

Success of millet cultivation

in eastern Himalayas

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Agro-climatic region of fifth zone of the Himalaya consists of temperate to cold and frigid climate, humid to semi-humid, which obtains >2800 mm annual rainfall. Arunachal Pradesh lies in this zone where farming system is characterized by the cultivation of subsistence crops including millets. Millets such as foxtail millet, proso millet, finger millet, and pearl millet are the most frequently grown crops among millets under shifting cultivation. They provide a variety of seasonal native foods for traditional uses including ceremonies, occasions, and festivities. Practices like integrated paddy, fish and finger millet farming followed by Apatani farmers are ecofriendly and sustainable.

Keywords: Apung, Cereals, Shifting cultivation, Sustainable organic farming

Millets include the group of small seeded millets such as finger millet (*Eleusine coracana*), foxtail millet (*Setaria italica*), proso millet (*Panicum miliaceum*), kodo millet (*Paspalum scrobiculatum*), little millet (*Panicum sumatrense*) and barnyard millet (*Echinochloa esculenta*) which are often grown in tropical and subtropical regions at an altitude of 2,100 m. Being a heat-loving plant, 8–10°C is the required minimum temperature for germination. These crops can tolerate a certain level of soil alkalinity and adapt well to a variety of soil types, from extremely poor to very fertile. Sandy, loamy and alluvial soils with good drainage are the best types of soil for them. At the onset of monsoon, land should be ploughed deeply with a soil-turning plough. For effective germination and crop establishment, fine tilth is crucial. Its cultivation in jhum field is ideal during the months of April and May. The ideal growth temperature range for millets is between 26–29°C for optimum production and good crop yield. It is grown in regions with rainfall between 500–900 mm.

Calcium, iron, protein, fiber and other minerals are abundant in millets. The cereal primarily

contains unsaturated fat, which has a low-fat content. The absence of gluten makes it simple to digest. Given its lower glycemic response or reduced capacity to spike blood sugar levels, it helps diabetics maintain blood sugar levels. Millets are one of the most nutrient-dense cereals and also aid in maintaining bone health, decreasing blood cholesterol, regulating anemia and keeping weight under control.

Significance of organic farming in millets

The continuous cultivation of cereals and other crops with heavy use of chemical fertilisers to increase

crop yields has wreaked havoc on the nation's rivers and waterways. A few of these rivers have developed such high levels of contamination that no use can be made of their water. If the problems are not resolved quickly, regions of eastern Himalayas could experience similar problems since the once-fertile soils are now unsuitable for cultivating any crop. The recent monsoon failure in India's north eastern states, where the majority of farmers rely on rain-fed agriculture to cultivate their crops, has, nevertheless, had a terrible effect on the local farmers in the region.



Foxtail millet cultivation in Upper Siang district of Arunachal Pradesh

Source: https://www.researchgate.net/figure/Foxtail-millet-plants-cultivated-in-field-condition-a-Fully-grown-foxtail-millet-plants_fig1_320536530



Proso millet cultivation in East Siang district of Arunachal Pradesh

Source: <http://encrypted-tbn1.gstatic.com/images?q=tbn:ANd9GcR>

Due to the increasing frequency of droughts in some of India's most productive agricultural regions, farmers must adopt farming techniques that have the least negative environmental effects while still yielding an adequate number of crops to support their livelihood and the nation's food demand. This is where sustainable organic farming and millet cultivation comes into play.

Organic nutrient management millet cultivation

For millets, chemical fertilisers are not much required. As a result, majority of the farmers produce it in purely ecological conditions using farmyard manure. Farmers have recently begun employing organic fertilisers like vermicompost from their own backyards. Also employed are growth-promoting substances like *Panchagavya* and *Amritpani*. These methods make millet production environmentally friendly. Nutrient management in organic millet farms should effectively meet the nutrient requirements of the crop, prevent nutrient depletion, and maintain or boost soil productivity without disproportionate nutrient losses.

Millet farmers frequently succeed in enhancing the physical and chemical characteristics of the soil for sustained productivity by:

- Using organic materials, such as compost, vermicompost, farmyard manure and bio-fertilizers, to preserve soil organic matter and deliver nutrients.
- Using cover crops to recycle soil nutrients and biologically fix nitrogen from the atmosphere.
- Planting green manure legumes *in situ* or using green leaf manuring and incorporating them into the soil.
- Intercropping or growing multiple crops simultaneously.
- Rotation of crops.
- Management of crop residues

Shifting cultivation of millets in hills/tribal areas

Tribal communities in Arunachal Pradesh practice shifting cultivation, also referred to as "slash and burn."

Table 1. Mean area, production and yield of millets in millet-growing districts of Arunachal Pradesh (1997–2016)

District	Small millets			Total millets		
	Area (ha)	Production (tonnes)	Yield (kg/ha)	Area (ha)	Production (tonnes)	Yield (kg/ha)
Anjaw	1106	1046	945	1106	1046	945
Changlang	1830	1446	790	1830	1446	790
Dibang Valley	779	695	892	779	695	892
East Kameng	624	638	1022	624	638	1022
East Siang	2214	2645	1195	2214	2645	1195
Kurung Kumey	448	471	965	488	471	965
Lower Dibang Valley	1466	1130	771	1466	1130	771
Lower Subansiri	1710	1826	1068	1710	1826	1068
Papum Pare	651	809	1243	651	809	1243
Tawang	948	1082	1142	948	1082	1142
Tirap	3895	2985	766	3895	2985	766
Upper Siang	1170	980	838	1170	980	838
Upper Subansiri	1319	1549	1174	1319	1549	1174
West Kameng	1148	1113	970	1148	1113	970
West Siang	2524	2161	856	2524	2161	856

Source: Bhat *et al.* 2019.

With this farming method, two or three yearly crops can be produced before the field is abandoned until the trees have recovered sufficiently to allow for a second filling. This cycle repeats until the area is so depleted of soil that there is no longer any hope for forest growth. Millets, notably finger millet, small millet, foxtail millet, proso, kodo millet, pearl millet, and sorghum, make up the majority of the crops grown on lands. Along with millets, commercial crops like red gram, horse gram, castor, plantain, and turmeric are also grown.

A variety of millet varieties, including finger millet, foxtail millet, pearl millet, barnyard



Integrated paddy, fish and finger millet cultivation

Source: <https://www.eastmojo.com/manipur/2021/11/19/is-manipur-govt-building-food-park-at-the-cost-of-its-farmers/>

millet, little millet and sorghum are broadcast on hill slopes during the summer, and paddy seeds are typically sown as the monsoon season approaches. Vegetables and other crops are also grown at the same time.

Since they do not use any chemical pesticides or fertilizers, tribal farmers do not need to take any action to control pest and diseases. By default, all aspects of jhum production fall under organic farming. Slash-and-burn techniques are frequently used to clear the land; trees, bushes, and forests are cut down by slashing, and the leftover flora is burned, adding potash to the soil as it burns. Hill soils are more susceptible to soil erosion and other natural processes because of the slope and topography, which lowers soil fertility. Additionally, in hilly places, animal dung is a crucial source for repairing and sustaining the fertility of these soil. By virtue of a symbolic connection, animals have continued to be a crucial component of diverse farming systems in the hills.

Integrated paddy, fish and finger millet cultivation

The paddy, fish, and finger



Zan porridge from finger millet
Source: <https://www.archanaskitchen.com/aranachal-pradesh-zan-recipe-finger-millet-porridge-with-vegetables-recipe>



Apong and Madua Apong extraction from rice and millet
Source: <https://www.archanaskitchen.com/aranachal-pradesh-zan-recipe-finger-millet-porridge-with-vegetables-recipe>

as compared to those prepared from rice. In addition to making local beverages, they are also used for making chapatti, porridge, etc.

SUMMARY

In the eastern Himalayas, where small farmers are the majority, millets are an essential component of subsistence farming. Some of the millet crop grown in the area include finger millet, foxtail millet, and pearl millet. Finger millet is the most common millet crop in the region. Due to their ability to thrive in hilly and mountainous terrain and their resistance to adverse weather conditions, indigenous populations in the area have been cultivating and using these small-seeded grasses for centuries. Their nutritious content, flavour, health benefits, social, ritual, and cultural significance, traditional fermented foods and beverages hold a special position in the Himalayas. Millets are sometimes known as miracle grains and are a blessing to the area because they are said to be the precursor of the evergreen revolution.

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millets farming system practised by the Apatani tribe in the lower Subansiri district of Arunachal Pradesh is distinctive in that it systematically practices all three components through judicious land use, taping the potential of every square inch of arable land through water conservation, fish rearing, and soil conservation through planting finger millets along the bund.

Consumption habits of millets in the region

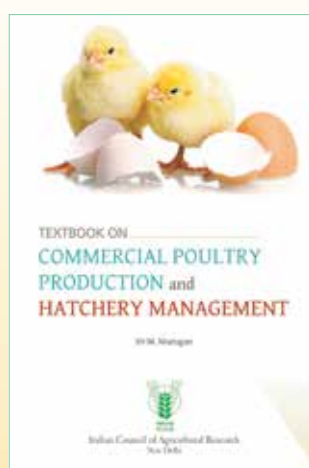
Zan: The most favoured porridge recipe among the Monpa tribes of Arunachal Pradesh. The dish is made using millet flour.

Apong: Apong and Madua Apong are two popular beverages made in Arunachal Pradesh using rice and millet, respectively, through an unrestrained fermentation process. Among the tribes, Mirung (Millet) is used to make Madua Apong, a dark red organic wine.

Traditional uses of finger millet

Depending upon the ultimate utilization, finger millet grains can be processed in several ways. Generally, the Memba people use it for making local beverages called Chang or Apong. The local beverages prepared from finger millet are highly valued and prized

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TECHNICAL SPECIFICATIONS

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