



"Indigenous Rice Cultivation in the Khasi Hills Region of Meghalaya: Production, Productivity, and Traditional Practices"

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ABSTRACT:

Rice cultivation, through indigenous technology, has a long history in the Khasi Hills, Meghalaya, and for many generations, it has been a part of the lives of the local people, whether it is profitable or not. Fitted with traditional techniques that support local livelihoods, the cultivation takes place in different agro-ecological zones, such as top hills, slope land, and low-lying places. To identify the main indigenous rice varieties produced in the Khasi Hills region, specifically in the Ri Bhoi District and East Khasi Hills District, this study aims to find those varieties and compare the productivity and production levels of each. Two districts were incorporated in the present study that had different ecological zones and the villages therein were practicing, native rice farming. The research aims at finding the level of production, the area cultivated, and the price-based productivity of native rice varieties as well as understanding the reasons that cause them to be less productive than the high-yielding varieties (HYVs). A trend of contemporary agriculture that puts traditional farmers up against the wall of knowledge, illiteracy and cultural disinclination sprang up, is the question of predominant concern. The evidence cited in the study that farmers have part of this knowledge through the selection of Indigenous landraces based on high yield, flavour, and regional ecosystem compatibility rather than targeting more efficient and high financial return plants, points to the cultural and ecological relevance of these cultivars. This paper explores a weak point for Khasi Hill's farmers who are economically afflicted and become part of the traditional rice farming culture, which is indispensable. The study of productivity decline, which simultaneously involves traditional methods of production, aims at the understanding of the conservation of traditional rice farming for the region.

KEYWORDS: Indigenous Rice Cultivation, Production, Productivity, rice area, yield

I. INTRODUCTION:

Cultivation of indigenous rice holds a long tradition in the Khasi Hills of Meghalaya which forms an intrinsic way of life for local people over several generations irrespective of its viability. The cultivation is done in different agroecological zones of the highest hills to slope lands and low-lying places using the age-old indigenous techniques so that it may be used as a means for sustaining their livelihood. This area, mostly home to the indigenous Khasi people, has a long history of farming methods firmly ingrained in harmony with the environment. The Khasi Hills region consists mostly of hilly regions and includes the Shillong Plateau with rolling grasslands, hills, and river valleys. It is mostly hilly with deep gorges and ravines on the southern portion. The region is known for its unique geographical features and rich cultural heritage. The Khasi people owing to their diverse habitats or varying agro-ecosystems grow different landraces of their preferences and choices based on taste, yield, production and traditional practices. The Khasi Hills region of Meghalaya is characterized by high rainfall, and humidity, with varied topography and altitude making this region a core region for the thriving of indigenous rice varieties. The Khasis grow a soft variety of rice which can be used in both flaked and raw form. To identify the main indigenous rice varieties produced in the Khasi Hills region, specifically in the Ri Bhoi District and East Khasi Hills District, this study aims to find those varieties and compare the productivity and production levels of each. Two districts were incorporated in the present study that had different ecological zones and the villages therein were practicing, native rice farming. The research aims to find the level of production, the area cultivated, and the price-based productivity of native rice varieties as well as understand the reasons that cause them to



be less productive than the high-yielding varieties (HYVs)

1.2: Study Area:

East Khasi Hills and the Ri-Bhoi district are selected for the present study because they have a complete physiographic unit of the Meghalaya plateau and have various indigenous rice grown within the district. Ri-Bhoi district, part of East Khasi Hills district, was carved out in June 1992. It

falls in the northern part of Meghalaya, while the East Khasi Hills fall on the central and southern parts of the Shillong plateau. The present area of study is covered in the survey of India toposheet no 18(K), 78(0) and 83(C) with a scale of R.F. 1/250,000. Assam bound the study area in the north, Bangladesh in the south, Jaintia Hills in the east and part of Assam in the extreme east, whereas, in the west, it is bounded by the West Khasi Hills district.

LOCATION MAP

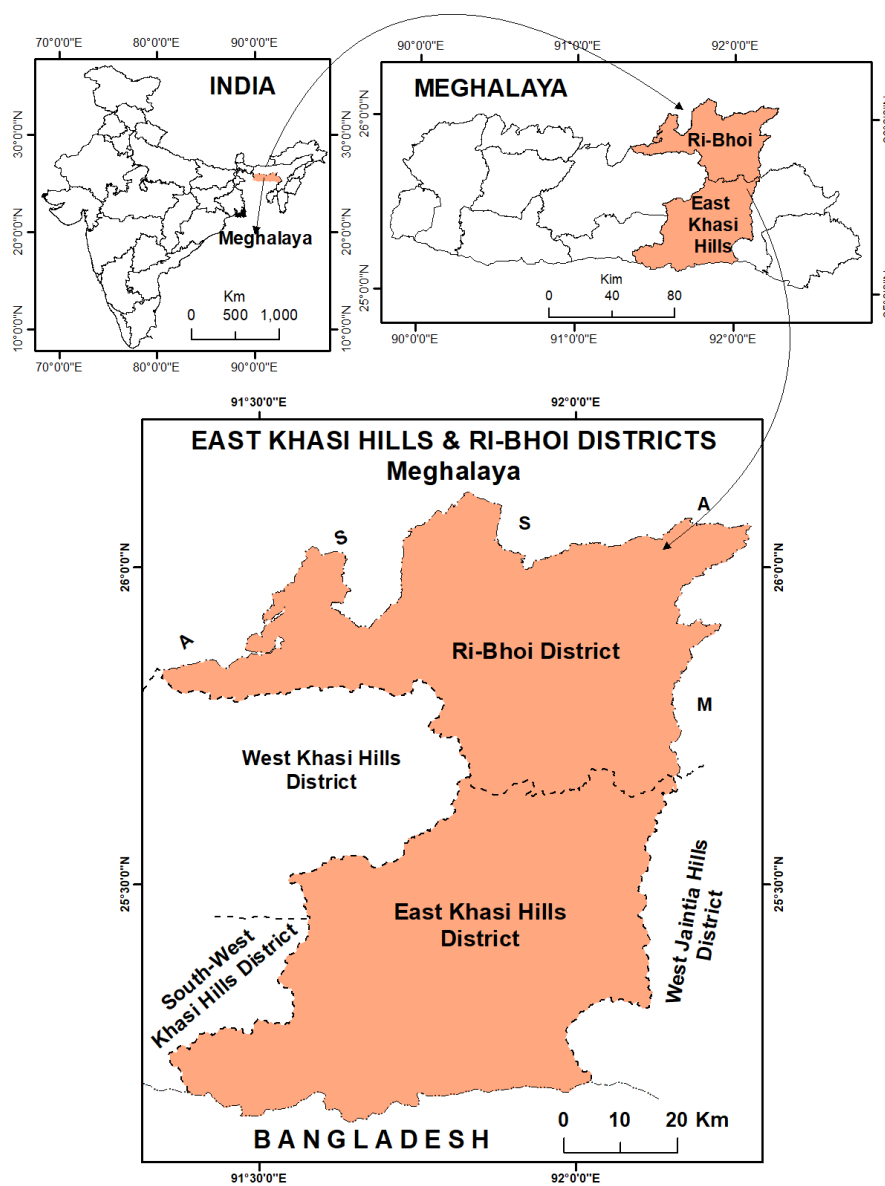


Figure 1: Location Map of the study area



1.3: Objective:

The main focus of this paper is to determine the major indigenous rice varieties grown in the Khasi Hills region of Meghalaya (Ri Bhoi District and East Khasi Hills District). In this study, the objective was to develop an understanding and the performance in production and Productivity levels of Indigenous rice varieties or folk rice that are native to the Khasi hills region with a long traditional history of farming.

1.4: Data source and methodology:

To address the research issues highlighted, the first aspect of this study is directly concerned with productivity level, production of each rice variety, and variations in production in the different ecological zones of Khasi Hills, such as upland, slope, lowland, etc. Therefore, the first aspect is more dependent on secondary sources, which would provide a sound base for selecting a sample village to analyse productivity levels in different zones. Secondly, primary data was collected to get more details about the varieties of indigenous rice grown. Compiling and taking into consideration by selecting two districts of Meghalaya emphasizing the villages that practice indigenous rice cultivation across different regions and ecological zones of the Ri Bhoi district and East Khasi Hills District. The main emphasis is laid on the production and Productivity levels of indigenous rice varieties based on rice yield, area and price. Here, in this paper, the local practices and management preferences of the local people are highlighted and analysed which plays an important role in the production of indigenous rice varieties. The market/value, prices and economic analysis of the collected indigenous rice varieties is ascertained and recommendations and strategies for improving indigenous rice varieties productivity for practitioners are also analysed.

The total number of 6 districts in the Khasi Hills of Meghalaya was surveyed. From a list of 2 districts, a random sample of 6 villages from each district representing the rice farming population is drawn. The sample is based on two different physical landscapes - Valley rice cultivation and terrace rice cultivation. Grain samples were collected from the villages in east Khasi Hills and Ri Bhoi District.

For this purpose, the village is considered a unit of study and village-wise area, yield, and rice production statistics were used for the present study. The productivity levels for each village were measured using the standard method given by Bhalla and Tyagi (1989). This method aggregates the total crop production based on crop area, yield,

and prices as productivity = $(\sum Y_i A_i P_i / \sum A_i)$, where Y_i = Crop yield of i th crops A_i = area of i th crop and P_i = market price of the i th crop. The simple Statistical calculation was used with the help of R programming and SPSS software to analyse the data collected and realise the objectives mentioned above.

1.5: Importance and Overview of Indigenous Rice Varieties:

Rice being the way of life is often referred to as the grain of life (B&B Organics, 2022). It is the staple food for the Khasis of Meghalaya. Currently, the cultivation of indigenous rice varieties is mostly preferred by paddy growers and has gained immense popularity. Health-conscious people prefer to eat indigenous rice varieties over HYV Varieties of rice and the growing demand from such people has led to its cultivation popularity. Indigenous rice varieties are generally low in sugar content, good for diabetic and overweight patients or regulating their sugar intake. Most of the indigenous rice varieties contain Higher amounts of glutamic acid, fibre, and vitamins.

In addition to being healthful, traditional cultivars are cultivated with consideration for the soil type and available resources, the advantage of Indigenous rice cultivation is that its cultivation reduces farmers' financial problems and the burden required for growing Hybrid variety. Higher yields and substantial food security are obtained at the cost of higher inputs of seeds, fertilizer, and pesticides (Lu, 1996 Qualset et al., 1997)¹. Many small farmers of Meghalaya are beyond the reach of affordability for costly inorganic fertilizers and pesticides.

The Khasis people primarily eat rice as a main diet. The major foods consumed for breakfast, lunch, and dinner are essentially rice and rice-based foods. Almost everyone eats three meals a day consisting of rice, without question. Numerous indigenous rice varieties have been partly preserved because of the special environmental circumstances and traditional knowledge. The Khasi Hills' agroecological diversity has made it possible to cultivate a range of native rice species suited to varying altitudes, soil types, and climatic conditions. They provided food for the families that grew them

¹ Youyong Zhu, Yunyue Wang, Hairu Chen, Bao-Rong Lu, Conserving Traditional Rice Varieties through Management for Crop Diversity, *BioScience*, Volume 53, Issue 2, February 2003, Pages 158–162, [https://doi.org/10.1641/00063568\(2003\)053\[0158:CTRVTM\]2.0.CO;2](https://doi.org/10.1641/00063568(2003)053[0158:CTRVTM]2.0.CO;2)



in the past. The Khasi people's traditional identity and rites are closely linked to the production of rice by their people. They have long-standing traditions about planting, gathering, and consuming food that are essential to their community. The relationships between people, land, and biodiversity are all reflected in these behaviours.

The need for more demand is preventing farmers from growing these types, even though they are eager to. Though demand seems to be lacking. The previous rice kinds became obsolete when white polished rice gained popularity. The cultivation of traditional grains was decreasing due to the necessity for greater yield and mass production.

The Khasis of Meghalaya grew rice over non-saline areas in a soil which is deep to slightly deep soils with varying soil reactions (Ph <4.5-7.5) and with a soil texture ranging from clay, silt clay, and sandy clay to loam. A lowland variety of rice is cultivated in the valleys with poor soil to moderate well-defined soils from level slope to gentle slope (0-8%). Whereas upland rice varieties are grown on the jhum field of the shifting cultivation or the hills slope land. In the Khasi hills of Meghalaya rice is found to be mostly grown in soils that are high in organic carbon or moderate and also in medium to low phosphorus and potassium availability. There are three rice ecosystems available in Meghalaya: -

Table No.1: varieties of rice in Khasi Hills according to altitude

Altitude	Altitude (In metres)	Indigenous Rice Cultivar Varieties
Low altitude	(Below 800m)	<i>Lakang, Manipur, mynri, jwain, Pnah Lieh, Pnah Lieh Latara, Pnah iong, linter, darjeeling, laispah kba stem, kba laipawa, goya, gyar agaro, etc</i>
Medium/ Mid-altitude	(800-1300m)	<i>Eithati Heh, Pyrhut, Kba Sakur, Kba Jwat, Kba Tasor, Kba Sohma, kba pnah lum, kba tlang sohpieng, kba thohriaw, kba saw, muthei, muro, mynai etc</i>
High altitude	(Above 1300m elevation)	<i>Kba lum</i>

Source: Compiled by the Research Scholar

Of these, three types of rice ecosystems, the low-altitude rice is the highest in the state with around 64.2% followed by middle altitude with 20%. High altitude with the least. The varieties grown in the low altitude (Below 800m) are *Lakang, Manipur, mynri, jwain, Pnah Lieh, Pnah Lieh Latara, Pnah iong, linter, darjeeling, laispah, kba stem, kba laipawa, goya, gyar agaro, etc*. These rice varieties are well adapted to the lowland environmental conditions. While the rice cultivars that are commonly grown in the slopes and Medium/ Mid- altitude with an altitude between 800-1300m are *Eithati Heh, Pyrhut, Kba Sakur, Kba Jwat, Kba Tasor, Kba Sohma, kba pnah lum, kba tlang sohpieng, kba thohriaw, kba saw, muthei, muro, mynai etc*. these varieties have specific adaptation that make them suitably grown in the middle altitude land. There are only a few varieties of upland rice varieties which are grown in high altitudes above 1300m that is *Kba lum*. *Kba lum* is a prominent variety grown in the upland or slope land in which the growing conditions required may be different from other varieties grown in the lowland or valley land. Overall, it is observed that different indigenous rice varieties are suited at specific altitudinal ranges within the study area, indicating

the adaptations of these varieties in different environments and climates as they thrive in different altitude ranges.

Though rice cultivation and production in the Khasi Hills of Meghalaya has been below the national average owing to its varied constraints and fragile ecosystem, however, it has been and continues to be a way of life for the people of the Khasi Hills region. Though not profitable and productive the people of the Khasi Hills region continue to grow indigenous rice varieties owing to their taste, fragrance, and health benefits and preference of the people by adopting their age-old indigenous rice cultivation methods and practices to sustain their livelihood.

II. Result:

Rice productivity is a measure in terms of the quantity of rice per unit land area. The area, production, yield price and physical factors are the aspects that influence rice productivity levels in the study region. Evaluation of the performance of rice in terms of its output is vital to understanding the nature of food security. The degree of variations depends on the nature of the rice crop production



techniques and system, its physical environment, its sensitivity to weather, and the availability of materials and inputs (Wasim, 1999). Farmers in both the study districts are small farmers and marginal farmers who have mostly small landholding sizes for jhum and terrace farming. Lack of modern irrigation facilities and water shortage or erratic rainfall rendered more difficulties to the farmers as most of the farmers depend on the rainfall to water their rice crop. Some of the farmers do not even own land so they cultivate rice either on a lease land on their clan's land, therefore they are subsistence rice growers which refers to growing rice only for their own consumption. As the farmers are still practising primitive traditional tools and lack the technical know-how to adopt modern production techniques results in low yield and productivity. The important limiting factors are the irrigation facilities, mechanization, fertilizer, modern techniques improved seeds etc.

To improve yield, limiting factors must be managed sustainably. Dawe and Debermann find out that change in the level of production and productivity can occur for more than one reason shifts in the production function itself or the shift along the production function. While the shift in

production function itself refers to the change in productivity and the shift along the production does not refer to productivity shifts. Although the net sown area may remain the same, there is variability in rice output from one year to another. The productivity change may take place and may be influenced by changes in environment and technology adoption despite the application of fertilizer (inorganic) and FYM by many rice growers, factors like lack of irrigation facilities etc have rendered low yield to the farmers. The valley land rice is more productive as compared to the upland rice varieties as the soil in the terrace land and valley land/lowland is fertile due to the nutrients washed out from the slope or upland and therefore require less fertilizer application while the jhum fields or the upland slope required more inorganic fertilizer application due to loss of soil nutrients washed by the surface runoff.

Using the productivity method according to Bhala and Tyagi (1989)

Where productivity = $\frac{Y_i A_i P_i}{A_i}$

Y_i = crop yield of the i th crop

A_i = area of the i th crop

P_i = market price of the i th crop

Table No 3: Indigenous Rice Area (In Acre), production (In Kg) and yield (Kg/Sq. Ft), Price (in Rs) and Productivity (Rs/ Acre)

Sl No	Genotypes	Upland/Lowland Varieties	Village	Area (In Acre)	Production (In Kg)	Yield (Kg/Sq. Ft)	Price (in Rs)	Productivity (Rs/ Acre)
1	<i>Kba Jrong</i>	Valley	Jowei Nongpoh	190	1360	1360	40	54400
2	<i>Darjeeling</i>	Valley	Jowei Nongpoh	2	1670	835	50	41750
3	<i>Eithati Rit</i>	Valley	Myrdon Village	5	1900	380	40	15200
4	<i>Kba Lyngkot Saw Khaw</i>	Valley	Thadnongia Village (Ri Bhoi)	3	2000	666	45	26640
5	<i>Pnah Pathar</i>	Valley	Jowe (Nongpoh)	1	660	660	50	33000
6	<i>Kba Mukra</i>	Valley	Umralleng	2	1230	615	40	24600
7	<i>Kba Laipawa</i>	Valley	Jowe	3	2050	1025	40	41000
8	<i>Kba Tlang Sohpieng (Kba Lum)</i>	Upland	Umralleng	2	1200	600	40	24000
9	<i>Mynri</i>	Valley	Myrdon	3	6400	2133	85	87125
10	<i>Pnah Lieh Pyllon</i>	Valley	Umralleng	2	800	400	85	34000
11	<i>Pnah Lieh Latara</i>	Valley	Myrdon Village	2	1600	800	85	68000
12	<i>Eithati Heh</i>	Valley	Thadnongia Village	1.5	2800	1866.66	85	158666.1
13	<i>Pyrhut</i>	Valley	Thadnongia Village	2	2000	1000	40	40000
14	<i>Kba Sakur</i>	Valley	Thadnongia Village	2	2500	1250	40	50000



15	<i>Kba Jwat</i>	Valley	Myrdon Village	3	2900	966.6 6	40	38666.4
16	<i>Kba Tasor</i>	Valley	Thadnongiaw Village	2	2000	1000	45	40000
17	<i>Kba Sohma</i>	Valley	Umralleng	2	1000	500	45	225000
18	<i>Kba Lum</i>	Upland	Myrdon Village	1	600	600	40	24000
19	<i>Pnah Lum</i>	Upland	Jowe Nongpoh	1	1400	1400	40	56000
20	<i>Kba Thohriaw</i>	Upland	Thadnongiaw Village	1.5	1200	800	50	40000
21	<i>Pnah Lieh</i>	Valley	Thadnongiaw Village	2	2400	1200	80	96000
22	<i>Kba Lyngkot</i>	Valley	Myrdon Village	4	2400	600	40	24000
23	<i>Lakang</i>	Valley	Jowe (Nongpoh)	4	4800	1200	80	96000
24	<i>Lynter</i>	Valley	Umralleng	2	1200	600	75	45000
25	<i>Kba Stem</i>	Valley	Umralleng	3.5	1900	542.8 5	40	21714
26	<i>Jwain</i>	Valley	Myrdon Village	3	3000	1000	80	80000
27	<i>Goya</i>	Valley	Umkhabaw, Shella Bholagang	3.5	3500	1000	40	40000
28	<i>Gyar Agaro</i>	Valley	Umkhabaw, Shella Bholagang	4	2640	660	40	26400
29	<i>MEGH-1</i>	Valley	Umkhabaw, Shella Bholagang	3	2400	800	40	32000
30	<i>Kba Saw</i>	Upland	Nongrim umpowin	1.5	1800	1200	40	48000
31	<i>Skuin</i>	Valley	Nonglum	3	1200	400	45	18000
32	<i>Pnah Mawtawar</i>	Valley	Nonglum	1.5	960	640	80	51200
33	<i>Pnah Iong</i>	Valley	Nonglum	1	720	720	80	57000
34	<i>Pnah Latara</i>	Valley	Nonglum	1	600	600	75	45000
35	<i>Manipur</i>	Valley	Nonglum	3	4800	1600	80	128000
36	<i>Laispah</i>	Valley	Nongrim Umpowin	1.5	3000	2000	45	90000
37	<i>Langmai</i>	Valley	Jowe	2	2400	1200	45	54000
38	<i>Muro</i>	Upland	Madanrtiang	1	1200	1200	40	48000
39	<i>Muthei</i>	Upland	Madanrtiang	1	480	480	40	19200
40	<i>Mynai</i>	Upland	Madanrtiang	1	600	600	40	24000

Source: Compiled by the Research Scholar

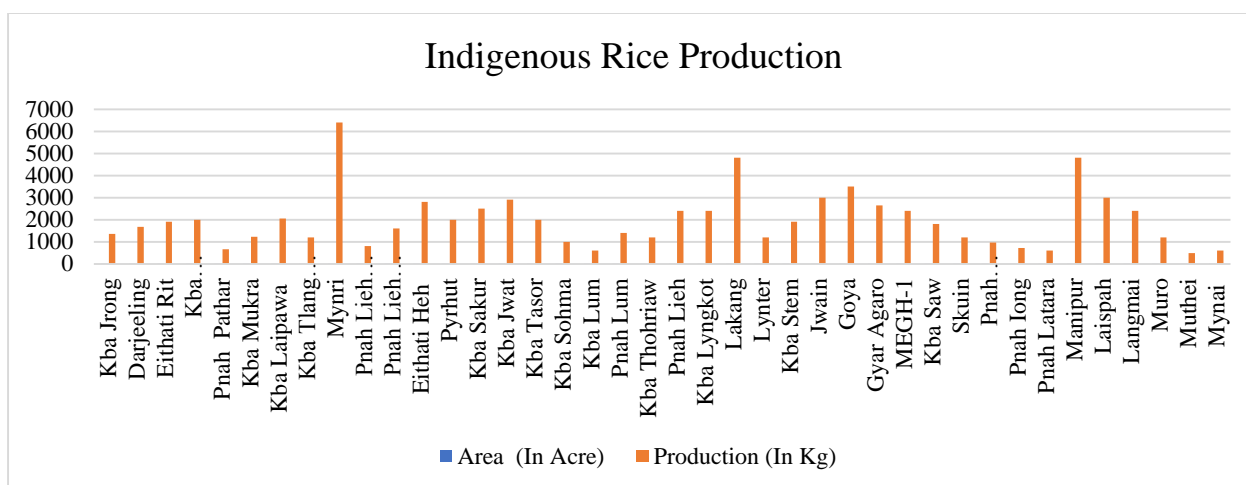


Figure 2: Indigenous Rice Production

Total production for all 40 genotypes, distributed in 12 villages, is about 61,440 kg on 64.5 acres. The average yield of indigenous rice varieties is roughly 952 kg/acre (range, 380-2,133 kg/acre). Overall, the upland variety's mean yield is 823 kg/acre from 8 genotypes and the valley variety's mean yield is 1,032 kg/acre from 32 genotypes. The five genotypes with the highest yield are *Mynri* 2,133 kg/acre, *Eithati Heh* 1,866.66 kg/acre, *Lakang* 1,200 kg/acre, *Manipur* 1,600 kg/acre, *Laispah* 2,000 kg/acre. The average top three yields are concentrated in the following villages-Myrdon Village 1,244 kg/acre, Thadnongiaiw Village 1,143 kg/acre, Umralleng 942 kg/acre. The largest area under cultivation is in Myrdon Village (14 acres), then in Umralleng (13 acres) followed by Thadnongiaiw Village with 12 acres. Genotype-to-genotype yield variance is considerable, and gain must be feasible either through selective breeding or some agronomic practices. For example, genotypes such as *Mynri* and *Eithati Heh* have generally stable values throughout villages, whereas others, such as

Kba Mukra and *Pnah Pathar*, are heterogeneously variable. Village-specific factors that may encompass the quality of soil, climate, and farming practices are likely to be behind yield variation. Overall, the yields of the indigenous varieties are relatively low compared with those of the modern varieties-high-yielding varieties. Indigenous rice varieties are mainly found in specific villages, thereby limiting the level of total production and impact.

From Table 3 given above, it is observed that there is significant variation in the production and yield of the various indigenous rice varieties. Varieties like *Mynri* from *Myrdon* village show a high level of production of 640 kg, and the yield is 2133 kg/sq. ft, *Mynri*, as an Indigenous rice variety, is a highly productive variety in the valley areas of the Ri Bhoi district, while *Pnah pathar* is also another Indigenous rise variety from *Jowe Nongpoh*, has the least production with only 660 kg and yields 660 kg/sq. ft.

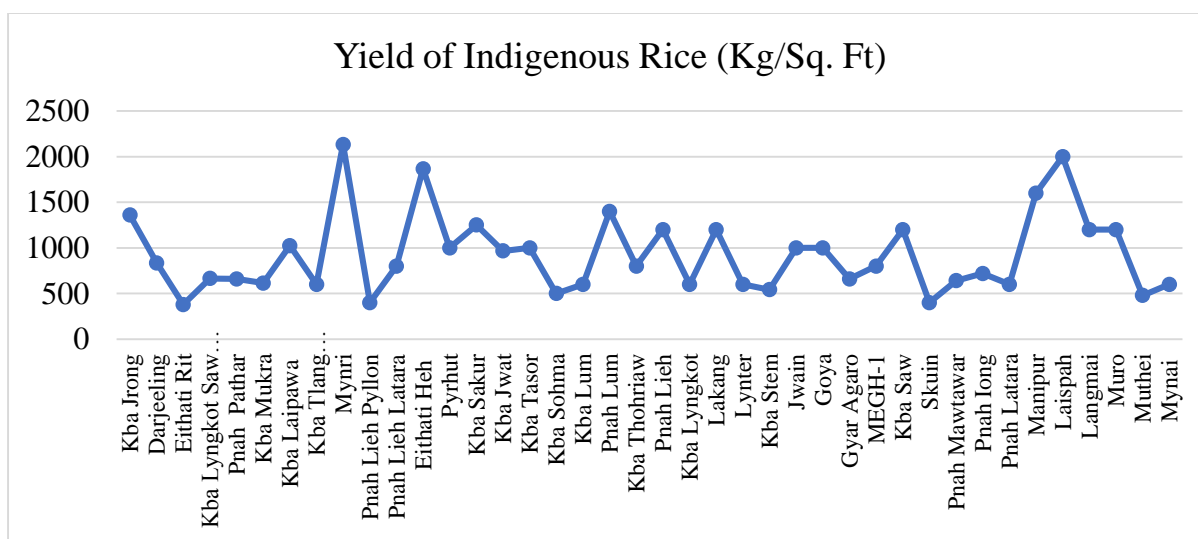


Figure 3: Yield of Indigenous Rice (Kg/Sq. Ft)

Other varieties such as *Laispah* and *Manipur* also demonstrate high yield indicating that these landraces are well adapted to the respective valley environment. Some varieties seem to consistently produce higher yields in the valley land for example *Kba lyngkot* which thrives in the Thadnongiaiw village demonstrates high productivity producing 240 kg with a 600 kg/sq. ft yield. Similarly, *Eithati Heh* produces 280 kg with an 1866.66 kg/sq. ft yield and *Pyrhut* also produces about 200 kg with a yield of 100kg/sq. ft.

In comparison to the valley rice varieties an upland rice variety also shows variation in productivity with some varieties achieving relatively higher yields such as Pnah lum from Jowe Nongpoh village which produces around 140 kg with a yield

of 140 kg per sq. ft. It is seen from the data above that the yield varies significantly among different genotypes and at different locations stressing the impacts of both genetic variation and the physical condition on productivity. Several varieties are suitable in different specific agroecological environments. Some of these indigenous rice varieties have a wide market potential and have shown higher levels of productivity within specific microclimates and geographic areas within the study area. Therefore, preserving this indigenous rice is crucial to enhance food security for traditional society and community by adopting more modern farming techniques, and improving seeds and fertilizer with adequate irrigation facilities to boost overall rice production in both the study district.

Table No. 4: Productivity Levels of Indigenous Rice Varieties

Categories	productivity levels	Indigenous Rice Varieties
High productivity	< 100000	<i>Kba Sohma, Eithati Heh, Manipur, Mynri,</i>
Medium productivity	50000-100000	<i>Kba Jrong, Darjeeling, Kba Laipawa, Pnah Lieh Latara, Pnah Long, Pnah Lum, Laispah, Langmai, Lakang, Lynter, Jwain, Pnah Lieh,</i>
low productivity	>50000	<i>Eithati Rit, Kba Lyngkot Saw Khaw, Pnah Pathar, Kba Mukra, Kba Tlang Sohpieng (Kba Lum), Kba Thohriaw, Kba Lum, Pnah Lieh Pyllon, Pyrhut, Kba Sakur, Kba Jwat, Kba Tasor, Kba Lyngkot, Kba Stem, Goya Gyar, Agaro, MEGH-1, Kba Saw, Skuin, Pnah Mawtawar, Pnah Latara, Muro, Muthei, Mynai,</i>

Source: Compiled by the Research Scholar

The table above categorises all the collected 40 indigenous rice varieties into three productivity levels that is high productivity level,

medium productivity level and low productivity levels.

The productivity levels are categorised based on the yield per acre, with high productivity



types of indigenous rice yielding above 100,000 Rs/acre, medium productivity rice varieties yielding between 50000 to 100000 Rs/ acre, and low productivity rice varieties yielding below 50000 Rs/ acre.

The indigenous rice varieties that have high productivity levels are *Kba Sohma, Eithati Heh, Manipur, and Mynri*, which yield more than 100000 Rs/ acre. These varieties have high potential and are usually grown for commercial purposes, grown in optimal conditions, with quality inputs, and efficient farming techniques and systems to maintain their high productivity levels.

The medium productivity level rice varieties are *Kba Jrong, Darjeeling, Kba Laipawa, Pnah Lieh Latara, Pnah Iong, Pnah Lum, Laispah, Langmai, Lakang, Lynter, Jwain, Pnah Lieh*, which

yield between 50000-100000 Rs/acre. They are grown mainly for subsistence purposes or small-scale cultivation requiring moderate levels of input and farming practices.

Whereas the lower-level productivity rice varieties are those varieties that yield less than 50000 Rs/acre. Low category varieties are *Eithati Rit, Kba Lyngkot Saw Khaw, Pnah Pathar, Kba Mukra, Kba Tlang Sohpieng (Kba Lum), Kba Thohriaw, Kba Lum, Pnah Lieh Pyllon, Pyrhut, Kba Sakur, Kba Jwat, Kba Tasor, Kba Lyngkot, Kba Stem, Goya Gyar, Agaro, MEGH-1, Kba Saw, Skuin, Pnah Mawtawar, Pnah Latara, Muro, Muthei, Mynaietc* which are grown in small quantity and solely for subsistence farming requiring minimal inputs, less or no fertilizer to maintain their productivity.

Table No.5: Price category of various Indigenous rice varieties:

SI No.	Category	varieties
1	Low price(<Rs.50)	kba jrong, Eithati rit, kba lyngkot saw khaw, mynai etc
2	Moderate price (Rs 50- Rs. 80)	Darjeeling, pnah pathar, kba thohriaw, lynter, jwain, phrang etc
3	High price (> 80)	Mynri, Pnah lieh, pnah iong, pnah latara, pnah pyllon, pnah, Manipur

Source: Compiled by the Research Scholar

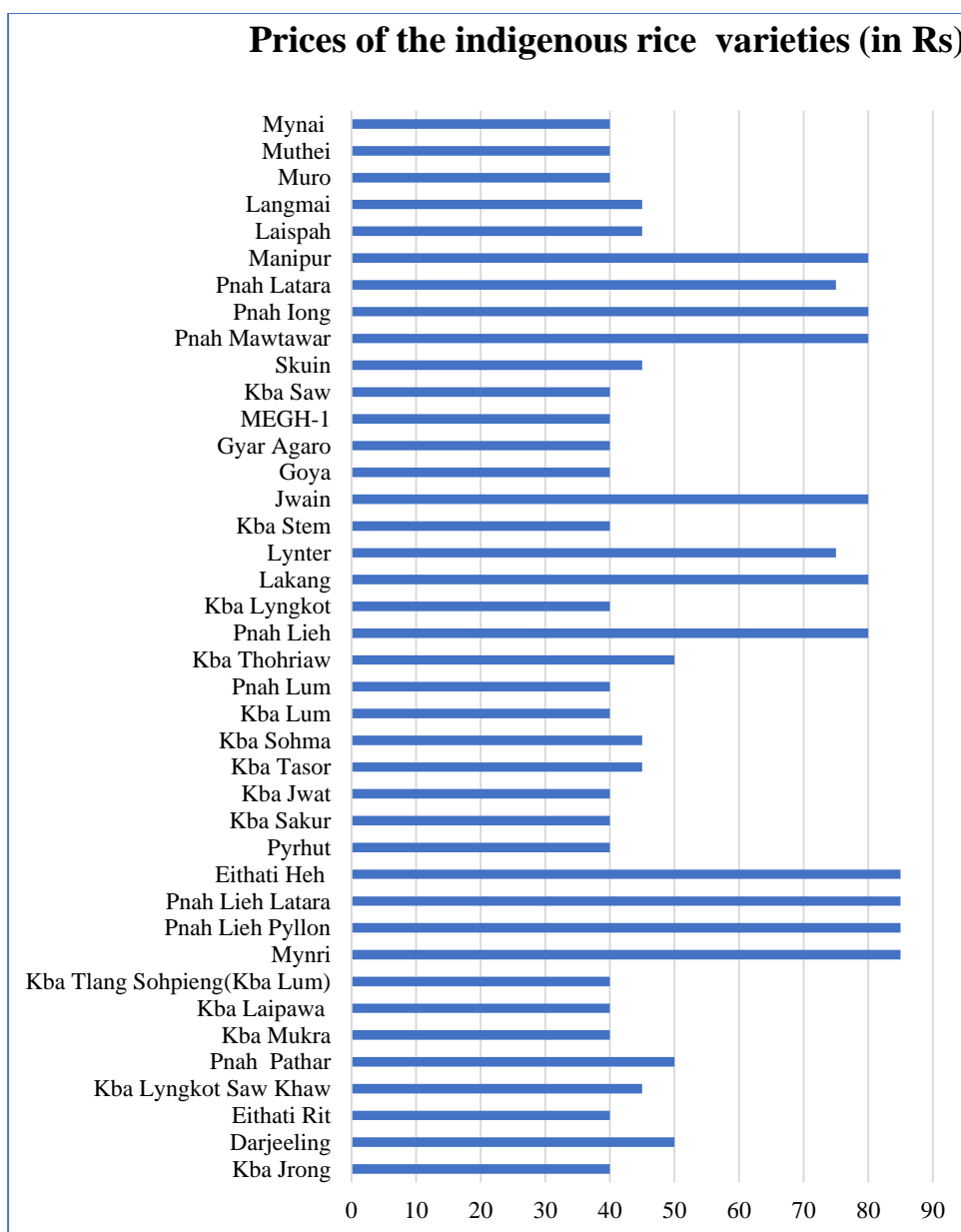


Figure 4: Prices of the Indigenous rice varieties (in Rs)

From the table given above the 40 indigenous rice for it are categorised based on their price range from Rs 40-Rs 120 per kg. It is observed that about 24 genotypes of rice (60%) of the collected varieties fall in the low category of the price range which is less than Rs 50 per kg. Varieties like kba jrong, Eithati rit, kba lyngkot saw Khaw, mynai etc are low-priced varieties.

There are 8 genotypes (20%) that fall in this category including *darjeeling*, *pnah pathar*, *kba thohriaw*, *lynter*, *jwain*, *phrang* etc while the high price category is *mynri*, *pnah lieh*, *pnah iong*, *pnah latara*, *pnah pyllon*, *pnah*, *Manipur* etc are

commercial varieties grown specifically to make rice base snack and cakes. They are mostly sticky rice varieties. Therefore, it emphasizes that the high-productivity genotypes tend to have high prices, while low-productivity genotypes have lower prices. Hence price ranges are correlated with productivity levels.

From the various price ranges and categories, it is learned that they are market segmentation opportunities with different price ranges catering to every customer and consumer's reach. Small farmers of the studied district and the traders developed price strategies based on



productivity levels, demands and market competition.

The analysis of the price category for various indigenous rice varieties highlights the requirement for value chain development, including milling, cleaning etc to enhance the market value of indigenous rice genotypes. Therefore, the rice

grower is encouraged to grow high-quality indigenous rice genotypes which enhance consumer preference demand and high price that balance farmers' incomes with consumer's affordability and overall enhancing market value.

Table no. 6: variety wise analysis

SI No.	Varieties	Analysis
1	<i>Mynri</i>	High yield, high price, and high productivity
2	<i>Eithati Heh</i>	High yield, moderate price, and high productivity
3	<i>Lakang</i>	moderate yield, high price, and high productivity
4	<i>Manipur</i>	High yield, Moderate price, and high productivity
5	<i>Laispah</i>	High yield, low price, and high productivity

Source: prepared by the research Scholar

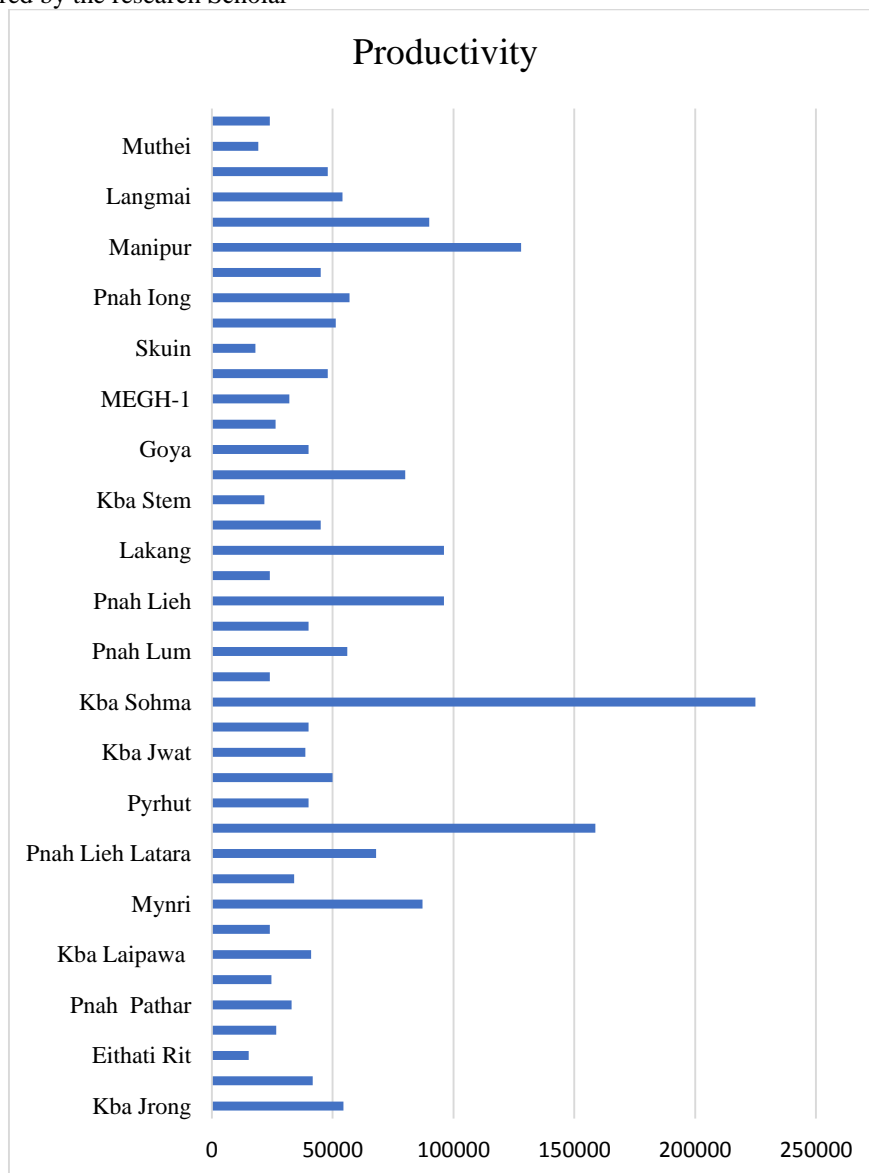


Figure 5: Productivity of Indigenous Rice Varieties



Based on the table above mynri (2133Kg/acre) eithati heh (1866.66 kg/acre), lakang (1200kg/acre), Manipur(1600/acre), laispah (2000/acre) are some of the top varieties in terms of yield while Pnah iong (Rs 120/kg) is the highest

price varieties from all the sample varieties shown. The second is mynri with Rs.80/kg and eithati heh Rs. 85/kg and Pnah lieh Katara (Rs.85/kg) while lakang is Rs.80/ kg.

Variation in rice yields and production in upland varieties versus lowland varieties.

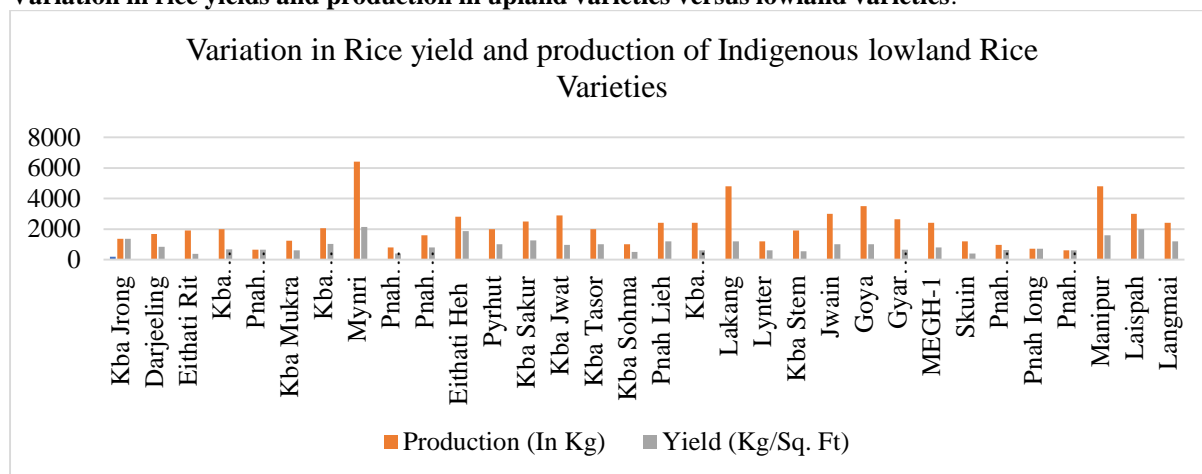


Figure 6: Variation in Rice yield and production of Indigenous lowland Rice Varieties

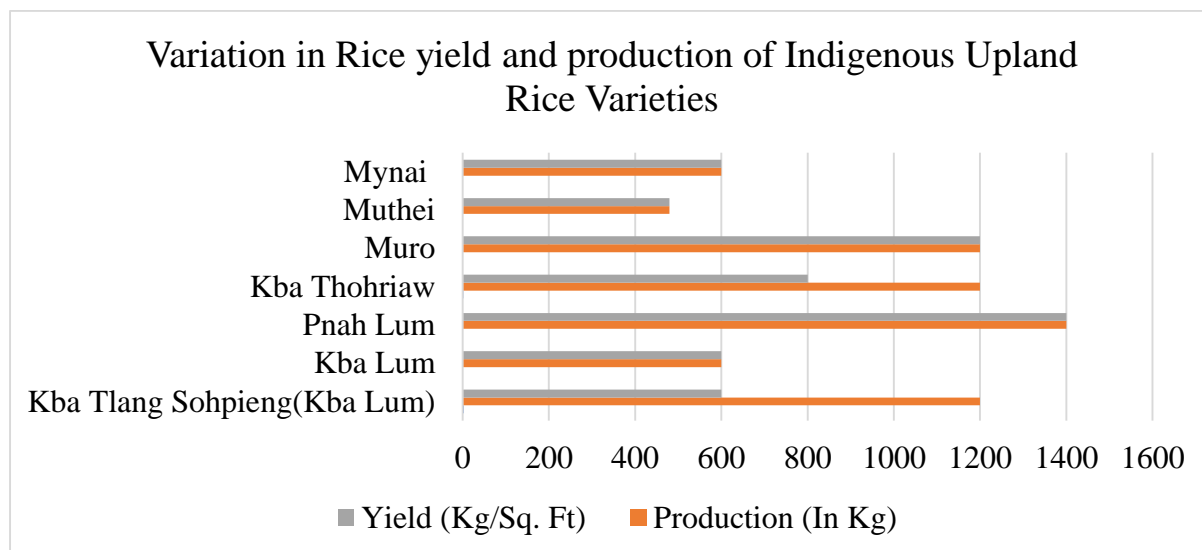


Figure 7: Variation in Rice yield and production of Indigenous Upland Rice Varieties

From the table given above 240 sample households were interviewed rice samples were collected and rice production data was computed as per the data obtained from a household survey the total production and yield of rice in the year 2019 are compared to identify the variations between the lowland and upland rice variety yield, and production. The lowland or valley rice varieties show higher yield and production with the top

variety that performs well in the lowland being *Mynri* (2133kg/ sq. ft) from Myrdon Village. In comparison, the upland or slope rice varieties on Jhum land also perform well however their yields are low compared to that of lowland rice with *Pnah lum* (1400kg/sq. ft) grown at Jowe Ri Bhoi District being the highest and the top performers among the upland rice varieties in the study area. The major factor contributing to the higher yield of lowland or



valley rice varieties is due to larger areas under low-land rice cultivation and more extensive cultivation compared to upland areas or slope land. However given the larger areas under low-land rice cultivation the overall production for lowland rice is low though the yield is high for example *mynri* grown in an area of 3 acres produces 64 kg while the upland rice variety grown in 1 acre of land produces 1400 kg of rice which is one of the highly productive strains for upland or Jhum fields varieties like *kba lum* and *kba tlang sohpieng* from Umlaleng Village, shows inevitable yields at 600 kg/ sq. ft indicating that these varieties are well adapted in the jhum fields or upland areas performing better than other varieties.

The influencing factors may be varied lighting the impacts of physical condition or factors and genetic factors on indigenous rice productivity. The lowland areas are rich in fertile soil and have better water retention potentially resulting in higher yields. Whereas the slope land or upland areas are prone to soil erosion caused by surface runoff rendering the soil fertility low. The lowland areas or valley land have more water retention capacity and water availability being supplied from streams, and

rivers through irrigation canals whereas upland areas have no irrigation facilities and are often rainfed and lack water thereby affecting the yield of upland rice varieties. Another influencing factor is the farming tools and implements as well as the practices adopted by the farmers. The rice grower in the valley land or lowland has more advantage in that they can adopt the use of tractors and threshing machines as the area of cultivation is large and the land is levelled making it easier for machines to operate. The jhum fields or upland fields are inconvenient for machines like tractors and threshers to use due to the sloping nature of the land and the thick-rooted trees which are difficult for technology and machines to operate. The upland rice growers have limited access to resource and technological intervention causing a huge variation in the yield and production of upland over lowland rice varieties.

Early and adequate rainfall is always good for rice productivity. The yield ratio for the upland versus lowland rice varieties shows contrasting results.

: Farmer's information based on various variables

Table no.7: Farmer's information based on various variables

SI No	Variable(s)	Household (HHs)/240	Percentage (%)
1	Farmers cultivating their lands	150	62.5
2	Farmers cultivating leased lands	90	37.5
3	farmers using Chemical Fertilizers	148	61.6
4	farmers using only organic Fertilizers of FYM	92	38.3
5	Farmers growing both upland and lowland rice varieties	28	11.6
6	Farmers growing only upland rice varieties	183	76.25
7	Farmers growing only lowland rice varieties	57	23.75
8	Farmers facing water scarcity /lack of irrigation facilities	204	85
9	Stream Dependent	39	16.25
10	Farmers facing a shortage of inputs/funds	194	80.83

Source: prepared by the research Scholar

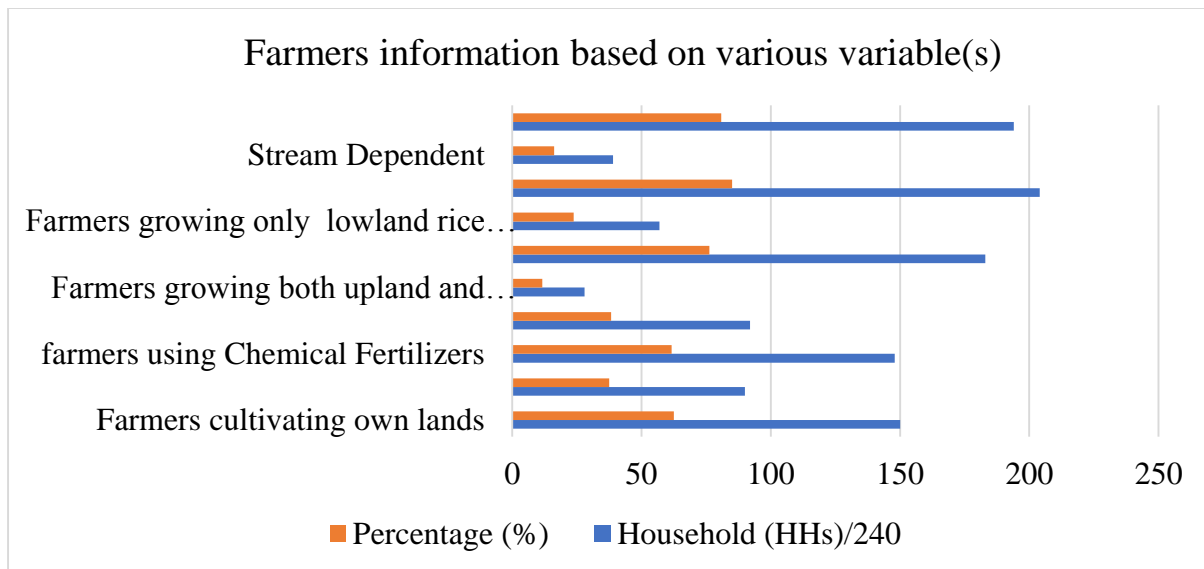


Figure No 8: Farmer's information based on various variable(s)

It is observed from Table No. 4 that the majority of the sample farmers cultivate or grow rice in their land which shows that there is a higher degree of land tenure systems and security. Having a majority of farmers in both the study districts having or cultivating rice on their land can lead to a better land management practice and long-term investment in the fertility of the soil as the farmer has control and authority over his land providing stability and efficiency over farming practices. About 150 households that are about 62.5% of the survey households have grown rice on their land whereas 90 households (37.5%) of the rice growers, grow on leased land which shows that they are quite a significant number of rice growers who do not have any land ownership and growing or cultivating rice in a lease land result or affect their long-term investment in the management of the soil fertility or soil health and improvement. These farmers may be facing limited long-term investment and problems or uncertainty in land-use rights and sense of ownership and may not bother much with sustainable practices.

Around 148 households are about 61.6% of the Indigenous rise Grover responded that they use chemical fertilizers like UREA and DAP (Diammonium phosphate) to boost yield and production of rice which is effective for a short-term or bumper harvest in the current year of growing. However, it may affect the long-term soil fertility leading to soil degradation and over time

environmental problems and issues. Whereas around 92 households (38.3%) farmers rely on or use only organic fertilizer and FYM (Farm Yard Manure). These significant farmers contribute to sustainable agriculture enhancing soil health minimising environmental impact improves biodiversity concentration.

Some farmers responded by growing both varieties of rice which are low-land and upland rice varieties. These farmers are aiming for both commercial and subsistence surplus. The lowland rice varieties have high market potential and upland rice varieties were used for their consumption only. However, the low percentage with only 11.6% which is around 28 households adopted this practice which is a practice that is beyond the reach of many small farmers of the Khasi hills regions to grow both rice varieties. Many farmers 180 responded by growing only upland rice varieties. This is because many of the farmers do not own paddy fields which is why they grow only upland rice varieties and also due to the non-availability of irrigation facilities. Depending on the rainfall and minimum labour requirements are also significant factors contributing to the preference of people for upland rice varieties though low in terms of yield and production. About 57 farmers (23.75%) of the rice growers prefer growing only lowland rice varieties which are small but a notable portion of rice growers due to the availability of paddy fields and family labour and irrigation facilities.



Table No 8: Labour Availability

Labour Availability	Nos	%
No. Difficulty	51	21.25
Have Difficulty	189	78.75
Total	240	100

Source: Compiled by the Research Scholar

Regarding labour availability, roughly 78.75% of farmers stated that they had trouble finding workers when needed for different operations in rice cultivation, such as planting, broadcasting, transplanting, weeding, harvesting, and threshing, among others. This can occasionally be one of the main reasons for delays in the various processes involved in rice cultivation, which results in a low harvest. About 21.25% of the sample rice growers said they had no trouble finding labour

because, in the majority of rural areas in both districts, farmers use an exchange system known as "Shaw Sngi or Shaw Nong" to pay labourers for their labour during the various stages of rice production. The majority of labourers in the village and surrounding villages would be called in first by a specific farmer to do the task, and when it was their turn, the other farmers would take over on a rotational basis.

4.12: An Overview of the Indigenous rice cultivation preferences by the local Khasi

Table No .9: An Overview of the Indigenous rice cultivation preferences by the local Khasi

SI No.	Rice Genotypes	Upland/Lowland Varieties	% According to Preference	Reasons given by the Rice Growers
1	<i>Kba jrong, Darjeeling, Kba Mukra, Kba Sohma, Kba Sakur, Langmai</i>	Lowland/Valley	10.4%	The tall Variant easily collapses, difficult to cut during harvesting due to the collapsing of the rice plants.
2	<i>Pnah iong, Pnah Lieh Latara, Pnah Pyllon, Pnah Mawtawar, Pnah Pathar</i>	Lowland	11.2%	High commercial value, used in making rice pancakes, rice-based snacks and cakes
3	<i>Pnah Lum, Kba Lum, Kba Thohriaw, Kba saw, Kba Tlang Sohpieng,</i>	Upland	9.1%	Cultivated by farmers who don't own paddy fields, easily maintained, require no irrigation,
4	<i>Lakang, Lynter, Jwain, Mynri,</i>	Valley	47.3%	High commercial value, High Demand, Value for its taste
5	<i>Kba Lyngkot, Kba Laispah, Kba Laipawa, Kba stem</i>	lowland	22.0	Short Variant, High Production, less taste
Total			100	

Source: Compiled by the Research Scholar

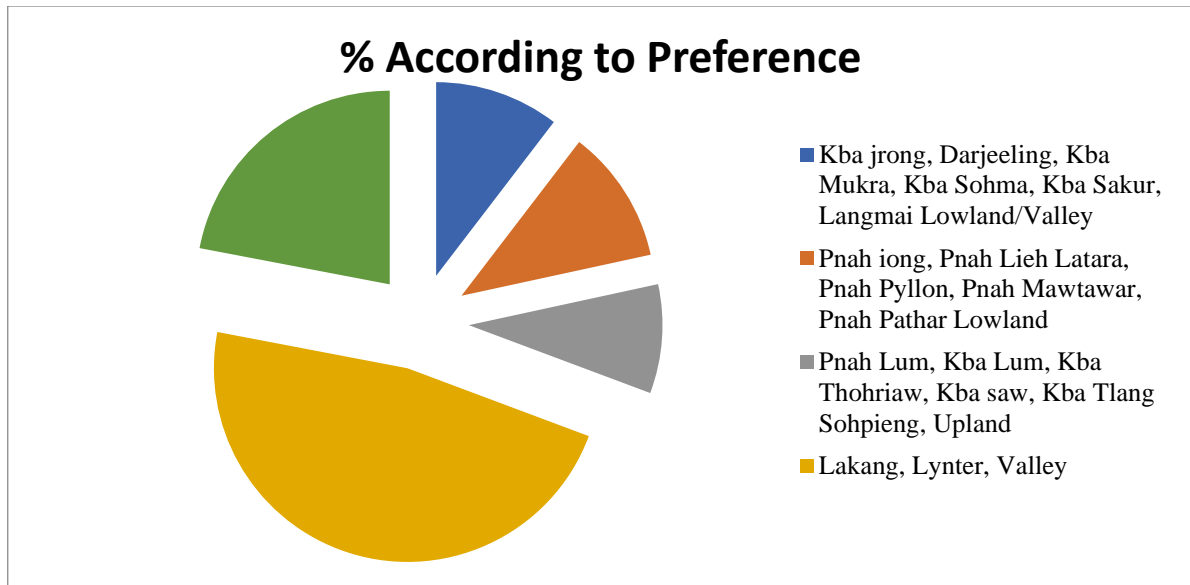


Figure 9: % According to Preference

From, the Table given above, it is observed that the percentage calculated is based on the preferences of cultivation of rice varieties in the studied area. The responses collected were analysed and ranked into percentages as per the record from the field survey. It is found that the highest preference for the cultivation of rice varieties is of the valley/ lowland varieties i.e., landraces such as *Lakang, lynter, jwain, mynri* etc. These crops are grown owing to their commercial values and also there is high demand for these rice varieties. These rice varieties are used widely almost in all the districts of Meghalaya to prepare Rice based snacks, rice cakes and rice pancakes (*pusaw, pudoh, putharo, pusla, pumaloi, putyndong, pulainsaw*, etc). Similarly, the sticky varieties which are locally known as *Kba pnah* are grown for their commercial values and demand possessing about 47.3% of records given by the respondents. While the short variants such as *kba laispah, kba laipawa, kba stem, and kba lyngkot* (20%) are grown for their high production irrespective of their low taste, however, they are highly preferred by large families in the rural areas owing to their high production. The long varieties such as *Darjeeling, kba jrong, kba mukra,*

and kba sohma were not preferred much by the local rice growers as these rice varieties are characterised by their tall height, easily bends down at their maturity stage rendering difficulties while cutting the rice plants. Therefore, there's only about a 10.4% preference record. Whereas the upland rice varieties such as *Pnah Lum, Kba Lum, Kba Thohriaw, Kba saw, and Kba Tlang Sohpieng*, records only about 9.1% cultivated by farmers who don't own/have a paddy field, but they are easily maintained as they don't require irrigation.

Consumer preferences for rice are heterogeneous and therefore the significance attached to each or specific attributes varies in terms of the socio-cultural context in which rice consumption is embedded. Some consumers prefer taste, whiteness, slenderness, short grain, aroma etc. which are associated with high-quality rice varieties.

Slenderness, good taste and whiteness are most preferred by people in the urban areas while it is different in the rural areas where people prefer high-production varieties of short, medium and bold grains.

4.13: Economic analysis of indigenous rice in traditional cultivation in Khasi hills.

Table No. 10: Economic Evaluation of Indigenous Rice Cultivation under Traditional method at farmer's field of Khasi Hills (Rs/ha)

SI No.	Particulars	TRP (Traditional Production) in Rs
1	Seeds (Rs)	-
2	Organic Manures (Rs)	6000 per ton
3	Labour (Human and Animal) in Rs	7450



4	Chemical fertilizers UREA (in Rs)	1200 /40 kg
5	Total Cost (Rs)	14650
6	Average Productivity(Q/ha)	16.2
7	Gross Return (Rs)	20,000
8	Net Return (Rs)	5656

Source: Compiled by the Research Scholar

Table 4.7 Economic evaluation of conventional rice farming pattern of Khasi Hills The total cost of cultivation is 200.00 INR. 14,650 (a very low amount) which is also very low, meaning they are highly dependent on external inputs, a traditional technique. Labour costs constitute 51% of the total (estimated at Rs. 7,450) which describes the dependence of agriculture in rural societies on human labour. The use of organic manures at Rs. 6,000 per ton indicates a dedication to the green and eco-friendly approach. The limited application of chemical fertilizers, priced at Rs. 1,200 40 kg, and a partially synthetic leaning. The overall productivity is about 16.2 quintal/ha, which is not quite high concerning modern farming practices. The gross return of Rs. Twenty thousand per hectare is good, even with the low input cost. A net return of Rs. The

figure,5,656 per hectare, clearly shows that conventional indigenous rice farming practices are economically sustainable. These conventional approaches are used to aid sustainable agricultural systems which can contribute towards reducing environmental damage and protecting natural resources. Because labour-intensive, these practices also offer promises of a great number of employment opportunities to the communities. Native rice types may seize opportunities in niche markets that are interested in organic, sustainable products. The government can help traditional farming by giving subsidies for organic manures and offering training courses. Future research can extend to increasing productivity and discover new market possibilities.

Table No.11: Usage of fertilizer

	No. of farmer	%
Organic	122	61
Inorganic	32	16
Both	46	23
Total	200	100

Source: compiled by the research scholar

From the field survey, it is learned that there is a certain percentage of farmers who practice organic rice farming and inorganic farming or both methods. There are around 61% of farmers (122 farmers) report to practice organic farming due to the low purchasing power and unaffordability to purchase chemical fertilizers and inputs they are rather happy with practising organic farming indicating an important inclination towards sustainable and eco-friendly methods of rice cultivation.

There are about 16% (32 farmers) who respond to relying on inorganic fertilizers and practising inorganic farming methods of rice cultivation to boost production. There are also 23 % (46 farmers) who respond to have adopted both

organic and inorganic methods of cultivation and are open to experimenting with different approaches.

Therefore, from the collected responses it can be set that the high percentage of organic farmers indicates a very strong preference for sustainable practices of rice cultivation contributing to environmental conservation and improving soil health. There are more training and extension education programs required to make the inorganic farmers realise and understand the benefits and sustainability of organic farming and integrated approaches.

Additionally, on a positive note, 23% of farmers who opted for both methods show the opportunity to promote integrated farming practices to help balance productivity and sustainability.



Table No.12: Practices followed by Indigenous farmers in the Khasi Hills Region:

SI No.	Particulars	Indigenous Practices
1	Tillage Practices	3-4 ploughing followed by levelling and planking mostly by bullock drawn plough or by tractors
2	Varieties/ breeds of crops	Low yielding-local varieties/ breeds of crops
3	Nutrient Management	Mostly cultivated under low levels of fertilizer application particularly N (Urea) at 40-50kg/hectare. FYM applied once in 3-4 years. About 30% of rice residues are recycled within the field. Fertilizers application like Urea is broadcasted by standing and throwing in the field.
4	Water Management	Rice is cultivated as rainfed during the kharif season. Continuous flooding is a prevalent practice.
5	Weeds Management	Only hand weeding (HW) is practised
6	Pest/Disease management	Indigenous technical knowledge (ITK) like the use of scarecrows is commonly practiced. The use of pesticides is only limited to a few advanced pockets and as a last-minute measure.
7	Cropping System	Rice monocropping or rice system is prevalent in lowlands

Source: Anup das et al., "Capturing Traditional Practices of Rice Based farming systems and identifying interventions for resources conservation and food security in Tripura, India

The table above presents an overview of Indigenous practices that are followed by Indigenous rice farmers in the Khasi Hills region of Meghalaya. These practices are based on local knowledge and tradition. For tillage practices, the farmers employ 3-4 ploughing followed by levelling off the field by blank primary use by bullocks or ox-drawn plough. The varieties grown are low-yielding local varieties or breeds of rice which are predominantly preserved locally.

For the management of nutrients for the rice plant, farmers apply low levels of fertilizer mainly UREA at around 40 to 50 kg/ hectares. Organic manure or Farm Yard Manure (FYM) is applied once in the field before planting once every 3-4 years and about 30% of rice residues are recycled in the field itself adding to the fertility of the soil.

To regulate the water requirement and management rice is mainly cultivated in the summer season as a rain fat cropped with continuous flooding which is one of the most common practices.

To control diseases, Indigenous technical knowledge (ITK), such as using scarecrows is a normal practice in most fields. The application of pesticides is limited to a few and certain areas and is often used as a last-minute measure.

Rice is grown as a mono-crop and is prevalent in lowland areas of the Khasi Hills region. Therefore, for the widespread use of traditional practices such as hand weeding, indigenous pest management displays an emphasis on the importance of preserving local knowledge. The low-

input use of fertilizer, and pesticides imply of focus on sustainable agriculture. Due to the lack of irrigation facilities in the region, the Reliance on rainfall cultivation indicates the requirement for more efficient water management strategies.

1.15: An Overview of the traditional practices in Indigenous rice cultivation:

Zizira, (2017) points out that traditional practices in Meghalaya embrace the original method that has been followed and instilled by the Khasi people since the ancient past. Such practices have been kept alive until today, balancing our daily needs while preserving the natural environment.²

The tribal people of Meghalaya follow two major types of agricultural practices.: Shifting cultivation and terrace cultivation.

Shifting cultivation is mainly carried out in the slope or upland area, whereas terrace cultivation is done on the lowlands or valley lands.³ The traditional knowledge that the Khasi of Meghalaya has regarding rice cultivation is well adapted to the environmental conditions. It has enabled them to maintain their ecological balance.

² Zizira, 2017, Traditional farming Practices in Meghalaya NE India, Farmers of Meghalaya, Aug 18, 2017

³ Jeeva et al., 2006, Traditional agricultural practices in Meghalaya, North East India, Indian Journal of Traditional Knowledge, Vol.5(1), January 2006, pp.7-18



In the Khasi Hills of Meghalaya shifting cultivation is usually carried out in the hilly or slope area; firstly, they cut down the bushes, and then the cleared patch of land is left for drying for three to four weeks. Then, when all the plants and branches of trees are dried and die, the patch of land is set on fire. The burned land is then left for a day to cool down. The land is plough manually done by human labour or by tractors on accessible lands. Lastly, the seeds were then broadcast using the hand hoe. This practice is a primitive method that is practised till today after a year of cultivating "*Kbalum*" in the upland/slope land, and then the land is left for a year or two years. However, due to the non-availability of lands, many farmers practise semi-permanent or settle cultivation for *kba-lum* in the two districts of Meghalaya. This practice of shifting cultivation has been followed for thousands of years, and it has an in-built system for conserving and life sustenance of the tribal people.

1.16: Terrace Cultivation

To preserve soil moisture and retain soil loss and erosion, terrace or Bun cultivation is usually practised in the lowlands, valley land, or even slope land. The soil is the plough, and the bun is made vertically or horizontally, depending on the slope. The space between the bun varied from place to place but usually not more than one metre to prevent soil loss from surface runoff from the slope or foothills; this method has been practised by the tribal of Meghalaya.

This is one of the oldest traditional practices in the Hilly region for retaining soil erosion and water resource management. The main practice behind this is to reduce erosion rate by surface water runoff and soil erosion. Terraces are made by levelling the land in stepwise conversions of land between two barriers into strips of flats of terraces. Buns were made and laid along the contours. Due to soil erosion by surface runoff and ploughing, soil is carried away and deposited at the barriers. However, when Buns were made, the eroded soil was retained within the bund's interspace, which gets level up to 4-8 years to form a bench terrace. Singh, 2007 opined that this method of terrace farming is preferred over a cut-filled method to avoid loss of soil fertility and soil manipulation. Although in the study area, the farmer prefers to use this method of farming on sloping land, bund cultivation has become a settled cultivation system to prevent land degradation. Jeeva et al., 2006 stress that both graded and level types of terracing are practised for their advantages and disadvantages. This practice is one of the

traditional methods which are practised in harmony with the environment or nature. However, with the change in technology adaptations and scientific methods, these methods of practice have changed, with no more equilibrium in man-nature relationships.

According to Singh, 2007, mechanical soil and water conservation techniques like bench terracing are widely practised and are one of the conservative methods to utilise sloping land for sedentary subsistence agriculture. Because of its soil and water retaining techniques, it has continued to be the prominent method for crop cultivation in the Hilly region. The terrace field obtained its water from the highland's streams and springs during the rainy months.

1.17: Cropping practice:

Rice, being the way of life for the Khasi of Meghalaya is grown under varied situations in the sloppy land/upland and the lowlands or valley land by adopting their indigenous growing methods. In Meghalaya, in some parts of it like the Garo Hills, rice is grown there in a year with three cropping seasons. In contrast, in East Khasi Hills and Ri Bhoi District, rice is grown only once a year during the summer season; that is, in April May, Rice is grown either by direct seeding into the jhum fields or hill slope and even in the lowlands or by transplanting method which practised only for valley rice varieties according to the respond from the rice grown of both the studied district of Meghalaya. The upland rice varieties are grown on hill slopes in the jhum fields as rain-fed upland where direct seeding or broadcasting is practised. In contrast, valley rice or lowland rice varieties are grown in flat land or terrace land where rice is grown by broadcasting or transplanting methods. The valley rice varieties are dependent on irrigation or monsoon rain. Rice monoculture is practised here in the same field year after.

1.18: Irrigation practices

Irrigation is one of the undeniable factors which favour rice production. Proper irrigation facilities permit and lead to increased yield and production. However, as observed from both the districts of Meghalaya, most of the rice growers responded that the lack of proper irrigation canals led to low rice production. Bench terrace irrigation is mostly found where farmers manually prepare a channel where water flows continuously from the upper to lower terraces. This method is commonly practised everywhere in Meghalaya to supply water to the rice fields. During heavy monsoons, the



channel is widened by surface runoff which can lead to blocking the channel or destroying the path for water flowing. To prevent this, farmers use stone gummy bags filled with sand to prevent soil erosion. Most of the rice growing process is carried out manually. Very few machines are employed in rice cultivation only during the plugging where tractors are used.

The traditional practices for rice cultivation in both districts enabled them to understand the diverse variety of rice, which is resistant to the varied types of agro-climatic conditions and is pest

and disease-resistant. Variety, however, leads to less preference for HYV seeds over large areas for enhancing productivity and production. Rice production could be higher in both districts le of local knowledge and management practices.

Rice farmers managed their rice production based on their past experiences and direct observations. Over time, changes in total rice production involved changes in yield based on the location type (i.e., irrigated, rain-fed, and upland areas), changes in seasonal harvesting patterns, and variety planted.

Table No 13: Source of Irrigation

Sl. No.	Source of Irrigation	Nos	%
1	Rainfall	116	48.33
2	Pond	10	4.16
3	Well	-	-
4	Lake	5	2.08
5	River	89	37.09
6	Canal	20	8.34
7	Total	240	100

Source: Compiled by the Research Scholar

With regards to water access or availability of irrigation facilities, a significant number of farmers about 24 farmers (85%) share that they face water problems and scarcity, especially during the growing season which is very critical for rice production and affects the rice yield and productivity. However, about 89 households (37.09%) rely on rivers, and streams to supply water to their paddy fields depending on the natural water source which is very unpredictable and inconsistent, especially in the years of erratic rainfall.

The majority of rice growers in both areas rely on rainwater for irrigation, according to data on their sources of water. Roughly 48.33% of rice farmers used rainfall as their primary irrigation source. Following a downpour, the majority of rice farmers in the research region rely on large rivers such as the *Umiam*, *Umran*, *Umsaitprah*, *Umiei*, *Umngot*, *Umsaw Umling*, *Umngi*, *Umngot Umkrem*, etc., which account for roughly 37.09% of the district's rice farmers. About 8.34% of the rice growers in the research area use canals as their primary method of irrigation, and the majority of the sample growers stated that they were unable to get enough water to irrigate their paddy fields due to improper canal irrigation. Following rivers and canals, the remaining bodies of water—lakes, ponds, and wells—pose very little percentage of reliance. This suggests that the low yield of rice in the

research area can be attributed to a lack of irrigation facilities.

: Reasons for low production:

The production of rice varies very much from one region to another region, from one season to another season, etc., due to various reasons such as imbalance use of fertilizers, soil moisture stress, and incidence of insect pests and diseases; fertilizer use also has a complementary relationship with the availability of irrigation facilities and finally increased the rice production etc. One of the major reasons for rice's low production is that most of the paddy growers in the district still cultivated only indigenous varieties, and very few adopted HYV varieties of seeds. High-yielding varieties are fertilizer-responsive/oriented; as such, small farmers of the rural villages in both districts can only use a little fertilizer per unit cropped area. Farmers in the hills are more convinced about their selected and cultivated varieties than HYV. The incidence of pests and diseases is also less in indigenous varieties. The cultivation of rice under upland conditions in both the district of Meghalaya is practised widely and is subjected to different degrees of moisture stress, which affects plant growth (height), tillering capacity, less leaf area, higher sterility, delayed flowering and lower harvest ratio (grain-straw ratio). These factors contribute to lower grain yield in upland rice areas. Upland rice



fields are always infested with a high degree of weed population which compete for water, nutrients and light than low land and fields. Therefore, the production of upland rice is affected considerably.

Among the various factors, availability of irrigation facilities, adoption of HYV of rice, rate of fertilizer use, farm size and credit availability greatly impact the region's rice production. Thus, the major policy thrust in this context should be enhancing irrigation facilities in the lagged states. Developing water harvesting techniques, such as micro-watershed-based farming systems in hill areas, can go a long way in increasing rice production in the region. There is enough scope to narrow the adoption gap in using fertilizers and HYV seeds in various states through intensifying extension services and institutional support. The existing pattern of tractorisation in the region was insignificant compared to the country's other states. In this context, implementing the Land Revenue Act and conversion of jhum fields into terrace fields in hilly areas need to be emphasized. Besides, it will further scale down the average holding size and consequently affect agricultural production. Financing and credit policies of financing institutions should be liberalized. These measures will facilitate equitable rice production growth among the states and the region's overall development.

The rice production in both districts is low and lags when compared to these states of North-eastern India. Owing to various constraints and undulating topography, acidic soils, steep slopes, fluctuation in Market prices, and poverty. Most of the farmers of Meghalaya needed help to afford modern technology and inorganic fertilizer or manure application; the rice growers in both districts are cultivating local rice varieties with very low inputs, resulting in low productivity.

1.17: Recommendations and Suggestions:

There is ample scope for increasing rice production in Meghalaya with proper generation and adoption of improved technologies through proper extension approaches. Rice is cultivated in the Khasi Hills of Meghalaya mostly for subsistence and self-sufficiency, and very few farmers cultivate it for commercial purposes.

With the interesting findings, Seeds, fertilizer, Pesticides and labour all had significant positive effects on rice production. Environmental factors like Climatic factors such as Temperature, sunlight and Rainfall are the major determinants of the growth and yield of rice. However, the prime concern for the increase in rice production in both

districts is increasing rice yield by applying high-yielding and quality varieties and suitable rice production technologies. It is difficult to increase in area due to the limitation of this factor, and the area has even declined in certain periods. The aspects of indigenous rice cultivation in the two districts of Meghalaya are driven by consumption rather than market surplus. The high cost of inputs like inorganic fertilizers and mechanization are beyond the reach of an ordinary farmer. The lack of technical know-how and poverty have remained a roadblock to the small farmers in Meghalaya.

Therefore, improving and expanding a proper market system would motivate and encourage the farmers in the hilly regions of Meghalaya to improve their rice production for subsistence and commercial surplus. Regular capacity building and training programmes would help the farmers minimize the technological gap and enable them to update their knowledge and skills regarding rice cultivation technology. Further, there is a need to enhance the scientific method of rice cultivation by introducing need-based and location-specific agricultural development technology by emphasizing the development of the infrastructure facilities of the area. These can be achieved by identifying areas of the technological gap and minimizing those gaps through proper extension approaches.

To conserve rice landraces and the rice agroecosystem, we can adopt the MSSRF three-pronged strategy: first, by using a participatory approach and technology transfer to close the yield gap between native crops and varieties; second, by promoting innovative farming techniques that increase productivity while lowering production costs; and third, by raising awareness of the need to conserve rice landraces, which is made possible by providing incentives for their cultivation while also defending the rights of custodian farmers over these landraces. It is vital to establish a science-based strategy to boost yield through purified seed production, excellent agricultural practices, and guaranteeing quality inputs to strengthen their competitive advantage against contemporary varieties.

Along with better farming techniques, this strategy can assist farmers in gaining access to information and farm equipment. Poor profit margins, rising labour costs, and the influx of lucrative alternative crops hurt the region's local food systems. Thus, by assisting rice farmers in increasing crop yield and lowering production costs by showing best practices and supporting the transfer of cutting-edge technologies and farming



methods. Using the participatory research technique, the agricultural department can promote novel paddy cultivation and improve farmer capacity through training and demonstrations.

1.18: Conclusion:

Tribal agricultural communities are linked to elements like belief, discrimination, customs, and food security. They are difficult to persuade to give up on the old landrace and accept the HYV of rice in its stead. This is a hidden blessing. However, genetic variety is essential to life and necessary for future nourishment, therefore genetic degradation is not desirable at all. Therefore, the introduction of HYV may be discouraged, especially in this part of the country where so many varieties of rice are available. To protect this gene pool, let farmers continue to conserve and multiply the traditional rice germplasm in their traditional ways. The greatest way to preserve the variety of native rice, particularly in these hilly states, will be to implement on-farm conservation techniques. Therefore, to allow for the natural continuation of their evolutionary process, all of these rice landraces that have acclimated to such an acclimatized ecology must be maintained in situ, or on farms.

The indigenous rice varieties of the Khasi Hills region can be grown in any type of soil available in Meghalaya. The indigenous rice varieties that are highly preferred by the locals owing to their taste and quality are of low productivity. The majority of the surveyed rice fields in the Khasi hills are rainfed fields and dependent on monsoon rivers. The Upland rice is grown in the Upland or slope where the moisture content is low and similarly in the low-lying areas due to the erratic monsoon rains. Most of the rice fields are acidic and due to a lack of awareness and inputs for soil fertility improvements, farmers are small and marginal and lack sustainable production of rice.

Rice cultivation is carried out in the same fields every year except on the Upland/slope varieties. Diseases and pest incidence in rice have contributed to low productivity levels due to a conducive environment and practising of shifting cultivation which is the major drawback to high productivity which has resulted in soil loss and nutrient loss. The Khasi Hills region lacks an irrigation system.

In the Khasi Hills, traditional rice farming represents more than just an agricultural skill; it means a way of life deeply entwined with the cycles of the land and the principles of sustainability. The Khasi people have been cultivating various rice

types for many generations, each one especially suited to the local temperature, soil, and cultural preferences.

In the Khasi Hills, the custom of growing rice by the traditional method persists despite the invasion of contemporary farming methods and socio-economic changes in the local economy. But modern issues, including land fragmentation, shifting climate patterns, competitive pressures, and the loss of traditional knowledge, threaten this age-old activity.

The current state of traditional rice agriculture in the Khasi Hills region shows present difficulties and creative solutions meant to conserve and revitalize this priceless cultural legacy. The agricultural dynamics as well as the significant cultural, ecological, and socioeconomic value buried beneath the Khasi Hills' paddy fields.

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