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Traditional Food System of Kumaon and its Role in Nutrition and Health

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Abstract—*Himalaya is an important area of food diversity due to availability of different climatic zone with high social and cultural traditions. Kumaon Himalaya has the wide base of genetic and crop varieties. It has the more than 150 plants which belong to more than 100 genera and 50 plant families. Kumaon Himalaya has large base of different agricultural biodiversity. Farmers are being cultivated so many traditional food crops which have important part in traditional food system of Kumaon. Ramdana (Amaranthus), Uggal (Buckwheat) are underutilized pseudocereals and their productivity is good under adverse climate condition. These would be potential to solve the malnutrition problem of the food insure regions. These traditional food crops are good source of nutrition and have the properties to treat many diseases in high hilly area. Farmers in the Kumaon reagion have enough information and skills regarding various food crops and wild edibles plants. This study has been focused on these super foods and discussed theirs nutritional and health implication on human body and presented the role in sustainable traditional food system in the age of global climate change. The study was conducted both on the primary and secondary databases. 'Field survey' and discussion of 'oriented groups' have been done for the primary data.*

1. INTRODUCTION

Traditional food system is important part of traditional knowledge. "Traditional food system" contains all foods that come from local natural resources and are culturally accepted within a culture. Additionally, sociocultural definitions, methods of acquisition processing, composition and nutritional implications for the people who use the food are also the main part. "Indigenous people" attribute to a cultural group within an ecological region that has established a strong subsistence base from the available natural resources. Whereas, "indigenous peoples" refers to peoples belongs to different cultural groups. Food system linked with indigenous knowledge of traditional foods and extend to beliefs and prosperity of Indigenous people [1]

Nutrition based traditional information is base for traditional food system and it helps to create healthy community. Traditional food and crops are also contributing to diversified diet, which is directly related to consumption of nutritious food. Some country like Vietnam (43 per cent), Japan (40 per cent) and China (75 per cent) has the very high consumption of traditional and wild plants [2]. Consumption of wild and tradition food increases only, when staple food storage decreases [3]. Around 1 billion population of world, depend on wild and traditional plants for food. India has good amount of wild and tradition food plants [4]. It has been seen mostly in developing countries, billions of people consumed traditional wild edible plants as food because these are affordable and wildly grown [5]. Especially rural and poor communities' area is the biggest consumer of local edible plants [6]. Wild edible plants are referred as emergency food supply for the local because these are good food during different disaster like drought and famine. In many developing countries, people who have good purchasing power, demand non-indigenous and exotic food crops. In market pressure, mostly famers must cultivate according demand [7]. These expensive and exotic food crops need certified seed, fertilizers, and pesticides. But in age of climate change and pressure of large population on food crops, world need an alternative food crops, which should have the potential to fulfill demand of healthy nutrition along with should have the capacity to tolerant the climatic variability in coming future [8]

Kumaon region has been developed one of unique systems, this region is rich in indigenous traditional knowledge. In this region total 160 plant species which classified into 117 genera and comes under 57 different families have been identified. Different landraces, varieties and wild plants are being cultivated at a large number. With different types of altitude, topography, climate (alpine to subtropical), watersheds valleys, soil types, rivers and forest resources, Kumaon region is appropriate for the growth of these traditional food plants [9]. The area under traditional crops is decreasing but these crops have their socio-economic and religious importance which makes them still in use and practices in rural area of Kumaon.

Amaranthus (*Ramdana/Chaulai*) and buckwheat (*Uggal*) are two pseudocereals of Kumaon region which are important part of traditional food system of Kumaon. These pseudocereals

are highly nutritious and have the potential to decrease the adverse impact of climate change.

2. RESEARCH AND METHODOLOGY

To analyze traditional food system of Kumaon region, primary data have been collected from villages. These villages are situated in different altitudinal zones (Figure 1). Information regarding traditional food, production and consumption of different verities of food, has been collected. Structure interview and group discussion have been used to gather the information from the study area.

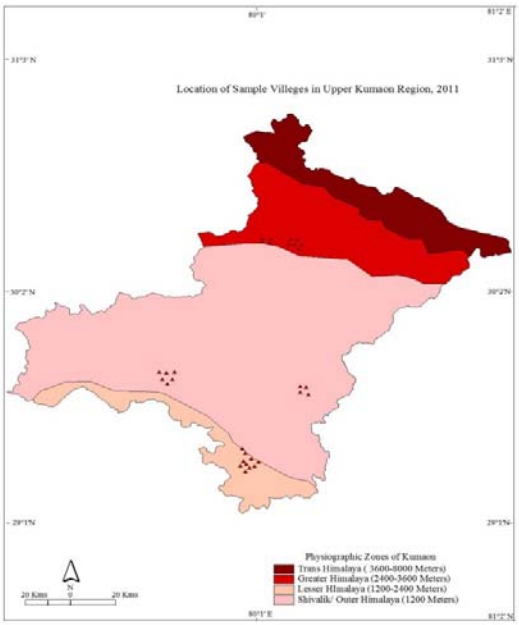


Figure 1: Study Area

3. RESULT AND FINDINGS

Pseudocereals are the one type of food grains but these are not belonging to grass family, as cereals belongs but both cereals and pseudocereal are consumed for the starchy food. Pseudocereals are not comes under grasses or true cereal grains. Pseudocereals are usually have high protein content and gluten free nature and considered as whole grains. A large number of 'ancient grains' are pseudocerels. A group of food grains, which are not cereals but consumed as cereals and generally referred as pseudocereals. Buckwheat and Amaranth are two majorly used pseudocereals of Kumaon, but their production is very low because high production demand of true cereals (wheat and rice) and change in food habits

3.1 Amaranthus/*Chaulai:* Amaranthus is highly nutritious, gluten-free, high in protein, iron, and fibrous. Collectively known as amaranths, belongs to family *Amaranthaceae*. The genus amaranth is mainly comprised of about 400 species in which nearly 60 species are presently identified [10]. All part can be eaten (seeds, leaves and soft straws). This globally distributed genus also contains several weedy species. Several species like *A. edulis*, *A. caudatus* (L.) and *A. cruentus hypochondriacus* (L.) are cultivated mainly for grain purposes.

Like other grains, this pseudocereal is rich in protein containing twice as many essential amino acids as wheat grain protein. Amaranthus is a rich source of essential amino acids, i.e. valine, phenylalanine leucine, isoleucine, arginine, lysine, tryptophan, etc. It can be used in celiac diseases because of its gluten free nature. Leaves and seeds of Amaranth are rich source of vitamin A, B_6 and C, carotenoids, riboflavin, and folate. Different minerals found in Amaranthus viz. Ca, K, Fe, Co, Mg, and Zn [11, 12]. Quantity of minerals in amaranthus are twice high in compared to cereals [13].

Amaranths as a food have medicinal properties also and can be used for pregnant women, children, lactating mothers, and can help in cure of constipation, haemorrhage, and anaemia. It may also help to boost immunity among HIV patients [14]. It is a great source of bio-available iron and protein, up to 57 ppm vitamin A, [15]. Amaranthus can play an important role in bio-fortification process [16]. Two anti-nutritional compounds found in amaranth namely oxalates and nitrates, which inhibit the absorption of calcium and zinc which latterly can causes kidney stones. But these anti-nutritional compounds removed by boiling of seeds or leaves for five minutes before use [17]. The red pigment part of amaranthus is used as a coloring agent in food and pharma [18].

3.2 Buckwheat (*Uggal*) is very old traditional and staple crop which is in underutilized food crop among local of Himalayan communities. Buckwheat name was come from Anglo-Saxon word *Boc (means small beech nut)* and *wheat (wheat).* It is recognized as ancient dicotyledonous crop, which belongs to the Polygonaceae family [19]. It is so important crop in food and nutritional security in Himalayan region of India; although it comes underutilized crops list [20]. There are 20 types of species in the genus of buckwheat but two species (Fagopyrum Tataricum/ Tartary buckwheat and Fagopyrum esculentum/ common buckwheat) are commonly cultivated in India. Buckwheat is known by different names in Himalayan states like *Kuttu, oggal and Phapher.*

Buckwheat has high demand as food, pharmaceutical and cosmetic industries because it has high biological, physiological, antioxidant, anti-inflammation and anti-hypertension properties [21]. This plant has diversified uses as food, medicine, raw material.

Protein value of buckwheat with essential amino acid lysine and 74 per cent of protein is absorbable for the human. It is great source of essential fatty acids [22]. Buckwheat is very good for the celiac patients because it is gluten free and it is highly rich in flavonoids, vitamin E and vitamin B. Rich in Vitamin B-Complex. It contains large amount of essential dietary mineral (zinc, phosphorus, copper, iron, manganese

and magnesium) [23]. It contains properties of phytosterols, fogopurins thiamins protein, flavonoids and flavones. It also contains choline, which helps to better functioning of liver. Buckwheat contains the flavonoid rutin which helps in vascular permeability and fragility, Oedema protection and hyalurnidase inhibition. Buckwheat has also medicinal uses. Buckwheat works as vascular-protector and reduces blood sugar. It is good food for radiation exposed patient and treat the gastric [24]. It has chemo-preventive property and reduces the mammary tumor and help full in treatment of Poly-Cystic Ovary Syndrome (PCOD) and insulin disorder including Type-2 diabetes and UV-B protection at high hilly region [25]. It is anti-fat-accumulator, anti-haemorrhagic, anti-hypertensive, antiflammatory [26] antioxidant components, antibacterial, anti-carcigenic, anti-viral, detoxifying enzymes and vasodilator activities. Buckwheat reduces the risk of gallstone formation and cholesterol level good for strong gum and teeth [27]. It can be used as main source of food industries (making of Soba noodles, baby foods, dumpling, biscuits, cake, breads and functional food) and used in honey production. The grains compose of several polyphenolic antioxidant compounds such as rutin, tannins, and catechin. Rutin (quercetin rutinoside) and catechin is found to have anti-inflammatory and antioxidant properties and help prevent platelet clot formation inside the blood vessels. Early laboratory studies suggest that rutin may offer a cure in hemorrhoids and clotting disorders.

3.3 Consumption of Traditional Pseudocereals in Kumaon

Amaranthus and Buckwheat is major pseudocereals of Kumaon region. These are super healthy food and come under the category of super food. Both crops are important part of socio-cultural life of high hilly region. These crops have some religious purposes also. Each part of Amaranthus can be use, but seeds, leaves and soft tender can be digested by human. Some sweet traditional dishes like *Kheer* (by seeds), *Laddoo* (by popping of seeds) and *Halwa* (by seeds), are inseparable part of culture.

Some spicy and salty traditional dishes are, *Sabji* (by fresh green leaves of Amaranthus), *Chapatis (*leaves*), Bhaat (*Seeds*)* and *Parathas* (leaves). These dishes are more frequently eaten in winter season. Amaranthus has iron so it is good for anemic person, pregnant and young ladies. People of village are using the outer layer of this seed to cure skin diseases. Some local beverages like *Jaan* also prepared by amaranthus.

Mainly seeds of Buckwheat are part of local diet. People make both sweet and spicy dishes from it. *Halwa* of uggaal, *Kheer, sweet Chilla* are some sweet dishes, whereas *pratahas,Puri, Kuttu ki Roti,* salty *Chilla* and soups are spicy traditional dishes of high hilly region (Table 1). People are usually eating buckwheat during fasting. In upper Pithoragarh and Bageshwar villages, this crop is being used in religious rituals also.

Table 1: Traditional Food with Cooking Techniques of Different Traditional Crops of Kumaon

Name of Traditional Crop	Method of cooking, Name of Dish, Taste of Dish,	Socio-Cultural Values	Season of Eating/ local use of cure a diseases
Amaranthus/ Chaulai	**Method**: Simmering /boiling, **Name of dish** :Kheer, **Taste**: Sweet,	Seeds of *Chaulai* are used for worship of god.	Outside layer of grains have been used to cure skin problems. Good for pregnant ladies
	Method: Poaching, **Name of dish**: *Bhaat* **Taste:** Salty		
	Method: Salute and poaching, **Name of dish** Halwa, **Taste:** Sweet,		
	Method: Salute, **Name of dish**: Laddoo **Taste:**Sweet,		
	Method: Gridding and Bake, **Name of dish**: *Chapaati*, **Taste:**Sweet or salty,		
	Method: Cutting the leaves and soft tender, Boiling **Name of dish** Sabji of Leaves of Amaranthus, **Taste:** Spicy,		
	Method: Fermentation, Local alcohol,		
Buckwheat / Uggal, Fafra	**Method**: Salute, Simmering and poaching, **Name of dish** Halwa, **Taste:** Sweet,	It is religious crop in upper region of Bageshwar and Pithoragarh	Grains and leaves can cure fever and abdominal pain.
	Method: Gridding and Bake, **Name of dish**: Chapaati/ Kutu ki Roti, **Taste:** Sweet and salty		
	Method: Gridding and Bake or Pan Fry **Name of dish**: Prathas, **Taste:** Salty,		
	Method: Fermentation, Local alcohol,		
	Method: Simmering, **Name of dish** Kheer, **Taste:** Sweet,		
	Method: Pan Fry, **Name of dish**: Chilla, **Taste:** Sweet, salty,		
	Method: Simmering, **Name of dish** Soup, **Taste:** Salty, spicy		

Source: Primary Survey, 2018-2019

3.4 Nutritional Density of Pseudocereals

Availability of protein in buckwheat seeds powder is significantly higher than rice, wheat, and maize. Per 100 grams of Buckwheat grain contains 14.8 grams of protein, 36 grams of fat, 8.3 grams of total carbohydrates and 8.3 grams of fiber. Whereas amaranthus has 13.56 grams of protein 65.25 grams of carbohydrates, 7.02 grams of total fat and 6.8 grams of dietary fiber in 100 grams serving of amaranthus seeds (Table 2).

Due to presence of numerous nutrients, these pseudocereals come under the category of super-food. Dietary fiber has the capability to manage insulin sensitivity. And both have a plentifully dietary fiber.

Table 2: Nutrition Densities of Pseudocereals (Unit/100 grams)

	Buckwheat [28]	**Amaranthus** [29]
Protein (g)	14.8±1.6	13.56
Carbohydrates (g)	79.6±2.8	65.25
Total Energy (KJ)	1739±4.6	371
Total Fat (g)	36±0.6	7.02
Dietary Fiber (g)	10.1±1.5	6.7

Note: Mean ± SD

These fibers are tremendously important for regulating blood sugar. Consumption of less fibrous food is leads to diabetes. Fiber controls the blood sugar and prevents from damage blood vessels and severe health difficulties related to uncontrolled diabetes like cardiovascular diseases, high blood pressure poor and blood circulation.

Besides, fiber is healthy for good bacteria or probiotics and these play a pivotal role in blood sugar control improvement of insulin response. Dietary minerals are essential part of human food. Different species have different quantity of mineral. But zinc, copper and manganese are found in good quantity. Buckwheat and amaranthus have good concentration of dietary minerals like magnesium (mg) copper (Cu) and. Magnesium (Mg) has the ability to heal the effects of headache and depression because it eases brain's blood vessels (Table 3).

Table 3: Essential Dietary Minerals in Pseudocereals

Essential Dietary Minerals (Unit/100grams)	**Buckwheat (mg/100 grams)[30]**	**Amaranthus (mg/100 grams) [12]**
Calcium (Ca)	110	283.14± 5.74
Zinc (Zn)	0.87	3.70 [8]
Iron (Fe)	4	29.35 ± 0.60
Copper (Cu)	0.95	1.25±0.03
Phosphorus (P)	330	55.59 ±1.13
Magnesium (Mg)	390	425.21± 8.62
Potassium (k)	584 [28]	770.15± 15.61

Note: (Mean ± SD)

Pseudocereals have Good quantity of minerals (magnesium, phosphorus, manganese); consumption of these crops, may decrease the risk of respiratory

Table 4: Vitamins in Pseudocereals (Unit/ 100 grams)

	Vitamin	**Buckwheat** [30]	**Amaranthus** [12]	**Wheat[30]**
Fat soluble vitamins * (Unit/100 grams)	A	0.0	2 IU	9 IU
	K	7.0 µg	0.0 µg	1.9 µg
	E	40 mg	1.19 mg	-
	D	440 mg	0.0 mg	31.2 mg
Water Soluble Vitamin* (Unit/100 grams)	C	0.0 mg [31]	4.2 mg	0.0 mg
	B1	3.30 mg	0.116 g	0.51 mg
	B2	10.60 mg	0.20 mg	0.11 mg
	B3	18.00 mg	0.923 mg	5.71 mg
	B5	11.0 mg	-	0.94 mg
	B6	1.5 mg	0.591 mg	0.34 mg
	B9	54 µg [31]	82 µg	43µg

* A: Retinol, C: Ascorbic acid, D: Choline/ Calciferol, E: Tocopherol, K: Phytomenadione B_1: Thiamine**;** B_2: Riboflavin; B_3: Niacin; B_5: Pantothenic; B_6: Pyridoxine; B_7: Biotin; B_9: Folates

deficiency, cardiovascular diseases anemia, osteoporosis, hypotension coronary, prostate cancer and heart disease by protecting the immune system [8]. Buckwheat has more vitamin-D and riboflavin (vitamin-B_2) than any cereal with good amount of vitamin-E (40 mg/100 grams). It has anti-oxidative property. Amaranthus grains have good amount of vitamins-B-complex group especially niacin (vitamin-$B_3$and riboflavin (vitamin-B_2)). It is good source of folate (82 micro grams/100 grams) also (Table 4).

Amino acids are the monomers of proteins as well as the end-products of protein digestion in the alimentary canal.

Table 5: Essential Amino Acids Densities of Pseudocereals (grams/100 grams)

Amino Acids (gram/100 grams protein)	**Buckwheat (g/100g)7**	**Amaranthus (g/100g)9**	**Quinoa/ (gram/100 g) 9**
His*	2.51	0.38	0.36
Isoleu*	3.5	0.55	0.48
Leu*	6.11	0.86	0.84
Ly*	5.71	0.83	0.7
Meth*	2.31	0.34	0.31
Cys*	2.21	0.19	0.15
Pheny*	4.31	0.61	0.5
Thr*	3.5	0.43	0.37

Tyr*	2.01	0.54	0.41
Val*	4.7	0.6	0.57

Note * His=Histidine, Isoleu=isoleucine, leu= Leucine, Ly=Lysine, Meth=Methionine, Cys=Cystine, Pheny=Phenylalanine, Thr=Threonine, Tyr=Tyrptophan, Val=Valine,

(Mean ± SD)

Usually they are classified into essential and nonessential amino acids. Both groups are essential for life. Amino acids contain carbon, hydrogen, oxygen and nitrogen, and some contain sulphur. The body needs to use about 20 common forms of amino acids to function. They are all important but eight of them cannot be synthesized by the body. They are essential (indispensable) and therefore must be obtained from food. The other ten amino acids are nonessential (also called dispensable), are not necessarily consumed because the body synthesizes them from other amino acids consumed. The essential amino acids comprise of valine, methionine, isoleucine, leucine, phenylalanine, threonine, histidine and tryptophan while the non-essential amino acids include glycine, alanine, cysteine, tyrosine, proline, glutamic acid, serine, aspartic acid, arginine and lysine. Buckwheat has very good amount of essential amino acid as compare to other pseudocereals amaranthus and quinoa. Amaranthus also have good amount of histidine, leucine, and valine in comparison to quinoa (Table 5).

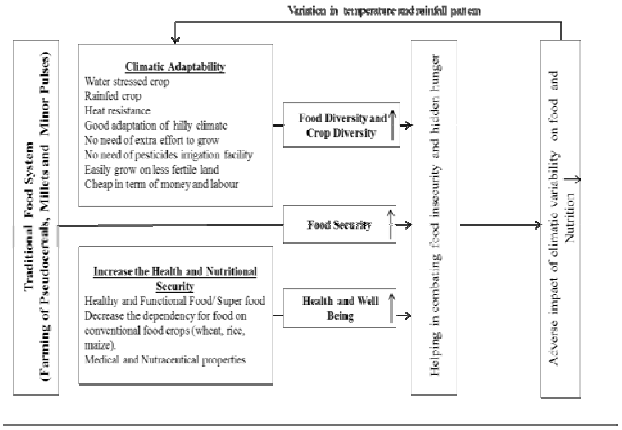
3.5 Traditional Food system and Climate Change

The possible effects of climate change on global agricultural production, such as poor crop yields, desertification, soil fertility and erosion, depletion and degradation of water resources, have broadly been projected to hinder upcoming crop productivity, thus further confounding the encounter of sustaining food security in agriculturally exposed areas. The addition of growth of global population and the above issues, together with growing energy prices and later on upsurges in prices of agricultural inputs, will augment to the encounter of sustaining worldwide food security. Most of polices suggested for climate change moderation and adaptation comprise the formation of more diverse cropping systems and proposed the addition of crops that are heat and drought stress tolerant. These crops should be capable to self-adapt to new pest or disease pressure with climatic variability impact.

Worldwide crop production is directly subordinate on as it were nine crops to supply more than 75 per cent of the worldwide plant originating energy. Wheat, rice and maize are the three main staple cereals provide more than 50% of the total production [33]. This dependency on such few species could be a genuine concern for future agrarian sustainability and susceptibility [34]. As a case, in 2007, the disappointment in food supplies according to then existing demand come about in agrarian item cost unpredictability and brought confusion to global food markets, thereby pushing people further into the current environment of food instability [35].

A few traditional and local crops are reasonable candidate for pleasing suitable climate impact moderation. Kumaon is the home more than 200 hundred indigenous food crops and fruits and vegetables. And many recent researches are proving that these crops are so nutritious and healthy for human. These can play and important role in combating hidden hunger and food insecurity. Amaranthus, buckwheat, millets, mirror pulses Kumaon region are common in rural area of Kumaon. But there is big gap between production, consumption and supply of these tradition food crops. Due to urbanization, variation in climatic condition, other socio-economic factors like (change in food habits of people and acceptance of global food item, change in traditional crop system and farming system) are some production and consumption of these crops at household level is declining. These tradition crops have so many positive impacts on health and nutrition, but these crops have also important role in adaptation of climate change (Figure 2).

Among traditional food crops, Buckwheat and Amaranthus is major traditional crop in middle and high hill region of Kumaon. Buckwheat plant has so many environmental protection properties also due to require less input, high adaptability of high altitudes and extreme climate [36]. Cold and arid region is most suitable region to cultivate this crop. Therefore, most of the Indian Himalayan states is cultivate and consumed at local level.



Source: Compiled by Scholar, 2019

Figure 2 Role of Traditional Food System in Adaptation Process of Climate Change

Buckwheat plant can compete with easily and grow faster than weed and these required very less soil fertility and irrigation facilities [37, 38]. It has been used as diversified the farm diversity in lean season and play important role in household dietary diversity due to very short crop growing period.

Amaranth comes under C4 plant in the classification system [39], which empowers water-use effectiveness and photosynthesis under high temperature and drought conditions

in compared to C3 crops. Even though amaranth is adapted to drought and less soil fertility conditions, it also performs well under less harsh conditions and can hence be intercropped with maize, bean, squash and pepper crops. The water necessity for developing seed amaranth is 53–58% less than that required for wheat; 40–50% less than maize; and 21% less than cotton [39]. Amaranth endures full sun, water-limited conditions and tall temperatures and has been developed in exceedingly differing regions such as tropical lowlands and up to 3500 m altitude in the Himalayas [8].

Amaranth constitute high-quality protein, as well as dietary fiber and lipids wealthy in unsaturated fatty acids. The seeds contain alluring levels of minerals, vitamins, in expansion to other bioactive components such as phytosterols, squalene, fagopyritols, saponins and polyphenols. Production of amaranth can be profitable due to its special supplement composition and characteristic resilience of drought and other stretch variables. Due to existing and anticipated impacts of climate changes, these qualities are getting to be progressively critical. A persistent increment in worldwide food demand has brought about in expanded consideration towards underutilized crops with the potential to progress worldwide food security and capacity to moderate hostile impacts of climate changes [40].

4. CONCLUSION

Indigenous food systems of any region are not only important for human nourishment but also institute a wealth of knowledge that maintains balance among health, environmental sustainability and human well-being. Kumaon Himalaya is a center of composite diversity of plants and crop species, which benefit the people with a variety of foodstuff. These crops can be wide up the food basket and verities for the consumers. Traditional Himalayan pseudocereals are rich in micro nutrition and show potential for providing vegetable proteins that the world will need in upcoming period. Still these crops are never been visible and distributed outside their homegrown areas, where they can be exchanged with money. Global climate change is fact and world is fronting its adverse consequences on nutrition and food securities. It has been observed that world need to upsurge food production for growing inhabitants.

These traditional and wild landraces of food crops have capacity to shrink the malnutrition from food insecure region. Traditional food system should be preserved, protect and advertise the benefit of these crops. These crops are unavoidable for self-survival, health and livelihood of indigenous people. New generation does not know about the unique characteristics of the local landrace varieties due to lack of availability of proper documentation on nutritional, nutraceutical and medicinal use of traditional pseudocereals and other underutilized landraces crops. Lack of this information frequently leads to suspension of cultivation of some of these landraces, which are of high nutritional value and health benefits equal to any conventional food crops.

5. ACKNOWLEDGEMENT

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REFERENCES

[1] Kuhnlein, Harriet V., Erasmus, B., and Spigelski, D. (Eds). (2009). *Indigenous Peoples" Food Systems: The Many Dimensions of Culture, Diversity and Environment for Nutrition and Health*. Rome, Italy: Food and Agriculture Organization of the United Nations. Available online at: ftp://ftp.fao.org/docrep/fao/012/i0370e/i0370e.pdf

[2] Ogle, B. M., Hung, P. H., and Tuyet, H. T., "Significance of wild vegetables in micronutrient intakes of women in Vietnam: an analysis of food variety", *Asia Pacific Journal of Clinical Nutrition*, 10, 1, February 2001, pp. 21–30.

[3] Da-Costa, M., "Household food insecurity in Timor-Leste", *Food Security*, 5, 1, February 2013, pp. 83–94.

[4] Bharucha, Z., and Pretty, J., "The roles and values of wild foods in agricultural systems", *Philosophical Transactions of the Royal Society* B, 365, 1554, September 2010, pp. 2913–2926.

[5] Shanley, P., and Luz, L., "The impacts of forest degradation on medicinal plant use and implications for health care in Eastern Amazonia", *BioScience*, 53, 6, June 2003, pp. 573–584.

[6] Shackleton, S., Twine, W., Hunter, L., Holding-Anyonge, C. and Petheram, L., "Forests as safety nets for mitigating the impacts of HIV/AIDS in Southern Africa", *Forest Livelihood Briefs*, 4, 1, September 2006, pp. 22-45.

[7] Maundu, P. M., "The status of traditional vegetable utilization in Kenya. Conservation and use". *Proceedings of the IPGRI International Workshop on Genetic Resources of Traditional Vegetables in Africa* Nairobi: National Museum of Kenya, 1995, pp. 23–30.

[8] Rastogi, A. and Shukla, S., "Amaranth: A New Millennium Crop of Nutraceutical Values", *Critical Reviews in Food Science and Nutrition*, 53, 2, January 2013, pp. 109-125.

[9]Pandey, V. L, Dev, S. M, Jayachandran, U.,"Impact of agricultural interventions on the nutritional status in South Asia: A review". *Food Policy* 62, July 2016, pp. 28–40.

[10] Chrisopher, B. Royal Horticulture Society: Encyclopedia of plants and flowers. Penguin pubication.Sept 2008.pp.1-1136

[11] Mampholo, M. B., Sivakumar, D., and Van Rensburg, J., "Variation in bioactive compounds and quality parameters in different modified atmosphere packaging during postharvest storage of traditional leafy vegetables (*Amaranthus cruentus* L and *Solanum retroflexum*)", *Journal of Food Quality*, 38, 1, February 2015, pp. 1-12.

[12] Palombini, S. V., Claus, T., Maruyama, R., Gohara, A. K., Souza, A. H. P., Souza, N. E., Visenttainer, V., Gomes, S. T. M. and Mastsushita, M., "Evaluation of nutritional compounds in new amaranth and quinoa cultivars", *Food Sci. Technol, Campinas*, 33, 2, June 2013, pp. 339-344.

[13] Saunders, R. M., and Becker, R., *Amaranthus*; A potential food and feed resource. **In:** *Advanced Cereal Science Technology*, Pomeranz, Y., Ed. American Association of Cereal Chemists, St. Paul, MN. 6, 1984, pp. 357-366.

[14] Alegbejo, J. O., "Nutritional value and utilization of Amaranthus : A review", *Bayero Journal of Pure and Applied Sciences,* 6,1, June 2013, pp. 136–143

[15] Rangarajan, A., Chenoweth, W. A., Kelly, J. F., and Agee, K. M., "Iron bioavailability from *Amaranthus* species: 2-Evaluation using haemoglobin repletion in anaemic rats", *J Sci Food Agric*, 78, 2, October 1998, pp. 274–280.

[16] Beswa, D., Dlamini, N. R., Amonsou, E. O., Siwela, M., and Derera, J., "Effects of amaranth addition on the provitamin A content, and physical and antioxidant properties of extruded provitamin A-biofortified maize snacks", *Journal of the Science of Food and Agriculture*. 6, 1, January 2016, pp. 287-294.

[17] Prakash, D., and Pal, M., "Nutritional and antinutritional composition of vegetable and grain Amaranth leaves", *J Sci Food Agric.* 57, 4, August 1991, pp. 573–583.

[18] Cai, Y., Sun, M., and Corke, H., "Characterization and application of Betalain pigmaent from plants of the Amaranthaceae", *Trends Food Sci* Tech, 16, 9, September 2005, pp. 370-376.

[19] Robinson, R. G., The buckwheat crop in Miniesota. In: Agricultural experiment station bulletin 539, University of Minnesota, 1980, pp. 3-14.

[20] Rana, J. C., Tyagi, S. K., and Shrama, S. K., "On fram conservation- initiatives by NBPGR in the western Himalaya region of India watershed based case study", *Current science*, 23, 1, 2010, pp. 122-155.

[21] Rana, J. C., Pradheep, K., Chaurasia, O. P. Sood S., Sharma, R. M., Singh, A., Negi, R., "Genetic resources of wild edible plants and their uses among tribal communities of cold arid region of India", *Genetic resources and crop evolution*, 59, 1, January 2011, pp. 135-149

[22] Bonafaccia, G., Gambelli, L., Fabjan, N., Kreft, I., "Trace elements in flour and bran from common and tartary buckwheat", *Food chemistry*, 80, 1, October 2003, pp. 1-5.

[23] Fabjan, N., Rode, J., Kosir, I. J. Wang, Z., Zhang, Z., Kreft, I., "Tartary buckwheat (Fagopyrum tataricum Gaertn.) as a source of dietary rutin and quercitrin", *Journal of agriculture and food chemistry*, 51, 22, October 2003, pp. 6452-6455.

[24] Steadman, K. J., Burgoon, M.S., Schuster, R. L., Lewis, B. A., Edwardson, S. E., and Obendrof, R. L., "Fagopyritols, D-chiro-inositol and other soluble carbohydrates in buckwheat seed milling Fraction", *Journal of Agriculture and food chemistry*, 48, 7, July 2000, pp. 2843-2847.

[25] Campbell, C. G., Buckwheat (Fagopyrum esculentum Moench. Promoting the conservation and use of underutilized and neglected crops. Institute of Plant genetic and crop plant research. Gatersleben/International Plant genetic resources Institute, Rome, Italy. 95, 1997.

[26] Chang, C., Yang, M., Wen, H., and Chen, J., "Estimation of total flavonoid content in propolis by two complementary colorimetric methods", *Journal food drug annals*, 10, 3, July 2002, pp. 178-182.

[27] Tomotake, H. Shimaoka, I., Kayashita, J., Yokoyama, J., Nakajoh, M., Kato, N., "A buckwheat protein product suppress gallstone formation and plasma cholesterol more strongly than soy protein isolate in hamsters", *Journal of Nutrition*, 130, 7, July 2000, pp. 1670-1674.

[28] Mattila, P., Makinen, S., Eyrola, M., Jalava, T., Pihlava, J.M., Hell strom, J. and Pihlanto.A., "Nutritional Value of Commercial Protein-Rich Plant Products", *Plant Foods for Human Nutrition*. Springer. 73, 02, March, 2018. pp. 108-115.

[29] Mourya, N. K. and Arya, P., "Amaranthus grains benefits : A Review". *Journal of Pharmacognosy and Phytochemistry*. 7, 2, July 2018. pp. 2258-2262.

[30] Marshall, H.G. and Pomeranz, Y., "Buckwheat: description, breeding, production, and utilization". *Adv. Cereal Sci. Tech.* 5, August 1982. pp. 157-210.

[31] U. S. Department of Agriculture (USDA). "Food Composition Databases Show Foods List". Available online. https://ndb.nal.usda.gov/ndb/search/. 2019.

[32] Prybylski, R. and Gruczynska, E., "A review of Nutritional and Nutraceutical Components of Buckwheat". The European Journal of Plant Science and Biotechnology. 3, 1, November 2009. pp. 10-22.

[33] Food and Agriculture Organization (FAO), How to feed the world in 2050, Rome, 2009, pp. 1-35.

[34] Frison, E. A., Biodiversity and livelihoods. In: S. Bala Ravi, I. Hoeschle-Zeledon, M.S. Swaminathan and E. Frison (editors). "Hunger and Poverty: The Role of Biodiversity. Report on an International Consultation on the Role of Biodiversity in Achieving the UN Millennium Development Goal of Freedom from Hunger and Poverty", Chennai, India, April 18–19 2006.

[35] Clapp, J. and Helleiner, E. "Troubled Futures? The Global Food Crisis and the Politics of Agricultural Derivatives Regulation", *Review of International Political Economy*, 19, 2, May 2012, pp. 181–207.

[36] Rana, J. C., Chauhan, R. C., Sharma, T. R. and Gupta, N., "Analyzing Problems and Prospectus of Buckwheat Cutivation In India", *The Europian Journal of Plant Science and Biotechnology*, 6, 2, February 2012, pp. 50-56.

[37] Nabhan, G. P., Pynes, P., Joe, T., "Safeguarding species. Language and cultures in the time of diversity loss: From the calorado plateau to global hotspots" *Annals of the Missouri botanical garden*, 89, 2, April 2002, pp. 164-175.

[38] Ohnishi, O., "Search for the wild ancestor of buckwheat III the wild ancestor of cultivated common buckwheat and tartary buckwheat", *Econ bot.*, 52, 2, April 1998, pp. 123-133

[39] Kauffman, C. S., and Weber, L. E., Grain amaranth. In: J. Janick, and J. E. Simon, eds. Advances in New Crops, *Timber Press*, Portland, 1990, pp. 127–139

[40] Alemayehu, R., Bendevis, F., Jacobsen, M. A., "The Potential for Utilizing the Seed Crop Amaranth (Amaranthus spp.) in East Africa as an Alternative Crop to Support Food Security and Climate Change Mitigation", *J Agro Crop Sci*, 201, 5, October 2014, pp. 321-329.