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DYNAMICS OF CROPPING PATTERN IN CHAMERA-II HYDRO POWER PROJECT AREA, HIMACHAL PRADESH

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Abstract

Agriculture is one of the essential sources of human life supporting foods, nutrients etc., of their daily needs. The present investigation attempts to scrutinize the changes during the past three decades of Hydropower project affected villages in Chamba district of Himachal Pradesh. The Cropping pattern is the proportion of area under different crops, the nature of rotation of crops, and area under double cropping in a region or in a country. A change in cropping pattern means a change in the proportionate area under different crops. The present study is based on secondary data, data was collected from twenty-one villages of eight Patwar circles. The overall study reveals that positive as well as negative impacts has been observed in the study areas. It shows the positive correlation of area in the form of cereal crops as well as cash crops. Whereas, the area under ailing crops like Urd and Mustard has been found in declined form.

Keywords: Cropping-Pattern, Spatio-Temporal, Hydro Power Project Area.

Introduction

India has the main source of livelihoods in Agriculture. Seventy per cent of its rural households still depend primarily on agriculture for their livelihood, with 82 percent of farmers being small and marginal. In 2017-18, total food grain production was estimated at 275 million tonnes (MT). India is the largest producer (25% of global production), consumer (27% of world consumption) and importer (14%) of pulses in the world. It is the second-largest producer of rice, wheat, sugarcane, cotton and groundnuts, as well as the second-largest fruit and vegetable producer, accounting for 10.9% and 8.6% of the world fruit and vegetable production, respectively (FAO 2020). The study of cropping pattern in relation to agro climatic conditions helps the planners and decision makers to evolve a suitable and scientific crop policy. The changing cropping pattern also indicates the path of development

undertaken in this agriculturally backward hilly region. Introduction of the alien crops may also influence the fragile ecosystems of the region (Jaglan M.S. and Thakur B.R. 2016). Chamba district is among the most backward areas of Himachal Pradesh. It has a population of 5.20 Lakh as per 2011 census. It is the only district in Northern western India to preserve in a well-documented history from 500 AD. Its high mountain ranges and helped in have given it a sheltered position and helped in preserving its centuries-old relics and numerous inscriptions. Chamba has been declared as the backward district by government of India. It is among the 115 districts selected by the government of India in keeping with its vision of a new India by 2022. The Chamba district was selected as backward district in November 2017 when the prime minster launched a program to development 115 most backward districts of the country under vision 2022 policy. Chamba being one of the 115 backward districts as identified by the NITI Aayog, occupies a unique place in the history of Himachal Pradesh (Kumar S and Thakur B.R. 2020). Agriculture is the main occupation of the people of Chamba District and has an important place in the economy of the State. Therefore dependency on Agriculture/ Horticulture is eminent as it provides direct employment to about 62 per cent of total workers of the State. (Economic Survey 2017-18). Maize (Zea mays), and urd (Phaseolus radiatus) are the major Kharif crops grown in the area while, wheat (Triticum aestivum), mustard (Brassica compestris), and barley (Hordeum vulgare) are staple Rabi crops in the area. Besides, fruit crops and many other minor crops are also raised in the study area and Kachalu (Colocasia esculenta), chili (Capsicum frutescens), tomato (Lycopersicon esculentum), bean, Coriander (Coriandrum sativum), garlic (Allium sativum), onion (Allium cepa) are the important vegetables crops of the study area.

Objectives of the Study

The present study is aimed at realising the following objectives:

1. To examine the cropping pattern during the construction of Hydro Power Project.
2. To study the spatial variations in cropping pattern before and after the construction of Hydro Power Project of various areas.

Material and Methods

The present study has been undertaken with reference to three trienniums. The first period of reference is 1990-93. This is the time

before the construction of the hydro power project. Second triennium selected for during the construction of the hydro power project 2000-03. Third and last triennium selected for the after the construction of the hydro power project 2010-13. The present study is based on secondary data. Data has been collected from Lal kitab and Khasra Girdauri of twenty-one villages of eight Patwar circles. The data of cropping pattern are presented as triennium averages of above mentioned periods so as to neutralise the influence of inter-annual fluctuations on cropping pattern. The changes in cropping pattern have shown by comparing the tables and with the help of pie-diagrams.

Ecological Setting of Study Area

Study area lies between 32°26′43″N to 32°33′13″ N latitude and 76°8′11″ E to 76°17′21″E longitude (Fig. 1) sprawling over an area of about 55 sq. km.

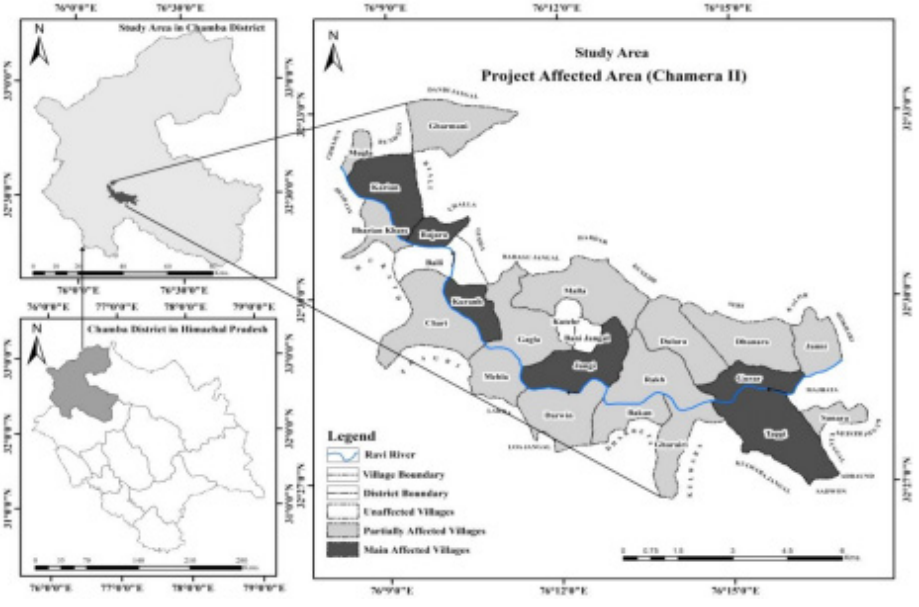


Fig. 1

Results and Discussion

It is evident from the table no.1 that there are two cropping seasons in the study area. These seasons include Kharif and Rabi. The major Kharif crops grown in the area are maize (Zea mays), and urd (Phaseolus radiatus). While, wheat (Triticum aestivum), mustard (Brassica compestris), and barley (Hordeum vulgare) are staple Rabi crops in the

area. Besides, fruit crops and many other minor crops are also raised in the study area. The other minor crops grown in the area are phullan (millets), chinae (Panicum miliaceum), bhrace (Fagopyrum esculentum), kodra (Paspalum scrobiculatum), rajmah (Phaseolus vulgaris), sieul (Amaranthus amaranthoides), potato (Solanum tuberosum), peas (Pisum sativum), paddy (Oryza sativa), kulth (Dolichos biflorus) til (Sesamum indicum), Kachalu (Colocasia esculenta), chili (Capsicum frutescens), tomato (Lycopersicon esculentum), bean, Coriander (Coriandrum sativum), garlic (Allium sativum), onion (Allium cepa), and vegetables etc.

Table reveals that the total cropped area in the first triennium period (1990-93) corresponding to pre-installation of project was 2186 sq km. It declined to 2127 sq. km during the construction period (2000-2003) of the hydro power project. The study shows that it gradually increased to about 2264 sq km in 2010-13 signifying installation period. The table reveals that the highest total cropped area during the first triennium period i.e.1990-93 was about 178 sq km observed in the 'Darwin' village a partially affected village followed by about 140 sq km cropped area registered in Taggi village which is a main project affected village. The lowest cropped area that is about 49 sq. km was witnessed in Kuranh a main affected village during early 1990s.

The study reveals that the same villages continued to have the highest as well as lowest acreage of cropland during the next two triennium period s i.e. 2000-03 and 2010-13.

Spatio-Temporal Distribution of Cropping Pattern

Agriculture is the base of the people of this area and mostly influenced by the physiographic conditions, diverse topography, varied soil types and irregular distribution of Temperatures and rainfall etc. In 190-93, 2000-03, and 2010-13, there are two diverse types of crop combination arrangement found in the area having dissimilar crops in the study area.

Maize

Table 1 represents that maize is the dominant *Kharif* crops grown in the study area. It accounts for about half of the total cropped area. Maize cultivation occupied about 49 percent of the total cropped area during the first triennium period that is 1990-93. It remained almost stagnant that is 50 percent during 2000-2003 and about 49 percent during the latest triennium period. The study shows that the highest allocation

of land that is 58.85 percent to maize cultivation was in Gurar and Malla villages during early 1990s. The lowest allocation to maize crop was found in Bharian Khass village. It was about one-third of the total cropped area of the village. During 2000-03 the highest acreage of the maize crop was found in Rakh village. It accounted for about two-third of the total area of the village. It was followed by Gurar village having as 61 percent of the total cropped area. The lowest area under the maize crop i.e. about 30 percent was observed in Bharian Khas Village. The study reveals that during the post construction period maize was a leading crop in Dhanara a partially affected village. It accounted for about 50 Percent of the total cropped area follows by about 55 percent of total cropped area in Gurar village. The lowest area under maize cultivation was registered in Bharian Khas village.

The study reveals that the highest preference to maize cultivation kept on changing from village to village during the study period. However, the lowest allocation of land to maize crop was observed in Bharian Khas village during the study period.

Urd

The study shows that Urd is another major Khrif crop grown in the study area. It occupied 6.44 percent of the total cropped area during 1990-93. It declined to 5.23 percent in 2000-03. It further declined to 3.57% of the total cropped area during the latest triennium period that is 2010-13. The study reveals that unlike maize there has been 2.87 percent point decline in urd cultivation during the study period. The study shows that urd was the dominant crop with about 27% of the total cropped area in the Sunara village followed by about one fifth of the total cropped area in Taggi village. The study shows that urd was not cultivated at all in two villages namely janghi and Mugla during the early 1990s. The five villages namely Karian, Rajera, Mehla, Gagla and Rakh had less than 2% of total cropped area under urd. During 2002-03 both Sunara and Taggi villages continued to be the leading growers of urd. These villages accounted for 19% of the total cropped area under urd. Four villasges namely Karian, Janghi, Bharian Khass and Mehla devoted less than 2% of the total cropped land.

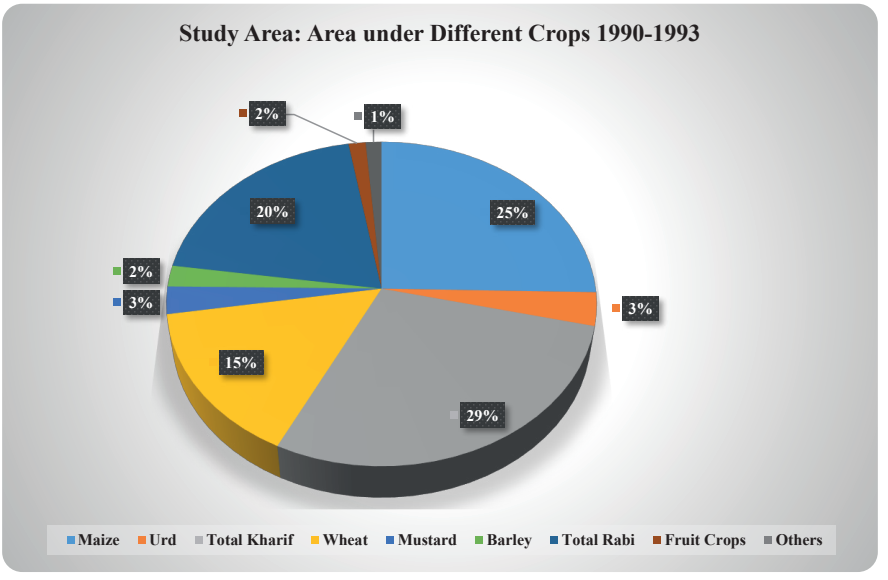
During the latest triennium period that is 2010-13 Sunara continued to be the leading urd grower village in the study area. It allocated about one-tenth of the total cropped area under the urd crop. The study shows that the Sunara village registered about three fold decline in the urd cultivation during the study period. The Gurar emerged as the second

Table 1: Study Area: Area Under Different Kharif Crops Area (Ha)

	Project Affected Villages	*Maize*			*Urd*			*Total Kharif*		
		1990-1993	*2000-2003*	*2010-2013*	*1990-1993*	*2000-2003*	*2010-2013*	*1990-1993*	*2000-2003*	*2010-2013*
Main Affected Villages	Karian	44.24(53.98)	41.95(50.84)	47.2(53.37)	1.07(1.31)	1.47(1.78)	1.61(1.82)	45.31(55.28)	43.42(52.61)	48.81(55.19)
	Rajera	41.54(49.87)	31.15(41.19)	41.98(53.88)	1.21(1.45)	5.53(7.31)	1.21(1.65)	42.75(51.32)	36.68(48.50)	43.19(55.53)
	Kuranh	25.49(51.56)	25.63(48.53)	24.41(47.81)	1.34(2.71)	1.21(2.29)	0.53(1.04)	26.83(54.27)	26.84(50.82)	24.94(48.85)
	Janghi	53.55(53.17)	47.34(49.67)	50.04(49.35)	0(0)	1.61(1.69)	1.47(1.45)	53.55(53.17)	48.95(51.36)	51.51(50.80)
	Gurad	58.95(58.85)	58.27(61.30)	57.19(55.30)	6.2(6.19)	7.82(8.23)	6.74(6.52)	65.15(65.03)	66.09(69.53)	63.93(61.82)
	Taggi	66.49(47.55)	71.09(55.14)	78.1(48.38)	28.05(20.06)	24.14(18.72)	7.55(4.67)	94.54(67.62)	95.23(73.86)	85.65(58.05)
Partially Affected Villages	Gharmani	42.35(55.80)	34.26(43.45)	43.16(53.27)	2.82(3.72)	2.96(3.75)	0.94(1.16)	45.17(59.52)	37.22(47.20)	44.1(54.43)
	Mugla	46.13(45.86)	45.45(45.07)	47.88(45.94)	0(0)	0(.00)	0(0.00)	46.13(45.86)	45.45(45.07)	47.88(45.94)
	Bharian Khass	28.32(32.08)	22.79(30.25)	25.89(28.46)	2.02(2.29)	0.53(0.70)	1.21(1.33)	30.34(34.37)	23.32(30.95)	27.1(29.79)
	Chari	61.91(47.55)	66.23(48.40)	71.62(53.12)	10.51(8.07)	6.47(4.73)	5.12(3.80)	72.42(55.62)	72.7(53.13)	76.74(56.92)
	Mehla	55.98(45.93)	55.44(45.19)	58(48.55)	0.93(0.76)	1.07(0.87)	0.8(0.66)	56.91(46.70)	56.51(46.06)	58.8(49.22)
	Gagla	44.78(51.25)	43.3(53.61)	43.97(56.23)	1.61(1.84)	2.02(2.50)	2.42(3.09)	46.39(53.09)	45.32(56.11)	46.39(59.32)
	Malla	73.38(58.47)	66.37(53.50)	64.47(48.15)	3.23(2.57)	4.04(3.26)	6.46(4.83)	76.61(61.04)	70.41(56.76)	70.93(52.98)
	Dhulara	63.39(51.68)	69.6(63.96)	62.32(53.38)	12.27(10.00)	4.04(3.71)	4.04(3.46)	75.66(61.68)	73.64(76.64)	66.36(56.84)
	Rakh	37.76(49.84)	34.66(65.27)	36.28(48.15)	1.34(1.77)	1.34(2.52)	3.23(4.29)	39.1(51.61)	36(67.80)	39.51(52.44)
	Darwin	84.84(47.77)	89.02(47.49)	89.97(46.68)	9.97(5.61)	6.33(3.38)	6.07(3.15)	94.81(53.38)	95.35(50.87)	96.04(49.83)
	Bakan	50.98(40.93)	50.85(38.51)	49.91(38.28)	7.95(6.38)	9.3(7.05)	8.22(6.30)	58.93(47.31)	60.15(45.56)	58.13(44.58)
	Dharairi	47.2(50.17)	52.6(46.56)	55.21(46.77)	9.7(10.31)	4.58(4.05)	4.31(3.65)	56.9(60.48)	57.18(50.61)	59.52(50.42)
	Dhanara	63.66(54.41)	64.47(61.96)	60.42(58.14)	9.97(8.51)	4.58(4.40)	4.85(4.66)	73.63(62.92)	69.05(66.36)	65.27(62.80)
	Janni	57.46(53.54)	61.1(62.44)	59.08(56.63)	8.63(8.04)	6.6(6.75)	4.71(4.51)	66.09(61.58)	67.7(69.19)	63.79(61.15)
	Sunara	30.89(37.74)	38.31(47.20)	40.06(41.79)	22.12(27.03)	15.5(19.10)	9.3(9.70)	53.01(64.76)	53.81(66.30)	49.36(51.49)
Total		**1079.29 (49.36)**	**1069.88 (50.29)**	**1107.16 (48.91)**	**140.94 (6.44)**	**111.14 (5.23)**	**80.79 (3.57)**	**1220.23 (55.82)**	**1181.02 (55.52)**	**1187.95 (52.48)**

Source: *Lal Kitab and Khasra Girdawari of Patwar Circles.*
Figures in the parentheses show the per cent to the total villages.

urd raising village in the study area. It had about 6.52% of the total cropped area under the urd crop. The study shows that the farmers in the Taggi village diverted a major part of the crop land to crops other than the urd. It is evident from the fact that Taggi village registered about more than 5 times decrease in the urd cultivation during the study period.



Graph 1: Study Area: Area under Different Crops 1990-1993

The study shows that seven villages namely Karian, Rajera, Kuranh, Janghi all main affected villages and Gharmani, Bharian Khass, and Mehla partially affected villages allocated less than 2% of the cropped land to the urd cultivation. The study reveals that the two major Kharif crops namely maize and urd constituted about 56% during the early 1990s and 2000- 03. It declined to about 52.48% during next decade in the study area. The study infers that there has been about 3 percent point decline in acreage of kharif crops during the study period. However, this decline is mainly attributed to shrinking area under urd crop. The spatio-temporal variations in the kharif crops attributed to the fluctuations in area of these two crops are across the villages.

Wheat

Wheat is second dominant crop after maize grown in the study area. It is quite clear from the table that wheat accounts for about 30% of the total cropped area during the early 1990s. Its acreage declined

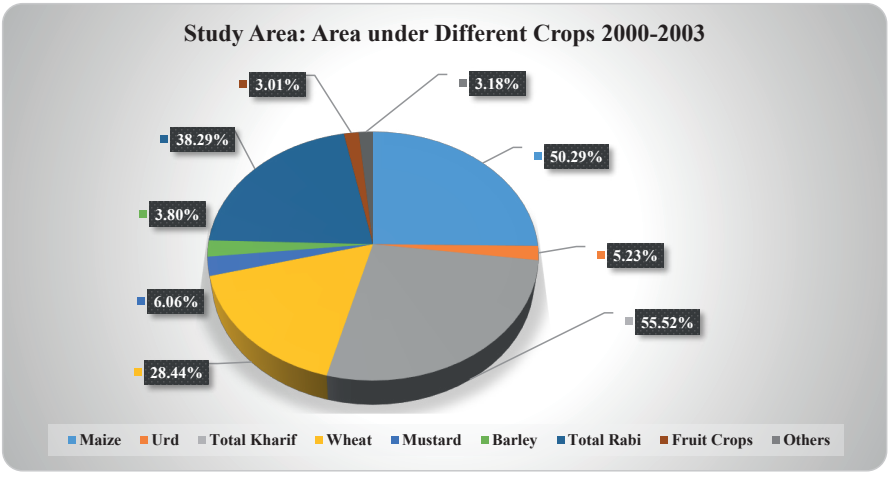
Table 2: Study Area: Area Under Different Rabi Crops Area (Ha)

	Project Affected Villages	*Wheat*			*Mustard*			*Barley*			*Total Rabi*		
		1990-1993	*2000-2003*	*2010-2013*	*1990-1993*	*2000-2003*	*2010-2013*	*1990-1993*	*2000-2003*	*2010-2013*	*1990-1993*	*2000-2003*	*2010-2013*
Main Affected Villages	Karian	32.37(39.49)	33.18(40.21)	33.85(38.27)	0.93(1.13)	1.61(1.95)	1.61(1.82)	2.01(2.45)	2.83(3.43)	2.69(3.04)	35.31(43.08)	37.62(45.59)	38.15(43.14)
	Rajera	31.83(38.21)	28.59(37.80)	27.51(35.31)	4.98(5.98)	3.37(4.46)	2.82(3.62)	1.2(1.44)	4.04(5.34)	2.83(3.63)	38.01(45.63)	36(47.60)	33.16(42.56)
	Kuranh	14.56(29.45)	17.26(32.68)	18.61(36.45)	2.42(4.89)	2.56(4.85)	2.15(4.21)	0.8(1.62)	0.8(1.51)	0.53(1.04)	17.78(35.96)	20.62(39.04)	21.29(41.70)
	Janghi	30.21(29.99)	29.8(31.27)	35.74(35.24)	10.11(10.04)	8.22(8.62)	6.06(5.98)	3.36(3.34)	3.77(3.96)	2.97(2.92)	43.68(43.37)	41.79(43.85)	44.76(44.15)
	Gurad	23.33(23.29)	11.87(12.49)	17.93(17.34)	2.96(2.95)	6.33(6.66)	10.92(10.56)	3.5(3.49)	6.6(6.94)	5.66(5.47)	29.79(29.74)	24.8(26.09)	34.51(33.37)
	Taggi	38.31(27.40)	26.16(20.29)	55.17(34.17)	1.61(1.15)	2.42(1.88)	7.82(4.84)	1.61(1.15)	2.96(2.30)	9.17(5.68)	41.53(29.70)	31.54(24.46)	72.16(44.70)
	Gharmani	13.21(17.41)	16.72(21.20)	15.24(18.81)	5.93(7.81)	6.6(8.37)	6.6(8.15)	4.17(5.49)	7.68(9.74)	8.49(10.48)	23.31(30.72)	31(39.32)	30.33(37.44)
	Mugla	44.78(44.52)	45.59(45.21)	44.65(42.84)	1.34(1.33)	1.2(1.19)	1.2(1.15)	2.42(2.41)	2.28(2.26)	2.29(2.20)	48.54(48.26)	49.07(48.66)	48.14(46.19)
	Bharian Khass	40.99(46.44)	34.93(46.36)	42.75(46.99)	0.4(0.45)	0.4(0.53)	1.07(1.18)	0.8(0.91)	0.4(0.53)	0.8(0.88)	42.19(47.80)	35.73(47.43)	44.62(49.05)
	Chari	37.36(28.69)	47.47(34.69)	44.64(33.11)	4.85(3.72)	4.98(3.64)	4.31(3.20)	7.14(5.48)	5.52(4.03)	3.77(2.80)	49.35(37.90)	57.97(42.37)	52.72(39.10)
	Mehla	54.76(44.94)	54.76(44.65)	52.47(43.92)	0.00	0.13(0.10)	0.4(0.33)	1.21(0.99)	1.21(0.99)	0.67(0.55)	55.97(45.92)	56.1(45.72)	53.53(44.80)
	Gagla	15.91(18.21	9.03(11.18)	18.35(23.46)	17.93(20.52)	21.98(27.21)	5.52(7.06)	4.45(5.09)	2.02(2.50)	4.31(5.52)	38.29(43.83)	33.03(40.89)	28.18(36.04)
Partially Affected Villages	Malla	9.7(7.73)	11.73(9.46)	29.53(22.06)	23.33(18.59)	25.08(20.22)	16.04(11.98)	7.28(5.80)	7.68(6.19)	5.53(4.12)	40.31(32.12)	44.49(35.86)	51.09(38.16)
	Dhulara	19.01(15.50)	9.97(9.16)	16.45(14.09)	3.77(3.07)	5.39(4.95)	9.43(8.08)	12.54(10.22)	5.79(5.32)	8.89(7.62)	35.32(28.79)	21.15(19.44)	34.77(29.78)
	Rakh	22.39(29.55)	4.71(8.87)	22.93(30.43)	9.43(12.45)	9.57(18.02)	8.35(11.08)	3.91(5.16)	2.42(4.56)	1.61(2.14)	35.73(47.16)	16.7(31.45)	32.89(43.65)
	Darwin	72.7(40.93)	79.45(42.38)	91.05(47.24)	4.04(2.27)	5.79(3.09)	0.8(0.42)	2.02(1.14)	2.42(1.29)	0.8(0.42)	78.76(44.34)	87.66(46.76)	92.65(48.07)
	Bakan	48.96(39.30)	53.95(40.87)	58.27(44.69)	4.99(4.01)	4.72(3.58)	2.69(2.06)	3.5(2.81)	2.69(2.04)	2.29(1.76)	57.45(46.12)	61.36(46.48)	63.25(48.50)
	Dharairi	24.27(25.80)	46.94(41.55)	49.37(41.82)	2.82(3.00)	2.96(2.62)	2.02(1.71)	5.66(6.02)	1.07(0.95)	2.83(2.40)	32.75(34.81)	50.97(45.11)	54.22(45.93)
	Dhanara	21.3(18.20)	13.75(13.21)	12.81(12.33)	7.55(6.45)	6.73(6.47)	7.95(7.65)	10.92(9.33)	5.79(5.56)	7.68(7.39)	39.77(33.99)	26.27(25.25)	28.44(27.36)
	Janni	26.02(24.24)	12.27(12.54)	16.45(15.77)	5.26(4.90)	4.31(4.40)	6.87(6.59)	8.36(7.79)	9.17(9.37)	12.53(12.01)	39.64(36.93)	25.75(26.32)	35.85(34.37)
	Sunara	23.33(28.50)	17.12(21.09)	34.66(36.16)	1.34(1.64)	4.58(5.64)	3.36(3.51)	2.56(3.13)	3.5(4.31)	6.33(6.60)	27.23(33.27)	25.2(31.05)	44.35(46.27)
Total		**645.3 (29.53)**	**605.25 (28.44)**	**738.43 (32.62)**	**115.99 (5.30)**	**128.93 (6.06)**	**107.99 (4.77)**	**89.42 (4.09)**	**80.64 (3.80)**	**92.67 (4.09)**	**850.71 (38.92)**	**814.82 (38.29)**	**939.06 (41.48)**

Source: *Lal Kitab and Khasra Girdawari of Patwar Circles.*

Figures in the parentheses show the per cent to the total villages.

marginally to about 28% during next decade which further increased to about one-third of total cropped area during 2010-13. The study therefore shows that wheat is the leading crop among all the Rabi crops grown in the study area. It is evident from the table no. 2 that there were notable variations in the wheat cultivation all across the villages. The Bharian Khass village accounted for as high as 46% area under wheat during the early 1990s followed by about 39% of total cropped area in Karian village. The lowest area under wheat cultivation (about 8% was registered in Malla village. During second triennium period both Bharian Khass and Karian village continued to be the leading wheat growing villages respectively. However, area under wheat remained almost unchanged in the both of villages.



Graph: 2: Study Area: Area under Different Crops 2000-2003

The study shows that Rakh village occupied the bottom place in the wheat cultivation during this period. The Rakh village registered about three-fold decrease in the area under wheat between the early 1990s and 2000-2003. The study shows that Darwin emerged as the leading wheat growing village in the area during 2010-13. It constituted about 47% of the total cropped area closely followed by the Bharian Khasas village. The lowest acreage (12.33%) during the said triennium period was registered in Dharnara village.

Mustard

The study shows that the oil seeds do not occupy a significant place in the cropping pattern of the study area. However, mustard is grown in the hilly villages of the area. The mustard cultivation finds preferred

position after wheat cropping in the area. The mustard cultivation has experienced furcating trends during the study period.

It is evident from the fact that 5.3% of the total cropped land was allocated to the mustard during the early 1990s. It increased to 6.06%between 2000-03. Which decreased to about 5% during the next decade. The table indicates that the highest area that is one-fifth was allocated to mustard cultivation in the Gagla village during the early 1990s. It was followed by about one-tenth of the total cropped area in the Janghi village. The mustard was not grown in the Mehla village. The study shows that five villages namely Karian, Taggi, Mugla, Bharian Khass and Sunara allotted less than 2% of the total cropped area to the mustards. The study reveals that the both Gagla and Janghi villages contributing to be the leading mustard growing villages in the area respectively 2000-03. However, Gagla village reported about seven percent increase between first and second triennium periods. The farmers in Mehla village also started raising mustard during 2000-03. Although it was an insignificant crop in the village and comprised 0.10% of the total cropped area. The farmers growing mustard only for self-consumption and allocating lesstan 2% of the total cropped area were found in four villages namely Karian, mugla, Bharian Khass and Mehla during 2000-03. The study indicates that Malla village was leading mustard growing village during 2010-13. It occupied about 12% of the total cropped area followed by the Gurar village (10.56%) The least area under the mustard was again reported in the Mehla village (0.33%) The five villages namely Karian, Mugla, Bharian Khass Mehla and Darwin devoted less than 2% of the total cropped area to the mustard.

Barley

Barley is another important crop cultivated during the Rabi season in the study area. Interestingly, the cultivation area under barley cultivation remained stagnant during the study period. It occupied 4.09%of total cropped area. However, it marginally declined 2000-03. The spatial pattern of barley cultivation during the early 1990srepresents that the highest acreage of barley accounting for one tenth of the total cropped area was registered in Dhulara village closely followed by Dhanara village (9.93%) The lowest area under barley 0.91% was found in Bharian Khass village followed by Taggi village. During 2000-03 Gharmani village emerged as the leading barley growing village in the study area. It accounted for about one tenth of total cropped area

Table 3: Study Area: Area Under Different Fruit Crops Area (Ha)

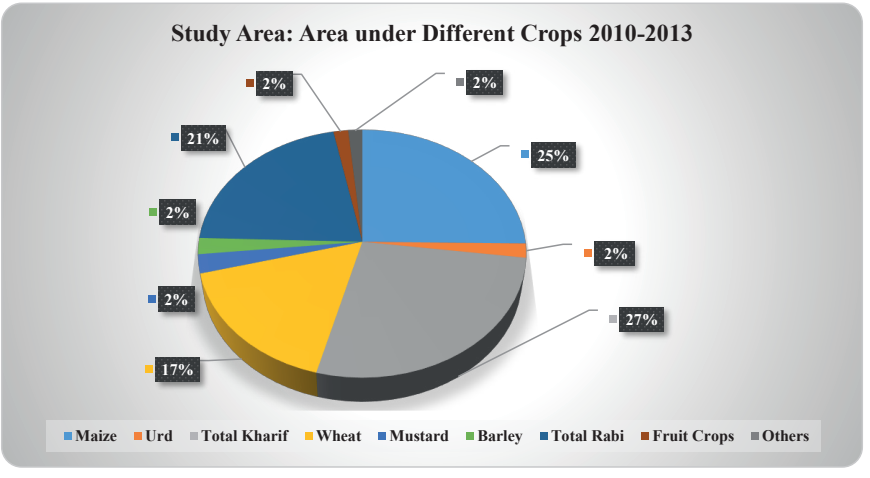
	Project Affected Villages	*Fruit Crops*			*Others*			*Total Cropped Area*		
		1990-1993	*2000-2003*	*2010-2013*	*1990-1993*	*2000-2003*	*2010-2013*	*1990-1993*	*2000-2003*	*2010-2013*
Main Affected Villages	Karian	1.21(1.48)	1.21(1.47)	1.21(1.37)	0.13(.16)	0.27(0.33)	0.27(0.30)	81.96(100.00)	82.52(100.00)	88.44(100.00)
	Rajera	1.21(1.45)	1.21(1.60)	1.21(1.55)	1.33(1.60)	1.74(2.30)	0.36(0.46)	83.3(100.00)	75.63(100.00)	77.92(100.00)
	Kuranh	2.42(4.89)	2.42(4.58)	2.42(4.74)	2.41(4.88)	2.94(5.56)	2.4(4.71)	49.44(100.00)	52.82(100.00)	51.05(100.00)
	Janghi	2.42(2.40)	2.69(2.82)	2.96(2.92)	1.07(1.06)	1.88(1.97)	2.15(2.13)	100.72(100.00)	95.31(100.00)	101.39(100.00)
	Gurad	4.31(4.30)	3.09(3.25)	3.64(3.52)	0.92(.93)	1.08(1.13)	1.34(1.29)	100.17(100.00)	95.06(100.00)	103.42(100.00)
	Taggi	2.02(1.44)	2.02(1.57)	3.23(2.00)	1.74(1.24)	0.13(0.11)	0.4(0.25)	139.83(100.00)	128.92(100.00)	161.44(100.00)
	Gharmani	5.26(6.93)	5.25(6.67)	4.04(4.99)	2.15(2.83)	5.37(6.81)	2.54(3.14)	75.89(100.00)	78.85(100.00)	81.02(100.00)
	Mugla	4.04(4.02)	4.04(4.01)	4.04(3.87)	1.88(1.86)	2.28(2.26)	4.17(4.00)	100.59(100.00)	100.84(100.00)	104.23(100.00)
	Bharian Khass	1.21(1.37)	1.21(1.61)	1.21(1.33)	14.53(16.46)	15.09(20.01)	18.04(19..83)	88.27(100.00)	75.34(100.00)	90.97(100.00)
Partially Affected Villages	Chari	2.42(1.86)	1.75(1.28)	3.1(2.30)	6.02(4.62)	4.41(3.22)	2.25(1.68)	130.21(100.00)	136.83(100.00)	134.82(100.00)
	Mehla	3.36(2.76)	3.37(2.74)	6.47(5.41)	5.62(4.62)	6.69(5.48)	.66(0.57)	121.86(100.00)	122.68(100.00)	119.46(100.00)
	Gagla	2.02(2.31)	2.02(2.50)	2.02(2.59)	0.67(0.77)	0.4(0.50)	1.6(2.05)	87.37(100.00)	80.77(100.00)	78.19(100.00)
	Malla	5.26(4.19)	5.26(4.24)	5.26(3.93)	3.33(2.65)	3.89(3.14)	6.59(4.93)	125.51(100.00)	124.05(100.00)	133.87(100.00)
	Dhulara	7.28(5.93)	8.26(7.59)	10.11(8.66)	4.41(3.60)	5.77(5.30)	5.5(4.72)	122.68(100.00)	108.82(100.00)	116.74(100.00)
	Rakh	.4(.53)	0.4(0.75)	0.4(0.53)	0.53(0.70)	0	2.55(3.38)	75.76(100.00)	53.1(100.00)	75.35(100.00)
	Darwin	3.23(1.82)	3.64(1.94)	4.04(2.10)	0.82(0.46)	0.8(0.43)	0	177.61(100.00)	187.45(100.00)	192.73(100.00)
	Bakan	4.04(3.24)	5.26(3.99)	5.26(4.03)	4.15(3.33)	5.23(3.97)	3.76(2.89)	124.57(100.00)	132(100.00)	130.4(100.00)
	Dharairi	4.04(4.29)	4.31(3.82)	3.64(3.08)	0.39(0.42)	0.52(0.46)	0.67(0.57)	94.08(100.00)	112.98(100.00)	118.05(100.00)
	Dhanara	1.61(1.38)	3.91(3.76)	2.83(2.72)	2(1.71)	4.82(4.63)	7.39(7.12)	117.01(100.00)	104.05(100.00)	103.93(100.00)
	Janni	.53(.49)	0.4(0.41)	0.4(0.38)	1.07(1.00)	4(4.08)	4.28(4.10)	107.33(100.00)	97.85(100.00)	104.32(100.00)
	Sunara	1.21(1.48)	2.02(2.49)	2.02(2.11)	0.4(0.49)	0.13(0.16)	0.13(0.13)	81.85(100.00)	81.16(100.00)	95.86(100.00)
Total		**59.5(2.72)**	**63.75(3.01)**	**69.51(3.07)**	**55.57(2.54)**	**67.44(3.18)**	**67.05(2.97)**	**2186.01(100)**	**2127.03(100.00)**	**2263.6(100)**

Source: *Lal Kitab and Khasra Girdawari of Patwar Circles.*

Figures in the parentheses show the per cent to the total villages.

followed by about 7% area in the Gurar village. The lowest area under barley (0.53%) crop was again recorded in Bharian khass village.

The study points out that Janni village allocated the highest share of land to the barley crop during 2010-13. It constituted about 12% of the total cropped area followed by about one tenth of the total cropped area in Gharmani village. On the contrary the lowest acreage (0.42%) of barley cultivation was registered in the Darwin village. It is also evident from the table that Rabi crops together constituted about 39% of total cropped area during the early 1990s. It marginally increased to about 41% during next two decades in the study area. The spatio temporal pattern of the Rabi crops is attributable to the changing space composition among three major Rabi crops namely wheat, mustard and barley grown in the study area.



Graph 3: Study Area: Area under Different Crops 2010-2013

Fruit Crops

The topographical and favourable agro-climatic conditions also offer suitable conditions for raising a variety of horticultural crops in the study area. These horticultural crops include tropical, subtropical, citrus and temperate fruits grown in the study area. These fruit crops together contributed 2.72% of the total cropped area during the early 1990s their proportion increased to 3.01% of total cropped area during 2000-03. It further increased to 3.07% during the latest triennium period that is 2010-13. The study reveals that there has been rise area under the fruit crops during the study period. It may be attributed to their highly remunerative value of their crops. The increase in the cultivation

of these high income yielding crops may be partly attributed to the contribution to hydro power project. The study reveals that Gharmani village reported the highest share (about 7%) followed by about 5% of total cropped area in the Karian Village during the Pre-construction period of the hydro power project. The two villages namely Janni and Rakh had less than 1% of the total cropped area under these cash crops during the early 1990s. It is evident from the fruit statistics that Dhulara village extended fruitcrops alone the suitable slopes and occupied the top place with about 8% of the total cropped area followed by Gharmani village (about 7% area) The study shows that both Dhulara (about 9% area) and Gharmani villages continued to be the leading villages in raising the fruit crops during 2010-2013.. On the contrary both Janni and Rakh villages continued to be at the bottom place with less than 1% of the total cropped area during the construction and post-construction period of hydro power project.

Other Crops

The tables 1 and 2 and Graphs 1, 2 and 3 reveal that there are many other minor crops grown in the study area. These other crops include both cereals and pulses cultivated in the project affected villages. These other crops include phullan, kodra, rajmah, sieul, bhrace, patoto, peas, paddy, kulth, til, kachalu, chili, tomato, bean, coriander, garlic, onion, vegetables. These minor crops together accounted for 2.54% of the total cropped area during the early 1990s. There share highly increased to 3.18% during next decade and further decline to 2.97% by 2010-13. It is evident from the table that Bharian Khass village allocated as high as 16% of total cropped area to these crops during the early 1990s. It was followed by about 5% of the total cropped area in Karian village. It is discovered that seven villages namely Karian, Gurar, Gagla, Rakh Darwin Dhareri and Sunara accounted less than 1% of total croppedarea. The study points out that the area under other crops increased to about one-fifth of the total cropped area in Bharian Khass village during 2000-03. It was followed by Karian village with about 5.56% of the total cropped area. It is also evident from the study that Gharmani village continued to be at the top (one fifth of the area) in the cultivation of crops followed by Karian village. The distributional pattern of insignificant portion (less than 1 %) of other crops remained almost unchanged between 2000-13 among the project affected villages.

Conclusion

It is evident from the foregoing discussion that the cropping pattern has not undergone spectacular transformation due to the execution of hydropower project in the study area. However, some changes have been observed during the study period. The study reveals that the food grains including major cereal crops and pulses together accounted for about 89% of the total cropped area during the pre-construction period of the project. The proportion remained almost unchanged during the next two decades. The study shows the area under cereal crops was about 83% during the early 1990s which slightly increased about to about 85%. The area under urd declined from about 6% to about 4% during the study period. It also reveals the slight decline in the mustard cultivation of the area. The study reveals increase in the area under fruit crops from 2.7% to 3.07%during the study period. The overall study reveals that positive as well as negative impacts has been observed in the study areas. It shows the positive correlation of area in the form of cereal crops as well as cash crops. Whereas, the area under ailing crops like Urd and Mustard has been found in declined form.

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