

The Colonial Legacy: Institutions or Infrastructure?

A Critique of Abhijit Banerjee and Lakshmi Iyer (BI), “History, Institutions and Economic Performance: The Legacy of Colonial Land Tenure Systems in India”, American Economic Review, 95(4), Sept 2005

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Outline of Presentation

- Summary of BI
- Strict Replication Issues (Coding of Data)
- An Alternate Framework
- Scientific Replication

Introductory Remarks on BI

- Influential article in international development.
- Winner of Inaugural Michael Wallerstein Award by the Political Economy Section of the American Political Science Association.
- In common with other work in this genre, traces current economic performance in LDCs to colonial institutions (Acemoglu-Johnson-Robinson, La Porta et al. and many others)

Key Arguments in BI

- Present day agricultural development in India can be explained in great part by colonial land tenure systems.
- Districts where the collection of land revenue was assigned to a class of landlords systematically underperform the districts where this type of intermediation was avoided, after controlling for a wide range of geographical differences.
- Differences show up in agric investment and yields, in various measures of public investment in education and health, as well as in health and educational outcomes.
- Exogenous placement of land tenure systems (landlord vs non-landlord) makes the identification of the effect of institutions on economic and non-economic outcomes possible.

Why should colonial institutions have such a sizeable effect on economic performance now?

- BI find that differences in agric investments and yields widen from 1965 onwards.
- Post-1965, Indian state was more active in rural areas, via the Green Revolution.
- Investment in HYV varieties of crops and public infrastructure (including fertiliser delivery system).
- Differences in Political Environment: lack of collective action in landlord districts, reflecting in low public expenditures in development. Higher conflictual environment in landlord districts, led to greater emphasis on land reform.

Coding districts into landlord and nonlandlord land revenue collection systems

- Zamindari=landlord; mahalwari (village based) and ryotwari (individual based)
- For UP, MP and Punjab: from district level land settlement reports, districts assigned as proportion of villages, estates or land area not under the revenue liability of landlords.
- For Madras Presidency, source is Baden-Powell (1892).
- For Bombay Presidency, Bengal Presidency, Orissa, Berar, and districts for which there is no district level settlement data, districts assigned 0 or 1, based on multiple sources.

APPENDIX TABLE 2: ESTABLISHMENT OF LAND REVENUE SYSTEMS IN BRITISH INDIA

Province	Date of British land revenue control	Formation of land tenure system
Bengal Presidency	1757, 1765	Revenue statistics in early 1770s, old landforms disorganised, several districts and farming-old landforms constituted in 1784, Lord Cornwallis successful Permanent Settlement in 1793; landform were fixed in perpetuity with stiff penalties for default.
Madras Presidency	1765, 1790-1801	1762 territories came under Permanent Settlement. Miris and land tried individual systems in some districts from 1790-1801; in 1807 all districts put under landform for 3 years, leases renewed for 10 years in 1810-11; Miris went to England and convinced the Directors of the East India Company to order an individual settlement in the whole of Madras; order implemented after 1820 when leases expired, all former defaulting landform estates also converted to individual system.
Bombay Presidency	1800, 1817-18	Individual system tried in Poona in 1820's, but failed; Wingate and Goldsmid about Bombay Survey System in 1835 for individual settlement system; a few long-standing landform left in place in certain areas.
North-West Province	1775, 1801-03	Permanent Settlement in 1775 areas. 3 and 4-year landform leases in 1802-1819. Question of Permanent Settlement widely debated; revenue secretary Robt Macleod's 1819 Miris recognized the existence of village bodies and asked for their rights to be protected in any settlement; regulation passed in 1822.
Oudh	1816	Lord Dalhousie successful settlement with village bodies wherever possible; Miris in 1857 believe this could be done; Lord Canning reversed policy in 1870 and brought back landform (Ashkhar) with full proprietary rights.
Central Province	1833, 1849	No fixed policy until landform settlement (awajganeri) announced in 1853, implemented in 1856. Tanthalgur district however put under individual cultivator system.
Bihar	1856	Was under Miris till 1856; landform system tried found unsuccessful; Bombay Survey System (individual cultivator based) implemented.
Assam	1785, 1824-26	Some areas transferred from Bengal had Permanent Settlement, others got individual-cultivator systems.
Punjab	1846, 1849	Village-based system put into place everywhere, practically no big landform.

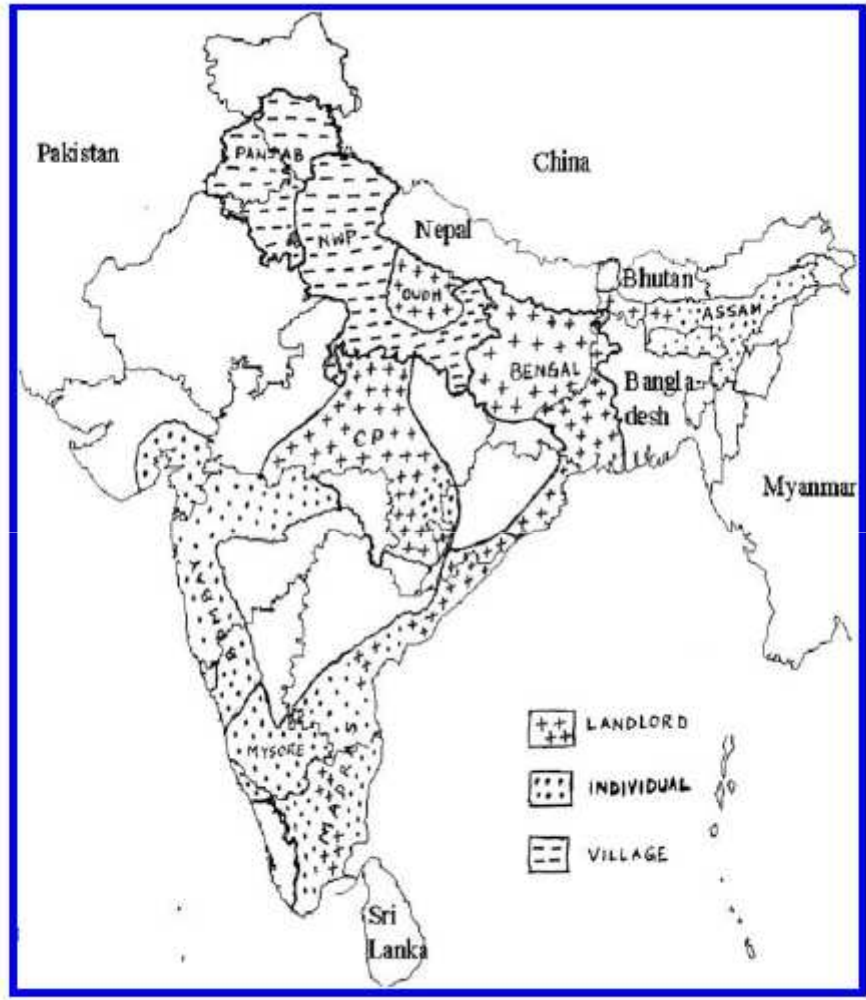


FIGURE 1. MAP OF INDIA

Problems with coding \ Strict Replication Issues

- Central Provinces: BI argue that landlord settlement (malguzari) implemented in 1850s, except Sambalpur which was individual based.
- Wrong to attribute CP (minus Sambalpur) as zamindari. Historical evidence suggests otherwise.
- BI also include 7 districts in Mysore princely state in their sample, and assign them to nonlandlord TS. Not clear why PS districts included, or whether nonlandlord TS was in place.
- Split districts: Dangs (parent British district: Surat) and Raipur (parent British district: Sambalpur) – wrongly attributed to parent districts.
- BI have agric investment and yield data for 271 districts, but only use 166 districts in regressions. One-third of Indian districts missing.

Data and Empirical Specification

- The landlord/non-landlord coding matched to data on agric investment and yields by districts, from 1956 to 1987, obtained from World Bank data-set. Education and health infrastructure data from 1981 census.
- The main data-set is panel data, with districts as units of analysis.
- $Y=f(\text{non-landlord TS proportion in district (or nonlandlord dummy), geographic controls, year dummies})$, where $Y=\text{agric investment/yields/other outcome variables}$.

TABLE 3—DIFFERENCES IN AGRICULTURAL INVESTMENTS AND YIELDS
(Mean non-landlord proportion = 0.5051 (s.d. = 0.4274))

	Coefficient on non-landlord proportion	Coefficient on non-landlord dummy
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TABLE 1—STATE-WISE DISTRIBUTION OF LANDLORD AND NON-LANDLORD DISTRICTS

State	Mean non-landlord proportion	Classification of revenue systems				Total districts
		Landlord based	Individual based	Village bodies		
				Landlord	Non-landlord	
Andhra Pradesh	0.66	2	8	0	0	10
Bihar	0.00	12	0	0	0	12
Gujarat	1.00	0	7	0	0	7
Haryana	0.85	0	0	0	5	5
Karnataka	1.00	0	15	0	0	15
Madhya Pradesh	0.10	14	1	0	0	15
Maharashtra	0.78	4	14	0	0	18
Orissa	0.32	6	2	0	0	8
Punjab	0.87	0	0	0	6	6
Rajasthan	0.00	1	0	0	0	1
Tamil Nadu	0.75	2	9	0	0	11
Uttar Pradesh	0.42	0	0	12	35	47
West Bengal	0.00	11	0	0	0	11
Total	0.51	52	56	12	46	166

Notes: This table lists only districts that used to be part of British India. Areas where the British did not set up the land revenue system are excluded. Districts of British India currently in Pakistan, Bangladesh, or Burma are excluded. The table also excludes the states of Assam and Kerala, for which agricultural data are not available in the World Bank dataset. The table lists 1960 districts, some of which were split into two or more districts over time. We use unsplit districts in all our analyses.

Notes: Standard errors in parentheses, corrected for district-level clustering. * significant at 10-percent level; ** significant at 5-percent level; *** significant at 1-percent level. Each cell represents the coefficient from a regression of the dependent variable on the measure of non-landlord control. Data are from 1956 to 1987. Data for area under high-yielding varieties (HYV) is after 1965. Geographic controls are altitude, latitude, mean annual rainfall, and dummies for soil type and coastal regions. The non-landlord dummy is assigned as follows: the dummy equals one for all individual-based districts and all village-based districts except those in Oudh. For landlord-based districts and the village-based districts of Oudh, the dummy is zero.

TABLE 3—DIFFERENCES IN AGRICULTURAL INVESTMENTS AND YIELDS
(Mean non-landlord proportion = 0.5051 (s.d. = 0.4274))

Dependent variable	Mean of dependent variable	Coefficient on non-landlord proportion		Coefficient on non-landlord dummy	
		OLS Full sample (1)	OLS Excluding Bengal and Bihar (2)	OLS Full sample (3)	OLS Excluding village-based districts (4)
<i>Agricultural investments</i>					
Proportion of gross cropped area irrigated	0.276	0.065* (0.034)	0.066* (0.035)	0.077*** (0.027)	0.005 (0.032)
Fertilizer use (kg/ha)	24.64	10.708*** (3.345)	10.992*** (3.406)	9.988*** (2.301)	10.695*** (3.040)
Proportion of rice area under HYV	0.298	0.079* (0.044)	0.094** (0.043)	0.016 (0.032)	0.074* (0.038)
Proportion of wheat area under HYV	0.518	0.092** (0.046)	0.119*** (0.045)	0.031 (0.036)	0.107** (0.052)
Proportion of other cereals area under HYV	0.196	0.057* (0.031)	0.084*** (0.024)	-0.035 (0.025)	0.109*** (0.041)
<i>Agricultural productivity</i>					
log (yield of 15 major crops)		0.157** (0.071)	0.152** (0.074)	0.173*** (0.053)	0.089 (0.085)
log (rice yield)		0.171** (0.081)	0.195** (0.081)	0.099 (0.062)	0.173** (0.079)
log (wheat yield)		0.229*** (0.067)	0.228*** (0.070)	0.188*** (0.054)	0.143 (0.098)
No. of districts		166	143	166	109
Year fixed effects		YES	YES	YES	YES
Geographic controls		YES	YES	YES	YES
Date of British land revenue control		YES	YES	YES	YES

Notes: Standard errors in parentheses, corrected for district-level clustering. * Significant at 10-percent level; ** significant at 5-percent level; *** significant at 1-percent level. Each cell represents the coefficient from a regression of the dependent variable on the measure of non-landlord control. Data are from 1956 to 1987. Data for area under high-yielding varieties (HYV) is after 1965. Geographic controls are altitude, latitude, mean annual rainfall, and dummies for soil type and coastal regions. The non-landlord dummy is assigned as follows: the dummy equals one for all individual-based districts and all village-based districts except those in Oudh. For landlord-based districts and the village-based districts of Oudh, the dummy is zero.

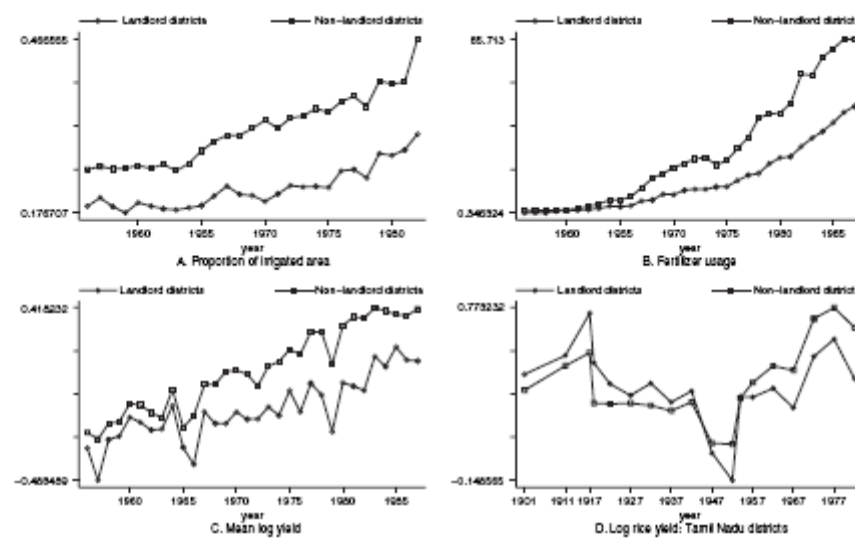
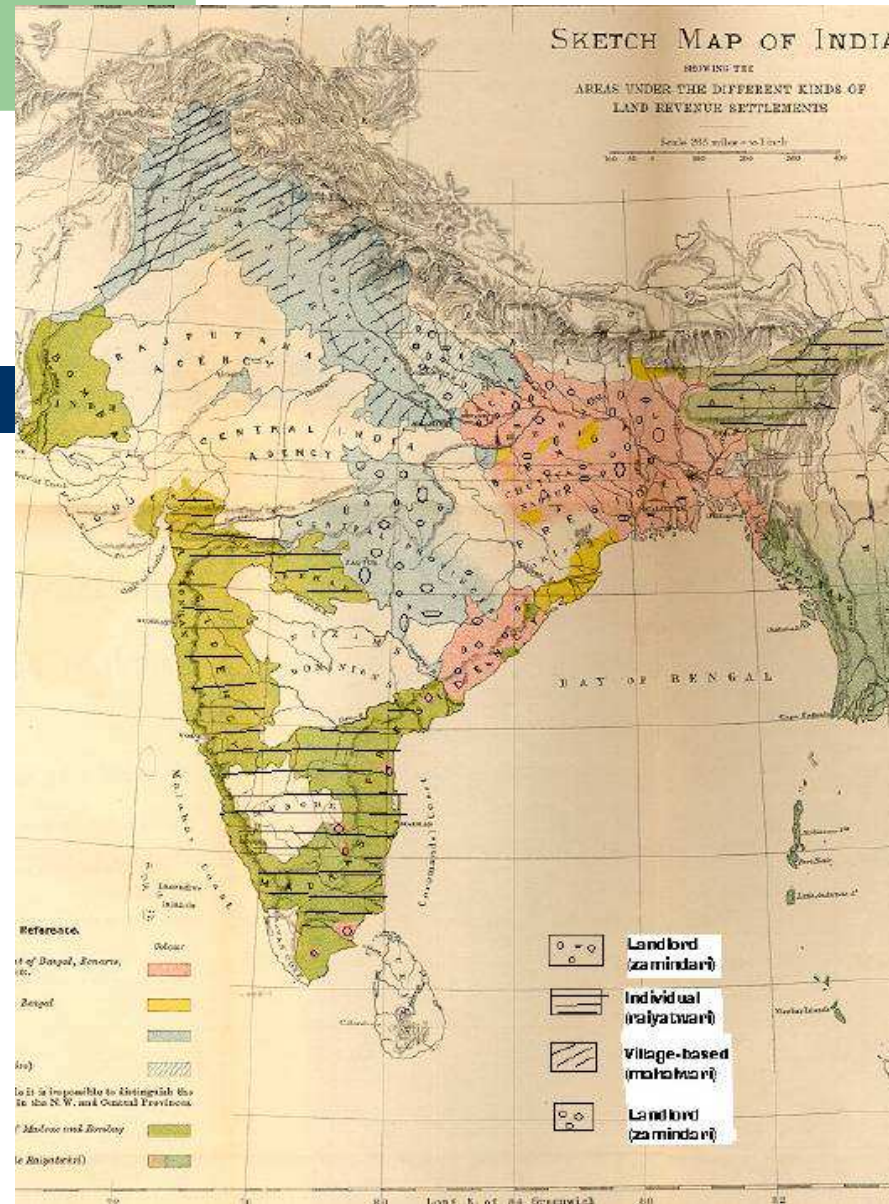


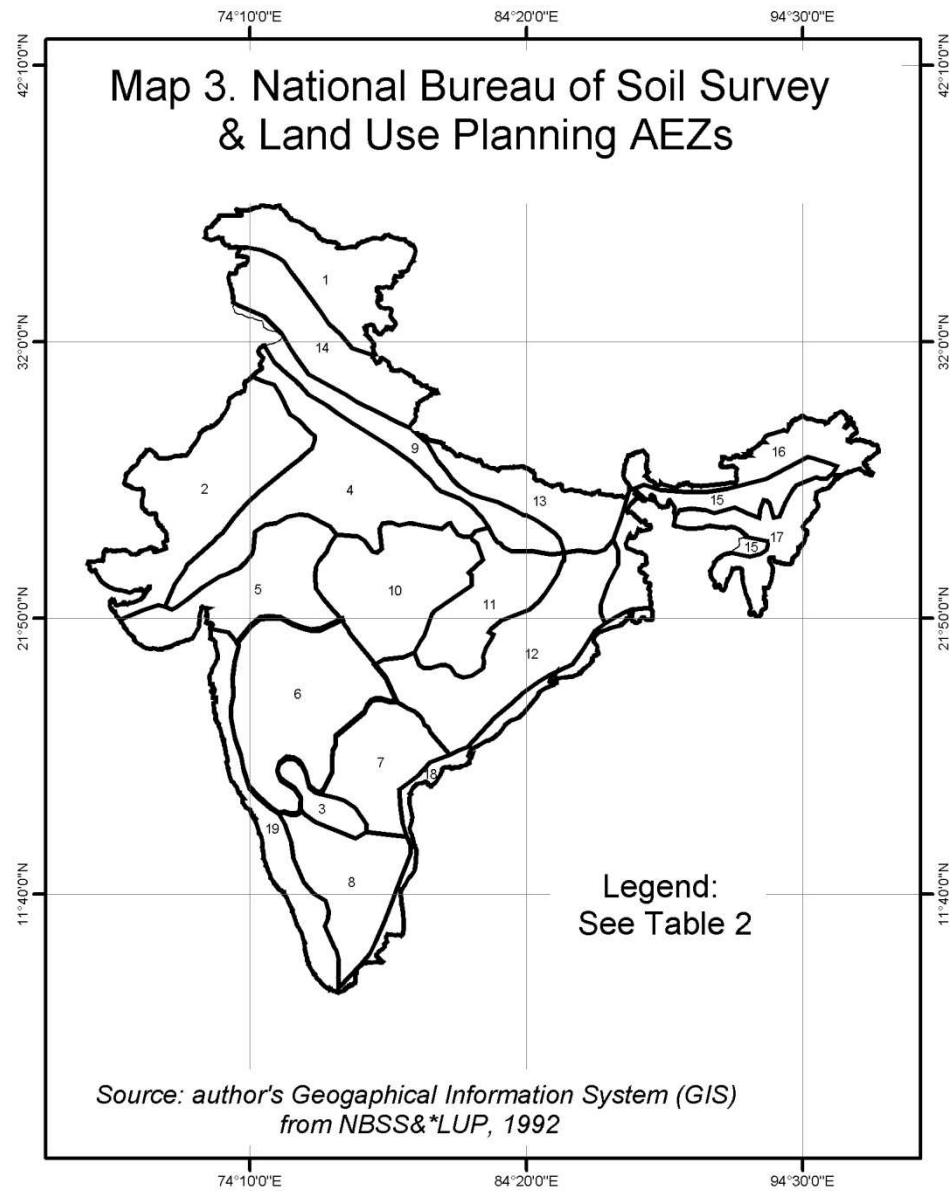
FIGURE 5. INVESTMENT AND PRODUCTIVITY TIME SERIES

An Alternate Framework: Infrastructure and Endowments

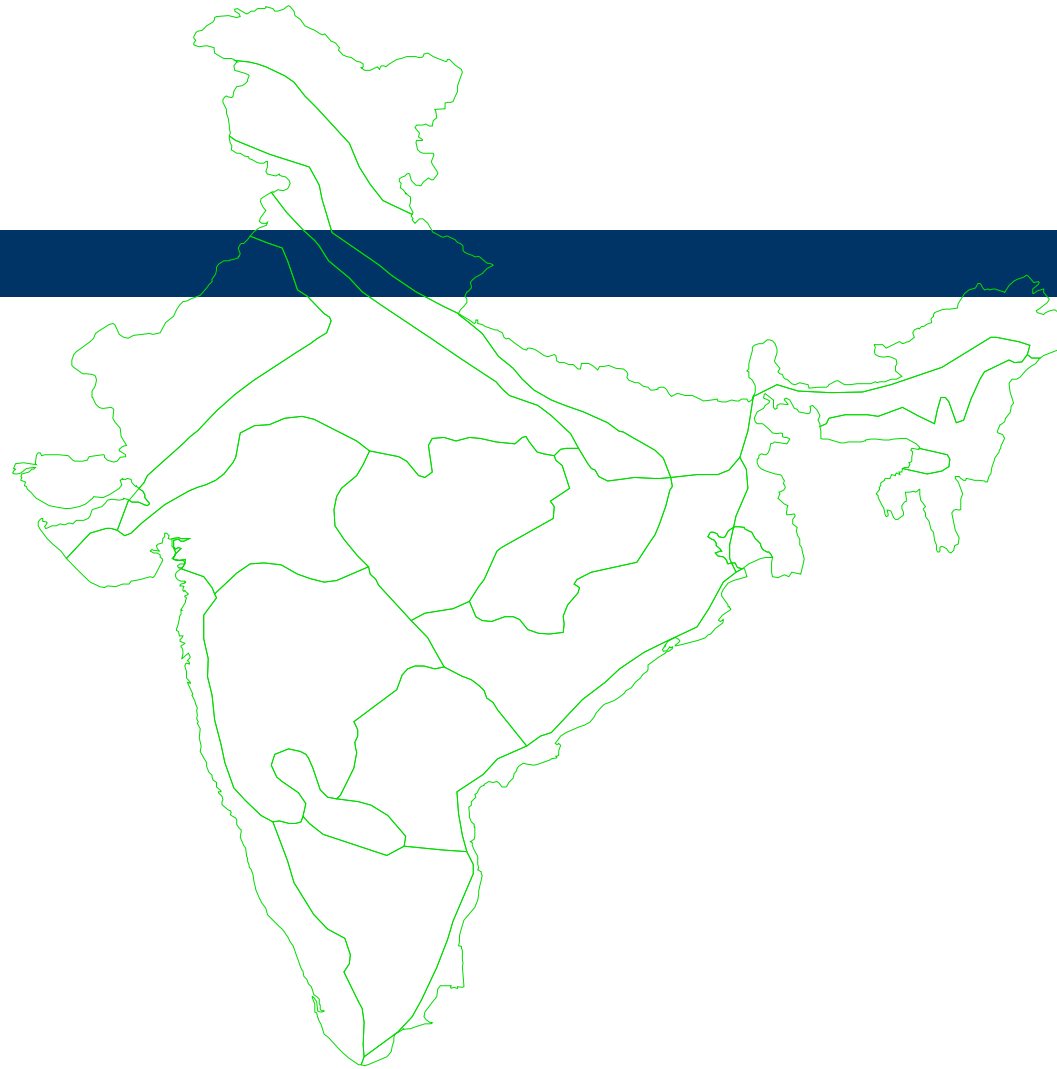
- Green Revolution and associated investments in agroecologically favoured regions.
- Placement of Indian govt investments in these regions in large part due to past colonial investments in irrigation, which were themselves conditioned by prevailing agroecology.
- Roy (2011) notes govt canal construction started in early 19th century, mostly in Punjab, deltaic Madras, Western UP and Sind. With the exception of deltaic Madras, all other regions located in Ganges or Indus floodplains. Floodplains contained favourable agroecological conditions (perennial and plentiful sources of natural water) for the construction of canals. And where canals were constructed, pvt wells followed.
- **Our argument: agroecology=> colonial irrigation => post 1965 public and pvt investments in HYV seeds and irrigation => agric development differences between districts**



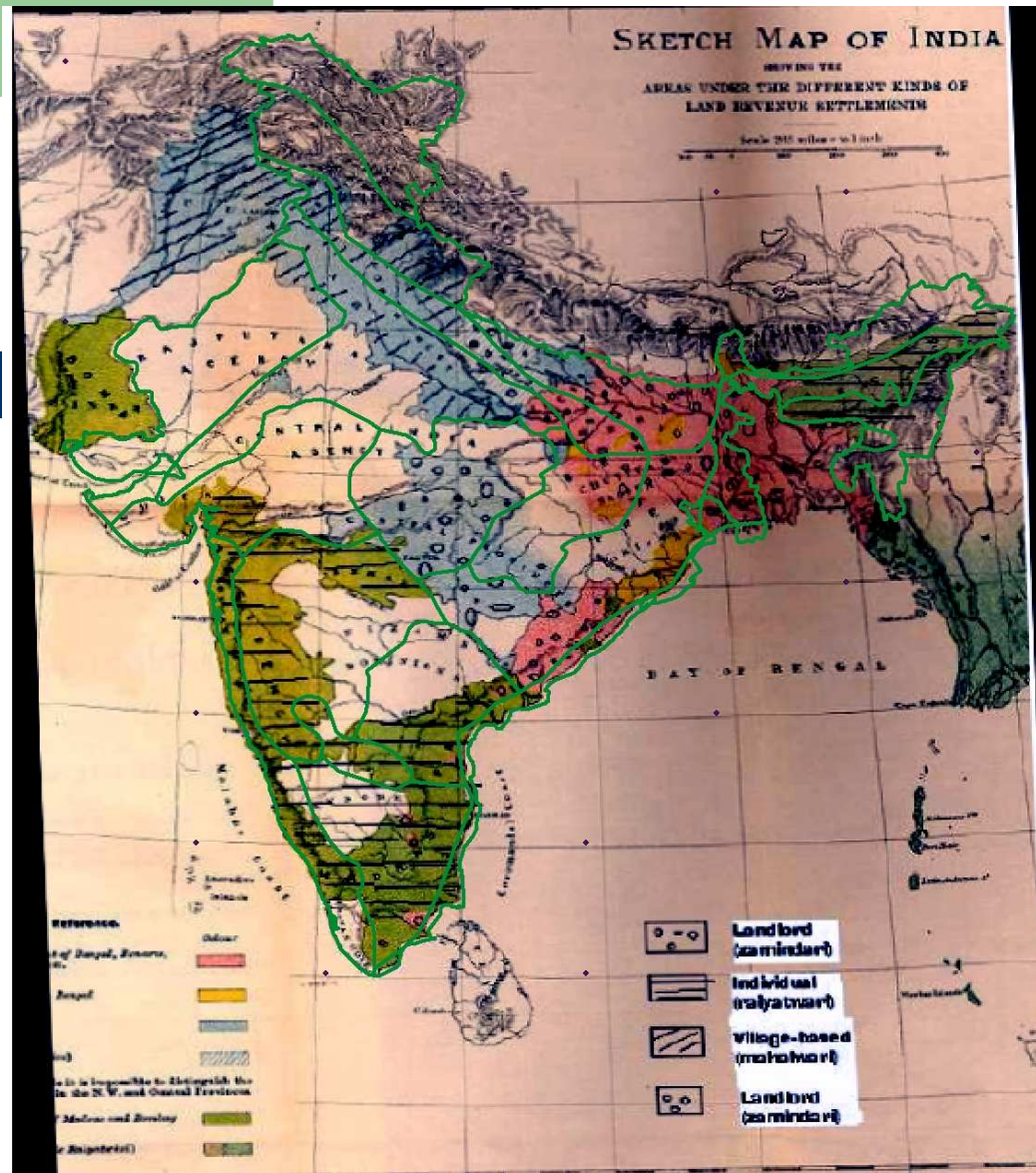
Land Systems of British India, probably circa 1875.
Source probably Baden-Powel, 1892.



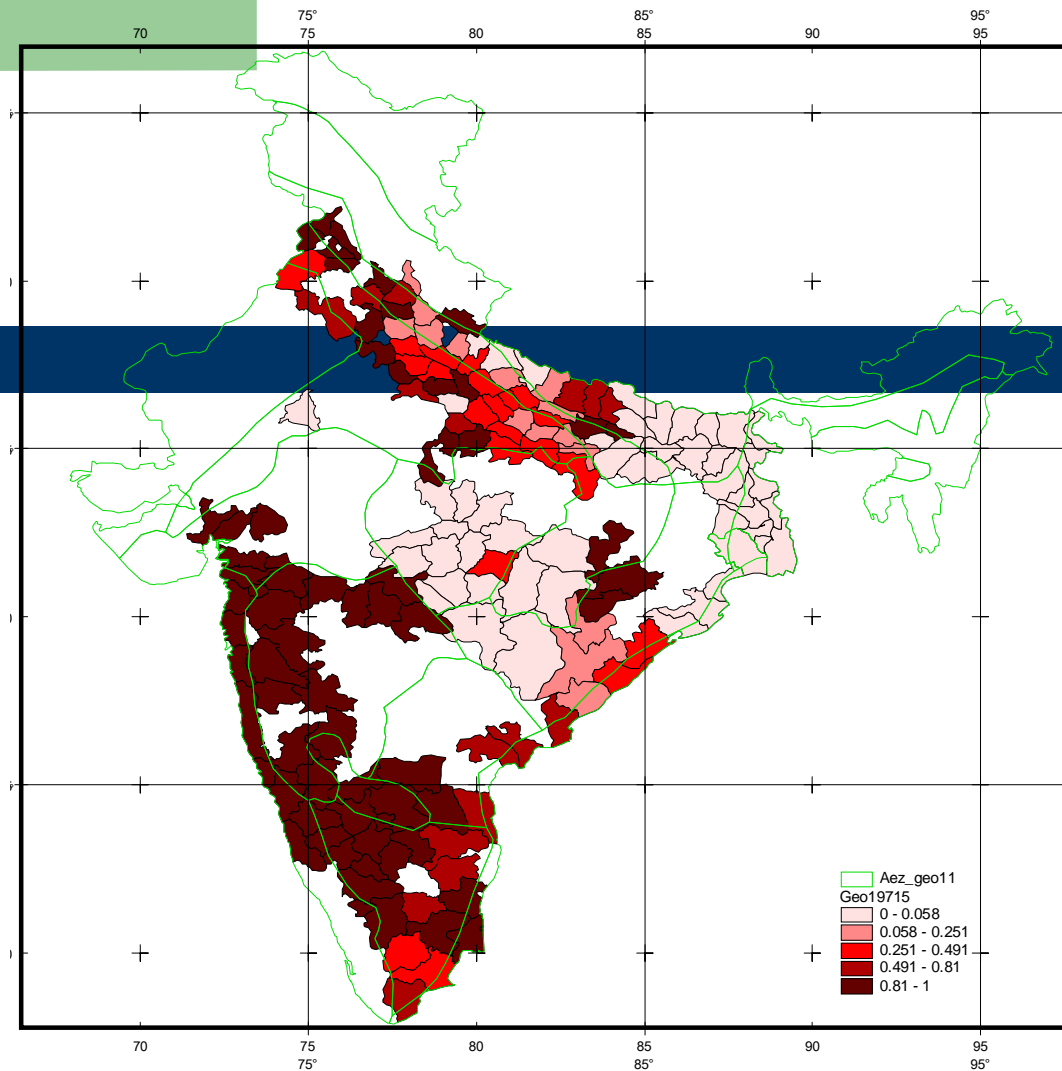
AEZs in India: source Palmer-Jones and Sen, 2003



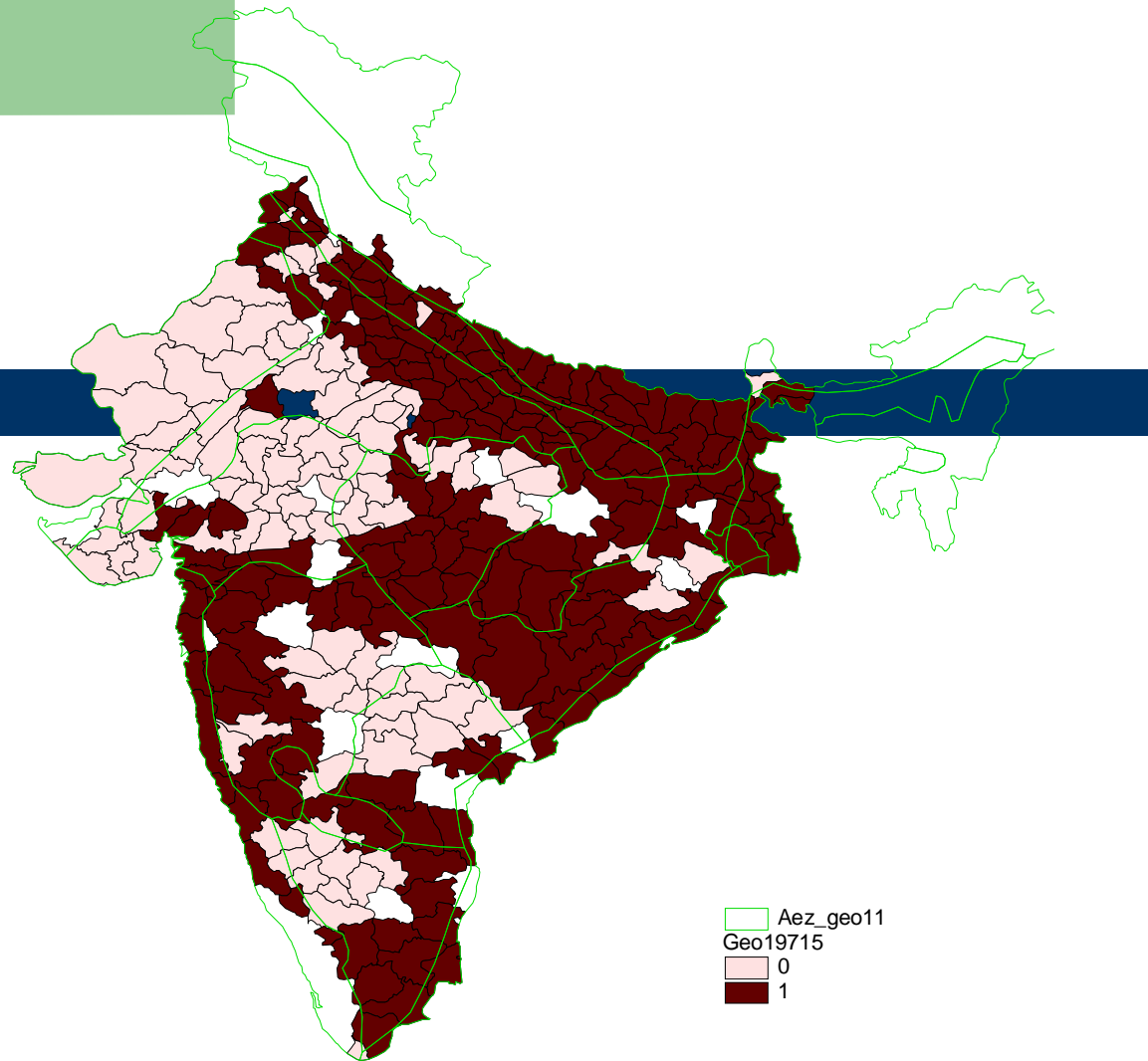
Map of AEZs used in this presentation: source Palmer-Jones & Sen



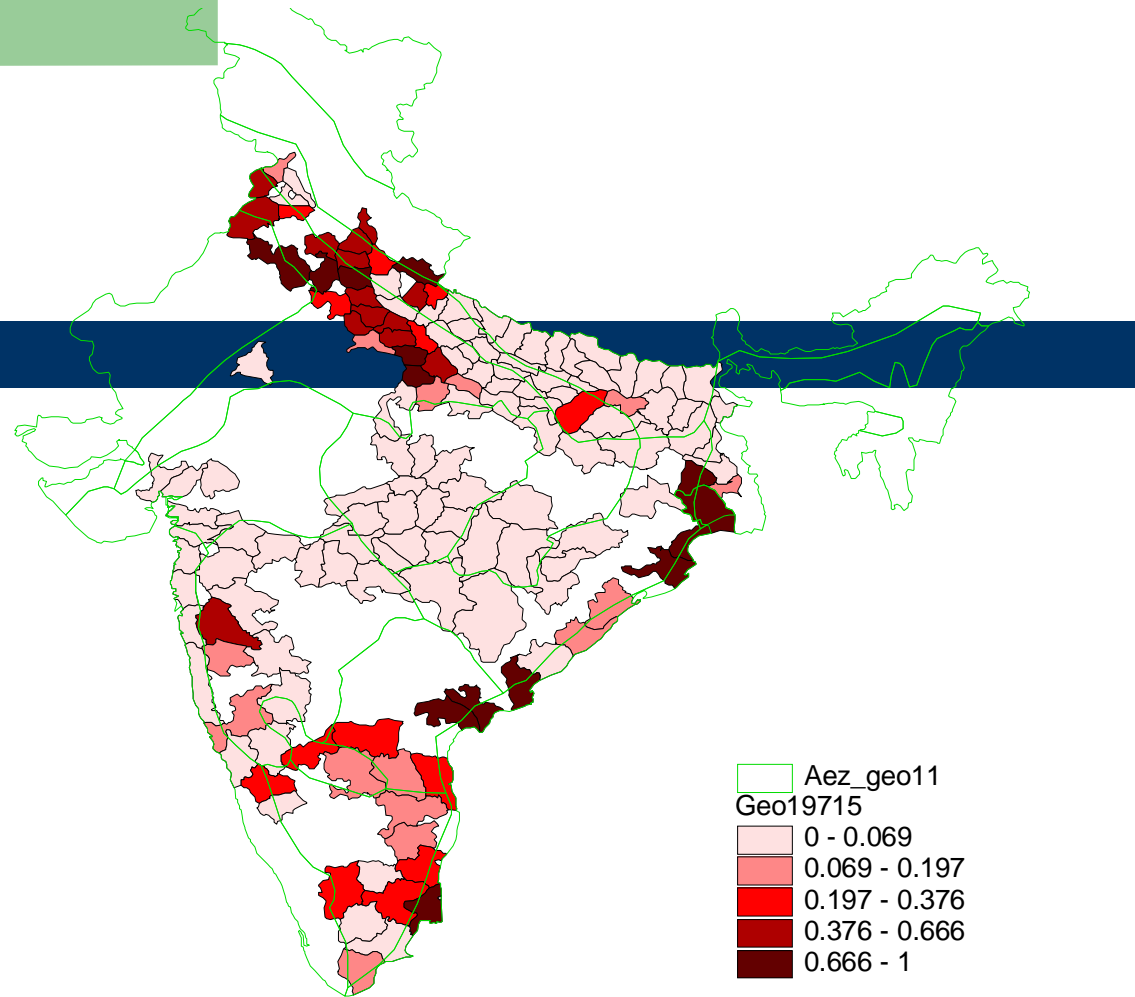
Distribution of Land Tenure Systems in British India, overlaid with agro-ecological zones – Projected (rather roughly)



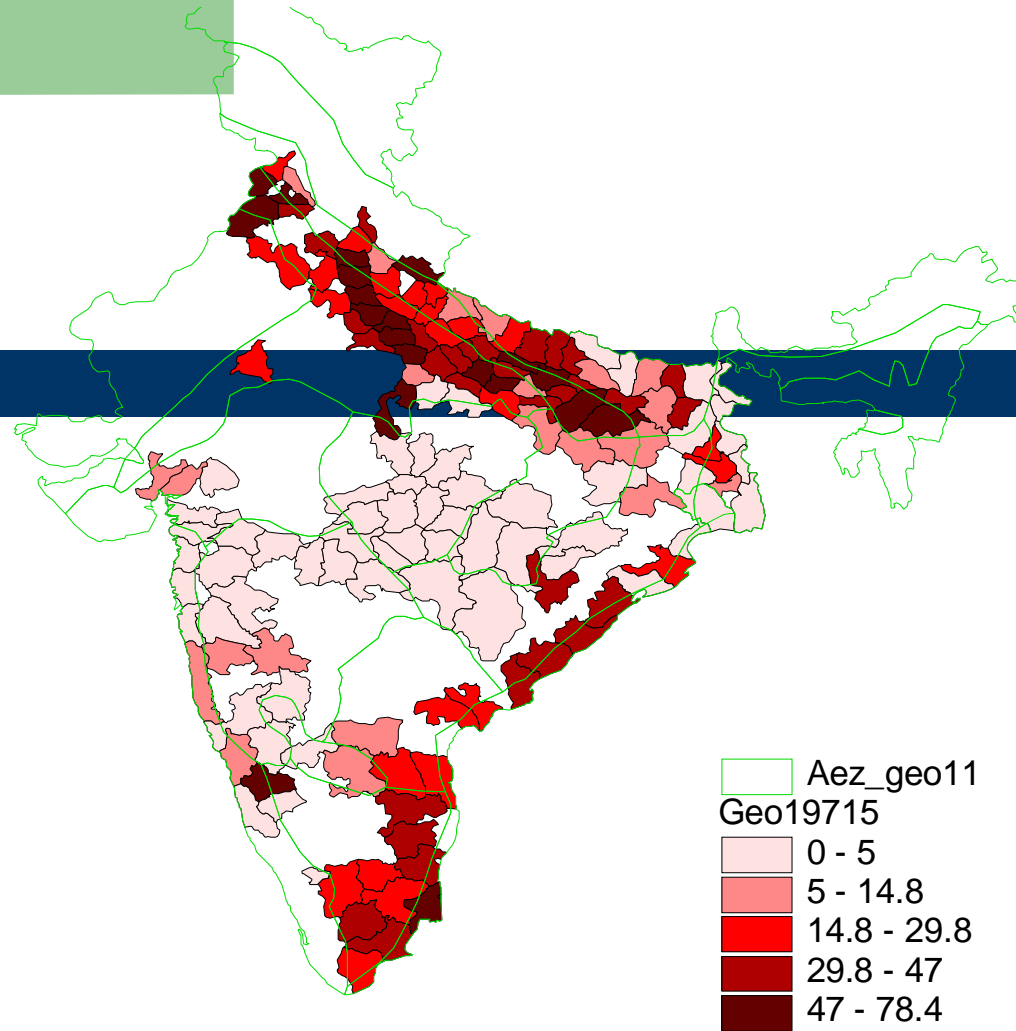
Distribution of Districts in B&I Agriculture estimation set,
by Proportion of Non-Landlord Land, Overlaid with AEZs
Blank districts have no data or are allocated to Princely States



Distribution of Districts in B&I agricultural data set,
By “britdum” – whether British or Princely State



Share of Government Canals (1901) in Gross Irrigated Area



Share of Irrigation in Gross Cultivated Area, 1901

Testing for the effects of colonial infrastructure and endowments vs BI landlord classification

- We replicate BI Table 3 regressions, with same dependent variables, key explanatory variables (proportion of district under landlord TS and dummy if district is assigned landlord) and same controls (altitude, latitude, mean rainfall, soil quality dummies).
- As in BI, we use district level clustering for std errors.
- We add our own explanatory variables – first colonial irrigation, then col irr + aez proportions in districts.
- We have used percent of gross cropped area irrigated in 1901, and then separately, govt canals and tanks.
- Here, we only present results for gross irr area in aggregate, 1901.

Historical data: sources

- Statistics on cultivation (broad) and irrigation collated from the 1901 Report of the Indian Irrigation Commission.
- District level information on irrigated areas disaggregated by type of irrigation (canals, tanks, wells, other sources) available for 'British' districts.
- Aggregate (less reliable) estimates for Princely states

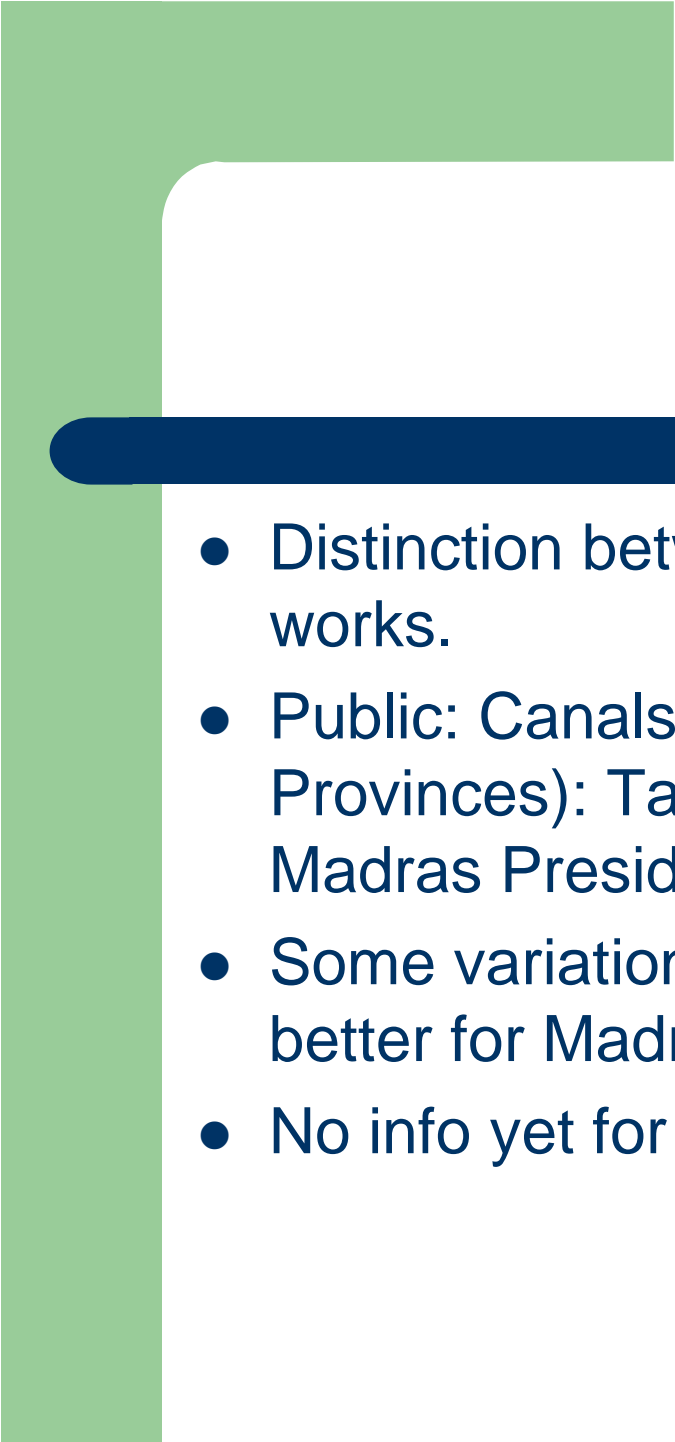

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- Distinction between private and public irrigation works.
 - Public: Canals in the North (Punjab, United Provinces): Tanks (canals in a few districts) in Madras Presidency.
 - Some variation in the level of detail reported (e.g. better for Madras than for Bengal)
 - No info yet for Mysore districts (British rule 1831-81).

Table 1: Descriptive Statistics of BI and Authors' data sets

Variables	Banerjee & Iyer				Authors				N	Difference between BI & Authors			
	mean	sd	difference	se_diff	mean	sd	difference	se_diff		mean	sd	difference	se_diff
Geographical													
Latitude	22.19	5.60	-4.35	0.96	22.18	5.61	-4.37	0.97	166	0.01	-0.01	0.02	-0.01
Altitude	366.41	148.14	93.64	25.98	367.63	147.75	91.02	26.08	166	-1.22	0.39	2.62	-0.10
Total rain	1263.09	471.64	373.99	80.83	1269.66	465.34	-395.62	79.33	166	-6.57	6.30	769.61	1.50
Coastal dummy	0.15	0.36	0.08	0.07	0.14	0.35	0.10	0.06	166	0.01	0.01	-0.02	0.00
Soils proportion													
Black	0.21	0.41	0.24	0.07	0.21	0.41	0.24	0.07	166	0.00	0.00	0.00	0.00
Alluvial	0.168	0.375	-0.135	0.067	0.566	0.497	0.083	0.091	166	-0.399	-0.122	-0.218	-0.024
Red	0.569	0.497	0.075	0.090	0.169	0.376	-0.139	0.068	166	0.400	0.121	0.214	0.022
Major Crops proportion													
Rice	0.366	0.298	-0.194	0.054	0.367	0.298	-0.203	0.054	5311	-0.001	0.000	0.009	0.000
Wheat	0.149	0.157	-0.058	0.026	0.150	0.158	-0.061	0.026	5311	-0.001	-0.001	0.003	0.000
Cereals	0.205	0.172	0.128	0.031	0.203	0.170	0.137	0.030	5311	0.002	0.002	-0.009	0.001
Oilseeds	0.067	0.088	0.065	0.013	0.067	0.087	0.067	0.013	5311	0.000	0.001	-0.002	0.000
Cotton	0.041	0.096	0.066	0.018	0.040	0.096	0.070	0.018	5311	0.001	0.000	-0.004	0.000
Tobacco	0.003	0.015	0.005	0.002	0.003	0.015	0.005	0.002	5311	0.000	0.000	0.000	0.000
Sugar cane	0.031	0.053	0.005	0.008	0.031	0.053	0.004	0.008	5311	0.000	0.000	0.001	0.000
Ratio of cash to all crops	0.149	0.257	0.152	0.048	0.148	0.257	0.158	0.049	5311	0.001	0.000	-0.006	-0.001

Note: regressions using authors' rather than BI data are indicated; BI have no data for 1901 and AEZ data.

Dependent Variable	Prop of non-landlord TS, with Gross Irrigated Area (as per cent of GCA), 1901	GIA, 1901	Prop of non-landlord TS , With Gross Irrigated Area (as per cent of GCA), 1901, and AEZ dummies	GIA, 1901
<u>Agricultural Investment</u>				
Prop of gross cropped area irrigated	0.03 (1.19)	0.61 (7.86)*	0.03 (0.33)	0.61 (7.86)*
Fertiliser Use	8.77 (2.82)*	35.83 (4.26)*	8.33(1.87)*	18.27(2.32)*
Propn of rice area under HYV	0.07(1.67)	0.07(0.38)	0.08(1.53)	0.16(1.67)*
Propn of wheat area under HYV	0.09(1.96)*	0.09(1.09)	-0.16(0.31)	0.24(3.04)*
Propn of other cereal area under HYV	0.06(1.91)*	-0.025(0.39)	-0.02(0.53)	0.11(1.29)
<u>Agricultural Productivity</u>				
Log total yield	0.12(1.93)*	0.70(4.9)*	0.16(2.66)*	0.37(3.09)*
Log rice yield	0.15(1.98)*	0.35(2.58)*	0.03(0.43)	0.36(2.42)*
Log wheat yield	0.19(2.87)*	0.48(3.67)*	0.20(3.7)*	0.32(4.07)*
Number of districts	156 (148 for log wheat yield)	156 (148 for log wheat yield)	156 (148 for log wheat yield)	156 (148 for log wheat yield)

Concluding Remarks

- *Initial results suggest our alternate framework, which stresses the role of infrastructure and irrigation, has more explanatory power than BI.*
- **Work remaining:**
- Strict replication: re-coding BI districts, how much of a difference does it make?
- State fixed effects: do they knock out the key BI results?
- Scientific replication: further robustness tests.
- Issues: how much of the tank (public) irrigation in Madras Presidency reflects investment by the British?
- Were irrigation investments during later stages of Colonial Rule of a higher quality than earlier investments (e.g. compare Punjab with United Provinces)?