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## An overview of the farming systems in Nagaland

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**Abstract**

Farming system is combination resources in farming, sustaining ecological balance and raising socio-economic status of the farming community. *Jhum* cultivation, WRTC and WTC, alder tree based and zabo system are traditional farming systems that are still dominant in Nagaland along with indigenous techniques and methods used by the farmers to meet the requirements of the population. With integration of livestock, crop production and fruit cultivation, creation of employment is adequate and income is generated at the same time, with secondary data collected a review of farming system is provided.

**Keywords:** Alder tree based, *Jhum*, Nagaland, Zabo

**Introduction**

Nagaland, the 16th state of Indian state has a total geographical area about 16,579 sq km out of which 7225 sq km (43.37%) falls under cultivable area. The state is abundant with agrobiodiversity and hence, the people have always enjoyed their authority over the land and its resources since time immemorial. The state is known for maximum average size of holding of area and number of holdings that exceeds 10 ha. With a total population of 2 million where more than of 73% of the people in Nagaland are dependent on agriculture [1]. Furthermore 90% terrain of the state are hilly and has flourishing climate, where monsoon rains are an integral feature of the state's weather, with an average annual rainfall of 2000-2500mm. The climate is similar to those of other hilly states of the Northeast region. Heavy rainfall occurs during July-September but rain commences from month of May onwards, and acts as the source of streams and water bodies. In the country, agriculture is the major sector of whole of Indian economy and where crop production occupies the major part of agriculture.

**Agriculture status in Nagaland**

Agriculture is the presiding occupation in Nagaland, in both employment and income source; it is the main stay of economy in the state and the traditional form of farming had been in practice by the nagas since time immemorial. In this process they have developed skills and ideas on how best to grow their crops and enhance its productivity. There also exists variation in the region in terms of soil and climatic conditions, geographical terrain, management practices etc which in a way is responsible for great diversity in rice cultivation among the people. The present agricultural status of Nagaland is organic by default as the state is hilly by nature, mechanization is not feasible unlike the modern mechanized farming system in plain areas of the country [2]. In comparison with all the states of India, Maharashtra alone has about 0.5 million ha area which is under organic farming, out of this only 10,000 ha is the certified area [3], while in Nagaland, out of 7,22,464 ha total cultivated area, only 3000 ha of land is under certified organic farming benefiting 3,575 farmers growing crops like maize, soybean, French-bean, ginger, large cardamom, passion fruit and chilli [4]. Among the various crops (maize, oilseeds, tapioca, millets, jobs tears, taro, yam and potato) rice being the staple food of the people, occupying maximum area under cultivation and constitutes about 75% of the total food production in the state. Rice plays a significant role in the socio-cultural life of the people in many parts of NE. However with the rise in population, traditional means of farming, modern techniques and machineries are also employed to meet the growing demand of the people and the framing community.

**Farming systems in Nagaland**

In Nagaland, agriculture occupies a huge role in the lives of the people and is greatly shaped by traditional skill and indigenous grip along geographical and other factors, variation of climatic and soil conditions result in diversified cultivation.

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Traditional means of practise and knowledge are integral part of the people and still followed even with the introduction of new ideas and inventions, and are deeply rooted into the society. Conventional methods of preserving soil quality and productivity, controlling insect invasion, maintaining seed and viability and preservation are still considered. Rainfed farming is usually carried out, depending on monsoon rains for cultivation of all crops especially paddy, which is the staple crop occupying 70% of the area (table1). In traditional kind of farming, the diseases and pests are usually managed by the use of indigenous methods like crab trap, spaying of cow dung, wood ash, plant extracts or hand picking etc <sup>[5]</sup>.

## The different kinds of cropping system followed by the people are-

### 1. Shifting cultivation

From the name itself, we get the objective that it follows a form shifting kind of pattern related to cultivation of crops from a specific location to another. In the hills of Nagaland, this is a dominant economic activity practised by the farmers. *Jhum* or slash and burn cultivation is the traditional system of farming in the state and is practised on a large scale mostly by the tribal community in hilly regions (image 1). *Jhum* area covers about 72% of total cultivable area and contributes to the total rice production about 49.26%. Around 100 or more tribes in NE, depend on shifting cultivation for supporting their livelihood. The technique of deforestation along with burning, drying and of the trees, followed by inter-cultural operations like sowing, weeding to harvest and leaving the field fallow, vegetation barriers (growing tall perennial grass) and mechanical barriers (bunds or stones) are put up in hilly slopes, local tribes- Konyak, Angami and Ao are said to follow bunding method with tree stumps and erecting stone barriers as shields in their field, as precaution and control for erosion <sup>[6]</sup>. With the strategy for market accessibility and keeping in view of the demand, farmers alter and adopt cropping patterns based on that. Diversified cropping is also commonly followed by other agricultural operations. The selected site/area are usually flared during February–March, along with sowing of the crop (usually paddy) in April – May. This kind of farming does not utilise any kind of fertilizers or chemicals and hence follows organic principle. Nagas after the cultivation in the particular area for two to three years, leaves the land fallow and shifts to another area then proceed to another site and after sometime goes back to the first plot of land, this form of rotation follows a pattern and the barren fallow site is blazed; in that way the nutrients and soil fertility would be replenished <sup>[7]</sup>. In Mon district of Nagaland, *jhum* cultivation is depended by 93% of the people and there has been reduction of fallow lands from 15 years or more to 6 years. The ashes are used by the farmers for their crops, this embarks with the traditional knowledge of the people. The entire rotation and process takes about six to ten years depending upon size of the field; it has been reported that the longer the duration the waiting period then more fertile the soil becomes and is beneficial for the crops, this method of cultivation is practised by tribes of Lotha, Sema and Ao. Traditional *jhum* is carried out as they bring in higher economic return alongside lofty production and conserve the soil and water issues. With the rise in demand for the food due to the increase in population, the period of fallow land has been reduced over the years. The farmers have started to conserve the agro-biodiversity amidst the *jhum* practise by growing various crops including- rice/ maize then soybean and other millets on sloppy areas along with bunds; for

controlling weeds common salt is usually used disseminated on the affected area. In the district of Wokha, multiple cropping in the blazed area is followed, where variation of crops around 20-40 or more are cultivated on the same piece of land and intercropped with paddy as the primary crop. Followed then, job's tears at the edges of the field accompanied with crops—sesamum, maize and other vegetables for checking soil erosion while for sloppy area vegetative barriers like ginger, colocassia for soil conservation purposes and preparing bunds at the required spots while legumes are also grown alongside. Cucurbitaceous crops – squash, pumpkin, cucumber and tuberous crops- potato, cassava, yam are grown for cover purpose and are usually harvested during May – June.

In the village of Koio, under Wokha district farmers usually focus on cash crops on the particular *jhum* area. Spice crops-cardamom are selected as primary crop and along the border Tung trees (*Aleurite montana*) are planted. Oilseed crops are also grown with horticultural crops like passion fruit as encircled along the primary crop. Over the years, this form of farming has generated high income returns for the farmers and has helped in reducing *jhum* cultivation. In the village of Khonoma, farmers have thrived in growing Alder trees alongside agricultural crops- rice and legumes, in order to improve the soil health and productivity and increase fertility with N fixing crops. Plantation crops are also grown in order to check erosion and provide side income to the farmers. With high rainfall intensity and hilly slopes, there arises an alarm to check on the erosion rate, and with the practise of shifting cultivation it is reported to degrade the soil fertility status and not environmental friendly with loss in forest cover. *Jhum* does not include the application of any chemicals hence is termed under 'Organic farming', however it is not as close as it sounds as deforestation plays a predominant part of it. From a total cultivated area of 7,22,464 ha about 3000ha is under certified organic cultivation, which benefits about 3,575 farmers by cultivating crops like soybean, maize, french bean passion fruit, large cardamom <sup>[8]</sup>.

Over the years, traditional *jhum* is in a critical juncture which is progressing into cultivation of new crops and technologies with unresolved issues pertaining to environmental topic and assisting in income for the farmers. The art of *jhum* cultivation is dominant in whole of NE region and contribute to about  $88.3 \times 10^6$  ton annual loss of soil, while loss of nitrogen, phosphorus and potassium results up to  $10.50 \times 10^6$  t,  $0.37 \times 10^6$  t and  $6.05 \times 10^6$  t <sup>[9]</sup>. To solve this issue, there should be a joint initiative and merging of modern ideas and technologies with traditional and orthodox knowledge with focal point on improving the biodiversity and enhancing living of the farming community <sup>[7]</sup>.

### 2. Wet terrace rice cultivation (WTRC)

Wet terrace paddy cultivation is one of the main methods of cultivation practised by the people of Nagaland. In local dialect, also known as pani-kheti. The fields are said to be inherited within the family and passed on from generation to generation. Terracing is a traditional method of rice cultivation in Nagaland. The terraces are usually cut slopes in hilly areas with water depth of 8-10cm into a series which resemble stairs and irrigation is by rain or other water channels and streams where water flows timely from one terrace to another for proper water usage, along with preventing erosion of soil, maintaining fertility and reduces surface runoff. Small water channels and outlets are constructed, along with bunding at the edges for proper

stability<sup>[10]</sup>. Wet cultivation is usually common in the lands of Angami tribe, depending with weather conditions from region to region. In Northern Angami zone, cultivation of rice usually commences in month of July, on the other hand Southern Angami take up during May. The terraces not only help in reducing soil erosion and control surface runoff and but also source of irrigation to rice and other crops.

A study trial was carried out during 2016-17 by Longkumer *et al.* 2019, to determine the efficiency of production in wet rice cultivation under Dimapur and wet terrace cultivation under Phek districts of Nagaland based on 300 households in both. This trial revealed that WRC under Dimapur recorded maximum productivity than WTC under Phek, due to better utilisations of inputs like fertilizers, seeds, machineries and access to irrigation which contributed on achieving higher productivity and production as compared to the other<sup>[11]</sup>. Both systems were found to be labour intensive and average labour per acre was noted as 41.57 man days in Phek district while 43.9 man days in Dimapur. The study concluded with WRC being more profitable and rewarding with more in come in comparison to WTC.

### 3. Alder tree based farming

With soil erosion being a major threat due to intense rainfall and sloppy topography the people of Khonoma village have started raising Alder trees alongside major agricultural crops- rice, maize. The main motive behind this idea is that the root nodules of the trees are able to fix nitrogen into the soil, hence improving soil fertility also providing shed and cover for plantation crops like cardamom grown at higher elevation or low elevation like coffee. This form of practised has been followed about 100 years by the people. With *jhum* is carried out for a period of 2 years - 9years, but in system of alder-based harvesting is done in 4-5years there is also increase in production and also checks erosion (image 2). The seedlings of Alder trees are sown on sloppy areas where it attains its growth by 6-10 years. In the beginning, the foliage and branches are blazed and ashes are incorporated in to the soil for land preparation. The practise of pruning is done once till it attains age of 6years. The leaves from the colossal branches are then removed and used as an alternate for fire wood, while the roots consisting of nodules (*Symbiotic frankia*) take responsible for restoring fertility into the soil and the roots acts as barrier to prevent slip and soil erosion for occurring in sloppy areas<sup>[12]</sup>. Symbiotic frankia are special structures or nodules present on the roots of the trees for nitrogen fixing and rejuvenating the *jhum* lands.

The leaves of the trees also provide to the cattle as forage. The seeds are broadcasted to stable the landslide areas as to restore the *jhum* areas that are degraded with low fertility status, along with losing of forest area, top soil due to soil erosion. The trees for planted for soil reclamation purposes and to control landslides and soil erosion<sup>[13]</sup>. Besides, N fixation in the atmosphere the dried leaves and litter provide calcium, potassium, phosphorus and other nutrients into the soil<sup>[14, 15]</sup> (Table2). Planting of horticultural crops and agro-forestry crops is a common trend as it protects the land, checks the environment and increases the income for improving the status of the farmers. Alder tree species (*Alnus nepalensis*) are planted in the *jhummed* site and allowed to grow as reclamation for the soil. The tree barks and wood are also used general furniture and carpentry, making boxes and matches, *Alnus nepalensis* is known for its dyeing and tanning purpose. Agro-forestry is largely practised by tribes of Angami, Chang, Yimchunger, Chakesang and Konyak where

along with the trees additional crops are also cultivated for personal consumption<sup>[7]</sup>. Similarly, some villages under Mokokchung district have begun the planting of *Zanthoxylum* sp, *Clerodendrum cordatum* etc, which after the summer crops are harvested, the area is fallow and abandoned till the next cropping season. In order to make better use of the wasted land, the farmers have started planting winter crops – peas, cabbage, carrot and mustard. The farmers have embraced growing crops two times a year- summer and winter crops as it generates more income upgrading their livelihood status. Farmers in *jhum* area also have adopted mixed cropping including rice, maize, colocassia, pumpkin, millet, chilli, tomato, ginger, cucurbits and other legume crops. This helps in sustaining the sloppy areas brings stability between non legumes and leguminous crops and acts as a guarantee in case of crop failure. Kithan (2014) outlined the interests of alder system practised by the farmers for conservation of water and soil at the same time<sup>[16]</sup>.

### 4. Zabo

This is an original farming system, native of Kikruma village under Phek district, which covers an area of 957.9 ha. The term meaning-system of impounding of water, which is a distinct water harvesting technique through rain-water for meeting the needs of drinking and irrigation purpose (image 3).

It includes the integration of agriculture, livestock husbandry and forestry with proper water source. It has been reported that the techniques of water harvesting and management, practised by the local farmers are so unique that modern era ideas and system are incomparable to it<sup>[17]</sup>, reservoirs and ponds are dugged in order to collect the water and water is channelled from inlets into the pond to reduce loss from seepage. Silt retention reservoirs are also erected at some places and cleaned at annual period.

Then water is released from the base of the pond for irrigation purpose and passed through pipes or bamboo outlets till to the tank or reservoir of the farmers. During the month of May-June terrace cultivation in paddy fields begin and water is kept in the field till crop period. Paddy is the primary crop cultivated in this system. All the farmers who share the outlets take in charge of cleaning it timely (image3). This type of system follows the integration livestock- cattle, pig, sheep, poultry and sheep alongside the pond and above to it vegetation is grown.

It includes vegetables –cucurbits, colocasia, squash and fruits like banana, lemon, papaya and oranges. For irrigation propose in rice fields, water is taken in from the ponds and passed through the animal sheds along with urine and dung from the animals that is utilised for increasing the soil fertility and provides necessary nutrients. In this form of practise, the paddy fields are located at lesser elevation. Paddy along with fish farming is also commonly followed by the farmers and some usually practise in the wet paddy terraces.

Ponds or mini pits are dugged in the centre of the paddy fields and fish fingerlings are then allowed into pits during July month. After the paddy gets matured by October ending, the fields are drained off before the harvest. The fishes are moved to the dugged pit from the pond after it dries off, and are harvested from there. About 50 kg-60kg of the fishes get harvested per hectare from this paddy with fish farming. The entire system consists of forest area at the top most followed by siltation tanks at the bottom with horticultural crops on the edges, consisting with an outlet channel then livestock shed

and below that vegetation area then fish terraced paddy cultivation along with fish farming.

This inbuilt technique for water recycling and harvesting along with conservation method to control soil erosion and manage fertility at the same time is a feasible method of using all available resources and also maintaining the environment status. In some areas, it becomes a hindrance for terrace construction as for water storage which leads to surface runoff directly into the rice fields as source of water. By placing, rice husk onto the shoulder or edge of the bunds and followed by thoroughly puddling the paddy fields <sup>[18]</sup>.

A study conducted by Singh *et al.* 2018 under zabo system at Kikrumba village under Nagaland, revealed that with variation in seed rate from 15-60 kg/ha, there was also variation in the paddy yield from 1400 to 2500 kg/ha. The fish from the small ponds usually yield between 40.00 to 80.00 kg with 61.75 kg/ha as average <sup>[19]</sup> (Table 3) Hence, zabo practise is therefore the most pre-eminent system of cultivation which also reduces chances of natural and man-made disasters <sup>[17]</sup>.

Kithan (2014) also reported the advantages of *zabo* system followed by the farmers in conserving the soil and water as well as environment for the long run.

### Problems faced by the farmers

Farming is a major part of the Indian economy, as it employs more than two third of the population in the rural sector. Nagaland is multiplying at a rapid rate and is influenced by the rural people. However, the facilities and provision availability related to the rural population are limited.

1. With man power and land as the major variable in development, the deficit of necessary resources also decreases the productivity rate hampering the growing demand of the people. With the new and up to date seeds suppressing the traditional ones causing indefinite fear among the locals. There is also a need of assistance from the government and the higher figure for the evolution of traditional system and in financial aid for the farmer as there is scarcity of capital for the farmers in the rural areas.
2. Weak road connectivity along with less accessibility towards rural areas of the state is one of the biggest problems faced by the farmers. Alongside frail infrastructure, poor bank and post office services,

impoverished medical/health centres and education amenities for the poor and rural areas.

3. Absence of an assembled and organised marketing system is another challenge faced by the farmers along with fluctuation in market prices causing great loss to the farming community and the perishable products usually go to waste. The farmers, at times in absence of market service or space depend on the middlemen or local or private traders for selling off their produce that are sold at cheap prices. Unavailability of marketing system and proper road connectivity, which usually results in the ruling of the markets by middlemen and traders.
4. Poor and inadequate cold storage structures and facilities also remain a major hindrance for the farmers of Nagaland. Under such circumstances, the farmers are forced and pressured to dispose off their produce at the earliest after harvesting them at low and cheap prices in the market. This leads to heartache and agony to the farmers as they are deprived from their valid income.
5. High labour cost is another problem faced by the farmers. With more man power needed in the hilly areas, it becomes quite labour extensive and leads to high cost of labour. Skilled labourers tend to charge more than unskilled labourers. The average rate of a labourer ranges from ₹300-₹500 per day depending upon the amount of work load.
6. Traditional tools are still in use by the farmers, as there are no adequate farming equipments and machineries suitable for hilly areas. With low mechanisation power, it prolongs the work leading to high labour extensive and even more labour costs.



Fig 1: Shifting cultivation/ Slash and burn / Jhum in Nagaland



Fig 2: Alder based tree cultivation in Khonoma Village, Kohima, Nagaland.



Fig 3: Zabo system, Kikrumba village under Phek district, Nagaland.

**Table 1:** Major indigenous farming systems

| Farming system       | states                         | Resource conservation method practised   | Crop productivity (paddy) |
|----------------------|--------------------------------|--|---------------------------|
| 1. Pani kheti/ WTRC. | Nagaland<br>Manipur and Sikkim | Terracing, diverting water to the terrace from the hills   | 2.5-3.0t/ha               |
| 2. Zabo              | Phek district of<br>Nagaland   | Forest area in the upper most hills, followed by animal shed in the centre hills then water harvesting reservoirs and tanks below that cattle shed followed by paddy and fish ponds with bunds to reduce runoff losses | 3.0-3.5 t/ha              |
| 3. Alder tree        | Nagaland                       | Alder trees are grown up to 2m, while leaves and biomass to his non leguminous N fixing tree is provide soil fertility   | 2.0-2.5 t/ha              |

**Table 2:** Litter yield and nitrogen added through alder tree-

| Alder population | Litter dry yield | N added | Litter yield |
|------------------|------------------|---------|--------------|
| 60               | 56.3             | 48.3    | 3.37         |
| 101              | 45.3             | 74.5    | 5.48         |
| 142              | 58.1             | 110.5   | 8.25         |
| 166              | 52.2             | 113.5   | 8.66         |
| 280              | 37.5             | 142.8   | 10.50        |
| 625              | 21.7             | 184.8   | 13.56        |

**Table 3:** Seed rate, yield of paddy and fish under zabo system

| Variable    | Maximum (kg/ha) | Minimum (kg/ha) | Average (kg/ha)         |
|-------------|-----------------|-----------------|-------------------------|
| Seed rate   | 60.00           | 15.00           | 37.90 ( $\pm 2.49$ )    |
| Fish yield  | 2500.00         | 1400.00         | 1950.00 ( $\pm 50.00$ ) |
| Paddy yield | 80.00           | 40.00           | 61.75 ( $\pm 1.79$ )    |

## Conclusion

With hilly topography and intense rainfall in the state leading to heavy soil erosion and soil loss, a review of the indigenous techniques and methods were done to study the various practises farmers taken up to for preventing soil erosion and focus on the conservation methods with proper utilisation of available resources along with crop production. These traditional farming systems of Nagaland are known for their rich indigenous knowledge based of soil fertility management and water conservation methods along with forestry in a sustainable manner. These systems have remained constricted in their place of creation due to the introduction of latest technologies which bring more and higher production. Agricultural methods and practises are basically aimed towards maintaining cropping pattern with increase in the total production in the hilly topography. The produce are insufficient in meeting the growing needs of the people, however, they depend on their traditional practises and indigenous knowledge in farming along with making use of available resources to meet their requirements.

## Conflict of interests

Authors declare no conflict of interest.

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