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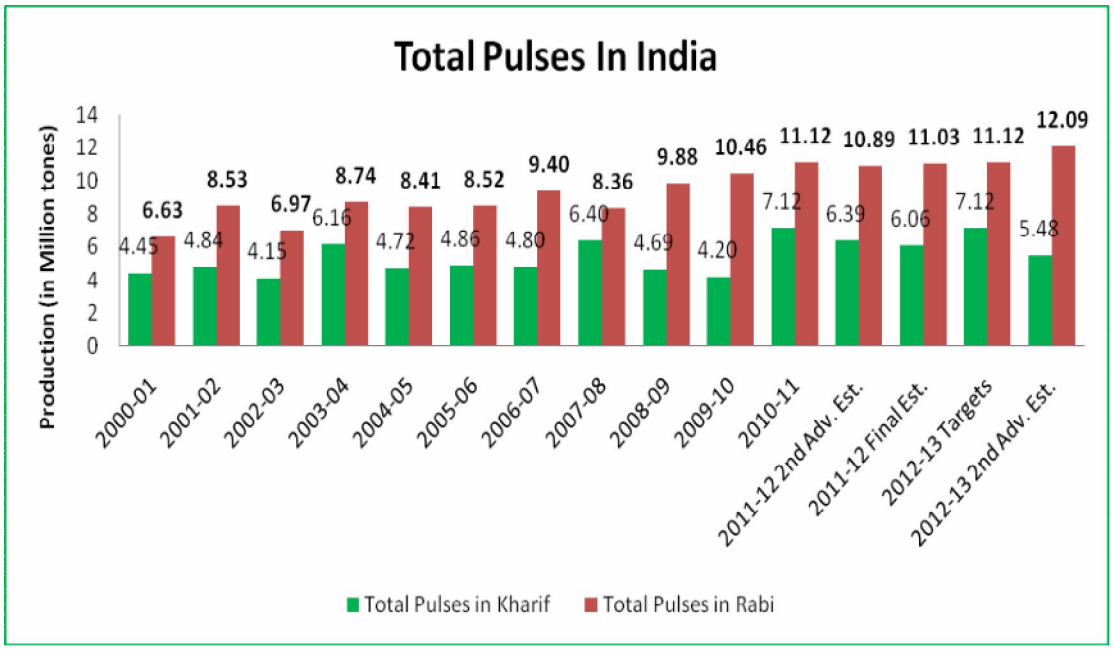
Lentil in India: An Overview

K.M.Singh[1] and A.K.Singh[2]

Introduction

Traditionally pulses have been considered important elements of cropping systems in the Indo-Gangetic Plains. They were popular because of their importance as a source of protein and ability to fix atmospheric nitrogen (N) and thus improve soil fertility (Joshi 1998). With the introduction of irrigation and due to high profitability of alternative sources of soil nutrients in the form of inorganic fertilizers in the mid-1960s, pulses were replaced or relegated to marginal lands. During the late 1960s and early 1970s, a large area under pulses in the Indo-Gangetic Plain (IGP) was substituted by high- yielding varieties of rice (*Oryza sativa*) and wheat (*Tritium aestivum*). The new technology of rice and wheat substantially changed the agricultural scenario and largely contributed to increase in agricultural production in the IGP.



Source: http://agricoop.nic.in/imagedefault/trade/pulses%20profile.doc

With the passage of time, excessive use of chemical fertilizers and irrigation in rice and wheat to maintain their productivity has created an imbalance in soil fertility and

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threatened the sustainability of the most productive food grain belt in South Asia (Hobbs and Morris 1996)2. Pulses are an effective source of reversing the process and can contribute significantly to achieving the twin objectives of increasing productivity and improving the sustainability of the rice and wheat- based cropping system in the IGP (Ahlawat et al. 19983; Lauren et al. 19984; Yadav et al. 19985). It has been reported that there is a scope of increasing area under lentil during the *rabi* season, as its cost per hectare is less with higher net returns than the competing crops like wheat, gram and mustard in water-deficit and resource-poor conditions. There are large returns for adoption of disease management (80 per cent increase in net return), and improved small-seeded varieties (about 40 per cent increase in net return) in lentil. The study has found that lentil-based cropping systems are profitable and also have high water productivity, hence are suitable for mostly un-exploited rice-fallows under water-deficit conditions (Reddy and Reddy 2010).

Area, Production and Yield of Lentil during 2010-11 and 2011-12 in major producing states in India

States	**2011-12**			**2010-11**		
	Area	**Production**	**Yield**	**Area**	**Production**	**Yield**
Uttar Pradesh	0.59	0.41	695	0 .59	0.48	814
Bihar	0.24	0.21	875	0.17	0.15	882
Madhya Pradesh	0.59	0.18	305	0.54	0.28	519
West Bengal	0.06	0.05	833	0.05	0.05	1000
Rajasthan	0.04	0.04	1000	0.03	0.02	667
Assam	0.02	0.01	500	0.02	0.01	500
Others	0.06	0.04	®	0.08	0.04	@
All India	**1.6**	**0.94**	**591**	**1.48**	**1.03**	**697**

Source: http://agricoop.nic.in/imagedefault/trade/pulses%20profile.doc

About Lentil

Lentil *(Lens culinaris*) is an edible pulse. It is a bushy annual plant of the legume family, grown for its lens-shaped seeds. It is about 40 cm (16 in) tall and the seeds grow in pods, usually with two seeds in each. Lentils have been part of the human diet since the aceramic (before pottery) Neolithic times, being one of the first crops domesticated in the Near East. Archeological evidence shows they were eaten 9,500 to 13,000 years ago. Lentil colors range from yellow to red-orange to green, brown and black. Lentils also vary in size, and are sold in many forms, with or without the skins, whole or split.

Lentil in culture

The lens (double-convex shaped) is so called because the shape of a lens is basically the same shape as lentils. Lens is the Latin name for lentil. Lentils are mentioned many times in the Hebrew Bible, the first time recounting the incident in which Jacob purchases the birthright from *Esau* with stewed lentils (a "mess of pottage"). In Jewish mourning tradition, lentils are traditional as food for mourners, together with boiled eggs, because their round shape symbolizes the life cycle from birth to death.

Lentils were a chief part of the diet of ancient Iranians, who consumed lentils daily in the form of a stew poured over rice. Lentils are also commonly used in Ethiopia in a stew-like dish called *kik*, or *kik wot*, one of the dishes people eat with Ethiopia's national food, injera flat bread. Yellow lentils are used to make a non-spicy stew, which is one of the first solid foods Ethiopian women feed their babies. In Pakistan, lentils are often consumed with *Roti/*bread or rice.

In India, lentils soaked in water and sprouted lentils are offered to gods in many temples. It is also a practice in South India to give and receive sprouted peas by women who perform *Varalakshmi Vratam*. It is considered to be one of the best foods because the internal chemical structures are not altered by cooking. In Italy and Hungary, eating lentils on New Year's Eve traditionally symbolizes the hope for a prosperous new year, most likely because of their round, coin-like form. In Shia narrations, lentils are said to be blessed by seventy Prophets, including Jesus and Mohammed. In "Cinderella", one of Grimm's Fairy Tales, Cinderella's stepmother assigns to Cinderella the task of fishing lentils out of ash. If she succeeds, she may go to the ball.

The seeds of lentil require a cooking time of 10 to 40 minutes, depending on the variety—shorter for small varieties with the husk removed, such as the common red lentil — and have a distinctive, earthy flavor. Lentil recipes are used throughout South Asia, the Mediterranean regions and West Asia. They are frequently combined with rice, which has a similar cooking time. A lentil and rice dish is referred to in western Asia as *mujaddara or mejadra*. Rice and lentils are also cooked together in khichdi, a popular dish in the Indian subcontinent (India and Pakistan); a similar dish, kushari, made in Egypt, is considered one of two national dishes. Lentils are used to prepare an inexpensive and nutritious soup all over Europe and North and South

America, sometimes combined with some form of chicken or pork. Dried lentils can also be sprouted by soaking in water for one day and keeping moist for several days, which changes their nutrition profile. Lentils with husk remain whole with moderate cooking; lentils without husk tend to disintegrate into a thick purée, which leads to quite different dishes.

Nutritional Status of lentil

With about 30% of their calories from protein, lentils have the third-highest level of protein, by weight, of any legume or nut, after soybeans and hemp. Proteins include the essential amino acids isoleucine and lysine, and lentils are an essential source of inexpensive protein in many parts of the world, especially in West Asia and the Indian subcontinent, which have large vegetarian populations. Lentils are deficient in two essential amino acids, methionine and cysteine. However, sprouted lentils contain sufficient levels of all essential amino acids, including methionine and cysteine.

Lentils also contain dietary fiber, folate, vitamin B_1, and minerals. Red (or pink) lentils contain a lower concentration of fiber than green lentils (11% rather than 31%). Health magazine has selected lentils as one of the five healthiest foods. The low levels of Readily Digestible Starch (RDS) 5%, and high levels of Slowly Digested Starch (SDS) 30%, make lentils of great interest to people with diabetes. The remaining 65% of the starch is a resistant starch that is classified RS1, being a high quality resistant starch, which is 32% amylose.

Lentils also have some anti-nutritional factors, such as trypsin inhibitors and relatively high phytate content. Trypsin is an enzyme involved in digestion, and phytates reduce the bio-availability of dietary minerals. The phytates can be reduced by soaking the lentils in warm water overnight. Lentils are a good source of iron, having over half of a person's daily iron allowance in a one cup serving.

Nutritional value of lentil per 100 g dry weight

Energy	1,477 kJ (353 kcal)
Carbohydrates	60 g
Sugars	2 g
Dietary fibre	31 g
Fat	1 g
Protein	26 g
Vitamins	
Thiamine (B1)	(76%) 0.87 mg
Riboflavin (B2)	(18%) 0.211 mg
Niacin (B3)	(17%) 2.605 mg
Pantothenic acid (B5)	(42%) 2.120 mg
Vitamin B6	(42%) 0.54 mg
Folate (B9)	(120%) 479 μg
Vitamin C	(5%) 4.4 mg
Trace metals	
Calcium	(6%) 56 mg
Iron	(58%) 7.54 mg
Magnesium	(34%) 122 mg
Phosphorus	(64%) 451 mg
Potassium	(20%) 955 mg
Sodium	(0%) 6 mg
Zinc	(50%) 4.78 mg
Other constituents	
Water	10.4 g
Units μg = micrograms, mg= milligrams, IU, International Units	

Source: USDA Nutrient Database

Production

Lentil production for the major lentil producing nations has been trending upwards during the past 7 years, ranging from 2.1 million tones (Mt) in 2002-2003 to 2.9 Mt in 2009-2010. Among the main producers, production has been trending upwards in Canada, the US, and Australia, but has been highly variable and trending down in India, Bangladesh, Syria and Turkey. In the US, production increased sharply when lentils were first included under the loan program in 2002.

Lentils are relatively tolerant to drought, and are grown throughout the world. The FAO reported that the world production of lentils for calendar year 2009 was 3.917 million metric tons, primarily coming from Canada, India, Turkey and Australia. About a quarter of the worldwide production of lentils is from India, most of which is consumed in the domestic market. Canada is the largest export producer of lentils in the world and Saskatchewan is the most important producing region in Canada. Statistics Canada estimates that Canadian lentil production for the 2009/10 year is a record 1.5 million metric tons.

Top ten lentil producers – 2012

Top 10 Lentil Producing Countries (in metric tons)

Rank	**Country**	**2010**	**2011**	**2012**
1	Canada	1,947,100	1,531,900	1,493,620
2	India	1,031,600	943,800	950,000
3	Australia	140,000	379,659	463,000
4	Turkey	447,400	405,952	438,000
5	United States	392,675	214,640	240,490
6	Nepal	151,757	206,969	208,201
7	Ethiopia	80,952	128,009	151,500
8	China	125,000	150,000	145,000
9	Syria	77,328	112,470	130,229
10	Iran	100,174	71,808	85,000
	World	4,686,673	4,386,870	4,522,097

Source: UN Food & Agriculture Organization

World: Major Lentil Exporters

Crop year	**2004-2005**	**2005-2006**	**2006-2007**	**2007-2008**	**2008-2009**	**2009-2010f**
	thousand tonnes					
Canada	372	576	853	811	973	1,395
United States	83	160	118	114	116	193
Australia	150	201	103	74	50	128
Turkey	171	118	147	130	25	44
India	137	0	0	0	0	0
Syria	71	0	0	0	0	0
Total	984	1,055	1,221	1,129	1,164	1,760

f: forecast

Source: FAO, Statistics Canada, USDA and Global Trade Atlas

Uses

On average, about 70% of all world lentil production is consumed in the countries where they are produced. Total world use has been trending upwards during the past 10 years. It is cultivated for its seed and mostly eaten as *dal*. *Dal* is seed that is decorticated and split. The primary product is the seed which has relatively higher contents of protein, carbohydrate and calories compared to other pulses and are the most desired crop because of its high average protein content and fast cooking characteristic in many lentil producing regions (Muehlbauer et al., 1985).

Lentils are generally used for food. They are canned or packaged, whole or split, for retail sale, or processed into flour. They are then used in soups, stews, salads, casseroles, snack food and vegetarian dishes. In southern Asia, split red lentils are used in curries. Lentil flour is added to cereal flour to make breads, cakes and baby foods. Lentils are often used as a meat extender or substitute because of the high protein content and quality. Lentils have a shorter cooking time than other pulses and do not need to be pre-soaked. Only a relatively small volume of low quality lentils are used for livestock feed when degrading factors such as chipping, wrinkling or staining make them undesirable for human food uses where visual attributes are important. However nutritional analysis indicates that they make an excellent feed. Husks, dried leaves, stems, fruit walls and bran (residues), can be fed to livestock. Lentil residues contain about 10.2% moisture, 1.8 % fat, 4.4% protein, 50% carbohydrate, 21.4% fiber, and 12.2% ash (Muehlbauer et al., 1985). According to Muehlbauer et al. (1985), when production of forage crops fall below the level required in the market, lentil residue commands an equal or a better price than lentil seeds in some Middle Eastern countries. Green plants make valuable green manure. Seeds are a source of commercial starch for textile and printing industries (Kay, 1979).

Yields and Economics

Seed yields range from 450-675 kg/ha in dry areas, may increase to 2000 kg/ha with irrigation, and yields over 3,000 kg/ha have been recorded. The straw-to-seed ratio in one cultivar was about 1.2:1 and in studies conducted on 28 cultivars in New Delhi, India, pulse yields ranged from 558 to 1,750 kg/ha, while dry matter yields ranged from 2,667 to 3,550 kg/ha (Duke, 1981). The major producer of lentils in the world is India, with about 1,160,000 hectares producing 850,000 MT in 1994; while World

production was 2.875 million MT on about 3.36 million hectares during the same year (FAO, 1994). Other important producers are USA, Australia, Canada, Pakistan, Syria, Argentina, Chile, Turkey, Ethiopia and Spain. In these countries, yields have ranged from 637 to 1263 kg/ha. The highest yield, 5000 kg/ha was recorded in Germany (FAO) while the world production of lentil increased by about 65% over the past 25 years (FAO, 1996). In developing countries alone, lentil production and yield rose by 60% (Hulse, 1994). Major production increases have been recorded in Turkey and Canada. In the USA, lentil occupies about 60,000 ha, and from 1984 to 1993, 65, 000 tons of lentil have been produced (Muehlbauer, 1996). Among the agronomic problems, pod shedding, pod shattering, lodging, and the spreading growth habit are important constraints in production (Robertson et al, 1996). Close to 80-85 % of lentil production in the USA is exported (Muehlbauer et al., 1995 and Muehlbauer, 1996). Canada, Turkey and the USA are major exporters of lentil.

Production of Lentil in India

Lentil production in India has always been important as it is the one of the most important *rabi* crops in the country. India has been producing lentil since 1st century AD and has always been an important producer of the crop. In fact, India was the largest producer of the Lentil crop in the world until recently Canada took over the lead leaving India at the second place. Indian production of this crop hovers around 10 lakh metric tons per year that is cultivated on about 14 lakh hectares of land. Lentil crop is grown in India in the winter season in the following states:

- Uttar Pradesh
- Madhya Pradesh
- Bihar
- West Bengal
- Rajasthan
- Haryana
- Punjab
- Assam
- Maharashtra

Around 90% of the production comes from the top four states in the list pertaining to the eastern and the northern part of the country. The southern part of the country hardly contributes to India’s total production. Uttar Pradesh accounts for the maximum production in the country contributing to around 45% of the country’s

production as well as for the maximum area under Lentil cultivation. The crop is both cultivated as a primary crop and a secondary crop in the country. Sagar, Jabalpur, Bundelkhand and Bhopal in Madhya Pradesh, *Tal* lands spread over south Bihar districts in Bihar, Kanpur in Uttar Pradesh and Kota in Rajasthan are the districts where Lentil is cultivated primarily.

Indian Lentil market

Indian subcontinent has a reputation of being an important player in the world's pulse scenario. Indian economy is largely affected from the fluctuations in world pulse demand and supply, as the country is one of the largest consumers of pulses due to a large population to feed to. In case of Lentil, India had been quite dominant country in the world production schedule as it was the largest Lentil producer till 2004 and had been leading since a very long time. Canada took over India's lead in 2005 with the help of a sharp rise in its production level. However, India still stands at the second place as far as the world production are concerned, producing around 10 lakh tons of Lentils every year. Uttar Pradesh in India is the state that contributes to around 45% share in the total production. The area which is utilized in the cultivation of Lentil in India, sums up to around 14 lakh hectares. India consumes almost 90-95% of its domestic produce to fulfil its domestic consumption demand as one of the most important constituent in the country's staple diet.

The major trading centres of lentil in India are located at Jabalpur, Rewa, Bhopal, Sagar and Vidisha in Madhya Pradesh; Sultanpur and Bahraich in Uttar Pradesh; Bhatpara in West Bengal and Rajnandgarh in Chhattisgarh. The factor which influence the market, include, weather fluctuations, information flow regarding the supply of the pulse, price movements of the substitute pulses and production level in the main exporting countries Also, lentil is traded in the various Indian commodity exchanges like Multi Commodity Exchange of India, National Multi Commodity Exchange of India and National Commodity and Derivatives Exchange.

Constraints in lentil production

Terminal Drought

There has been a high degree of risk in pulses production in general and lentil production in particular. More than 87% of the area under pulses is presently rain fed and the mean rainfall of major pulse growing states of India is around 1,000 mm with

coefficient of variation of the rainfall being 20-25 percent. Moisture stress is the oft-cited reason for crop failures. Terminal drought and heat stress results in forced maturity with low yields. Drought stress alone may reduce seed yields by 50% in the tropics (Reddy 2009).

Excess soil moisture and humidity

Water-logging during seed germination and initial seeding growth phase is a constraint for pulses grown in rice-fallows. High humidity during vegetative growth stages (particularly during November to January) makes lentil susceptible to diseases such as BGM. This can happen in some years, where excessive rainfall occurs during the winter that can encourage excessive vegetative growth leading to lodging, and also encourage development of various leaf and root diseases (Subbarao et al. 2001).

Temperature

Grain yield is mainly influenced by temperature. Cold is an abiotic stress, limiting the grain yield of pulse crops. All hot season pulses are sensitive to low temperatures, but generally these are not exposed to low temperatures. On the other hand, cool season pulses (chickpea) are often subjected to chilling temperatures especially in areas of north India. However there has not been much improvement in the development of chilling and frost tolerant varieties.

Soil acidity

Soil acidity was a serious constraint to legume introduction into rabi season as most pulses are highly sensitive to soil acidity as compared to cereals and other non-pulses crops (Choudhary and Pande 1986, Chong et al. 1987).

Uncertainty in Rainfall

Uncertainty in rainfall is a serious abiotic constraint in lentil production. Poor drainage/water stagnation during the rainy season causes heavy losses on account of low plant stand and increased incidence of blight disease, particularly in the states of UP, Bihar, West Bengal, Chhattisgarh, MP and Jharkhand. Since most pulse crops are drought tolerant, most of the research efforts have been confined to develop genotypes and associated production technologies to suit dry land conditions. Consequently, germplasm suited to high rainfall and irrigated conditions are lacking (Reddy 2009)

Socio Economic Constraints

Lack of knowledge, non availability of improved seed, poor technical guidance were few socio economic institutional constraints (Subbarao et al. 2001 & Pande et al 2003)12 while seed storage, poor irrigation and poor marketing were socio economic infrastructural constraints in pulses production (Pande *et al*. 2003). According to Reddy 2009 lack of knowledge, availability of seed, lack of technical knowledge regarding improved pulses cultivation as some of the important constraints in pulses production. Followed by lack of availability of suitable agro chemical and inputs are as an important institutional constraint. Among infrastructural constraints, in pulses production; seed storage and poor marketing of pulses are important constraints. Markets for pulses are thin and fragmented in comparison with rice and wheat. It is generally perceived that the government procurement for pulses is not as effective as it is for rice and wheat, and often, farmers do not realize the minimum price announced by the government. Also the price spread (i.e., the market margin) for pulses is much higher than that of rice and wheat (Joshi and Pande 1996). Because of this, farmers do not benefit by the higher market prices of pulses, as most of the profits go to the traders, rather than to the farmers. Hence the farmers are less motivation for pulses cultivation and thus, the serious threat to sustainable agriculture system and the economy of the country. Problem of poor transportation is a very common problem faced by the growers. In addition, to the above, poor irrigation also affects the pulse crops in general and lentil in particular.

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