Exploiting Potentials of Neglected and Underutilized Crops for Food Security under Climate Change Scenarios in India

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Abstract
Climate change predictions warn complications in monsoon dynamics which will adversely affect the production and productivity of major staple crops such as wheat and rice. Neglected and under-utilized plant species are the plant species whose potential has not yet been exploited to the fullest extent. These crops could be the key to sustainable agriculture in most developing countries facing a resource crunch as well as rapid depletion of natural resources. India is one of the main producers of minor millets and other underutilized crops. The major group of crops includes small millets (finger millet, foxtail millet, barnyard millet, little millet and kodo millet) pseudo-cereals (grain amaranth, buckwheat). In hilly state Uttarakhand, improved varieties of finger millet, barnyard millet and grain amaranth along with improved packages of practices recorded 42% more yield compared to traditional practices. Similarly in Koli hills of Odisha, tribal areas in Tamil Nadu and different parts of Karnataka, different small millets have been successfully deployed as a viable alternative against erratic weather situations. Thus these crops can be well deployed in contingent planning for erratic weather situations, crop diversification, dual purpose crops for ensuring food and fodder supply and fighting against hidden hunger. This paper presents the current status, nutritional significance and impact of successful utilization of these underutilized crops under changing climate conditions to ensure nutritional and food security.

Keywords: NUS, climate change, small millets, pseudo-cereal
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Introduction

Neglected and under-utilized plant species are those plant species whose potential has not yet been exploited to the fullest extent (Bhag Mal, 2007). These crops could be the key to sustainable agriculture in most developing countries facing a resource crunch as well as rapid depletion of natural resources. Climate change and narrowing of genetic base of major cultivating crops and thus widening of this food basket is considered imminent and in this diversification process, there is an important role of underutilized crops/ species, contributing to food security, income generation and poverty reduction - meeting the Millennium Development Goals (MDGs). Small millets and pseudo-cereals are important group of underutilized food crops and grown from sea level to 10000 ft amsl in the country (Yadav et al 2010). In India six small millets viz. finger millets (*Eleusine coracana* L), foxtail millet (*Setaria italica*), little millet (*Panicum sumatrense*), proso millet (*Panicum miliaceum L*), barnyard millet (*Echinochloa frumentacea* and *E. utilis*), kodo millet (*Paspalum scrobiculatum L*) and two pseudo-cereals i.e. grain amaranths (*Amaranthus hypocondriacus*) and buckwheat (*Fagopyrum* spp). Small millets besides being an excellent food crops provides nutritious fodder for animals. These crops are very hard and grow well on marginal lands under low inputs conditions while adapted from sea level to 10000 m amsl. Pseudo-cereal are very important in view to provide unique nutritional attributes and developing contingent plan for erratic weather conditions.

Materials and Methods

Small millets and pseudo-cereals are cultivated in India since ages but the systematic research work on the crops started with the initiation of All India Coordinated Research Project on Small Millets (AICRPSM) in 1986 with 14 centres and 22 voluntary centres and All India Network Project on Underutilized Crops in 1989 with 11 centres spread across the country. Later significant contributions have been made through CGIAR institutes viz. Bioversity International and ICRISAT through augmentation and enrichment of germplasm and knowledge base of the crops. Besides different International and National funding agencies viz. IFAD, Bill and Melinda Gates Foundation, DBT, ICAR and DST also facilitated the generation and dissemination of improved technologies. Realising the importance of small millets under changing climate scenarios, Indian government has launched a national wide progamme known as Initiative for Nutritional Security through Intensive Millets Promotion (INSIMP) in 2011. This paper presents some salient achievement made through these progammes on the crops.

Results and Discussion

These crops are excellent source of nutrients, minerals and vitamins (Table 1). All small millets are excellent source of protein, calcium, iron, dietary fibres Grain amaranths with an excellent amino acid balance can supplement a diets deficient in lysine and those based on legumes (deficient in the sulphur amino acids). Wide genetic diversity for these crops have been reported in various crop growing areas of the country and many high yielding varieties have been developed. Improved varieties has played an vital role in the rekindling the interest of farmers and enhancing nutritional and economical security in different remote and tribal areas viz. Koli hills (Table 2), Uttarkhand hills (Table 3), Tamil Nadu and Karnataka (Padulosi *et al* 2009). These success needs to be replicated and disseminated in similar situations.

Table 1: Comparative nutritional composition of major small millets and pseudo-cereal with rice and wheat (value per 100 g)

Crop	Protein (%)	Fat (g)	Ash (g)	Crude fiber (g)	Carbo-hydrate (g)	Energy (kcal)	Ca (mg)	Fe (mg)	Thiamine (g)	Riboflavin (mg)	Niacin (mg)
Rice	7.9	2.7	1.3	1.0	76.0	362	33	1.8	0.41	0.04	1.6
Wheat	11.6	2.0	1.6	2.0	71.0	348	30	3.5	0.41	0.10	5.1
Small Millets											
Finger Millet	7.7	1.5	2.6	3.6	72.6	336	350	3.9	0.42	0.19	1.1
Foxtail Millet	11.2	4.0	3.3	6.7	63.2	351	31	2.8	0.59	0.11	3.2
Proso Millet	12.5	3.5	3.1	5.2	63.8	354	8	2.9	0.41	0.28	4.5
Little Millet	9.7	5.2	5.4	7.6	60.9	329	17	9.3	0.30	0.09	3.2
Barnyard Millet	11.0	3.9	4.5	13.6	55.0	300	22	18.6	0.33	0.10	4.2
Kodo Millet	9.8	3.6	3.3	5.2	66.6	353	35	1.7	0.15	0.09	2.0
Pseudo-cereals											
Grain amaranths	15.6	6.3	2.90	2.43	72,70	410	212	13.9	0.1	0.20	0.9
Buckwheat	12.0	2.4	2.93	10.3	72.90	355	114	13.2	0.10	0.42	7.02

Source: USDA National Nutrient data base

Table 2: Performance of some small millets in Koli hills of Odisha

Crop/variety	Days to flower	Grain yield (q/ha)	Dry Fodder yield (q/ha)	Type of variety
Finger millet				
GPU 49	64	12.25	48.75	Improved variety
IE 3023	87	7.63	29.68	ICRISAT line
Foxtail millet				
Senthinai	61	8.33	46.68	Land race
TNAU 173	61	9.07	44.58	Improved variety
Little millet				
KattavettiSamai	113	7.15	34.00	Land race
Sukshema	64	650	32.93	Improved variety

Modified from Padulosi et al (2009)

Table 3: Performance of improved barnyard millet variety (PRJ-1) in the hilly district of Uttarakhand

Year	No. of villages	No. of farmers	Grain yield Of PRJ 1 (q/ha)	% increase over farmers practice
District: Tehri Garhwal				
2003	10	22	22.6	101.8
2004	04	21	15.65	53.34
2005	06	26	16.27	57.30
2006	09	46	15.40	57.30
2007	12	95	15.92	66.70
2008	17	144	15.72	57.86
2009	07	41	14.77	57.77
District : Pauri Garhwal				
2005	12	30	20.20	122.00
2006	48	102	13.10	59.76
2007	35	100	17.95	80.22
2008	17	44	18.12	126.50

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