

REVIEW ARTICLE

PROSPECTS AND POTENTIALITY OF LENTIL IN NEPAL: FOOD SECURITY AND TRADE PERSPECTIVE

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ABSTRACT

Lentil (*Lens esculenta*) is considered a major food crop in terms of food and nutrition security in Nepal and is primarily grown in the lowland Terai and hilly region of Nepal. This study aimed to evaluate prospects and potentiality of lentil focusing on nutrition and trade perspectives. Secondary data was used for assessing the area of production, yield, coefficient of variation, instability index, and trade specialization index. The area for lentil production increased slightly in one decade, however its production has increased significantly during this period (2009-2019). The import value has soared at the rate of 22.7% per annum whereas the export value has decreased with 17% per annum. The trade specialization index was discovered 0.13, which indicates that the lentil is in the growth phase. The study provides sufficient information that it is necessary to surge the production and productivity to decrease the escalating imports while making the country independent in lentil production with an increased investment in research and development. Additionally, it is suggested to strength the Research and Development (R & D) in order to improve the productivity of lentil. More focus should be given in disseminating packages of Practices (POP). More focus needs to be given to develop policies and implement to encourage commercialization of lentil in order to meet the domestic demand and increase export.

KEYWORDS

Lentil, nutrition security, productivity, trade

1. INTRODUCTION

Lentil is considered the most ancient food crops that have been grown as an important source of food. It is among the early cultivated plants in the near East, about 10,000 years ago (Cubero et al., 2009). It is the most important pulse crop of Nepal with 208,766 ha of land under cultivation (MoALD, 2019). Nepal ranks 5th position after Canada, India, Australia, Turkey according to Food and Agriculture Organization (FAO, 2019). It is grown primarily in Nepal's lowland Terai region after harvesting of rice. It is usually planted between mid-October and November and harvested between March and April. Twelve high-yielding varieties have been released in Nepal so far. Sagun and Maheswor Bharati are bred at ICARDA and are specifically adapted for South Asia. Simal and Sisir varieties are abundant in iron and Zinc and has been promoted as crops to the producers.

The recent data of Ministry of Agriculture and Livestock Development shows that lentil is cultivated in 72 districts except in Taplejung, Solukhumbhu, Kathmandu, Manang and Mustang (MoALD, 2020). The leading production districts of Nepal for this crop are Kailali, Bardiya, Bara, Rautahat and Kanchanpur. The productivity of lentil was found highest in Rupandehi (1.55 mt/ha) followed by Gulmi (1.37 mt/ha) and Bardiya (1.36 mt/ha) (MoALD, 2020). It is an important source of protein. In fact, the protein obtained from lentil is considerably less expensive in comparison to the animal foods. Thus, it is known as poor man's meat. Moreover, lentil seeds contain an average of 25.7 percent protein, which is about three times that of cereals and 59% carbohydrate (Erskine and Witecombe, 1984; Bakhsh et al., 1991).

It is estimated that one-third of food produced for the human consumption globally is wasted. Lentils have a long shelf life and can be processed for a long time without losing nutritious value, making them an excellent choice for ensuring household food security. Drought-resistant lentils (*Lens culinaris* Medik) may be grown in dry climates having scarce and unpredictable rainfall. It improves the food security and nutritional status of farmers in rural areas. Therefore, people residing in arid places, where food security is a major concern, may improve their production systems (FAO, 2016).

Due to domestic consumption and export market, its cultivation in Nepal has been increasing. Although there are some fluctuations in yield and trade, the area and production in the country has been continuously increasing. Lentils are the most widely traded items among Nepal's agricultural exports. Nepalese lentils have big demand in international markets as they are rich in micronutrients like iron, zinc, etc. Due to this, lentils from Nepal are receiving a huge amount which is comparatively more than that of other countries. Lentil is one of 19 commodities with export potential in Nepal, according to Nepal Trade Integration Strategy.

Though Nepal ranks 5th position in terms of production, a very limited research study and development has been done. There is a decline in productivity of Lentil in 2018/19 (1203 kg/ha) as compared to that of 2017/18 (1256 kg/ha). The import quantity of Lentil is far more than the export quantity which can be seen from the year 2013 to 2019 (MoALD, 2020). Therefore, the aim of this research is to determine the prospects and potentiality of lentil by evaluating its production system, production, contribution to food security, and trade in Nepal. Beside this, the study also

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aims to assess the competitiveness of the lentil production by identifying Strengths, Weakness, Opportunities and Threats.

2. MATERIALS AND METHODS

Most Basically, this study is based on review and synthesis and it has no direct data collected from the population, rather it is dependent on the secondary data published by government and non-government agencies. Statistical Information of Nepalese Agriculture of the Ministry of Agricultural and Livestock Development provided data on lentil area, production, and yield. Beside this, data on international trade were gathered from Trade and Export Promotion Center of the Ministry of Industry, Commerce, and Supplies (MoICS). Analysis of data was done using 11 years of data from 2009 to 2019 on area, production, yield, import, and export of lentil. This paper used a specific analytical approach to analyze the area, productivity, trade growth rates, as well as the trade specialization index, as mentioned in this section. The most recent research publications and review papers were reviewed thoroughly.

2.1 Analysis of Compound Growth Rate

Growth rates are often used in agriculture because they have significant policy implications (Prajneshu and Chandran, 2005). The analysis of growth has widely been used to determine the trend of a specific variable over time (Gairhe et al., 2018). Some researcher also reported that the concept of computation of compound growth rate has been used maximum number of times, particularly in the discipline of agriculture economics (Prajneshu and Chandran, 2005). Some researchers also examined at the dynamics of main cereal productivity in Nepal using growth rate (Gairhe et al., 2018). The area, production, productivity, and quantity of lentil import and export in Nepal were all modeled using an exponential growth function, which is given below:

$$Y_t = xy^t z_t \tag{1}$$

Where,

Y_t = Dependent variables for which the growth rate was estimated

x : Intercept

y : Regression coefficient (1+g)

t : Years

z_t : Disturbance term for the year t

The equation was transformed into log-linear form and the ordinary least square technique was used.

The following formula was used to calculate the compound growth rate (in percent)

$$CGR = \{Antilog\ of\ (\ln\ b) - 1\} \times 100$$

Regression coefficient significance was analyzed by using the student's test.

2.2 Coefficient of Variation

A simple analytical technique such as the coefficient of variation was used to measure the variance in any time-series data (Gairhe et al., 2018; Gairhe et al., 2021). It is estimated as follows:

$$CV = (Standard\ deviation / Mean) * 100$$

2.3 Trade specialization index (TSI)

The TSI was used to assess the lentil's competitive status in Nepal. A group researchers used TSI to determine the competitiveness of millet in Nepal (Gairhe et al., 2021). The formula used is as follows:

$$TSI = \frac{N_x - N_m}{N_x + N_m}$$

Where,

TSI = Trade Specialization Index

N_x = Value of lentil exports from Nepal

N_m = Value of lentil imports to Nepal

The value of this index ranges between -1 to +1. The lentil has strong competitiveness as an exporter if the value lies between 0 to 1. Otherwise, inclined as the importer or competitiveness is weak. The TSI is divided into four phases based on position of a commodity's competitiveness in trade: (1) Phase introduction (index value between -1.00 to -0.50); (2) Phase import substitution (-0.51 to 0.00); (3) Stage growth (0.01 to 0.80); (4) Phase Maturity (0.81 to 1.00).

2.4 Instability Index

Cuddy-Della Valle instability index was used to measure the instability in the area, production, productivity, import and export of lentil by using the formula (Cuddy and Valle, 1978).

$$I = CV * (1 - Ad.R^2)^{0.5}$$

Where,

I = instability index (in percent)

CV = Co-efficient of Variation (in percent)

$Ad.R^2$ = Adjusted R^2 (coefficient of determination)

Some researchers also used Instability index to identify the variation in finger millet and cereal crops (Gairhe et al., 2021; Gairhe et al., 2018; Bansal and Singh, 2020).

2.5 Competitive analysis

Beside this, a competitive analysis was carried using SWOT analysis to analyze the prospects and potential of lentil production based on strengths, weakness, opportunities, and threats.

3. RESULTS AND DISCUSSION

3.1 Production System

Lentil has been cultivated by the farmers in the majority of the districts from Eastern to Far-western region of hill and Terai varying approximately from 100 masl to 3000 masl in various agro-ecological zones. It has been cultivated in a broad range of soil types. The important varieties with production domain and productivity are briefly presented in table below

S.N.	Varieties	Productivity (Mt/ha)	Production Domain
1	Sindur	1.5	Terai, InnerMadesh and Hill
2	Simrik	1.5	Terai, InnerMadesh and Hill
3	Sishir	2	Terai, InnerMadesh and Hill
4	Simal	4.1	Terai, InnerMadesh and Mid-hill
5	Shikhar	3.5	Terai, Inner Madesh and Mid-hill
6	Khajura 1	1.5	Mid-western to far-western region
7	KhajuraMuro 2	2.1	Mid-western to far-western region
8	KhajuraMuro 3	1.78	Terai, Inner Madesh and Mid-hill
9	Sagun	1.3	Mid-hill

3.2 Trend analysis in area, production, and yield

Area, production, and yield of lentil during the period between 2009 to 2019 is as shown in Figure 1 and 2.

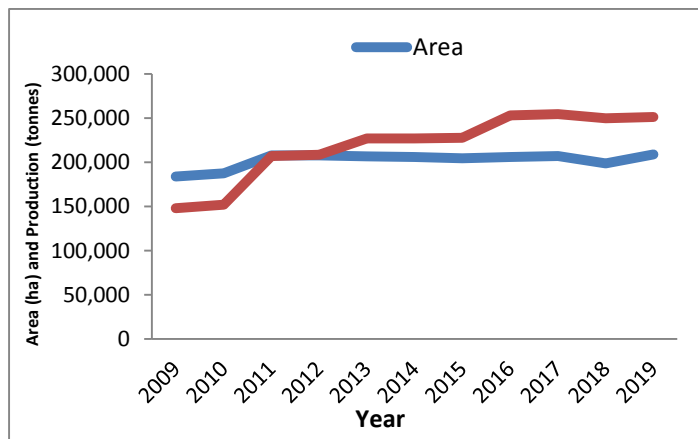


Figure 1: Area and production of lentil in Nepal from 2009 to 2019

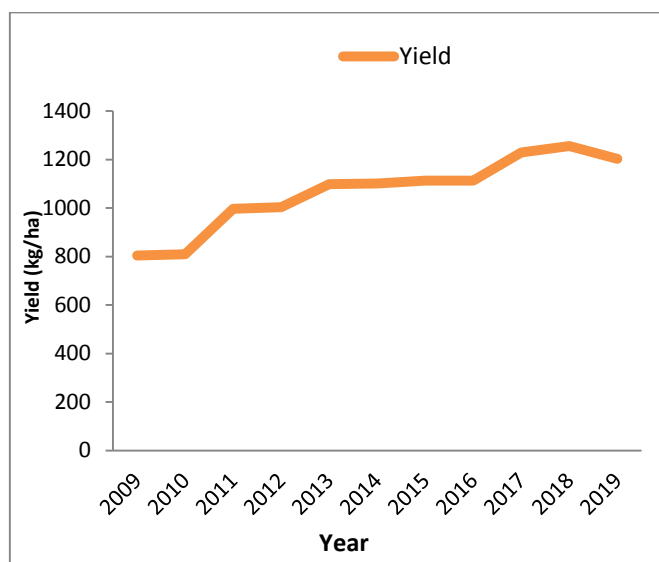


Figure 2: Yield of lentil in Nepal from 2009 to 2019

The above figures showed that the production and yield of lentil has increased considerably from 2009 to 2019 while the production area showed a moderate increase between 2009 to 2019. The yield is low which is hovering over 1 mt/ha as compared to the potential yield of about 1.3 to 4.2 mt/ha. Lentil yields in Nepal have been stable in recent years due to factors such as limited input investment, cultivation of older varieties, and increased disease pressure (Shrestha et al., 2017; Manandhar et al., 2011; Devkota, 2014). Therefore, it is necessary to increase the production and yield of lentil using production technologies, improved varieties, and management practices.

Table 2: Top ten lentil production districts in Nepal (2019)

S.N.	Districts	Area (ha)	Production (tonnes)	Yield (tonnes/ha)
1	Kailali	20171	27065	1.35
2	Bardiya	17400	23730	1.36
3	Rautahat	15206	18055	1.19
4	Bara	14525	18052	1.24
5	Kanchanpur	12871	16876	1.31
6	Dang	14076	15088	1.07
7	Banke	10881	14340	1.32
8	Siraha	12612	13827	1.1
9	Parsa	11050	12122	1.1
10	Dhanusha	9656	10651	1.1
	Share of 10 districts	66.32 %	67.60 %	1.17 % higher

According to Table 2, production of lentil is concentrated in Terai region. It is due to favorable environment and soil conditions (Prasain, 2016). Production of lentil is maximum in Kailali district with 27,065 tonnes subsequently Bardiya district (23,730 tonnes) and Rautahat district (18,055 tonnes). Top-ten lentil producing districts in Nepal about sharing 67.60 % of national production and 66.32% of growing area. Average productivity in these districts is 1.17 percent higher than the country's national average of 1.20 tonnes /ha.

3.3 Import and Export

Import volume and values are presented in the table 3. Even though Nepal is the main producer of lentil, it also imports to fulfill the growing nutritional demand of the population. Import quantity decreased sharply from 2009 to 2012 and showed an increasing trend till 2015. After that the quantity fluctuated from 2016 to 2019. The unit value increased from 2009 to 2016 and showed an increasing and decreasing trend till 2019.

Table 3: Lentil import from 2009 to 2019

Year	Import Volume (tonnes)	Import cost (1000 US\$)	Unit price (US\$/tonnes)
2009	32260	12973	402
2010	7645	3147	412
2011	5638	2823	501
2012	5303	2501	472
2013	19741	13232	670
2014	23230	14736	634
2015	37017	32749	885
2016	27565	22943	832
2017	55936	34944	625
2018	45749	22822	499
2019	38946	18344	471

Export quantity and values are shown in table 4. The export quantity decreased considerably from 2009 to 2011 and saw a period of fluctuation from 2012 to 2019. The value of lentil decreased from \$1287/Mt to \$1025/Mt over a period of decade. Import unit price of lentil is significantly below the export unit price because of small, sweet in taste and high grain concentration (Fe, Se, Zn, protein, etc.) lentils from Nepal which have big demand in international market (Darai et al., 2020). That is why, Nepalese lentil receives a huge amount which is comparatively more than that of other countries.

Nepal also exported lentils to neighboring nations, namely Bangladesh, until 2014. However, exports are currently restricted. The emphasis on pulses and farmer subsidies by the Indian government have enhanced production. Bangladesh has also made lentils a prioritized crop, increasing both cultivation area and yield (Joshi, 2020). Over the last 10 years, global demand for lentil has grown at a healthy annual rate of 6.2 percent, and it is projected that export earnings from lentil in Nepal may double or treble if appropriate measures are adopted to increase production area, productivity, and market integration (USAID, 2013; ITC, 2007).

Table 4: Export of Nepal's lentil from 2009 to 2019

Year	Export quantity (Mt)	Export value (1000 US \$)	Unit value (US\$/Mt)
2009	56768	73081	1287
2010	37570	51193	1363
2011	22533	24287	1078
2012	33729	33719	1000
2013	12407	15771	1271
2014	15861	18534	1168
2015	5979	8378	1401
2016	8497	13709	1613
2017	7923	9279	1171
2018	8000	11000	1375
2019	11241	11523	1025

3.4 Compound growth rate

Table 5: Compound growth rate of area, production, yield, import & export volume, and value of lentil in Nepal beginning in 2009 to 2019

Details	CGR	R ²	p-value
Area (ha)	0.8	0.326	0.067

3.5 Coefficient of variation and Cuddy-Della Valle instability index

Table 7: Estimation of C.V. and Cuddy-Della Valle instability index of area, production, yield, import and export of lentil in Nepal beginning in 2009 to 2019		
Details	C.V.	CDVII
Area (ha)	4.27	3.71
Production (Mt)	17.38	7.77
Yield (kg/ha)	14.26	5.37
Import volume (ton)	61.86	45.62
Import value (US \$)	68.59	51.64
Export volume (ton)	81.41	47.41
Export value (US \$)	85.41	50.1

The coefficient of variability and Cuddy-Della Valle instability index has been illustrated in the table 7. In the above table, the result shows that the greatest CV has been observed in export value subsequently followed by export quantity, import value, and import quantity. Least was observed in area. On the other hand, the maximum instability index has been observed in import value subsequently export value, export volume, import volume while least has been observed in production, yield, and area. A researcher also found higher instability index of the import and export value in lentil in his study (Tuteja, 2009). ITC also reported that exports are always varying significantly in quantity and value over years (ITC, 2007). This result implies that there needs to be market diversification and the exporters should also focus to maintain a good relationship with other clients on different destination countries to stabilize the trade.

3.6 SWOT Analysis

Following competitiveness analysis defines strength, weakness, opportunities, and threats in lentil production in Nepal. Strength and weakness addressed the internal factors in lentil production while the opportunities and threats define the external factors in the lentil production.

Table 8: SWOT analysis on production of lentil	
Strength	Weakness
<ul style="list-style-type: none"> Fifth largest producer globally Lower production costs and high-level potential for profitability National median yield is greater than India and close to the global average. A gross production capacity of about 251185 Mt, with 67.6% of total production concentrated in ten Terai districts. Intercropped with other companion crops to provide a variety of foods at household level and production safety in case of crop failure. 	<ul style="list-style-type: none"> Less supply of better-quality seeds, fertilizers, and pesticide due to inadequate manufacturing and distribution. Lack of irrigation provision during vital phases of crop growth Lack of awareness about seed priming and rhizobium inoculums among the farmers. Deficiency of boron and Molybdenum in terai region of Nepal.
Opportunities	Threats
<ul style="list-style-type: none"> Availability of new and improved varieties (Khajura 1, Khajura 2) throughout the terai region and central hilly region of Nepal. Achievable yield is larger than the national average yield Likelihood of increasing small farmer's productivity (priming – treating seed with rhizobium, insect pest management, Nutrient, and irrigation management) 	<ul style="list-style-type: none"> Subsistence production among the small-scale farmers have low incentives for improving productivity. Unwillingness of farmers to produce lentil as the sole crop because of food security, conventional practice, and greater profitability in other Pest and diseases

4. CONCLUSION

The Lentil is grown in every part of the Terai and hilly region of Nepal. All the top ten lentil producing districts are from Terai region signifying

important crops in terms of food security of farmers. The area for lentil production increased slightly in one decade, however its production has increased significantly during this period. The import value has been growing at the rate of 22.7% annually whereas the export value has decreased with 17% per annum. This denotes that the existing production have not been able to fulfill the escalating demand of lentil in the country. Similarly, the average value of TSI has a strong competitiveness as the exporter. Furthermore, highest CV and instability index has been observed in the export and import suggesting a high variation in the imports and exports of lentil in the country. TSI was found to be 0.13 which suggests lentil is in the stage of growth. There is also a need to increase investment in the research and development to increase the production of lentil as the lentil productivity is very low as compared to its potential productivity, and to lessen the rising imports and making the country independent in lentil production. Based upon an analysis it can be suggested that:

- There is a need for strengthening R& D in order to improve the productivity of lentil in Nepal.
- There is a need to develop package of practices (POP) for growing lentil and disseminate it to the farmers in order to increase the productivity of the lentil.
- Government should develop and implement plans and policies to encourage farmers to grow lentil commercially as lentil is considered as a commodity with higher export potentiality.

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