

Process and Pattern of Marginalization of Gram Cultivation in Haryana: A Spatio-temporal Analysis

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Abstract

The present study attempts to understand the process and pattern of marginalization of gram pulse crop in Haryana since the initiation of Green Revolution in late 1960s. Gram was a dominant crop in the state till mid 1960s and its cultivation was spread all over the state. But during last four and half decades area and production of this Rabi crop in the state has declined at the rate of 5.9 percent and 5.4 percent per annum, respectively. Consequently, currently it has been reduced to a minor crop from a dominant position in 1966-67. However, during same period the acreage of its competing crops, wheat and rapeseed & mustard, has enhanced appreciably. Till mid 1980s gram was wiped out from eastern and northeastern parts of the state. But it continued occupying a significant position in the cropping pattern of western and southwestern parts of the state. The process of marginalization of gram was complete by 2009-12 as this crop got confined to only Bhiwani district and there too as a minor crop. It is the expansion of rapeseed & mustard cultivation that has finally ejected out gram from its last bastion i.e. southwestern region of the state. Correlation analysis revealed that diffusion of irrigation and package technology in the state enhanced the yield of wheat and rapeseed & mustard which created positive feedback mechanism for spatial expansion of these crops and geographical marginalization of the gram pulse crop.

Keywords: Pulse, gram, acreage, irrigation, marginalization, competing crops

Introduction

Pulses are the main source of protein for the predominantly vegetarian society of India. They contain 22 to 24 percent protein, which is almost twice the protein content in wheat and thrice that of rice. Besides being a rich source of protein for humans, pulses are also used as fodder for cattle. These crops are valued for soil enrichment and sustainable crop production as they improve soil fertility through nitrogen fixation (Pande and Joshi, 1995; IIPR, 1998). The major pulse crops grown in the country are chickpea (gram),

pigeonpea (tur), uradbean (black gram), mungbean (green gram), mothbean (Turkish gram) and lentil etc. At present, India is largest producer (about 25 per cent of global production) and largest consumer (about 27 percent of global consumption) of pulses. It accounts for about 33 percent of the world's acreage under pulses (Srivastava et al., 2010; Ali and Gupta, 2012). However, the yields of pulse crops in India are quite low in comparison to other countries.

Green Revolution initiated in mid 1960s marked the transformation of subsistence

agricultural economy in India. It has been responsible for spurt in the growth of foodgrains production but it has been mostly confined to the cereal crops. Green revolution has also been termed as grain revolution because of tremendous rise in production of cereals. But it has led to loss in the acreage and production of pulses (Kumar, 1978). Consequently, daily per capita availability of pulses in the country has drastically declined from a comfortable position of 61 g/person/day in 1951 to 32 g/person/day during 2010 (Anonymous, 2011) against Indian Council of Medical Research recommendation of 40 g/person/day. To meet the shortage of production the government has to resort to import of pulses to the tune of 0.5 to 1.5 million tonnes every year (Roy et al., 2006; Mundinami, 1989).

The state of Haryana in India has semi-arid climatic conditions which are conducive for the cultivation of pulses such as gram, moong, arhar etc. But these pulse crops have become progressively marginalized in the cropping pattern since the initiation of Green Revolution in mid 1960s. Consequently, pulses have occupied only about 3 percent of total cropped area in the state during last two decades. Gram was the most important pulse crops in the cropping pattern of the state till 1960s. It has been most dominant pulse crop in the state occupying about 60 percent area under pulses (Tuteja, 2011) but its acreage has declined drastically and it was reduced to a minor crop by 1990s. It has got marginalized on account of expansion of area under fine foodgrains and oilseeds (Jaglan, 2005). The present study analyses the process and spatial pattern of marginalization of gram in Haryana over last four decades.

Objectives

Objectives of the study are as following:

- To study the trend of area, production and yield of gram in Haryana over the period 1966-67 to 2011-12.
- To understand the spatial marginalization of gram cultivation in the Haryana over last four and half decades with reference to the trienniums 1966-69, 1986-1989 and 2009-12.
- To examine the correlates of marginalization of gram cultivation in the state.

Study Area

The present study pertains to the state of Haryana, covering an area of 44,212 km² in north-western part of India. It is located between 27°39' N to 30°55' N latitudes and 74°27' E to 77°36' longitudes (Fig. 1). It is bordered by Punjab and Chandigarh in the north, Delhi and Uttar Pradesh in the east, Himachal Pradesh in north-east and Rajasthan in the south and west. There were seven districts in the state in 1966 which increased to twelve in 1986 but there are 22 districts at present. According to the Census of India 2011, the population of the state is 25,353,081 with a density of 573 persons per km². The state is self-sufficient in food production and the second largest contributor to India's central pool of foodgrains. There is semi-arid monsoon climate found in the state. The state gets approximately 45 cm average annual rainfall, 80 percent of which is received during monsoon season and the rest of 20 percent occurs in winter season by western disturbance from November to March. Haryana is one of the heavily irrigated states of the country with 85 percent cultivated land under irrigation.

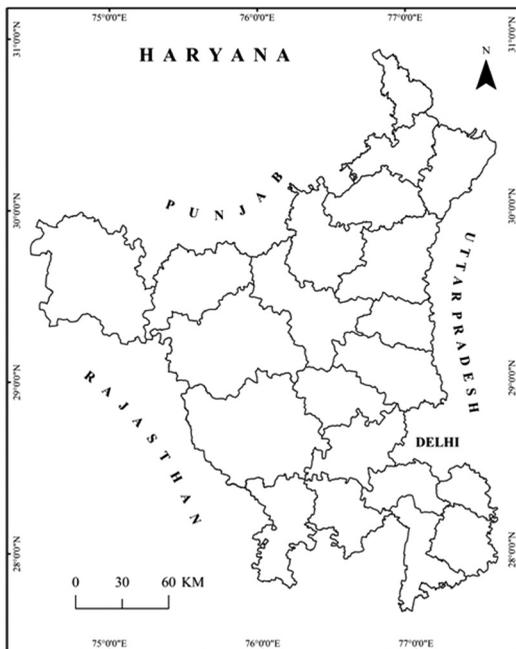


Fig. 1 : Location of study area

Database and Methodology

The present study is based on secondary sources of data. The study covers the period 1966-67 to 2011-12. The time series data related to area, production, yield of gram and competing crops and net irrigated area have been collected from Statistical Abstract of Haryana, Department of Economic and Statistical Analysis, Government of Haryana. The data have been analyzed by using suitable statistical and cartographic techniques. Trend graphs have been drawn to show the temporal changes in area, production and yield of gram and competing crops for the period 1966-67 to 2011-12. Further, the compound growth rate of all the parameters have also been computed for inter triennium periods. It is computed by using the following formula:

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

To assess the change in spatial pattern of gram and competing crops triennium average of parameters have been taken for the years 1966-69, 1986-89 and 2009-12. Proportion of area under gram and competing crops and their average yield has been computed for three different triennium periods. Proportionate change in area under crops and their yield level has been depicted using choropleth technique and bar diagrams. Pearson's correlation coefficient has been computed to assess the degree of association between gram acreage and other parameters.

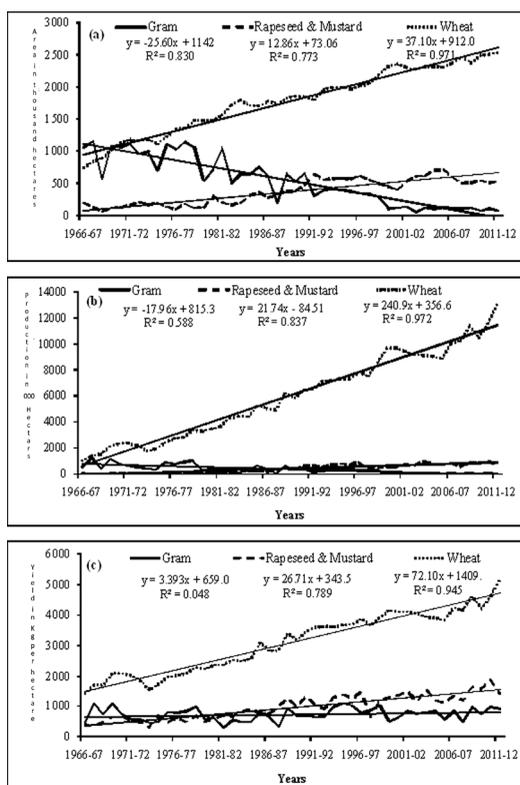


Fig. 2 : Trends of (a) area, (b) production and (c) yield of gram, rapeseed & mustard and wheat in Haryana from 1966-67 to 2011-12

Trend of Area, Production and Yield of Gram and Competing Crops

The trends of area under gram, rapeseed & mustard and wheat in Haryana have been depicted by Fig. 2a. It is evident that gram acreage has decreased continuously with fluctuations over the period of about four and half decades in the state. The area under gram was 1062 thousand ha at the time of formation of Haryana, but it has diminished rapidly as this crop occupied 78 thousand ha in 2011-12 (Fig.2a). Area under gram declined at the rate of 5.92 percent per year (Table 1). Maximum decline in acreage was recorded during the decade following mid-1990s. On the other hand, however, the area of the competing crops such as wheat and rapeseed & mustard has increased consistently over the period of time. Interestingly, in the mid-1960s area under wheat was 743 thousand ha which experienced almost fourfold increase (2531 thousand ha) by 2011-12. It increased at

the rate of about 4.2 percent over the study period with a high growth recorded between mid-1970s to mid-1990s. The trend showed that rapeseed & mustard was a minor crop in 1966-67 and occupied only 198 thousand ha area. But its area increased to 525 thousand ha during 2011-12. Acreage of rapeseed & mustard has increased at moderate rate (2.23 percent) recording highest growth between mid-1960s and mid-1980s. It appears from Fig. 2a that the loss of gram acreage is mainly the gain of wheat area. Expansion of area under wheat has coincided with the introduction of new agricultural technology in the mid-1960s in the form of high yielding varieties of seeds, chemical fertilizers etc. The sharp increase in area under wheat is also coterminous with the period experiencing increase in net area irrigated in the state. Though marginally benefited, it appears that rapeseed & mustard has also gained in terms of area at the cost of shrinking area under gram cultivation.

Table 1 Compound growth rate of Area, Production and Yield of Gram, Rapeseed & Mustard and Wheat during 1966-67 to 2011-12

Crops		1966-67 to	1976-77 to	1986-87 to	1996-97 to	2006-07 to	1966-67 to
		1975-76	1985-86	1995-96	2005-06	2011-12	2011-12
Gram	Area	-0.30	-4.52	-2.16	-11.55	-4.32	-5.92
	Production	-3.63	-8.70	4.06	-12.79	0.46	-5.42
	Yield	-3.36	-4.34	6.37	-1.41	4.98	0.53
Mustard	Area	3.60	9.72	7.60	2.88	-1.06	4.16
	Production	4.86	14.44	11.09	4.35	2.61	7.25
	Yield	1.20	4.30	3.22	1.43	3.70	2.97
Wheat	Area	4.42	2.78	1.28	1.13	0.97	2.23
	Production	5.53	6.04	3.92	1.29	3.51	4.71
	Yield	1.20	4.30	3.22	1.43	3.70	2.42

Source: Computation based on data obtained from Statistical Abstract of Haryana

Furthermore, the production of gram has also considerably declined mainly due to the decrease area under gram over the period of time. The production of gram has declined from 531 thousand metric tonnes in 1966-67 to merely 73 thousand metric tonnes in 2011-12 (Fig. 2b). Gram production has declined at the average rate of 5.92 percent per annum (Table 1). High rate of decline in production was recorded during the decades following mid 1970s and mid 1990s. Contrary to this production of wheat has increased from 1059 thousand metric tonnes in 1966-67 to 13119 thousand metric tonnes in 2011-12 on account of high growth of both area and yield of the crop. Wheat production has increased at an impressive growth rate of 7.25 percent with the highest growth recorded from mid 1970s to mid-1990s. The production of rapeseed & mustard has also increased from mere 80 thousand metric tonnes in 1966-67 to 747 thousand metric tonnes in 2011-12 (Fig. 2b). Rapeseed & mustard production has increased at the rate of 4.71 percent per annum. High growth of this crop was recorded between mid-1960s to mid-1970s.

Fig. 2c reveals that gram yield is highly fluctuating and it has been largely stagnant during the study period. It increased merely at the rate of 0.53 percent per annum (Table 1). But yield level of wheat has increased by more than three times during the study period (Fig 2c). It increased at the

growth rate of about 3 percent during the study period. Rapeseed & mustard yield has also doubled during this period.

Spatial Pattern of Shrinking Gram Acreage

Table 2 and Fig. 3 showed the spatial pattern of acreage of gram and competing crops (wheat and rapeseed & mustard) in Haryana during 1966-69, 1986-89 and 2009-12. It has been observed that the acreage of gram in the state has declined sharply over four and half decades. During 1966-69, gram was most dominant Rabi crop in the state, occupying 20 percent of total cropped area. Its acreage declined to 11 percent in 1986-89 and merely 1 percent in 2009-12. In 1966-69, Jind and Hisar districts had highest proportion of area occupied by this crop (about 25 percent) followed by Mahendergarh and Rohtak districts (about 21 percent each). Ambala district in north had lowest area under gram which was about 12 percent of the total cropped area.

Over next two decades, by 1986-89, the acreage of gram decreased drastically all over Haryana and occupied only about 11 percent of total cropped area in the state. Gram acreage was found to be highest in Bhiwani district where this pulse crop occupied about one-fourth of total cropped area. It was followed by Sirsa district (17 percent) and Mahendergarh district (15 percent).

Table 2 : Area under Gram, Wheat and Rape & Mustard (000' ha) in Haryana

District	1966-69			1986-89			2009-2012		
	Gram	Wheat	Mustard	Gram	Wheat	Mustard	Gram	Wheat	Mustard
Ambala	237.33 (12.21)	71.67 (22.44)	5.33 (1.67)	9.17 (2.48)	130.50 (35.30)	10.10 (2.73)	0.07 (0.32)	86.90 (42.05)	1.23 (0.60)
Panchkula							0.30 (0.76)	16.00 (40.34)	1.73 (4.36)
Yamunanagar							0.10 (0.05)	84.67 (39.63)	2.43 (1.14)
Kurukshetra				6.10 (1.11)	245.6 (44.52)	11.60 (2.10)	0.10 (0.04)	113.47 (41.01)	1.13 (0.41)
Kaithal							0.10 (0.03)	174.13 (45.62)	0.73 (0.19)
Karnal	113.00 (13.48)	245.33 (29.28)	19.33 (2.31)	2.50 (0.45)	243.2 (44.03)	2.53 (0.46)	0.10 (0.03)	171.33 (44.23)	0.90 (0.23)
Panipat							0	86.70 (45.55)	0.87 (0.46)
Rohtak	143.00 (21.13)	172.00 (25.42)	8.33 (1.23)	40.57 (9.37)	147.4 (34.07)	37.70 (8.71)	0.97 (0.42)	102.60 (45.07)	22.60 (9.93)
Jhajjar							0.50 (0.21)	100.17 (42.69)	29.70 (12.66)
Sonipat				2.47 (0.97)	128.66 (50.65)	6.17 (2.43)	0	149.13 (48.58)	2.50 (0.81)
Gurgaon	103.00 (16.68)	117.67 (19.05)	25.00 (4.05)	12.13 (4.43)	99.73 (36.40)	38.33 (13.99)	0	51.60 (45.26)	12.87 (11.29)
Mewat							0.50 (0.29)	72.43 (41.95)	25.77 (14.92)
Faridabad				1.70 (0.70)	113.03 (46.71)	8.20 (3.39)	0	32.03 (48.05)	0.77 (1.16)
Palwal							0	98.60 (51.18)	3.10 (1.61)
Mahendergarh	82.33 (21.29)	10.33 (2.67)	10.67 (2.76)	55.47 (14.56)	67.33 (17.67)	64.97 (17.05)	7.30 (2.63)	42.57 (15.35)	93.80 (33.85)
Rewari							0.07 (0.03)	49.13 (25.24)	64.00 (32.86)
Bhiwani				142.5 (25.09)	61.8 (10.88)	31.63 (5.57)	57.63 (7.84)	155.67 (21.19)	148.80 (20.25)
Jind	85.33 (26.29)	57.33 (17.73)	5.00 (1.55)	28.07 (6.20)	172.43 (38.12)	16.63 (3.68)	0.17 (0.03)	215.87 (45.67)	4.80 (1.02)
Hisar	367.33 (25.53)	153.00 (10.63)	58.67 (4.08)	99.73 (11.64)	226.36 (26.41)	65.60 (7.65)	14.60 (2.32)	240.03 (38.14)	57.80 (9.18)
Fatehabad							0.60 (0.14)	187.23 (44.51)	9.23 (2.19)

Sirsa				88.43 (16.52)	143.96 (26.89)	37.87 (7.07)	8.40 (1.19)	289.40 (40.88)	39.80 (5.62)
Haryana	1131.32 (20.28)	827.33 (17.98)	132.30 (2.88)	488.84 (10.93)	1780.13 (32.54)	331.33 (6.06)	91.50 (1.43)	2507.67 (39.07)	524.60 (8.13)

Figures in parentheses are the percentage of area under crop in total cropped area

Gram was almost wiped out of the cropping pattern in eastern partsof the state by late 1980s. Cultivation of this Rabi pulse got concentrated in un-irrigated dry lands of western Haryana. The process of spatial marginalization of gram in the state was almost complete by end of the first decade of 21st century. In 2009-12, gram merely

occupied about 1.4 percent of total cropped area in the state. Cultivation of the pulse was confined to southwestern parts of the state with a drastically declined acreage. Bhiwani district had again highest proportion of area under gram throughonly 8 percent, followed by Mahendergarh district (3 percent).

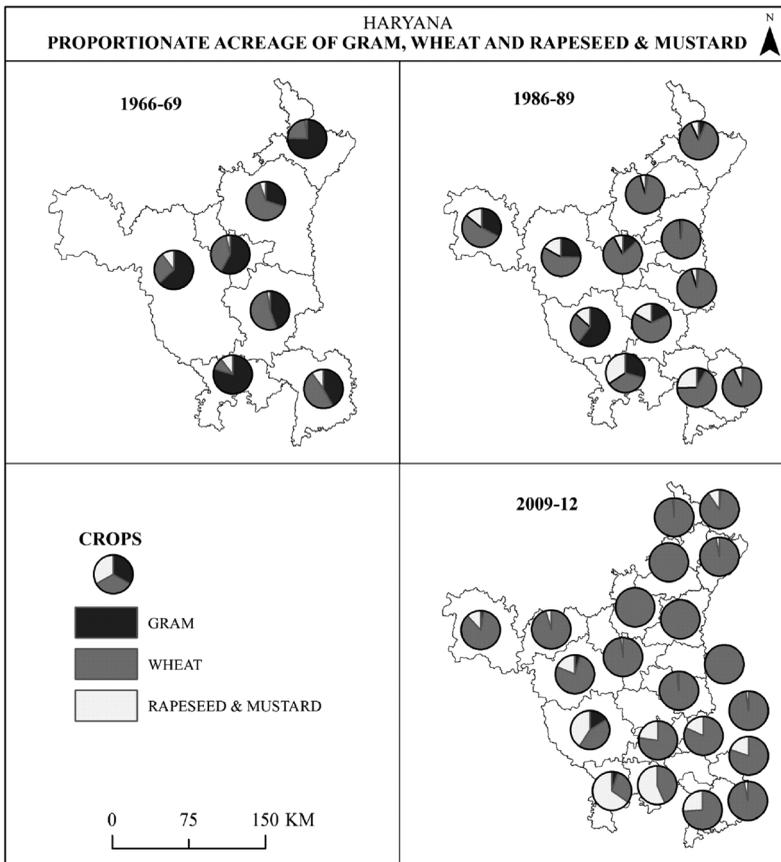


Fig. 3 :

Spatial Expansion of Wheat and Mustard Cultivation

Wiping out of gram from the Rabi cropping pattern in Haryana is directly linked to expansion of irrigation and diffusion of package technology since mid-1960s. As irrigation expanded from east to west and southwest rainfed gram crop got washed out of cropping pattern paving the way and yielding the space to more remunerative and irrigated crops wheat and lightly irrigated rapeseed & mustard during Rabi season. Consequently the acreage of the competing wheat and rapeseed & mustard has recorded a significant acreage gain. Wheat was a second ranking crop and occupied about 18 percent of total cropped area in 1966-69 in the state (Table 2). Acreage of this fine cereal increased tremendously during next two decades. It occupied 32.5 percent area in 1986-89 and about 39 percent area in 2009-12. Old Karnal, Rohtak and Ambala districts (eastern part of the state) had comparatively higher acreage under wheat in mid-1960s. On the other hand, gram was a dominant crop during Rabi season in western parts. By 1986-89 wheat emerged as most the dominant crop in the state. It occupied over 35 percent of total cropped area in eastern parts of the state. But gram continued to compete with wheat as rainfed crops in the less irrigated western and southwestern parts of the state. However, in 2009-12 spatial dominance of wheat stretched all over the state. Though, in southwestern region it faced competition from rapeseed & mustard in areas with limited irrigation facilities.

Rapeseed & mustard was a minor crop in mid-1960s in the state as it occupied only about 3 percent of total cropped area. Its cultivation gained momentum particularly

in southwestern parts of the state and it occupied about 6 percent of the total cropped area in 1986-89 and about 8 percent area in 2009-12. It is a hardy crop that requires only a couple of irrigations. Hence, it has competed well with both gram and wheat in the moisture deficit south western parts of the state.

Fig. 3 shows the spatial marginalization of gram cultivation in Haryana over last four and half decades. It reveals that during 1966-69, gram cultivation had dominance in Rabi season all over the state. But the scenario has changed with the initiation of Green Revolution. By mid-1980's acreage of gram sharply declined all across the state. Fast expansion of wheat cultivation forced gram exit from Rabi cropping pattern except the southwestern parts of the state. The process of marginalization of gram was complete by 2009-12 as it got confined to only Bhiwani district and there too as a minor crop. Fig. 3 also shows that it is the expansion of rapeseed & mustard cultivation that has ejected out gram from its last bastion i.e. Southwestern region of the state. At present wheat is the most dominant and well spread out crops in the state during Rabi season. It is only in the southwestern parts of the state having limited irrigation facilities, this crop shares space with mustard.

Factors in Marginalization of Gram Cultivation

There are indications from the preceding discussion that sharp decline in the acreage and production in gram in Haryana is connected to the initiation of Green Revolution and consequent diffusion of wheat cultivation with expansion of irrigation in the state. Expansion of rapeseed and mustard

cultivation in less irrigated southwestern region of the state particularly since 1980s has also led to spatial marginalization of gram. Difference in the level and growth of the yield of gram vis-a-vis the competing crops, i.e. wheat and rapeseed & mustard, has been one of major factor in ejecting out gram from the cropping pattern in the state. Fig.4 shows district-wise change in the yield level of gram and competing crops. There has been a very marginal increase in the yield level of gram (793 to 893 kg per ha) over the period 1966-69 to 2009-12. Whereas, during the same period, wheat and mustard yield jumped from 1622 to 4677 kg per ha and from 401 to 1618 kg per ha respectively. Furthermore, the yield of these competing crops has shown much more temporal consistency as compare to gram. It is evident that gram yield declined all over the state during the period 1966-69 to 1986-89.

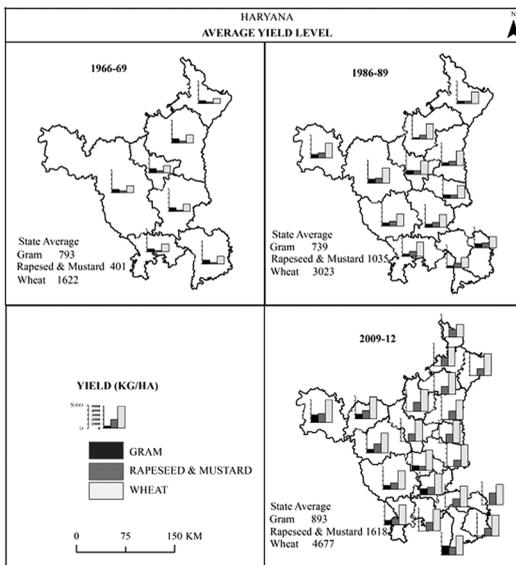


Fig. 4 :

However, it showed little improvement during next two decades in southwestern parts of the state. Contrary to this, the wheat yield almost doubled during first two decades and it particularly picked up the momentum in the northern parts of the state. During next two decades wheat yield increased by one and half time and the trend was witnessed all over the state. Almost similar trend has been observed in case of rapeseed & mustard yield. Its yield increased by two and half time during first two decades and by one and half time during next two decades. This increasing yield gap between competing crops (wheat and rapeseed & mustard) and gram has played a huge role in ejection of this pulse crop from the Rabi cropping pattern in the state.

Table 3 presents the correlates of gram acreage. The matrix shows correlation coefficients revealing the nature of relationship of gram acreage with acreage and yield of competing crops and net sown area. The computation of correlation matrix is based on time series data of the state for the period 1966-67 to 2009-12. Correlation coefficients presented in the table show that the area under gram has very high negative association (r value above 0.8) with area under wheat, wheat yield, area under rapeseed & mustard, rapeseed & mustard yield and net area irrigated. It reveals that as over the period of four and half decades area under irrigation expanded in the state, wheat and rapeseed & mustard emerged as dominant Rabi crops replacing the rainfed gram crop. Table 3 also shows that net irrigated area has a very high positive relationship (r value above 0.85) with acreage and yield level of wheat and rapeseed & mustard. It divulges that diffusion of irrigation and package technology in the state enhanced the yield of

wheat and rapeseed & mustard which created a positive feedback mechanism for spatial expansion of these crops and geographical marginalization of the gram pulse crop. This process started with the initiation of Green

Revolution in late 1960s in eastern parts of the state and continued till the end of first decade of 21st century. Presently, Bhiwani district in southwestern part of the state has few remnants of gram cultivation.

Table 3 Correlation Matrix for different variables

	Area Under Gram	Gram Yield	Area Under Wheat	Wheat Yield	Area Under Mustard	Mustard Yield	Net Area Irrigated
Area Under Gram	1						
Gram Yield		1					
Area Under Wheat			1				
Wheat Yield				1			
Area Under Mustard					1		
Mustard Yield						1	
Net Area Irrigated							1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Conclusion

Gram cultivation has been progressively marginalized since the initiation of Green Revolution in Haryana. Trends of area under gram, rapeseed & mustard and wheat brings out that gram acreage has decreased continuously with fluctuations over the period of about four and half decades (1966-67 to 2010-11) in the state. Area under gram has declined at the rate of -5.92 percent per year since mid-1960s. Maximum decline in acreage was recorded during the decade following mid-1990s. On the other hand, however, the area of the competing crops such as wheat and rapeseed & mustard has increased consistently which is also coterminous with the period experiencing increase in net area irrigated in the state.

During 1966-69, gram cultivation had dominance in Rabi season all over the state. But the scenario changed with the initiation of Green Revolution. Till mid 1980s gram was wiped out from eastern and northeastern parts of the state. But it continued occupying a significant position in the cropping pattern of western and southwestern parts of the state. The process of marginalization of gram was complete by 2009-12 as this crop got confined to only Bhiwani district and there too as a minor crop. It is the expansion of rapeseed & mustard cultivation that has finally ejected out gram from its last bastion i.e. southwestern region of the state. At present wheat is the most dominant and well spread out crops in the state during Rabi season.

Correlation analysis based on time series data revealed that area under gram has very high negative correlation with area under wheat, wheat yield, area under rapeseed & mustard, mustard yield and net area irrigated. It implies that as over the period of four and half decades area under irrigation expanded in the state, wheat and mustard emerged as dominant Rabi crops replacing the rainfed gram crop. Net irrigated area has a very high positive relationship with acreage and yield level of wheat and rapeseed & mustard. It divulges that diffusion of irrigation and package technology in the state enhanced the yield of wheat and rapeseed & mustard which created positive feedback mechanism for spatial expansion of these crops and geographical marginalization of the gram pulse crop.

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