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Review Article

An Overview: Distribution, Production, and Diversity of Local Landraces of Buckwheat in Nepal

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Buckwheat is a sixth staple food crop after rice, wheat, maize, finger millet, and barley in Nepal. It is considered as an alternate cereal and poor man's crop, representing an important food supply in remote places of Himalayas. It is the best crop in higher altitude in terms of adaptation to different climatic variables and easily fitted to different cropping patterns due to short duration. It is cultivated on marginal land in 61 out of 75 districts of Nepal from some 60 m to 4500 m asl, especially hilly and mountain districts like Rukum, Rolpa, Jajarkot, Dolpa, Humla, Jumla, Kalikot, Kavre, Dolakha, and Okhaldhunga. Sweet buckwheat varieties are generally grown in midhill and Terai but Tartary buckwheat varieties are grown in higher altitude. There are altogether 19 local landraces of sweat buckwheat and 37 for Tartary buckwheat listed from Nepal. The largest producers are China, USA, and Russia and Japan is principal user of global buckwheat grown in the world. In Nepal, it is cultivated in 10510 ha area with production of 10355 t/yr and yield of 0.983 t/ha. It has also medicinal value used in different forms including all its parts so the demand of buckwheat is increasing.

1. Introduction

Nepal (26°–31°N latitudes to 80°–89°E longitudes) is a land-locked country dominated by huge mountains with varied climate and topography, orography within about 240 Km north-south. The climate ranges from tropical to temperate and alpine due to its topography and elevation, Figure 1.

Agricultural sectors contribute about 36% to National Gross Domestic product (GDP) and sixty-five percentage of total population still depends on agriculture in Nepal [1]. The agricultural lands are diverse in different physiographic regions. Mountain and high Himalaya has difficult sloping land and topography where people depend only on agriculture for their livelihood [2]. There are 125 ethnic communities residing in various regions in Nepal having their own system of culture and agricultural practices [1]. The major components of agriculture are cereals, legumes, cash crops, fruits, vegetables, and livestock. Cereal crops include paddy, wheat, maize, finger millet, buckwheat, barley, naked barley, Chino (Proso millet), and Kaguno (Foxtail millet). Farmers commonly prefer those crop varieties that produce high yield in low input, can tolerate stresses, need less care, can be grown in diverse agroclimatic condition, possess balance nutrients, and have good market prices.

Buckwheat is one of the best crops in higher altitude in terms of adaptation to climatic variables, water stress regimes, unfertile soil, and freezing temperature and is easily fitted to different cropping pattern due to short life cycle [3, 4].

Taxonomy. *Fagopyrum esculentum* Moench (sweet buckwheat) and *Fagopyrum tataricum* (L.) Gaertn. (bitter buckwheat) belong to family Polygonaceae. Globally 18 species are known to be the members of genus *Fagopyrum* including two cultivated species *Fagopyrum esculentum* and *F. tataricum* [5].

Synonym. *F. esculentum* subsp. *ancestralis* Ohnishi is a synonym for sweet buckwheat; *Polygonum tataricum* L., *F. suffruticosum* F. Schmidt., *F. dentatum* Moench, *Fagopyrum*

Figure 1: Distribution of cultivated buckwheat in districts of Nepal.

rotundatum Bab., and *F. subdentatum* Gilib. are synonyms for bitter buckwheat [6].

Common Names. The following is a list of the common names: sweet buckwheat or common buckwheat, Tartary buckwheat or bitter buckwheat (English), *Mithe Phaper* for common buckwheat, *Tite Phaper* for Tartary buckwheat (Nepali), *er chi* for common buckwheat, *er ka* for Tartary buckwheat (Chinese), *Ogal* for common buckwheat, Phaper for Tartary buckwheat (India), *Jare* for common and *bjo* for Tartary buckwheat (Bhutan), and *Soba* in Japan [6].

In Nepal, buckwheat cultivation ranges from 60 m in Terai to 4500 m above sea level (asl.) [4, 5, 7, 8]. *F. esculentum* is generally grown in lower altitude (Terai and mid-hills) but in higher altitude *F. esculentum* is replaced with *F. tataricum* in different cropping pattern [4, 9, 10]. It is cultivated in 61 out of 75 districts of Nepal Figure 1 [4]. Buckwheat varieties are summer crop in hill (high altitude > 1700 m asl), autumn and spring crop in mid-hills (600–1700 m asl), and winter crop in Terai [10, 11]. However, all seasons (summer, autumn, winter, and spring) are suitable to cultivate buckwheat in different agroecological zones of Nepal.

It has been occupying an important place in the Nepalese agriculture system and contributing greatly in food supply especially remote places in Himalayas, though it is popularly considered as pseudocereals, poor man's crop, and underexploited and neglected crops in Nepal [12]. It has been cultivated in almost all parts of Nepal mostly at high altitude of western and mid-western regions. It prefers to grow best in cool, moist climatic condition though it is sensitive to frost, high temperature, high speed wind, and drought. These stresses to buckwheat crop critically reduced yield when they occur during flowering periods. It matures within 10–12 weeks of plantation that is essential in high Himalayan region of Nepal where it is favorable for cropping duration to be short. Buckwheat is the sixth staple food crop after rice, wheat, maize, finger millet, and barley in terms of cultivation area (10510 ha.), production (10355 t/yr), yield (983 kg/ha.), and uses in Nepal [13].

The aim of present paper is to attempt to augment and update the available information on buckwheat crop from Nepal based upon literature, web-based information, proceedings, annual reports of Ministry of Agriculture Development, Nepal Agricultural Research Council (NARC), and Department of Agriculture in Nepal.

2. Biology of Buckwheat Plants

2.1. Fagopyrum esculentum Moench. It is an annual herbaceous plant with free branches, reddish stem produces sucker for adaptation in its existing environment, reaching up to the height of 1.5 m. It has deep rooted branched taproot system. Leaf is simple and petiolate, leaf blade is ovate-triangular, 2–8 cm long, and tip acuminate, leaf base is cordate or hastate, and upper leaves are small and sessile. Corymbose or paniculate cyme type of inflorescence is either terminal or auxiliary position. Each inflorescence consists of 7–9 small flowers, white, pink, or yellow in colour, and flowers are heteromorphous in nature. Pedicel is 2-3 mm long and articulate; perianth is 3 mm long; 8 nectaries are yellow, alternating with stamens, being heterostyly; stigma is capitate. Achene is triquetrous, acute angle, longer than 5 mm, more than twice the length of the persistent perianth, brown or black-brown, and lucid [14]. It has two types of flowers, that is, pin and thrum flowers cross-pollinating type of fertilization [4]. Seeds are fully matured within 35–45 days after pollination but depend upon the temperature [15]; seeds are generally triangular but vary with varieties. Seeds hull density is less than water that makes easy to remove from seeds [16].

2.2. Fagopyrum tataricum (L.) Gaertn. Herbaceous plant is characterized with colourful branches or unbranched stem reaching up to 1 m, branched taproot system, petiolated leaves, triangular leaf blade with the length being almost equal with width, 2–8 cm, and cordate or hastate leaf bases. Inflorescences are dense spicate or corymbose. Flowers are yellow-green, 2.5 mm in diameter, pedicels are nonparticulate; perianth is 2 mm long; 8 nectaries are yellow, alternating with stamens, being homostyly, that is, self-pollinated flowers; stigmas are capitate. Triquetrous achene is about 5 mm long, exserting more than twice the length of the persistent perianth, with three deep grooves, and the angles are rounded, except at the tip. Flowers are homomorphic, self-fertile, and cleistogamous with pollination occurring before the flower opens [14].

3. Distribution

The cultivated species of buckwheat is assumed to be native to temperate east Asia, particularly eastern site of Himalayas and southwestern China [14, 17, 18]. The exact place of origin of common buckwheat is considered as Yunnan province and in between Yunnan and Sichuan provinces of China [19]. Buckwheat was cultivated nearly 5000–6000 years ago in China and it entered Europe through Russia and spread to North America through immigrants [14].

Buckwheat is cultivated in hilly areas in Europe (also in lowlands), east Asia, and the Himalayan region. China is the biggest producer and exporter of buckwheat followed by USSR, and Japan is a principal importer of buckwheat

Table 1: Local names of common and bitter buckwheat in Nepal.

SN	Type of buckwheat (local landraces)	
1	Common (sweet) buckwheat	Bitter (Tartary) buckwheat
	Bahramase, Batule, Bisam, Chhendrak, Chendrung, Ghode, Ghabre, Gulio, Jhusile, Kalo Madane, Mithe, Mithi, Ogale, Seto, Seychun, Sathiya, Seyekar, Thulo, Tote Phaper	*Oule, Barkhe, Bharule, Bhadre, Bhalu, Tite, Jhoumle, Chiniya, Chuchche, Dalle, Dhahasur, Dhau, Dhesu, Dhop, Ghamre, Gharelu, Gore, Jamdalo, Jhaumre, Kalo kise, Seto kise, Kamre, Khumbeli, Lekhari, Pranah, Rani tite, spangre, Tabre, Tan, Tar, Tasung, Techhung, Tensya Teta, Thou, Thinkunde tite, Tuchi, Tuchi tite Phaper*

up to 2000 [20], but the scenario has changed, and USA became main exporter and Japan remains a major importer of American buckwheat although China, Russia, and Canada are leading sources of buckwheat flour in 2012 [21]. In Nepal, nowadays, the demand of buckwheat is increasing due to its multiple uses [8].

Buckwheat is a pseudocereal/minor food, has a short duration, a cash crop but it is one of the major staple food crops of high mountain people of Nepal. It is commonly grown in hilly and mountain regions especially in Rukum, Rolpa, Jajarkot, Dolpa, Kavre, Dolakha, Okhaldhunga, Mustang, Solukhumbu, and Taplejung districts regularly since time immemorial. But recently it has been grown in some Terai districts like Chitwan, Jhapa, and Nawalparasi for commercial purposes especially for green vegetable which has very high demand due to rutin contents (farmers interview). Every family grows Tartary buckwheat in upper Mustang and Dolpa districts and diversity of buckwheat is very high in Manang, Dolpa, Mustang, Jumla, and Solukhumbu [4, 22]. Bitter buckwheat is grown in marginal land in higher altitudes. It can withstand the poor, infertile, and acidic soils, nutrients, moistures, and heat stress with wider adaptability [14] which is prevalent to hilly area of Nepal, as shown in Figure 1. These unique characteristics of buckwheat show a great potential crop in future in food-deficit areas like high mountains which has high risk of climate change impact.

Buckwheat is drought-tolerant crop and requires approximately 100 mm rain for its whole growth period [23]. In midhills, the cultivation area of buckwheat may be increased if seedlings are insufficient and/or if the land is fallow due to poor fertility [24]. Buckwheat is short duration crop but its flowering period is more than 30 days [25] which is much useful to beekeepers as this yields quality honey.

4. Diversity of Local Landraces of Buckwheat in Nepal

So far five species of *Fagopyrum* (buckwheat), namely, *F. esculentum* subsp. *esculentum*, *F. tataricum* subsp. *tataricum*, *F. tataricum* subsp. *potanini*, *F. tataricum* subsp. *annum*, *F. cymosum*, *F. gracilipes*, and *F. megacarpum*, have been reported from Karnali zone [26] with the local names of following buckwheat landraces including crop calendar and productivity from western Nepal.

Mithe Phaper, local chuchche, Local Lekhari, Bhate, ACC#2223 (recommended variety by NARC), *Dalle, Kalo, Barule, Takule, Tilkunde, Tote, Ghode,* and *Tite Phaper* are the names of local landraces recorded from Karnali zone and seeding time varies from *Jestha, Ashad*, and *Srawan* months and harvesting time from *Bhadra, Aswin*, and *Kartik* months, respectively (Table 1). The productivity of these varieties varies from district to districts and also depends upon the type of local varieties. Joshi et al. (2014) recorded from 0.90 t/ha (Jumla) lowest to 1.96 t/ha (Mugu) highest production in that year within five districts (Jumla, Kalikot, Dolpa, Humla, and Mugu) of Karnali zone.

Local landraces of buckwheat from Jumla districts of Karnali zone from Nepal include *Barule, Bharule, Chuchche, Chode, Kalo, Mithe, Seto, Tilkhude, Tite,* and *Tote Phaper* [27]. However, Rana et al. (2000) compiled six local landraces of buckwheat from Talium Village Development Committee (VDC) of the same district as *Batule, Bharule, Mithe, Murali, Tilkhunde*, and *Tite Phaper. Bharule, Mithe, Tilkhude*, and *Tite Phaper* are included on red list due to vulnerability of their conservation (Table 1) [28].

Joshi et al. (2014) compiled main morphological characters of some preferred local landraces of buckwheat based on liked or disliked traits by farmers in the Karnali zone as follows:

(1) *Mithe Phapar* having red stem and leaf, tall plant with white flower and shiny black triangular large seed are tasty, thick husk, lodging resistance, and good for dizziness disease but farmers dislike their low grain yield straw which is not good for livestock.

(2) *Barule Phaper* having medium plant and leaves size and seeds without pointing are of high yielding, short duration variety, leaf useful for vegetables, more branching, and more flour yield, do not need of intercultural operations, are useful for livestock, and are good for pregnant livestock; those are the liked traits, but bitterness, flour that come out from seeds when rainfall occurs after maturity, and difficulty to grind when eating more which can create swelling problem are disliked traits.

(3) *Chuchche Phaper*, tall pant with triangular leaf of low branching with long triangular seeds, are liked by farmers due to its low cost of intercultural operations, leaves that are useful for fresh and dry vegetables, high yield, early maturity, usefulness for cough, jaundice, and diabetes diseases, low weed problems, and usefulness for sick animals and animals during bleeding but they are disliked due to their bitterness, causing headache, turning eye yellow, and swelling the body

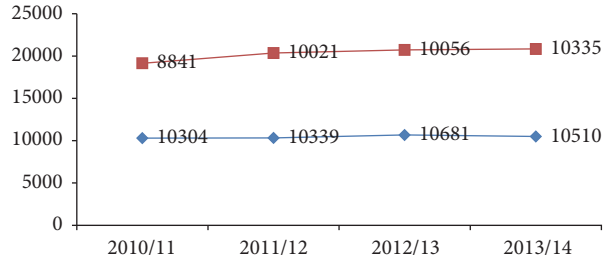

Figure 2: Cultivation area and production of buckwheat in Nepal from 2010 to 2014.

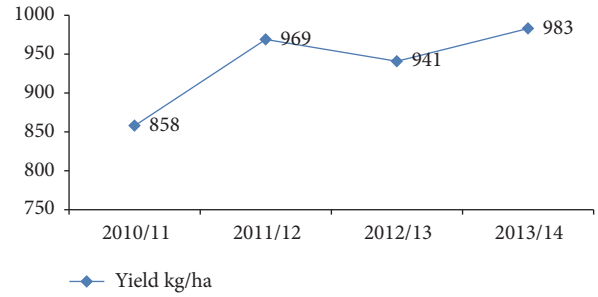

Figure 3: Yield of buckwheat in Nepal from 2010 to 2014.

when eating more, no seed set in case of high moisture and fertile soil, and lodging problem in fertile soil.

Joshi and Ghimire (2015) have compiled the local names of landraces of buckwheat from Nepal as in Table 1.

5. Production

There is a report of country-wise production of buckwheat: higher producers are Russia (833,936 t.) followed by China (733,000 t.), Kazakhstan (276840 t.), and Nepal (10056 t.) and Slovakia (68 t.), Republic of Moldova (40 t.), and Kyrgyzstan (25 t.) are lower producers in each year [29].

Grain yield and landraces varieties richness of Tartary buckwheat in Nepal are higher than that of common buckwheat but farmer less prefer the Tartary buckwheat one because of more bitterness and difficulty in producing flour after dehulling [26]. The production of bitter buckwheat is recorded more than common buckwheat due to self-pollinating nature [30].

According to Ministry of Agricultural Development, Nepal cultivates the buckwheat in 10510 ha. area with production of 10355 t/yr and yield of 0.983 t/ha [13]. The trend of production and yield of buckwheat in Nepal is slightly changed from 2010 to 2014 AD (Figures 2 and 3). This production of buckwheat is unable to meet the country demand. From the last 10 months (September, 2015–July, 2016) records showed that 2548 tons of buckwheat were imported from various countries with worth of about 67 US dollars in Nepal [31].

Productivity of *F. esculentum* is highly variable in global. It is recorded as 0.55 t/ha in Nepal, 3.0 t/ha in USSR, and 0.89 t/ha in the world. Productivity of this crop depends on numerous factors like site specificity, quality of seed, time of seed sowing, and so forth [4]. The production of buckwheat in five districts of Karnali zone was recorded and it found that it was highest in Mugu district with 982 t/ha., followed by Humla, Dolpa, Kalikot, and Jumla districts, respectively, and average production and yield in Karnali zone (Pocket area of buckwheat in Nepal) were 377 t/ha. and 1.082 t/ha, respectively [26].

6. Growth Value of Buckwheat

Buckwheat is a multipurpose crop and has been cultivated for its uses as staple food, animal feed, vegetable, soup, beverage, and medicine [32]. All parts of buckwheat plants are used in varieties of ways. The leaf produced rutin important pharmaceutical product which is used to brew tea used to treat hypertonia; flowers which bloom about one month produce good quality nectar for honey; grain is the staple food; hulls of grain are used to make pillows; straw is good source feed for livestock; and green plants are used as green manures [18].

There is a list of 34 food items prepared from buckwheat in Nepal such as dhindo (thick porridge), roti (bread), momo (Chinese pancake), lagar (very thick bread), dheshu (thicker than lagar), fresh vegetables, dried vegetables, Kancho pitho (raw flour), chhyang or jaand (local beer), raksi (alcohol), salad (leaves), pickle (fresh and dry leaves), soup, ryale roti, Noodle, sel roti, bhat (rice), sausage, dorpa dal, tea, vinegar, jam, macaroni, biscuit, cakes, mithai (sweet), haluwa, puri, puwa, bhuteko Phapar (roasted grain), satu, phuraula, porridge, and pakauda. Nepalese mountain people prefer dhindo than other items because of its specific taste [4].

Common buckwheat is mostly used as bread pancake attractive item to the tourist in the tracking root of Mustang. Thick porridge prepared by mixing the flour of bitter buckwheat with Uwa (Oat) or finger millet in 1 : 3 ratio is common food of poor people in hilly area. Buckwheat has high nutrition because of balance amino acids and minerals [33] as well as free from cholesterol [34]; nowadays, it is a preferred diet in urban areas. Both buckwheat species have pharmaceutical value; the food of buckwheat has a preventive action on leg oedema [35], high blood pressure and cholesterol, and cardiovascular disease [36]. Major component of buckwheat is rutin, which is higher in bitter buckwheat than in sweet one due to the high nutrients and pharmaceutical value; Nepal has a great scope to export the buckwheat. Paste of Tartary buckwheat's flour is applied for treating wounds and fire burn, and its semicooked flour is used orally to cure cold, cough, jaundice, and fever; fresh flour is good for dandruff treatment as well as for stopping hair fall; flour paste is used in pimples and skin scratches; Tartary buckwheat flour drained water after dipping overnight is used for epilepsy; tender, twigs, and leaves of wild buckwheat is used in dysentery, pneumonia, and cholera and reduces the effect of poison; soaked flour is useful for internal worms [26]. Buckwheat flour is given to the sick goat and sheep. Common buckwheat is also preferred by local people during the fasting on the religious occasions [4, 37]

7. Conclusion

The agricultural land of Nepal is very diverse due to varied physiography. The cropping pattern is varied in different region of Nepal; it also depends on elevation, culture, and agriculture practices of ethnic communities. Sixty-five percentage of total population still depend on agriculture and contributed 36% for National GDP.

Buckwheat is native crop of temperate east Asia, that is, eastern site of Himalaya and southwestern China. It was introduced to Europe and American countries through immigrants. China, Russia, and USA are major producers and exporters of buckwheat and Japan is the main importer. Buckwheat is one of the major crops in high mountain of Nepal and cultivated in 61 out of 75 districts ranging from 60 m to 4500 m altitude, especially Rukum, Rolpa, Jajarkot, Dolakha, Solukhumbu, Kalikot, Kavre, and Okhaldhunga districts as well in the districts of Karnali zones of western Nepal. It is summer crop in hill (high altitude > 1700 m asl), autumn and spring crop in mid-hills (600–1700 m asl), and winter crop in Terai.

To date, five species of *Fagopyrum* (buckwheat), namely, *F. esculentum*, *F. tataricum*, *F. cymosum*, *F. gracilipes*, and *F. megacarpum*, have been reported from Nepal [4]. Buckwheat is multiple useful crop plant with medicinal value and all its parts (roots, stem, leaves, flower, fruits, and flour) are used to care various alignments (diseases) locally in traditional healthcare system. The demand of buckwheat is increasing nowadays due to its multiple uses.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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