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Chapter

# Rice Cultivation - A Way of Life for the People of North Eastern Hill Region of India

*Noren Singh Konjengbam, Mayurakshee Mahanta and Andrean Allwin Lyngdoh*

## Abstract

Being an amazing picturesque of land, the North Eastern Hill Region of India, consisting of more than 200 ethnic groups, has only about 2.27% of the total rice area and shares only 1.96% of the total rice production in the country. Whether profitable or not, the rice cultivation is a way of life for the people of North Eastern Hill Region of India. Till today, the production and productivity of rice in this region is below the national average because of its fragile ecosystem and the varied physio-graphic conditions pertaining to this region. Neither the wider recommendation of agricultural technology such as variety nor the use of a single technology or variety can solve this problem of low yield. However, the development of location specific high yielding rice variety using the existing land races prevalent in the area can be one of the promising technique for improving the production and productivity of rice cultivation in this region.

**Keywords:** Rice, North Eastern Hill region, India, Rice Improvement, Fragile ecosystem

## 1. Introduction

Rice is the staple food crop of the North East Hill (NEH) Region inhabited by different tribes/ethnic groups. The varying agro-ecosystem and different tribe grow different land races of their preference based on quality and other religious purpose. The North-Eastern region of India has got a strategic importance and is surrounded by Bhutan and China in the north, Myanmar in the east while Bangladesh is in the south eastern side. More than 200 ethnic groups inhabit this region. This region is characterized by high rainfall, humidity, with varied topography and altitude making it a hub rich in floristic and crop diversities [1].

Rice being the way of life and culture of the people of NEH Region, irrespective of remunerative or non-remunerative, is cultivated under different rice growing situations of NEH states ranging from low lying lake areas to sloppy land of high hills in different rice growing seasons by adopting their age old indigenous rice growing methods and practices for their food and livelihood. In Arunachal Pradesh, rice is grown up to an altitude of 2000 m. Assam is characterized by both hilly and plain areas and rice is found to be cultivated in both. In Manipur, both upland and lowland local cultivars of rice are grown. In Meghalaya, soft varieties are cultivated

and used as both flaked and in raw form. In Mizoram, cultivation of rice is limited only to the valley and lowland areas. Rice is also a main staple in the state of Nagaland where more than 400 accessions of rice germplasm have been collected. Rice, in Tripura, is cultivated in hills, hillocks and flat valley. In Sikkim, is a hilly stretch in the Himalayas where rice is cultivated annually [2].

### 1.1 Agro-climatic and physio-graphic condition of the region

The North East Hill (NEH) Region comprising the states of Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura, is lying between 21.57° to 29.30° North latitude and 88° to 97.30° East longitude representing a distinct agro-climatic area of the country. The region is having a total geographical area of 262185 Sq. km and it has international border with China in the north, Myanmar in the East, Bhutan in the North West and Bangladesh in the South Western part [3].

The NEH Region is divided into three geographic regions:

i. The Eastern Himalayan Region: This region includes the state of Sikkim and Arunachal Pradesh excluding Tirap District and part of Lohit District

ii. The Purvanchal Region: This region comprises Nagaland, Manipur, Tripura and Mizoram states including Tirap and Lohit Districts of Arunachal Pradesh

iii. The Meghalaya-Mikir Region: This includes Khasi, Jaintia and Garo Hills of Meghalaya.

These broad geographical regions show a wide diversity of climate due to altitudinal, physiographical and edaphic factors contributing to the diversity of agricultural crops as well as agricultural activities of the people [4]. The broad geographical regions of the North Eastern Hill States is given in **Table 1**.

The variation in the agro-climatic condition is due to its location and topography of this region. Being the hilly zone intercepted by small valley areas in between the hills and its position in the latitude and longitude pinning in the Sub-tropical areas, existence of these wide variation is the outcome. Although the agro-climatic zones show distinct differences in agro-climatic characteristics, it was difficult to draw a clear line of demarcation between two zones. However, to cater the specific needs of agriculture in these zones, the above delineation would serve the purpose and cover the maximum proportion of land, water, climatic conditions existing in the entire NEH Region.

### 1.2 Classification of rice in NEH region

According to rice growing seasons, rice in the region may be classified into three groups as under as given by [5]:

i. Autumn or Pre-*kharif* or *Ahu* paddy

These groups of rice are grown generally from the month of February as irrigated transplanted rice and may continue upto the month of May. Harvesting starts from May to August.

ii. Winter or *kharif* or *Sali* paddy

These groups of rice are grown during the month from July–August as rainfed direct seeded or transplanted rice and irrigated transplanted rice. The crop is harvested during the month of November and December.

| Zones | Altitude Range | Approx. geographic-al area (sq.km) | Annual Average Rainfall (mm) | Mean Temp. Min/Max | Areas | Remarks |
|---|---|---|---|---|---|---|
| **1. Alpine Zone** | >3500 m | 47068 | 750 | 2°C / 17°C | **Arunachal Pradesh:** Gorichen Upper Tawang, Tulungla, Bumla, Sela pass areas of West Kameng District, Jidu and adjoining areas of Northern Siang.<br>**Sikkim:** Gnathong, Chhangu, Serrathong, Thangu, Yakthan, Zema, Lachen, Heegyathang, Samsinggeling, Cholemu, Lima, Nathula range | No rice crop is generally grown in this zone. |
| **2. Sub-alpine and Temperate zone** | 1500-3500 m | 33564 | 2000 | 11°C / 20°C | **Arunachal Pradesh:** Tawang, Dirang, Bomdila, Shergaon, areas West Kameng District, Dibang Valley, Northern part of East Siang, Upper Subansiri District, Part of West Siang around Anini & North Eastern part of Lohit District<br>**Meghalaya:** Upper Shillong, Mawphlang and Mairang of East Khasi Hills District<br>**Manipur:** Mao & Maram areas of Senapati District, Ukhrul and adjoining areas of Ukhrul District<br>**Sikkim:** Karponang, Bordong, Resi, Kangdin, Melli, Param, Lachem, Laichung, Hilley, Yoksum.<br>**Mizoram:** Blue mountain, Halikhan, Tuipang, Nauzuarzo, Tiang<br>**Nagaland:** Tuensang and Zunhoeboto Districts, Vangkong area of Wokha District, Higher areas of Mokokchung District. | Rice crop, mostly local varieties, are grown either as transplanted rice in the terraced fields or as direct seeded rice in *jhum* field of hill slopes. |
| **3. Sub-tropical hill zone** | 1000-1500 m | 29021 | 1600 | 12°C / 30°C | **Arunachal Pradesh:** Changyak, Naga and Khonsa area of Tirap District, Basar area of Siang District<br>**Meghalaya:** Jowai Sub-division of Jaintia Hills, Part of Nongstoin Sub-division, Nokrek and Kailash area of West Garo Hills and Western part of East Garo Hills<br>**Sikkim:** Namchi, Gayzing, Rongli, Rehnok, Mangan, Changthang, Uttre, Gangtok<br>**Mizoram:** Whole State except lower valleys of Northern and Western part and area adjoining Cachar District and lower parts of Chhimtuipuii District<br>**Nagaland:** Mokukchung District, Lower parts of Kohima, Wokha District and Mon District. | Rice crop is grown in *jhum* fields of hill slopes as direct seeded rice and in terraces as wetland rice mostly by transplanting. |

| Zones | Altitude Range | Approx. geographic-al area (sq.km) | Annual Average Rainfall (mm) | Mean Temp. Min/Max | Areas | Remarks |
|---|---|---|---|---|---|---|
| **4. Sub-tropical plain zone (valley area)** | 400-1000 m | 812 | 1375 | 12°C / 27°C | **Manipur:** Manipur Valley<br>**Nagaland:** Bhaghti & Longnak valley<br>**Meghalaya:** Umkiang area of Jaintia Hills. | Rice is grown as rainfed and irrigated wetland rice either transplanted or direct seeded with sprouted seeds. |
| **5. Mild -tropical hill zone** | 200-800 m | 26349 | 1400 | 12°C / 30°C | **Arunachal Pradesh:** Southern part of lower Subansiri District.<br>**Meghalaya:** Southern part of Jowai Sub-division adjoining Karimganj, Southern part of Nongpoh Sub-division of Khasi Hills, Eastern part of East Garo Hills and West Khasi Hills.<br>**Manipur:** Tamenglong District including Jiribam Sub-Division, Churachandpur and Thanlon of Churachandpur District. Moreh area of Chandel District.<br>**Sikkim:** Rongpoh area of East District.<br>**Mizoram:** Lower valley of Northern and Western parts of Chhimtuipuii District.<br>**Tripura:** Jampui Hills.<br>**Nagaland:** Medziphema area of Dimapur Sub-Division. | Rice is grown mostly as direct seeded upland crop in *jhum* fields of hill slopes and in terraced fields as wetland transplanted rice. |
| **6. Mild -tropical plain zone** | 0-200 m | 29333sq | 2000 | 17°C / 33°C | **Arunachal Pradesh:** Pasighat area, Singphow area of Tirap District and lower parts of Lohit District.<br>**Meghalaya:** Lower part of West Garo Hills District.<br>**Mizoram:** Parts of adjoining Cachar District of Assam and North Tripura District.<br>**Tripura:** Major part of Tripura excepting Jampui Hills<br>**Nagaland:**Southern part of Dimapur Sub-Division excluding Medziphema area. | Rice is grown as rainfed and irrigated wetland rice either transplanted or direct seeded. |

**Table 1.**
*The broad geographical regions of NEH states (delineated into six distinct agro-climatic zones).*

iii. Spring or Summer or *Boro* paddy

These groups of rice are grown during the month of November–December and harvested in the month of April–May mostly in water stagnated areas.

Further, rice grown in the low land areas of NEH region is further classified into two groups:

i. *Ashara* or shallow water rice

Rice is grown from March–April and harvested in November–December in shallow water rice area of 0.5 to 2.0 m water depth.

ii. *Bao* or deep water/floating rice

Rice is also grown from March–April and harvested in November–December in deep water areas as floating rice with water depth of 2 m and above.

Based on the rice agro-ecosystems prevailing in the NEH Region, rice may also be classified as under:

i. Hill or slope land rice

These groups of rice are grown in hill slopes either in the *jhum* field (**Figure 1**) as rain-fed upland direct seeded rice or in terraces (**Figure 2**) mostly as irrigated wetland transplanted rice. The hill rice may be of low-altitude (1000-1500 m MSL), mid-altitude (1500-2000 m MSL) and high-altitude (above 2000 m MSL).

ii. Valley or flat land rice

These groups of rice are grown in flat land either as rain-fed dry-land direct seeded rice or rain-fed wetland direct seeded rice with sprouted seeds (**Figure 3**) or rain-fed wetland transplanted rice or irrigated wetland



**Figure 1.**
Jhum *cultivation.*



**Figure 2.**
*Terrace cultivation.*



**Figure 3.**
*Direct seeded rice.*

transplanted rice (**Figure 4**). The rice in valleys are generally grown at an altitude of about 400 to 1000 m above MSL.

iii. Low lying semi-deep water and deep water rice

These groups of rice are generally adapted to semi-deep water (say from 0.5 to 2.0 m) and deep water conditions (more than 2.0 m) (**Figure 5**). This rice is generally direct seeded before monsoon rains. These areas are generally available in an altitude from 100 to 700 m above MSL.



**Figure 4.**
*Transplanted rice.*



**Figure 5.**
*Deep water rice.*

## 2. Present status of rice production in NEH region

Rice is the most important cereal crop of the North Eastern Hill Region covering an area of about 998000 hectares producing about 2154000 tonnes of rice with an average productivity of 2.00 t/ha which is below the national average of 2.50 t/ha (average from 2014 to 2015 to 2018–2019). The rice area of NEH Region to the total area of the country is only about 2.27% with a rice production of 1.96% to the total rice production of the country. The present deficit in rice productivity of NEH Region from the national average is about 19.71% [6].

The average area, production, productivity, requirement, excess/deficit and per cent excess/deficit of rice in NEH states from the year 2014–2015 to 2018–2019 are presented in **Table 2**.

The average rice productivity in the NEH states varies from 1667 kg/ha in Mizoram to 2941 kg/ha in Tripura with a total rice excess of about 1.39 lakh metric tonnes. With the availability of land for rice cultivation becoming a limiting factor, increasing the level of productivity wherever possible by adopting the best available rice production technology to meet the ever increasing demand of rice has now become a great concern for NEH Region.

| Name of state | Area ('00000 ha) | Production ('00000 tonne) | Productivity (kg/ha) | Requirement ('00000 tonne) | Percentage excess (+) / Deficit (−) | Requirement of quality seed at 25% SRR ('000 tonne) |
|---|---|---|---|---|---|---|
| Arunachal Pradesh | 1.30 | 2.36 | 1814.80 | 2.02 | (+) 14.40 | 1.63 |
| Manipur | 2.35 | 4.23 | 1791.80 | 4.16 | (+) 1.65 | 2.94 |
| Meghalaya | 1.11 | 2.62 | 2361.80 | 4.33 | (−) 65.27 | 1.39 |
| Mizoram | 0.37 | 0.61 | 1667.00 | 1.60 | (−) 162.30 | 0.46 |
| Nagaland | 2.06 | 3.63 | 1771.60 | 2.88 | (+) 13.22 | 2.58 |
| Sikkim | 0.10 | 0.18 | 1701.40 | 0.89 | (−) 394.44 | 0.13 |
| Tripura | 2.69 | 7.92 | 2941.00 | 5.36 | (+) 32.32 | 3.36 |
| **Total (NEH)** | 9.98 | 21.54 | 2007.05 | 21.24 | **(+) 1.39** | 12.48 |
| **All India** | 439.066 | 1097.648 | 2499.80 | | | |

***Source:*** *[6].*
***Per capita consumption of cereals:*** *146 kg/person/year (based on RDA of NIN, Hyderabad).*
***Population:*** *As per 2011 census.*

**Table 2.**
*Average rice area, production, productivity (2014–2015 to 2018–2019) and quality seed requirement of rice crop at 25% seed replacement rate in NEH states of India.*

The total gross annual domestic income from rice agriculture for the NEH states of India, by taking average yield of rice from 2014-15 to 2018-19, is presented in **Table 3**.

As per **Table 2**, it is observed that rice production is in short from the requirement of cereals in the Mizoram, Meghalaya and Sikkim states of this region. However, when we look NEH states as a whole, the region is self-sufficient in rice considering the shortage is made up from the surplus states. The rice economy of this region is about 1.96% of the whole country and a lesser productivity from the national average productivity of this crop. The requirement here is also calculated on the basis of total cereals required per capita as per [7]. The only cereals which are staple food that consumed twice a daily is rice in this region.

## 3. Problems and opportunities through SWOT analysis on rice production in NEH region

As the rice crop is grown in the NEH Region under widely diverse agro-climatic conditions resulted from varied altitudinal, physiographic, edaphic, rainfall, etc. conditions, there is immense variability among the rice cultivation practices as well as rice cultivars from one place to another. Hence, the SWOT analysis on rice cultivation in the NEH Region may clarify the problems and opportunities of rice production in the region as under as given in [8, 9]:

Strength:

i. Rice is the staple food of NEH region and consumed in different forms *viz*., cooked rice, popped rice, rice flakes, rice cake, rice flour, etc.

ii. A large number of land races/local cultivars including wild relatives *viz*., *Zizania* spp., *O. rufipogon*, *Oryza nivara*, *O. sativa f. spontenea,* etc. are available in the region.

| Name of state | Area ('00000 ha) | Production ('00000 tonne) | Productivity (kg/ha) | Requirement ('00000 tonne) | Gross income per hectare (INR) | Gross state income from rice (INR in crores) | Remarks |
|---|---|---|---|---|---|---|---|
| Arunachal Pradesh | 1.30 | 2.36 | 1814.80 | 2.02 | 31,759.00 | 413.00 | NEH States of India share only 1.96% of country's gross income from rice |
| Manipur | 2.35 | 4.23 | 1791.80 | 4.16 | 31,356.50 | 740.25 | |
| Meghalaya | 1.11 | 2.62 | 2361.80 | 4.33 | 41,317.50 | 458.50 | |
| Mizoram | 0.37 | 0.61 | 1667.00 | 1.60 | 29,172.50 | 106.75 | |
| Nagaland | 2.06 | 3.63 | 1771.60 | 2.88 | 31,003.00 | 588.00 | |
| Sikkim | 0.10 | 0.18 | 1701.40 | 0.89 | 29,774.50 | 31.50 | |
| Tripura | 2.69 | 7.92 | 2941.00 | 5.36 | 51,467.50 | 1386.00 | |
| **Total (NEH)** | 9.98 | 21.54 | 2007.05 | 21.24 | **35,123.37** | **3769.50** | |
| **All India** | 439.066 | 1097.648 | 2499.8 | | **43,746.50** | **192088.40** | |

*Procurement price during 2018–2019 = Rs. 1750 per quintal.*

**Table 3.**
*Rice agriculture economy of NEH states by taking average yield of 2014–2015 to 2018–2019.*

iii. Rice grows from deepwater conditions (e.g. deep water rice) to high hills (e.g. *Jhum* rice) in the region.

iv. Monsoon rain spreads from the month of May–June to October–November in the region.

v. Rice can grow in all the soils available in the region.

vi. Two Central institutes viz., Indian Council of Agricultural Research-Research Centre (ICAR-RC) for NEH Region and Central Agricultural University (CAU). with its constituent colleges in all the states of NEH Region, are located in the region.

Weakness:

i. Most of the available land races with consumer's preference in regard to eating quality are of low productivity. Availability of semi-glutinous or glutinous high yielding rice varieties suitable in NEH Region are minimum.

ii. Most of the rice production areas are rainfed and dependent on monsoon rains. Many a time, there is shortage of moisture in upland and even in lowland due to erratic monsoon rains.

iii. Most of the rice soil in the region is acidic in nature and farmers lack awareness of improved soil fertility management for sustainable production.

iv. Rice variety bred in mainland is not widely adapted in NEH region due to varied altitudinal and physiographical conditions of the region. Hence, availability of high yielding rice varieties for specific rice agro-ecosystem of the region is lacking.

v. Unavailability of quality seeds for different agro-ecosystem specific H.Y.V. rice varieties and lack of properly functioning Seed Certification Agency in the NEH Region.

vi. Poor communication system of the region to reach rice production and protection inputs in time to the rice farmers.

vii. Lack of technological intervention and effective extension services to the desired level for rice crop production, crop protection, farm mechanization, processing, value addition, etc.

viii. Rice monoculture is practiced on the same field year after.

ix. Existence of community land ownership system.

Opportunities:

i. Availability of land races adapted to different rice growing systems for use in breeding programme to develop rice variety suitable for different rice agro-ecosystems of the region as well as eating quality preferred by NEH people.

ii. CAU with its different constituent colleges at different NEH states with a mandate of teaching (HRD), Research and extension and ICAR Research Centre for NEH Region with its research centres in each NEH states is the opportunities for this region to address rice related problems and technological interventions.

iii. ICAR Seed Project can be converted into opportunity for this region to multiply and distribute good quality seeds of released rice varieties for different rice agro-ecosystems of the region.

iv. Availability of medium to high rainfall under monsoon is the opportunity for rice production, although the region has poor irrigation system.

v. Possibilities for adequate rain water harvesting in the region is an opportunity for rice based multiple cropping systems.

Threats:

i. Most of the rice growing areas in this region are rainfed with acidic soil.

ii. Requirement of agro-ecosystem specific rice variety is too many, demanding small quantity of seeds.

iii. Private Sector Seed Companies are less interested as the requirement of seed is low.

iv. Due to climate change, distribution of rainfall is rather erratic and unpredictable leading to unprecedented flood and drought.

v. Due to poor road connectivity, production inputs cannot reach farmers timely and in adequate quantities.

vi. High diseases and pests incidence on rice due to conducive environment prevailing in the region.

vii. Widespread prevalence of shifting cultivation which causes soil and nutrient loss.

viii. Farming community are small and marginal farmers.

Problems are many at the same time equal opportunities are also available for increasing rice production and productivity in the North Eastern Hill States.

## 4. Conclusion

To feed the ever increasing population in the NEH Region as well as to maintain the rice self-sufficiency in the region to-day, the present productivity of rice has to be increased at least to the tune of national average. The less productivity of rice in this region may be due to its varied physiography including hilly terrain forming different rice ecosystem. Any single improved variety cannot be grown suitably in all the ecosystem demanding lot many number of varieties with less quantity of seeds. The region is inhabited by more than 200 different ethnic groups who have

different preference of crop variety and quality, taste preference along with spiritual and religious difference. Because of this feature of land and people, no seed industry comes forward to establish their business for profit. When the yield and cost involved per hectare is looked in to, the rice cultivation in this region usually landed with less profit, sometimes loss due to harsh environment and low productivity. But, whether it is profitable or not, people of this region have to continue to grow rice which have been continuing since time immemorial because of its subsistence nature of agriculture, simple life and a sense of food security with rice.

Being rice the staple food of the NEH region, its cultivation under varying agro-ecosystem ranging from rain-fed lowland to deep water and fragmented land holding system of NEH farmers, a strong breeding program and quality seed production looking into the demand of rice farmers has to be initiated. Proper linkage for better input supply system with the concerned State Govt. and Research institutes should be strengthen leaving each other ego behind for the interest of improving livelihood of rural poor farmers of this region.

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## Conflict of interest

The authors declare no conflict of interest.

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