



A Review of Environmental Issues Due to Shifting Cultivation in Arunachal Pradesh, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JEAI/2023/v45i112238

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/107279>

Review Article

Received: 09/08/2023

Accepted: 13/10/2023

Published: 09/11/2023

ABSTRACT

Since the dawn of human civilization, shifting farming, or Jhum cultivation, has been practiced. It continues to be practiced traditionally in hilly areas today. Because it causes so many issues, like soil erosion, loss of soil fertility, extinction of flora and fauna, depletion of water supplies, etc., it is a plague on human existence. The objectives of the study have tried to explore the adverse impacts of shifting cultivation and different causes of water pollution. Some recent studies are reviewed and research gap is identified. This study is descriptive by nature based basically on data of secondary sources. Some adverse impacts are sought out. Some findings are sought out. Some suggestions are given to solve the adverse impacts to bring the allround development of the State. It is necessary to make an integrated research on the basic problems raised with the shifting cultivation by scientists of all the disciplines including social scientists.

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Keywords: *Jhum cultivation; human existence; soil erosion; soil fertility; flora and fauna; water resources.*

1. INTRODUCTION

Arunachal Pradesh is located in the far north-east of India and has a long international boundary with China to the north and north-east (1030 km), Myanmar to the east (440 km), and Bhutan to the west (160 km). The State is bordered by China (and Tibet) on its north, north-east, and north-west; Assam and Nagaland on its south; Myanmar on its south-east; and Bhutan on its west. It is located between longitudes 91° 30'E and 97° 30'E and latitudes 26° 28'N and 29° 30'N. Its overall area is 83,743 square kilometers. It is primarily a state with hilly terrain. It has a rough and typical topography. The entire landscape is made up of tall hill ranges and wide valleys, which both occupy and define it. The placement of the hill ridges is random. One ridge comes to an end, and the other takes over, running parallel or in the opposite direction. Due to these carelessly placed hill ridges and valleys, the surface land is seen to be maimed and varied practically everywhere. The hills' altitudes range from 150 to more than 7,300 meters. Agriculture is divided into two separate categories: settled cultivation and jhum, or shifting cultivation [1].

According to the State Forest Report-1999 (issued by the Forest Survey of India), Arunachal Pradesh has a forest cover of 68,951 square kilometers, or 82.21% of its total land area. 51,540 square kilometers, or nearly 62% of the state's total land area, are considered to be its documented forest area. In comparison to the national rate of 23.28, the state is lucky to have such a high percentage of its land covered by precious forests. Again, of its size, 70% is made up of wide and narrow valleys, 10% are foothills and flat plains, and 20% are areas with snow-covered peaks. Only 5% of the overall geographic area is used for agricultural operations, out of which 62 per cent to 65 per cent are under shifting cultivation (jhum) [2].

With the exception of the Apatanis and Khamptis, nearly all of the 26 tribes of Arunachal Pradesh use shifting agriculture. The Apatanis and Khamptis practice settled agriculture. The men who cultivate jhum are known as jhumias, and they produce all the crops that they require. The people who live in the hills of Assam, Meghalaya, Nagaland, Mizoram, and Arunachal Pradesh frequently practice these kinds of farming [3-5]. It goes by many various local names depending on where you are. It is known as Jhum in North-East

India. The cultivation technique is quite similar throughout these vast expanses. The majority of the North East Hill Region of the country still practices this most archaic form of agriculture.

Approximately 80% of the State's population, as determined by the 2001 Census, resides in rural areas and is either directly or indirectly engaged in jhum cultivation [6-8]. Additionally, it is asserted that slash-and-burn farming causes the vegetation on the hills to deteriorate, with forest regions turning into sterile grassland and arid ground. Therefore, it is said that this agricultural system is unsustainable and causes the tribal people who depend on it to become economically impoverished.

The slash and burn method of farming is another name for shifting cultivation, or jhum cultivation. Farming involves a labor-intensive procedure and considerable usage of land. Due to the outdated technology, there is relatively little production and money [9-11]. It has a specific place in the state's tribal economy's socioeconomic fabric. The hillside field is chosen by the jhumia (a person who cultivates jhum) on a rotating basis. The jhumia is forced to move his farming to another plot due to the decline in soil richness. He leaves the area fallow for a while to allow the forests to regenerate. He uses the same land once more. This practice is also known as shifting cultivation because of this.

2. OBJECTIVES

The study has tried to explore (1) the adverse impacts of shifting cultivation practiced by the farmers on environment in Arunachal Pradesh, and (2) to search probable remedies so as to bring sustainable development.

3. LITERATURE REVIEW

Debajit Datta, R.N. Chattopadhyay and Shovik Deb [12] studied that comprehensive information of the state of these mangrove-dominated ecosystems and their patterns of use are required to achieve sustained productivity of natural resources through appropriate management regimes. Sachchidananda did a comparative study of shifting cultivation (Jhum) in five countries: India, Indonesia, Malaysia, the Philippines and Thailand and saw that forest plays an important role in providing goods and services to the forest dependent communities.

The diverse needs of the communities could all be possible from the forest due to the prevalence of diversity of vegetation in the region [13]. Forest dependent communities have protected their natural forest for securing livelihood and stabilizing their economic condition by retaliating logging of natural forest and further conversion to plantation viz., chipko movement [14]. The participation of communities who rely on forests in forest protection and regeneration is essential to the forest's continued survival. The Indian national forest policy has long acknowledged the symbiotic relationship between tribal tribes and forests. The wisdom of the people who depend on the forest has been used as a strategy to preserve the important ecological diversity that ensured the traditional civilizations' socioeconomic advancement. Through the Convention on Biological Diversity (CBD) and the National Biodiversity Act of 2002, international and national measures have also emerged to protect the indigenous knowledge system (IKS) or traditional knowledge system [15]. The northeastern Indian region's forest resources currently persist as a consequence of community efforts to safeguard them through a village council-adopted protection system and the application of regionally appropriate customary rules. The local Arunachal Pradesh communities have consumed a variety of wild plant species as food, including green vegetables, roots, and fruits [16]. Mima Bam [17] in his "Jhum Cultivation Practices of The Galo of Arunachal Pradesh" shows that Jhumming is a kind of subsistence cultivation. It is self-reliant with a high degree of economic independence and the resultant economy is almost static with little chance of rapid improvements. Hosen, Shafat, Alam, Ohiduland Haque, S. M. Sirajul [18] have examined the impact of shifting cultivation on soil microorganisms as well to determine different soil biological properties in shifting cultivated land and natural forest land.

Need of the Study: There is no region-based study, where we can get the safeguard of our natural resources and thereby we get the proper supply of water for all purposes.

4. METHODS AND MATERIALS

This study is descriptive in nature based basically on data of secondary sources. The data of secondary sources are collected from government offices, books, articles, various census reports, and websites published in different times.

5. RESULTS AND DISCUSSION

5.1 Adverse Impacts

5.1.1 Environmental problems

Due to ignorance or a lack of understanding for techniques of conserving and managing natural vegetation (whether a forest, grassland, or mixed type), as well as of destroying the vegetation for cultivation, the ecological balance favoring the full hydrological cycle has been gravely upset over huge areas. Due to the abuse and loss of plant cover as well as the dramatic rise in the number of people and animals, there is now fierce rivalry for natural resources, including forestry, grazing, and food production. The overall state of the habitat has deteriorated to a very great extent in the absence of conservation efforts and an appropriately coordinated land use system. Shifting cultivation unquestionably causes issues with the environment and society and culture. A consumption gap appears in the hills as a result of the increase in the number of jhumia families and the number of people per jhumia family being unable to be accommodated by settled areas and jhum agriculture. The increased food needs cannot be satisfied by the decreasing returns from jhumming plots of land with ever-shorter following seasons. The state of the forests deteriorates as a result of the overuse of jhumming forests for commercial interests. The problem of the eco-system has been made worse by the abuse and destruction of plant cover as well as the dramatic rise in human and cattle population. The effects of the growth of the hill economy have included ecological harm to the hills, widespread poverty among hill-dwelling people, social unrest, and the expansion of extension.

It has also produced external diseconomies. A climate of uncertainty has been generated among the jobless tribal.

5.1.2 Soil erosion

High rainfall and undulating topography are always linked to the issue of severe soil erosion, which has a negative impact on the ecosystem. The excessive deforestation brought on by excessive tree-cutting for commercial purposes and shifting farming are sending out dangerous and terrifying signals for the survival of humans. According to estimates, shifting farming away from the north-eastern hill region results in a loss

Table1. Effect of burning on soil properties

| Soil properties | Before burning | After burning |
|--------------------|----------------|---------------|
| pH | 5.10 | 5.50 |
| Organic Carbon (%) | 1.32 | 1.05 |
| P20s(Kg.ha-1) | 3.30 | 3.31 |
| K20 (Kg ha-1) | 210.00 | 570.00 |
| Exch.Ca (Meg%) | 7.15 | 9.46 |

Sources: 1. Borthakur, et al. 1983. [19,](Ed.), "Shifting Cultivation in North East India," Omsons publications, Guwahati, New Delhi, p-147].

2. Task force report on shifting cultivation in India, Ministry of Agriculture, 1983.

of roughly 181 mt of soil each year [2]. Soil erosion, landslides, floods, and droughts in the plains have been brought on by development in the hills and its effects on the ecology and economy of the hills. The ecological equilibrium favoring the entire hydrological cycle has been gravely upset across wide areas due to ignorance or lack of appreciation of methods of conserving and managing natural vegetation, according to the forestry specialists' soil conservationists. Shifting cultivation is regarded as one of the most destructive method of land operation causing ecological imbalance, which raises temperature of the environment.

5.1.3 Soil fertility

When vegetation is burned during the transition from one type of agriculture to another, the plant's nutrient supply is chemically changed from an organic form to a mineral one in the ash, a large percentage of which is frequently lost during drainage. The following table displays how burning affects several soil characteristics that have been researched in labs.

The shorter the jhum cycle brings less in the soil. Suppose there is five years jhum cycle. It generates very low level of soil fertility. Thus, it is seen that jhum cultivation becomes uneconomic progressively. It necessitates immediate switching over to settled cultivation.

5.1.4 Loss of flora and fauna

Since tropical forests produce more than 50% of modern medicine, the scale of tropical forest deforestation has raised alarm throughout the world. Only a small portion of the treasures found in tropical forests have been made available for scientific research, making them living museums and laboratories. Arunachal Pradesh is like a natural garden with more than 20,000 species of medicinal plants that have been identified, while many more are still unexplained. During the process of shifting farming, notable flora and

faunal variations are disappearing, which requires quick attention for thorough and intensive study.

The length of the jhum cycle determines the sort of plant that is killed. In contrast to short cycle forests, dense long cycle forests have more species of trees than grasses. In North-Eastern India, only about 300 of the native plant species are utilised for food. Of them, more than 25 produce raw or boiling tubers, rhizomes, etc. About 170 mature fruits, which are pulpy and sweet/sub-sweet and are eaten raw; many of these are used for pickles/vegetables, when unripe; about 15 contain edible seeds are eaten raw or roasted. Over 50 are consumed as green with their leaves/tender shoots cooked as vegetable.

The most significant element of the ecosystem, which efficiently contributes to the energy flow and bio-geochemical cycle, is wildlife in its natural setting. Interactions between animals, plants, and plants as well as between animals and one another are the fundamental indicators of an ecosystem's productivity. As a result, the ecosystem's richness indicates its capacity to support a variety of diverse species, but deforestation has jeopardized the basic foundation of the existence of wildlife and the environment in the area. As many as 55 significant mammalian species, including 17 that are rare or extremely rare, have their home in this region. This area is home to several species of insects as well as 21 highly rare bird species. As a result, this area is home to a variety of wild animals. The Protection Act of 1972 declares almost all of them to be protected species. Other forest resources, including the flora, are also diminishing and becoming scarce.

5.1.5 Water resources

The North-Eastern Hill Region has a lot of water resources. This region receives around 10% of the nation's total rainfall. Less water is retained

underground due to soil erosion and deforestation, and more runoff water floods the plains. Both crops and human and animal life are severely damaged as a result. The availability of drinking water has recently become a major issue in every municipality in the hill region.

6. FINDINGS

From the above discussion, we get the following main findings.

- 1. Environmental problems:** Due to ignorance or a lack of understanding for techniques of conserving and managing natural vegetation (whether a forest, grassland, or mixed type), as well as of destroying the vegetation for cultivation, the ecological balance favoring the full hydrological cycle has been gravely upset over huge areas.
- 2. Soil Erosion and Soil Fertility:** High rainfall, undulating topography, excessive tree-cutting for commercial gain, and shifting cultivation are all linked to the problem of severe soil erosion, which has a negative impact on the environment and raises red flags for human survival.
- 3. Loss of flora and fauna:** The capacity of the ecosystem to support a wide variety of species is a sign of its richness, but deforestation has put the basic foundation of the existence of the local flora and fauna and ecosystem in jeopardy.
- 4. Water Resources:** Almost 10% of the total rainfall of the country is being received in this region. It is seen that soil erosion and deforestation create less retention of water under ground and more runoff water causing flood in the plains.

7. SUGGESTIONS

Jhum cultivation today is regarded as an alternative farming to permanent or settled cultivation on mountain slopes. But the government has to try his level best to abolish it completely. The following issues may be considered for positive approach towards shifting cultivation.

3.1 Diversification of the Hill Economy

Jhumming, an environmentally destructive practice, should be banned on the steep slopes in order to effectively develop the State's Hill Economy. All-around development can broaden

the tribal people's economic chances and give them additional employment options, but it won't give the uneducated, untrained, and unskilled tribal people access to jobs. The best they can hope for is to work as wage laborers. The public distribution system in the hills will need to be updated and strengthened, and new employment opportunities and guaranteed employment plans will need to be created for the jhumias till they are rehabilitated in higher earning occupations for their upliftment.

3.2 Land Reforms

Without resolving the issue of land reforms and land distribution, no strategy for improved agricultural techniques can come to fruition. The following three broad types of land ownership systems are present in Arunachal Pradesh:

1. Community-owned property.
2. Property owned by the Chiefs, who allot plots of land to different households for jhum production.
3. Individual family-owned land.

It is widely acknowledged that eliminating the Chief-owned land ownership system is necessary to properly transition from shifting to established agriculture. Without fundamentally altering the nature of social relationships in this condition, it is difficult to substantially solve the issue of transition from a nomadic to a settled life. This is a crucial matter.

The government has implemented a number of reform initiatives. However, it does not do its function very well. The following recommendations should be taken into account by land reform policy makers in order to obtain factual results in this regard because there is no systematic land record.

- A unified land policy should be created after the documented and analyzed the customary land laws of all communities.
- Since there is a shortage of plain land in Arunachal Pradesh, a cap on arable land should be established. Depending on the quality of the land, the ceiling should vary.
- Some arable land should be provided to landless impoverished people. Sharecropping should be discouraged, and poor individuals with small plots of land should be stopped from selling their land.
- Registration of all land sales should be required.

- The selling of cultivable land to non-cultivators should be restricted.
- A progressive land tax needs to be implemented.

3.4 Land Administration

The soil and land use survey should be carried out to determine the eligibility for what kind of forest, horticulture, or crop can be grown in established agriculture. In areas where established land management is supported by an efficient supply of inputs such as seeds, manures, fertilizers, tools and implements, etc., adequate protective measures, including soil conservation, should be applied. Studies must be conducted to enhance the jhumias' agricultural methods in order to reduce soil erosion and soil fertility loss.

a) Soil Survey: One solution to the negative consequences of shifting farming is the terracing of land for established agriculture. Terracing, however, is expensive and cannot be done right away in many of this state's steep slopes. Survey is a crucial prerequisite for terracing. A soil survey can evaluate the suitability of the soil for agriculture by highlighting issues such as water logging, erosion, salinity, acidity, and other factors. For the development of pastures, horticulture, and forestry, soil surveys are also crucial. The state has not yet conducted a thorough soil survey. A detailed survey work should be undertaken keeping in view the nature of slope, soil depth and prevalent practices to reclassify the land for proper use in the form of terraces.

b) Conversion of jhum land into settled Cultivation: The implementation of terrace cultivation is the primary strategy on which the jhum control system in Arunachal Pradesh is based. 2300 hectares of the approximately 70,000 hectares of jhum land have reportedly been restored for wet rice farming, according to a recent report. It is Government, who can accelerate the process of conversion as much as possible and he can also try to convince the jhumias about good effect of settled cultivation. Agricultural practice by slash and burn method must be avoided. Their practice has to be improved upon so that productivity per hectare rises without causing soil erosion.

c) Surrender of land: The government should induce the jhumias to give up at least 50% of their jhum cultivable land through sales, pensions, leases, and donations. This site should

only be used for forest purposes by the government.

3.5 Agricultural Knowledge

Every district headquarters should establish an agricultural school to provide the jhumias with hands-on training in various forms of farming. Again, the school administration will occasionally host seminars and symposiums in virtually every hamlet to inform the jhumias about the negative impacts of jhum cultivation.

3.5.1 Subsidiaries to agriculture

a) With a focus on crops that won't harm the delicate hill ecosystem, tribes should be encouraged to engage in horticulture, floriculture, silviculture, agroforestry, producing medicinal and fragrant plants on hill slopes, and fodder crops. Arunachal Pradesh having undulating topography and rich diversity of agro-climatic condition has scope for growing wide variety of tropical, sub-tropical and temperate fruits. The government has been trying to enhance the scope of horticulture since 1987-88 with set up of Directorate of horticulture at Itanagar. But this is much lagging behind the expectation due to lack of proper marketing, transportation etc. The area under fruits has gone up from 12,175 hectares in 1987-88 to 49,102 hectares in 2002-03 and production rose from 29,025 M.T. in 1987-88 to 96,438 M.T. [Directorate of Economics and statistics, Govt. of Arunachal Pradesh, Itanagar].

b) Cultivation of Tea, Coffee, Rubber and Black pepper: The hill economy of Arunachal Pradesh can include substantial quantities of tea, coffee, rubber, and black pepper. The proper growth of these industries will not only increase money but also provide up job opportunities for the state's expanding population. The Arunachal Pradesh Forest Corporation Limited began growing tea in the region in 1978–1979 at Kanubari in the Tirap District. Encouraged by the forest corporation's success, numerous large and small private tea gardens have sprouted up in recent years. In addition to tea, the Arunachal Pradesh Forest Corporation also cultivates rubber, black pepper, and coffee in the districts of Tirap, Lohit, and Changlang. Therefore, cultivation of tea, horticulture, coffee, black pepper and rubber as alternative and subsidiary occupations may be desirable and feasible to bring the jhumias from their attachment with the traditional practice of jhum cultivation.

c) Fisheries, Piggeries, Dairies and Duckeries: Whenever possible water bodies should be created for starting fisheries, piggeries, dairies and duckeries. These should be encouraged among the hill people to diversity the hill economy.

Livestock rearing is an integral component of the rural economy. It plays an important role in improving the economy of the rural population. For livestock development Govt. has paid his attention on (i) Animal and disease control (ii) cattle development (iii) poultry development (iv) piggery development (v) dairy development and (v) Education and Training.

The total livestock and poultry population as per 1997-98 livestock census was 11.87 lakhs whereas in 1992-93 livestock census it was 9.59 lakhs. But it is very little supply as per demand. There are bright scopes to develop the livestock in the state. Government should pay more attention in this respect.

d) Forest based industries: In order to employ the jhumias in the industrial job, it should be a priority to establish industries based on forest products throughout the hill region. If there is a ready market for the forest products, the tendency to protect forests will increase. In reality, the establishment of such companies will alter the tribal economies and have a detrimental effect on the practice of jhuming. the industries that rely on forests, including those that produce paper pulp, plywood, vineer, matches, sawmills, wooden train shoes, etc. It would be very helpful to achieve the economic rehabilitation of the jhumias if Arunachal Pradesh were to become at least 50% industrialized. They will naturally wish to conserve these resources, which will be a constant source of revenue for them, once they know the potential value of the bamboos, timber species, etc. that they will sell to the industrial authorities. The industrialization program is an essential and unavoidable component of the region's overall development plans. Agriculture enhancement programs cannot be successful without an industrialization plan. The industrialization program would employ any extra farm laborers. This will lessen the undue strain that an expanding population is putting on the land. Soil conservation program would benefit indirectly from industrialization program.

e) Tourism, Power and Trade: Arunachal Pradesh is endowed with a variety of fundamental resources that are essential for the growth of the tourism industry, including

exceptional natural beauty, numerous wildlife species, historic sites, religious locations, appealing tribal cultures, and amiable and welcoming locals. The expanding population can find alternate employment in tourism activities with proper tourism sector development.

Despite Arunachal Pradesh's vast potential for energy (in the form of hydro, oil, natural gas, and coal resources), the state's success in this area has not been on a scale commensurate with the resources' availability. The state currently has a significant disparity between the amount of power available and the amount needed.

The mega hydro power project in the Siang and Subansiri basin, with an estimated installed capacity of 20,700 MW, has been surveyed and investigated by the National Hydro Power Corporation (NHPC). When power becomes available, several industries will be established along with an infrastructure revolution. For employment in the state, it will usher in a new age. Estimates place the state's untapped hydropower potential at 49,000 M.W. Even if only a portion of the state's hydropower potential is used, it will still be able to meet its own energy needs and generate income by selling electricity to its neighboring states.

Shyam Saran, secretary of the external affairs ministry, stated during a high level official meeting in Itanagar on December 26, 2004, that border trade with neighboring nations is a priority of the central government, for which infrastructure would be constructed in Arunachal Pradesh. GegongApang, the state's chief minister, stated that because of cross-border trade, border communities should receive priority development through the construction of transportation, healthcare, and educational infrastructure. Free commerce and the flow of products with China and South East Asian nations as part of the "Look East Policy" would balance out the disadvantage of the North-East Region, notably Arunachal Pradesh (The Arunachal Times, 27.11.2004). Arunachal Pradesh has a long international border with Bhutan to the West (160 Km), China to the North and North-East (1,030 Km) and Myanmar to the east (440 Km).

In a meeting with Kolkata-based US Consulate General George N Sibley and Economic Advisor SouravSen held at Itanagar, dated 02.12.2004, GegongApang said that Arunachal Pradesh has power potential to meet half of the Country's demand. But power potentials could not be

tapped properly due to paucity of fund, he pointed out and regretted that the state was lagging behind due to wrong attitude of successive Central Government. Apang also requested the consulate general to take initiative to convince US firms to invest in power and tourism sectors in Arunachal. Sibley pointed out the inner line restriction as a hindrance to tourism development. He also added that Arunachal Pradesh could be the richest state in India if its huge water resources were harnessed properly [The Arunachal Pradesh Times, 03.12.2004].

f) The government, district council, village organization, village leaders, and farmers must all work together in a coordinated and integrated manner to find a solution to the shifting cultivation problem. However, it is also crucial to have the support of agricultural scientists, economists, sociologists, political leaders, and social workers in developing and carrying out an action plan to address these issues.

g) Transport and Communication: Under Make in India and Border Area Development, Transport and Communication are being developed beyond of the expectation. The State will be no more lagging behind the other states within a span of next plan period. Transport and communication play a vital role on the overall development of an area in general and industrial development in particular. Arunachal Pradesh being hilly State no any other suitable and viable mode of communication like railways and waterways. Road is the principal mode of communication for movement of goods as well as movements of passengers. At present, the entire Districts' Head Quarters are being interlinked with each other by road. The Government has to take attention on priority basis to develop transport and communication so as to bring the jhumias in the main stream of the people.

In addition to the above suggestions, the following has to be minded:

1. Even though the property relationship that exists amongst the jhumias forbids it, a suitable method should be developed to aid in the extension of bank credit to them. It is not required that banks only extend loans when real estate is pledged as collateral.
2. A successful approach should involve planned growth together with concurrent efforts to conserve genetic material by creating national parks, arboreta, and biosphere reserves.

3. Jhumming should be encouraged and not banned whenever it is necessary. Jhumming can be upgraded in two different ways. First, jhum land might be transformed into horticultural gardens that are more financially viable. Horticultural gardens can open the door to a booming economy and provide much-needed cash for the populace. Second, it is equally possible to consider the notion of using scientific jhumming. Scientific jhumming aims to capitalize on the positive aspects of jhumming while limiting its negative impacts.

4. If a modification is made, considering the overall geography of the area, the question of whether it will be accepted by the locals and fit into their way of life emerges. In this regard, it can be advised that some scientific steps be taken to stop topsoil erosion and that investigations be made to see whether it might be possible to use contemporary advances on jhum land in order to increase yield per unit area. In addition, the growth of animal husbandry, or livestock raising, such as poultry farming, sericulture, beekeeping, and other forms of alternative livelihood, such as plantations, economic and conservational forestry, horticulture, and so on, may also be supported. The issues caused by jhumming in Arunachal Pradesh can be resolved while taking into account the various aspects of shifting agriculture, the sociocultural makeup of the population, the viability of altering the associated costs, and the maintenance of a modified pattern.

8. CONCLUSION

As an economic proposition, till the shifting cultivation is replaced by an improved form of land management, it is essential to make the above alternative techniques more productive so that it can sustain the growing pressure of population and improve the quality of life of the people concerned without creating imbalance in the fragile eco-system of the region. We think, question may arise if such considering the region's complete topography, a change is made. Will the inhabitants of the area find it acceptable and compatible with their way of life? Keeping in mind the numerous aspects of shifting cultivation, such as the sociocultural life of the population, the viability of change over the investment required, and the maintenance of a changed pattern, the population issue emerging from jhumming can be resolved. It is important to make efforts to alter society from inside. To accept new advances, the growers need receive the

appropriate training and education. Last of all, I feel that it is necessary to make an integrated research on the basic problems raised with the shifting cultivation by scientists of all the disciplines including social scientists.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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