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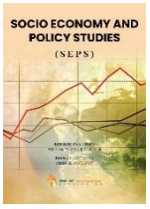

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REVIEW ARTICLE

PRESENT STATUS, IMPORTANCE AND CHALLENGES OF NEGLECTED AND UNDERUTILIZED CROPS SPECIES (NUCS) IN NEPAL

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ABSTRACT

Globally, more than 30,000 plant species are edible. Out of them only 150 to 200 plant species are used by human beings and three of them are only rice ,wheat and maize (FAO 2011). About 84% of human diet and nutrition come from plants but human beings are more continuously consuming only a few different crops. Nepal ranks 49th in world for biodiversity richness. Among 577 cultivated species 484 are indigenous and 93 are introduced . About 85% of these cultivated crops are neglected and underutilized (Joshi *et al*., 2019). More than 83% of total cultivated area of Nepal is covered by just three crops i.e rice ,wheat and maize. In Nepal NUS are those crops species that are cultivated long time before but now being neglected and are not included in formal research and development. Such crops are Millet species such as Foxtail millet (Kaaguno) Proso millet (Chino), Taro (Pindaau), Sorghum (Junelo) etc. These crops are known for their high adaptability to changing climate, can be grown in marginal soil and harsh climatic condition. Beside their tolerance to abiotic stress these crops are nutritionally rich and play major role in combacting vitamin and micronutrient deficiency. The main aim of this paper is to review some of the important but neglected and underutilized crops species which have very important role in food and nutrition security.

KEYWORDS

Neglected and Underutilized Species, Agro biodiversity, Food security, Sustainability, Orphan crops

1. INTRODUCTION

The agro-ecological zones of Nepal (Tarai, Mid Hill and High Hill) experiences a wide range of climate from sub-tropical to temperate, and alpine cold semi desert, resulting in the evolution and maintenance of diverse crop gene pools. Crop cultivation ranges from 60 m (Kechana Kalan, Jhapa) to 4700 m (Khumbu, Solukhumbu) altitude.Almost eight agro-ecosystems available in the country are rainfed high hill, rainfed mid hill, rainfed Tarai, irrigated high hill, irrigated mid hill, irrigated Tarai, wetland agriculture and rangeland agriculture (Joshi *et al*., 2019). Government of Nepal has given high priority to agriculture since 3rd five year plan (1975-1980) to address food and nutration security. but priority was given only for three crops they are rice, wheat and maize. The mountain regions are agro-ecologically suitable for the cultivation of traditional food crops, such as barley, millets, sorghum, buckwheat, beans, gram and other pulses, taro, yam, amala and jammun, a vast range of wild vegetables and fruit and medicinal plants, which are important sources of micronutrients (Sah *et al.,* 2002) and (Gopalan *et al.,* 1989) . However, agricultural intensification has resulted in a decline in the cultivation of traditional food crops and the underutilization of this nutritionally-valuable food source. This has led to low dietary diversity and, ultimately, a higher prevalence of malnutrition in the mountains as well as whole country (Sah *et al.,*2002) and (Schmidt *et al.*,2010). NUCs have high nutritional value, but their role in the nutrition security of mountain people is not adequately understood, and they have not been mainstreamed into existing policies and programs on nutrition. For example, foxtail and proso millet is a typical example of NUCs from mountain areas of Nepal. Despite its high importance for food and nutrition security, this crop is still neglected and underutilized due to lack of market opportunities, consumer's demand and low yield potential.

About 65% of total populations are dependent on agriculture for their livelihood. Cultivated land is 30,91,000 ha (Joshi *et al*., 2019). Presently, landraces of major food crops (rice, wheat, maize) provide limited food sources at the national level even though landraces of underutilized crops provide major sources of food and nutrition security particularly in marginal regions of hills and mountains. NUCS requires traditional knowledge for its cultivation and management. Since the cultures and rituals are handed down from generation to generation, traditional knowledge is also transmitted in the same way. Such knowledge needs to be studied and documented. The documentation of underutilized plants and traditional knowledge on their utilization can be useful in making strategies to check the loss and erosion of these valuable genetic resources (Khanal *et al.,*2014)

In the present situation availability of productive land is declining day by day. Water scarcity, salinenity and poor soil fertility are becoming major threats to irrigated agriculture in arid and semi arid regions (Basra *et al.,* 2016). Major staple food crops such as rice ,wheat and maize cannot able

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to tolerate such harsh condition. Continuously cultivation of these three crops made productive agricultural land vernable to insect pest and diseases but some neglected and underutilized crop species are key resource to meet the change.

2. Objective

The objective of this study is to know about Present status, Importance and Challenges of Neglected and Underutilized Crops Species (NUCS) in Nepal.

3. Methodology

The information was collected from secondary sources such as Research articles, books, reports, news and other various e-sources including Google, Google Scholar, Research Gate, Directory Of Open Access Journal etc during the preparation of this manuscript.

3.1 Neglected and Underutilized Crops Species (NUCS)

NUCS are domesticated plant species that have been used for centuries or much more for their food, fiber, fooder, oil or medicinal properties, but have been reduced in importance over time. These crops are also known as: orphan, abandoned, lost, underused, local, minor, traditional, alternative crops. They are any indigenous crop species which have food, nutritional and cultural values but given zero or less attention by researchers, extension and development organizations, policy and decision makers. Such crop species are important for the subsistence of local community however they were poorly documented, studied and neglected by the mainstream research and developmental activities.

3.2 Reasons behind being Neglected and Underutilized

- Lack of research and extension of these crops
- Low yield potential
- Lack of awareness about its nutritional value and medicinal value
- Reputational problems (famine food or "poor people's food")
- Intensive labor requirement for production
- Poor shelf life
- Low production in compare to demand
- More competitive crops (rice, wheat, maize) are entering market niche

3.3 Criteria defining crop species under NUCS

- Cultivated and domesticated crop species
- Have food, nutritional, economical and cultural values
- Availability of landraces and diversity within crop species
- Indigenous species and not exotic or introduced species
- Not included in formal seed system (ie not registered and released any variety), if included, it may be for short period of time eg 5 years
- Not commercially cultivated
- Zero or very less investment from public and private sectors for research and development
- Not included in any national research, development and policy documents
- Zero or little attention from researchers, extension services, policy and decision makers
- Scientific information not available or very poorly documented

3.4 Projects working on NUCS in Nepal

3.4.1 IPGRI-APO 1991:

Supported NARC in evaluation of barely, buckwheat, amaranth, finger millet and proso millet.

3.4.2 In-situ Global Project, Strengthening the scientific basis of in-situ conservation of agricultural biodiversity on-farm, 1995:

NARC/LI-BIRD/Pratigya Cooperative had focused some NUS crops, finger millet and taro. Major approaches were strengthening local institutions, creating income by linking rural-urban markets through value chain alliances and diversifying livelihood options of impact groups.

3.4.3 IFAD High-Value Agriculture Project in Hill and Mountain Areas (2010 – 2017):

The project purpose was to integrate the rural poor, especially women and marginal groups in high value agriculture and Non-Timber Forestry Products (NTFPs)/Medicinal and Aromatic Plants (MAPs) value chains and markets, and improve income, employment opportunities and ability to respond to market demand and opportunities based on marketing agreements with private agribusiness.

3.4.4 IFAD-NUS3 Project, Research on Amaranth 2013:

Conducted in Jumla, Kaski, Bara, Dolakha and implemented by HCRP; Nepal Genebank; Network for Agrobiodiversity Conservation (NABIC); Bioresource Conservation Movement, Begnas, Kaski; Agriculture Development and Conservation Society (ADCS), Bara; BCDC, Namdu, Dolakha and Talium Jumla; Lekhnath Municipality, DADOs, business actors, schools, Anamolbiu Pvt. Ltd., Bioversity International, MSSRF, Proinpa, IFAD.

Figure 1: Indigenous women in Manang district of Nepal harvesting Finger millet. Source: https://www.nepalitimes.com

3.5 Some NUCS found in Nepal

Proso millet (Chino)

Foxtail millet (Kaaguno)

Sorghum (Junelo)

Red amaranth (Laal Saag)

Wild millet (Baale Banso)

Wild rice (Jungali Dhaan)


Wild asparagus (Ban Kurilo)


Taro (Pidalu,Karkalo)


Yam (Ban Tarul)


Drumstick (Sital Chini)


Tartary buckwheat (Titephapar)


Custured apple (Sita Fal)


Poke berry (Jaringo)


wild fern (Niuro)


Stinging nettle (Sisnu)


Lvy gourd (Kundruk)

3.6 Productivity and Area of cultivation of NUCS in Nepal

Many of the NUCS are not at main stream of agricultural research. Their Phenology and crop management practices are still unknown. So their Productivity and area of cultivation is very low in compare to other main crops.

Table 1: Productivity and area of cultivation of some of the NUCS in Nepal

S.N	NUCS	Productivity (ton/ha)	Area of cultivation (ha)
1.	Foxtail millet	0.99	1000
2.	Proso millet	0.819	1000
3.	Grain amaranth	1.55	5000
4.	Taro	10	4040
5.	Greater yam	13	775
6.	Drumstick	40 t green pods	1500
7.	Tartary buckwheat	1-1.4	10819
8.	Faba been	8	1200
9.	Rice been	1.3	5000
10.	Wood apple	20	450
11.	Custard apple	13	800
12.	Perilla	1.2-1.4	2000
13.	Nepali pepper	0.6-0.8	200
14.	Chayot	44.6	3536

Source: Ministry Of Agriculture and Livestock Development, 2017

3.7 Present Status of finger millet production in Nepal

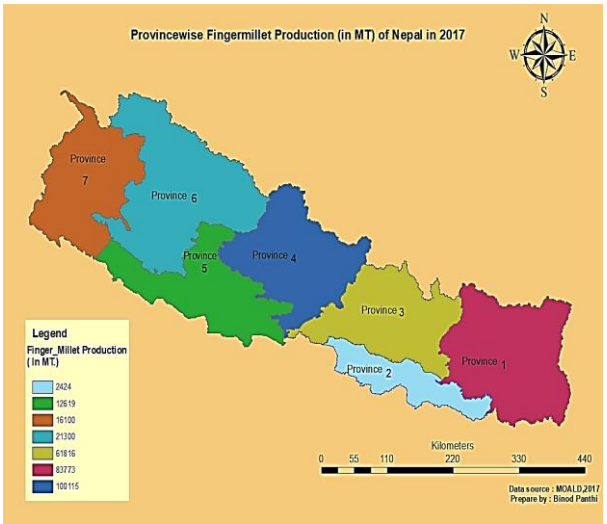

Figure 2: Provence wise finger millet production in Nepal
Source: Ministry Of Agriculture and Livestock Development, 2017

3.8 Importance of NUCS

It is important to broaden research on neglected and underutilized crops species (NUCS) from the perspective of mainstream agricultural research. To rural farmers, these crops remain valuable. Adapted to niches and marginal areas and with rich indigenous knowledge, these crops are important for local consumption and production systems.

3.8.1 High Nutritional and Medicinal Value

The Green Revolution only focuses on increasing crops yield but less attention was given to the nutritional Quality. As a result, diets deficient in essential vitamins and micro-nutrients still persist in many parts of the world. Of the world's estimated 7,000 million people, 500 million still suffer from protein-energy malnutrition, but over 1,600 million suffer from iron deficiency, over 200 million from vitamin A insufficiency (WHO 2008, 2009). Many NUCS are high in carotenoids and minerals and therefore could play a role in helping to improve the micro-nutrient content in the diets of millions of people around the world.

However many people of developing countries like Nepal it is very difficult to afford high quality food products, these products are often out of reach for the poorest in society. But this demand can be easily fulfilled by many locally available fruit and vegetable. The transition from traditional diets based on local foods to a 'Westernstyle' diet, high in fats, salt, sugar and processed foods, increases the incidence of non-communicable diseases, such as diabetes, obesity, heart disease and certain types of cancer. Thus those problems only can be tackled by increasing production, productivity and quality of NUCS.

3.8.2 Socio Economic Importance

NUCS, especially high value crops, locally available fruits and vegetable can be the major source of income for the people especially living in rural Nepal. Small-scale farmers and entrepreneurs can get benefits from these crops by improving quality and quantity of production.

According to the data presented by the Ministry of Agriculture and Livestock Development at the Office of the Prime Minister and Council of Ministers In finalcial year 2075-2076. The import of rice, maize, soybean and potato worth over Rs 73 billion last fiscal year. Rice worth Rs 13.58 billion was imported in five months of the current fiscal and its import throughout the year last fiscal was put at Rs 23.87 billion. There is another statistics as well. Maize remains as one of tthe major crops of Nepal, but the scenario is something opposite. In the past five months, the country spend Rs 19 billion in import of maize. According to the Foreign Employment Promotion Board, around 4.5 million Nepali youths were abroad for foreign employment. A big chunk of their remittance has been spent in the unproductive sector.

The above data shows that Nepal loss lots of money yearly in the imports of various food crops. Thus, in order to replace import and to inhance echonomy of our country increasing the production and quality of NUCS can play the vital role in present context of Nepal.

3.8.3 Maintaining Biodiversity and Soil Fertility

Increasing in the cultivation and production of NUCS help in maintaining biodiversity. Cultivation of NUCS in barren and marginal land can increase plant diversity for maintaining balance in whole ecosystem. Introduction of NUCS in cropping pattern can be best suited in Neplease farming system. Inter cropping of NUCS with major food crops helps to increase cropping intensity (CI) as well as land efficiency ratio (LER). Generally NUCS uptake less nutrients from soil in compare to other major crops which can helps in maintaining soil fertility.

3.8.4 Importance in Maintaining Cultural Identity

Generally, it is being recognized that traditional food systems are intertwined with the cultural identity of indigenous peoples. Their knowledge of local ecosystems and food sources has evolved over generations. It is becoming clear that conserving traditional food systems is a powerful way to contribute toward saving local ecosystems and food sources as well as their cultural identity. For example buckwheat and finger millet is grown by Magar community of Himalayan and midhills . Fingermillet is cultivated by those tribes in order made alcohol which is used by them in various occasions such as marriage ceremony etc.

3.9 Challenges of Neglected and Underutilized Crops Species

Neglected and underutilized crops have great potential to support smallholder farmers and rural communities by improving their incomes and food and nutritional security while also sustaining the genetic resources needed to address present and future environmental and economic challenges.

Some of the challenges of NUCS according to FAO (2010)

Table 2: Challenges of Neglected and Underutilized Crops Species

Social	• Decisions of farmers to replace traditional, local crops with new varieties and improved crops • Changes in diet that accompany urbanization • Loss of the indigenous knowledge of traditional and local crops • Inadequate awareness of the nutritional value of local varieties • Perceived low status of some local and traditional foods • Migration of farm labour to urban areas • Overexploitation of wild resources
Economic	• Changes in land use • Low commercial value of NUS • Lack of competitiveness of NUS with other crops • Lack of market infrastructure • Lack of market niches for NUS • Lack of incentives for farmers to continue to maintain NUS in their fields and gardens
Environmental	• Genetic erosion of NUS genepools through the effects of droughts, fires, pests, diseases, overexploitation, overgrazing, land clearing and deforestation • Effects of climate change • Environmental pollution • Ecosystem degradation
Agronomic	• Insufficient propagation materials and seeds • Lack of seed supply systems • Insufficiently trained human resources • Overuse of pesticides, fertilizers and other agrochemicals
Political	• Failure of national and local governments to make conservation and use of NUS a priority • Lack of funds for ex situ conservation • Lack of adequate facilities and electricity supplies to maintain ex situ collections • Failure of governments to support scientific research on NUS • Lack of characterization, breeding and evaluation information • Absence of legal frameworks, policies, projects, national programmes and strategies • Lack of integration between conservation and use programmes

Source: Country reports for the Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture (FAO 2010).

How to promote NUCS?

i) Increase policy, research and development work on NUCS
ii) Improve germplasm
iii) Ensure conservation, and protection of local landraces
iv) Strengthen its seed supply.

4. Summary and Conclusion

Nepal has great diversity of neglected and underutilized crop species. These species have enormous nutritional, medicinal and economic values which could contribute to proverty reduction mainly in rural areas and improvement of both nutritional and health status of local population. But unfortunately these crops have never been in priority of national agricultural research system. It is possible that the key to future food and nutrition security may very well lie in the untapped potential of NUCS. Therefore, it is imperative that we study locally available neglected underutilised crops and evaluate them for drought tolerance using agronomic techniques as well as modern techniques such as crop modelling, which allow for rapid evaluation of production scenarios.

Hence, instead of developing the foreign Genetically Modified crops (GMOs) such as Tritium, priority should be given towards indigenous NUCS for maintaining food and nutrients security as well as for sustainable development of agriculture.

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