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NEPALESE LENTIL: POSSIBLE FORTHCOMING TRANSITION FROM THE TOP EXPORTABLE TO THE MOST IMPORTABLE LEGUME

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ABSTRACT
Lentil is an important winter food legume crop component of farming and food systems, contributing significantly on food and nutrition security, soil health and livelihood improvement of rural and marginal farmers of Nepal. Because of diverse benefits and increasing population, demand of lentil is escalating while production is decreasing. With the objective to investigate potential production, marketing and trade factors resulting wide gap between import and export of lentil, this study thoroughly analyze the global and national level, trader level and household level scenario of lentil production and trade in Nepal. Secondary data from secondary sources were used to critically examine the trend of lentil production and trade at the global and national level while primary data collected through household survey, Focus Group Discussion (FGD) and Key Informants Interviews (KII) with lentil producing, marketing and trading actors were used to investigate the present scenario along with possible opportunities and existing challenges. This study revealed that, globally, area under lentil cultivation and production are decreasing since 2017 while productivity of lentil is increasing. In Nepal, lentil had shared almost 5% of global area and almost 4.7% of global production in between 2011 to 2014 while the contribution is slightly decreased and reached to 4.24% and 4.02% in 2020. Up to the year 2013, export quantity of Nepalese lentil was higher that import quantity but after 2013, import quantity has always exceeded the export quantity. In the year 2020, import quantity of lentil was almost 24 times higher than export quantity. Milling quantity of Nepalese lentil is decreasing year after years and some large millers of Nepal has shifted their milling industry towards the other legumes because of quantity constraints. At the farmer's levels, production of lentil is also dwindling year after years. Biotic and abiotic threats especially erratic and heavy rainfall at the time of pre-flowering and flowering stage, prevalence of Stemphylium Blight and root rot disease along with the persistence of low input use and insect/pest in lentil cultivation has caused the drastic yield loss in lentil. Existing extension and development programs of lentil formulated and implemented by government are not sufficient to increases the production. Decreased production in recent years has reversed the trade scenario of lentil from top exportable to the most importable legume. Effective government policies and programs along with the technology development from public and private side is the most needed condition to uplift the lentil sector in Nepal.

KEY WORDS
Lentil, production, trade, constraints, opportunities, policies.

Agriculture in Nepal represents an extremely powerful economic force, still the largest sector of economy, produces only one-third of total value added, although remains the largest employer, accounting for 67% of total employment (World Bank, 2018). The share of agriculture sector to employment, income, food and nutrition security, poverty reduction and

shared prosperity, especially in rural areas, is quite considerable. Most of the poverty reduction between 2003/04 and 2010/11 occurred in rural areas and was driven by rising agriculture incomes (ADB, 2017). However, this large agricultural sector is performing poorly, absorbing 66% of labor force but accounting for only 1.3 percent of growth and contributing 13% of total foreign trade (World Bank, 2018). Recently, Agriculture in Nepal is characterized by volatility and relatively low yields for major crops compared to neighboring countries (World Bank, 2018). Much of the increase in agricultural income has come from gains in prices, not yields. Most of the Nepalese farmers are diversifying away from grain staples to fruits, vegetables and cash crops, but the trend is unlikely to occur on a larger scale. As a result, agricultural productivity growth and its contributions for national GDP has been one of the lowest in the region. In the year 2020, agriculture, livestock, fishery and forestry shared only 22.96% to the total national GDP. Three major cereals namely; Rice, Wheat and Maize has shared almost one third to the total AGDP. We can see the decreasing trend of contribution of agricultural value added products to the total value added products (MoALD, 2021). The principal factor inhibiting growth in agricultural productivity in Nepal is the low level of technical change and technical efficiency, particularly in the Terai region, the grain basket of Nepal (Cosic, Dahal & Kitzmuller, 2017). The Total Factor Productivity (TFP) growth rate for the period 1981– 2013 was only 0.06 percent per year, which is the lowest in South Asia region (Anik, Rahman & Sarkar, 2017). Government prioritization for the development of agricultural sector is found as relatively weak as reflected by only 10.6% of expenditure on agricultural total outlays and allocation of below 3 percent of total budget in consecutive fiscal years for central federal agriculture ministry (MoF, 2020).

The lentil (*Lens culinaris* Medikus sub sp. *culinaris*) is a lens shaped winter grain legume popularly known as a nutritious food. Globally, it is also an important food legume crop component of farming and food systems. It plays an important role in human, animal and soil health improvement occupying a unique position in cereal based cropping systems (Erskine, Muehlbauer, Sarkar & Sharma, 2009). It is proven fact that, lentil is more preferred over the other grain legumes in human nutrition because of low level of nutrition hindering factors, high protein content and shorter cooking duration than the other grain legumes. Likewise, higher level of protein content and insignificant level of cholesterol, fat and anti-nutrients found in lentil cotyledon attributed to it being the most preferred protein source for human consumption (Sultana & Ghafoor, 2008). Whole lentil contains 25.8% protein while split lentil contains 25% protein (Kim et al., 2016). Lentil is important source of Minerals (Calcium, Iron, Magnesium, Potash, and Sodium), Vitamins (Vitamin C, Thiamin, and Riboflavin) and Lipids (Fatty acids and cholesterol). Lentil also have various potential health benefits such as anti-carcinogenic, blood pressure-lowering, hypo-cholesterolemic and glycemic load lowering effects (Faris, Takruri, & Issa, 2013).

In the developing countries like Nepal, legumes are the major part of the dietary protein for the poor families having low level of income who cannot afford expensive animal proteins, as they supply up to 20-25% of protein by weight, which is 2-3 times that of wheat and rice (Shahwar, Bhat, Ansari, Chaudhary & Aslam, 2017). Including lentil, legumes are the major source of nutrient supply to the Nepalese consumer. So, these sectors should be the most prioritizing ones to address the food and nutrition security in Nepal. Lentil from Nepal covers only 3% of total world market of lentil (ITC, 2019). Lentil is cultivated across all provinces in Nepal and in terms of agro-climatic zones; the cultivation of lentil is concentrated in the Terai region with a share of greater than 95% in total production. During the year 2013, Nepal, with its 4.6% share, was the sixth largest producer of lentil in the world, after Canada (35.1%), India (22.2%), Turkey (8.9%), Australia (8.3%), and the United States (4.8%) (Kumar, Roy, Joshi, Tripathi & Adhikari, 2016). During the previous years, production of lentil found changing over the years. In the period of 2013 to 2015, production was stagnated. Considering the total production of lentil in 2015, almost 11% higher production was there in 2016 (MoALD, 2020). After the year 2016, total lentil production and yield in Nepal have stagnated due to various factors including low levels of investment in inputs, low level of use of improved technology, cultivation of older varieties, and increased biotic and abiotic stresses. Although the yield of lentil has increased in recent years, current yields are still low

while comparing with other crops mainly because of the limited yield potential of lentil landraces, along with the vulnerability to an array of stresses. Study conducted by (Thapa, Kumar & Joshi, 2019) suggested that demand of lentil will increase rapidly in the near future and in order to meet the demand for lentil, both production or productivity has to be increased. Increased health awareness among the rural and urban people has changed the food consumption patterns. Domestic demand of lentil is found increasing every year but the production is decreasing which has caused ballooning between import and export of lentil. To formulate the appropriate policies and programs having the purpose of uplifting the lentil sector, current scenario of production, prevailing constraints at the farmers and traders levels and possible intervening points should be on hand. Holistic approach on lentil sector development should be prioritized analyzing the existing pro and cons on production, marketing and trade of lentil. Genetic resource development and improvement, niche expansion, input and technical support on production, legal and financial support on marketing and trade could be the possible breakthrough exploring the lentil sector in Nepal. Analyzing the present scenario of production and trade, indicating the opportunities and constraints along with the analysis on trend of area, production, productivity and trade of lentil, this research paper aims to investigate the forthcoming future possible condition on production and trade of lentil in Nepal.

METHODS OF RESEARCH

For the thorough analysis of lentil sector, including production, market and trade aspect, information and data from three levels: a. Production and trade of lentil on global and national level, b. Marketing and trade aspects from major national and international traders, and c. Scenario on production and existing constraints from household levels were taken for the study. To analyze the global and national prospective of lentil sector, secondary data collected from secondary sources like FAOSTAT, MoALD, other government & non-government organization and published articles, books, magazine, and newsletters were used. However, scientific research methodology was used to collect primary data from the lentil producing farmers and traders.

Description and selection of the study area. Among the seven provinces of Nepal, Province 2 (Madhesh Province) comes first in total area of lentil production (36.68% of total national area) followed by Lumbini Province (35.83% of total national area) and Sudurpaschim Province (13.56% of total national area). According to the production, Lumbini Province has higher lentil production (37.15%) followed by Province 2 (35.48%) and Sudurpaschim Province (14.34%) (MoALD, 2018). Considering this production potential, firstly, three provinces namely: Madhesh Province, Lumbini Province and Sudurpaschim Province were selected for the study. Among all lentil producing districts of Nepal, top six lentil producing districts are Dang, Kailali, Rautahat, Bardiya, Siraha and Bara. Top six lentil producing districts shares 58.52% of total production and 47.27 % of total lentil cultivated area (MoALD, 2018). Considering Terai region of Nepal and provincial representation, Kailali, Dang and Siraha districts were purposively selected for this study.

Selection of lentil grain producer. Among the lentil grower, two categories were made; local seed using lentil grain producer and improved seed using lentil grain producer. To find the population frame of both categories of farmers during the study, field visit and consultation were made with the agrovets, seed companies, cooperatives, local government bodies and with other government and non-government organization. To get the appropriate and representative sample size for lentil grain producer, Cochran formula was used:

$$n_0 = Z^2pq/\ e^2$$

Where: n_0 = the sample size, Z = Selected critical value of desired confidence level, e = the desired level of precision, p = the estimated proportion of an attribute that is present in the population, q = 1-p.

Using the Cochran formula, 100 lentil grain producing farmers from each targeted study district were selected randomly. Among those 100 lentil grain producing farmers for each districts; 50 farmers were improved seed using lentil grain producing and 50 farmers were local seed using lentil grain producing farmers.

Selection of foreign traders of Nepalese lentil. In Nepal, major foreign traders of Nepalese lentil are the millers. Those millers are found scattered all over the Nepal but typically are concentrated in major cities having border with India. Those major cities are Kakarvitta, Biratnagar, Birgunj, Bhairahawa, Nepalgunj and Mahendranagar. These six cities are the major area for lentil miller. Among those six major cities, major millers are located in Birgunj and Bhairahawa. So, those two cities which are adjacent to the Indian border were selected for the study purpose. Five foreign traders from each selected cities were taken randomly.

Techniques of data collection. To obtain the necessary information for the study, different techniques of data collection such as interview/field survey by using structured questionnaire, Focus Group Discussion (FGD) with concerned stakeholder, Key Informants Interview (KII) with local collector and local lentil consuming industries were conducted.

Sources of data collection. Primary data was collected using the household survey, KII, FGD and consultation workshop. For the secondary data, national and international reports, publications, articles, newspapers and online data published by FAO, ADB and World Bank was used for the study.

Problems on production and marketing. For identifying major problems of production and marketing, index was prepared based on response frequencies. Production and marketing problems were ranked by using five point level of influence comprising most serious, serious, moderate, low and very low or no problem at all using scores of 1.00, 0.80, 0.60, 0.40 and 0.20 respectively. The priority index for each variable was calculated by weighted average mean in order to draw valid conclusion and making responsible decision. Index of influence is calculated by using following formula:

$$I_{inf} = \sum \frac{s_i f_i}{N}$$

Where: I_{inf} = index of influence, Σ = summation, s_i =scale value, f_i = frequency of influence given by respondents, N = total number of respondents.

RESULTS AND DISCUSSION

Globally, there was a period of stagnation in pulses production between 1997 and 2003 when the production has not exceeded 60 million tonnes and varied from 55.8 (1997) to 59.2 (2003) million tonnes and at that period average annual growth rate was only 0.1%. In 2017, production reached 96 million tonnes, so since 2003, it increased by 62% with average annual growth rate of 3 percent (Joshi & Rao, 2016). The largest annual increase was recorded in 2017, as the harvest was 15% higher than in 2016. Analyzing by regions, each year Asia represents the highest level of production with over 43% share in global production in 2017, followed by Africa with 20% contribution and American regions with a very similar share. Europe's contribution in the global pulses production equals 12%, and the share of 4% ranked Oceania on fifth place. The observed global increase in production was reached mainly due to the growth in Asia (Sczebylo, Halicka, Jackowska & Rejman, 2019). In global scenario area under legume crop is increasing but total production seems to be decreasing. During the year 2017 area under pulse crops and total production was found as 93.75 million hectare and 93.59 million tonnes respectively while in 2018, area under pulse crops and total production was found as 95.72 million hectare and 92.27 million tonnes respectively (FAOSTAT, 2018). India was the biggest pulses producer in 2017 followed by Canada, Myanmar, China and Nigeria. Total pulses production in India reached over 23 million tonnes in 2017, which constituted almost one fourth of the global production of this food (Szczebylo, Rejman, Halicka & Jackowska, 2019).

Lentil contributed for 5.3% of global pulse area during the year 2011–2013, accounting for 15% in developed countries and only 4% in developing countries and among the developing countries, countries of Asia region had 6.6% of pulse area under lentils. Lentil production globally was 4.7 million tonnes during the year 2011–2013, grown on an area of 4.3 million hectare with yields averaging around 1 ton/ha. During the period of 2011 to 2013, it can be clearly seen a dynamic change in regional shares of lentil production. In the period 1980–1982, Asia accounted for almost 80% of lentil production, North America accounted for only 8% and Africa, 4.8%. Among the developed country group, Canada and the United States in North America and Australia are the major producers. In fact, Canada was the world's largest producer comprising 1.65 million tonnes production of lentils in 2011–2013. The United States is another country newly growing lentils with production at 0.22 million tonnes in 2013. Among the developing countries, India is the largest producer producing 1.1 million tonnes of lentil in 2011– 2013 followed by Turkey, which had production of 0.4 million tonnes (Joshi & Rao, 2016). Total lentil cultivated area during the year 2017 was found as 5.9 million hectare, which is highest in between 2015-2020. After the year 2017, global lentil cultivated area is decreasing slowly but not significantly. Total production of lentil in 2016 was found as 7.08 million tonnes and in 2017 it was 6.8 million tones showing decreasing trend (FAOSTAT, 2018). Lentil is one of the worldwide trading agricultural commodity and the data shows that in 2017 almost 3.82 million tonnes of lentil was imported globally while at the same year 3.49 million tonnes was exported (FAOSTAT, 2018). Analyzing the area, production and productivity trend of lentil globally, can be said that, area of lentil since 2017 is decreasing but there is no significant change in production except in the year 2019. This is because the increasing trend of productivity since 2017 to till data. Comparing with the data of 2015, it can be said that, area has been increased by only 5.1% while production and productivity has been increased by 19.33% and 13.47% respectively (Figure 1). Comparing the productivity figure of the year 2019 and 2020, there was almost 9.3% increase in global productivity of lentil in 2020 over the year 2019 (FAOSTAT, 2021).

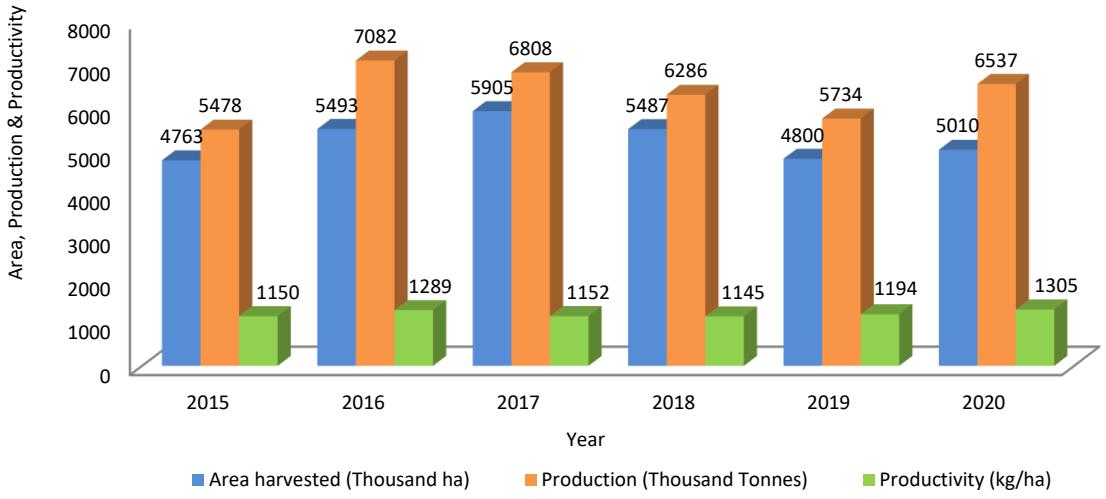

Figure 1 – Area, Production and Productivity of lentil in global scenario (Source: FAOSTAT, 2021)

During the period of 1980 to 2013, globally, Nepal ranked first in terms of share of lentil area compared with total legume area of the country which constituted 37.2% during 1980-82, 44.1% during 1990-92 and 70% during 2011-13. During the period of 2011-13, Nepal ranked fourth in terms of area harvested having total area harvested of 207 thousand hectare (4.8% of global lentil harvested area) and ranked sixth in terms of total production having production of 214 thousand tonnes (4.6% of global production) and at the same period India was the top country in terms of total area harvest and Canada was the top country in terms of total production (Joshi & Rao, 2016). At that period, lentils contributed 66% of the total protein intake from pulses in Nepal. During the period of 1990-92, Nepal had shared 4.6% of

global export but export had decreased during the period of 2009 to 2011, sharing only 2.03% of global export. The contribution of lentil to the agricultural value of production also has risen marginally from 2.4% in 1981 to 2.9% in 2013. Further, lentil emerged as the most valuable export commodity of Nepal with its 11.4% share in agricultural exports in 2013. In between 1981 to 2013, area under lentil cultivation, yield, and production of lentil in Nepal increased dramatically. The area under lentil cultivation had more than doubled from 97 thousand hectare to 207 thousand hectare, with an average annual growth of 2.5%. The yield of lentil increased from 497 kg ha^{-1} to 1033 kg ha^{-1} in the same time period. A more than two fold increase in the area as well as the yield of lentil has resulted in a rise in production by more than four times, from 48.7 tonnes to 214 tonnes (ANSAB, 2011).

Table 1 – Area, Production and Productivity of lentil in Nepal

Year	Area (ha)	Share in global area (%)	Production (tonnes)	Share in global production (%)	Productivity (kg/ha)	Deviation from global productivity (%)
2010	187437	4.29	151757	3.05	809	-28.84
2011	207591	5.05	206896	4.74	996	-6.21
2012	207630	5.00	208201	4.72	1002	-5.73
2013	206522	5.06	226931	4.29	1098	-15.34
2014	205939	5.07	226830	4.79	1101	-5.49
2015	204475	4.29	227492	4.15	1112	-3.30
2016	205939	3.74	253041	3.57	1228	-4.73
2017	206969	3.50	254308	3.73	1228	+6.59
2018	198605	3.61	249491	3.96	1256	+8.80
2019	208766	4.34	251185	4.38	1203	+0.74
2020	212876	4.24	262835	4.02	1235	-5.36

Source: MoALD, 2020.

Similarly, area, production and productivity of lentil have been increased by 111%, 257% and 69%, respectively in between 1985/86 and 2012/13. During the period of 2012/13, Lentil was the major grain legume and accounted for 62% of area and 65% production of total grain legumes in Nepal and has emerged as an important agricultural export commodity. During that period, lentil was recognized as one of the major agricultural product among 12 goods having high export potential and medium socioeconomic impacts by Nepal Trade Integration Strategy (Gharti, Darai, Subedi, Sarkar & Kumar, 2014). From the period of 2012/13 to 2014/15, area under lentil cultivation decreased while productivity remains increased and in 2015/16, area slightly increased while productivity still increased. From the year 2015/16 to 2017/18, area under lentil cultivation decreased resulting decrease in total production while productivity increased. During the period of 2014/15, lentil has shared almost 62% of total legume area, 64% of total legume production but in 2017/18, it has shared almost 64% of total legume area and 68% of total legume production. Area and total production of all legumes seems to be decreasing while share of lentil is still increasing. Among the newly formed seven provincial region, Province 1 shares 6.37% of total lentil area, 6.29% of total lentil production and yield remains almost at par with national yield, Province 2 shares 36.68% of total lentil area, 35.48% of total lentil production and yield is slightly lower than national yield, Province 3 shares 3.17 % of total lentil area, 2.97% of total lentil production and yield is slightly lower than national yield, Gandaki province shares 2.58% of total lentil area, 2.39% of total lentil production and yield is slightly lower than national yield, Province 5 shares 35.83% of total lentil area, 37.15 % of total lentil production and yield is slightly higher than national yield, Karnali province shares 1.8% of total lentil area, 1.34% of total lentil production and yield is almost 25% lower than national yield and Sudurpaschim province shares 13.56% of national lentil area, 14.34% of national lentil production and yield is slightly higher than national yield (MoALD, 2018). Analyzing the trend of area cultivated of lentil, 2018 was the year of much less area cultivated but having the higher productivity in Nepal. In the year 2018, productivity was comparatively higher than that of any years in between 2010 to 2020 (Table 1). From the year 2010 to 2014, area of lentil had shared almost 5% of global area and production had shared greater than 4% to the

global production but the productivity was lower than global productivity. In the year 2015 to 2018, on an average, share of area of Nepalese lentil to the global area decreased to about 4%, share of total production to global production also decreased to below 4% while on an average, productivity during that period had been increased. In the year 2018, productivity of lentil in Nepal was almost 8.8% higher than global productivity (Table 1). National data obtained from Ministry of Agriculture and Livestock Development (MoALD) shows that, in the years 2019 and 2020, both the area of lentil cultivation and total production of lentil in Nepal have been increased, sharing the 4.34% and 4.24% of global lentil cultivated area in respective years. Similarly, Nepalese lentil production has shared 4.38% and 4.02% to the global lentil production in the year 2019 and 2020 respectively (MoALD, 2020).

Pulses are important agricultural export commodities in the country while the share of lentil is dominant. Lentil was Nepal's third largest exportable commodity during the year 2009/10 (TEPC, 2011). Although Nepal is recognized as a potential lentil exporting country, wide variation in the volume of export persist across each years, primarily due to changes in volume of production as a result of biotic and abiotic constraints, or as a result of changes in production scenario in the Indian market which plays significant influence in world trade of lentil. In the fiscal year 2008/2009, Nepal exported 56.76 thousand tonnes, whereas in 2009/2010 only 37.56 thousand tonnes of lentils were exported. Since the very early years, Nepal used to export lentil to Korea, USA, UK and Bangladesh. Among the various countries where Nepal exports the lentil, Bangladesh has emerged as a major importer of Nepalese lentil. Bangladesh was the major buyer importing 83% of lentils from Nepal in 2015. Export price of lentils was US$ 1299/tonnes in 2008/09 and US$ 1364 per tonnes in 2009/2010. In 2010, India imposed restriction on the export of lentils, and as a consequence the imports from India were reduced from 32.36 thousand tonnes in 2009 to 7.64 thousand tonnes in 2010. Its implication was the reduced volume of export from Nepal in 2009/2010 (Shrestha, Neupane & Adhikari, 2011).

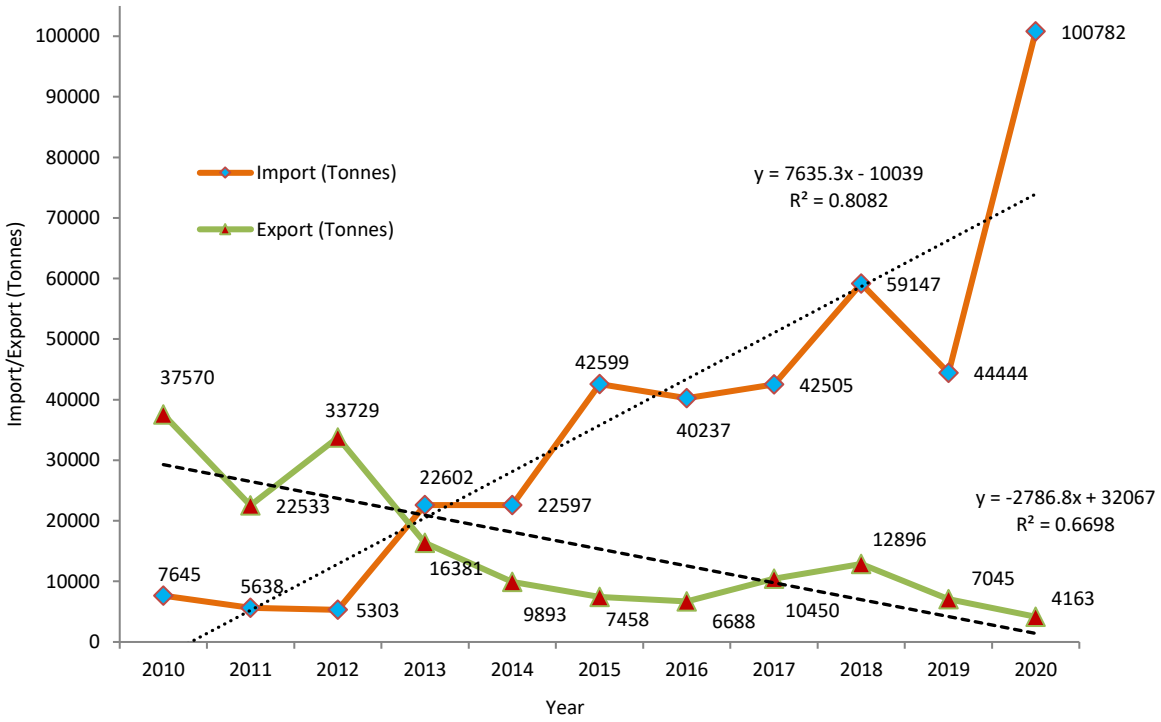

Figure 2 – Import and export trend of lentil in Nepal (Source: MoALD, 2020)

The local consumption of lentils imported from India and other countries provides export opportunities for Nepalese lentils. In 2009/10, 44.03 thousand tonnes of pulses valued NRs. 1376.67 million was imported, mainly from India. Dried peas, chickpea, Bean

(Phaseolus, Broad bean) and lentil were the major import grain legumes. The volume of imports fluctuates across years mainly due to changes in trade policy of India. Each year, Nepal has to deal policy and structural constraints while importing legumes from India. Import trend of lentil from Nepal showed that import was continuously increasing from the year 2012 to 2015 but during 2016 import decreased and again continued to increase rapidly. There exist large gap between import and export of lentil and it is increasing from the year 2016 to till date **(Figure 2)**. Till the year 2013, export of Nepalese lentil to the foreign market was higher than import but after 2013, scenario just reversed and in 2020, import of lentil from abroad market is almost 25 times higher than total export of Nepalese lentil in abroad market **(Figure 2)**. In the year 2020, study shows that there is increase in area, production and productivity of lentil in Nepal, but at the same year there exist huge gap between export and import as historically there is high import of lentil in Nepal than that of other years (MoALD, 2020). This fact revealed that, per capita consumption of raw and processed lentil have increased dramatically in the recent years. Having vast area (290 thousand hectare) of fallow land after rice harvest in the Terai and Inner Terai regions, there is an ample scope for the horizontal expansion of area and increase in the productivity and production of lentils and thus stabilizes the volume available for exports.

Nepal has previously imported large amount of lentil from neighboring country India but at present scenario, Canada ranked apex among import destination of lentil **(Figure 3)**. Large amount of lentil nowadays imported from Canada followed by Australia, USA, India, Myanmar, Turkey, Argentina etc. Import quantity remained significantly higher than export quantity during previous year. Out of the total lentil imported, Canada shares 56.34% followed by Australia (32.66%) and other countries shares 11% only (MoALD, 2020). Canada and Australia are the major countries to import the lentil in Nepal.

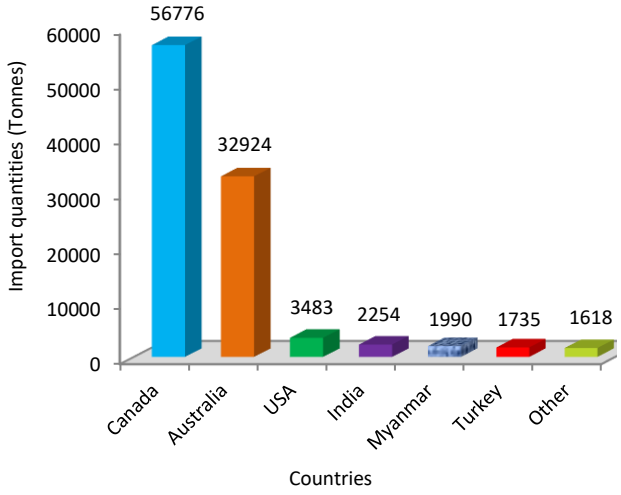

Figure 3 – Import destinations and imported quantity of lentil in Nepal during 2019-2020 (Source: MoALD, 2020)

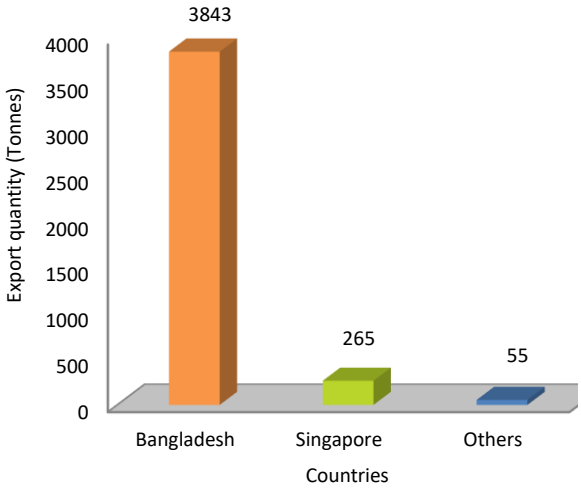

Figure 4 – Export destinations and exported quantity of lentil in Nepal during 2019-2020 Source: MoALD, 2020)

Although, GoN/MoC (2016), NTIS has identified lentil as potential exportable commodity, export of lentil is decreasing each year in Nepal. During the period of 2008, Nepal had exported 16.41 thousand tonnes of lentil and total export quantity was increased almost by three times giving export quantity of 56.76 thousand tonnes during the period of 2009. Total export of lentil was decreased in the year 2010/11 while again increased in the year 2012 with quantity export of 33.72 thousand tonnes. Again export quantity had decreased in the year 2013 and slightly increased in the year 2014. Total export of lentil is decreasing from the year 2016 and gap of import and export is widening each year. Among the exportable countries, Bangladesh was the major export destination of Nepalese lentil during the year of 2015 having export quantity of 4289 tonnes. National data shows that, in the year 2019 and 2020, area, production and productivity of Nepalese lentil has increased

but trade data shows the decreasing trend in export. At the same time we are importing higher amount of lentil than that of any year between 2010 to 2020. In 2020, only 4163 tonnes of lentil was exported to the foreign countries and Bangladesh shares almost 92.3% to the total export (Figure 4). After Bangladesh, Singapore is another potential export destination of Nepalese lentil which shares almost 6.3% of total export (MoALD, 2020).

Table 2 – Import-export scenario of lentil from trader side

Traders name	Year	Nepalese lentil purchased (Tonnes)	Selling in local market (%)	Purchasing cost (NRs/kg)	Selling price in foreign market (NRs./kg)	Foreign lentil purchased (Tonnes)	Selling in local market (%)	Purchasing cost (NRs/kg)	Selling cost (NRs./kg)
Durga	2020	788	10	86	134	1740	95	65	78
Modern	2019	840	10	82	130	1100	90	62	80
Daal Mill	2018	1220	12	87	126	1350	88	60	72
Arpit	2020	832	10	88	140	3450	95	63	84
Aadhunik	2019	910	7	84	132	1830	93	58	86
Daal Udhyog	2018	1615	10	86	128	1720	90	62	75
Manoj	2020	1100	15	82	135	2400	95	65	90
Modern	2019	1150	13	85	128	2080	87	62	82
Daal Mill	2018	1875	15	95	125	2200	85	56	78
Ananda	2020	1160	12	92	132	2650	90	70	85
Khadya	2019	1370	17	90	130	2100	83	59	75
Udhyog	2018	2035	10	82	132	1870	90	55	72
Shyam	2020	970	5	85	135	3140	95	65	78
Modern	2019	1140	12	95	130	2250	88	58	72
Daal Mill	2018	2210	5	88	128	2600	95	52	75
Tribeni Daal	2020	1240	10	85	133	4150	90	68	85
and Oil	2019	930	7	90	130	3210	93	60	82
Industries	2018	1850	10	85	136	3860	90	55	75
Narayani	2020	300	0	92	135	2300	95	70	92
Modern	2019	450	10	88	130	1860	90	55	75
Pulses Industries	2018	940	10	85	130	2830	90	48	78
Shree	2020	0	-	-	-	6300	100	63	75
Adhunik	2019	0	-	-	-	3480	100	59	77
Daal Udhyog	2018	0	-	-	-	4600	100	52	72
Roongata	2020	0	-	-	-	3150	100	65	82
Processing	2019	0	-	-	-	2200	100	58	80
Industries	2018	0	-	-	-	2870	100	50	75
Krishna	2020	0	-	-	-	3000	95	70	85
Modern	2019	200	8	95	130	1780	92	63	77
Daal Udhyog	2018	580	10	90	125	2340	90	55	75

Source: Field survey, 2020.

Trade data of Nepalese and foreign lentil taken from the sampled traders/millers of three major foreign trading districts of Nepal revealed that quantity purchased of Nepalese lentil by the miller is decreasing while the import of lentil from the foreign countries is increasing. Majority of the lentil millers and traders perceived that, they even cannot afford their operating cost with the trading of Nepalese lentil only as the quantity purchased and trading is decreasing year after year. If they operate their mill purchasing Nepalese lentil only, their business will remain close for almost six month in a year. Study found that, due to the loss from processing and trading of Nepalese lentils due to the quantity constraint, some millers ended up purchasing Nepalese lentil and started to process and trade foreign lentil only. It was found that, comparing with quantity purchased of Nepalese lentil in 2018, average decrease in quantity purchased of Nepalese lentil in the year 2019 and 2020 was 42.34% and 46.48% respectively. While, average increase in quantity purchased from foreign countries in the year 2019 and 2020 was 3.24% and 31.27% respectively (Table 2). Large portion of purchased Nepalese lentil goes to foreign market than local market having the average price of NRs. 134.95 per kg in the year 2020. Price of Nepalese lentil in foreign market has increased in recent years. There is significantly higher gap between the

purchasing price and selling price of Nepalese lentil while this gap is somewhat narrow in case of lentil purchased from abroad. Miller/trades generally purchase foreign lentil at the price of NRs. 52 to NRs. 70 per kg and price of foreign lentil is also increasing. Average selling price of foreign lentil from miller/traders was found between NRs. 72 per kg to NRs. 92 per kg. Import-Export data from the traders/millers side revealed that, we are exporting large portion of Nepalese lentil and at the same time, for the consumption purpose, we are importing comparatively large volume of lentil from foreign market.

Among the studied variables, ethnicity of the respondent's households was found statistically significant at 10% level. The male Household Head (HHH) was found 87.67% whereas the female HHH were 12.33% in the study area (Table 3). The ethnical composition of the study area revealed that the majority of the households were dominated by *Aadibasi/Janajati* ethnic group which is almost lies on 3rd percentile signifying as dominant group. There are 18% household who belongs to *Brahmin/Chhetri* ethnic group which is less than national percentage for *Brahmin/Chhetri* ethnic group which is 28.8%. In the study area, 52.67% of the household has joint type of family structure and 47.33% has nuclear type of family structure.

Table 3 – Socio-demographic characteristics of sampled Household by lentil seed use

Variables	Local seed user (n=150)	Improved seed user (n=150)	Overall (n=300)	Chi-square value
Gender of Household head				
Male	128 (85.33)	135 (90)	263 (87.67)	1.51 (p=0.219 at 1 df)
Female	22 (14.67)	15 (10)	37 (12.33)	
Ethnicity				
Brahmin/Chhetri	18 (12)	36 (24)	54 (18)	
Aadibasi/Janjati	132 (88)	108 (72)	240 (80)	14.4** (p=0.002 at 3 df)
Dalit	0 (0)	5 (3.30)	5 (1.67)	
Other (Muslim etc.)	0 (0)	1 (0.67)	1 (0.33)	
Family type				
Joint	84 (56)	74 (49.33)	158 (52.67)	1.33 (p=0.248 at 1 df)
Nuclear	66 (44)	76 (50.67)	142 (47.33)	

*Note: Figures in parentheses indicate percentage. ** and * indicate significant difference at 5% and 10% levels, respectively.*

Among the studied continuous variables, numbers of family members abroad was only found statistically significant (Table 4). Dependency ratio is slightly higher for local seed user (70.9%) than improved seed user (70.1%) with average value of 70.51%. In this study average household size for improved and local seed user category was found as 7.11 while it was 7.24 for grain producer and seed producer categories which were found greater than the national average household size which is 4.88. Compared with districts, it is 5.40 for Siraha, 4.75 for Dang and 5.44 for Kailali. Nepal being geographically diverse, population distribution in all states of Nepal is not uniform. Province 2 contributes 20.4% of total population, Province 5 contributes 16.9% and Sudurpaschim province contributes 9.6% (CBS, 2017). Major reasons for higher household size might be due to the higher household size in the study districts compared with other districts and higher population in two provinces where study was conducted. For improved seed user and local seed user category, there were 87.67% male headed households while 12.33% were female headed households. Similarly, for grain producer and seed producer categories, there were 86.5% male headed households while 13.5% were female headed households. Comparing distribution of male and female nationally, male headed household contributes 74.27% and female headed household contributes 25.73 signifying lower percentage of female headed household in the study area than national average (CBS, 2017). For improved and local seed user, this study found dependency ratio of 70.51% while for grain and seed producer it was 79.04% and comparing with national average (56.96%) those values are higher. Declining fertility and improving mortality over the years have contributed to the decline in the dependency ratio in Nepal. The dependency ratio was found high in 2011, when every 67 persons were dependent on 100 persons of the working age population. It is assumed that dependency ratio will decrease to 52.2% in 2021 (UNFPA, 2017).

Table 4 – Socio-demographic characteristics (continuous variables) by lentil seed use

Variables	Overall (n=300)	Local seed user (n=150)	Improved seed user (n=150)	Mean differences	t-value
Age of HHH	46.73 (9.18)	46.45 (8.99)	47.00 (9.40)	-0.55	-0.52
Total family size	7.11 (2.36)	7.11 (1.89)	7.12 (2.75)	-0.006	-0.02
Economically active HH members[1]	4.35 (1.41)	4.36 (1.35)	4.35 (1.48)	0.006	0.04
Dependency ratio (%)	70.51 (45.65)	70.9 (46.00)	70.10 (45.46)	0.76	0.14
Members involved in lentil cultivation	3.5 (1.5)	3.48 (1.44)	3.53 (1.57)	-0.05	-0.28
Number of family members abroad	1.18 (0.57)	1.08 (0.33)	1.30 (0.75)	-0.22***	-1.98
Total numbers of illiterate family members	1.03 (1.09)	1.06 (1.06)	1.00 (1.11)	0.06	0.52

*Note: Figures in parentheses indicate standard deviation. *** indicates significant difference at 1% level. [1] represents the members of household of age group 15 to 59 years.*

Lentil is major winter pulse crop in South Asia and typically sown after rice in the annual crop rotation (Paudel, Devkota, Keil & McDonald, 2020). In Asian countries, sowing of lentil is popular as mono and sequential cropping, intercropping, mixed cropping and relay cropping. However, in Nepal, rice-lentil system is more common and cultivation can also be done after maize, millet, and sorghum. Most of the farmers in Terai regions of Nepal prefer intercropping of lentil with wheat, barley, mustard and linseed (Sekhon, Singh & Ram, 2007). In this study, the different types of cropping patterns were found to be statistically insignificant among the local seed user and improved seed user categories. This study found that majority of the improved and local seed using farmers (58.33%) follow relay cropping of lentil with rice (Table 5). Among local seed user, 11.33% follow sole cropping of lentil while it was 10% for improved seed user. Similarly, 24% of local seed users follow mixed cropping of lentil and oilseed while it was 29.33% for improved seed user. To intensify the rice based cropping system, from the age ago, farmers of Terai and Inner Terai regions of Nepal are practicing relay cropping with rice. Study conducted by Malik et.al (2016) revealed that the substitution of relay-sown lentil for fallow in the monsoonal rice–fallow–rain-fed rice cropping pattern is a most potential option to intensify and diversify cropping in the South Asian regions including Nepal.

Table 5 – Position of lentil in major cropping patterns categorized by type of lentil seed use

Cropping pattern	Local seed user (n=150)	Improved seed user (n=150)	Overall (n=300)	Chi-square value
Sole cropping	17 (11.33)	15 (10)	32 (10.67)	1.14 (p=0.766 at 3 df)
Relay cropping with rice	90 (60)	85 (56.67)	175 (58.33)	
Mixed cropping with oilseed	36 (24)	44 (29.33)	80 (26.67)	
Mixed cropping with other legumes	7 (4.67)	6 (4)	13 (4.33)	

Note: Figures in parentheses indicate percentage.

Several biotic and abiotic factors affect the production and yield of lentil (Sehgal et.al, 2021). However, winter rainfall pattern during the flowering season and prevalence of fungal diseases mainly Stemphylium Blight are the major threating factors for the yield reduction of lentil in Nepal (Sharma & Joshi, 2021). Recently, erratic and heavy winter rainfall pattern especially during the pre-flowering and flowering time has caused dramatic yield loss. The study also found that, total lentil production and amount of lentil sold in market is decreasing year after year (Table 6). Lentil production in 2019, among local seed user and improved seed user found significantly different at 5 percent significance level. Farmers who are using improved seed of lentil are getting significantly higher production than local seed user. Study conducted by Cokkizgin and Shtaya (2013) had also found the higher yield of lentil using the improved or hybrid seed than using the local seed. The average sold of lentil over consecutive three years by improved seed user was statistically higher than that of local seed user. Considering both local and improved seed user, the price of lentil found increasing in last three years and can be predicted that, despite the decreasing trend of lentil production, price of lentil is increasing in current years. However, the seasonal fluctuation of

price was one of the major marketing constraints in the study area. During year 2017, price of lentil grain was NRs. 50.9 kg while it rises to NRs. 55.9 in 2019.

Table 6 – Trend of differences in production and price of lentil categorized by type of lentil seed use

Variables	Overall (n=300)	Local seed user (n=150)	Improved seed user (n=150)	Mean difference	t-value
Total production (kg)					
2019	259.4 (201.4)	238.8 (181.9)	280.1 (228.8)	-41.3**	-1.73
2018	285.8 (234.3)	251.2 (205.7)	320.4 (256.7)	-69.2***	-2.89
2017	293.5 (226.8)	246.6 (162.4)	340.5 (320.1)	-93.9***	-4.37
Price (NRs./kg)					
2019	55.9 (10.3)	55.2 (9.9)	56.6 (10.7)	-1.4	-1.1
2018	53.0 (9.2)	52.7 (8.4)	53.3 (9.7)	-0.6	-2.05
2017	50.9 (9.7)	50.8 (9.8)	51.1 (9.7)	-0.3	-1.17

*Note: Figures in parentheses indicate standard deviation. ***, and ** indicates significant difference at 1% and 5% levels respectively. Average lentil cultivated land is 8.09 kattha for local seed user and 9.74 kattha for improved seed user.*

Farmers training on lentil cultivation and strengthening of extension works helps to share the idea and techniques on recent development and scientific cultivation, thereby contributing to increase the production and yield of lentil (Matin, Islam & Huque, 2018). However, this study found that only 39.67% of total lentil producing farmers have taken training for lentil cultivation. Among local seed user, only 24 percent have taken training for lentil cultivation while for improved seed user significantly higher (55.33%) have taken training for lentil cultivation (Table 7). Majority of the improved seed user farmers (47.62%) have taken training from groups and cooperative. Similarly, among lentil producing farmers categorized by local seed user and improved seed user, only 55.67% farmers got technical assistance regarding lentil cultivation (Table 7). Significantly higher improved seed users (73.33%) have taken technical assistance regarding lentil cultivation than local seed user (38%). This study also revealed that, cooperatives, farmers group, and seed companies are mostly providing technical assistance for improved seed user than local seed user. Extension activities like training of lentil producing farmers have significant positive impact on adoption of scientific lentil production techniques (Singh, Singh, Varma & Singh, 2016). However, in the study area, significantly lower numbers of lentil producing farmers had taken training and technical assistance from government and non-government organization regarding the scientific production and crop management of lentil, which signifies the urgent need of technical support through the extension work.

Table 7 – Training and technical assistance regarding lentil cultivation according to seed use

Variable	Local seed user (n=150)	Improved seed user (n=150)	Overall (n=300)	Chi-square value
Training regarding lentil cultivation (1=Yes)	36 (24)	83 (55.33)	119 (39.67)	30.76*** (p=0.001 at 1df)
Technical assistance (1=Yes)	57 (38)	110 (73.33)	167 (55.67)	37.94*** (p=0.001 at 1 df)

*Note: Figures in parentheses indicate percentage. *** indicates significant difference at 1% level.*

The value obtained from the rank scale showed that good return from the lentil cultivation was the most decisive factor for lentil cultivation with index of 0.784 followed by the high market demand for lentil with index of 0.677, prior knowledge about techniques of lentil cultivation with index of 0.583, land suitability for lentil cultivation with index of 0.542 and finally neighbors influence on lentil cultivation with index of 0.430 (Table 9). Despite the several hindering factors, farmers are still willing to expand the area of lentil cultivation mainly because of price advantage than other winter crop along with the increasing market demand. Among the other winter crop of Nepal, lentil is the only one crop for which farmers are using significantly low level of inputs but getting higher income during the good harvest period. In the study area lack of technical/ scientific cultivation knowledge was the major problems related with lentil cultivation with highest index value of 0.756. Most of the farmers did not have scientific lentil cultivation knowledge. They are using their traditional farming

experience and significantly lower farmers are adopting scientific cultivation technique. Similarly, farmers had faced serious problems of attack of pest/disease in the study area, which ranked second most serious problem among the categorized problems with index value of 0.755 (Table 9). Farmers perceived problem of lack of technical knowledge on cultivation and problem of attack of disease and pest as equally severe. *Stemphylium blight* and root rot were the major diseases in study area while lentil aphid was the major storage pest of lentil.

Table 9 – Factors influencing lentil cultivation and problems in lentil cultivation and marketing in the study area

Lentil cultivation Factors	Index	Rank	Problems on lentil cultivation	Index	Rank	Marketing problems	Index	Rank
Good return	0.784	I	Lack of technical cultivation knowledge	0.756	I	Low seasonal price/Price fluctuation	0.783	I
Market demand	0.677	II	Attack of pest/disease	0.755	II	More gap between farm gate and retail price	0.746	II
Prior knowledge	0.583	III	Irrigation/poor rainfall	0.554	III	Lack of marketing knowledge	0.557	III
Land suitability	0.542	IV	Lack of quality seed	0.464	IV	Poor transportation facility	0.463	IV
Neighbors influence	0.430	V	Lack of farm labor	0.442	V	Distant market	0.453	V

Heavy rainfall at the time of just prior to flowering and at flowering was also found most serious problem to attain the desirable yield of lentil. Lentil *Stemphylium blight* disease, caused by *Stemphylium botryosum,* once had least significant effect but now it is a serious threat to lentil cultivation in many parts of the world (Das et.al, 2019). Research conducted in different regions showed that yield loss due to *Stemphylium blight* is up to 100% depending on disease severity (CSISA, 2018). Study conducted by Sarker (2011); Kumar, Barpete, Kumar, Gupta and Sarkar (2013); Deshpande and Singh (2001); Shrestha et al. (2011) have also found *Stemphylium blight* as a major disease of lentil which may cause yield loss up to 100%. Similar study conducted by Thapa Magar, Gauchan and Darai (2014) also revealed that, limited availability of quality seed of improved varieties, limited awareness of farmers on improved lentil varieties and production technologies, uncertain rainfall leading to heavy disease infestation and occurrence of early and terminal drought during lentil growing is threatening to undermine sustainable lentil production in Nepal. Similarly Among various marketing related problems, value obtained from the ranking scale revealed that the low seasonal price/price fluctuation has the highest index value (0.783) and ranked as major marketing problem among categorized problems followed by problem of more gap between farm gate and retail price which had index value of 0.746, problem of lack of marketing knowledge showing index value of 0.557, problem of transportation facility with index value of 0.463 and problem of distant market with index value of 0.535.

CONCLUSION

Lentil is the most important winter crop legume in Nepalese farming system, significantly contributing not only to the food and nutrition security but also in improving soil health and livelihood of marginal farmer of Nepal. Because of increasing health concern of consumer, most of the people in South Asia consumes highly nutritious and easily affordable lentil. Increasing demand of lentil paves the opportunity to the farmers for higher income and improved livelihood but nowadays, the Nepalese lentil producing farmer are not able to grab this opportunity. Nepal was one of the potential countries for lentil production and export in foreign countries ranking the apex place in previous years. However, several biotic, abiotic and policy constraints on lentil production has changed the scenario. Globally, area and production of lentil is decreasing but productivity is increasing. Comparing with the global demand, it is not possible to cover global demand of lentil only with increased in productivity. It is evident from different level of study that, from the years ago, area and production of lentil is gradually decreasing despite the increased demand in Nepal. Higher gap between

demand and supply has caused significantly higher import of lentil than export. With the decreased production, majority of the lentil miller are processing imported lentil from other nations while some millers has shifted the processing from lentil to other legumes. Household level study suggested that, lack of technical knowledge, erratic and devastating winter rainfall pattern, persistence of fungal diseases along with insect/pest attack are the major threats in lentil cultivation. However, government support and extension services for strengthening the technical knowledge of lentil producing farmers found relatively weak and inconsistent. Recently, increased demand and lower supply of lentil has provided the better price for farmers but due to the seasonal price fluctuation and more gaps between farm gate and retail price, hindering the higher price benefit for farmers. It is clearly evident that, biotic and abiotic stresses along with the inappropriate supports from government side has reducing the production and compelling the higher import than export. Decreased production in recent years has reversed the trade scenario of lentil from top exportable to the most importable legume. Effective government policies and programs along with the technology development from public and private side is the most needed condition to uplift the lentil sector in Nepal.

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AUTHOR'S DECLARATION

The authors declare that there is no conflict of interest for the publication of this paper. All authors read the final manuscript and approved the final version.

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