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Economics of Pulse Production in Bundelkhand Region of Uttar Pradesh, India: An Empirical Analysis

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Abstract: Bundelkhand region contributes more than half of total pulse area of the Uttar Pradesh state but the productivity is below the state average, which calls for various technological interventions, development of infrastructure and marketing strategies. This study assessed the profitability of pulse cultivation, identified the constraints and suggested policy measures using the data collected during 2016-2017 from 100 pulse growers selected from two backward districts of Bundelkhand region, namely Jalaun and Hamirpur. Growth in area, production and yield was estimated using data for 1980-2015 through compound annual growth rate and the highest growth was observed during 1980-1990 period. Modern cost concepts were used to assess the profitability of pulse cultivation and results revealed that the cost of cultivation per hectare was significantly higher in pigeon pea in comparison to gram, pea and lentil crops. The marketing charges paid by the village trader, wholesaler and retailer ranged between INR 20 to INR 40 per quintal for different crops. It was also observed that the quantum of marketable surplus and its percentage share to total production in pigeon pea, gram and lentil increased with the increase in size of land holding. The pulse production in the region faced with constraints related to production, processing and marketing. Hence, technologies and infrastructure need to be embraced through suitable policies to favour farmers, so as to maintain balance and keep the interest of both producers and the consumers.

Keywords: Bundelkhand; Cost of cultivation; Marketable surplus; Pulse production

1. Introduction

Among the total agricultural crops grown in India, pulses are most important being a major source of protein to the majority of the people in the country, especially those lives on a vegetarian diet and remains a very important crop group from the perspective of nutrition as well as environmental sustainability [1,2]. They are rich in complex carbohydrates, micronutrients, protein and B vitamins; low in fat and rich in fibre, therefore excellent for manag-

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ing cholesterol, digestive health and regulating energy levels [3]. Pulses not only have nutritional value for human beings but also contribute fertility to the soil. In spite of huge nutritive value, per capita availability and consumption is very low, which has been reduced almost half from about 60.7 g/day in 1950-1951 to 48 g/day during 2018-2019 [4].

The production of total pulses in India is about 23.40 million tonnes, covering an area of about 29.03 million hectares (ha) during 2018-2019 [4], the majority of which fall under rainfed, resource-poor and harsh environment, frequently prone to drought and other abiotic stress condition. The 3rd estimates for 2020-2021 indicate that the total pulse production is 25.58 million tonnes from 29.51 million ha area [5]. To meet the demand of pulses, India is at present importing about 3 million tonnes chickpea, which continues to be the largest consumed and comprising of 45%-50% of the total pulse production of India. Major producers of pulses in the country are Madhya Pradesh (24%), Uttar Pradesh (16%), Maharashtra (14%), Rajasthan (6%), Andhra Pradesh (10%), followed by Karnataka (7%), which together share about 77% of total pulses production, while remaining 23% is contributed by Gujarat, Chhattisgarh, Bihar, Odisha and Jharkhand. India was the world's largest pulses importer and Myanmar, Canada and Australia are major suppliers of dry peas and Kabuli chickpeas to the Indian market.

Uttar Pradesh is the second-largest producer of pulses with about 2.8 million tonnes, which accounts for 21.4% of the national production. It continued to record the highest pulses productivity among the major pulses growing states in the country. Pigeon pea, *mung* bean (green gram) and *urad* bean (black gram) during *kharif* season and chickpea, lentil and field pea, during *rabi* season are the important crops with its share of 31.4% of the total area under pulse in the state followed by lentil (21.5%), *urad* bean/*mung* bean (16.5%), pigeon pea (14.1%) and field pea (10.1%) [6]. During the year 2018-2019, the area under pulse was 2.30 million ha, production was 2.40 million tonnes and productivity recorded at 1044 kg/ha [7].

Agro-climate zone wise information indicated that the Bundelkhand zone shares maximum area under major pulses (44.5%) followed by central plain zone (20.5%). These two zones together share 65% area under pulses in the state [8]. The northeastern plain zones also share considerable acreage under pigeon pea and lentil. Looking at the productivity of individual pulse crop, it reveals that in the case of *urad* bean and *mung* bean, the mid-western plain and western plain zones have the highest productivity of 5.5 q/ha and 5.8 q/ha, respectively, however, the Bundelkhand zone with considerable area possesses lower average yield (1.3 q/ha and 2.6 q/ha). For pulse crop against the state average of 5.3 q/ha and 5.5 q/ha in the case of lentil, Bundelkhand zone possesses the highest acreage as well as productivity (10.1 q/ha) [6]. Bundelkhand region is the central semi-arid plateau of India that spans over about 7.1 million ha area. The region covers 14 districts comprising Jhansi, Jalaun, Lalitpur, Hamirpur, Mahoba, Banda and Chitrakoot of Uttar Pradesh and, Newari, Datia, Tikamgarh, Chattarpur Damoh, Sagar and Panna district in Madhya Pradesh state. The region is complex, rainfed, risky, under invested, vulnerable, socio-economical heterogeneous, ethically unique, agrarian and backward [9,10]. Among all the nine agro-climatic zones of Uttar Pradesh state, Bundelkhand region of Uttar Pradesh has the lowest average annual household income [11] and lowest livelihood security [12]. Bundelkhand region suffers from water scarcity, natural resource degradation, low crop productivity (1 q/ha ~ 1.5 q/ha), low rainwater use efficiency (35%–45%), high erosion, poor soil fertility, frequent droughts, poor irrigation facilities, inadequate vegetation cover and frequent crop failure resulting in scarcity of food, fodder and fuel [13,14]. The region experiences extremes of temperature, varying from more than 45 °C during summers to about one degree centigrade in winters and receives average 800 mm-900 mm annual rainfall. The occurrence and distribution of rains however have no definite pattern rendering farmers unprepared for timely crop sowing and almost every year they faced the problem of drought even during good rainfall year [15]. A declining and irregular trend of annual rainfall and a gradual drying up of the region has emerged as a challenge to sustain crop yield in the region [16]. Droughts, short-term rain and flooding in fields add to the uncertainties. Based on the composite drought hazard analysis, eight districts of Bundelkhand region are under severe to moderate drought vulnerability [17]. Bundelkhand region contributes 8.4% (1377 tonnes) of total pulse production in the country. The contribution of the region to total area and production of crops like field pea, lentil and *urad* bean is highly significant as it contributes about 43%, 16% and 11.5% of total national production of field pea, *urad* bean and lentil in the country. The overall productivity level of pulses in the region (677 kg/ha) was slightly higher than national average (655 kg/ha), the yield levels of field pea, chickpea and lentil crops were also higher as compared to the national average (2015-2016). Among the major pulse crop growing in the Bundelkhand region are pigeon pea, *mung* bean & *urad* bean in *kharif* season and gram, pea, lentil in *rabi* season. Gram is the most important pulse crop in the Bundelkhand region followed by *urad*, lentil, pea and *mung* bean.

Keeping in view the importance of pulse production in the Bundelkhand region of Uttar Pradesh, this study has been conducted to estimate pulse production status and growth rates and make an objective assessment in terms of cropping pattern, cost & returns, market intermediaries and marketed surplus as well as identify the constraints in production and marketing of major pulses in the region.

2. Material and Methods

2.1 Area and Data

The study used both secondary and primary data to achieve the objectives. Secondary data were collected from published sources of Government Departments. For collection of primary data, a multi-stage sampling technique was adopted to choose the study units, i.e. farmer respondents. Bundelkhand region was selected purposively as cropping pattern in the region is dominated by pulse crops. Bundelkhand region comprised of two-divisions, viz. Jhansi and Chitrakoot Dham. At the first stage, one district has been selected from each division, namely Jalaun from Jhansi division and Hamirpur from Chitrakoot Dham division on the basis of higher area and production of pulses. At second stage, one block from each district has been selected randomly, in which Kadoura block from Jalaun district and Kurara block from Hamirpur district got selected. Third stage of sampling comprised of selection of 5 villages from each block and a total of 10 villages from the selected blocks were chosen randomly for the study. From the universe of selected 10 villages, a list of all those farmers i.e. pulses growers have been prepared and thereafter a total of 100 respondent/pulse growers have been selected randomly. Again these respondents have been categorized in four groups based on land holding size i.e. marginal (0 ha ~ 1 ha), small (1 ha ~ 2 ha), medium (2 ha ~ 4 ha) and large (4 ha and above). Primary data were collected from each respondent by personal interview using a structured interview schedule regarding farmer and farm details, cultivation practices, input used, output marketed and returns received. The number of selected cultivators from selected villages under each size groups has been presented in Table 1.

2.2 Analytical Techniques

2.2.1 Estimation of Growth Rates

Data on area, production and yield collected for the period of 1980 to 2015 were grouped into 3 periods, viz. 1980-1990, 1991-2000 and 2001-2015 and compound annual growth rate (CAGR) was calculated separately for each period.

2.2.2 Estimation of Costs and Returns

Costs of cultivation were also estimated using other cost concepts [18] that are widely adopted in farm management research [19]. The concepts used were: (i) Cost A= All variable expenses incurred to procure the material inputs and expenditure on hired labour, all types of machine labour and including land revenue, depreciation and interest on operational expenses, land (leased in) rent paid, (iii) Cost B= Cost A + interest on value of permanent assets and imputed rent of owned land, (v) Cost C= Cost B + imputed value of family labour. On the similar line, income

Table 1. Description of selected villages and number of farmers in different size group

S. No.	Name of the district	Name of the blocks	Name of the Selected villages	Number of cultivators selected in different size groups				Total
				Size-groups (ha)				
				0-1	1-2	2-4	4 & above	
A.								
1.	Hamirpur	Kurara	Deviganj	5	3	2	1	11
2.			Jalla	6	2	2	1	11
3.			Para	4	3	1	2	10
4.			Jakhela	3	2	3	2	10
5.			Beri	4	3	2	1	10
B.								
1.	Jalaun	Kadoura	Udanpur	4	2	2	2	10
2.			Chatela	3	3	2	1	09
3.			Bugi	5	3	1	1	10
4.			Babina	3	2	2	2	09
5.			Sujanpur	4	4	1	1	10
	Total			41	27	18	14	100

concepts used were as: (i) Gross return = Total value of the produce (main product and by product), (ii) Net income = Gross return - Cost C, (iii) Family labour income = Gross return – Cost B, and (v) Farm business income = Gross return – Cost A.

Cost C includes all the possible costs and is considered as the real cost of production in a farm situation. But rental value of owned land and managerial costs for the farmer can be excluded in a marginal profit situation and Cost A can be taken as the standard cost of production which includes all actual expenses expressed in cash and kind, the depreciation and interest on value of owned capital assets (excluding land) [19]. Similarly, if we want to calculate the income over family labour, we can consider Cost B or subtract the value of family labour from Cost C.

2.2.3 Estimation of Marketable Surplus

Marketable surplus refers to the quantity of produce available for disposal through markets after fulfilling all consumption requirements. In this study, the marketable surplus was estimated by subtracting requirements for consumptions, seeds from the total production of pulses.

3. Result and Discussion

3.1 Production and Growth Rates

India is the largest producer of chickpea, sharing 65% of global production [20]. The production of pulses in India during 2015-2016 is shown in Table 2. It is evident that chickpea occupies a major share (46.68%) in total pulse production in India followed by red gram, *mung* (green gram), *urad* (black gram) and others.

Table 2. Share of different pulses production in India [21]

Pulse crop	Production (2015-2016) ('000 tonnes)	Share in total production (%)
Red gram	2550	14.71
Chickpea	8090	46.68
Urad (black gram)	1740	8.94
Mung (green gram)	1550	10.04
Other pulses	3400	19.62
Total pulses	17330	100

The estimated growth rates of red gram, chickpea, *kharif* and *rabi* pulses with respect to area, production and yield for the periods 1980-1990, 1991-2000 and 2001-2015 are given in Table 3. The period-wise analysis revealed that the maximum growth rate in the area for all pulses, except chickpea was observed during 1980-1990 in comparison to other periods. The overall growth rate in the area for all pulses was also highest (6.12%) during the period 1980-1990 and there was a negative growth rate for the next decade (1991-2000) and a positive growth rate to the extent of 1.12% during the period 2001-2015. Further crop-wise analysis of the growth rate in area of *kharif* pulses was observed to be high in 1980-1990 and it increased at the rate of nearly 8.08% per annum. Against this, the area under the same crop during the period 1991-2000 declined at a maximum rate of 8.26% per annum and a negative growth rate was observed during 2001-2015 (–0.25% per annum). In the case of chickpea, growth rate

Table 3. Compound annual growth rate of pulses - All India

Crop	Items	1980-1990	1991-2000	2001-2015
	Area	2.3	2.3	–2.5
Red gram	Production	2.80	5.40	–1.73
	Yield	0.55	1.60	1.04
	Area	–1.5	17.42	5.36
Chickpea	Production	–0.8	10.01	5.82
	Yield	0.74	1.68	1.77
	Area	8.08	–8.26	–0.25
Kharif pulses	Production	8.67	–6.55	2.05
	Yield	0.55	1.87	2.30
	Area	4.32	–4.75	2.32
Rabi pulses	Production	5.50	–3.15	4.22
	Yield	1.13	1.68	1.86
	Area	6.12	–6.49	1.12
Total pulses	Production	6.74	–4.48	3.45
	Yield	0.58	2.15	2.30

Source: Author's calculations

in area was observed to be high (17.42%) during 1991-2000 and the growth rate declined to one-third (5.36%) during 2001-2015, while the negative growth rate was observed for the same crop during 1980-1990. The growth rate in the area in case of red gram was observed to be the same (2.3%) in the period 1980-1990 & 1991-2000 and it declined at a rate of nearly 2.5% per annum during 2001-2015. The growth rate in the production of different pulses in different periods shows that maximum growth has been exhibited by chickpea which was 10.01% per annum followed by red gram (6.3%) during 1991-2000. During the period 1980-1990, the growth rate of production of all pulses was positive except chickpea. The growth rate in production of total pulses was 3.4% during the period 2001-2015.

The Table 4 showed that the average size of farms, which was 2.18 ha. The number of farmers in the marginal size category (0 ha ~ 1 ha) accounted for 41% of the total number of sample farms, commanding only 11.11% of the total cultivated area, whereas, the farmers of the largest size group (4 ha and above) accounted for only 14% of the total number of holdings but commanded as much as 42.50% of the total cultivated area. This indicated the uneven distribution of cultivated land among the farmers of different size groups.

3.2 Cropping Pattern

In Uttar Pradesh, the Chitrakoot Dham region is famous for pulse production, where production takes place under rainfed condition due to lack of irrigation facilities and typical physiography. Chitrakoot Dham accounts for 18.11% of the total area and 25.67% of the total production of the state. The productivity of pulses in this region was higher in the state being 8.76 q/ha as against 8.08 q/ha of the state average during 2012-2013. However, the pulse production in the state as well as in the area did not show any appreciable increase for the last fifty years, rather it has been declined. The growth of pulse production in the state was (–) 0.11% per annum, while it was 0.62% per annum in Chitrakoot Dham and (+) 2.71% per annum in Banda district.

Table 5 indicates that on an average, gram occupied the highest area (20.70%) to the total cropped area followed by wheat (20.18%), jowar + pigeonpea (16.92%), lentil (12.15%), pea (10.14%), pigeon pea (9.93%), jowar (6.99%), *mung* (4.88%), *urad* (4.19%), linseed and mustard (6.30%) and others (4.50%). With regard to the size groups for individual pulse crops, it is to be noted that large farmers put higher proportion of cropped area to gram, pea and *urad*, whereas for linseed-mustard, pigeon pea and other crops, area decreased with increase in holding size. For the crops like lentil, wheat and jowar, no such trend was observed.

Table 6 presented the production, costs and returns of pulse crops from per unit area in the region. It is observed that the cost of cultivation was highest for pigeon pea to the extent of Rs. 20675 and the lowest was for lentil (Rs. 18161). However, due to higher yield level, per quintal production expenses were lower in case of gram and pea in comparison to pigeon pea and lentil. Due to higher selling price of pigeon pea, gross return was sufficiently high than other pulses. On estimation of various categories of costs, it was observed that though Cost C per ha was highest for pigeon pea, Cost A & B per ha was highest for gram followed by pigeon pea, pea and lentil. With regard to various types of income per ha, again pigeon pea recorded the highest income and highest benefit-cost ration in comparison to other pulses.

From the above results, it can be concluded that pigeon pea crop is the most economical and profitable pulse crop having a higher benefit-cost ratio followed by gram than that of lentil and pea crops and recommendation can be made to put more emphasis toward their cultivation in the study region.

Table 4. Distribution of farms under different size groups

Sl. No.	Size group (ha)	No. of farmer	Cultivated area (ha)	% age of total cultivated area	Average size of holdings (ha)
1.	0-1	41	24.19	11.11	0.59
2.	1-2	27	36.18	16.61	1.34
3.	2-4	18	64.80	29.78	3.60
4.	4 & above	14	92.55	42.50	6.61
Total		100	217.77	100.00	2.18

Source: Author's calculations

Table 5. Cropping pattern on the sample farms of different sizes (area in ha)

Sl. No.	Crops	Size groups (in ha)				Total area
		0-1	1-2	2-4	4 & above	
Rabi						
1.	Gram	4.79 (16.67)	7.53 (16.91)	17.99 (21.89)	26.62 (22.42)	56.75 (20.70)
2.	Lentil	3.57 (12.43)	6.39 (14.35)	8.46 (10.29)	14.71 (12.39)	33.31 (12.15)
3.	Pea	2.33 (8.11)	4.34 (9.72)	8.73 (9.83)	12.42 (10.46)	27.81 (10.14)
4.	Linseed & Mustard	2.14 (7.48)	3.26 (7.32)	5.59 (6.80)	6.28 (5.28)	17.28 (6.30)
5.	Wheat	5.81 (20.22)	8.19 (18.40)	17.66 (21.48)	23.67 (19.94)	55.33 (20.18)
6.	Pigeon pea	3.53 (12.29)	5.24 (11.77)	8.05 (9.79)	10.41 (8.76)	27.23 (9.93)
Kharif						
7.	*Mung* bean	1.89 (6.58)	2.18 (4.89)	3.67 (4.46)	5.65 (4.75)	13.39 (4.88)
8.	*Urad* bean	0.96 (3.34)	1.69 (3.79)	3.17 (3.85)	5.67 (4.77)	11.49 (4.19)
9.	Jowar	1.26 (4.38)	3.17 (7.12)	6.18 (7.52)	8.57 (7.21)	19.18 (6.99)
10.	Others	1.98 (6.89)	2.53 (5.68)	3.33 (4.05)	4.52 (3.41)	12.36 (4.50)
Total cropped area		28.72	44.51	82.18	118.72	274.13

Note: Figure in parenthesis show the percentage to their respective total

Table 6. Costs and returns of pulse crops in Bundelkhand region

Particulars	Crops			
	Gram	***Pigeon pea***	***Lentil***	***Pea***
Cost of cultivation (’000 rupees/ha)	20.55	20.68	18.16	20.28
Yield per hectare (q/ha)	12.70	9.71	9.66	12.47
Price per quintal (’000 rupees)	2.34	3.61	2.51	2.23
Total value of output (’000 rupees/ha)	33.41	38.03	27.15	30.09
Cost of production (’000 rupees/q)	1.62	2.13	1.68	1.50
Various categories of costs (’000 rupees/ha)				
(a) Cost A	11.14	10.45	9.86	10.18
(b) Cost B	14.58	13.89	13.30	13.62
(c) Cost C	20.55	20.68	18.16	20.28
The measure of farm profit (’000 rupees/ha)				
Farm business income (over Cost A)	22.28	27.58	17.29	19.91
Family labour income (over Cost B)	18.83	24.14	13.85	16.47
Net income (over Cost C)	12.87	17.35	8.99	9.81
Benefit-cost ratio	1.62:1	1.83:1	1.49:1	1.48:1

Source: Author’s calculations

3.3 Marketing Charges

The marketing charges paid by the village trader, wholesaler and retailer in the marketing of gram, pigeon pea, lentil and pea were worked out at Rs. 40, Rs. 26 and Rs. 20 per quintals, respectively. Total marketing charges paid by different marketing middlemen were observed to be Rs. 86, spread over the consumer's price for the crops gram, pigeon pea, lentil and pea has been shown in Table 7. The sale price received by the producer was the highest being Rs. 3610 per quintal for pigeon pea, Rs. 2510 per quintal for lentil, Rs. 2335 per quintal for gram and Rs. 2230 per quintal for pea. The purchase price of consumers came to Rs. 2440, Rs.3763, Rs.2629 and Rs. 2324 per quintal of gram, pigeon pea, lentil and pea, respectively. There were different intermediaries, viz. village traders, wholesalers and retailers who incurred market expenses to the extent of Rs. 40, Rs. 26 and Rs. 20, respectively. Among the pulses, price spread and market margins were highest in case of pigeon pea followed by lentil, gram and pea. Producer's share in consumer's rupee was calculated, which was almost similar for all the pulse crops indicating similar margin for the farmers.

Table 7. Marketing charges, producer's share and margins of intermediaries

S. No.	Particulars	Gram	Pigeon pea	Lentil	Pea
1.	Sale price by producer (Rs.)	2335	3610	2510	2230
2.	Consumer's price (Rs.)	2440	3763	2629	2324
3.	Price spread (Rs.)	105	153	119	94
4	Market charges (Rs.)[#$]	86	86	86	86
5	Market margins (Rs.)[#]	19	67	33	8
6	Producer's share in consumer's rupee (%)	95.70	95.93	95.47	95.96

[#]Total for all intermediaries; [$]Market charges for village traders, wholesalers and retailers were Rs.40, Rs.26 and Rs.20, respectively.

Source: Author's calculations

3.4 Marketable Surplus

In rural areas, family sizes remain almost similar, hence, lower production owing from less cropped area led to low quantum of marketable surplus of gram, pigeon pea, lentil and pea and their percentage to the total production on the farms of lower size group as compared to the large sized farms (Table 8). It is observed that the quantum of pulses consumed was highest is gram, as it is a good source of energy, protein, minerals, vitamins, fiber, and also contains potentially health-beneficial phytochemicals [22]. The quantity utilized per household for all purposes comprising seed, consumption, wages and others were also highest in case of gram followed by pea, pigeon pea and lentil. The amount of marketable surplus was highest in case of pea followed by gram, lentil and pigeon pea. However, when we calculated marketed surplus as percentage of quantity produced, again it was observed to be highest for pea followed by lentil, pigeon pea and gram.

Table 8. Marketable surplus of pulse grains (per household)

Sl. No.	Particular	Gram	Pigeon pea	Lentil	Pea
1	Total quantity produced (q)	12.70 (100.00)	9.71 (100.00)	9.66 (100.00)	12.47 (100.00)
2	Quantity retained for seed (q)	0.87 (6.85)	0.55 (5.66)	0.56 (5.79)	0.96 (7.69)
3	Quantity consumed by family (q)	0.98 (7.71)	0.87 (8.95)	0.76 (7.86)	0.57 (4.57)
4	The quantity given as wages (q)	0.70 (5.51)	0.74 (0.74)	0.65 (6.72)	0.83 (6.65)
5	Others (q)	0.66 (5.19)	0.37 (3.81)	0.45 (4.65)	0.51 (4.08)
6	Total quantity utilized (q)	3.22 (25.35)	2.54 (26.15)	2.41 (24.94)	2.88 (23.09)
7	Marketable surplus (1-6)	9.49 (74.72)	7.17 (73.84)	7.24 (74.94)	9.59 (76.90)

Note: Figures in brackets indicates per cent of total quantity produced

Source: Author's calculations

4. Constraints in Cultivation of Pulses in Bundelkhand Region

4.1 Constraints in Production

Non-availability of high yielding pulse varieties, in general, have poor harvest index (HI). Improvement in the HI in cereal crops in recent years has resulted in very high yields. In pulses, the HI ranges from 10 to 20 as compared to 40 and above in wheat. Mixed cropping of pulses with other crops is an important agronomic practice in the Bundelkhand area of the state. Here we could have two

situations (i) the pulse crop completes its life-cycle before the second crop enters the active growth phase, or (ii) the pulse crop enters the active phase of growth only after the subsidiary crop has completed its life-cycle. Although, a number of improved varieties of different pulse crops have been recommended, yet they have not become popular among the farmers in the study area mainly due to lack of a systematic seed multiplication and distribution program. Adequate plant population makes a big difference in yield. Farmers in the study area generally do not follow the recommended seed rate, which causes low yields.

4.2 Constraints in Marketing

During the course of the investigation, the following market problems were ascertained in different regulated *mandis* in the study area. When the farmer reached in the market, they had to arrange with the *kaccha arhatia* (commission agents) for the sale of produce. *Kaccha arhatias* though employed by the producer, but they remained more inclined towards the buyer and favored them at the expense of producers. More number of intermediaries in marketing channel reduces the producers' share in consumers' price. There was common practice that after settlement of price and during the time of weighing, the buyer complained of the quality of product and levied some refraction charges in spite of the price was settled on the basis of a sample.

4.3 Constraints in Processing

The present-day processing technologies use direct solar energy for drying in large open yards. In order to loosen the husk, prolonged sun drying is essential for all pulses, pigeon pea, black gram and green gram. The conversion of grains into *dal* become difficult to mill mainly during the summer months, whereas pulses that are easy to dehusk are processed in other seasons. This limitation restricts milling and production schedules. The cost and time taken for processing of pulses in these units were about 2-3 times higher when compared to the traditional units. The time interval between each step and natural splitting of grains produces good quality dal and improves dal recovery and increases keeping quality of *dal*, which fetches them a better price for their products.

5. Conclusions

It can be concluded that pigeon pea crop is the most economical and profitable crop having a higher benefit-cost ratio and contributing higher return than that of gram, lentil and pea crops under study. In fact, pulses can be profitably cultivated in rice fallows in the post rainy season, which also contributes in saving N fertilizer and increased the yield of subsequent cereal crops, thus decline the cost of production. Therefore, it is recommended that more emphasis should be given towards the cultivation of pigeon pea and gram than other pulse crops. Moreover, it was observed that gross income, net income per ha and the benefit-cost ratio was significantly higher on pigeon pea as compared to gram, lentil and pea crops. Further, lower or higher producer's share cannot be considered as a true indicator of an efficient marketing system. Efficient marketing system is one in which both the producers and consumers are well satisfied, benefited and protected from the clutches of the marketing functionaries and middlemen on the one hand and the consumers are in position to get the product according to their preference and quality. The government should take necessary steps in the regulation of laws of regulated markets, control on the processor, wholesaler and retailer in the interest of both producers and consumers.

Author Contributions

All authors contributed equally.

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Data Availability

Data based on which this research was conducted can be accessed by contacting the corresponding author through sending emails at the address provided on the title page.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this paper.

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