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Millet Cultivation and Food Security in Tribal Region of Odisha, India: A Microlevel Analysis

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Abstract: As the world is facing challenges due to climate change and food insecurity, millet has proven its adaptivity to adverse agro-climates such as poor soil, minimal water, and significant weather variation. The present study attempts to assess the cultivation and consumption of millet in the tribal region. Hence, the tribally dominated Koraput district has been chosen as the study area. It is based on a primary survey of 150 millet cultivators. Although finger millet cultivation has been taken up by the farmers, it is mostly done for household consumption rather than sale at market. However, it is known that millet cultivation generates significant returns. Hence, farmers prefer to cultivate paddy instead of millet for commercial sales due to procurement and productivity issues, marketing problems. Furthermore, though millet along with rice is the staple food for a tribal household, rice consumption is highest in the food basket. This is prevalent as rice is being sold by the government at a very subsidised price. Hence, a proper strategy focussed on revamping millet cultivation and consumption would be beneficial in the fight against food insecurity and climate change, particularly in the tribal regions.

Key words: Climate, food security, millet, tribal.

Introduction

The world is challenged by declining food security in the context of climate change (Food and Agriculture Organization, 2011; Mancosu et al., 2015). Also, uncertain climate is further aggravating it, it has become a cause of concern for both developed and developing nations (Sultan et al., 2013). Climate change not only portends less rain and reduced water availability, it is also found to have a direct impact on crop yields i.e., food security is being threatened (Jena and Kalli, 2018). Changes in climatic conditions are affecting agriculture as well as creating climatic variations. Studies have shown that the agricultural sector is one of the prime contributors to the generation of greenhouse gases (Pathak et al., 2014; Smith et al., 2008). Although cereals crops such as wheat, rice, and maize have high emission rates, yet these crops are widely cultivated as a source of nutrition for millions of people (Smith et al., 2018). Furthermore, these crops require abundant water supply, suitable climatic conditions and soil quality (Wang et al., 2018). Thus, to adapt to climate change, we need crops that have greater resilience and do not require scarce natural resources. In this context, millet cropping is found to be adaptive to adverse agro-climates with the poorest soil, minimal water, and significant weather variation (Badyopadhyay et al., 2017). These crops adapt to climate-change and help fix carbon in the soils, thereby increasing the soil fertility (Ullah et al., 2017). They can be cultivated throughout the year and can surivive drought conditions and high temperatures. Furthermore, they are disease-resistant

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and do not need pesticides (Anderson and Gugerty, 2013). These crops are also more nutritious than other cereal crops (Gupta et al., 2017).

Though the millet crop is facing a critical situation, India is the biggest global producer of millets with 40 to 41% global market share (PRNewswire, 2019). In the last two decades, the importance of millet as food staples has declined. It is due to various factors including rising incomes, growing urbanisation, and government policies. It is unfortunate that after independence our agricultural policies always focussed on increasing the production of paddy and wheat as crops. Millet is indeed one of the oldest foods known to humans, but wheat and rice have always been considered as superior foods (Indian Institute of Millet Research, 2019). Ironically, before the Green Revolution in the 1960s, millets made up around 40% of all cultivated grains, as a result contributing more than wheat and rice. The production of rice has doubled and wheat tripled since then whereas millet production has declined (Sarkar, 2018). Realising its unique characteristics to cope up with climatic uncertainties as well as its capabilities of providing nutritional security, Central Government has initiated the promotion of millets on mission mode (NITI Aayog, 2020). As a result, these crops were included in the Public Distribution System in the National Food Security Act, 2013 and more recently recommended by NITI Aayog and the National Food Security Mission (George and Mckay, 2019).

Many states including Odisha have taken special initiatives to promote the production and consumption of millet. Government of Odisha in 2017 has launched Odisha Millets Mission, a special programme for the promotion of millets in tribal areas. Millet has been an integral part of tribal life for centuries which can be seen through their farming systems and agricultural operations (Behera, 2017; Patil et al., 2015). The millet crop has multiple utilisation such as medicinal purposes, strengthening of mud walls, and as fodder by the tribal communities (Sahu and Sharma, 2013). In Odisha, these crops have traditionally been cultivated and consumed by tribal communities mostly in the southern rainfed regions of the state (Mohanty, 2020). Odisha, one of the least developed states in India, has been placed in the category of the "severely food insecure" regions (Behera and Penthoi, 2017; Das and Sahu, 2016). Furthermore, this issue is more glaring in tribal regions (Food and Agriculture Organization, 2017).

Millet, once considered as coarse grains, are now nutri-cereals choices. Many states in India including Odisha are coming up with a more sustainable way of farming, which has renewed focus on millet. Apart from their climate resilience and comparatively low level of resource dependency, millet is also more nutritious than other major cereals—wheat, rice, and maize. Thus, the cultivation and consumption of millet crops can help to address the problem of food insecurity, especially in the tribal region. Since a micro-level analysis to understand this situation would be helpful to tackle the problem, as seen unreported in various studies, an attempt has been made in the present study to assess the cultivation and consumption of millet in the context of food security and climatic variations by the households in the tribal region of Odisha.

Materials and Methods

Study Area

Odisha, one of the major millet-producing states of India, also cultivates its varieties such as sorghum millet, finger millet and spiked millet. Finger millet enjoys a substantial and prominent position in terms of production, yield, and the area cultivated. Koraput district is the top finger millet producing district of Odisha, contributing 41% of Odisha's total finger millet output. Half of the total finger millet cultivated area is found to be in the Koraput district.

Within the Koraput district, finger millet accounts for 16% of the total gross cropped area and 28% of the total area under cereal crop cultivation (Pradhan et al., 2019). The major crops grown by the farmers in Koraput district are paddy followed by finger millets, pulses, maize, and other small millets (Adhikari, 2014). However, the district is experiencing climatic variation. Earlier, the district usually experienced 150 to 187 days of monsoon rain, with an average annual rainfall of 1655 mm. But over the last five years, the average number of rainy days has been reduced to 84 days and the annual rainfall is about 1567 mm (*ibid*). Further, the district is also experiencing recurrent disasters such as drought, flash flood and cyclones (Rahman, 2016). Additionally, the district is also one of the most tribal-dominated districts that comes under the KBK region of Odisha. This region is considered to be one of the most backward and poorest regions of our country struggling with the problem of food insecurity (Behera and Penthoi, 2017; Rahman, 2016).

Sampling Design

A multi-stage random sampling technique has been used in the present study. Pottangi block among 14 blocks district, has been randomly selected. Of which,

150 finger millet cultivators from 14 villages have been chosen by simple random sampling method in proportion to their total population. The sampling design is shown in Table 1.

Table 1: Sampling Design

Village	*No.*	*Percentage*
Kunduli	20	13%
Maliguda	30	20%
Deopattangi	16	11%
Maliput	12	8%
Jhankar guda	4	3%
Pakhajhola	7	5%
Sorisa padar	3	2%
Renga	7	5%
Mulasankar	5	3%
Pajel guda	10	7%
Marua	12	8%
Solapguda	10	7%
Tema	10	7%
Kharaji	4	3%
Total	**150**	**100%**

Source: Constructed by author

Data Sources and Methods

The study is based on both primary and secondary data. Primary data has been collected using a structured surveyed schedule from the finger millet cultivators during Feb-April, 2018. In addition to this, observation and group discussion with sarpanch, ward members and respondents of sample villages were also done to collect the information. The secondary data has been collected from different sources, such as Directorate of Agriculture and Food Production, Government of Odisha; Pottangi Block office; Reports of Odisha Millet Mission; Reports of research projects done by NGOs and individual researchers.

Data collected has been summarised and portrayed in statistical tables, graphs and charts. Besides, mathematical and statistical techniques such averages, percentages, *t*-test have also been used where appropriate for the analysis in order to achieve the objective of the present study.

Results and Discussion

Socio-Economic Profile of the Millet Cultivators

As mentioned above, the study is based on the data that have been collected from the 150 finger millet farmers across 14 villages in the Pottangi block of Koraput district of Odisha. Analysis of the socio-economic conditions of millet cultivators in this area will elucidate patterns related to gender, educational status, housing conditions, and income level, all of which is discussed below.

In the study area, 93% of the sample millet cultivators are males whereas only 7% are female, which indicates that labour distribution in rural agricultural activities in the study area is gender-specific. Education plays a very important role in the process by which region's residents learn new skills, new technology, and new ideas. It improves the social and economic condition of the people, creating novel forms of empowerment. But in the study area, 77% of sample farmers are illiterate, 16% have done primary education and only 7% have secondary education. Housing conditions indicate general socio-economic conditions and the overall standard of living. A total of 38% of finger millet farmers live in mud houses, 43% in mixed houses and 19% in concrete houses. Electricity is common to all sample households. This has been due to the implementation of Biju Gram Jyoti Yojana by the Government of Odisha where all respondents have been granted access to electricity. In the study area, primary sources of income for people are agriculture, daily labour, and small business (vendor). Some households also earn income from fishing, animal husbandry, and weaving as secondary sources of income. Among them, majority cultivators (51%) earn within the income level of Rs.5000-Rs.10000 monthly. Only 3% of the finger millet cultivators earns more than Rs.15000 per month.

Economic Analysis of Cultivation of Finger Millet

Koraput district is characterised by a warm and humid climate, 80% of the total annual rainfall is received from the south-west monsoon in the months from June to mid-October. The annual average rainfall varies between 1320 and 1520 mm. The mean daily maximum temperature is around 40°C while the mean daily minimum temperature is around 14°C. Major soil type found in the area is matured red lateritic soil, mixed grey soil and unaltered soils with coarse parent materials. The prevailing soil texture in the area is mostly sandy loam (Pradhan et al., 2019). So farmers mainly cultivate during kharif season via a crop rotation pattern. Mainly, the traditional procedures are used to cultivate finger millet. The study finds that 92% of finger millet cultivators are marginal farmers (less than one ha), whereas only 8% are small farmers (1-2 ha). Canal irrigation provided by the government is used

by cultivators for watering their crops. Along with the hired labours, family members are also involved in agricultural activities. Mostly seeds stored from the previous cultivation are used for the cultivation. Inputs of modern technology, chemical fertiliser, pesticides, and herbicides were not found in the study area for finger millet cultivation. Even the soil nutrients management is processed naturally using organic ways. Thus, cultivation cost mainly includes labour cost. Additionally, transportation costs are borne by those farmers who sell their output in the market.

In order to calculate the profitability, cost-return analysis has been used in the current study. Various studies have shown millet cultivation to be profitable (Mukhtar, 2017; Ravi et al., 2018). Now, in order to examine this in our study area, Table 2 gives details about the average cost of production and output of the finger millet.

Table 2: Production and cost details of finger millet in sample area

Average size of land holding	*49 decimal*
Average Output	372 Kg
Input cost	Rs.1947
Value of output	Rs.9285
Return	Rs.7338

Source: Compiled by author

The average return earned by the farmers selling finger millet in the market at the rate of Rs.25 per kg at market price (as on April 2018) is Rs.38238/- per hectare (Figure 1). Furthermore, in order to find out whether the difference between return and cost is significant or not, a *t*-test was applied and results presented in Table 3. The result shows a significant difference between the return to be earned from millets and their cost of production. Thus, we can say that finger millet is economical as well as profitable in the study area.

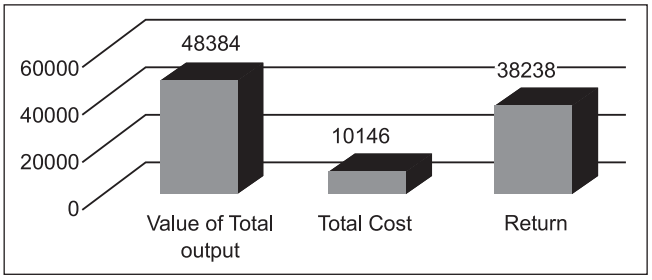

Figure 1: Cost and return per hectare from finger millet cultivation (in Rs.).
Source: Compiled by author from field survey, 2018.

Basically, food crops are grown either for home consumption or selling in the market. In this study, it has been found that most of the cultivators (63%) grow millet for home consumption. Rest cultivators (37%) grow finger millet for self-consumption and market sale. Thus, millet cultivation in the study area has been taken up for consumption purposes rather than for business purposes.

Thus, raising a question: why only few proportions of farmers are cultivating millet for selling purpose and majority are cultivating for household consumption? It was revealed from focussed group discussion with villagers that farmers prefer to cultivate paddy rather than millet. Reasons are as follows: first, the productivity of paddy is higher than millet. While paddy yield is 25-28 quintal per hectare, it is 15-18 quintal per hectare in the case of millet with irrigation facilities. Second, villagers have revealed procurement issues such as low procurement, lack of infrastructure at procurement centres, very poor marketing facilities. Similar problems were revealed in a study Nayak et al. (2019) and supported by Mishra (2019). Finally, they have highlighted that they are producing paddy because there is a demand for these crops in the market has an organised supply chain system whereas it is lacking in the case of millets.

Table 3: Result of *t*-test

Variable	*Paiews Differences*					*t*	*dt*	*Sig. (2-tailed)*
	Mean	*Std. Deviation*	*Std. Error Mean*	*95% Confidence Inbterval of the Difference*				
				Lower	*Upper*			
Return - Cost	7553.33	8863.36	723.69	6123.31	8983.36	10.437	149	0.000*

Source: Compiled by author
Note: *implies value significant at 1% level of significance

Economic Analysis of Consumption of Finger Millet

A high level of food insecurity can be evident in the form of higher mortality and under-nutrition. Koraput district also is characterised by poor nutrient intake and higher infant mortality ratio. Rahman (2016) has shown that average per-capita consumption of calorie, protein and fat is lower in the KBK region of Odisha as compared to the non-KBK districts. Besides being based on food security parameters i.e., food availability, access and absorption, Koraput is considered to be one of the food insecure districts (Das and Sahu, 2016).

Finger millet can help to overcome the problem of malnutrition and food and nutritional insecurity (Pradhan et al., 2019; Saxena, 2018). A comparison of the nutritional composition of cereal i.e. rice and finger millet is shown in Table 4.

Finger millet was the most important staple food of the tribal in Koraput district (Mukherjee et al., 2018) but the consumption of rice has increased in last 10 to 15 years. Finger millet consumption is the second highest consumed food item after rice, constituting 16% of total food consumption (Figure 2). This is because the old generation still is fond of traditional varieties of millet. On an average, 18 kilograms of millet is consumed every month by a tribal household.

It was revealed from focussed group discussion that though millet is still the staple food but households are preferring rice as they get it at a very lower subsidised rate from Public Distribution System (PDS), which is also tastier. However, huge consumption of rice might result in decline in nutrient intake and may adversely affect the food and nutritional security.

Conclusion and Policy Suggestion

In summary, the study found that though finger millet cultivation has been taken up based on the traditional methods, it is mostly produced for household consumption rather than selling at the market. This is despite the capability of millet cultivation generating good returns. Farmers prefer to cultivate paddy instead of millet for commercial purposes because of procurement and productivity issues, marketing problems. Furthermore, though rice and millet both are staple foods for a tribal household, rice consumption tops the food consumption basket as it is available at a very subsidised price from the government.

Since finger millet is capable to confront both food insecurity and climate change, its production and consumption should be promoted. To encourage production, various incentives and institutional support

Table 4: Comparison of nutritional composition of finger millet with rice

	Protein (g)	*Fat (g)*	*Minerals (g)*	*Crude fibre (g)*	*Carbohydrates (g)*	*Energy (Kcal)*	*calcium (mg)*	*Phosphorus (mg)*	*Iron (mg)*
Finger Millets	7.3	1.3	2.7	3.6	72	328	344	283	3.9
Rice (Par boiled, milled)	6.4	0.4	0.7	0.2	79	340	9	143	1
Rice (Raw, milled)	6.8	0.5	0.6	0.2	78.2	345	10	160	0.7

Source: Pradhan et al. (2019)
Note: All values are per 100 g of edible portion.

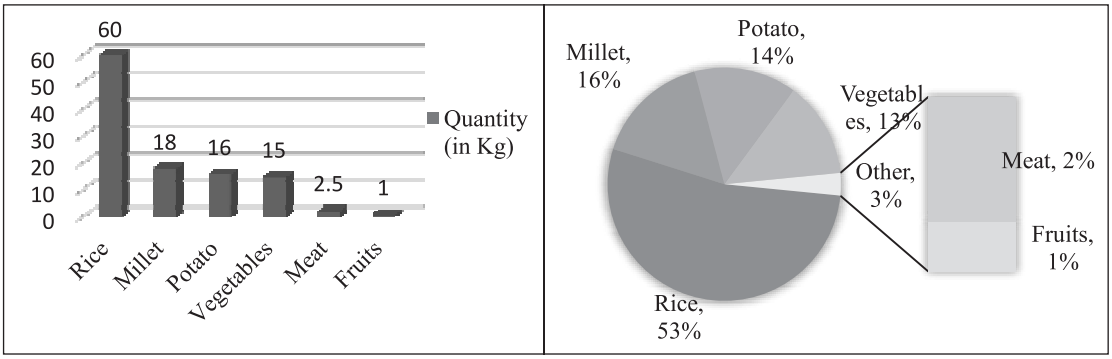

Figure 2: Average monthly consumption of various foods and their percentage to their total food consumption.
***Source*: Compiled by author from field survey, 2018.**

like provision of infrastructural facilities at procurement centres, developing proper marketing channels, an improved method of cultivation to increase productivity should be provided. Furthermore, considering its nutritional benefits, concerted efforts should be taken by the local government to promote it as a staple food preferable to major cereals such as rice and wheat. Although it is difficult to get people to change their diets, the scene for millets might be changing for the better. To encourage people to consume millets, value addition of millets can be taken up in form of snacks, millet-based dishes. Thus, a proper strategy focussed on revamping millet cultivation and consumption would be beneficial in the fight against food insecurity and climate change, particularly in the tribal regions.

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