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Food security and climate change: Role of small millets with special reference to Uttarakhand

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Abstract

Small millets are climate resilient crops that can grow in drought conditions. Climate change is adversely affecting food security with direct effect on food availability and indirect effects on other dimensions of food security namely, food accessibility, food affordability and food utilization in Uttarakhand. Given the situation, small millets having various health benefits and high nutritional quality can help to ensure food and nutritional security. In this study, dynamics of area under small millets in Uttarakhand has been examined and role of small millets in climate change adaptation and food and nutritional security has been reviewed. Comparing the years 2011-12 and 2019-20, it was found that the area under small millets has declined in all the districts in Uttarakhand except Rudrapur.

Keywords: Food security, small millets, climate change, nutritional security, hilly state

1. Introduction

Millets are small grained cereals. On the basis of grain size, millets have been classified as major millets and minor millets. Minor millets are also known as small millets. The major millets include sorghum and pearl millet while small millets include finger millet, barnyard millet, foxtail millet, proso millet, kodo millet and little millet. Minor millets are a group of small seeded cereal crops ^[1]. Millets have short growing season and grow well under marginal conditions of soil fertility and moisture. They are also well adapted to perform under various agro-climatic conditions.

Unlike cereals such as wheat, rice or maize, millets are capable of growing under drought conditions or non-irrigated conditions even in very low rainfall regimes and have a low water footprint. Millets can address some of the biggest global challenges together-nutrition and health needs, poverty of smallholder and marginalized farmers in the dry zones, mitigation and adaptation to climate change-some of the toughest areas that will take longer to reach the sustainable development goals. Owing to the nutritional value and climate-resilience of small millets, the year 2023 has been declared as International Year of Millets by FAO. A vast literature is available on potential of small millets, their production and underutilization. In this backdrop, the literature has been reviewed and dynamics of area under small millets in Uttarakhand has been examined in this study.

1.1 Role of small millets in nutrition and health

Millets are playing a secondary role in agriculture as compared to cereal grains like wheat and rice ^[2]. However, as food, they are either nutritionally equivalent or superior to many cereals. In spite of good nutritive value, uses of millets are limited in India. The main reasons are low availability of processing technology and lack of availability of variety of products at commercial level.

Small millets are rich source of nutrients like protein. They contain high levels of methionine, cystine, and other vital amino acids, micronutrients like minerals (zinc, copper, iron, calcium) and B-complex vitamins viz., thiamine, folic acid, riboflavin and niacin. The range of protein, fat and carbohydrate contents of small millets has been reported to be between 8-12, 2-5 and 60-75 per cent, respectively. The dietary fibre content of small millets varies between 15-20 per cent. So, they have a major role to play in combating various lifestyle diseases. Compared to maize, the essential amino acid profiles of small millets protein are better. Also, the protein quality present in finger millet is better because of the presence of sulphur containing amino acids. Both small millets and cereals are poor source of lysine but when they are combined with lysine rich pulses and legumes, the protein profile of both millets and pulses complement

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each other making them nutritionally rich [3]. Hence, nutritionally, small millets are richer compared to cereals. They are high in calcium e.g. finger millet has very high amount of calcium that varies between 300-350 mg/100g. Small millets contain lecithin also in high amount. Lecithin is considered good for imparting strength to the nervous system [4].

Small millets are also very good sources of phytochemicals having nutraceutical properties. Small millets are rich sources of dietary fibre, which is a non-nutrient content and possesses various therapeutic properties providing many health benefits like improvement in gut health, reduction in high glucose levels and blood cholesterol. There are lower incidences of diabetes in millet consuming populations [5]. This is because of low Glycemic Index (GI) of millets.

Small millets act like major detoxifying agents in the body and that is how they protect from various degenerative diseases [6]. The high dietary fibre content and antioxidants present in millet-based diets are good to cure cardiovascular diseases and diabetes, cancer and obesity. Besides, small millets are good for gluten sensitive or celiac disease patients. Small millets are non-acid forming foods and non-glutinous and therefore are easy to digest [7]. Small millets can also be used as staple food substitute for celiac patients as they require gluten-free cereal [8].

1.2 Role of small millets in food & nutritional security

Millets are highly nutritious. They share a set of characteristics that make them unique amongst the group of staple crops. The world population is increasing. There is also a need to ensure nutritious and balanced diet to all. Getting rid of hunger and malnutrition can be made possible through sustainable development.

Small millets are excellent examples of climate resilient C4 crops. They are temperature, drought and pest tolerant. They are capable to tolerate dry conditions. They can thrive in comparatively poor soils and they require only few external inputs. Therefore, they prove to be excellent substitutes to other refined cereals. They are quick growing crops which give crop yield in shorter period of time. Thus, they have the potential to meet the requirements of growing population faster and to mitigate food insecurity. Small millets also make a strong case for economic sense as they are used as dual-purpose crops i.e. used for food as well as fodder in the mixed farming systems.

The term nutritional security not only refers to access and availability to balanced diet at a cost that is affordable but also involves the provision of safe environment. In this aspect, millets contribute towards safe environment as well as balanced diet [9]. The programme of Nutritional Security through Intensive Millets Promotion (INSIMP) was initiated under Rashtriya Krishi Vikas Yojna by Government of India to uplift the level of millets in production and consumption. The main aim behind the initiative was to make millets affordable and easily accessible to people and to spread awareness regarding high nutritional value of millets and the benefits of millets to health. Thus, inclusion of millets in the diet on regular basis was encouraged. Pearl millet and finger millet were covered under Minimum Support Price (MSP) under this scheme. This scheme is now merged with National Food Security Mission (NFSM). Rainfed Area Development Project (RADP), National Mission on Sustainable Agriculture (NMSA) and National Food Security Act are few programmes implemented to promote utilization of millets for food and

nutritional security [10,11]. These underutilized crops with good nutritional properties are the best weapons to fight against malnutrition. These crops are capable of making India a nutritionally secure nation.

2. Materials and Methods

The study is based on secondary data obtained from published documents and reports of Government of Uttarakhand. Interpolation was done to fill the data gaps. Small millets are the major crops in 11 districts of Uttarakhand. Therefore, only those 11 districts were studied. The Compound Annual Growth Rate (CAGR) was calculated using the following log-lin model as given in Eq. (1):

$$Y_t = AB^t e^u \quad (1)$$

Where,

Y_t = Area under small millets

A is a constant

B = $1+r$, where r is Compound Annual Growth Rate

u is the error term

Cuddy Della Valle Instability index [12] is a modification of coefficient of variation. This is done to accommodate for trend present in the data. This measure is also superior over the scale dependent measures like standard deviation. The formula of Cuddy Della Valle index (CDVI) is as follows as given in Eq. (2):

$$CDVI = CV\sqrt{1 - R^{*2}} \quad (2)$$

Where CV is coefficient of variation (%) and R^{*2} is adjusted coefficient of determination. The ranges of CDVI [13] are as follows: Low instability (between 0 and 15), Medium instability (greater than 15 and less than 30) and High instability (greater than 30).

3. Results and Discussion

The main small millets grown in Uttarakhand are finger millet, barnyard millet, foxtail millet and proso millet. Table 1, 2 and 3 show area, production and yield respectively of small millets in districts of Uttarakhand. Comparing the years 2011-12 and 2019-20, the area under small millets has declined in all the districts except Rudraprayag. In Rudraprayag, area under small millets showed increase. The highest level of decline in area was registered in Pauri Garhwal. The production figures conform with the area trend. Yield of small millets showed increase in all the districts except in Nainital, Rudraprayag and Pithoragarh, where it showed a decrease.

Table 1: Area (ha) of small millets in districts of Uttarakhand

District	2011-12	2019-20	Change (%)
Almora	14870	12387	-16.70
Bageshwar	881	614	-30.31
Chamoli	5074	4914	-3.15
Champawat	1369	718	-47.55
Dehradun	1497	733	-51.04
Nainital	538	157	-70.82
Pauri Garhwal	15536	9003	-42.05
Pithoragarh	1250	1029	-17.68
Rudraprayag	2833	3135	10.66
Tehri Garhwal	16354	14165	-13.39
Uttarkashi	3741	3450	-7.78

Table 2: Production (tones) of small millets in districts of Uttarakhand

District	2011-12	2019-20	Change (%)
Almora	18366	13919	-24.21
Bageshwar	543	776	42.91
Chamoli	5061	6285	24.18
Champawat	1773	1059	-40.27
Dehradun	1330	823	-38.12
Nainital	696	178	-74.43
Pauri Garhwal	19438	12074	-37.88
Pithoragarh	1891	1516	-19.83
Rudraprayag	4382	4805	9.65
Tehri Garhwal	21691	22040	1.61
Uttarkashi	4693	4492	-4.28

Table 3: Yield (tones per hectare) of small millets in districts of Uttarakhand

District	2011-12	2019-20	Change (%)
Almora	1.235	1.124	-9.02
Bageshwar	0.616	1.264	105.05
Chamoli	0.997	1.279	28.23
Champawat	1.295	1.475	13.88
Dehradun	0.888	1.123	26.38
Nainital	1.294	1.134	-12.36
Pauri Garhwal	1.251	1.341	7.19
Pithoragarh	1.513	1.473	-2.61
Rudraprayag	1.547	1.533	-0.91
Tehri Garhwal	1.326	1.556	17.31
Uttarkashi	1.254	1.302	3.79

Table 4 and 5 show compound annual growth rate (CAGR) (%) and Cuddy Della Valle Index (CDVI) of instability for area under small millets in the districts of Uttarakhand for 2 periods viz. period-I (2000-01 to 2009-10) and period-II (2010-11 to 2019-20) respectively. It was observed that in Nainital, Almora, Champawat, Dehradun and Pauri Garhwal, CAGR of area was decreasing in both the periods. However, it decreased with a faster magnitude in period-II than in period-I. Bageshwar and Pithoragarh showed positive CAGR in period-I indicating increasing area whereas in period-II they showed negative CAGR indicating decreasing area. In Chamoli, Tehri Garhwal and Uttarkashi, CAGR declined at less negative rate in period-II as compared to period-I. In Rudraprayag, area under small millets increased in both the periods. However, it increased at faster rate in period-II than in period-I.

Table 4: Growth and instability of area under small millets in the districts of Uttarakhand in Period-I

District	CAGR (%)	CDVI
Almora	-1.72	17.37
Bageshwar	-0.81	5.25
Chamoli	5.24	28.99
Champawat	-1.22	7.27
Dehradun	-1.24	15.00
Nainital	-5.86	25.03
Pauri Garhwal	-1.31	5.97
Pithoragarh	2.15	8.77
Rudraprayag	0.62	3.71
Tehri Garhwal	-2.05	3.22
Uttarkashi	-3.54	5.83

Table 5: Growth and instability of area under small millets in the districts of Uttarakhand in Period-II

District	CAGR (%)	CDVI
Almora	-12.38	19.74
Bageshwar	-2.29	5.43
Chamoli	-5.02	21.35
Champawat	-0.19	7.45
Dehradun	-4.36	18.48
Nainital	-8.24	12.15
Pauri Garhwal	-6.38	6.17
Pithoragarh	-4.67	20.52
Rudraprayag	2.16	7.77
Tehri Garhwal	-1.65	3.17
Uttarkashi	-0.62	9.96

Nainital, Bageshwar and Champawat showed medium instability in both the periods. Almora, Chamoli, Pauri Garhwal, Rudraprayag, Tehri Garhwal and Uttarkashi showed low instability in both the periods whereas Dehradun showed medium instability in period-I and low instability in period-II whereas Pithoragarh showed low instability in period-I and medium instability in period-II.

3.1 Ways to improve production and consumption of small millets

Owing to the various advantages, small millets are also termed as super foods. They face challenges at production and consumption level. The characteristic small size and hard outer surface increase the drudgery of the farmer especially women in the processing of small millets. Unavailability of machines designed especially for small millets processing forces the women to process small millets manually which is energy and time consuming. Poor availability of local market to sell their produce is also one of the reasons for having indifferent attitude towards cultivation of millets by the producers. At consumption level, absence of large variety or unavailability of small millet-based food products, high price of the limited small millet products available, ignorance considering millets as food for the poor and the animals, cheap availability of refined cereals such as rice and wheat through Public Distribution System (PDS) are some of the reasons leading to neglect of small millets at consumer level. Lack of a good number of government initiatives to prioritize small millets also leads to the development of negative perception by producers and consumers towards small millets. However, in recent past the seriousness of use of small millets and importance of small millets have been recognised by producers, consumers and policy makers. Promotion of sustainable agricultural practices like breeding strategies, plant population management, promotion of varietal improvement and mixed farming system, introduction of low-cost implement, availability of quality seeds, use of dehuller and improved harvester, development of local processing infrastructure, post-harvest infrastructure and market are being done which is helping in increase of production. Creating awareness among masses of India to consume the healthier small millet-based products, development of low-cost value-added products, improvement of the availability of small millet-based products in local market, promoting start-ups in agriculture that also includes small millets and making small millets part of welfare scheme related to attainment of

food security are few strategies and measures undertaken to promote the consumption of small millets. Beside these, government is also concentrating its efforts on strengthening of research institutes working in the fields of small millets improvisation^[10, 14].

4. Conclusions

Small millets are hardy crops requiring very little inputs and alleviating pressure on environment in comparison to other refined cereals. They are the climate resilient crops with shorter life span, providing yield in lesser time. In addition, small millets are superior in nutritional quality than their refined counterparts. Small millets are rich source of vitamins, protein, and minerals. They also contain appreciable amount of dietary fiber and phytochemicals which give them with therapeutic properties, and therefore they are rightly called nutraceuticals and super foods. However, it has been found that area under small millets in Uttarakhand has been declining. Only in Rudraprayag out of all the 13 districts of Uttarakhand, the compound annual growth rate of area under small millets was positive in both the periods, period-I (2000-01 to 2009-10) and period-II (2010-11 to 2019-20) with higher growth in period-II. Moreover, in Uttarakhand, adverse effects of climate change are being observed. Therefore, it is the need of the hour to promote production and consumption of small millets in Uttarakhand. Various measures are being adopted to remove the constraints in usage and cultivation of small millets, so as to combat nutritional and food insecurity. Start-ups in agriculture, including small millets are being encouraged. However, there is need to create awareness among masses regarding benefits of small millets, development of post-harvest technologies for small millets, increasing the availability of small millet-based products in local market, development of marketing facilities for small millets, assuring purchase of small millets at Minimum Support Price (MSP), development of low-cost value-added small millet products and including small millets in Public Distribution System (PDS).

5. References

1. NAAS (National Academy of Agricultural Sciences). Role of millets in nutritional security of India. Policy paper. 2013;66:16.
2. Weber SA, Fuller DQ. Millets and their role in early agriculture. *Pragdhara*. 2008;18:69-90.
3. Gopalan C, Ramshashtri BV, Balasubramaniam SC. Nutritive value of Indian Foods. Edn 2, National Institute of Nutrition, ICMR, Hyderabad, 1995, 156.
4. Nutritional and Health Benefits of Millets, 2022 May. https://millets.res.in/m_recipes/Nutritional_health_benefits_millets.pdf.
5. Saleh ASM, Zhang Q, Chen J, Shen Q. Millet grains: nutritional quality and potential health benefits. *Comprehensive Reviews in Food Science and Food Safety*. 2013;12:281-295.
6. Rao BR, Nagasampige MH, Ravikiran M. Evaluation of nutraceutical properties of selected small millets. *Journal of Pharmacy and Bioallied Sciences*. 2011;3:277-279.
7. Michaelraj PSJ, Shanmugam A. A study on millets-based cultivation and consumption in India. *International Journal of Marketing, Financial Services & Management Research*. 2013;2(4):49-58.
8. Shahidi F, Chandrasekara A. Millet grain phenolics and their role in disease risk reduction and health promotion: a review. *Journal of Functional Foods*. 2013;5(2):570-581.
9. Is Teff the New Super Grain? 2022 June. <https://en.wikipedia.org/wiki/Teff>.
10. Small Millets. Big potential: diverse, nutritious and climate-smart, 2022 June. https://www.dhan.org/smallmillets/docs/report/SSmal_millets_big_potential_diverse_nutritious_aan_climate_smart.pdf.
11. Anbukkani P, Balaji SJ, Nithyashree ML Production and consumption of minor millets in India-A structural break analysis. *Annals of Agricultural Research*. 2017;38(4):1-8.
12. Cuddy JDA, Della Valle PA. Measuring the instability in time series data. *Oxford Bulletin of Economics and Statistics*. 1978;40(1):79-85.
13. Sihmar R. Growth and Instability in Agricultural Production in Haryana: A District level Analysis. *International Journal of Scientific and Research Publications*. 2014;4(7):1-12.
14. Meena PC, Meena PC. Millets crop role in food and nutritional security in India. *International Journal of Food Science Nutrition*. 2018;3(6):216-218.