respiratory tract and cough, and NO₂ causes inflammation of lungs.⁸ 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.⁹ By clearing the forests they removed the shade afforded by the trees and deprived the soil of much of its capacity to absorb water.¹⁰ Air pollution is a serious threat to the diversity of life as they alter the physical and chemical environment. Mizoram Pollution Control Board (MPCB) also published in the State of Environment Report, Mizoram (2005), although there is no significant contributor, it states that pollution in the city is largely contributed by agricul-

ture activities (slash and burn cultivation) and increase in vehicle population.¹¹ In general, air pollution decreases the yield of all crops by affecting their photosynthetic activity and growth.¹² Estimates have shown that hardly 12 to 15% of the total dust particulates released into the environment is man-made and the rest is by nature.¹³ The National Commission on Agriculture (1976) held that shifting cultivation cannot be considered as a balanced part of an ecosystem, and stated that both from the point of forest development and economic well being of the tribal, shifting cultivation should be regulated, contained and replaced as expeditiously as possible.¹⁴ Meteorological factors responsible for air pollution includes wind profile, temperature, topography; this govern the dispersal of pollutants from the source into the surrounding atmosphere.¹⁵

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. The objectives of study include assessing the environmental impact of jhum burning on the local atmosphere by analyzing: (a) suspended particulate matter (SPM), (b) respirable suspended particulate matter (RSPM), (c) nitrogen dioxide (NO₂), (d) sulphur dioxide (SO₂) and carbon monoxide (CO).

MATERIALS AND METHODS

Study sites

The study sites were located at Lengpui Airport, which is 42 kms approximately from Aizawl City, with their adjoining villages, which are Sairang, Sihhmui and Hmunpui. Lengpui village and the airport lie within Aizawl district of Mizoram. Geographically, Mizoram lies between 22°45'-24°31' latitude and 92°16'-93°26' E longitude and having 21,081 sq km of land

area. Aizawl, the state capital of Mizoram is located at 92°43' E longitude and 23°43' N latitudes. The proposed sites mentioned above are situated in the west of Aizawl city.

Collection and sampling period

High volume air sampler was used for monitoring of air quality which was stationed near Lengpui Airport. The monitoring of ambient air quality was also done prior to jhum burning during jhum and after jhum burning and was taken to the laboratory for analysis. Analysis was done once every week and the sample was monitored for 8 hours. The absorbing reagents and the filter paper were kept a day before analysis. After the monitoring was done for 8 hours, the samples were then taken back to the laboratory. The analysis was done on the same day and the data were recorded on a well-maintained register.

Particulate estimation

The methodology involved for the estimation of ambient air includes – SPM by using high volume method; RSPM by cyclonic flow technique; NO₂ by Jacob & Hochheiser modified (sodium arsenite) method;¹⁶ SO₂ was determined by the modified West and Gaeke method¹⁷ and CO by using Lutron digital meter.

RESULTS AND DISCUSSION

The monitoring of ambient air quality was carried out during jhum burning season from the 25 February to 25 March, 2010 and from 24

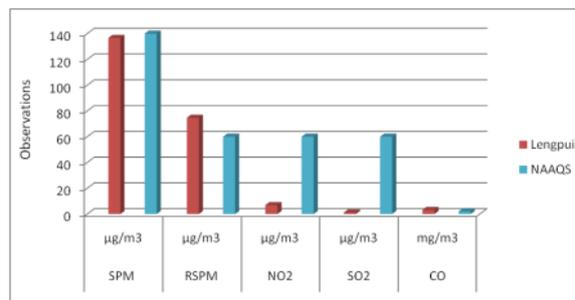


Figure 1. Levels of different air pollutants with the standard given by NAAQS.

February to 24 March, 2011. Analysis was done once every week and the sample is monitored for 8 hours. The average concentration of gases and particulates are weighted against the National Ambient Air Quality Standards (NAAQS) laid down by Central Pollution Control Board. The average concentration of the estimated particulate and gases is given in Table 1 and Fig. 1.

From Table 1, the average concentration of suspended particulate matter, respirable suspended particulate matter are quite high, while nitrogen dioxide, sulphur dioxide and carbon monoxide are quite low as compared with the National Ambient Air Quality Standards. These particulates and gas pollutant not only have pathological effects on human health, they also reduce visibility, and increase atmospheric turbidity besides its harmful effects on vegetation, animal, materials and buildings. The maximum amount of pollution release by a forest fire is the particulate matters which gets transported and diffuse within the atmosphere. The SPM having a concentration of 136.69 µg/m³ is compara-

Table 1. The average concentration of different air pollutants during Jhum burning at Lengpui.

Sampling Site	Station Type	Average concentration				
		SPM µg/m ³	RSPM µg/m ³	NO ₂ µg/m ³	SO ₂ µg/m ³	CO mg/m ³
Lengpui	Residential	136.69	74.73	6.96	1.20	3.17
	rural & other	SD ±27.415	SD ± 9.256	SD ± 3.755	SD ± 0.601	SD ± 0.707
	areas	SE ±19.388	SE ± 6.546	SE ± 2.655	SE ± 0.425	SE ± 0.5
NAAQS		140	60	60	60	2.0

tively high even though they are within the standards limits while the RSPM exceeds the Standards limits with the average concentration of $74.73 \mu\text{g}/\text{m}^3$. The pathological effects such as chronic bronchitis, bronchial asthma, emphysema and lung cancer are particularly associated with SPM. RSPM has been retained in the respiratory system causing chronic respiratory diseases, cardio-vascular damage, etc. Pollutants release in the form of gases like NO_2 and SO_2 having $6.96 \mu\text{g}/\text{m}^3$ and $1.20 \mu\text{g}/\text{m}^3$ respectively are detected which are well below the standards limits while CO have an average concentration of $3.17 \text{mg}/\text{m}^3$ which is above the permissible limits of NAAQS. 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. CO combines with the oxygen carrying hemoglobin of the blood to form carboxyhemoglobin (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 the society by deteriorating the health status of the local people. There is a problem of flight scheduling and cancelling because of the smog caused by slash burning, specifically around the airport every year due to jhum burning. Air pollution (weather) directly influence every human activities 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.

Suggestions

1. Social and economical aspects need to be considered as pollution problems cannot be tackled by technology alone.
2. The formulation of laws and regulations for the control strategy are a must as the society

cannot be governed without law.

3. Each individual should understand his/her responsibility towards the society and take an active part in a fight against the pollution.

4. Public education can be imparted through newspapers, journals, AIR, etc.

5. Jhum burning can have a very serious impact on the society by deteriorating the health status of the local people which can be studied using PRA method and educating the community of the extent of its effect and recommend remedial measures.

6. Emissions and corresponding air quality impacts from prescribed fires can be reduced by adopting smoke reduction techniques and choosing better dispersion conditions for burning.

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