Research Article
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# Varietal adoption and marketing of lentilin the mid and far western terairegion of Nepal

## Abstract

Lentil (*Lens culinaris subsp. culinaris* Medikus) locally known as Masuro is the major pulsecrop of Nepal in terms of area, production and export quantity. Nepal Trade Integration Strategy (NTIS) has also identified lentil as one of the major agricultural products among 12 goods having high export potential and medium socioeconomic impacts. This study was conducted with the aim of analysing the varietal adoption and marketing of lentil in the mid and far western terai region particularly in Dang, Banke, Kailali and Kanchanpur districts which are one of the major lentil producing domains of Nepal. Primary data were collected through a household survey, focus group discussions and key informants interview which were conducted in May-June 2013. During household survey, a total of 140 farmers growing lentil at least in 5kat has of land were randomly selected from the lentil production clusters of the study districts. The study revealed higher adoption (43%) of local variety of lentil followed by Khajura-2 (31%), Khajura-1 (16%) with a very low level of adoption of other improved varieties in the study area. Own saved seed was the major source of seed not only for growing local lentil variety but also for improved lentil varieties. Low level of awareness among farmers on improved varieties, limited seed availability of improved lentil varieties, common practice of using own saved seed by farmers were the major factors behind lower adoption of improved varieties of lentil. Lentil was grown either as a sole crop, mixed crop or a relay crop in the study area. Average lentil production was 772kg ha-1 when grown as sole crop, 698kg ha-1 when grown as mixed crop and 488kg ha-1 as relay crop. Farmer's usual practice of growing lentil with own saved poor quality seeds and poor crop management practices as well as crop damage due to occurrence of rainfall at lentil flowering with severe disease infestation (Stemphyliu blight and wilt) were the major reasons affecting the lentil production. Inconsistent seed demand, poor market information, infrastructures and quality assurance services were the major constraints on producing and marketing lentil as seed.

**Keywords:** lentil, Nepal trade integration strategy, lentil productivity, farming practice

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**Abbreviations:** NTIS, Nepal trade integration strategy; SPSS, statistical packages for social science; NGOs, non-government organizations

## Introduction

Lentil (*Lens culinarissub sp. Culinaris* Medikus) locally known as *Masuro* is one of the major pulse crop of Nepal. Lentil is the main pulse crop in Nepal accounting 62% area and 64% production of the total legume.[1] Lentils are grown in terai, inner terai and mid hills of the country. It is also one of the major agricultural commodities exported from Nepal. Lentil alone accounts for 90% of the total export of pulses and contributes about 2.3% of total national exports and shares about 3.1% of the total lentil export in the world.[2] Nepal exports both whole and split lentils. Nepal's lentil has a reputation of being "pink, small in size and sweet in taste"- characteristics that are popular in the international market.[3] Bangladesh, Singapore, SriLanka, Germany, Korea, UK, Indonesia are the major export markets for Nepalese lentils.[4] Lentil has also been identified as one of the the major agricultural products among 12 goods with high export and medium socioeconomic impacts potential by Nepal Trade Integration Strategy (NTIS).[5]

Lentil cultivation in Nepal has been increasing because of it increasing research and development efforts, domestic consumptions as well as remunerative export market.[4,6] Although there are some fluctuations in lentil trade and yield, the area under lentil production and quantity produced in the country has been continuously increasing (Table 1). The exportable lentil production of the country is located in about a dozen districts of Terai, where approximately 150,000 ha of lentil are harvested annually.[3] Nepal accounts for 4.57% of the world's lentil production (208,201 tons in 2012) and stands in sixth place after Canada, India, Turkey, Australia and the United States of America in lentil production in the world.[7]

Various technologies such as improved varieties and different crop management practices of lentil have so far been developed and released in Nepal. However, studies regarding the adoption of technologies on lentil are very limited. This study was conducted with an aim of analysing the varietal adoption of lentil as well as exploring production and marketing practices and constraints of lentil in its pocket areas of the mid and far western terai region of Nepal.

**Table 1** Area, production, yield and export quantity of lentil from Nepal. Source: FAOSTAT, 2013; na refers to not available

| Year | Area harvested (ha) | Production (Ton) | Yield (Mt/ha) | Export quantity (tones) | Export value (in `000 $) |
|---|---|---|---|---|---|
| 2005 | 188895 | 160716 | 0.86 | 14591 | 7273 |
| 2006 | 183170 | 157963 | 0.87 | 7778 | 4670 |
| 2007 | 189181 | 164694 | 0.85 | 4109 | 3129 |
| 2008 | 189497 | 161147 | 0.80 | 16417 | 22075 |
| 2009 | 183798 | 147725 | 0.81 | 56768 | 73081 |
| 2010 | 187437 | 151757 | 1.0 | 37570 | 51193 |
| 2011 | 207591 | 206869 | 1.0 | 22533 | 24287 |
| 2012 | 207630 | 208201 | na | na | na |

## Methodology

Dang, Banke (Mid western terai region) and Kailali, Kanchanpur (Far western terai region) represent the major lentil production regions of Nepal. Therefore, these districts were purposively selected for conducting this study. Lentil pocket areas or lentil production cluster sim each of these selected district wer identified with the consultation of the stakeholders. Two lentil production clusters from each of the district were purposively selected for this study. Prior to the field survey, a checklist and semi-structured questionnaire was prepared to generate the information related to lentil farming practices, technology awareness and adoption, lentil marketing and utilization practices of the farmers. The questionnaires were also pretested through the interaction with 15 farmers during reconnaissance visit made in the selected areas. Then farmers growing lentil at least in 5katt has of land (i.e. 0.17 hectare) in the identified lentil production clusters were identified through the focus group discussions and key informant interviews. Primary data were collected through the household survey which was conducted in May-June 2013. Household survey comprised randomly selected 140 farmers (Dang-35, Banke-39, Kailali-32 and Kanchanpur-32) growing lentil in at least 5katt has of land in the study districts. Details of the study area and sampling design scheme are presented in the (Table 2).

**Table 2** Study area and sampling design scheme

| S. No | Study district | Cluster or village development committees | Total sample size |
|---|---|---|---|
| i. | Dang | 1. Bela and Gadhawa VDCs<br>2. Sonpur and Satbariya VDCs | 35 |
| ii. | Banke | 1. Betahani, Bankatti, Holiya VDCs<br>2. Baijapur, Binauna VDC | 39 |
| iii. | Kailali | 1. Masuriya VDC<br>2. Manuwa VDC | 34 |
| iv. | Kanchanpur | 1. Shankarpur and Kalika VDCs<br>2. Tribhuvan Basti and Parasan VDCs | 32 |
| Total Sample Size | | | 140 |

Secondary data were also collected from various published articles, reports and other documents to supplement the study. Collected da ta were cleaned and analyzed using Microsoft Excel and Statistical Packages for Social Science (SPSS) software. Adoption index for each of the prominent lentil varieties grown in the area was estimated by using the formula used by Saka et al.,[8] which are given by $\beta v = \sum i=1 nRvi \sum i=1 nRt \times 100$

Where $\beta_v$=the adoption rate for lentil variety v, Rvi = land area grown to lentil variety v by farmer i (i=1,2,…n), and RT = total land area grown to lentil by farmer.

## Results and discussions

### Lentil farming practices by the respondents in the study area

Lentil is grown as a sole crop or, mixed crop with tillage or relay crop in the study area. The study revealed that out of the total acreage in lentil production, 47% was in sole lentil, 38% in mixed lentil and 23% in relay lentil (Table 3).

Among the districts, area under sole cropped lentil was found to be higher in Banke and Kanchanpur districts than mix cropped and relay lentil. In Dang district, area under relay lentil was greater than sole and mix cropped lentil while in Kailali district, area under mix cropped lentil was higher than sole and relay lentil. Lentil were grown as sole crop with tillage particularly for three major reasons which include getting higher yield, ensuring less weed competition in the crop and reducing moisture stress in the field. Farmers selling lentil primarily as seed grow lentil as a sole crop or with tillage. Lentil was grown as a mixed crop mostly with rapeseed and chickpea to ensure maximum use of limited resources. More over lentil was also grown as relay crop in which seed was broadcasted one to two weeks prior to the rice harvest to ensure germination using the residual moisture as well as to avoid tillage operation and minimize cost.

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**Table 3** Lentil farming practices and cultivated area (ha) among respondents. Figures in parentheses indicate percentage

| Study District | Area under lentil cultivation( ha) | | | Total area |
|---|---|---|---|---|
| | Sole crop | Mixed crop | Relay crop | |
| Dang(N=35) | 7.5( 35) | 4.8( 22) | 9.2( 43) | 21.5( 100) |
| Banke(N=39) | 18.3( 54) | 9.3( 27) | 6.6( 19) | 34.2( 100) |
| Kailali(N= 34) | 11.7( 43) | 15.3( 56) | 0.4( 1) | 27.4( 100) |
| Kanchanpur(N=32) | 12.2( 57) | 6.0( 28) | 3.1( 15) | 21.3( 100) |
| Total | 49.8( 47) | 35.4( 38) | 24.3( 23) | 104.4( 100) |

## Lentil productivity

The productivity of lentil varied mostly based on the farming practice adopted by the farmers in the study area. Overall, average productivity of lentil was 772kgha$^{-1}$ when grown as a sole crop, 598kgha$^{-1}$ when grown as mixed crop and 488kgha$^{-1}$ as relay crop. Although average productivity of lentil grown as a sole crop was higher than other farming practLens culinarissub sp. Culinaris ices, productivity of relay crop was found higher than a mixed crop lentil in Banke and Kailali districts. Overall, average productivity of lentil was 661kgha$^{-1}$ in the study area and among the districts, it was found higher in Banke district (811kgha$^{-1}$) followed by Kanchanpur (688kgha$^{-1}$), Dang (568kgha$^{-1}$) and Kailali district (524kgha$^{-1}$) respectively (Figure 1).

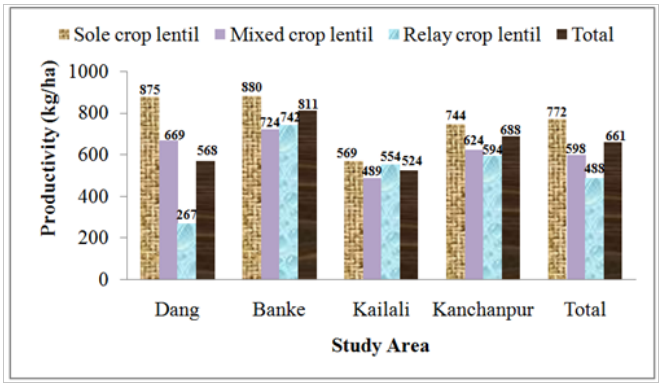


**Figure 1** Average productivity of lentil in different farming practices.

The productivity of lentil in the study area was below the national average of 1000kg/has.[7] Use of local and poor quality (own saved) seeds, practice of growing lentil with low inputs as well as poor crop management practices, occurrence of heavy rainfall during flowering period of lentil crop causing severe disease infestation (Stemphylium blight and wilt diseases) were the major reasons behind lower yield of lentil in the study area.

## Adoption of lentil varieties in the study area

Although a number of improved lentil varieties are released in Nepal, the study revealed a higher adoption of only few of the improved varieties in the study area. Khajura 2 and Khajura 1 were the major improved lentil varieties having higher adoption while local variety of lentil was commonly cultivated by the farmers. Overall, the adoption of local variety of lentil was found higher (43%) followed by Khajura 2(31%), Khajura 1(16%) while other improved varieties had very low rate of adoption in the study area (Figure 2). The reasons behind lower adoption of improved lentil varieties than the local variety are low level of awareness among farmers on improved varieties, limited availability of improved varieties seed and common practice of using own saved lentil seed among farmers. Due to limited awareness on improved lentil varieties and difficulties in differentiating improved varieties from local varieties, majority of the farmers even have the tendency to report improved varieties as local since majority of the farmers retain and recycle own seed for next planting.

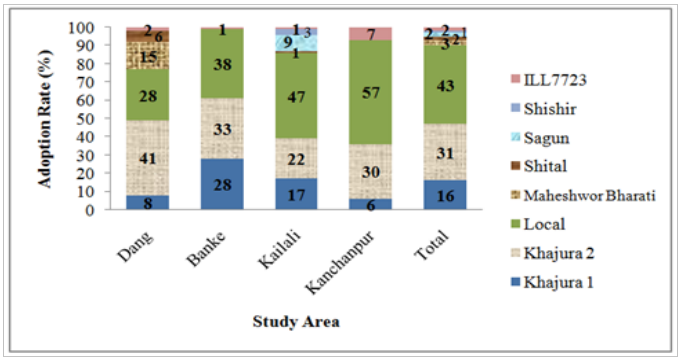


**Figure 2** Adoption rate of lentil varieties in the study area (in percentage).

Among the studied districts, local variety of lentil was a dominant variety in all studied districts except in Dang district where Khajura-2 an improved variety was a dominant variety of lentil. Higher adoption of improved varieties particularly Khajura-2 and Khajura-1 was due to better their better seed access ibility, good yield, disease tolerant, better taste and cooking quality as well as better market price attributes which were preferred by the farmers.

## Source of seed for improved lentil varieties

Majority of the farmers in the study area had a tendency of saving part of lentil produced and using it for planting the next lentil crop. Almost all the respondent farmers used own saved seed to cultivate local lentil variety while they obtained improved varieties of lentil seed through the various sources. Own saved seed is the major source of seed to the majority of the respondents (54%) in the study area even for the improved varieties of lentil (Figure 3).

The farmers also obtained lentil seed from governmental organizations such as District Agriculture Development Offices and Regional Agriculture Research Station, Khajura, Banke (17%),

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agricultural cooperatives/farmers groups (15%), non-government organizations (NGOs) such as FORWARD, LIBIRD and USAID`s NEAT project (6%), agrovets (5%) and seed companies such as GATE Nepal and Sea Seeds Company Private Limited (3%) respectively. Due to accessible markets, increased participation of government and non-government organization as well as seed producer cooperatives and private seed companies on lentil related activities, the farmers of Dang, Banke and Kailali districts had increased access to improve lentil varieties, however it was lower in Kanchanpur district so majority of the farmers in this districts mostly relied on own saved seed for growing lentil.

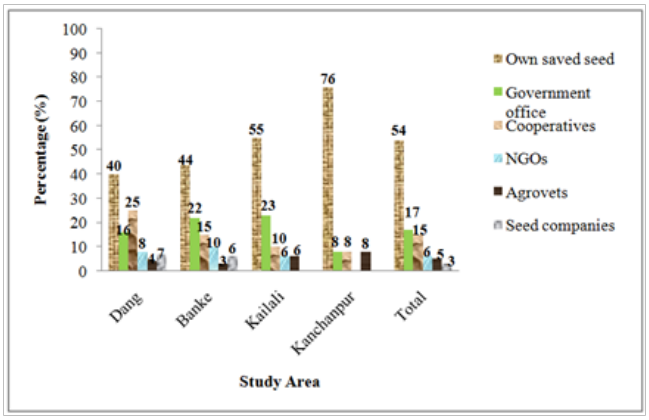


**Figure 3** Source of seed for improved lentil varieties in the study area.

## Production and consumption of lentil in the study area

Majority of the farmers (74%) in the study area produced lentil for sale as pulse and for home consumption while only 26% of the total respondents produced lentil for selling as seed in the market. Out of the total lentil of 68989kg produced by the entire respondents during winter season of 2012/13 in the study area a large proportion of the total production (55%) was sold as pulse in the market. About 27% of the total production was kept by the respondents for household consumption and using it as seed for planting the next season crop. Only 18% of the total production was sold as seed lentil in the market. Selling of lentil as seed was found to be higher in Banke (26%) and Dang (24%) followed by Kaillai (12%) and Kanchanpur (10%) district respectively which was due to having well established market and better linkage of lentil seed producers with the cooperatives, agrovets and private seed companies in Banke and Dang than in Kailali and Kanchanpur districts (Figure 4).

### Value chain map and marketing practices of lentil in the study area

Selling of lentil as pulse as well as seed was one of the major sources of income to the farmers in the study area. Majority of the respondent farmers had a practice of selling lentil as pulse in the market while few of them were producing lentil to sale it as seed. Lentil as pulse after production reached to the consumers through number of channels/traders while as seed, lentil reached to the farmers from farmers or through agricultural cooperatives, agrovets sand the seed companies. The value chain map and marketing practice of lentil as pulse and seed is shown in a Figure 5.

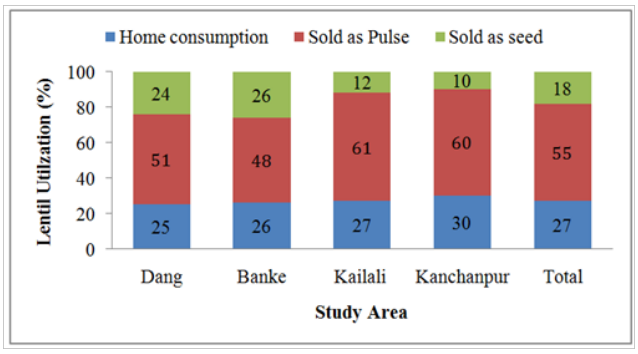


**Figure 4** Consumption of lentil in the study area (in percentage).

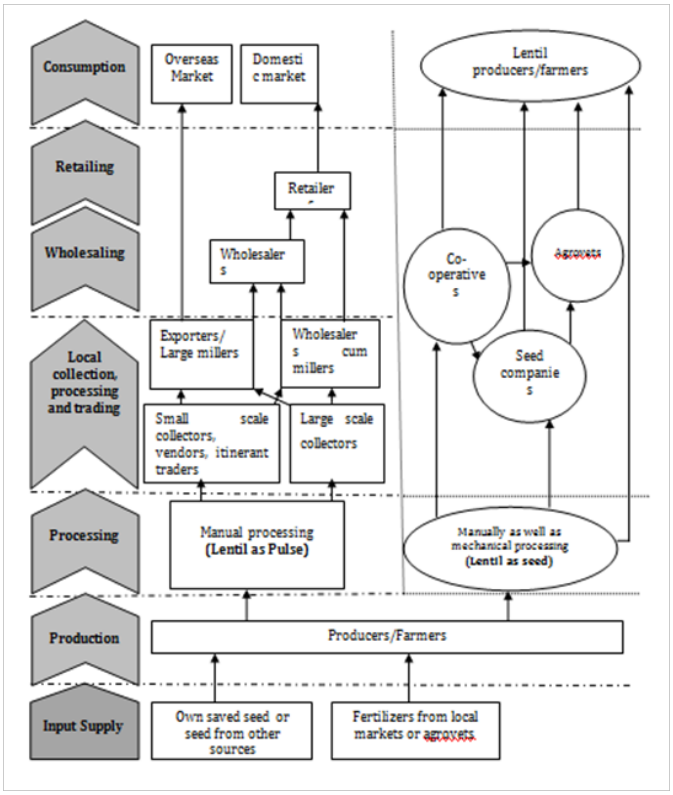


**Figure 5** Value chain map of lentil as pulse and seed in the study area.

### Price of lentil as a pulse and seed in the study area

The price of lentil varied based on the quality of the grain, grain size and the market place where it was sold. Price was mostly fixed by the traders for pulse. However for seed lentil, price was either fixed by seed companies or cooperatives oragrovets or in mutual understanding between the farmers and seed traders. During the study period, the price for lentil as pulse ranged from Nepalese Rupees (NRs.) 60/kg to NRs. 75/kg and the farmers selling good quality and small sized lentil directly to the large scale collectors received higher price while those selling to small scale collectors or vendors received lower price. Price for lentil seed ranged from NRs. 90/kg to NRs. 100/kg with private seed companies offering the higher price to the farmers.

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Most of the large scale collectors or traders who handle large quantity of lentil in the market tend to fix the price of lentil primarily based on seed quality. Grading of lentil is usually done to determine the quality of the lentil in which a composite sample of 40 *shear* (200gram) lentil is taken from different lentil lot sand passed through a standard lentil grading sieve which is built up with four containers. Then, lentil price is fixed based on taking account of the weight of the grains deposited in the second and fourth container of that sieve. 34 *shear* (or 170 gram) is the standard level for fixing the lentil price and if a sample lentil deposited in the second and fourth sieve while weighing meets that standard level (34 *shear*) then that lot of lentil from where the sample was taken was paid a standard price of NRs. 7000 per quintal during the study period. And if a sample lentil has weight above or below the standard level, then addition or subtraction of NRs. 145 per unit *shear* per quintal to the standard price was done to determine its price. An experiment was also conducted to assess the quality of released and promising lentil varieties in order to identify their market value (or price) in which different released varieties and promising lines of lentil were collected, cleaned (processed) and tested in that grading sieve. While passing a sample of 40 *shear*s of different lentil varieties/promising lines in the grading sieve and weighing the following results were obtained (Table 4).

The results revealed that lentil varieties such as Shimal (37.1 *shear*), Sagun and Khajura 1 (37 *shear*), Khajura 2 and Shital (36 *shear*), Maheshwor Bharati (35.1 *shear*) were found to have weight above the standard level (34 *shear*). Similarly the promising lines such as ILL4402 (37.4 *shear*), ILL7715 (37.2 *shear*), ILL7164 (37 *shear*) also had the weight above the standard level which indicates that the price per quintal of these varieties and promising lines would be above the standard price i.e. Rs. 7000/quintal. However, a promising line 'ILL7723' which has been proposed for the variety release in Nepal, having its bold sized seed had a weight of just 29 *shear* and ILL7716 had only 21 *shear* weighting grading analysis. These promising lines had weights (*shear*) far below the standard level which indicates that per quintal price of these varieties would be remarkably lower than the standard price. A promising line 'ILL7723' which is micronutrient rich and bold sized is proposed for variety release, however, due to its bold seed size, it is more likely that this variety would get lower price in the market and this may result into its lower adoption unless a market for bold seeded and micro-nutrient rich lentil varieties is developed. Therefore, breeding and varietal improvement programs on lentil should also emphasize on market dynamics while developing new varieties.

## Constraints on production and marketing of lentil

Farmers in the study area were facing a number of production constraints that hindered the full yield potential of the lentil crop. Biotic (disease infestations particularly Stemphylium blight and Fusarium wilt and BGM (*Botrytis cinerea*), abiotic (terminal drought, uncertainty in rainfall) and socio-economic (limited availability of improved seeds, limited technical knowledge) were the major constraints on lentil production (Table 5).

Majority of the farmers were involved in selling lentil as pulse and it could be easily sold in the market. However, only few farmers were involved in production and marketing of lentil as seed. A number of constraints were faced by farmers while marketing lentil as seed in the study area which include poor and inconsistent seed demand, limited market information, limited infrastructures and services available for quality maintenance of lentil seed, limited services for quality assurance.

## Benefit cost analysis of lentil production (per hectare of land)

An analysis on economics of lentil production in different farming practices was also carried out during this study. While doing the benefit cost analysis of lentil crop in different farming practices in the study area, benefit cost ratio was found higher (1.26) in lentil grown as a relay crop followed by lentil grown as a sole crop (1.16) and as a mixed crop (1.15) respectively. Although lentil grown as relay crop had lower productivity than lentil grown as sole and mixed crop, the cost associated with relay cropped lentil was much lower than sole and mixed cropped lentil and the profit per hectare of land was also as high as that of sole cropped lentil. This indicates that relay lentil could be a useful lentil farming practice in order to generate higher return with low cost particularly to the resource poor farmers (Table 6).

**Table 4** Weigh of tested lentil varieties/promising lines in grading analysis

| Variety | *Shera* | Promising Lines | *Shera* |
|---|---|---|---|
| Shimal | 37.1 | PL4402 | 37.4 |
| Sagun | 37 | ILL7715 | 37.2 |
| Khajuraho1 | 37 | ILL7164 | 37 |
| Khajuraho 2 | 36 | **ILL7723** | **29** |
| Shital | 36 | ILL7716 | 21 |
| Maheshwor Bharati | 35.1 | | |

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**Table 5** Constraints associated with production and marketing of lentil

| Production constraints | | Marketing( as seed) constraints | |
|---|---|---|---|
| i. | Limited availability of quality seed of improved varieties. | i. | Poor demand of lentil seed by farmers due to increasing practice of using own saved seed by farmers. |
| ii. | Limited awareness of farmers on improved lentil varieties and production technologies. | ii. | Limited market information and market assurance. |
| iii. | Uncertain rainfall leading to heavy disease infestation. | iii. | Limited capacity of farmers for processing and storage of lentil seed. |
| iv. | Occurrence of early and terminal drought during lentil growing period. | iv. | Limited availability of lentil seed certification and quality assurance services. |

**Table 6** Benefit-cost analysis of lentil production (Rs/ha) in study area

| Particulars | Benefit-cost of lentil production (NRs/ha.) | | |
|---|---|---|---|
| | As a sole crop | As a mixed crop | As a relay crop |
| Seed, fertilizers, pesticides cost (NRs.) | 19760 | 15560 | 11660 |
| Labour cost for land preparation, intercultural operations, harvesting, threshing, processing, packaging (NRs.) | 18600 | 15300 | 12900 |
| Tractor (ploughing), thresher, jute/plastic bags (NRs.) | 8360 | 5660 | 2660 |
| Total cost (NRs.) | 46720 | 36520 | 27220 |
| Total lentil production (kg/ha) | 775 kg | 600 kg | 490kg |
| Price for lentil pulse/kg (NRs.) | 70 | 70 | 70 |
| Gross Income (NRs.) | 54250 | 42000 | 34300 |
| Net profit/ha of land (NRs.) | 7530 | 5480 | 7080 |
| Benefit Cost Ratio | 1.16 | 1.15 | 1.26 |

## Conclusion and Suggestion

Lentil is one of the major agricultural commodities exported from Nepal. It occupies the largest share in terms of area and production among the grain legume crops produced in the country. Sale of lentil (as pulse and seed) is one of the major sources of income to the farmers. Lentil is primarily grown by farmers for selling as pulse. Production and marketing of lentil as seed is often practiced to a small extent and limited to only in government research stations and few of the private seed companies and cooperatives. Own saved seed is still the major source of seed and local lentil variety is still the dominant variety of lentil among the farmers which implies limited awareness and availability of the improved lentil varieties among the farmers. The productivity of lentil is also far less than the yield potential of the crop. Limited availability of quality seed, limited technical knowledge, disease incidences, climatic stress mostly occurrence of early and terminal drought and erratic rainfall are the key constraints associated with production of lentil while inconsistent seed demand, poorly developed market and market information, poor infrastructures and quality assurance service share the major constraints associated with production and marketing of lentil as seed in the study area. Lentil is a crop with high export potential and socio-economic impact therefore, addressing the constraints associated with its production and marketing will not only benefit the farmers but also enhance the economy of the country. Hence, focus should be paid not only on developing high yielding and demand driven lentil varieties but also on extending the available technologies (improved lentil varieties, technical knowledge including quality seed and other inputs, seed multiplication) and other support services (market information and market linkage/networking, mechanical (processing equipments)/ infrastructural (collection centers and storage house)/credit support) to enhance the capacity of the farmers on production and marketing of lentil.

## Acknowledgements

None.

## Conflict of interest

The author declares no conflict of interest.

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