

Research Article

Bung: A traditional practice of potato cultivation in eastern hills of Nepal

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ABSTRACT

Eastern hill region is one of the high potato producing areas of potato in Nepal. There are many traditional potato production systems existing in the region. Among them, 'Bung' and 'Lhose' are very popular systems. There are some under-proven views of naming to this unique cultivation practice. Field observations, key informants' interview, and group discussion were carried out at three sites of Okhaldhunga and Solukhumbu districts in July 2019 to explore the basic information on the bung system. The results of this investigation revealed that the century-old practice utilized marginal sloppy lands of mountains for cultivation of potatoes. Farmers left land fallow for 4-5 years to grow weeds and herbs. Thereafter, they slashed them with a thin layer of soil, stacked them over winter, burned and mixed with the soil making a raised pit. They planted 15-25 potato seed tubers into these pits depending upon the pit size. No additional fertilizer is added to these pits. No intercultural operations are carried out until harvesting. It was explained that the yield of potato from the bung was significantly higher (15-20 kg) than that of general local practice called lhose system (5-7 kg) from the area equivalent to Bung. Some interventions such as high yielding varieties, easy-to-handle equipment for bung preparation and introduction of fast-growing non-hazardous weeds, etc. were the demands of the farmers to increase profit from the bung system.

Key words: Bung, Slash and Burn, Pit, *Khumbule*, *Bhotange*

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INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the major crops in Nepal. It is more popular among the rural, resources poor and small landholding farmers of Nepal (Sapkota & Bajracharya, 2018). Potato is one of the important crops to address food insecurity in the country (Subedi et al., 2019). It is mainly grown and utilized as vegetables in plains and mid-hills (Kafle & Shah, 2012), but one of the major staple food crops in the high-hills (Kafle & Shah, 2012; Timsina *et al.*, 2011). Based on the area, potato ranks the fifth position in Nepal with coverage of 195,173 ha and production of 2,881,829 mt potatoes (ABPSD, 2018). The mid-hills is the main domain of potato production (41.5% area coverage) followed by plains (38.5%) and highlands (20%). Moreover, it ranks the second position based on production with the productivity of 14.7 t/ha in 2017/18 (MoAD, 2018). Current productivity of potato in Nepal is low as compared with other neighboring countries. According to FAO (2017), its productivity in Bangladesh, China, India and Pakistan was 22.5, 18.9, 24.6 and 24.8, mt/ha, respectively. According to national statistics, the area, production and productivity of Solukhumbu district were 10,145 ha, 153,799 mt and 15.16 t/ha while in Okhaldhunga, they were 1,494 ha, 15,751 t and 10,543 t/ha, respectively.

There are many reasons for the low productivity of potato in Nepal. Adhikari and Ghimire (2017) illustrated some major issues (varieties, post-harvest technologies, a traditional system of farming, quality seeds, etc.) responsible for low productivity of potato in Nepal. Lack of knowledge of improved cultivation practices was a major cause of low productivity in hills (Panta *et al.*, 2017). Though many traditional practices are applied for potato cultivation in different parts of Nepal, their detail information is yet to be collected.

Sloppy lands and rugged terraces are the main characteristics of the high hills and mountains. The success of crop production under these sloppy hills of Nepal needs labor-intensive and meticulous management of the agricultural land (Bajracharya, 2001). Some of the rural hill farmers are still following unique traditional practices such as *lhose* system in eastern high hills, *navo* system in mid and western hills, *khoria* in marginal sloppy lands, seeding with plowing in highlands, etc. *Khoria* is an old practice of 'slash and burn' prevalent in small pockets of the mid-hills of Nepal, such as in Gorkha, Chitwan, Dhading, Makwanpur, Tanahun, Nawalparasi districts and in the Makalu-Barun area (Bajracharya, 2001). *Bukma* or *buk* system of fertilization method is generally found in the north-central and northeastern parts of Nepal (Dhakal, 1993). *Navo* system is followed in high hills where farmers leave small tubers in the field for the next-season crop (Khairegoli, 1998). No written evidence has been found of when the bung cultivation began, but some written documents have estimated it to have existed before the middle of the eighteenth century when the potato was introduced into Nepal. For example, in a book entitled 'An Account of the Kingdom of Nepal' written by Colonel Kirk Patrick of Britain after his visit to Nepal in 1793, Kathmandu's farmers mentioned that potato could not be cultivated even if fresh seeds were not brought from Patna, indicating that potato was prevalent in Nepal before that date.

Similarly, in the book 'The Sherpas of Nepal', published by Fürer-Haimendorf in 1964, potato farming is estimated to have begun in the mid-19th century in the Solukhumbu region. Earlier, in the book 'In Highest Nepal' written by Norman Hardy in 1957, before the beginning of potato farming in the Solukhumbu area, Sherpas used to live a livelihood of livestock farming, but potato farming changed their livelihoods by changing their cultural, religious, social and economic status (Khairegoli, 1998), thus, it is not difficult to imagine that the Sherpas would have planted potatoes wherever they were reached in search of grasslands for livestock. It may have been called a revolving life to graze on highland pastures or sometimes down to grazing. Not only Sherpa during the potato cultivation but also other communities of the area went to cultivate potatoes wherever possible; from the highlands, sloppy lands, forests to cultivable land. While cultivating this way, different methods of cultivation have been developed as well as the beginning of the bung system.

The word 'bung' literally means in Nepali that the dust should suddenly fly or smoke, but the word may have come from the words of a tribal group of indigenous people who are more abundant in that area. In the language of Kulung (Rai) in the local Mahakulung area, the word bung means the flower (DZI Foundation, 2018). The Kulung Rai and Sherpa Cultural Trek on the website of the United Brothers' Trek and Expedition say that bung is a beautiful flower in the Rai language. The fact that bung means a flower in the Rai language can be seen in some dictionaries and other sources. There is no connection between the bung cultivation of potato and the flower, but when mature plants of potatoes appear in bung, they look like a bunch of decorative flowers.

Although, these traditional practices seem logical because of ecology, topography, social, cultural and economic perspective; in-depth knowledge is very necessary to make plan and policies to protect, investigate and modify traditional practices to uplift the farmers' livelihood. The area and production under bung in Solukhumbu and Okhaldhunga is a matter of study because the national statistics has no separate data for bung and *lhose*. Therefore, this paper depicted on the 'bung' system of potato production as unique and traditional system in highlands of Solukhumbu and Okhaldhunga districts of Nepal.

METHODOLOGY

Study area

A field visit was organized by Agricultural Environment Research Division at Thade (Siddhicharan Municipality) of Okhaldhunga and Patale and Salleri (Dudhkunda Municipality) of Solukhumbu district. Thade and Patale were borders of two districts (27° 18' 60" N and 86° 29' 59" E) while Salleri (27° 29' 59" N and 86° 34' 59" E) was a city of district headquarter. The altitude of Thade and Pattale ranged from 2800-3000 masl while Salleri was situated at 2000-2300 masl. Thade and Pattale were 10-12 km from the district headquarter of Okhaldhunga. The

lands of this type of system were characterized by less fertile sandy to sandy loam soils. The soils get wet during rainy season while remain dry during winter and summer.

Data collection and sampling procedure

Twenty farmers involved in 'bung' system of potato cultivation were selected from simple random sampling technique. A transect walk was carried out to know the agro-techniques, soils-crop status during the second week of July 2019. A semi-structured questionnaire was designed for getting information from the farmers. A group discussion was done with 20 farmers in which 90 percent were females. This was the exploratory investigation in which the information was collected in the local language and translated. Key informants namely Mr. Jhalak Nath Kandel, Head of Krishi Gyan Kendra, Salleri; Mrs. Buddha Maya Magar, a progressive farmer of Thade and Mr. Shyam Magar, a key informant from Patale were also consulted for data collection and verification..

Observations were recorded on history and nomenclature of bung, area and season for bung, agro-techniques, comparison of price and yield of potato to normal practice, merits and demerits of bung system, hindrances for its continuation and researchable issues in bung system. The data were collected from primary sources i.e. farmers. Supplementary information was collected from the Agricultural Knowledge Center, Salleri. The numerical data were tabulated in excel and mean values are presented.

RESULTS AND DISCUSSION

Local definition of 'bung'

Different views were collected from the key informants about the definition of bung. One local key informant Sushil Dorje Sherpa said that the word bung came from the Sherpa language. According to him, in the Sherpa language, the bung is considered to be a heap. He said that the slashing of the weeds in the bung cultivation would be made by stacking one on top of the other. According to Shyam Magar, an intellectual from Thade village on the border of Okhaldhunga and Solukhumbu, in the local language, bung means a pile of anything.

Similarly, Mrs. Buddha Maya Magar, an entrepreneur of the same place, said that the word is related to the thick smoke that cannot burn properly when burning an object. Besides, does this word have any meaning in the language of other ethnicities living in that area? This is a matter of research.

There is also no solid evidence on how bung cultivation was renamed in the potato crop. Local senior citizens also have different opinions. According to one view (50 % of the respondents),

there is a village called bung in Solukhumbu district, since this is the first time that this village has used this type of farming, it is said that its name is known as bung farming. According to another opinion (50 % of respondents), it is said that after burning the weeds in a pit for cultivating potatoes for the first time, the smoke arose like Bungbung in the local language, it was named as bung farming.

Area and season for bung cultivation

Bung system is popular especially in the highlands of Solukhumbu and Okhaldhunga districts. All respondents said that potato was the major crop in Solukhumbu and about 90 percent of the people cultivating potatoes in highlands of these districts. It is also supported by the findings and presentations reported by a survey paper titled ' Solukhumbu: Detailed Need Assessment ' (ACTED, 2015). About 40 percent of total potato was produced in bung system every year. It was observed that the bung system was used at an altitude of more than 2500 meters above sea level. But in some places, it is also reported that the cultivation is done from around 1800 meters. The areas of Okhaldhunga, including Thade, and Patale and bung of Solukhumbu were famous for this farming.

Cultivation usually began after the winter when temperatures increased and frost began. In the absence of snow, the potatoes were planted from the beginning of March. In most of the highland areas, cultivation began from the beginning of February. Thus, some of the preparation works such as slashing grasses with thin soil layer, making a pile of them and turning them at least once were done during winter. It was also a good way to utilize wasteland, starting from the beginning of the season. It was a general trend of planting tubers from February to April and harvest from July to September.

Agro-techniques in bung

Farmers selected seeds from previous season's lot stored in cool and dry open floor of their own house. Seeds were allowed to sprout without any treatment. They didn't wait for sprouting while the time of planting appears. According to the farmer Mr. Shambhu Magar, the tubers stored in August started sprouting after February, if not sprouted, not much time was spent for germination because its dormancy had started breaking.

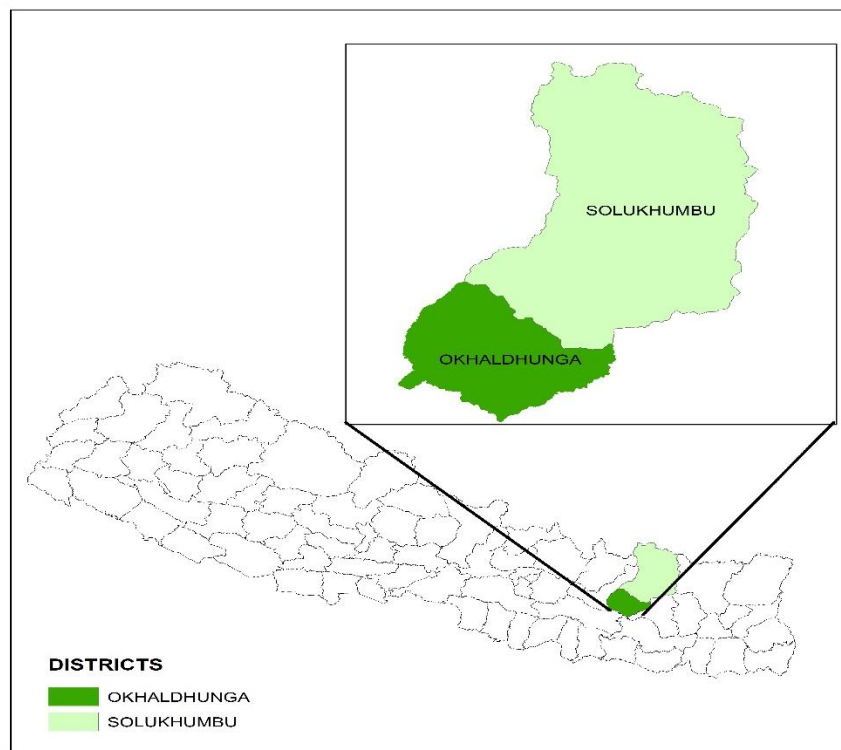


Figure 1: The survey districts for bung system of potato cultivation

Bung preparation started in October-November when weeds germinated in the rainy season had covered the sloppy highlands, their growth had been stopped. These weeds were grown for at least 4 years to obtain an adequate amount for potato cultivation. Farmers scrapped weeds with a thin layer (4-5 cm) of topsoil together or slashed weeds and made circular piles at an irregular distance. According to the farmers, it took 1 day to make pile of weeds scrapped in 5 days. This pit or pile was called as a bung. In piles, the soil portion remained outside while the weed portion remained covered by soil portion. To avoid fermentation of weeds, they turned over at least once during winter. After the winter, the weeds were crushed and dried. There was no determined size of the bung, neither the distance was specified between bungs, though the size of bung ranged from 1 ft to 3 ft in diameter while the distance between bungs ranged from 0.5 m to 1.5 m in the farmer's field. The size and spacing relied on the growth, density and amount of weeds. When weeds were completely dried, farmers burnt them to make char and ash. This heated soil with char and ash was the main source of nutrients for the plants. This particular 'nutrient media' for potato plants was free from pathogens of diseases; eggs, nymphs or larvae of insect pests; and seeds of weeds.

A similar method of potato cultivation was explained by Sah *et al.* (2006) practiced in Meghalaya, India. It was called *Bun* in Meghalaya, India. However, its method of land preparation and planting was quite different. For instance, in *Bun*, pits were formed on the

rectangular, long raised beds and drainage between beds were made, which were lacking in Bung (Plate 1). Similarly, *Bung* was applied in new forest for cultivation while, *Bun* was done in existing lands. In *Bun*, summer and autumn crops (different crops) were produced while in *Bung*, a single potato crop was produced.



Plate 1. Practice of Bung in Thade, Okhaldhunga

The heated soil, char and ash were mixed with soil by digging a pit. The pit was raised making a circular bed for planting seed tubers of potato. Seed tubers with a medium size (20-50 g) were planted in the bung at a distance of 5-10 cm with a planting depth of 10-15 cm and covered with soil. No additional nutrient sources were added to the bung either as basal or as a top dress. No intercultural operations were done after planting until harvesting. Replanting was done if no seed was germinated. No intercrops were planted between and within bungs.

Harvesting was done in July-August when the crop reached at maturity. Farmers uprooted plant with tubers first and remaining tubers dug with a hoe. The tubers were dried to remove soil attached to the surface of the tubers. Thereafter, tubers were graded into three sizes: small, medium and large. Tubers were packed in jute bags and transported to distant markets. For the local market, they were transported physically by filling in '*Doko*' and '*Thunse*', the local conical shaped containers made of bamboo.

Potatoes were stored in open floor of the house where temperatures were comparatively low, humidity was medium and light was diffused with darkness. Thus, a cycle of bung was completed. To begin another cycle in the same land, it should be allowed at least 4 years to grow weeds and herbs in these dry highlands.

Comparison of price for potatoes

It was found that potatoes produced in bung were more delicious than that of common system *lhose*. Therefore, potato produced from bung fetched about 1.5 times higher price than that of *lhose* (Fig. 2), and more than 2 times higher than imported potatoes in their main season (Fig. 2).

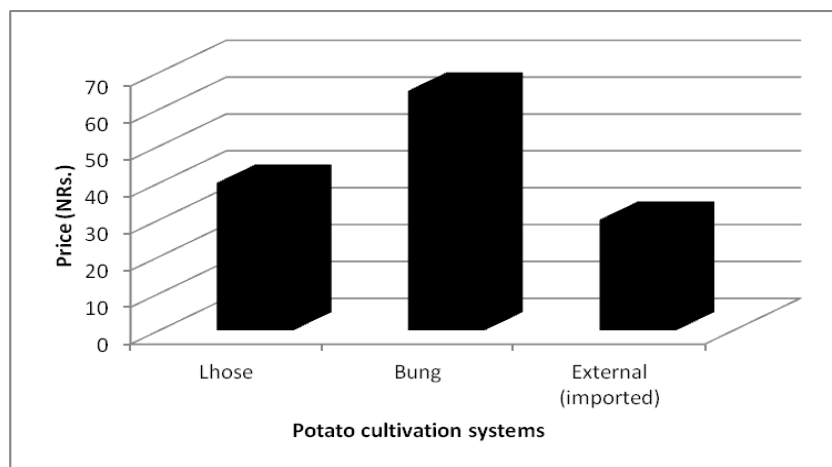


Figure 2. Price for potatoes in Nepalese Rupees per kilogram produced in different system of cultivation in Solukhumbu and Okhandhunga districts

Comparison of production of potatoes

Farmers randomly selected 20 plants from *lhose* and the same number of plants from bung and compared their Yield. There were a significantly higher number of tubers per plant in bung than the *lhose*. Farmers also shared their experience that the yield of potatoes in bung was significantly greater than in *lhose*. However, the size of the tubers was greater in *lhose* due to the more space between plants. Since area of bungs vary depending upon their size and availability of weeds, it was hard to compare the yields in hectare basis. Sometimes, large gaps were appeared between bungs, therefore, the number of bungs per hectare varied significantly. Mean yields of potatoes in 20 farmers' field were recorded based on area of bungs (average of 20) and equivalent area of *lhose* system. Results are presented in Figure 3.

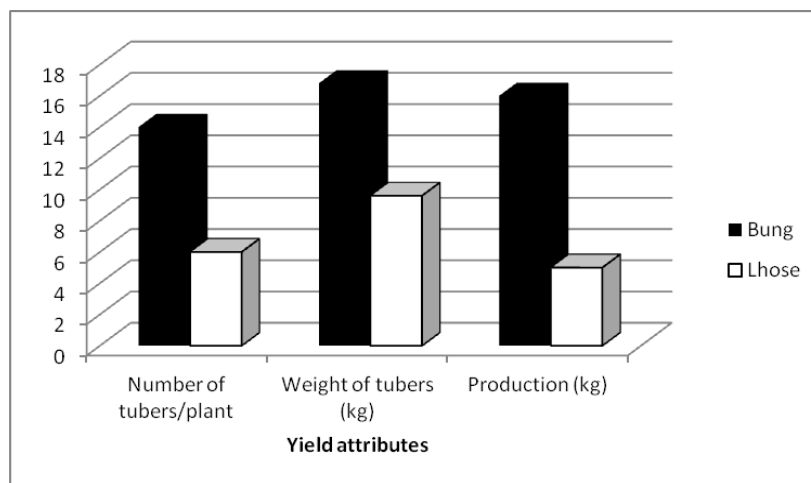


Figure 3. Production of potatoes in different system of cultivation

Merits and demerits of bung system

Farmers explained some merits and demerits of bung system of cultivation during the interview and group discussion. Among the merits, utilization of marginal lands and high yield compared to common practice *lhose* were responded by 30 and 35 per cent of the respondents, respectively.

Table 1: Merits and demerits of bung system of potato cultivation

Merits	Per cent of respondents	Demerits	Per cent of respondents
Utilization of marginal lands	30	Risk of soil erosion	20
High yield compared to common practice <i>lhose</i>	35	Complicated and time consuming	20
Saving laborer for inter-cultural operations	15	Low annual production and income from the same bung	20
High income and delicious produce	5	Possibility of expensive in upcoming time due to scarcity of laborers	5
Organic produce	5	Weather-relying cultivation	15
Aesthetic, ornamental and tourism value	5	Degeneration of continued use of same variety for decades	5
No need of trained manpower	5	Difficult to go for mechanization	15
Total	100	Total	100

For demerits, risk of soil erosion, complicated and time consuming, low annual production and income from the same bung, and weather relying cultivation and difficult to go for mechanization had high votes by respondents. The summary of the results is given in Table 1.

Diseases and insect pests

Warts and late blight of potato were major diseases in the region. Local varieties (15%) were more infected than the released varieties (disease free). According to the respondents, hundred percent of crops was infected by late blight disease when weather was worst due to continued cloud and frequent rain for a week or longer. If disease occurred later after tuber development, no significant losses occur due to this disease. The weather was favorable for the crop in the season when the data were recorded for this study. Similarly, white grubs were major insect pest. Farmers applied no pesticides against the diseases and pests. Other pests were wild pigs, deer, porcupine, etc. No control measures were applied against these wild animals.

Hindrances of bung system

According to the farmers, recently, the continuation of this traditional practice is questioned due to the many problems. Forty percent of the respondents voted for lack of adequate number of laborers while 30 percent were in favor of low priority for bung in government policy. Migration, a problem occurred in recent years, was responded by 30 percent of the respondents. A summary of the Hindrances expressed in field observation, group discussion, personal communication is given in Table 2.

Table 2: Hindrances for the continuation of bung system

S.N.	Hindrances	Per cent of respondents
1.	Lack of adequate laborers	40
2.	Low priority in government policy	30
3.	Change in lifestyle/migration from rural to urban areas	30
Total		100

Researchable issues in bung system

Bung is a traditional and local practice of cultivation. There has been no intervention, modification or research works done for increasing yield. According to the respondents, research priority should be given to appropriate number of seeds and spacing within and between bungs, equipments for scrapping weeds, and varieties. The researchable issues are summarized in Table 3.

Table 3: Researchable issues in bung system of potato cultivation

S.N.	Researchable issues	Per cent of respondents
1.	Bung size	5
2.	Number of seeds and spacing within and between bung	10
3.	Bung cycle (rotation in years)	5
4.	Equipment for scrapping weeds	30
5.	Varieties of potato	10
6.	Fertilizers	5
7.	Fast growing weeds	5
8.	Comparative study with other common practices	5
9.	Post-harvest qualities	5
10.	Market study	5
11.	Relation to climate change	5
12.	Socio-economic study	5
13.	Possibility of expansion of bung in other districts	5
Total		100

CONCLUSION

It is always a great concern on traditional practices for growing crops as they have evolved by taking longer period under different climatic conditions as well as management practices. Bung system of potato production, a dominant system in the highlands of Okhaldhunga and Solukhumbu districts of Nepal, carries great cultural, economical, social values for the farmers. The organic production system with minimal cultural operation makes this system of production catchy for large groups; however, the decreased trend of production, lack of mechanization, lack of labor and minimum research work have put great challenges for the concerned stakeholders.

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Author Contributions

Kalika Prasad Upadhyay made and prepared overall manuscript in consultation with Amit Prasad Timilsina.

Conflicts of Interest

The authors declare that there is no conflict of interest.

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