The Dynamics of Service Delivery and Agricultural Development in India
– A District Level Analysis –

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1. Introduction

Effective public rural service delivery is one condition for creating conditions for inclusive rural economic and social development, especially in environments characterized by rising population pressures, resource scarcity, climate change, and production uncertainty (World Bank 2006a, 2006b, 2007). In India, service delivery is generally perceived to be suboptimal in terms of availability, quality, and outreach. At the core of the problem are systemic failures such as (1) expanding salary expenditures which reduce operational spending, (2) short tenures and premature transfers of public service providers which cause service provision to be discontinuous, and (3) manpower shortages which weaken supervision and accountability, and create opportunities for corruption and mismanagement (World Bank 2006b, World Bank and IFPRI 2010). The systemic deficiencies constitute barriers to accelerating and improving service delivery, especially in the area of water resources, sanitation, health, education and agricultural extension. However, these services are contemplated to be important development interventions (1) for increasing the growth potential of the rural farm and non-farm sector and (2) for promoting sustainable, inclusive, and pro-poor agricultural and accordingly economic development (cf. World Bank 2006a).

In order to improve and ensure the equal and inclusive access to rural services, especially to the poor, India pursued a range of governance and institutional reforms in different service sectors and Indian states as of 1993. These include (1) demand-side strategies (e.g., decentralization and community-driven activities) so as to empower the rural poor to *demand* services more effectively and to hold service providers accountable as well as (2) supply-side strategies (e.g., public sector management reform, outsourcing and the training of service providers) in order to increase the capacity of service providers to *supply* services more efficiently.[1]

The demand- and supply-side strategies include design features that aim at overcoming two types of governance challenges that complicate service delivery: (1) the challenge to avoid elite capture and to actually provide services to the poor and the disadvantaged, and (2) the challenge to manage the funds allocated to the reform programs effectively and to avoid leakages and corruption. The first challenge is predominantly addressed by using self-targeting mechanisms such as food for work or wage for work. The second challenge is more difficult to meet because most reform initiatives and programs are "transaction-intensive" in terms of time and space. That is, their implementation requires day-to-day action throughout a country that spans an entire sub-continent and strongly differs in terms of ecosystems, agro-ecological zones, and accordingly cropping patters and cropping systems. Second, the reform initiatives and programs require discretion, since decision-making on the dimension of service delivery such as the type of infrastructure to be created cannot easily be standardized. In fact, different sectors in different regions are characterized by different initial conditions in terms of institutional and organizational and human capacities (e.g., World Bank 2004, Ghuman and Chima 2005; Besley, Pande, and Rao 2007) as well as needs, which in turn requires different local need-based interventions.

The effective delivery of services in areas such as rural road infrastructure or human capital formation is important from a development perspective as it (1) determines the growth potential of the agricultural sector in the light of rising demand- and supply-side pressures, and (2) promotes sustainable, inclusive, and pro-poor (smallholder-friendly) agricultural and non-farm development (World Bank 2007, Fan, Hazell, and Thorat 2001, Iami et al. 2011). For instance, effective agricultural extension and veterinary services are perceived to be necessary instruments for helping the rural poor to employ agricultural innovations, become integrated into markets, and improve their livelihoods and well-being (e.g., Rivera,

[1] Chand (2006) associates successful institutional and governance reforms with changes in the internal business processes and the introduction of accountability instruments (e.g., right to information laws) and Sadanandan and Shiv Kumar (2006) emphasizes the introduction of new autonomous service providers.

Qamar, and van Crowder 2001, Sulaiman and Hall 2002, 2004, GoI, Planning Commission 2005, World Bank 2006a). Veterinary services are hereby particularly important in marginal drylands with low agricultural potential. The access to effective and high-quality drinking water and drainage services is important given their direct implications for the health of people and livestock. Inadequate drainage and drinking water facilities have a direct and negative effect on the income position of households through the detrimental effect of water-borne and sanitation-related disease infections on the productive potential of people as well as livestock.

Regional differences in agro-ecological conditions necessitate different service delivery interventions. At the same time, regional differences in the capacity to provide services affect the scope for agricultural and ultimately rural development. This paper uses district-level data from India for the Census period 1991-2001 to investigate the nexus between service delivery and agricultural development. It asks whether local differences in public service provision cause some areas to fare better in terms of agricultural development than others. The objective is to provide insights regarding the factors promoting agricultural sector development at the local level in India. An understanding of the local drivers of agricultural sector development is important as it helps to define 'tailor-made' strategies for strengthening agricultural sector performance, taking into account local cropping patterns.

Throughout this paper, the yield level of specific commercial and field crops is used as indicator variable of agricultural sector performance. Rural service provision is approximated using information on the district availability of infrastructure facilities related to schooling, health, transportation, and communication. The choice of indicator variables is motivated by the lack of information on the quality of local governance.

The paper is organized as follows. Section 2 and section 3 describe trends in the district-level development of crop productivity growth and rural infrastructure, respectively. Section 4 presents the empirical approach that is employed to identify the determinants of the district-level performance of individual crops and presents the respective results. Section 5 discusses the implications of the results for the direction of development strategies.

2. District-Level Development in Crop Productivity

This section examines the district performance of agriculture in India between 1991 and 2001. The analysis is carried out for widely produced commercial and field crops (rice, wheat, pulses, potatoes, and sugarcane) and for total food grain, using crop yield as performance indicator variable. District-level information on crop yield is compiled from the Indian Harvest database of the Center for Monitoring the Indian Economy and from India's statistical office (Indiastat).

No doubt, crop yield is an imperfect measure of agricultural productivity because changes in productivity may reflect changes in the quantity of inputs used rather than changes in technologies and thus efficiency improvements (cf. Nin Pratt, Yu, and Fan, 2009). Unfortunately, this paper cannot employ a more sophisticated expression of total factor productivity because district-level input factors are not available for individual crops.

Using yield as productivity proxy, crop performance differs widely across districts within and between states in 1991 and 2001.[2] For each individual crop, low- and high-yield districts tend to belong to a narrow set of Indian states. For instance, below-median yield levels in wheat and pulse production are

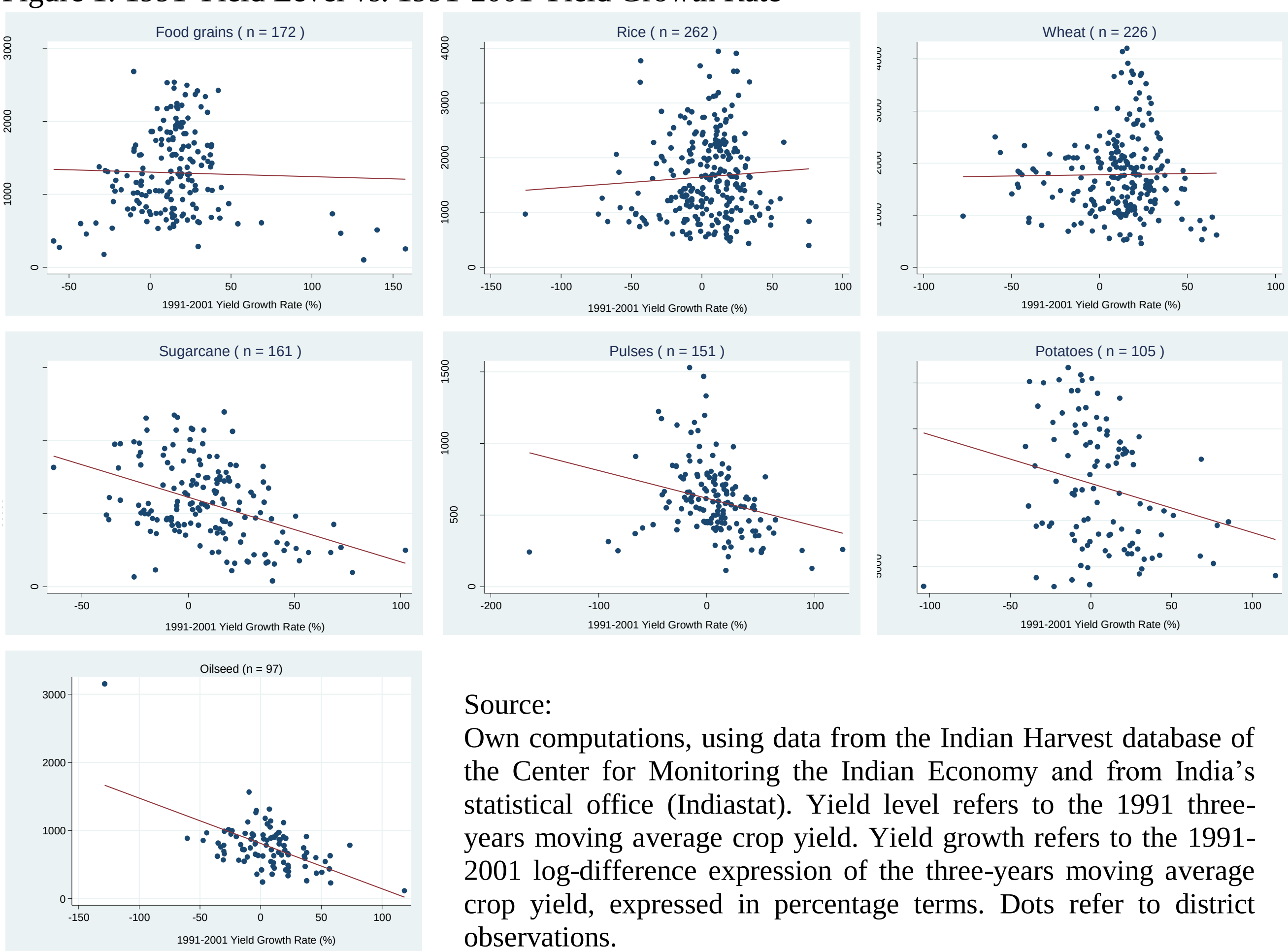
[2] In order to smooth the time variation in the crop yield data, tests are carried out for three-years moving averages. The results of Kruskal-Wallis independence test statistics are available on request. Throughout this paper, all test statistics mentioned, but not reported in the text, are available from the author.

predominantly reported by districts in Rajasthan. Districts with above-median yield levels in sugarcane production mainly belong to Gujarat and Karnataka and in potato production mainly belong to Uttar Pradesh.

Economic growth models predict a negative relationship between the initial output level and growth rates (Barrow and Sala-i-Martin 2003). Assuming that these growth predictions also hold for crop yields, districts with low crop yield levels in 1991 are expected to have grown faster between 1991 and 2001 than districts with high yield levels. The convergence hypothesis receives some support (Figure 1). The productivity gap narrows among districts producing sugarcane, potatoes, and pulses, but remains unchanged among districts producing wheat and marginally increases among districts producing rice. The latter effect originates with districts in Andhra Pradesh, Maharashtra, Madhya Pradesh, and Karnataka, which report productivity growth rates of rice in excess of ten percent in spite of high initial yield conditions. In comparison, low productivity districts in 1991 have 1991-2001 yield growth rates of less than one percent.

Agricultural sector performance determines the well-being of the rural population (World Bank 2007). For instance, the green revolution states achieved substantial reductions in poverty which resulted from agricultural productivity gains and their effect on real wages as well as from government development programs (e.g., Foster and Rosenzweig 2004, Fan, Hazell, and Thorat 2001). Given the green revolution experience and the fact that districts tend to derive income from farming a narrow set of crops, poverty incidence is thus expected to be negatively related to the rate of agricultural productivity and productivity change.

Figure 1: 1991 Yield Level vs. 1991-2001 Yield Growth Rate



Source:
Own computations, using data from the Indian Harvest database of the Center for Monitoring the Indian Economy and from India's statistical office (Indiastat). Yield level refers to the 1991 three-years moving average crop yield. Yield growth refers to the 1991-2001 log-difference expression of the three-years moving average crop yield, expressed in percentage terms. Dots refer to district observations.

Tests for the existence of a relationship between agricultural yield and poverty are complicated by the nonexistence of district-level poverty incidence rates. Poverty estimates are only available for state-specific regions for few selected years such as 1993/94 and 1999/2000 (Deaton 2003). Using these, Spearman rank correlation coefficients suggest that poverty is more pronounced in districts with low-productivity food grain, rice, and potato production. Although there is some support that poverty incidence is negatively related to the level of agricultural productivity, there is scarce support that districts with positive advances in agricultural productivity belong to regions which report larger improvements in poverty incidence rates. Such evidence only prevails in the case of wheat. Because the relationship between the rate of change of agricultural productivity and poverty is even positive in the case of sugarcane, these results casts doubt on the effectiveness of yield growth as poverty-reducing instrument. However, the evidence should not be overemphasized as it is derived for region- rather than district-level poverty estimates. The resulting lower cross-section variability could preclude the identification of statistically significant relationships. Furthermore, the regional poverty estimates are unavailable for all districts for which crop yield data is available.

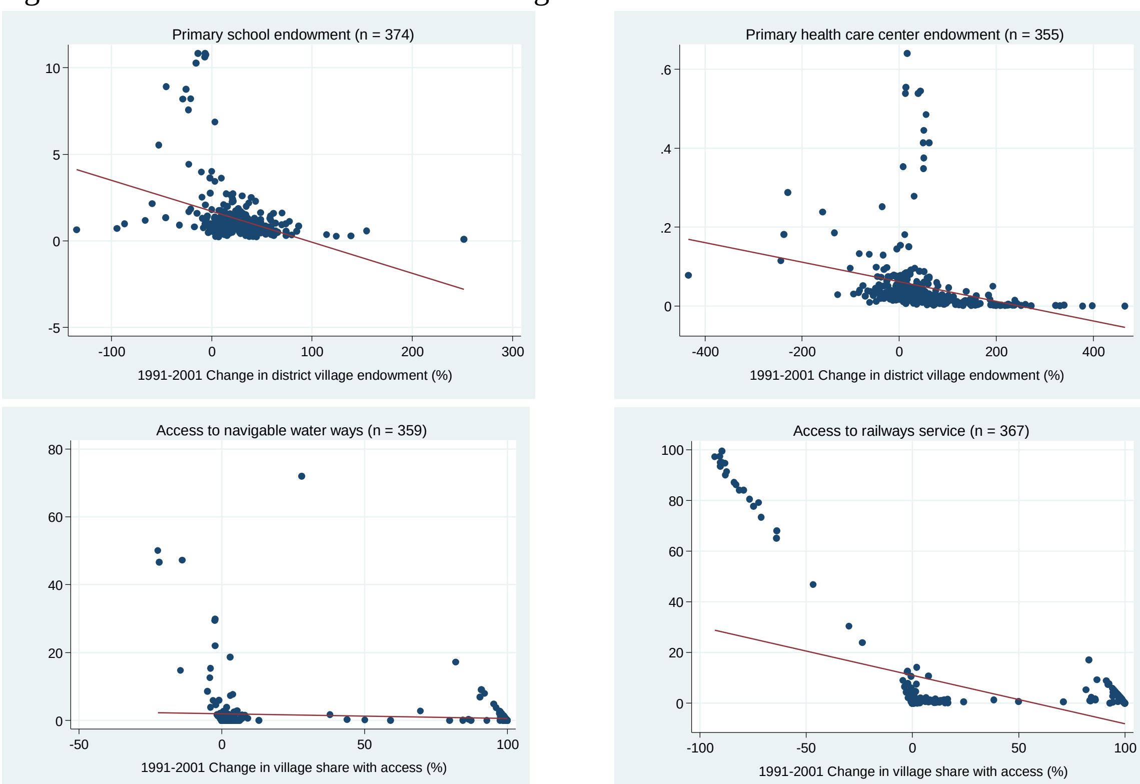
One possible, although hypothetical explanation for the absence of a link between yield growth and poverty could be population growth and the adverse effect of population pressure on land availability and soil fertility (World Bank 2007, ch. 2 and ch. 10). Another explanation could refer to local heterogeneities in the extent to which agricultural subsidies crowd out investment in agricultural research and development, road infrastructure development and rural education and distort cropping patterns (Fan et al. 2008). The latter aspect emphasizes the importance of activities in the area of infrastructure development as possible source for local differences in agricultural development. Motivated by the objective to explore the nexus between crop-specific yield growth and infrastructure development, the next section describes the district distribution of rural service provision in more detail.

3. District-Level Development in Rural Infrastructure

This paper approximates district-level rural service provision with information on district infrastructure endowment in the area of education and human capital formation, health, and transportation and communication facilities. The respective data are compiled from the 1991 and 2001 Indian Census. The Census collects information on the number of primary schools per district village or district literacy rate. These variables are subsequently used as proxies of service provision in the area of human capital formation to test the theoretically and empirically proposed positive association between human capital accumulation and agricultural productivity and economic growth (Fan, Hazell, and Thorat 2001, Bandyopadhyay 2006 and the references therein). Census data on the number of primary health care centers per district village are used to approximate service provision in health. Health infrastructure facilities are included in order to cover the adverse effects of uncovered health risks or untreated health shocks on farm productivity and ultimately crop yield and agricultural sector performance (World Bank 2007, ch. 3). Service provision in the area of transportation and communication is approximated with Census information on the number of post offices in district villages, district village electrification and the district village access to bus services, navigable water ways, and railways, or the inter-village connectivity via blacktop asphalt roads (pucca roads). These factors describe the integration of farmers with and their access to markets and approximate the importance of information and finance flows and transaction costs for agricultural sector performance (World Bank 2007, ch. 2 and ch. 6, Fan, Hazell, and Thorat 2001). In addition, the district share of electrified villages provides indirect information regarding the scope for operating systems of (high yield) irrigated rather than rainfed agriculture.

Visual inspection of these proxy variables of rural service delivery and Kruskal-Wallis independence tests indicate that districts within states as well as districts between states significantly differ in terms of physical infrastructure and human capital formation. Because road infrastructure, health, and education are state subjects, among others[3], the regional heterogeneities may reflect differences in the level of decentralization and accordingly differences in the devolution of funds, functions, and functionaries to the different tiers of local government. Differences in local decentralization affect budget expenditure decisions and the capacity of service providers to construct, maintain, and manage physical infrastructure through channels such as fund and manpower availability (cf. World Bank and IFPRI 2010). Standard regression models with state fixed effects and visualization of the data (Figure 2) suggest that the state and district heterogeneities in the village endowment with road infrastructure, health, and education facilities somewhat diminished during the period 1991-2001).[4] This development may reflect the efforts of Indian states to unbundle service provision such that services are provided at the level of local government where the responsiveness to need-based changes in demand and the degree of efficiency, public transparency, and accountability is likely to be most pronounced (cf. Raabe, Birner, Sekher 2009).

Figure 2: 1991 Level vs. 1991-2001 Change in Rural Infrastructure Facilities at the District Level

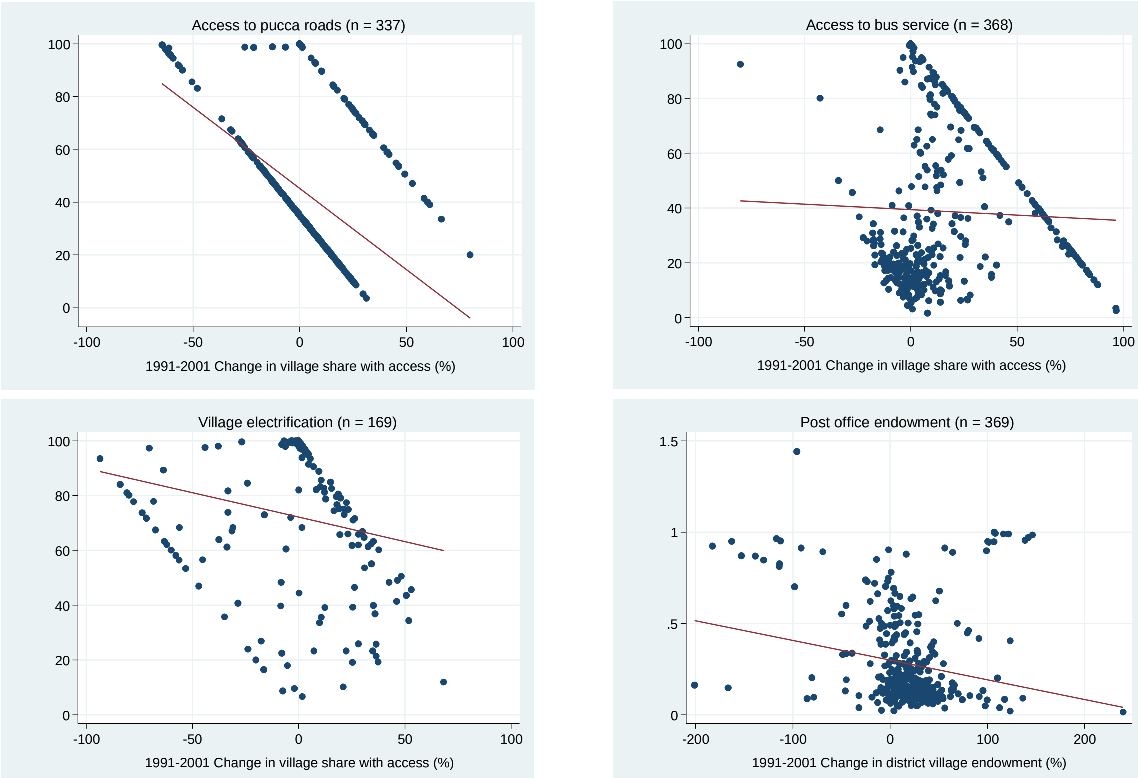


– Figure 2 continued on next page –

[3] This means that it is up to the discretion of the state to decide the extent to which function, functionaries, and funds are devolved to the local level.

[4] The results from model estimation with state fixed effects are available on request.

– Figure 2 continued from previous page –



Source: Own computations, using data from the village directories of the 1991 and 2001 Census. "No. per village" represents the number of infrastructure facilities in district villages. Dots refer to district observations.

4. Agricultural Productivity Growth and Rural Service Provision

The evidence reported so far suggests that crop productivity as well as infrastructure endowment differs across districts. District differences in the availability of infrastructure facilities lend support to the existence of cross-district differences in service delivery. Given these findings, this section asks: Is there a relationship between crop-specific yields and the endowment of districts with infrastructure facilities in the area of education, health, transportation and communication?

4.1 Empirical Model

Equation (1) describes the function that is estimated to explore the nexus between infrastructure endowment and crop yield.

$$\Delta Y_{ij} = \alpha + \beta Y_{ij,1991} + \delta Z_j + \gamma S_k + \varepsilon_{ij}. \quad (1)$$

The dependent variable ΔY_{ij} is the 10-year log-difference operator of the yield of crop i in district j. This variable is expressed in percentage terms and referred to as the yield growth rate of crop i. $Y_{ij,1991}$ represents the 1991 (initial) yield level of crop i in district j. Parameter ε_{ij} is an i.i.d. random variable with zero mean and constant variance, i.e., $N \sim (0, \sigma^2)$.

Z_j is a vector of district characteristics. The vector comprises the indicator variables of public service delivery mentioned in section 3 (road, transportation and communication infrastructure and infrastructure facilities related to health and education) as well as (rural) population density. The relationship between yield growth and population density is ambiguous. High population density may lower yield growth through adverse effects on soil fertility and average land holdings (World Bank, 2007, ch. 2, 3) or promote yield growth through positive effects on infrastructure investment and agricultural and social service provision (World Bank 2007, ch. 2, 10). The positive effect can arise if population pressure corresponds with lower per capita investment expenditures. Throughout this paper, the Z_j variables are expressed as 1991-2001 rates of change to effectively use all available information and to control for the effects of possible structural changes between 1991 and 2001. Finally, model (1) also includes state-level fixed effects S_k to control for unobserved state level characteristics.[5]

Model (1) is subject to limitations. These mainly result from data availability constraints at the district level such as the unavailability of time-series information on public service delivery. Because that information is available for two points in time (1991 and 2001), the respective data cannot be normalized along both the cross-section and time dimension and the evidence thus may fail to be representative for the time period 1991-2001. In addition, the absence of sufficient time-series information precludes the estimation of a comprehensive multi-equation estimation model, which could effectively utilize the information from the joint-determination and interdependence of variables (cf. Fan, Hazell, and Thorat 2001 or Fan and Rao 2008). Finally, the analysis cannot consider important yield determinants such as irrigation potential or the availability of fertilizer, agricultural credit, or mechanical farming implements (tractor) because respective information is only available for a small number of districts.

4.2 Empirical Results

The present empirical analysis faces a tradeoff between model performance and model sophistication that results from the unavailability of information on crop yield and service provision for the same set of districts. The specification of more complex multivariate models thus comes at the expense of a substantial data loss. This paper therefore reports the results of parsimonious model specifications, which only include one indicator variable from vector Z_j at a time. Ramsey reset F-statistics are used to evaluate the explanatory power of the empirical models. Attributable to the small time-series dimension of the models and the limited district comparability of explanatory variables, the respective statistics occasionally point to an omitted variable problem. The present analysis can only acknowledge this shortcoming.

Table 1 summarizes the results for standard least squared estimations with state fixed effects. The relation between the 1991 yield level of crop i ($Y_{ij,1991}$) and the 1991-2001 percentage change in crop yield (ΔY_{ij}) is consistent with the relationships in Figure 1 and robust to the choice of indicator variable from vector Z_j. Given this, Table 1 only reports the coefficient estimates of the different vector variables Z_j and model performance statistics. Complete regression outputs are available on request.

4.2.1 Population Pressure

Population density is included to accommodate the effect of population and land pressure on yield growth through the effect on infrastructure investment, land pressure, and soil degradation (see World Bank 2007, ch. 2, 10). The evidence in Table 1.a only lends support to the existence of a relationship between population density and yield growth in the estimation for oilseeds. The yield of oilseed production is found to expand in response to an increase in population density. The statistical insignificance of the results for the other crops may reflect both: the negative effect of higher population density on soil fertility and the positive effect on physical infrastructure investment and consequent improvements in market access. More detailed data would be needed to explore these transmission channels.

4.2.2 Service Provision in the Area of Education

[5] District fixed effects cannot be included due to the small number of cross-section observations.

Service delivery in the area of education and accordingly human capital development is approximated with information on the village number of primary schools in each district. Regardless of the crop, yield growth does not depend on changes in the availability of primary schooling facilities (Table 1.b). This finding does not imply that crop yield growth and ultimately agricultural sector performance is insensitive to the availability of schooling facilities and accordingly human capital formation. It indicates, however, that the number of primary schools is not the best variable to approximate the crop yield effects of service delivery in the area of human capital formation as it disregards the quality dimension of schooling services. For instance, manpower and funding constraints may cause schools to function poorly or not at all. In addition, socio-economic constraints may prevent children from attending school. Given these concerns, a better proxy variable of service delivery in human capital formation might be literacy. Using 1991 and 2001 Census information on district literacy rates, a weak positive productivity effect results from an increase in the share of literate women in the case of pulse and oilseed farming (Table 1.c). The significance of this effect could reflect the gender sensitivity of the 1990s education programs, which included major efforts for granting at least primary education to women. Women are a major agricultural input factor, and the positive effects of (primary) female education on yield growth may reflect improvements in the women's access to and the adoption of (written) agricultural extension advice and health information.

4.2.3 Service Provision in the Area of Health Care Facilities

The empirical results in Table 1.d do not point to the existence of a significant relationship between the availability of health care services and yield growth. The reason for the insignificance of the relationship could be the same as for primary education, namely that the number of primary health care centers is imperfectly related to the quality of health care services and health care outcomes. For instance, evidence from a survey in Karnataka[6], Rajasthan and Bihar[7] suggests that households which are unsatisfied with public health care services mainly complain about irregular and short opening hours, inadequate or rude treatment, and the lack of health care facilities in the village itself. Unfortunately, better proxy variables of health conditions at the district level are unavailable for the present set of estimations.

4.2.4 Service Provision in the Area of Transportation and Communication

Included to account for the effects of transportation and the dissemination of information, the entries in Table 1.e - Table 1.h indicate that improvements in the (market) connectivity of villages via pucca roads, railways, bus, or navigable waterways do not stimulate crop yield growth in most instances. Exceptions prevail for (1) yield growth in potato production, which expands in response to an increase in the share of villages with railways access and for (2) yield growth in food grain and oilseed productiion, which expands in response to an increase in the share of villages with access to navigable waterways. Unfortunately, we cannot tell whether and to what extent the yield changes reflect a shift in the crop portfolio of farmers in response to improvements in the access to markets and the associated intensification of (price) competition between farmers.

Village electrification is frequently perceived to be incremental for achieving agricultural productivity gains as it improves the regular access to irrigation water through the operation of, for example, electric water pumps. In the present sample, this relationship may explain why increases in the share of electrified villages correspond with higher yield growth in water-intensive sugarcane production (Table 1.i). Else, yield growth does not depend on the share of electrified villages or changes thereof. This finding is

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[6] The survey was implemented by the Institute for Social and Economic Change (ISEC) and the International Food Policy Research Institute in 2006.

[7] The survey was implemented by the Institute for Environmental Economics and World Trade and the Centre for the Study of Law and Governance in 2010.

consistent with the evidence in Fan, Hazell, and Thorat (2001) who show that rural electrification is associated with low agricultural productivity effects.

Finally, post offices are included as instruments that increase the outreach of rural finance and credit, which could be used for agricultural purposes (cf. World Bank 2007, ch. 6). The evidence in Table 1.j does not confirm this proposition. In fact, productivity growth of food grains and pulses is significantly lower in districts that report an increase in the village number of post offices.

Table 1: Explaining the 1991-2001 Rate of Change in Crop Yield

	District characteristic Z_j from model (1)	Food Grain	Rice	Wheat	Oilseed	Pulses	Sugarcane	Potatoes
1.a	1991-2001 %-change rural population density per district	0.09	0.12	0.03	0.13 **	0.06	0.01	0.11
		(0.12)	(0.07)	(0.05)	(0.04)	(0.05)	(0.07)	(0.12)
	N	103	167	164	71	103	107	82
	Ramsey reset F-statistic	0.22	0.67	5.89 ***	0.91	1.80	0.89	0.57
1.b	1991-2001 %-change in number of primary schools per district village	7.53	-2.39	3.23	-4.99	1.65	2.63	1.53
		(11.6)	(7.25)	(5.23)	(5.30)	(16.6)	(2.80)	(10.4)
	N	136	209	198	93	117	132	101
	Ramsey reset F-statistic	0.27	2.69 **	4.64 ***	1.97	3.60 **	0.65	0.10
1.c	1991-2001 %-change in female literacy per district	0.07	-0.43	0.12	1.19 **	0.87 *	-0.08	1.17 **
		(0.22)	(0.68)	(0.37)	(0.40)	(0.36)	(0.45)	(1.82)
	N	168	248	223	96	149	160	102
	Ramsey reset F-statistic	0.32	3.58 **	5.67	1.83	3.46 **	0.06	0.36
1.d	1991-2001 %-change in number of PHC[1] per district village	-0.85	-2.05	1.14	2.98	-1.07	-3.16	0.29
		(1.38)	(1.86)	(1.84)	(2.91)	(3.02)	(2.60)	(3.00)
	N	124	197	189	81	105	121	95
	Ramsey reset F-statistic	0.29	3.31 **	3.39 **	3.11 **	2.71 **	0.23	0.07
1.e	1991-2001 %-change in the share of villages with navigable waterways §	0.18 ***	0.06	-0.08	0.13 *	-0.11	0.06	0.03
		(0.04)	(0.05)	(0.07)	(0.06)	(0.13)	(0.12)	(0.09)
	N	125	196	187	88	112	122	96
	Ramsey reset F-statistic	0.04	2.31 *	6.35 ***	2.16 *	2.76 **	0.28	0.10
1.f	1991-2001 %-change in the share of villages with railways services	-0.23	0.002	-0.09	-0.40	-0.19	-0.05	0.12 ***
		(0.30)	(0.05)	(0.08)	(0.47)	(0.49)	(0.05)	(0.02)
	N	131	202	193	88	112	126	101
	Ramsey reset F-statistic	0.55	2.79 **	6.26 ***	3.71 **	2.82 **	0.68	0.17
1.g	1991-2001 %-change in the share of villages with bus service	-0.11	-0.05	-0.11	-0.19	-0.18	-0.06	-0.06
		(0.23)	(0.12)	(0.12) ***	(0.17)	(0.31)	(0.15)	(0.12)
	N	132	203	193	89	113	127	101
	Ramsey reset F-statistic	0.33	3.08 **	4.78 ***	2.82 **	4.11 ***	0.45	0.17
1.h	1991-2001 %-change in the share of villages with pucca roads	0.05	0.01	0.04	0.08	0.21	0.04	-0.002
		(0.15)	(0.08)	(0.09)	(0.16)	(0.20)	(0.09)	(0.20)
	N	143	197	184	81	130	123	85
	Ramsey reset F-statistic	0.96	0.80	3.29 **	2.60 *	3.42 **	1.30	0.05
1.i	1991-2001 %-change in the district share of electrified villages	0.23	-0.22	-0.10	-0.50	0.11	0.18 **	0.24
		(0.36)	(0.18)	(0.11)	(0.34)	(0.17)	(0.06)	(0.60)
	N	77	98	107	44	61	71	47
	Ramsey reset F-statistic	4.10 ***	1.00	0.60	0.14	1.11	2.76 *	0.02
1.j	1991-2001 %-change in number of post offices per district village	-11.56 *	5.17	0.912	-13.6	-15.6 ***	1.24	-12.1
		(5.68)	(5.80)	(2.90)	(6.81)	(1.10)	(1.34)	(9.19)
	N	132	205	196	89	113	128	101
	Ramsey reset F-statistic	1.69	1.86	4.52 ***	2.73 **	2.97 **	0.89	0.54

Note: The dependent variable is the 1991-2001 growth rate of the yield of the crop mentioned in the header row. Column one identifies the explanatory variables. There, 'crop' refers to the crop mentioned in the header row of the subsequent columns. Standard errors are clustered at the state level and reported in parentheses. ***, **, and * denote the statistical significance at the one, five, and ten percent level, respectively.

[1] PHC = Primary health care center

5. Conclusion

This paper adopted a district-level perspective to investigate the nexus between service delivery and agricultural development so as to provide insights regarding the factors promoting crop output and ultimately agricultural sector development at the local level in India. The evidence from standard regression models suggests that crop yield growth was largely unresponsive to changes in infrastructure facilities related to education, health, transportation and communication at least during the period 1991-2001. Although data limitations affect the explanatory power of the empirical model, the absence of significant infrastructure effects on crop yield growth may suggest that (government) investment spending was too low to significantly boost agricultural productivity at least during the period 1991-2001. Existing evidence suggests, however, that public infrastructure investment spending in, among others, road infrastructure and education is a necessary condition for promoting agricultural productivity and for reducing rural poverty (e.g., Fan, Hazell, and Thorat 2001). The overall requirement for investment spending is not the same for all regions, but dependent on agricultural potential (Fan and Hazell 2003). Extending this line of reasoning, the requirement for investment spending likely depends on the district portfolio of crops and the corresponding choice of cropping systems and cropping patterns. Paired with district-specific infrastructure development characteristics, one-size-fits-all strategies are unlikely to promote crop output in all districts equally well.

The evidence presented in this paper does not clearly identify and specify the factors that contribute to agricultural development. It appears, however, that strategies towards agricultural development should not only aim at increasing investment spending and the number of infrastructure facilities. Instead, growth-promoting strategies should also be concerned with strengthening the quality of public services that existing infrastructure facilities provide. This asks for accentuated views on the governance challenges of providing public services. Why is service delivery in some districts more effective, inclusive, and pro-poor than in others? What is the role of institutional arrangements and the institutional and managerial capacity of service providers at different local government tiers in that respect? Answers to these questions are likely to increase the effectiveness of existing growth-promoting strategies with the existing infrastructure facilities.

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