REVIEW ARTICLE

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NEGLECTED AND UNDERUTILIZED CROP SPECIES OF NEPAL: SMART FOODS FOR UNCERTAIN FUTURE

Toyanath Joshi [1,*], Ram Prasad Mainali[2], Sabina Bhandari[3], Prashiksha Acharya[3] and Krishna Hari Ghimire[2]

[1] National Centre for Potato, Vegetables and Spice Crops Development (NCPVS), Kirtipur, Kathmandu

[2] National Agriculture Genetic Resources Center (Gene bank), Khumaltar, Lalitpur, Nepal

[3] Agriculture and Forestry University (AFU), Rampur, Chitwan, Nepal

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[*] Correspondence:
joshitoyanath@gmail.com
Tel.: +977-9845088408

ABSTRACT

The majority of crop species that are cultivated for food in Nepal are not prioritized in formal research, education and development making them neglected and underutilized. A narrative review and expert interviews were carried out to investigate the significance of neglected and underutilized species in the realms of food and nutrition, climate change, economic activities, and culture. We listed 65 neglected and underutilized species as future smart food based on their potential value in food and nutrition. Neglected and underutilized species can play a crucial role by improving incomes and enhancing the food and nutrition security of smallholder farmers and rural communities. Furthermore, these crops have the capacity to adapt against extreme climatic conditions and be tolerant to biotic and abiotic stresses. There is an urgent need to broaden the food basket of the country by supporting the promotion and commercialization of neglected and marginalized crops through research and development.

1. INTRODUCTION

Globally, approximately 30,000 edible plant species have been identified. Of them, more than 7,000 plant species have been used for food purposes (Padulosi *et al*. 2002). Over 84% of the global human diet and nutrition come from plants, contributing 90% of the average human diet in Asia (Joshi *et al*. 2019). At present, however, not more than 150 species are commercially cultivated, and of these, just 103 crops provide 90% of the calories in the human diet (Padulosi *et al*. 2013). Just four of these (rice, wheat, maize & potato) account for fully 60% of the human energy supply. Agricultural species that are not among the major staple crops are often grouped as 'neglected and underutilized crop species' (NUS) and are sometimes called 'orphan' crops. Interestingly, NUS holds the potential to ensure food and nutritional security for the growing global population through their significant contribution to human nutrition and their use as traditional medicine for ages. However, little attention is paid to or is entirely ignored by agricultural researchers, plant breeders and policymakers to NUS (Shrestha *et al*. 2018). Nevertheless, NUS has tremendous opportunities for fighting poverty, hunger, and malnutrition and building agricultural production systems more resilient to climate change.

Currently, more than 100 national and international organizations are working in Nepal for agricultural research and development, with some involvement in the academic sector as well. The government has given utmost importance to agriculture since the commencement of the third five-year plan (1975-80) for addressing the issues of food and nutritional security. Indeed, three crops, rice, wheat and maize, remain the most priority crops for research and development. A small percentage (approximately 5%) of NUS landraces are utilized in research and breeding programs. (Joshi *et al*. 2020). Currently, landraces of major food crops

provide limited food sources at a national level, even though landraces of NUS provide major sources of food and nutrition in marginal hills and mountains. Agriculture gets priority in different plans and policies; however, every time the emphasis was given to major cereals by both the research and development sector. Apparently, NUS get less priority in research and development programs.

Before the 13th three-year plan (2013-2016) of the country, NUS were considered non-commodity crops in national policies and agricultural statistics. Research on NUS was initiated in 1991 and systematic conservation of these crops was started in 2010 (Joshi *et al*. 2019). The Hill Crop Research Program (HCRP), under the umbrella of NARC, has been working in NUS. However, HCRP with minimal human and financial resources is compelled to work on multilocation trials on rice, maize and wheat, resulting in a negligible focus on NUS. This can be seen clearly from the number of varieties released/registered in four decades of research. There are only five varieties of finger millet, one variety each of buckwheat, naked barley and amaranth but no varieties of foxtail millet, prosomillet and sorghum, released and or registered as compared with 139 varieties of rice, 32 varieties of wheat and 93 varieties of maize (SQCC, 2019). Similar is the situation of grain legumes. Strategies to encourage NUS production in lower food production areas were given in the country's 14th three-year national plan. Then, the Ministry of Land Management, Agriculture & Cooperative (MoLMAC) announced the 58-point agricultural transformation roadmap in 2018, emphasizing NUS's promotion and conservation. From the fiscal year 2018/19, the promotion of NUS was started in three districts, namely Lamjung, Humla and Bajura, representing three provinces Gandaki, Karnali, and Far-western, respectively. Later this program was extended to 12 districts of Nepal. In 2018, the government of Nepal in collaboration with Pacific of the FAO, qualified six NUS as Future Smart Foods (FSF), namely Tartary buckwheat, Grass pea, Taro, Drumstick, Jackfruit, and Nepal butter tree. These six NUS were selected based on the four-dimensional features such as nutrient-dense, climate-resilient, potentially viable, and locally adaptable.

The NUS are gaining interest in Nepal, reflecting a growing trend within agriculture to identify and develop new crops for national and international markets. Consumer interest is also creating the demand for NUS in the domestic market. The Government of Nepal also emphasized the promotion and commercialization of NUS in policies, programs and budget. Further, in collaboration with the Food and Agriculture Organization (FAO) of the United Nations and Bioversity International, the National Genebank, NARC of Nepal has focused on improving NUS conservation and use and have been spearheading specific national and international activities to improve the conservation and use of these species over the past few years. However, there is a gap in exploiting NUS potential, their documentation (Joshi and Shrestha 2018) and prioritization. Further, limited literature is available on the nutritional values and climate resilience of NUS. Therefore, the present study aimed to explore the status of NUS in Nepal, their nutritional and medicinal values, and their potential for climate resilience and agrotourism.

2. METHODOLOGY

A narrative review was conducted to search for available literature. In this study, we identified the five keywords; (i) underutilized crops, (ii) indigenous crops, (iii) traditional crops, (iv) neglected crops and (v) orphan crops. The keywords were searched online using Google and Google Scholar, Scopus, ScienceDirect and SpringerLink search engines. For the grey literature, information was retrieved from the official websites of related organizations such as the Ministry of Agriculture and Livestock Development (MoALD), National Genebank, Food and Agriculture Organization (FAO), Bioversity International. Relevant policies, laws, and regulations existing in NUS were also taken into consideration. The outcomes of quantitative and qualitative research were combined. This study has been structured into three parts, listing major NUS with their food value in Nepal, their prospects for climate change, and the importance of NUS in maintaining cultural diversity and agrotourism.

3. RESULTS AND DISCUSSION

3.1 Criteria for NUS

Many researchers defined NUS with different criteria. Adhikari *et al*. (2017) defined NUS as having high nutritional value, but their role in achieving nutrition security is not adequately understood, and they do not feature in food and nutrition policies and programs of the countries. International Plant Genetic Resources Institute (IPGRI) of FAO defined NUS are those crop species neglected by science and development; some, therefore, call them 'orphan crops. Moreover, NUS

are those to which little attention is paid or which are entirely ignored by agricultural researchers, plant breeders and policymakers (Padulosi *et al*. 2013). The IPGRI (2002) reported six features of NUS (Box I).

Box I. NUS criteria
- Of local importance in consumption and production systems
- Highly adapted to agro-ecological niches/marginal areas
- Receive scarce attention by national agricultural and biodiversity conservation policies, research and development
- Represented by ecotypes/landraces
- Cultivated and utilized relying on indigenous knowledge
- Scarcely represented in *ex situ* collections

3.2 Nutritional value of NUS

NUS are potential Future Smart Foods (FSF) because they are socially acceptable, have strong nutritional values (social sustainability), and are vital to the agrobiodiversity and resilience of farming systems (environmental sustainability) (Joshi *et al*. 2020). NUS provides essential micro-nutrients and thus complements staple foods. Additionally, NUS provides flavoring in local cuisine, strengthens local gastronomic traditions and provides income opportunities for both the rural and urban poor that's why they are also called 'poor man's food'. Many NUS are high in carotenoids and minerals and, therefore, could play a role in improving the micro-nutrient content in the diets of millions of people in food-insecure areas. It was reported that increased consumption of locally available indigenous or traditional fruits, vegetables, grains, roots and tubers could improve human nutrition and increase local productivity (Padulosi *et al*. 2013; Ebert, 2014).

Many of the people in Nepal are facing the severe challenge of malnutrition. About 41% of children younger than five years of age in Nepal are experiencing chronic malnutrition, and 11% suffer from acute malnutrition (Acharya *et al*. 2018). The situation has alarmed us in achieving the United Nations Sustainable Development Goal (SDG) of zero hunger by 2030. Recently, import-based consumption and dietary shift of Nepalese people have led to the deterioration of such traditional mountain food systems, resulting in a decline in agro-biodiversity and further increasing the risk of food and nutrition security. The national policies on NUS are becoming congenial; however, not in their practical implementation or not observed in the real field; hence NUS are gradually disappearing from food systems. NUS have a considerable potential to be 'future smart foods' if they are revitalized in local farming systems. According to the available literature, and discussion with experts working in the research and development of NUS, we listed major 65 NUS as priority crops for Nepal with their nutritional value and role in food security from the total list of NUS developed by Joshi and Shrestha (2018), Joshi *et al*. (2020) and Joshi *et al*. (2022). It is clearly seen that these NUS provide not only a good calorie supply but also essential nutrients for better health.

Table 1. Nutritional values of neglected and underutilized crop species of Nepal

SN	Scientific name	English name	Nepali name	Parts used and the local form of consumption	Nutritional value
1	**Cereals**				
1	*Eleusinecoracana* (L.) Gaertn.	Finger millet	Kodo	Grains are used for pancake, beverages, fodder, porridge	Rich source of calcium, dietary fiber, phytates, phenolics, thiamine, and riboflavin.
2	*Panicum miliaceum* L.	Proso millet	Chino	Grains are used for pancake, beverages, fodder.	Rich source of protein, dietary fiber, several B vitamins, and numerous dietary minerals, especially manganese.
3	*Pennisetum glaucum* (L.) R.Br.	Pearl millet	Baajraa	Grains used for bread.	Grains are gluten-free, higher dietary fiber than rice, similar in lipid content to maize, and high essential amino acids (leucine, isoleucine and lysine) than wheat and rye.
4	*Setariaitalica* (L.) Beauvois	Foxtail millet	Kaaguno	Grains are used for pancake, beverages& fodder	Rich in protein, fiber, minerals, and phytochemicals. Possesses hypolipidemic, low-glycemic index, and antioxidant characteristics.
5	*Hordeum vulgare* L.	Barley	Jau	Grains are used for beverages & leaves for fodder	Considered superfoods because it contains a high amount of dietary fibers and phytochemicals.
6	*Hordeum vulgare* var. *nudum L.*	Naked barley	Uwa	Grains for bread & leaves for fodder	Manganese and carbohydrate-rich fruit support Antioxidant, Anti-microbial, antifungal and Antitumor activity.

SN	Scientific name	English name	Nepali name	Parts used and the local form of consumption	Nutritional value
7	*Sorghum vulgare* Pers.	Sorghum	Junelo	Grains are used for bread& leaves for fodder	The plant is usually used for fodder and has medicinal value also.
8	*Echinocloa frumentacea* Link.	Barnyard millet	Sama	Leaves for forage and grains for bread	Good source of highly digestible protein and is the least caloric dense compared to other cereals.
2	**Pseudo cereals**				
1	*Fagopyrum esculentum* Moench	Common buckwheat	Mithe Phapar	Grains for bread, young leaves are used for vegetables& other parts for fodder	Rich in Vit. B1 and B2 and lysine. The rutin content of buckwheat has a hypotensive effect.
2	*Fagopyrum tataricum* (L.) Gaertn.	Tartary buckwheat	Tite Phapar	Tender leaves used for vegetables & seeds for bread	Rich source of amino acid, lysine & rutin (which reduces blood cholesterol count), dietary fiber, lipids & minerals.
3	*Amaranthus hypochondriacus* L.	Prince's feather	Latte dana	Tender leaves used for vegetables &grains for bread	Rich in protein, carbohydrates &minerals (Ca, Fe, Na & K).
4	*Amaranthus caudatus* L.	Foxtail amaranth	Jhule latte	Leaves used for vegetable &grains for bread	Rich in protein, fat, ash, starch and dietary fiber. Seeds have a higher content of fiber essential amino acid.
5	*Amaranthus cruentus* L.	Blood/Red amaranth	Rato latte	Leaves used for vegetables & grains for bread	Rich source of Ca, K &amino acids.
3	**Pulses**				
1	*Vigna umbellata* (Thunb.)	Rice bean	Mashyang	Used as a grain and fodder legume	Contain 25 % higher protein than many cultivated legumes.
2	*Pisum sativum* L. var. *arvense* L.	Small pea, field pea	Saanokeraau	Fresh vegetables and other dried food products	Contain starch, protein and other phytochemicals which are anticarcinogenic.
3	*Mucuna pruriens* (L.) DC.	Velvet bean, horse eye bean	Kaausesimi	Used as an important forage, fallow and green manure crop	Important forage, fallow and green manure crop (nitrogen fixation). It is also a medicine against snake bites.
4	*Lathyrus sativus* L.	Grass pea	Khesari	Grains for human food and other parts for livestock fodder	Seeds are rich in proteins and essential amino acids. Different unsaturated fatty acids the essential PUFA α-linolenic, linoleic and γ-linolenic acids are also present.
5	*Vigna mungo* (L.) Hepper	Black gram	Mas	Grain legume in mid-hills used for daal and fodder for livestock	It contains high levels of protein, potassium, calcium, iron, niacin, thiamine, and riboflavin.
6	*Glycine max* (L.) Merr.	Soybean	Bhatmas	Seeds used to prepare baby food, green pods used as green vegetables and dry seeds roasted or fried eaten as snacks	A green plant serves as a high-quality forage for livestock. The seed contains high-quality protein and oil which is also a good source of vitamin E
7	*Phaseolus vulgaris* L.	Common bean	Asaresimi	Grains used as *simi ko daal*. S*imi ko daal* remains a recipe for special occasions	Good source of protein, carbohydrates, vitamins & minerals especially for poor populations throughout the world
8	*Macrotyloma uniflorum* (Lam.) Verdc. curing stone	Horse gram	Gahat	Gains used to prepare the recipe of Gahat ko jhol & to cure kidney stones	Medicinal uses (tonic, astringent, diuretic) and recommended for rheumatism, neuralgia &other several diseases. Seeds are rich in natural phenols, mostly phenolic acids, flavonoids and the major antioxidants.
9	*Vicia faba* L.	Broad bean, faba bean	Bakula	Pods are consumed mostly as green vegetables and dry seeds as roasted beans and small seeds usually split and consumed as soup	Unique legume crops rich in nutrients like proteins, complex carbohydrates, dietary fiber, choline, lecithin, minerals and secondary metabolites such as phenolics

SN	Scientific name	English name	Nepali name	Parts used and the local form of consumption	Nutritional value
4	**Root and Tubers**				
1	*Ipomoea batatas* (L.)	Sweet potato	Sakharakhand	Tuber eaten as roasted and boiled	Rich source of starch, sugar sum, protein, vitamin C, ascorbic acid and minerals (P, Ca & Mg)
2	*Manihot esculenta* Crantz	Tapioca, cassava	Simaltarul	Tuber eaten as roasted in a special festival such as *makarsankranti*	Roots and leaves contain a higher level of vitamin C and some minerals. Rich source of starch and fiber
3	*Dioscoreaalata* L.	Greater yam, white yam	Tarul, ghartarul	Tuber eaten as roasted in a special festival such as *makarsankranti*	Higher food energy calories, fiber &minerals (Ca, P & Fe), amino acids (tyrosine arginine, Isoleucine, leucine, lysine
4	*Colocasia esculenta* (L.)	Taro	Pindaalu/ Gaba	Leaves (*karkalo ko paat*), the young stalks (*gaaba*), and the taro tuber or corms (*pidhaalu*) to prepare various dishes. The taro tubers are used as a root vegetable, steamed & preparation of some daal dishes	Good source of thiamin, riboflavin & minerals (Fe, P, Zn, K, Cu & Mn), and an excellent source of vitamin B6, vitamin C, niacin. Taro also contains higher amounts of vitamin B-complex than whole milk.
5	*Dioscorea nepalensis*(Jacquem. ex Prain& Burkill) Sweet ex Bernardi	Deltoid yam	Vhyakur	food values and sources of different kinds of medicine Fruits used for food and medicine. Seeds used to wash hair	Used as a medicine, hair wash & food. The juice of the root tuber is taken in the evening as a treatment for roundworms. Also used to alleviate constipation.
6	*Amorphophalluspaeoniifolius* (Dennst.) Nicolson	Elephant foot yam	Oal	Root is eaten as deep-fried, curry, or *chokha* (a kind of achaar)	Rich in vitamins, minerals, and energy. Also, has medicinal and therapeutic value
5	**Leafy vegetables**				
1	*Chenopodium album* L.	Lamb's quarter	Bethe	Leaves used as vegetable and medicine	Contains high amino acids (lysine, methionine & cysteine), protein, carotene & vitamin C
2	*Trigonellafoenum-graecum* L.	Fenugreek	Methi	Seeds used as spices and medicine. Fresh leaves for vegetable	Seeds are rich in minerals (P, S, Mg, &Ca.). Seeds and leaves contain biologically active substances (protein, amino acids, biogenic elements, lipids & fatty acids), which are used in traditional medicine, functional food &cosmetics industry.
3	*Brassica nigra* (L.) Koch	Black mustard,	Rayo	Fresh leaves for vegetables and seed for oil	Rich in calories, protein & fatty oil, mainly oleic acid
4	*Dryopteris cocheleata* (D. Don) C. Chr.	Fern	Niuro	Fresh thallus is used for vegetable	Contains germacrene D, 1, 3-cyclohexanedion,2-methyl-2 (3-isobutyl), neoisolongifolene,8, 9-dehydro compounds which show medicinal properties
5	*Spinacia oleracea* L.	Spinach	Palungo	Leaves consumed as a vegetable	Possesses a higher concentration of vitamins, minerals (Ca, P, K& Fe) and protein.
6	*Amaranthus gracilis*Desf.	Green amaranthus	Lunde	Leaves used as a vegetable	Contain a higher amount of proteins compared to true cereals. Relatively well-balanced food that has been shown to have medicinal benefits
7	*Nasturtium officinale* R.Br.	Water cress	Sim saag	Leaves used as vegetables and seeds as medicine.	Rich in Vit. K and contains significant amounts of Vit. A, C, riboflavin, B6, Ca & Mn.

SN	Scientific name	English name	Nepali name	Parts used and the local form of consumption	Nutritional value
8	*Phytolaccaacinosa*Roxb.	Indian poke	Jaringo saag	Tender leaves and stalks are used as vegetables.	Root is antiasthmatic, antibacterial, antidote, antifungal, antitussive, diuretic, expectorant, laxative & vermifuge. The plant has exciting chemistry & it is currently being investigated as a potential anti-AIDS drug
9	*Moringa oleifera* Lam.	Drumstick tree	Sitalchini	Leaves used as food. The roots, leaves, bark &pods are said to have medicinal properties.	Contain larger amounts of essential nutrients than the common foods often associated with these nutrients, for instance: two times more protein in milk, four times the calcium in milk, four times the vitamin A in carrot and more. So, they can help to combat malnutrition.
10	*Asparagus racemosus*Wild.	Asparagus	Kurilo	Roots, tubers and tender shoots are widely used for food & medicinal purposes.	Said to promote fertility and have a range of health benefits, particularly for the female reproductive system. Also, has Antioxidant and Anti-anxiety effects.
6	**Oilseeds**				
1	*Perilla frutescens* (L.) Britton	Perilla	Silam	Seeds used to extract oil and prepare pickles	Famous for its medicinal benefits and phytochemical compounds such as phenolic, flavonoids, Phytosterols, Tocopherols, Policosanols & fatty acids.
2	*Sesamum orientale* L.	Sesamum	Til	Seeds used to prepare traditional, pickles and used as *hawan* material during *yagya*	Increase plasma g-tocopherol and enhance Vit. E activity, which is believed to prevent human aging-related diseases such as cancer & heart disease
3	*Aesandra butyraceae* (Roxb.) Baehni	Nepali butter tree	Chyuri	Seed used to prepare ghee that is used for fuel lamps, and body lotion; the fruit is eaten fresh and used for alcohol distillation, oil cakes are utilized as manure, and the tree itself is used as firewood	Rich in sugars and fatty acids. It also bears medicinal value.
4	*Linum usitatissimum* L	Linseed	Aalash, Tisi	Seeds used in bread and cereals as well as oil	Rich in soluble dietary fiber, oil (saturated fatty acids), protein & Vit. E (gamma-tocopherol)
5	*Prinsepia utilis* Royle	Himalayan cherry	Dhatelo	Used as an ornamental elsewhere for its striking shiny brown bark	Rich source of unsaturated fatty acids mainly oleic acid & linoleic acid
6	*Ricinus communis* L.	Castor bean or castor oil plant	Ander	Seed extracted for castor oil to be used as medicine	Potential tropical feed resource because of its high nutrient profile for farm animals. It has medicinal value and used as a purgative and laxative. Castor toxin, ricin itself is being studied for therapeutic use in cancer chemotherapy, bone marrow transplantation and cell-based research.
7	**Fruits**				
1	*Annona squamosa* L.	Custard apple	Sariphaa, sitaaphal	Fruit is eaten Fresh	Good dietary supplements have high content of minerals, Vit. C and carbohydrates. Antioxidant potential due to phenolic and flavonoids.

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2	*Tamarindusindica* L.	Tamarind, Indian date	Imli	Fruits used for human consumption	The fruit pulp is rich in protein fiber, moisture, ash, carbohydrate, fat and minerals (Ca, Mg, Na & K). It also contains alkaloids, cardiac glycosides, flavonoids, phenols, saponins, steroids, tannins &terpenoids.
3	*Myrica esculenta* BuchHam. ex D. Don	Hairy Bayberry	Kaphal	Fruit is eaten fresh	Widely used in folk medicine to treat several ailments such as asthma, cough, chronic bronchitis, ulcers, inflammation, anemia, fever, diarrhea, and ear, nose, and throat disorders. Fruits used for preparing syrups, jams, pickles & refreshing drinks.
4	*Aegle marmelos* (L.) Correa	Golden apple	Bel	Fruit and seed used for medicine and religious purpose. The fruit pulp is used as a refreshing juice by mixing the pulp, sugar and ice in water.	Has excellent medicinal, nutritional, environmental and commercial importance. Also, rich in carbohydrates, fiber, minerals & vitamins.
5	*Choerospondias axillaris* (Roxb.) B.L.Burtt& A.W. Hill	Nepalese hog plum	Lapsi	Fruit used to make pickle	Wood is used as light construction timber and fuelwood; seed stones are used as fuel in brick kilns & the bark has medicinal value. The fruits are rich in vitamin C.
6	*Citrus limon* (L.) Burn f.	limon	Nibuva	Fruit pulp used as fresh green salad, juice and processed products likechuk, squash, and pickle	Rich in phytochemicals including essential oils, alkaloids, flavonoids, coumarins, psoralens, carotenoids with a wide range of nutritional components including vitamins, minerals and trace elements.
7	*Citrus junos* Tanka	Yuzu	Kali jyamir	Fruit juice used for making vinegar which has medicinal values	Used industrially in the production of sweets, beverages, cosmetics, perfumes, and aromatherapy products. Important bioactive components present in yuzu fruits include vitamin C, β-carotene, flavonoids, limonoids, and dietary fiber.
8	*Citrus grandis* (L) Osbeck	Pummelo	Bhogate	Fruit eaten fresh	Rich in flavonoids, antioxidants and phenolics content. The peel is also used for beauty purposes.
9	*Syzygium cumini* (L.) Skeels	Java plum	Jamun	Fruit eaten fresh and as medicine	Rich in bioactive compounds such as phenols, flavonoids, and tannin which have medicinal value and used to cure cardiometabolic disorders.
10	*Juglans regia* L.	Walnut	Okhar	Fruit has religious importance during worship. Oil extracted from fruit is edible. Fruit is a subsistence food item.	Rich in proteins, fat, antioxidants, some vitamins & minerals. A rich source in terms of Omega 3 which is useful for regular health.
11	*Artocarpus heterophyllus* Lam.	Jack fruit	Rukh katahar	The fleshy pulp is eaten raw. Young-stage fruits used as vegetables. Seeds are eaten boiled, roasted, or cooked into a variety of food dishes	Rich source of Vit. A, C, thiamin, riboflavin, minerals (Ca, K, Fe, Na, Zn), & niacin. Rich source of potassium and helps to lower blood pressure.
12	*Phyllanthus emblica* L.	Indian gooseberry	Aamala	Fruit used to make shampoo, hair oil, sauces, candy, dried chips, pickles, jellies and powder.	All plant parts are used in various Ayurvedic medicine herbal preparations. The fruit is also used for culinary purposes. Also used in inks shampoos and hair oil. Due to its high tannin content, it is used for fixing dyes in fabrics.

SN	Scientific name	English name	Nepali name	Parts used and the local form of consumption	Nutritional value
8	**Fruit vegetables**				
1	*Trichosanthes dioica* Roxb.	Pointed gourd	Parvar	Fruit used as a vegetable	Rich in Vit. A, Vit. C, tannins, saponins, alkaloids, a mixture of novel peptides, proteins tetra & pentacyclic triterpenes. Plant leaves used as antipyretic, diuretic, cardiotonic, laxative, antiulcer.
2	*Sechium edule* (Jacq.) Sw.	Chayote	Skush	Fruit used as a vegetable	Rich in vitamins, minerals, fiber, water, and several amino acids. It also possesses diuretic, anti-inflammatory, and hypotensive activities.
3	*Benincasa hispida* (Thunb.) Cogn	Wax gourd	Kubindo	Fruit used as a vegetable when young. ripe fruit are popular in making crystallized candied sweet called "*petha*"	Nutritious vegetables and a good source of natural sugars, amino acids, organic acids, mineral elements and vitamins. Several medicinal properties such as anti-diarrheal, anti-obesity, anti-ulcer, and antioxidant and diuretic have been ascribed.
4	*Momordica balsamina* L.	Balsam Apple	Barela	Fruit used as a vegetable	Important green leafy vegetables as a source of nutrients to supplement another major source. Leaves are used to make soup for lactating mothers and babies to meet up the body's nutrient demand.
9	**Spices**				
1	*Zanthoxylum armatum* DC.	Nepal pepper	Timur	Fruit used as a spice in Nepali cooking either fresh or in dried form. A special recipe timur ko chhop is also prepared from seed. Fruit and oil from seed used for therapeutic, pharmaceutical products, flavoring agents and in perfumery	Medicine as a carminative, stomachic, and relieves toothache. Fruits and seeds are also extensively used in fever, dyspepsia, and to kill roundworms. The essential oil of its fruits exhibited excellent antibacterial, antifungal, and antihelmintic activities.
2	*Trachyspermum ammi* (L.) Sprague	Caraway, ajowan, ammi	Jowano	Leaves used as vegetables. Seeds used to feed lactating women. Soup from seed has medicinal value	Rich in carbohydrates, glycosides, saponins, phenolic compounds, volatile oil, protein, fat, fiber and minerals (Ca, P, Fe) and nicotinic acid. It also has medicinal value.
3	*Bunium persicum* (Boiss.) B. Fedtsch.	Black cumin	Himaalijiraa, kaalo jiraa	Seed used as spice	Has antimicrobial and antioxidant properties and has excellent potential for the medicinal and food industries. In traditional medicine, it is used to treat or improve some cases such as digestive and urinary disorders, diabetes, obesity and increased breast milk.
10	**Hallucinogenic/ Narcotics**				
1	*Cannabis sativa* L.	Hemp	Bhang	Seeds have been used in pickle. Hemp fiber from the stem used to prepare a rope. Leaves used to make *ganja* and insecticides	High levels of calcium, fiber, fatty acids and protein. It also contains polyphenols which are well-known antioxidant. Seeds have Omega-3 (linolenic acid).
2	*Papaver somniferum*	Poppy/Opium	Aphim/ KhusKhus	Opium is the dried latex obtained from the opium poppy which contains morphine, an alkaloid, which is also used to produce heroin in some parts of the country illegally.	Seeds contain Selenium, which is necessary for human and animal nutrition. It helps several antioxidant enzymes to function normally.

Source: (Khanal et al., 2014; Joshi and Shrestha, 2018; Joshi et al., 2020)

NUS are the Future-smart food (FSF) because of their high adaptability and also a high potential for food and nutrition (Xuan and Siddique, 2018). Pacific of the FAO (2018) qualified six NUS namely Tartary buckwheat, Grass pea, Taro, Drumstick, Jackfruit, and Nepal butter tree as FSF for Nepal, to reinforce the importance of agricultural diversification. These six NUS fulfill the four-dimensional features of a FSF such as nutrient-dense, climate-resilient, potentially viable, and locally adaptable. Recently, the Government of Nepal has qualified buckwheat and mungbean as a FSF for the hilly and Terai regions, respectively. Prioritizing only a few NUS again leaves so many neglected crops as orphan crops creating problems in the country's food and nutrition security. Therefore, we agreed to prioritize above 65 NUS as a set of certain important crops for an uncertain future.

3.3 Prospects of NUS in climate change

NUS are predominantly climate-resilient, but their yield and quality are compromised due to selective breeding. Several orphan crops are identified as nutritious, resilient, and adapted to niche marginal agricultural environments. NUS can also provide a safety net during periods of stress and following disasters and other emergencies (Padulosi *et al*. 2013). NUS yields are typically lower than the main staple crops, often compensating for this by being more resistant to biotic stress and providing reliable harvests under unfavorable climatic conditions or on difficult soils (Padulosi *et al*. 2013). The adaptive capacity under biotic and abiotic stresses is one of the key traits of many NUS. Moreover, they are the most resistant to local pests and diseases. The erosion of agricultural diversity, especially of NUS, thus has serious implications for agriculture – the loss of resilience in the face of climate change, social and economic shocks and less ecosystem functionality. Thus, enhancing the diversity of NUS crops will not only diversify agroecosystems but will also improve their adaptability to extreme climatic conditions and provides resilience to biotic and abiotic stresses (Padulosi *et al*. 2002). Also, their diversity provides environmental services, such as clean water and carbon sequestration. Most of the growing NUS concern also focuses on their ability to contribute to adaptation to climate change (Aliyu *et al*., 2014). However, other than selected reports of drought and heat stress tolerance, there is limited research confirming their suitability for future climates. For the NUS priority, research should focus on evaluating the impacts of climate change on their production for selected bioclimatic regions, with a focus on fitting them into semi-arid and arid regions.

3.4 NUS for agro-tourism and cultural diversity

NUS could be a potential crop for enhancing agro-tourism or culinary tourism in the country. The use of plants has long been an intimate part of local cultures and traditions. Many NUS play a role in keeping alive cultural diversity associated with food habits, health practices, rituals, and social exchanges. NUS have its most significant cultural importance at the local level, which puts greater emphasis on NUS as an important way to promote cultural diversity in an increasingly globalized world. The food culture that emphasizes NUS could fit into sustainable development programs such as agro-tourism, which highlights the agricultural and cultural inheritance of traditional knowledge, the agricultural landscape and agro-diversity. Localization of NUS into tourist areas might be the reason for tourist attraction, and promotion NUS by branding their geographic identification (GI). There should be a provision in a national policy that every homestay in the tourist area must feed the food to tourists, which constitutes at least 60% of the local food. Localization of local food not only promotes tourism but also promotes the diversity of neglected and underutilized food crops.

4. CONCLUSION

Nepal has a great diversity of NUS. These species have enormous nutritional, medicinal, environmental and economic values, and have the potential to contribute to poverty reduction, mainly in food-insecure areas. Considering their huge values for food and nutrition security, environment rural transformation, NUS promotion and utilization have been supported by national policies and programs. However, the promotion and commercialization of NUS are not gaining momentum. The reason behind this is the unavailability of seed materials, changing consumer behavior and less priority in research and development. For the utilization and promotion of NUS, it is essential to have a specialized research organization. Further, educational institutions should also include the NUS in their curriculum. NUS, in particular, should be studied for adaptability to extreme climate and nutritional and economic values. Considering the situation, we recommend that, for the next coming decade, national and international research and development organizations in the field of agriculture should provide grants for research and development of NUS. Mainstreaming these crops into national programs and policies, as well as integrating them into local food systems, is imperative. Besides, it is crucial to utilize

advanced breeding technologies for unlocking the true potentials of NUS as this is crucial for ensuring national food and nutritional security, promoting biodiversity, strengthening local communities, and ultimately achieving the United Nations Sustainable Development Goals (SDGs).

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