Growth of Employment and Income in Agriculture sector

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INTRODUCTION

The main motive for independent India has been to eradicate mass poverty and hunger. Almost 3/4th population was poor and lived in rural India. It was clear that agricultural growth is very significant to attain self-sufficiency in the production of food grains which will ultimately help in reducing poverty and eliminating hunger. So focus on agriculture development was increased through public investments in irrigation, input subsidies and HYV technology along with price incentives to farmers which resulted positive. The country was able to uplift the food shortage in general and contributed significantly to poverty reduction though in a limited number of states by the first phase of green revolution during the 1960s and early 1970s. The food grain production growth has surpassed the rate of growth in population, and India became a net food exporter.

But also, the country faces serious challenges of accelerating productivity and efficiency to raise farmers' income, maintaining equity and sustainability. The rate of agricultural growth in terms of employment and income remained modest between 2 and 3% despite the initiation of economic reforms under the structural adjustment programme. By the end of the 1990s growth performance decreased significantly resulting in agrarian crisis in several states. Consequent occurrence of drought after 1998 combined with inadequate irrigation facilities, credit and crop insurance facilities, high cost of inputs and less profit, fewer off farm opportunities forced farmers to end their lives. Maharashtra, Karnataka and Jharkhand and other are few states faced back-to-back droughts and declining agriculture incomes.

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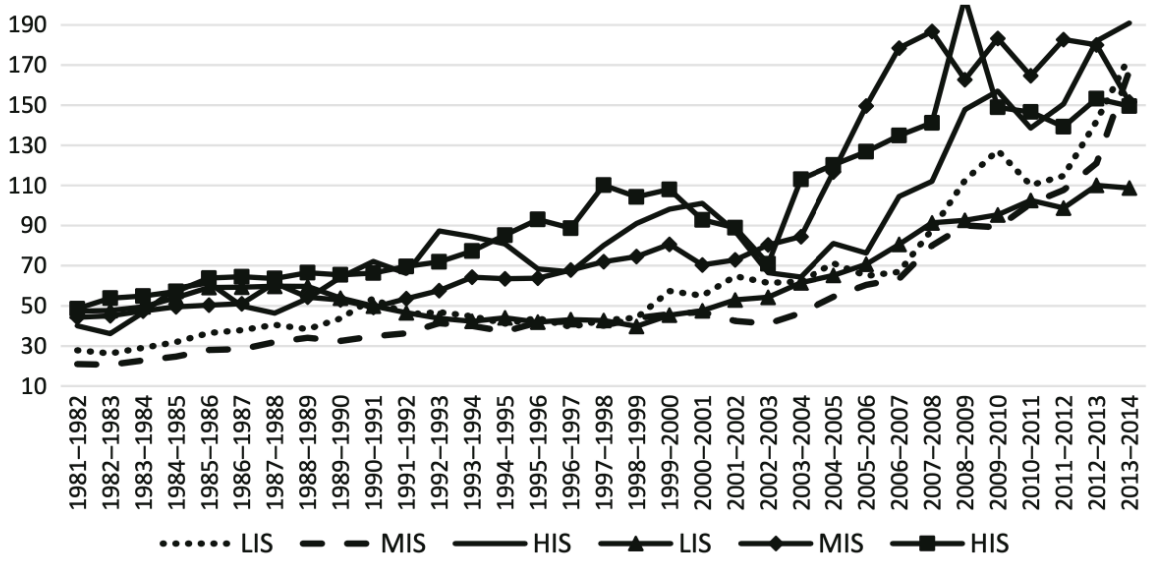
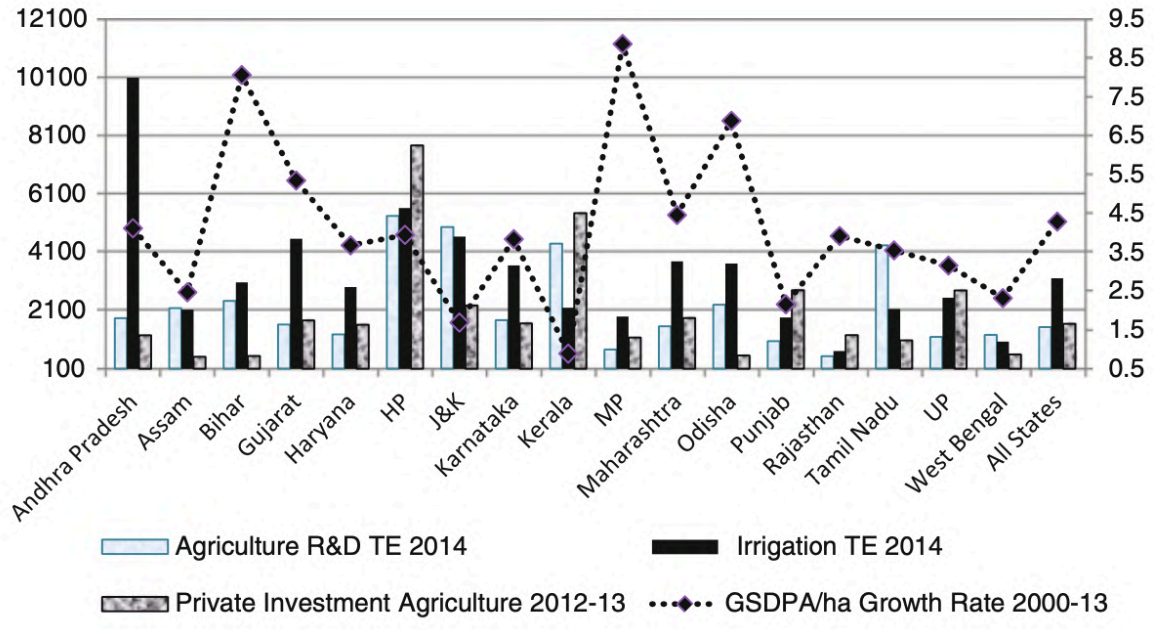
The relationship between public investments in agriculture and irrigation and income

Using OLS and GMM approaches, the research is based on a time series of public expenditures on agriculture R&D and irrigation for 17 major states from 1981–82 to 2013–14. The analysis demonstrates that during the 1990s, low and insufficient public capital formation harmed farmers' investments and risked technical advancement and agricultural growth. An important governmental endeavour from 2003–04 was a significant increase in resource allocation to agriculture and irrigation. Significant increases in irrigation system spending in developing countries have aided in reversing productivity declines and boosting private investment and income.



Public expenditure on agriculture and irrigation (Rs. billion at constant (2004–05) prices)

With the exception of Himachal Pradesh and Jammu & Kashmir, large interstate differences in public spending on agriculture and irrigation persist, with richer (developed) states spending more than poorer (less developed) agriculturally reliant states. Despite these interstate inequalities in agriculture and irrigation spending, empirical evidence shows that they have a beneficial and considerable impact on farm income. The results of both the OLS and GMM techniques are consistent. However, the projected coefficients on public spending on farm R&D and irrigation in effecting agriculture income are substantially larger, at 0.05 and 0.19, respectively, according to the GMM specification. It also emphasises the significance of the composition of government spending in agriculture. The report concludes that the agriculture sector need immediate attention in fiscal policy. It calls for more resources to be allocated to poorer states, as well as capital deepening, in order to boost farm productivity and revenue.



Annual rate of growth in GSDPA and Per ha public expenditure and private investment on agriculture (2000–13)

Investment Behaviour of Farmers Across Indian States

From 1981 through 2012, the decennial National Sample Survey Debt and Investment Surveys were used to assess the investment behaviour of agricultural households. It starts with a look at spatial patterns and differences in the composition of fixed capital expenditure, then moves on to the factors that influence agricultural investment and its impact on farm revenue. The data showed a spectacular growth in real investment by rural households, with residential land and structures accounting for 68 percent of total investment, followed by farm business at 23.3 percent and non-farm business at 8.7%.

During this time, it has also risen at a far faster pace of 4.66 percent than investment farms and non-farm enterprises, which grew at 2.52 and 3.31 percent, respectively. Increasing urbanisation, development of industrial activity, and demographic variables, such as a growing trend of nuclear family system and hence land partition, all contribute to higher growth in industrialised countries. State governments' acquisition of land for infrastructure development may have made such investments profitable.

Furthermore, farmers may decide to invest more in land-buildings in the hopes of receiving larger returns than crop production, which has been unable to generate a respectable income for quite some time. This has ramifications for agriculture in the future, as non-farm activities are funded at the price of agricultural investment.

These findings are supported by an empirical exercise based on the three-stage least squares method. Farmers' desire to invest for residential purposes has been demonstrated to have a negative impact on private agricultural investment. Terms of trade, public investment in irrigation and infrastructure, and institutional lending all have a favourable impact. According to the findings, about 85% of agricultural investment is financed with borrowed funds, with institutional borrowing accounting for 63.4 percent of the total. Bank outreach should be

expanded, particularly in less developed countries and to small and marginal farmers who invest a smaller amount of money.

Furthermore, public irrigation investment has an incentive effect on private investment, but this is mostly dependent on the extent of the state government's spending, the magnitude of input subsidies, and demand-side factors.

From the mid-1980s to the early 2000s, weak public investment growth and few banking reforms hampered private investment and agricultural expansion. From 2003 to 2004, the situation improved as the government invested more in irrigation and provided loans, which helped farmers to some extent. The findings show that private and state investment, as well as a favourable incentive structure and infrastructure development, all contributed to increased agricultural output and faster expansion. Given the low revenue from farming, as well as demographic and market-driven shifts, it is critical to maintain all landholders' interest in agriculture, which can be accomplished by increasing financing and spending on irrigation and technology. It goes without saying that each state must play a proactive role.

Composition of FCE by rural HH (percentage share of each in total FCE)

	1981–82			1991–92			2002–03			2012–13		
States	RLB	FB	NFB	RLB	FB	NFB	RLB	FB	NFB	RLB	FB	NFB
Andhra Pradesh	47.59	40.61	11.58	58.65	37.14	4.21	52.26	19.02	28.72	64.22	20.22	15.5
Assam	61.33	25.23	13.26	77.29	11.67	10.73	75.68	17.74	6.76	68.66	22.20	9.14
Bihar	70.19	21.22	8.07	57.50	33.00	9.50	62.86	15.78	21.36	88.97	9.02	2.05
Gujarat	34.80	56.90	8.15	54.47	31.45	14.07	50.80	37.30	11.90	42.61	50.93	6.46
Haryana	38.99	53.45	7.54	83.40	15.54	1.05	36.70	27.40	35.90	85.58	11.94	2.47
Himachal Pradesh	74.74	23.25	1.79	68.86	15.63	15.50	81.50	8.30	10.30	74.81	21.39	3.80
Jammu and Kashmir	65.41	13.85	20.59	62.52	21.56	15.92	78.00	12.20	9.70	84.28	12.50	3.21
Karnataka	52.64	39.04	8.33	39.35	54.14	6.51	69.70	23.00	7.30	68.85	22.90	8.25
Kerala	79.62	11.94	8.34	71.16	9.18	19.66	81.60	6.60	11.80	79.38	9.32	11.30
Madhya Pradesh	40.49	49.39	10.12	38.64	58.12	3.23	44.90	34.90	20.20	44.01	51.88	4.11
Maharashtra	35.76	48.84	15.06	48.36	45.22	6.49	58.70	29.70	11.60	59.80	32.45	7.74
Odisha	67.05	19.22	13.29	76.94	15.54	7.27	53.50	13.50	33.00	76.38	16.11	7.51
Punjab	31.91	52.00	16.04	51.46	46.22	2.31	51.70	37.10	11.20	42.48	47.16	10.36
Rajasthan	58.26	34.80	6.84	50.32	45.85	3.83	52.10	40.50	7.50	61.40	27.02	11.58
Tamil Nadu	59.05	32.47	8.36	67.74	26.31	5.88	76.80	14.30	9.00	85.15	5.72	9.14
West Bengal	74.80	17.08	8.00	66.40	18.33	15.07	80.30	5.20	14.50	88.72	5.17	6.12
AP-Telangana										60.30	24.91	14.79
Bihar-Jharkhand							72.66	12.68	14.57	75.39	13.77	10.8
MP-Chhattisgarh							60.27	25.59	14.10	54.01	41.15	4.8
UP-Uttarakhand	54.15	34.49	11.22	64.43	27.35	8.14	63.65	30.91	5.38	59.84	30.36	9.84
India	54.34	35.30	10.46	59.46	32.81	7.81	64.10	21.80	14.10	67.94	23.32	8.74
CV	68.52	85.9	88.29	92.12	68.63	124.82	91.76	78.67	112.65	70.87	63.76	110.29

Source AIDIS

Note: *RLB* Residential land and buildings; *FB* farm business (agriculture); *NBF* non-farm business; *CV* is coefficient of variation. New states merged with their respective parent state in 2002 and 2012. Data for Telangana available only in 2012

State-wise FCE in FB (agriculture) by rural HH (Rs.) at 2004–05 price

	1981–82		1991–92		2002–03		2012–13	
State	FCEFB	FCEFB/GCE	FCEFB	FCEFB/GCE	FCEFB	FCEFB/GCE	FCEFB	FCEFB/GCE
Andhra Pradesh	687	20.30	533	21.55	484	16.12	1287	17.25
Assam	248	13.84	80	6.37	119	10.65	303	14.86
Bihar	186	9.82	142	15.68	73	6.53	172	6.00
Gujarat	1405	39.08	781	23.37	1220	29.56	3163	38.93
Haryana	2029	27.73	1429	10.93	2646	18.75	2593	10.75
Himachal Pradesh	496	12.29	783	11.72	1228	6.63	3412	19.01
Jammu & Kashmir	538	7.62	520	14.17	711	9.13	1475	9.69
Karnataka	1045	19.19	1902	38.67	586	17.43	2430	19.09
Kerala	686	8.00	658	7.73	703	5.09	2188	7.16
Madhya Pradesh	664	22.02	1589	40.10	353	18.73	3019	40.63
Maharashtra	1129	28.95	1367	31.51	1015	22.46	2674	26.00
Odisha	181	8.42	134	7.42	327	10.81	350	11.16
Punjab	3245	36.19	1940	29.14	2091	23.21	4720	37.49
Rajasthan	1134	23.42	1677	33.83	1605	23.25	3442	23.59
Tamil Nadu	634	20.63	791	20.51	620	11.89	626	5.21
Uttar Pradesh	769	18.86	703	17.05	831	19.63	2253	29.82
West Bengal	232	10.31	194	9.73	119	3.87	263	4.15
AP-Telangana							1150	14.66
Bihar-Jharkhand					76	6.53	300	8.59
MP-Chhattisgarh					272	12.49	1685	26.68
UP-Uttarakhand					1170	21.76	1451	23.19
All-India	753	20.17	815	22.24	669	15.56	1631	18.78
CV	85.9		70.7		85.4		69.4	

Source AIDIS

Note Deflated using GDCF given in NAS, CSO; The newly created states are merged with their parent states to make the estimates comparable. Telangana (AP); Chhattisgarh (MP); Uttarakhand (UP) and Jharkhand (Bihar)

Annual rate of growth in key activities (per rural HH at 2004–05 Prices): 1981–91, 1991–2002 and 2002–2012

States	RLB	FB	NFB	All	RLB	FB	NFB	All	RLB	FB	NFB	All
Andhra Pradesh	0.43	−2.52	−11.10	−1.64	4.26	−0.86	25.46	5.36	11.88	10.27	3.08	9.59
Assam	−1.33	−10.74	−5.61	−3.59	−0.39	3.67	−4.31	−0.20	6.35	9.83	10.69	7.39
Gujarat	4.63	−5.71	5.67	0.05	1.88	4.15	0.97	2.53	4.78	9.99	0.33	6.63
Haryana	15.60	−5.32	−12.00	7.13	−6.79	5.76	38.42	0.44	18.03	−0.20	−17.02	8.44
Himachal Pradesh	8.02	4.67	35.18	8.91	12.06	4.18	6.29	10.36	−0.11	10.76	−8.78	0.75
J&K	−5.09	−0.35	−7.08	−4.66	10.54	2.89	3.59	8.33	8.16	7.56	−3.92	7.33
Karnataka	−0.19	6.17	0.24	2.75	2.32	−10.15	−1.79	−2.86	15.17	15.29	16.67	15.32
Kerala	1.10	−0.42	11.39	2.24	4.96	0.61	−1.04	3.66	7.94	12.02	7.77	8.24
Maharashtra	5.86	1.93	−5.57	2.72	2.92	−2.67	6.60	1.12	9.40	10.17	4.88	9.20
Odisha	0.48	−2.98	−6.70	−0.90	6.32	8.48	26.08	9.89	2.47	0.66	−14.71	−1.11
Punjab	0.82	−5.01	−20.82	−3.89	2.77	0.68	18.61	2.72	3.84	8.48	5.03	5.90
Rajasthan	−0.31	3.99	−4.54	1.16	1.04	−0.40	7.03	0.73	14.25	7.93	17.43	12.38
Tamil Nadu	5.85	2.24	0.80	4.41	4.56	−2.20	7.42	3.38	10.84	0.10	9.92	9.70
West Bengal	−3.63	−1.78	3.90	−2.48	9.08	−4.38	6.82	7.21	9.46	8.29	−0.57	8.37
Bihar-Jharkhand	−8.68	−2.64	−5.31	−6.84	5.21	−5.58	7.08	3.00	14.23	14.77	10.50	13.81
MP-Chhattisgarh	6.86	9.12	−4.22	7.36	−4.46	−14.84	4.90	−8.24	13.21	20.03	2.85	14.46
UP-Uttaranchal	3.21	−0.90	−1.78	1.43	3.44	4.74	−0.26	3.56	1.76	2.18	8.71	2.39
India	2.45	0.80	−1.38	1.54	2.64	−1.77	7.58	1.94	9.22	9.31	3.50	8.58

Source NSS AIDIS

Supply Response Function in Indian Agriculture

For the years 1980–81 to 2013–14, the supply response in terms of area and yield across India. Various price and non-price factors were tested as crop area predictors. The real farm harvest price of the own crop was the most significant price component with a positive sign, while the competitor crop (real) price was significant with a negative sign. In some cases, the real price of fertiliser was more important than the price of competing crops. Rainfall was a key non-price influence, with a positive sign in almost all crops. However, different rainfall indicators were utilised in different crops depending on their sowing season coming in different months, such as annual, monsoon, post monsoon, or winter. Only wheat, rice, and rabi coarse cereals had positive and considerable irrigation. The kharif coarse cereals were rainfed crops, with irrigation coefficients that were largely minor, and in some cases even negative. The lagged dependent variable was the most significant, with a positive sign indicating that previous behaviour influenced farmers' future decisions. Our findings support recent research that suggests non-price factors, particularly irrigation, have a larger role in farmers' acreage decisions than price reasons. Price concerns were not the driving force for bringing in more land under cultivation, especially in the case of coarse grains. The area of these rainfed crops was mostly determined by weather factors such as rainfall.

Yield determinants resembled area determinants in appearance. In wheat and coarse grains, own actual price exhibited a significant coefficient with a positive sign, showing that profitability influences yield through input consumption and management. Rainfall was the most important component, with a positive sign suggesting that the climatic factor was present. Fertilizer consumption per hectare was highly important, with a positive sign suggesting the changing contours of Indian agriculture, implying that fertiliser price subsidies could assist farmers achieve higher yields. In terms of the pricing element, it was discovered that, in comparison to rice, higher wheat prices drove farmers to produce higher yields.Similar to wheat, it was discovered that a strategy that guaranteed farmers a better price and lower fertiliser prices would boost the production of coarse grains. In the case of kharif coarse cereals, non-price and technological factors such as rainfall and irrigation play a big role in yield. Even though rabi

coarse cereals can be cultivated under rainy conditions, bigger yields can be achieved with better irrigation and more rainfall. Although these crops may be produced with rain water, the favourable effect of irrigation on production demonstrates that irrigation has a positive effect on yield.

Area response for rice (for the periods from 1980–81 to 2013–14)

Model	Constant	Real domestic price	Real competing crop price	Rainfall	Irrigation	Price deflated by fertilizer/competing crop price	Yield ratio of competing crops	Lagged dependent	R^2	DW
1	−1.07 (−1.03)	0.10 (1.15)	−0.09 (−1.91)	0.26 (6.64)	0.11 (2.36)			0.74 (4.59)	0.80	2.59
2	1.21 (1.52)			0.26 (6.90)	0.12 (2.93)	0.09 (1.96)		0.73 (5.03)	0.81	2.60
3	0.02 (0.04)			0.24 (6.35)	0.17 (2.16)	−0.03 (−0.82)		0.57 (4.39)	0.79	2.48
4	−1.08 (−1.03)	0.10 (1.15)	−0.09 (−1.85)	0.27 (6.56)	0.13 (2.50)		0.03 (0.89)	0.69 (4.11)	0.80	2.59
5	−0.01 (−0.02)		−0.05 (−1.27)	0.24 (6.54)	0.15 (1.84)	−0.004 (−0.12)		0.62 (4.61)	0.79	2.58

Yield response for rice (for the periods from 1980–81 to 2013–14)

Model	C	Real domestic price	Rainfall	Irrigation	Fertilizer use	Lagged dependent	Trend	R^2	DW
1	4.32 (2.48)	−0.03 (−0.27)	0.26 (3.69)	0.30 (0.79)	0.24 (3.12)		0.004 (0.93)	0.95	1.69
2	2.82 (1.47)	−0.02 (−0.15)	0.29 (3.60)	0.88 (2.26)			0.01 (1.62)	0.94	1.21
3	2.02 (1.31)	0.01 (0.10)	0.27 (3.88)	0.40 (1.36)	0.21 (2.43)	0.22 (1.69)		0.95	2.29
4	4.12 (2.32)	0.01 (0.07)		0.36 (1.00)	0.27 (2.65)	0.09 (0.59)		0.93	2.04
5	−0.63 (−0.5)	0.05 (0.36)	0.30 (4.09)	0.95 (4.55)		0.35 (2.71)		0.94	2.13
6	4.12 (2.32)	0.01 (0.07)		0.36 (1.00)	0.27 (2.65)	0.09 (0.59)		0.93	2.04

Note Figures in the parentheses indicate *t* values of the estimated coefficients

Area response for wheat (periods from 1980–81 to 2013–14)

Model	Constant	Real competing crop price	Real domestic price	Price deflated by competing crop price	Irrigation	Real fertilizer price (−1)	Rainfall	Period dummy	Lagged dependent	Dummy_NFSM	R^2	DW
1	−0.40 (−1.20)			0.15 (3.97)	0.36 (3.16)		0.14 (3.17)		0.48 (3.96)		0.92	2.07
2	−1.05 (−2.34)	−0.12 (−2.42)	0.17 (3.43)		0.36 (3.12)		0.14 (3.21)		0.47 (3.75)		0.92	2.05
3	−.37 (−1.04)			0.14 (3.31)	0.37 (3.1 2)		0.13 (3.10)		0.46 (3.47)	0.006 (0.34)	0.9 2	2.0 7
4	−2.57 (−2.30)		0.18 (3.08)		0.49 (2.29)	0.06 (0.95)	0.14 (2.91)	0.04 (1.84)	0.52 (3.98)		0.91	2.09

Note Figures in the parentheses indicate *t* values of the estimated coefficients

Yield response for wheat (periods from 1980–81 to 2013–14)

Model	Constant	Real domestic price	Rain-fall	Price deflated by fertilizer price/comp crop price	Fertilizer use	Irrigation	Real fertilizer Price	Lagged dependent	R^2	DW
1	−1.86 (−1.57)	0.14 (2.02)	0.14 (2.22)		0.01 (0.12)	1.47 (3.23)		0.20 (1.18)	0.96	2.11
2	0.62 (0.60)	0.12 (1.51)	0.18 (2.55)		0.13 (1.90)			0.64 (5.20)	0.95	2.62
3	−2.00 (−3.94)	0.14 (2.33)	0.14 (2.29)			1.50 (3.97)		0.21 (1.21)	0.96	2.12
4	−2.74 (−1.86)	0.15 (2.361)	0.14 (2.29)			1.70 (3.21)	0.04 (0.54)	0.16 (0.88)	0.96	2.11
5	−1.30 (−2.60)		0.13 (2.06)	0.17 (1.53)		1.54 (3.88)		0.21 (1.16)	0.96	2.11
6	−0.58 (−0.77)		0.12 (2.00)	0.07 (1.60)		1.24 (2.64)		0.26 (1.42)	0.96	2.15

Note Figures in the parentheses indicate *t* values of the estimated coefficients

Area response for kharif coarse cereals (for the periods from 1980–81 to 2013–14)

Model	Constant	Rainfall	Real domestic Price (−1)	Price deflated by fertilizer/competing crop price	Real competing crop price	Irrigation	Real fertilizer price	Trend	Lagged dependent	R^2	DW
1	−1.90 (−2.28)	0.30 (4.26)	0.36 (4.10)	−0.32 (−3.36)		−0.13 (−3.03)			0.75 (13.8)	0.95	2.06
2	−1.69 (−2.00)	0.28 (3.15)		0.26 (2.15)		−0.16 (−3.31)			0.74 (10.1)	0.92	2.46
3	0.31 (0.40)	0.24 (2.68)		−0.07 (−0.10)		−0.09 (−1.53)			0.76 (8.57)	0.91	2.29
4	−2.62 (−3.21)	0.30 (4.26)	0.36 (4.10)		−0.32 (−3.36)	−0.13 (−3.03)			0.75 (13.8)	0.95	2.06
5	−2.58 (−2.42)	0.26 (3.14)	0.28 (2.46)			−0.17 (−3.21)	−0.008 (−0.10)		0.81 (8.57)	0.92	2.10

Note Figures in the parentheses indicate *t* values of the estimated coefficients

Yield response for kharif coarse cereals (for the periods from 1980–81 to 2013–14)

Model	C	Rainfall	Real domestic price (−1)	Irrigation	Time trend	Fertilizer use	Real fertilizer price	Lagged dependent	R^2	DW
1	−3.98 (−1.66)	0.43 (2.38)	0.63 (2.85)	−0.21 (−1.68)		0.45 (3.92)		0.30 (1.72)	0.83	2.09
2	−6.38 (−2.24)	0.63 (2.91)	0.52 (1.95)	0.03 (0.20)				0.84 (6.61)	0.75	2.26
3	−4.39 (−1.73)	0.58 (3.08)	0.75 (3.10)	−0.11 (−0.90)			−0.49 (−3.24)	0.53 (3.66)	0.81	2.32
4	0.13 (0.08)	0.66 (4.80)	0.45 (2.84)	−0.11 (−1.17)	0.03 (5.66)	−0.08 (−0.63)			0.92	2.58

Note Figures in the parentheses indicate *t* values of the estimated coefficients

Area response for rabi coarse cereals (for the periods from 1980–81 to 2013–14)

Model	Constant	Real domestic Price(−1)	Real competing crop price(−1)	Price deflated by fertilizer price(−1)	Fertilizer use	Irrigation	Trend	Rainfall (Oct–Dec)	Irrigation (wheat)	R^2	DW
1	3.32 (3.24)	0.17 (1.58)	−0.31 (−1.82)			−0.28 (−1.22)	−0.006 (−1.58)	0.04 (1.25)		0.78	1.74
2	2.27 (4.10)	0.17 (1.55)	−0.33 (−1.94)				−0.01 (−7.71)	0.06 (1.91)		0.78	1.73
3	2.38 (4.14)	0.17 (1.56)	−0.30 (−1.72)		−0.07 (−0.78)	0.06 (1.96)	−0.007 (−1.93)			0.77	1.77
4	3.36 (3.25)	0.17 (1.58)	−0.28 (−1.63)		−0.06 (−0.68)	−0.27 (−1.14)	−0.003 (−0.74)	0.05 (1.32)		0.77	1.76
5	3.32 (3.24)	0.17 (1.58)	−0.31 (−1.82)			−0.28 (−1.22)	−0.006 (1.58)	0.04 (1.25)		0.78	1.74
6	3.43 (3.23)		−0.09 (−0.73)	−0.03 (−0.52)		−0.26 (−1.07)	−0.003 (−0.91)	0.03 (0.86)		0.76	1.69

Note Figures in the parentheses indicate *t* values of the estimated coefficients

Analysis of Rice Productivity and Sources of Growth in India

Now we would be looking at how rice production has changed over time and how it has grown. TFP growth was decomposed into technical change and technical efficiency change using the distance function-based Malmquist productivity index. Paddy accounts for around 40% of total food grain output, and its performance has a strong influence on the entire trend in food grain production. Paddy output expanded dramatically from 40 million tonnes in 1968/9 to 104 million tonnes in 2012/3, thanks to the introduction of high-yielding variety technology. Between these times, paddy yield nearly doubled, from 1.1 to 2.5 tonnes/ha, with more or less stable area, and appeared to have significantly contributed to an increase in production. Paddy production increased by 4.32 percent each year between 1980/1 and 1989/0, with yields increasing by 3.35 percent per year. During the 1990s, however, a decrease in yield growth led to a decrease in production. Although rice yields increased from 2000 to 2012, area growth was negative, resulting in a decrease in production. The state-level performance of paddy revealed a diverse pattern of growth.

Rice yield of more than 2.5 tonnes/ha was recorded in all of Punjab's districts, as well as most rice-growing districts of Tamil Nadu and Haryana. In Madhya Pradesh, Bihar, Orissa, and Assam, however, inter-district variation in rice productivity was found to be larger. These low-productivity regions are located in the rainfed rice ecosystem and lack the necessary production technologies. Through the adoption of suitable modern varieties and institutional mechanisms for the supply of inputs and provision of marketing facilities, there is a significant deal of potential to boost rice production.

High-yielding varieties (HYVs) were adopted in a variety of ways across the states, with 100% coverage in Andhra Pradesh and Punjab. In Madhya Pradesh, Haryana, and Bihar, fewer than half of the land was planted with contemporary types. One of the reasons for these states' low rice yield was their lack of adoption of contemporary cultivars. Furthermore, the yield difference

was found to be lowest in West Bengal at 4% and greatest in Assam at 41%. It means that bridging the yield gap through effective extension services for technology transfer and public investment in irrigation infrastructure has a lot of potential to boost paddy production.

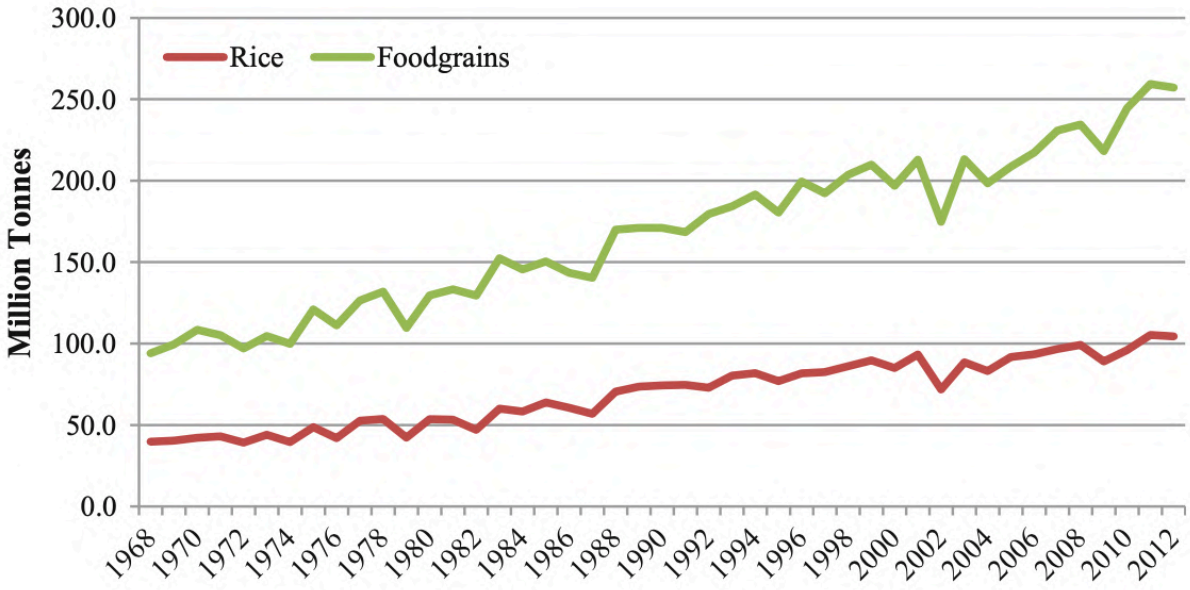
Between 1990/1–1999/0 and 2000/1–2012/13, the weighted average income from paddy agriculture grew across India, from Rs. 10,571 to Rs. 11,520 per hectare. Although the average paid-out cost increased over time, the value of production increased more than proportionately, resulting in an increase in agricultural company income. Except for animal labour and irrigation, the use of most other inputs such as seed, fertilisers, pesticides, and machine labour has increased over time, according to an analysis of input cost growth.

Between 1991/2 and 2012/3, the average TFP increase for rice in India was predicted to be 3.28 percent. Technical change accounted for the majority of the increase in TFP. Although there was little improvement in technical efficiency change, there was a negative trend in pure technical efficiency change. Except for Assam, all other states had positive TFP growth between 1991/2 and 2012/3. The frontier shift effect in Assam has gotten worse. Punjab had the greatest rate of TFP growth, at 5.71 percent, followed by Andhra Pradesh, at 5.19 percent. Other states, with the exception of Andhra Pradesh, did not exhibit any technical efficiency gains, implying that more paddy is produced per hectare by utilising more inputs. Overall, technical change was found to be the rimary driver of TFP growth in paddy, with little improvements in technical efficiency.

Average annual growth in area, production and yield of rice by major states (%)

States	1990–91 to 1999–00			2000–01 to 2012–13		
	Area	Production	Yield	Area	Production	Yield
Andhra Pradesh	0.48	2.35	1.38	0.71	2.64	1.68
Assam	0.73	2.04	1.23	−0.38	2.73	2.92
Bihar	−0.71	11.59	12.10	−2.57	8.21	8.79
Haryana	5.82	4.64	−0.58	1.07	3.60	2.77
Karnataka	2.47	5.11	2.54	−0.46	2.26	1.74
Madhya Pradesh	0.51	2.16	1.70	0.47	7.28	6.71
Orissa	0.51	2.02	1.27	−0.99	8.35	8.63
Punjab	2.93	3.47	0.56	0.71	2.16	1.44
Tamil Nadu	2.02	4.17	1.90	−1.82	−0.61	−0.12
Uttar Pradesh	0.92	3.15	2.23	0.09	2.21	1.50
West Bengal	0.65	3.25	2.65	−0.71	1.00	1.67

Source Government of India (2014)



Trend in production of rice and foodgrains in India. *Source* Government of India (2014)

Average annual growth in area, production and yield of rice in India (%)

Period	Area	Production	Yield
1980–81 to 1989–90	0.65	4.32	3.35
1990–91 to 1999–00	0.70	2.09	1.36
2000–01 to 2012–13	−0.40	1.80	1.99

Source Government of India (2014)

Classification of rice-growing districts based on productivity groups: 2002–03 to 2006–07

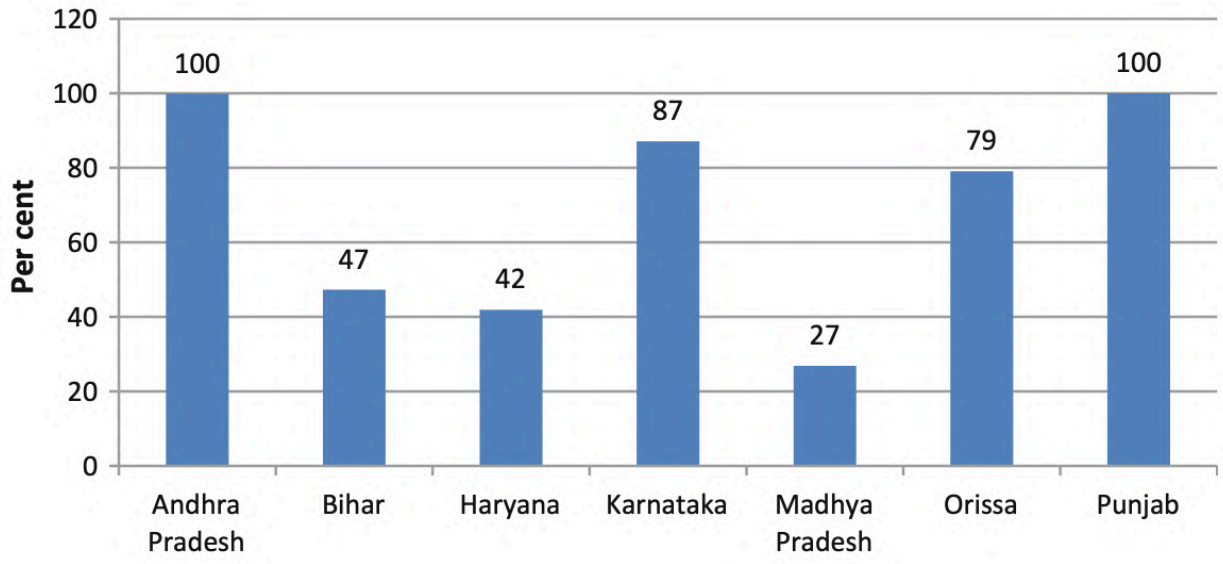
States	High productivity (>2.5 ton/ha)			Medium productivity (1.5–2.5 ton/ha)			Low productivity (< 1.5 ton/ha)		
	No. of districts	Area share (%)	Production share (%)	No. of districts	Area share (%)	Production share (%)	No. of districts	Area share (%)	Production share (%)
Andhra Pradesh	14	78.10	83.26	8	21.90	16.74	–	–	–
Assam	–	–	–	12	44.63	53.41	14	55.37	46.59
Bihar	1	5.48	10.98	9	20.38	29.67	28	74.14	59.35
Haryana	12	77.70	82.80	7	22.30	17.10	–	–	–
Karnataka	11	36.97	47.99	12	51.76	46.81	4	11.26	5.20
Madhya Pradesh	–	–	–	4	1.31	3.15	40	98.68	96.85
Orissa	–	–	–	8	25.85	31.70	22	74.15	68.30
Punjab	19	100.00	100.00	–	–	–	–	–	–
Tamil Nadu	25	71.55	80.34	4	28.45	19.66	–	–	–
Uttar Pradesh	5	4.78	6.24	56	90.46	90.86	9	4.76	2.90
West Bengal	8	49.38	55.40	10	50.62	44.60	–	–	–

Source Computed from Government of India (2009)

Sources of output growth by major states (%)

States	1990s			2000s		
	Area effect	Yield effect	Interaction effect	Area effect	Yield effect	Interaction effect
Andhra Pradesh	19.13	79.13	1.74	56.12	38.30	5.57
Assam	2.82	96.98	0.20	−6.90	108.71	−1.81
Bihar	2.95	93.84	3.20	−114.17	244.48	−30.31
Haryana	141.11	−26.76	−14.35	56.43	35.24	8.34
Karnataka	45.49	48.43	6.07	19.55	77.06	3.38
Madhya Pradesh	−312.10	390.54	21.56	−1.27	102.34	−1.07
Orissa	−38.36	136.82	1.54	−21.69	131.16	−9.47
Punjab	94.96	4.19	0.84	51.69	43.38	4.93
Tamil Nadu	53.79	38.00	8.21	62.67	52.00	−14.67
Uttar Pradesh	26.90	68.44	4.66	8.50	90.07	1.43
West Bengal	22.14	74.70	3.16	−568.93	733.37	−64.44
India	30.21	66.49	3.30	−5.13	106.36	−1.23

Source Computed from Government of India (2014)



Area under HYV (%). *Source* Government of India (2014)

Changes in Production Structure and Class Composition in Agriculture

This study tried to investigate changes in agricultural production structure and class composition within the theoretical context of agrarian issues raised by Marxian analysis. Using Punjab as a case study, the analysis shows that the state's agricultural sector has seen significant changes in production structure as a result of favourable policies and investments in irrigation and other infrastructure, primarily to ensure the success of the Green Revolution approach. Without a doubt, these adjustments, which were imposed by the national food security policy, have resulted in increased production and productivity for more than two decades. At the same time, the state has experienced a crisis as monoculture (wheat–paddy rotation) has replaced traditional crops…

In most parts of the state, agriculture revenue and productivity have already plateaued. Cultivators who could not afford the greater cost of modern inputs have been uprooted by capital-driven agriculture. As the manufacturing system has changed, so have the production interactions. The state's rural economy is dominated by a large landlord class engaged in both agricultural and non-agricultural enterprises. The problem has worsened since 1991, when neoliberal reforms strengthened the power of the big landowning class and the new Green Revolution-generated rich capitalist farmer class (both of whom share the same class interests and thus act as a unified group) by allowing them to diversify their occupations in order to maintain/increase profits. The capital gained by large landowners as a result of the adoption of capitalist farming methods has been re-invested not only in agriculture but also in other occupations. Investment diversification has been critical in sustaining their economic, social, and political supremacy in the rural hierarchy. It's important to remember that, notwithstanding changes in the state's production structure and relations, land ownership and capital play a crucial role in determining production relations. In this respect, the agricultural question remains relevant in rural Punjab in order to comprehend changes in production method and class

composition. Farmers and agricultural labour organisations may require a more detailed grasp and analysis of the issue in order to advocate for their interests and rights in this environment.

Land utilisation pattern in Punjab (area in 000' ha)

Items	1960–61	1970–71	1980–81	1990–91	2000–01	2012–13
Total geographical area	5036	5036	5036	5036	5036	5036
Area under forests	35	123	216	222	280	262
Uncultivable barren land	–	208	96	83	28	51
Land put for non-agricultural use	–	416	436	343	410	486
Uncultivable land excluding fallow land	255	92	49	57	–	06
Fallow land	313	139	45	110	43	45
Net sown area	3757	4053	4191	4218	4250	4150
Cropped area	4732	5678	6763	7502	7941	7870
Cropping intensity	126	140	161	178	186	190

Source Statistical Abstract of Punjab, various issues

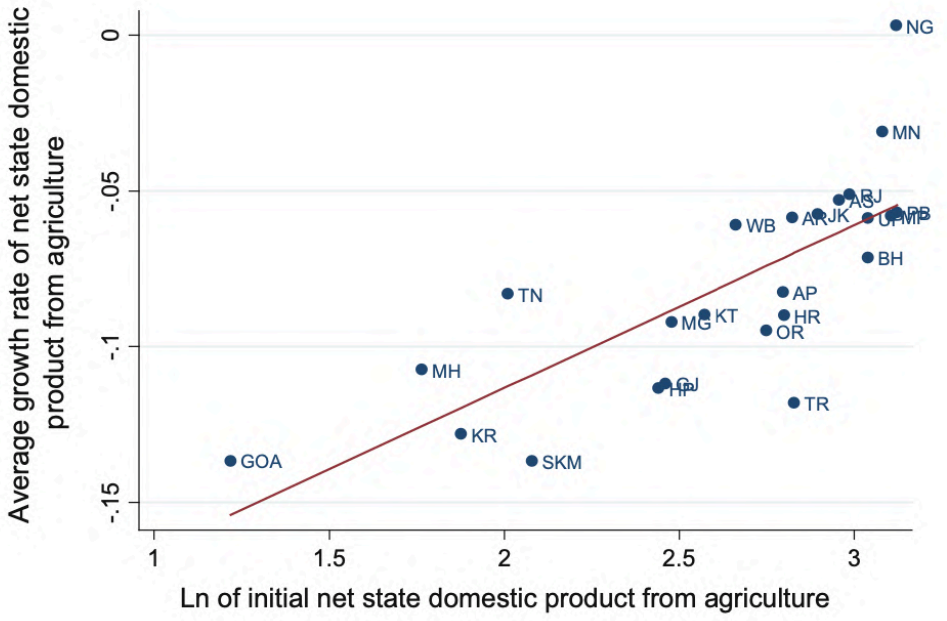
Distribution of operational area among size groups

Years	Marginal and small farms	Medium farms	Large farms	Extra-large farms	Total
1970–71	600,385 (15.03)	7,951,07.9 (20.01)	1,514,223.3 (38.10)	1,067,373.1 (26.86)	3,974,091.1 (100)
1980–81	399,130 (9.52)	790,855 (18.87)	1,565,674 (37.36)	1,434,717 (34.24)	4,190,376 (100)
1990–91	492,000 (12.20)	841,000 (20.86)	1,622,000 (40.23)	1,077,000 (26.71)	4,032,000 (100.00)
2000–01	319,514 (7.94)	876,441 (21.85)	1,730,713 (43.17)	1,095,590 (27.03)	4,022,258 (100)
2010–11	370,088 (9.33)	855,112 (21.56)	1,712,859 (43.18)	1,028,575 (25.93)	3,966,634 (100)

Note Figures in parentheses represent percentages of operational area
Source Agriculture census, Government of India

Disparities in Agriculture Income Across the Indian States

The study using multiple convergence and divergence methodologies, tried to analyse regional inequalities in farm income from 1980 to 2011. The NSDPA has been diverging among Indian states over time, according to the results based on estimated cross-sectional unconditional b-convergence. Richer states' agricultural expansion has outpaced that of poorer states, resulting in growing disparities in farm revenue between states. Conditional b-convergence data reveals that states have diverse steady state levels and tend to converge towards their own steady states. In different time periods, the pace of divergence is observed to be minimal. Physical capital has a positive impact on agricultural output growth, meaning that a more concerted effort on infrastructure development is needed to bridge the income gap across states. Implementing farm policies and expanding agricultural investment could help the lagging states catch up to the wealthier states in the north and south, helping them to catch up to the wealthier states in the north and south.



Average growth rate of NSDPA (1980–2011) against the ln of initial NSDPA (1980)

Income Mobility and Poverty Dynamics Across Social Groups in Rural India, 1993–2005

During the period 1993/94–2004/05, India pursued a pro-market development approach because of income mobility and poverty dynamics across socioeconomic groups in rural India. The data set used yield poverty estimates that are relatively comparable to poverty estimates derived from traditional sources, while there are often significant discrepancies between states. The advantage of using this data set is that a substantial number of families are identical in both rounds, allowing individual household trajectories to be tracked.

We find evidence of significant income increase that is not significantly different across socioeconomic categories, as well as significant relative income mobility. The poorest groups—Muslims, Dalits, and Adivasis—have seen the most rapid reduction in poverty. These categories are disproportionately found among individuals who exit poverty and among the chronically poor, according to analysis of the poverty dynamics that underpin these transitions. The advantage of being able to use panel data for poverty study is that aggregate poverty changes based on repeated cross sections cannot convey such complexity.

Poverty dynamics and real income changes (%) by social group (1993/94–2004/05)

	Adivasis	Dalits	High-caste Hindus	Muslims	Other religions	Total
Still poor	16.7	19.7	14.7	2.7	−9.9	14.4
New poor	−61.6	−54.4	−65.6	−68.2	−78.7	−63.7
No longer poor	221.3	261.6	380.0	265.6	305.5	313.0
N	795	2,175	5,341	758	76	9,145

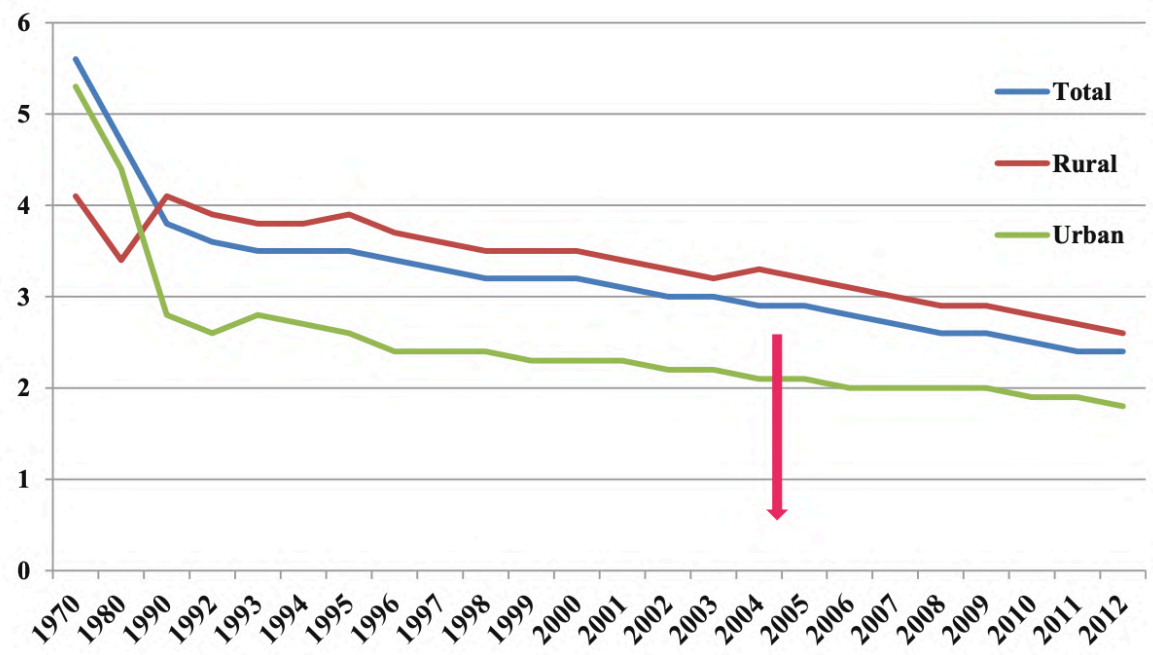
Shortages in Agriculture Labour Market and Changes in Cropping Pattern

Changes in the rural labour market are caused by a variety of variables, the most important of which is migration. Rural outmigration has an impact on labour demand and supply, as well as pay rates in the places of origin. This chapter tried to assess growing trends in the rural labour market in Uttar Pradesh's Bundelkhand region, as well as the variables that contribute to labour shortages and their impact on cropping patterns. The research is based on a primary farmer survey as well as secondary data sources.

The investigation demonstrates that labour availability, accessibility, and affordability have an impact on the region. In most Indian states, the ratio of farm workers to non-agriculture workers is decreasing, as is the ratio of agriculture labourers to cultivators. Migration to urban and non-farm activities, the MNREGA, the low wage rate in farming, education and awareness that farm employment is less remunerative and has a low status are some of the factors that have dissuaded workers from choosing non-farm work. The resulting labour shortages for agricultural operations in the region appear to be negatively influencing cropping patterns and land production. Low labor-intensive crops and mono-cropping are two main changes that have emerged in rural regions as a result of a large disparity in agriculture labour supply and demand (low supply and high demand during cropping season). The majority of farmers have stopped growing vegetables and reduced the number of dairy animals. Farming appears to be a relic of the past, carried out by individuals who are unable to work in other fields. The region's principal food farmers are illiterate, elderly males and females, destitute, and unskilled. Cropping intensity was found to be higher in families with enough family labour.

Agriculture's labour shortages could be addressed through mechanisation, but this has a number of drawbacks..High startup expenses, seasonal usage, upkeep costs, and a tiny land holding are all factors to consider. For harvesting, farmers have embraced labor-saving technologies such as reapers, harvesters, and combines. However, these technologies are more expensive. Cooperative

farming and the implementation of the MGNREGA in agriculture with subsidised salary rates are two other possible solutions to the labour crisis in the agriculture industry.



Total fertility

Top 10 states of India by total out-migrants and residence from 2007 to 2008

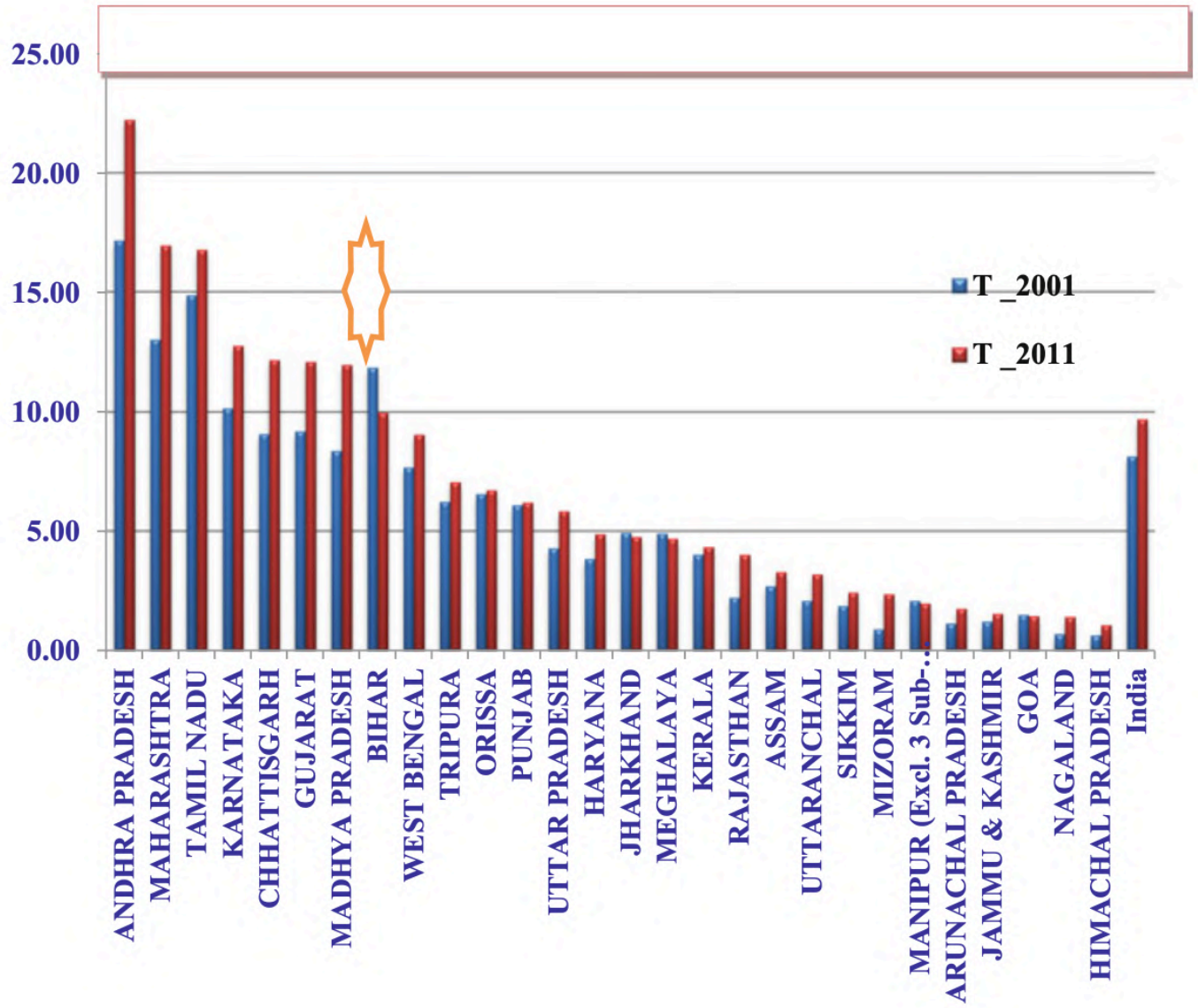
Rank	State	Rural		Urban		Total	
		%	Number	%	Number	%	Number
1	Uttar Pradesh	15.0	821,986	10.5	222,877	13.7	1,044,863
2	Madhya Pradesh	13.4	735,666	6.2	131,090	11.4	866,756
3	Maharashtra	7.6	417,016	17.1	364,226	10.3	781,242
4	Andhra Pradesh	8.4	462,937	14.9	316,770	10.2	779,707
5	Bihar	9.8	535,537	1.9	40,368	7.6	575,905
6	Tamil Nadu	3.9	213,180	15.7	333,255	7.2	546,435
7	West Bengal	8.3	452,879	1.7	37,164	6.4	490,043
8	Gujarat	6.6	362,740	5.5	117,033	6.3	479,773
9	Kerala	4.6	252,734	6.0	126,909	5.0	379,643
10	Karnataka	3.3	182,259	6.6	140,374	4.2	322,633

Source NSSO (2010)

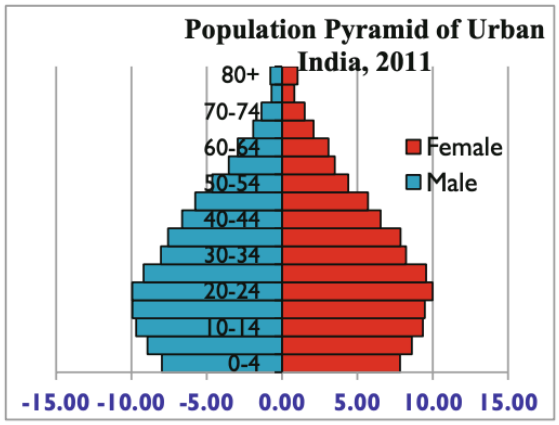
Odds ratio for labour availability in the village

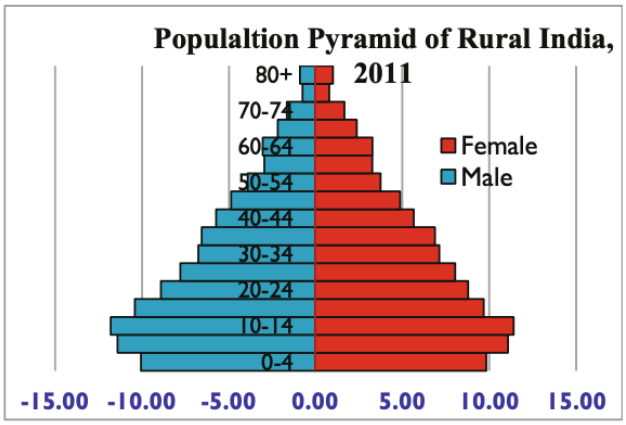
Item		Exp(*B*)	Sig.
1	*Distance of the village from main city*		
	Nearest (<10 km)®	–	0
	Nearer (10–15 km)	1.417	0.348
	Distant (>15 km)	0.365	0.006
2	*Caste*		
	Schedule caste®	–	0.09
	Other backward castes	0.884	0.663
	General	0.901	0.786
3	*Type farmers*		
	Marginal and small farmer®	–	0.053
	Medium farmer	0.878	0.66
	Large farmer	2.058	0.066
4	*Type of family*		
	Single®	–	–
	Joint	3.483	0
5	*Source of irrigation*		
	Own		
	Hired	1.744	0.062
6	*Household*		
	NMHs	–	–
	MHs	1.754	0.021
	Constant	0.39	0.029

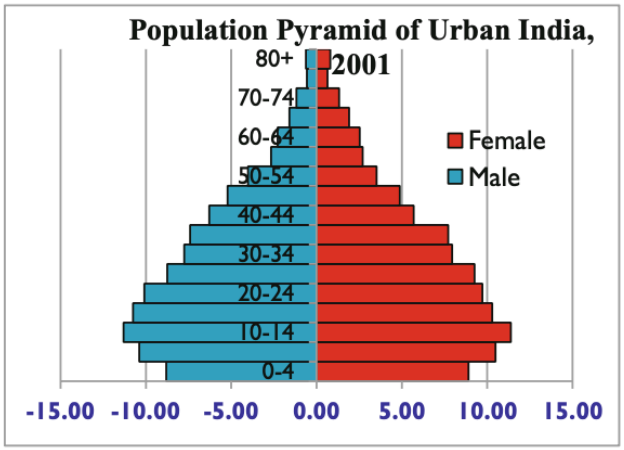
Source Primary Survey (2011)

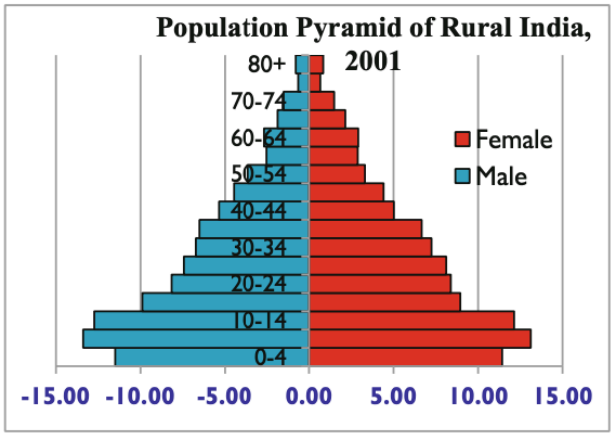


Main agriculture work participation rate (%) 2001 and 2011 (*T*-total). *Source* Registrar General, India (2001a, 2011)









Age–sex population pyramid by residence in 2001 and 2011

CONCLUSION

Study 1 sets the tone by empirically examining the relationship between public agriculture and irrigation investment and agricultural growth in India. To determine the impact on agricultural growth, the author creates a time series of revenue and capital expenditures incurred by the government on agriculture and irrigation for seventeen major states between 1981–82 and 2013–14. During the 1990s, low and insufficient public capital formation harmed farmers' investments and jeopardised technological change and agricultural growth, according to the analysis. From the early 2000s, there has been a significant shift in resource allocation towards agriculture and irrigation. A significant increase in irrigation system spending in developing countries has helped to slow productivity growth and stimulate private investment. However, capital intensity has not increased significantly, which could explain why many states are experiencing a slow rate of growth. Except for Himachal Pradesh and Jammu and Kashmir, the data suggests that there are significant inter-state differences in public spending, implying that developed states spend more on agriculture than less developed agriculturally dependent states. Despite inter-state differences, empirical analysis using OLS and GMM models shows that they have a significant impact on agriculture income. Other factors that have influenced income include private agricultural investment, non-agricultural income, land, and rainfall. The findings highlight the urgent need to give the agricultural sector due priority in fiscal policy. It recommends increased budgetary outlays and capital deepening for poorer states in order to boost agricultural productivity and income.

Study 2 used the decennial National Sample Survey Debt and Investment Survey from 1981 to 2012 to examine farmer investment behaviour. It starts with a look at spatial trends and variations in the composition of fixed capital expenditure, then moves on to the factors that influence agricultural investment and its impact on income. According to the analysis, per household investment increased dramatically from Rs. 2133 in 1981–82 to Rs. 6993 in 2012–13 at 2004–05 prices. Residential land and buildings account for 68 percent of this, with farm business accounting for 23.3 percent and non-farm business accounting for 8.7%.Residential land and building capital expenditure grew at a much faster rate (4.7 percent) than farm and non-farm business capital expenditure (2.52 and 3.31 percent, respectively) during this time period.

Growing urbanisation, industrial expansion, and low agricultural income may have made land investment more profitable than farming. The authors emphasise that farmers' shifting investment priorities have consequences for agricultural growth because they are made at the expense of farm assets. Although there was a slight increase in agricultural investment in the 2000s, irrigation structures, transportation, and machinery continue to dominate the sector's composition. Investment disparities between states and farms are still significant. Furthermore, nearly 86 percent of investment is made with loans, with institutional borrowing accounting for 63.4 percent of total borrowing, and thus should be increased. Farmers' changing preferences are found to be negatively affecting agricultural investment, while institutional borrowings and public investment are positively affecting it, according to the empirical analysis based on three-stage least squares. Agriculture income is impacted positively and significantly by private and public investments, as well as a favourable incentive structure and infrastructure development. In light of rapid changes in their investment priorities, the study emphasises maintaining farmers' interest in farming. The authors believe that the role of the state government in increasing resource allocation and institutional credit to agriculture is critical at this time.

The importance of incentives in influencing farmers' acreage allocation decisions is examined in Study 3. For key crops grown in the country, the supply response of farmers is examined in terms of area and yield. The study found that among the price factors, the real farm harvest price of the own crop is the most significant with a positive sign, while the competing crop (real) price is the most significant with a negative sign. Rainfall is a significant factor in almost all crops when it comes to non-price factors. Only wheat, rice, and rabi coarse cereals show a positive and significant effect of irrigation. The kharif coarse cereals are a good example of rainfed crops because the irrigation coefficient is so low. The kharif coarse cereals are rainfed crops, with an irrigation coefficient that is negligible, if not negative. The lagged dependent variable is positive and significant, indicating that past behaviour has an impact on farmers' future decisions. The findings support recent research that shows non-price factors, particularly irrigation, play a larger role in farmers' acreage decisions than price factors. Yield determinants are similar to area determinants in that they affect yield. In wheat and coarse grains, own real price has a significant coefficient with a positive sign, implying that profitability influences yield through input usage and management. Fertiliser use per hectare is highly significant and has a positive sign,

indicating that the contours of Indian agriculture are changing, and that fertiliser price subsidies may help farmers achieve higher yields. The positive effect of irrigation on yield highlights the need to increase major and medium irrigation, including check dams, to boost agricultural productivity.

Based on cost of cultivation surveys for ten major rice producing states for the periods 1990–91 to 2012–13, Study 4 estimates the sources of productivity growth in rice across the selected states. All states, with the exception of Tamil Nadu, have experienced positive and relatively high yield growth in recent years. In states such as Madhya Pradesh, Bihar, and Odisha, however, there is a greater level of inter-district variation in rice productivity. Although the average paid-out cost has risen over time, the value of output has increased more than proportionally, resulting in an increase in paddy cultivation farm business income. All other states, with the exception of Assam, have experienced positive growth. With the exception of Assam, all other states' total factor productivity (TFP) increased at a positive rate from 1991 to 2012. Other states, with the exception of Andhra Pradesh, show no improvement in technical efficiency gains. These findings suggest that adopting suitable modern varieties, better management practises, and institutional mechanisms for input supply can significantly improve rice production.

Study 5 elucidates the true causes of changes in production structure and relations, which are largely due to the expansion of capitalism in the agricultural sector. Using Punjab as an example, the authors demonstrate the importance of the agrarian question by pointing out that no comprehensive study of the impact of national and international policies on rural production structure and class composition exists. Several attempts have been made to understand the causes of agricultural production and productivity growth and stagnation over time, but the true causes have remained a mystery. The authors claim that the development of production forces and changes in the production structure necessitate the use of a Marxian framework, which is largely absent from the literature. Understanding changes in production relations and class composition necessitates a thorough understanding of social-political relations at the village level, as well as changes over time. Until now, land ownership, which is dominated by large landowners, has played a key role in determining production relations. For the sake of the larger interests and rights of farmers and agricultural labourers, it is critical to address the emerging situation.

Study 6 states that from 1980–81 to 2011–12 the convergence hypothesis in agricultural income across major Indian states. The analysis, which employs the Barro and Sala-i-Martin and Sala-i-Martin approaches, reveals significant interstate differences in agriculture's net state domestic product. Only seven of the 24 states investigated show a tendency toward convergence, while the remaining states show significant divergence. The agricultural sector in the northern states, namely Punjab, Haryana, and western Uttar Pradesh, has grown rapidly, possibly as a result of initiatives taken by the central and state governments, such as the adoption of high-yielding varieties, land consolidation, and assured irrigation, procurement, and price support measures for foodgrains. These and other factors may be to blame for the widening regional income disparities. The authors argue that agricultural policies should be redesigned in order to achieve regional development balances.

All seven chapters cover various aspects of agriculture over the last three decades and highlight those that have the potential to contribute to increased agricultural growth and farmer welfare. Almost all of the papers advocate for an integrated approach based on a market-oriented agricultural economy with strong government support to develop canal irrigation, R&D and extension, infrastructure, technology, credit, and institutions. Increased public investment in agriculture and irrigation, as well as incentives, would 'crowd in' private investment (by farmers) and help to achieve higher productivity and regional convergence in farm income. It's important to know how far agricultural growth and land productivity, combined with government job creation programmes, have enabled occupational transformation and 'pulled' people out of agriculture in order to reduce poverty faster. On the other hand, the 'push' factors may force diversification into non-farm employment, but this may not be enough to get people out of the crisis. The remaining five chapters delve deeper into this critical question, based on research conducted in various states.

Study 7 looks at income growth and poverty in rural Indian households from 1994 to 2005, using data from the National Council for Applied Economic Research in New Delhi's Human Development Survey from 1993–94 and the first India Human Development Survey (IHDS-I) from 2004–05. They concentrate their research on the benefits of growth to various social groups in India's rural sector, examining how rural households benefited from the expansion of the

agricultural and allied sectors in the 1990s and early 2000s. They report significant income growth among rural households while examining income mobility and poverty dynamics across social groups. In spite of significant relative income mobility, income growth does not differ significantly across social groups. They claim that the poorest people—Muslims, Dalits, and Adivasis—have seen the greatest reduction in poverty. These groups are disproportionately present among those who exit poverty and among the chronically poor, according to an analysis of the poverty dynamics that underpin these changes.

Study 8 examines changes in Uttar Pradesh's selected districts in the agriculture labour market and their impact on cropping patterns. The author emphasises that the agriculture labour market is influenced by a variety of factors including socioeconomic, environmental, and agricultural marketing infrastructure. All of these variables are not mutually exclusive and do not exist in a static state. The study is based on primary data collected in 2011 from 180 households in six villages in two districts of Uttar Pradesh's Bundelkhand region, including migrant and non-migrant households. Labour shortages in agriculture have been experienced by all types of farmers, regardless of caste or land holding, but they have been particularly problematic for large farmers and high-caste households, according to the findings. Harvesting is the most serious and depressing field operation, with a severe labour shortage forcing farmers to abandon farming or lease their land holdings to other farmers with sufficient family labour and machinery. It shows that households with leased-in land are more likely to have a large family, receive remittances, have insufficient landholding for farming, and have farm machinery. The main causes of labour shortage in agriculture were out-migration, MGRNEGA, disinterest in agricultural work, and wage disparities. Farmers have suggested that incorporating MGNREGA into agriculture, as well as introducing and implementing cooperative farming, are the most effective ways to address the labour shortage.