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Millet Production in India with special reference to Assam

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Abstract: *This paper is an attempt to study the case of Millet production across districts of Assam, India during the period 2020-22. It also examines the problems faced by Farmers and impact of policies on Millet production. To study the problem, secondary data is collected from the Directorate of millet development, Statistical Organisation. Data collected are analysed using basic statistics and presented through diagrams and tables. Compound annual growth has been used to study the progress of millet production in Assam, India. The study finds that millet cultivation occupies a negligible portion in Agriculture in Assam. However, it has lot of developmental prospects as the environment of Assam is suitable for millet cultivation. Therefore, it has been recommended that government should support the millet growers through subsidy policies and setting appropriate prices. Moreover, policies are also required in the field of infrastructure development and expansion of the market. Policies also recommended training the millet growers so that they can offer more efforts to increase millet production and help in post-harvest management.*

KeyWords: *Millet Production, Food Security, Smart Cereal, Agriculture, Sustainability, etc.*

1. Introduction

In India's agricultural system, 'Millet' group of drought-tolerant cereals have fewer requirements of water and fertilizer as compared to the rest of crops *(Dhedhi et al., 2016)*. These grains, having a vast array of nutritional attributes such as proteins, fibres, vitamins, together with the vital amino acids like cystine and methionine, become very essential for those regions prone to drought. Often millets have been the cornerstone of the diets traditionally held by much rural population and notionally prized for their adaptability to harsher growing conditions and remarkable nutrient contents *(Maitra, 2020)*. For thousands of years, these grains were symbol of the Indian Agricultural Heritage portraying how the primary basis of subsistence was farming and resourceful. Millets are one of the main categories of cereals produced in India *(Maske & Samui, 1987)*. The domestic production of millets amounted to around 34.6 million tonnes in 2020-21, with consequent concentration of Mranas and Bajra production in Rajasthan, Maharashtra, Karnataka, and Andhra Pradesh respectively. Rajasthan contributed more than 40% Millets are one of the crops that help to prosper the rural economy and prevent shortage of food in regions that cannot support rice cultivation *(Choudhary & Kumar, 2023)*.

In the last twenty years or so, Millet Production Incidentally has seen a lot of trends affected by Economic, Environmental and Socio-economic factors in the early and mid-twentieth century, underlining among the poorest the peasantry, millets were held as the core element of their diet *(Choudhary & Kumar, 2023)*. Nevertheless, the green revolution of the 1960s brought new specialties of wheat and rice with high production, which made a huge effect on whole cultural practices of field works *(Dhedhi et al., 2016)*. This phase was as a result of government policies that intensified support for these cereals through providing price supports and better irrigation infrastructure, hence there is a fall in Millet Cultivation *(Maske & Samui, 1987)*.

In the last few years, millets have now started to regain its place among the staples of the food basket; however, this renaissance of millets is driven by a number of concerns such as nutrition, food security and sustainability *(Maitra, 2020)*. This increased attention, as seen in the government's activities like increasing the popularity of millets has led to their categorization as "Nutri-cereals" and inclusion in various Agricultural and Nutritional Programmes. The History is Continuing, but the rate of Millet Production increase is only slowly because of these efforts.

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This paper is about the agricultural aspect of millet farming in India, which specifically focuses on the states of Assam, where the cultivation of millet is rapidly growing in order to foster its production and the entire value chain, through the state government's Millet Mission *(V P et al., 2012)*. They present the trends in milk production, problems the farmers come up with as well as the policies' impact on millet production. The analysis is made to help to formulate the strategies which are in favour of millet's potential as much as possible, especially for the awakening needs of millets in bringing about the change in Assam's scenario of agriculture and to bring into picture the increase of importance of millets in national agriculture.

The goal of this research is to study millet production throughout India for the years 2020 to 2022 and, across the districts of Assam. The main goal is to carry out a comprehensive analysis of the millet farming trends in the agricultural zones and produce information concerning which area tamed production during which year. Additionally, the study has two secondary objectives: firstly, the study will be focused on the challenges of the millet farmers; economic, environmental and policy factors will be highlighted; and secondly the analysis will deal with the impact of government policies on millet production levels, it will be shown if they are in the reasonable support of millet cultivation or not. Moreover, two research question are taken as

- What are the wildlife issues of the millet farmers in Assam (environment, economy, policy) and how will they influence the all-round farming of millet in the area?
- Taking into account the fact that the government offers policies specifically directed towards production of millet compared to other important millet-producing states of India – what results does it produce for ratings of millet production in Assam?

The paper is divided in a systematic manner to offer a thorough assessment of the cultivation of millet. Section 1 provides background information on the study that in India and other similarly affected regions, millet is an essential crop as it is a drought-resistant cereal containing nutritional value. Section 2 of this chapter presents a closer look at previous studies exploring the old and the new value of millets to human history and economy as a result of health and dietary diversification and innovation caused by the need for sustainability. Section 3 outlines the research methods which are used to identify the analysis of millet production areas, experience the challenges faced by the farmers and evaluate the effect of enacted policies. Section 4 particularly on India examines the major millet producing states providing relevant data and analyses at state levels. Section 5 provides district-level data on millet production and examines the various aspects like climate and soil practices, and socio-economic factors associated with millet production in Assam only. Section 7 presents a comparison of millet production strategies employed both in Assam and with other leading producers with insights and identified good practices. In Section 8 conclusions and recommendations are provided, expecting to contribute to the improvement of millet production and the better promotion of millet farmers in Assam and other relevant regions.

2. Review of Literatures

The millet cultivation of India had a long and rich history and the significance of it for the country 's agricultural economy is undisputed. Well-known for their nutritional value, it is so reported that humans have been using Pearl Millet, Finger Millet, and Sorghum as staple foods in India since 2000 BC. These small millets are rich in proteins, fibres, and vitamins which are basic to the rural human systems. Nevertheless, the modern introduction in India from the 1960s which aimed to maximize production in addition to utilizing other advanced agricultural technologies, wheat and rice evolved at the expense of millet *(Singh, Gupta, & Choudhary, 2016)*.

Just in the last few years, the cereal millet has begun making a comeback with the urgency of health reasons, and the sustainability issue. The Indian government customizes the programs to guarantee that farmers produce and grow millets by including millets in the public distribution system and promoting millets as 'Nutri-cereals' consequently

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(Kumre, 2024). These policies are nested to subsidies for millet farmers, as well as research on the development of high-yielding, pest-resistant millet plants, which provide a better yield in states, especially Rajasthan and Maharashtra *(Choudhary & Kumar, 2022)*.

It should be recognized that these achievements have not gone without any problems. Millets are fragile to climate factors and necessitate particular soil types with little rainfall for a perfect planting environment. In places that do not have adequate irrigation, the plants may not flourish well *(Gowri, 2020)*. It is hard to match millet farming in terms of income at times due to the fact that other crops such as rice and wheat which receive support from the government seem to have an upper hand when it comes to profits. Millet demand for continuing to increase steadily and at the moment consumer awareness is rather low; millet supply chains operate at a low level of development; all this jeopardizes the economic viability and scalability of millet farming *(Kundu, Kumar & Mit, 2019)*.

Though the trend of millet production has been increasing rapidly in India, specifically in Assam, they are yet to assume a major portion of the production area compared to other states in the country. The Assam government has come up with the Millet Mission indicating more investments in the farmers' development providing them with the technical support and training by the government *(Neog 2022)*. Nonetheless, the state experiences its own worries associated with below average agro-infrastructure and unfolding markets for millets. These constraints are however not a limiting factor since the millet's value chain is very lucrative and the local economy can benefit by increased social importance and higher market values for these crops *(Maske & Samui, 1987)*.

Recent studies suggest that millets are an important facet of sustainable agriculture in affected areas which the tropics are susceptible to thoroughly to drought and climatic variability *(Sharma et al., 2023)*. Millet's require little water and can sustain in nutrient deficient soils, making them the perfect crop to grow on marginal farms *(Ghosh & Kumar, 2022)*. Studies show how millet cultivation helps in decreasing soil erosion and improves biodiversity for long term agricultural sustainability *(Kumari; et al., 2021)*. Also, the carbon footprint of millets is extremely low, a critical element in lowering the deteriorating impact of agriculture on the environment *(Verma et al., 2023)*.

Over the years, millets have been gaining a lot of hype and they have garnered recent research attention considering their high contents in fibre, protein, and essential minerals *(Jha et al., 2023)*. Millets are unlike the refined cereals, which have a lower glycaemic index so are useful in diabetic and obese conditions *(Rao et al., 2022)*. It is also known that finger millet (ragi) and pearl millet (bajra) have a very rich presence of antioxidants and thus have a potential in reducing the risk of cardiovascular diseases *(Mishra & Gupta, 2021)*. Secondly, studies have also investigated the potential of millet-based diets not only in combating macronutrient deficiencies in general, but also in particular for addressing the growing levels of micronutrient deficiencies auguring rural and tribal populations *(Patel & Sharma, 2022)*. In parallel with this movement, millets have also been promoted as "super foods" for a healthier diet by governments, especially in India, where millets are being used as "super foods" *(Kumar et al. 2023)*.

To no surprise, millets have been increasingly recognized by the Indian government as having the potential in addressing food security and agricultural sustainability *(Singh & Verma, 2022)*. Rising production as well as demand *(Deshpande et al., 2023)* of millets are due to their inclusion in the National Food Security Mission (NFSM) and inclusion of millets in the Public Distribution System (PDS). The declaration of the United Nations for the "International Year of Millets 2023" has further added to the development on the globe to enhance the production and consumption of millets all over the world *(Goyal & Yadav, 2023)*. Although there are challenges of pricing incentives, infrastructural support and market linkages to further expand millets cultivation *(Chaturvedi et al., 2022)*.

Consumer trends and the importance of wheat and rice in the Indian diet fluctuated the demand of

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millets *(Bhattacharya et al., 2023)*. Nevertheless, millet-based products have developed a fresh health pantry that has seen an increase in its availability in urban markets *(Mohan and Iyer, 2022)*. According to market research, the awareness towards the health benefits of millets is a crucial factor of demand *(Shukla & Singh, 2023)*. While we have these positive trends, there are many supply chain challenges to the millet industry *(Tiwari & Mehta, 2022)*. Improving logistics and marketing strategies for developing millet value chains can improve their economic viability *(Rastogi et al., 2023)*.

Historically important but declining because of competition from rice and maize farming, millet cultivation in Assam has been *(Deka & Bora, 2023)*. Subsidies, technical training to farmers by Assam's Millet Mission has helped in reviving interest in millet farming *(Neog, 2022)*. Nevertheless, the benefit of millet production in the state is limited by lack of foreign exchange receipts, lack of irrigation facilities, and poor access to markets *(Sarma & Das, 2023)*. Studying shows that modern millet variety adoption and regionally appropriate agricultural policies can greatly boost millet production in Assam *(Hazarika et al., 2022)*. Furthermore, the integration of millet in school meal programs and public food schemes could go an extra mile to facilitate its adoption by farmers *(Borah & Sharma (2023)*.

In recent years, agricultural technology has resulted in high yielding varieties and good agronomic practices *(Saxena et al., 2022)* to advance the millet yields. Hybrids of drought resistant millet have reduced the effects of climate challenges *(Yadav et al., 2023)*. Further productive gains in millet have been aided by mechanized farming techniques such as precision agriculture and automated irrigation systems in several Indian states *(Reddy and Mishra 2022)*. Furthermore, the digital platforms and mobile applications are now used to share real time weather updates and advisory services to the millet farmers thus making the process efficient and decisions making *(Garg & Patel, 2023)*. Research is also underway that would use the role of biotechnology to develop pest resistant millet strains to increase their production as well *(Kaur & Singh, 2023)*.

Millets are one of India's largest global producers but the production strategies are distinct from Africa and China where they are also staple foods *(Chakraborty & Sen, 2023)*. Millet production is included in traditional farming systems and coordinated by community led initiatives *(Owusu et al., 2022)* in Africa. On the other side, China has employed novel research and development to boost millet productivity via incorporating genetic improvement and agronomic strategies *(Li et al., 2023)*. A comparative study indicates that India can adapt Africa's grassroots and China's technological competencies to establish a balanced millet production strategy *(Nair et al., 2023)*. India can enhance its millet industry further through global best practices in order to contribute to global food security *(Sharma and Agarwal, 2023)*.

3. Research Methodology

3.1 Data Sources

Secondary data collected from self-determined highly authoritative sources has been the first choice for this research. The main sources of data are the government statistics, which in majority are supplied by the Directorate for Development of Millet; they generate a lot of analyses on the production and impact of policy of the millet harvest. Further, information has been pooled from different statistical bodies and governmental agencies that are meant to superintend and report on the current and past agricultural practices and their effects in India *(V P et al., 2012)*.

3.2 Research Design

The study makes use of the descriptive research design, where the data that is already available is used for the field comprising a thorough description of present millet production in India, and of special attention to Assam. This strategy is going to be used for the fieldwork of detailed examination of the spatial distribution of the millet cultivation through different districts and the recognition of some principles of production trends for the evaluation period from year 2020 to year 2022. Through the

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monitoring of such trends the research will identify unexplored areas, production amounts and an outline of the agricultural growth patterns, thereby giving a clear image of the millet farming situation. Hence, this framework is of great relevance because it helps to comprehend the dynamics that lead to the production of millet on the backdrop of the regional agricultural practices.

3.3 Data Analysis Techniques

For this study we employed descriptive statistics to analyse the data accessed on millet cultivation. A key strategy involves several visual diagrams like bar charts, line graphs, or pie charts that assist in the presentation of patterns and distributions of the data samples through different territories and periods of time. As for the matter, the Compound Annual Growth Rate (CAGR) is used to understand the rise or fall patterns of millet production from 2020-22.

3.4 Methodological Challenges

The reliability and validity of data sources, particularly the secondary data sources, pose the most prominent problem in this study. It is viable that the data from governmental and statistical organizers should be evidenced on whether they are current and comprehensive enough, so that they include all the variables that have an impact on production of millet. Besides that, the problem is also the issue of dealing with missing data which is the challenging one. Strategy techniques like imputing missing data points will be useful to fill the gaps where missing data exists by estimating values that align with and support the existing information on hand. For instance, sharpening data interpretation procedures to accommodate incomplete database selection could be an option with the purpose of endorsing the integrity of final results despite possible flaws during data entry.

4. Millet Production in India

India is the most extensive millet-producing country throughout the world. Millet holds an indispensable place in our country's food and is grown in a wide expanse of area throughout India. The millet industry is divided into 3 main varieties in India, pearl millet (bajra), finger millet (ragi), and sorghum (jowar) *(Gowri, 2020)*. As per the Ministry of Agriculture and Farmers Welfare (COA), Government of India, India recorded millet production of around 34.6 million tonnes in the year 2020-21, which marks an increase of Rajasthan, Maharashtra, Karnataka, and Andhra Pradesh respectively are the Big Four of millet production in India *(Kumari et al., 2021)*. Rajasthan is the largest millet producer all over India which produces 40 percent of millet in total production of the country. Karnataka and Andhra Pradesh are the major state producers, having a contribution of their 15% portions in the total production figure *(Choudhury et al., 2010)*. Millet is one of the many small and large marginal farmers` crops in India that is less cost intensive and comparatively involves low-maintenance as compared to other crops.

4.1 Millet producing states

Some of the major millet producing states in India is:

1. **Rajasthan:** Rajasthan is the prime millet producer of the country where the state occupies over 50% of the country's total millet production. Millet pearl (bajra) is considered as the most favourable cultivation species of the familiar millet crops.
2. **Maharashtra:** Maharashtra ranks second in the country followed by 20% of the total production parameters of millets. Jowar (sorghum) is one of the foremost domesticated crops in the state.
3. **Karnataka:** Karnataka stands at the qualifying position of the third-largest millet producer in India manufacturing about one-tenth share of the country's millet production. Tusu (ragi/finger millet) is the most widely spread millet crop in this state *(Choudhary & Kumar, 2023)*.
4. **Andhra Pradesh:** Which yields another major millet producing state in India, Andhra Pradesh as being a producer of almost 8% selected millet records of the country. Usually, the most offered millets are Jowar and Bajra in our state.
5. **Tamil Nadu:** Millets are one of the main product categories that Tamil Nadu state produces in India. Approximately 4% of India's total millet production is provided by this state.

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Ragi and kodo millet are the most widely cultivated millet crops in the region.

Besides the Coimbatore region, the other states that produce millet in India are also Gujarat, Uttar Pradesh, Madhya Pradesh, and Haryana *(Bhattacharya et al., 2023)*. Assam is one of the states of north-eastern India and is decently known for the millet mid cultures there *(Choudhary & Kumar, 2023)*. Millet is the crop which people of Assam have been growing since so far back in the past. Unlike Assam millet is not a significant millet growing state in India but still the is a significant millet producing state for some of the varieties millets.

Table 4.1: State Wise Millet Production

CROP: JOWAR	**Area (A) in Lakh ha, Production (P) in lakh tonnes**					
State	**2019-20**		**2020-21**		**2021-22**	
	A	**P**	**A**	**P**	**A**	**P**
Andhra Pradesh	1.55	3.89	1.20	4.11	0.77	4.11
Bihar	0.01	0.01	0.01	0.01	0.01	0.01
Chhattisgarh	0.03	0.04	0.02	0.03	0.01	0.03
Gujarat	0.49	0.67	0.41	0.57	0.43	0.57
Haryana	0.30	0.16	0.31	0.16	0.23	0.16
Jharkhand	0.02	0.01	0.02	0.01	0.02	0.01
Karnataka	8.27	9.87	7.50	9.04	6.23	9.04
Kerala	0.00	0.00	0.00	0.00	0.00	0.00
Madhya Pradesh	1.08	1.65	1.12	2.17	1.24	2.17
Maharashtra	22.91	18.08	20.79	17.47	16.49	17.47
Odisha	0.06	0.04	0.06	0.03	0.06	0.03
Rajasthan	6.43	4.56	5.60	5.90	6.20	5.90
Tamil Nadu	4.50	5.20	4.05	4.27	3.97	4.27
Telangana	0.88	1.24	0.91	1.56	0.67	1.56
Uttar Pradesh	1.68	2.27	1.74	2.75	1.71	2.75
West Bengal	0.00	0.00	0.00	0.00	0.00	0.00
All India	**48.21**	**47.69**	**43.74**	**48.08**	**38.04**	**48.08**

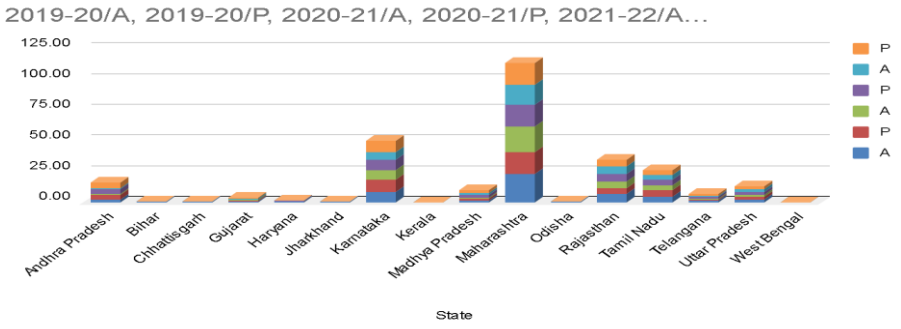

Figure 4.1: graph of state wise millet production (JOWAR)

4.2 Interpretations of the data

4.2.1 Jowar

Last year the Jowar had the highest area in Maharashtra, and conversely, it had a small or no area under cultivation in Kerala, Bihar and West Bengal. Maharashtra state was the highest producer of sugarcane in the years 2020-21 and also in 2021-22, while the State of West Bengal, Kerala and Bihar produced the least *(Dekaraja & Borah, 2024)*. There are several factors that contribute to the high production of jowar millet in Maharashtra:

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1. **Agro-climatic conditions:** Jowar is resistant to drought and therefore survives even when rainfall is low. It can hence be cultivated in areas with this particular challenge. Maharashtra has a semi-arid climate with a moderate rainout, and makes a good place for jowar farming *(Singh & Kumar, 2018)*.
2. **Availability of suitable land:** The state of Maharashtra is fortunate to own a considerable area of the cultivable land. A big part of it is also compatible with jowar growing. The state includes the suitable areas of Vidarbha region as well as Marathanudyas province for josale cultivation *(Maske & Samui, 1987)*.
3. **Adoption of modern farming techniques:** The state government of Maharashtra enlivens a multitude of programs to usher in a contemporary approach to farming among farmers. This involves the introduction of improved sexual maturity jowar varieties, more reliable irrigation, and combating pest and disease.
4. **Demand for jowar:** Jowar is a main crop in Maharashtra and in many areas in the state, it is taken to be a type of food that is eaten daily. The demand for jowar is huge; this has emboldened maize farmers to be more attentive and cultivate more jowar.
5. **Government support:** The Maharashtra state government has introduced numerous policy and program interventions to boost jowar as a cluster crop in the state. The implementation of such schemes must encompass the provision of money to farmers either as soft loans for the purchase of seeds, fertilizers, and other inputs besides supporting the use of jowar for animal feeds and its incorporation in the industrial sector.

When considering the jowar situation in India, we have Bihar, Kerala, and West Bengal as the relatively low jowar producing states compared to the other major jowar producing states in India. There are several reasons for this:

1. **Agro-climatic conditions:** Jowar is an adjustment for the climate, even in agro-climatic conditions, it can be mentioned that it grows particularly well. The immediate growth conditions (rainfall, moderate temperatures and well-drained soil) are important to converting a healthy growth. In Bihar, Kerala and West Bengal, the jowar cultivation may be not that smooth as the agro-climatic condition may also be not suitable.
2. **Soil type:** The sandy-loam soil is well aerated and retains a lot of organic matter. Jowar prefers such soil. The soil type in Bihar, Kerala, and West Bengal might be either denser or more acidic which again, is not ideal for the farming process of jowar.
3. **Crop preferences:** The farmers in Bihar, Kerala, and West Bengal can opt for the cultivation of other crops for different purposes such as profitability and ease of cultivation. Let's say, in Kerala the development concentration is more of the coconut, rubber and tea crops, while in West Bengal, it is likely to be the rice as the dominant crop.
4. **Market demand:** The need of jowar is not high in Bihar, Kerala and West Bengal states, in this way it could be a reason that farmer does not want to cultivate jowar. Furthermore, dissemination of jowar market to the states may not have been enough which can lower farmers' sales.

Table 4.2: State wise millet production (BAJRA)

CROP: BAJRA	**Area (A) in Lakh ha, Production (P) in lakh tonnes**					
State	**2019-20**		**2020-21**		**2021-22**	
	A	**P**	**A**	**P**	**A**	**P**
Andhra Pradesh	0.25	0.58	0.31	0.71	0.31	0.55
Bihar	0.03	0.04	0.04	0.05	0.03	0.03
Chhattisgarh	0.00	0.00	0.00	0.00	0.00	0.00
Gujarat	4.35	9.13	4.60	10.09	4.46	10.56
Haryana	4.93	10.19	5.69	13.50	4.83	11.20

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Himachal Pradesh	0.00	0.00	0.01	0.00	0.01	0.00
Jharkhand	0.00	0.00	0.00	0.00	0.00	0.00
Karnataka	3.22	3.67	2.22	2.76	1.47	1.71
Madhya Pradesh	2.96	6.57	3.27	7.38	3.43	8.69
Maharashtra	6.73	5.12	6.88	6.57	5.26	4.75
Odisha	0.02	0.01	0.01	0.01	0.02	0.01
Punjab	0.01	0.00	0.00	0.00	0.01	0.00
Rajasthan	42.87	46.86	43.48	45.61	37.36	37.51
Tamil Nadu	0.67	1.85	0.67	1.59	0.60	1.57
Telangana	0.09	0.10	0.10	0.09	0.04	0.03
Uttar Pradesh	9.17	19.39	9.07	20.14	9.04	19.49
West Bengal	0.00	0.00	0.00	0.00	0.00	0.00
All India	**75.30**	**103.51**	**76.35**	**108.50**	**66.87**	**96.10**

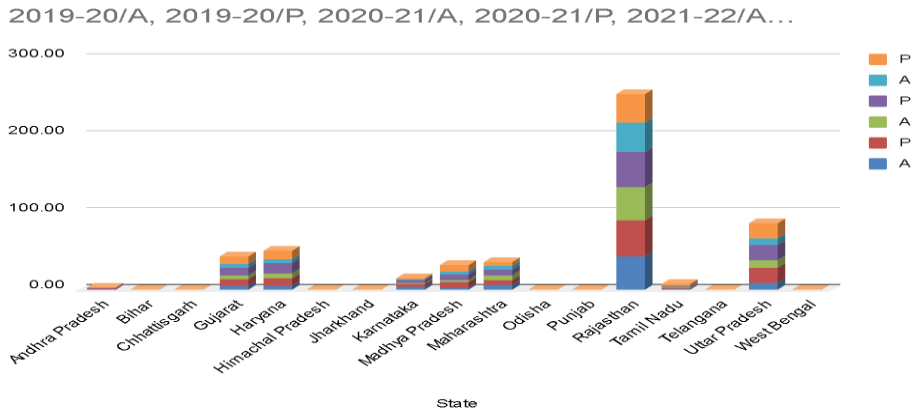

Fig 4.2: Graph of state wise millet production (BAJRA)

4.2.2 Interpretation of data (Bajra)

Rajasthan occupies second position among the Indian states on Bajra (pearl millet), supplying around 50% of the total production of the country. There are several reasons for this:

1. **Agro-climatic conditions:** Bajra has a very specific environment where it grows better and can cope much better with the extreme hot and dry conditions than with humid and wet ones. Rajasthan State has semi-arid to arid area, which is cool due to monsoons and hot temperature when the region is dry. This makes the growing condition perfect for Bajra cultivation. The state experiences good rains of medium to high intensity, which helps in growing Bajra in the land.
2. **Soil type:** That millet grows well in the sandy soils which are very well drained and infertile. According to Rajasthan, the state has a large area of sandy soils that is always suitable for Bajra cultivation.
3. **Adoption of modern farming techniques:** The state administration of Rajasthan has made substantial efforts to increase the acceptance of modern farming approaches at the local level *(Choudhary & Kumar, 2023)*. This is accomplished through utilization of short duration Bajra varieties, advanced irrigation facilities, and better controls of pests and diseases problems.
4. **Demand for Bajra:** The Bajra is the most famous crop in Rajasthan and is exceptionally berated and cherished in many patches of the state *(Singh, 1981)*. Farmers are going by the demand for Bajra which has stimulated their production in large amount.
5. **Government support:** The state of Rajasthan in India has taken multiple initiatives involving

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schemes and policy programs to improve Bajra harvesting in the region. This should be done, for example, by offering to farmers some financial help in buying seeds, fertilizers, and so forth, and raising Bajra's awareness as a feed for animals and industrial usage *(Maitra, 2020)*.

Table 4.3: State wise millet production (RAGI)

Area, Production and Yield of Millets during 2017-18 to 2021-22						
CROP: RAGI	**Area (A) in Lakh ha, Production (P) in lakh tonnes**					
State	**2019-20**		**2020-21**		**2021-22**	
	A	**P**	**A**	**P**	**A**	**P**
Andhra Pradesh	0.34	0.45	0.33	0.40	0.30	0.30
Bihar	0.03	0.02	0.03	0.03	0.02	0.02
Chhattisgarh	0.06	0.01	0.05	0.02	0.03	0.01
Gujarat	0.12	0.10	0.10	0.13	0.10	0.19
Himachal Pradesh	0.02	0.02	0.01	0.00	0.01	0.00
Jharkhand	0.15	0.13	0.19	0.16	0.19	0.17
Karnataka	6.41	11.64	7.85	13.70	8.49	11.33
Kerala	0.00	0.00	0.00	0.00	0.00	0.00
Madhya Pradesh	0.00	0.00	0.00	0.00	0.00	0.00
Maharashtra	0.82	0.87	0.82	0.94	0.74	0.93
Odisha	0.36	0.26	0.41	0.33	0.55	0.44
Tamil Nadu	0.85	2.75	0.83	2.89	0.74	2.21
Telangana	0.02	0.03	0.01	0.01	0.01	0.02
Uttarakhand	0.84	1.20	0.89	1.30	0.86	1.27
West Bengal	0.03	0.04	0.06	0.06	0.05	0.06
All India	**10.05**	**17.52**	**11.58**	**19.97**	**12.09**	**16.95**

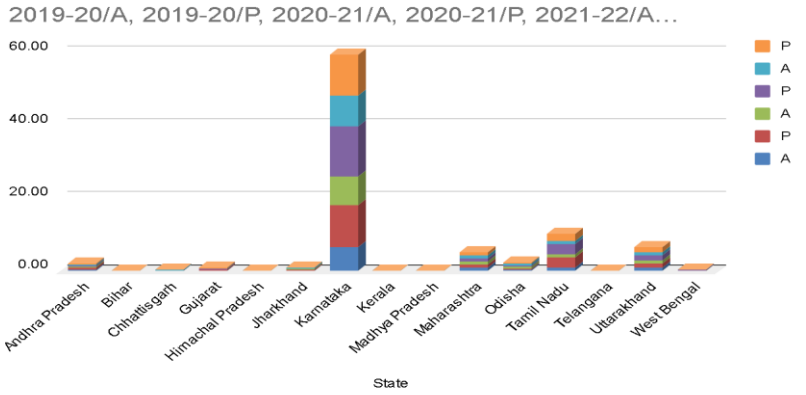

Fig 4.3: State wise millet production (RAGI)

4.2.3 Ragi

Karnataka figures as the largest agricultural producer of Ragi (finger millet), having a command over over 50% of the total Ragi (finger millet) output in India. There are several reasons for this:

1. **Agro-climatic conditions:** Ragi, is suitable for dry regions with semi-arid to arid climate fully, thus establishing the capacity to produce yields under harsh climatic conditions. Ragi is grown in trade with this varying climate change as the state of Karnataka has a different agro climatic

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region from coast belt dry plateau region which are favourable areas for Ragi production.

2. Soil type: With red, black and sandy loam type of soils which are well aerated and organic-rich, the crop grows well. A large part of the land in Karnataka consists of red and black soil. Hence, Ragi is very well suited to that type of soil.
3. **Traditional crop:** Ragi enjoys tradition associated with Karnataka and has been grown in the state for ages. In Karnataka, farmers have been the key drivers in Ragi production and got huge expertise which has helped to produce more than ever before.
4. **High demand:** Ragi ranks as one of the primary crops in the State, and the food is primarily used in various traditional cuisines spread all over. A number of farmers have responded to Ragi demand by introducing it as a part of their agricultural activities.
5. **Government support:** The Karnataka government takes over several policies as well as schemes to artificially push Ragi cultivation in the state. This is achieved via the resolution of the fiscal burden on farmers if they need seeds, fertilizers, and other inputs, to mention a few as well as the utilization of Ragi for animal feed and other industrial objectives.

5. Special Focus on Assam

5.1 Millet Cultivation in Assam

Millet cultivation of Assam is more limited against large nutritious millet-growing states in India. On one hand, despite the increasing popularity of millet cultivation in Assam due to nutritional benefits, low water requirements and suitability to the region's agro-climatic conditions, there is a displacement of wildlife habitat and forest lands by agriculture to meet the growing food demands. The main millets which are grown in Assam are the finger millet, pearl millet and the foxtail millet *(Choudhary & Kumar, 2023)*. As Per the Ministry of Agriculture and Farmers Welfare- Government of India, the total millet production in Assam in the FY 2020-21 was just about 69,000 tonnes, which is a slight growth over last year's production, as charted by the GoI (Government of India).

Nagaon, Sonitpur and Dibrugarh and the three districts are the main millet producing districts in Assam. Millet formation is the appropriate name for this millet, which is most intensely cultivated in the state after bajra and nakshi millet *(Singh et al., 2016)*. Millet cultivation has gained significance in different states like Assam, but in the case of Assam the state has come forward to execute these initiatives. Thus, the Ministry establishes a Millet Mission for the cultivation of millets, training farmers to grow millet crops to enhance its productivity, and to improve the value-chain of millets.



Fig 5.1: Foxtail millet in Assam

As of now, millet production in Assam is low, and there are a lot of things left to do to make Assam one of the leading millet producing states in the future, with the help of right policies and support.

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District wise Area, Average Yield and Production of SMALL MILLETS in Assam, for the year 2022-23

Table 5.1: District wise millet production

Sl No	District Name	**OTHER CEREALS AND SMALL MILLETS**		
		Area	Average yield	Production
1	Baksa	245	1108	271
2	Barpeta	526	623	328
3	Biswanath	322	690	222
4	Bongaigaon	825	471	389
5	Cachar	65	780	51
6	Charaideo	0	0	0
7	Chirang	327	1048	342
8	Darrang	83	682	57
9	Dhemaji	33	422	14
10	Dhubri	345	928	320
11	Dibrugarh	0	0	0
12	Dima Hasao	0	0	0
13	Goalpara	187	690	129
14	Golaghat	69	502	35
15	Hailakandi	2	500	1
16	Hojai	20	1190	24
17	Jorhat	151	500	76
18	Karbi Anglong	160	844	135
19	Kamrup (M)	19	600	11
20	Kamrup (R)	246	775	191
21	Karimganj	9	500	5
22	Kokrajhar	192	1136	218
23	Lakhimpur	58	422	24
24	Majuli	20	1450	29
25	Morigaon	609	1200	731
26	Nagaon	492	650	320
27	Nalbari	31	625	19
28	Sibsagar	10	620	6
29	Sonitpur	150	690	104
30	South Salmara - Mancachar	140	900	126
31	Tinsukia	261	645	169
32	Udalguri	194	834	162
33	West Karbi Anglong	94	852	80
ASSAM		**5885**	**779**	**4589**

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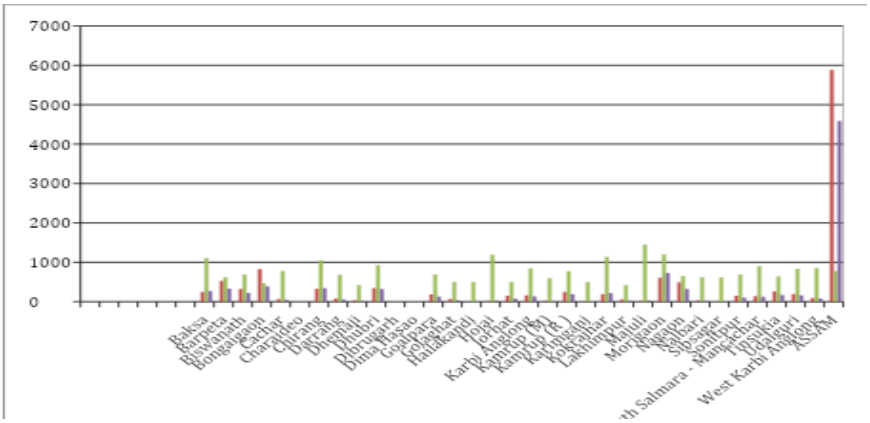

Fig 5.2 graph of district wise millet production

5.2 Factors Affecting Millet Production

1. Climatic and Soil Conditions

The area has a kind of climate that is on the borderline between the cold and hot places. It does not have much temperature fluctuation. There is also high humidity and substantial rainfall that make both finger millet (ragi) and little millet to grow favourably *(Kumre, 2024)*. These varieties, being drought tolerant and their tolerance to poorer soil resources that are present in some of the parts of Assam, thus, make them perfect for areas where rice cultivation is a tough job.

The Brahmaputra Valley is fertile and arable. This contributes to the bulk of economic activities in the state. Nevertheless, millets are typically planted in harder and generally hilly or flatland regions, among which the soil is less fertile. These soils can be acidic and deficient in the mineral nutrients necessary for crop development. However, millet is a deseed crop, which means it does well even in such conditions. Millets' environmental friendliness is their using fewer fertilizers on degraded soils makes them very suitable for using on Assam's less arable land.

2. Agricultural Practices

In Assam the common farm methods include slash and burn production (Jhum cultivation) that is mostly adopted by the tribal communities in hill districts. This approach encompasses the remaining of an insignificant portion of land, and then subsequently, it is burnt as a way of making the nearby land fertile for planting crow millets. The enrichment may occur in the soil during the first stage of the process, but without the sustainable agricultural practices and after constant rainfall for irrigation, a drop in yield is likely to occur in the future.

Over the last few years, there was a movement seeking to introduce quality farming methods incorporating to the list the varieties of good seeds, proper use of fertilizers and small-scale irrigation projects to help millet production *(Bora, 2023)*. Through the progress from subsistence farming to a profit-making venture, the buzzing of these modern farming practices is increasingly making millet cultivation an attractive exercise both in terms of quantity and quality.

3. Socio-Economic Factors

The socioeconomic variables that influence the millets production in Assam are both widespread and complex. In terms of economic viability, the millets do not hold water against the tea and rubber that are the backbone of the agricultural industry of the region. The farmhouse often makes farmers identify millet crops on the grounds of poor financial return in most cases. Millets are also more affordable in that they require less input costs, while rice is a high-demand crop which attracts resource-reliant farmers.

Millets is a socially significant crop for several local communities, who incorporate this item as a staple in their daily foods and festive celebrations. Such close ties to the land keep alive the growth of millet in some countries in spite of the fact that the

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profitability is lower. Apart from this, gradually the realization that millets are super foods laden with all nutrition is changing the consumption pattern of consumers not only locally but also nationally. The country is now getting on its way to cash in this trend *(Dekaraja & Borah, 2024)*.

However, the state government as a lead actor in the generation of the socio-economic backdrop of millet production is of utmost importance. Efforts such as Millet Mission that try to breathe life into production of millets by giving farmers additional benefits like subsidies, tech support and market access are examples of such initiatives. The programs are put in place to solve the problems of hunger, hunger, and malnutrition, thus actuating the choice by farmers to raise the maize.

5.3 Problems of millet production to farmers

This is where the gap comes in when the government programs are not reaching out to the farmers. At some occasions they are even able to sell on the market if they grow too much. For bulk sale we have to go shop to shop where farmers sell their fruit and then gather big quantities on a cart to sell at the market stall. And so, the speed is so slow that no-one ever had a chance to use that data before *(Dekaraja & Borah, 2024)*. Whichever govt comes into existence are targeting their programs mainly on the big cities, enlightening the farmers about the programs is not their concern. The prime factors constraining the expectations of millet planting are as follow:

1. The area devoted to millet farming has hit a low of 35millions hectares which–

a. Millet cultivated in a land area plummeted to the level of about 35 million hectares. However, in the last several years, the total land use has declined significantly as it is now grown at only 15 million hectares.

b. The culmination of factors that cause shift in land use includes low yields, the handling-over of the laborious and time-consuming processing of millets which served as women's responsibilities among others.

2. A **restricted productivity of Millets**– There has been a falls sorghum (jowar) production, stagnation in pearl millet (bajra) production and the rest of millets' production, which include finger millet (ragi), have stagnated or dropped during the last ten years.
3. **Limited Supply–** Though they are common in organic and farmer's markets, millets are not easily accessible at the traditional and online (e-commerce) markets, which makes them difficult to purchase.
4. **Rivalry between millet and rice or wheat-** Both millet and rice are staple food for India and widely available; hence, it becomes competition in the market due to the easy availability of them.
5. **Agriculture Challenges–** Generally speaking, the traditional farming of millets is largely synonymous with low yields and low profitability. There is a high chance that farmers would often abandon growing them. An increase in yield which ultimately results in more produce for consumers wants breeding for drought tolerance, the main problem in all millet environments. This is difficult again because it is a hard thing to accurately stimulate these drought conditions.

Environmental deterioration has been roughly with most kinds of crops, particularly with millet *(Verma & Agarwal, 2023)*. This happened in the worst cases. The multiplicity of the problems associated with millet cultivation both in expansion and marketing is inherent in its very significance. Firstly, labour requirements in finger millet come out to be higher than the major cereals viz rice, maize etc, particularly for the stages of transplanting, weeding, harvesting, threshing and grinding *(Dhedhi et al., 2016)*. This will therefore greatly increase the burden on the shoulders of the farmer, most especially the women since they will be involved from the time of planting and the entire process of cultivation.

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6. Comparative Analysis: Millet Production Practices in Assam vs. Other Major Producing States

6.1 Comparison of Millet Production Practices

Millet's production practices of Assam state are much more different from those practices that are commonly followed in three top millet producing states of India like Rajasthan, Maharashtra and Karnataka *(Kargwal et al., 2023)*. These are the areas of the country where the cultivation efficiency of millet is greatest, encouraging the generation of drought resistant millet varieties such as pearl millet (bajra) and sorghum (jowar) that naturally flourish in these arid and semi-arid environments *(Karthikeyan & Gayathri, 2024)*. Such states developed systems for assistance included advanced agricultural stores, protection of millet farms by the government, and complex market infrastructures that allow large scale production and marketing.

On the contrary, the milk production stage in Assam has remained in the initial developing phase. The region's humid and tropical climate resulted in a new set of challenges and opportunities for millet cultivation, majority good for finger millet cultivation (ragi). Millet crop production in Assam in the whole is characterized by traditional procedures, ownership of small farms, and low amount of connection with market demand in trade.

6.2 Lessons Learned and Best Practices

From the successful millet production models in states like Karnataka, several lessons can be drawn and adapted to the Assamese context:

- **Seed Development and Distribution:** Mimicking Karnataka state in that its cultivation of millet that results in higher yields with pest resistance and in easy access of supply to farmers can be reflected in Assam to have a better crop yield.
- **Training and Capacity Building:** Through conducting all-inclusive farmer training on modern farm practices coupled with sustainable practices like those practiced in the state of Rajasthan, millet production and sustainability increases in the state of Assam.
- **Market Integration:** The millet production and marketing model of Maharashtra, for making it profitable and increasing the attractiveness of millets, as a health food, if transferred, adopted in Assam, will yield good results.
- **Government Policies and Incentives:** Ensued by the adaptation and implementation of policy design in those states, Assam will stand to benefit from government's-built initiatives and incentive measures that are adapted specifically to the cultivation of millet that are unique and particular to the region's climatic and cultural landscape *(EI-Hosary et al., 2004)*.

7. Economic Analysis: Millet Production in Assam

7.1 Contribution to the Rural Economy

Millets have travelled many miles and witnessed a diverse makeover of weather patterns getting exposed with its widespread cultivation in Assam. Whether through rice farming or tea plantation, millet plays a significant role in the economy of rural Assam, predominantly in the fringe and vulnerable region. Sometimes millets are cultivated by small, marginal farmers who make their living by selling the millet crop. While subsistence farming is practiced, millets have an edge over others in the low costs of production compared to other bigger farmers' crops, as well as they are adapted to less fertile lands providing a more sustainable option for food security. Moreover, the importance of millets is being realized more than ever for their nutritious value as a solution for the malnutrition in the villages.

7.2 Market Dynamics and Value Chain Analysis

The market-player scene for millet in Assam is slowly being reshaped. As a long-time practice, millets (Assam's main food source) have limited contacts with and consumed within the local markets and the surrounding communities of its growers. Meanwhile, people who have recently learned about the millet's advantages are consuming more and more of these grains, therefore, this phenomenon creates the urban market for such products

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(Chaturvedi et al., 2022). Though millets in Assam may have a valuable chain, it miserably lacks necessary developments. Capacity issues consist of low processing machines, insufficient warehouse space, and fair-trade difficulty, all of which obstruct the flow of local food into the broader market. Improvement of these links of value chain could strongly as if millet production is a concern for profit purpose.

7.3 Impact of National and International Markets

Millet is a commodity that is being more widely marketed nationally and internationally as people are now interested in purchasing healthy and sustainable food items *(Dhedhi et al., 2016)*. This creates a big chance for Assam to tap into these markets, but this is portable to its cities at the increase in the quality of the product, branding, and marketing *(Verma & Agarwal, 2023)*. The interest of foreigners in traditional Indian millets can be translated into local producers, on the other hand, giving them opportunity to expand their business activities and to improve growing methods *(Goyal & Yadav, 2023)*. Along with this, the policies of the government including the promotion of millet as a super food in various agriculture and export promotion plans can create a milieu in which the farmers can devote importance to these markets.

8. Conclusion and Recommendations

The research done in India for the production of millet shows concern centrality for Assam, this crop, on one hand, is a moving transformational process that helps people to consume food securely with a diversified nutritional benefit. 'Millet with its capability of withstanding harder growing conditions and little need of inputs are good candidate crops for conditions in Assam which are challenging to grow.' As Rajasthan, Maharashtra or Karnataka showed-off the efficiency of advanced agricultural practices on millet production, and also put in place supportive policy frameworks, the state of Assam can learn a lot from their examples.

In Assam, although millet cultivation occupied a negligible portion in agriculture, it holds a considerable prospect for development and improvement. In general, the implementation of high yielding crop varieties, relevant use of agricultural commodities, and innovative farming methods including crop rotation and organic matter supply are crucial for yield enhancement. Millets industry′s to seize share of local and national market becomes a struggle confronting inadequacy of processing and storage facilities and a limited knowledge of the product.

To enhance millet production in Assam and across India, several strategic measures are recommended:

- **Policy Support and Incentives:** Getting the policies with payment directly to millet farmers through support of subsidies, support guaranteed prices, and incentives for using green practices.
- **Research and Development:** Injecting money in agricultural research so as to get high yielding pest resistant millet varieties which are matched best to the different climates but can particularly cater to the unique conditions of Assam *(Karthikeyan & Gayathri, 2024)*.
- **Infrastructure Development:** The determination of strong infrastructures for processing and storing to overcome the post-harvest losses in addition to improving and efficiencies of the markets *(Kargwal et al., 2023)*.
- **Market Development:** Through a perception campaign that focuses on the advantage of millets, drawing consumers closer into the market that is both national and international, they should be included as part of the bigger picture.
- **Training and Capacity Building:** Installing workshops and training sessions for farmers to attend to teach them the good options and advanced farming techniques, making sure to actualize and make profits from millet farming using sustainable farming methods.
- Future research should focus on several key areas to further the understanding and development of millet cultivation:

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- **Climate Adaptation Strategies:** The possibility of investigating the coping of diverse millet species against the pressures of varied climatic stresses might indeed reveal suggestions concerning varieties to be planted and management measures to be adopted under the changing climatic conditions.
- **Nutritional Analysis:** Scientifically based results and comparison of the nutritional effects of millets to the traditional staples of rice and wheat can be a great method for their establishment as essential components of daily diet.
- **Socio-Economic Impact Studies:** Comprehensive assessments on socio-economic implications of growing millet could allow it to extend its impacts on the lives of the farmers and the local economy.
- **Value Chain Optimization:** Researches into improving the millet value chain starting from the farm to the market including technology and innovation that lead to bringing it closer to people and are profitable as well.

Through the application of appropriate policy measures and the efforts of all the stakeholders, the producers of millet in these parts of the country can in fact notice tremendous increases both in prominence of the millet industry within that region and in the nutritious content of the national diet. In India places like Assam, which stand to gain a lot from the introduction of this nutrient rich food crop.

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