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RESEARCH ARTICLE

# Study of soil organic carbon on current jhum and jhum fallows from Rawpuichhip, Mamit District

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Jhum cultivation commonly known as shifting cultivation is the main form of agricultural practice in Mizoram. This gradually causes changes in the physico-chemical properties of soil. The study of soil organic carbon on current jhum and jhum fallows intends to find out the impact of jhum cultivation on soil organic carbon in relation to the period of jhum fallows. Soil samples were collected in triplicates from four different sites seasonally i.e. thrice in a year. The study was conducted within Rawpuichhip, Mamit i.e., Current Jhum, J and Jhum Fallows (which is categorized into two sites; Short fallow, SF - 2 to 5 years and Long fallow, LF - more than 8 years) and undisturbed area (adjacent forest) during the year 2022. Soil samples were collected in triplicates from three different depths 0-10 cm, 10-20cm, and 20-30cm with the help of a soil corer. It was found from the study that Soil Organic Carbon (SOC) value ranges from 1.21±0.17 % - 2.38±0.10 %. The results indicate that among the study area, short fallow has the least amount of SOC while current Jhum and the undisturbed area tend to have higher concentrations of SOC.

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## Introduction

Slash and burn cultivation, locally known as 'Jhum', is being practiced in about 1.47 million ha of the northeastern Himalayan region.[1] Shifting cultivation (also known as Jhum cultivation in North Eastern part of India) is the primary method of agricultural land usage adopted by subsistence farmers in the humid tropics.[2-3] According to the people from Rawpuichhip Jhum fallows on the other hand differ from the period of fallows, Jhum fallows (land left for regeneration) periods may vary from one place to another. In this study, the fallow period ranges from Short fallow - 2 to 5 years, SF and Long fallow - more than 8 years, LF. Fallow land left for around 20 years is considered virgin forest.

In light of climate change, soil organic carbon (SOC) is regarded as the major terrestrial source of carbon (C).[4] The term "soil organic carbon" exclusively refers to the carbon part of organic molecules.[5] Since soil pH largely influences microbial activity and thereby affects soil organic matter formation and decomposition,[6] Monitoring and evaluation of the effects of either natural or human-induced disturbances on the soil component of ecosystems depend, thus, on the proper selection of quantifiable and integrative soil quality parameters and their critical limits, which must be attained for regular ecosystem functioning.[7-8]

Soil organic carbon is required to hold water and nutrients which decreases the risks of erosion and degradation.[9] Organic-rich systems of agriculture with much-improved soil-water relations greatly reduce the hazard of soil erosion at a given place, because the soil is better protected against raindrop damage and is more porous and absorptive.[10] The forest ecosystems contain more

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than 70% of global soil organic carbon and forest soils are believed to hold about 43% of the carbon in the forest ecosystem to 1m depth Carbon is stored in forest ecosystems mainly in biomass and soil and to a lesser extent in coarse woody debris. The carbon stock in forest soils plays a large role in the global carbon cycle.[11]

## Materials and methods

### *Study sites and area*

Mizoram is situated in the North Eastern part of India and covers a geographical area of 21,081 sq. km, which is 0.64% of the geographical area of India. The State lies between 21o.58'N to 24o.31'N latitudes and 92o.16'E to 93o.26'E longitudes. Mizoram shares borders with Tripura in the west, Assam and Manipur in the north. Mizoram also shares an international border with Myanmar on the east and Bangladesh in the south and west.[12]

Mamit District is situated in the western part of Mizoram. The district occupies an area of 3025.75 km2 and accounts for 14.35% of the total geographical area of the State. Mamit is geographically located at 23° 55' 37.31"N Latitude and 92° 29' 22.85"E Longitude. The average elevation is 718 meters. Soil samples were collected from Rawpuichhip village located in the Reiek subdivision of Mamit District in Mizoram, India which is 40km away from Aizawl. As off 2011 census Rawpuichhip has a total population of 1,507 people, out of which the male population is 746 while the female population is 761. The literacy rate of Rawpuichhip village is 83.68% out of which 83.24% of males and 84.10% of females are literate. Lengpui is the nearest town to Rawpuichhip for all major economic activities, which is approximately 25km away.

### *Soil sampling and processing*

Soil samples were collected in triplicates from the four selected sites in the year 2022 from different land-used sites i.e., Current Jhum and Jhum Fallows (which is categorized into two sites short fallow - 2 to 3 years and Long Fallow - more than 8 years) and Undisturbed (Adjacent Forest) within Rawpuichhip, Mamit.

The soil sample was air-dried under room temperature, passed through a 2 mm sieve for analysis. Soil Organic Carbon was determined by following Walkley and Black's Rapid Dichromate Oxidation Method.[13]

## Results

Soil samples were taken from three different depths at Jhum, Short Fallow, Long Fallow and Undisturbed (adjacent forest) with the main value with standard error presented in Table 1. SOC gradually decreases with an increase in soil depth, in the present study SOC was mostly higher in the top soil 0-10cm depth considerable for litter-fall decomposition and moderate soil moisture content for breakdown of organic matter. Jhum site contains the highest percentage of SOC (2.38%), however, it decreases with an increase in soil depth to 1.72% of SOC .

The average Mean ± SEM of SOC content was represented in Table 1. By analysing the data for the different climatic seasons, it was observed that maximum SOC was found during the Pre-monsoon season (Jhum 2.38±0.10%) and minimum during monsoon season (Short Fallow 1.21±0.17%).

## Discussion

The results indicate that among the study area, short fallow has the least amount of SOC while current Jhum and undisturbed area tend to have a higher concentration of SOC. However, the SOC tends to decrease with increases in depth. From the

**Table 1:** Content of soil organic carbon from different sites at different soil depths (Mean ± SEM)

| Period | Depth | Jhum | SF | LF | UD |
|---|---|---|---|---|---|
| Pre-Monsoon | 0-10 | 2.38±0.10 | 1.61±0.15 | 1.76±0.06 | 1.87±0.09 |
| | 10-20 | 2.08±0.13 | 1.55±0.24 | 1.84±0.12 | 1.80±0.04 |
| | 20-30 | 1.73±0.21 | 1.36±0.38 | 1.68±0.12 | 1.84±0.03 |
| Monsoon | 0-10 | 2.20±0.12 | 1.45±0.15 | 2.07±0.25 | 2.22±0.40 |
| | 10-20 | 2.07±0.05 | 1.21±0.17 | 1.79±0.38 | 1.90±0.10 |
| | 20-30 | 1.91±0.12 | 1.21±0.33 | 1.60±0.51 | 1.81±0.04 |
| Post Monsoon | 0-10 | 1.86±0.17 | 1.78±0.05 | 2.07±0.11 | 2.11±0.07 |
| | 10-20 | 1.73±0.14 | 1.56±0.06 | 1.95±0.31 | 1.95±0.04 |
| | 20-30 | 1.62±0.02 | 1.37±0.22 | 1.75±0.46 | 1.88±0.22 |

data of different climatic seasons, it was observed that the maximum SOC was found during Pre-monsoon season (Jhum 2.38±0.10%) and minimum during monsoon season (Short Fallow 1.21±0.17%) which can be caused by heavy rainfall and surface runoff in SF due to less vegetation and direct exposure to heavy rainfall.

From the above observation, we can conclude that land used has a severe impact on the quality of soil. Jhum sites tend to have higher soil quality than that of jhum fallows which can result from burning of forest before cultivation in the process of clearing the land for agriculture which is further followed up by the rainy season that enriches the soil quality for a short period of time.

The percentage of SOC is higher in the topsoil than that of the soil underneath, which Bleam states below ground carbon decrease with increasing depth within the soil profile.[14] that can be seen on each site from 0-10cm depth to 20-30cm depth where the average SOC content decreases from 2.15% to 1.75% in Jhum and on to SF, LF and UD.

It is already known that a decline in soil organic carbon upon conversion of forest into agricultural land.[15] Thus, SOC percentage drop in a 2 -year-old short fallow where a jhum site has 2.07±0.05 whereas short fallow has 1.21±0.17 Mean ± SEM of SOC. Furthermore, slash and burn practices in Thailand and Sri Lanka resulted in soil carbon losses,[16] reduced in organic carbon content typically results from turning a forest into a jhum field or agricultural land.[17]

One method to improve soil ecosystem services is to regulate soil organic carbon through improved management practices. OC storage in the soil not only increases sequesters atmospheric carbon but often enhances soil physical, chemical, and biological processes and properties.[18] Shifting cultivation changes the physical, chemical and biological properties of the soil due to changes in the quality and quantity of organic carbon inputs into the soil.[19]

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