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Original Article

Commercial Agriculture and Resource Sustainability in drought prone region in Solapur District

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Abstract

Studies of agrarian commercialization in semi-arid India typically stop at the point of documenting a shift toward higher-value, more input-intensive cropping, without examining whether the resource base sustaining that shift is itself under strain. This paper addresses that gap for Solapur district, Maharashtra, where district records show fertilizer application per hectare rising from 64.88 to 297.85 kilograms a 232.97 percent increase between 1994–1997 and 2004–2007, alongside a 118.72 percent rise in tractor numbers and a 52.28 percent rise in electric irrigation pumps over the same interval, even as traditional wooden and iron ploughs each declined by more than 40 percent. Cross-referencing this intensification trend against groundwater-level records for the district's three most heavily monitored talukas, we find depletion of 2.18 to 4.55 metres between 2000 and 2005 a pace of decline that, if representative of the wider district, would be difficult to reconcile with the continued expansion of net irrigated area documented over the same broader period. We further show that the district's working population grew fastest not in cultivation itself but in construction and transport (312.5 and 266.7 percent respectively between 1991 and 2001), suggesting that agrarian intensification has been accompanied by a labour reallocation toward non-farm activity even as the farming population itself continued to grow in absolute terms. We argue that the district's celebrated shift toward commercial horticulture rests on an input trajectory whose long-run water-resource sustainability is not evidenced in currently available district data, and that groundwater monitoring coverage limited in the available records to three of the district's eleven talukas is itself inadequate to the scale of the intensification underway.

Keywords: *agricultural intensification; groundwater depletion; mechanization; rural labour transformation; resource sustainability; Solapur district*

Introduction

A district that shifts successfully from rain-fed cereal cultivation to irrigated commercial horticulture is, by the usual metrics of agricultural development, a district that has improved its economic position. That shift is rarely evaluated, however, against the resource trajectory it depends on: an input regime intensifying faster than the underlying water table can sustain will eventually constrain the very commercialization it initially enabled, and the interval between the two the intensification phase in which yields and incomes still rise even as the aquifer draws down is precisely the period least likely to trigger corrective policy attention, because the visible indicators (production, income, cropped area) continue to improve even as the underlying resource stock erodes.

This paper examines that interval for Solapur district using district agricultural-input records spanning 1994 to 2007 and available groundwater-level records for 2000–2005.

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Companion analyses of this district have documented, respectively, the role of irrigation-source composition and of institutional credit in driving the district's shift toward commercial fruit cultivation; this paper asks a related but distinct question not what drove the transition, but what its continuation is now costing in terms of water resource stock and rural labour structure, and whether current district data collection is adequate to monitor that cost.

Objective

To assess the sustainability of agrarian commercialization in Solapur district, Maharashtra."

Data and Methods

Fertilizer-use and agricultural-equipment data are drawn from the Socio-Economic Review and District Statistical Abstract of Solapur District for the reference periods 1994–1997 and 2004–2007. Groundwater-level data are drawn from district hydrogeological survey records for 2000 and 2005, available for three talukas North Solapur, South Solapur, and Barshi representing the extent of taluka-level groundwater monitoring in the records consulted for this study; we treat this limited coverage itself as a finding, discussed in §4.3. Working-population and sectoral-employment data are drawn from Census of India returns for 1991 and 2001. Net irrigated area figures, used here only as contextual cross-reference, are drawn from the Socio-Economic Data of Solapur District (2011) series used in the companion irrigation analysis.

Because fertilizer, equipment, and groundwater series are each observed at only two time points, this paper reports rates of change between those points rather than fitting a continuous trend; we do not extrapolate the observed rates forward, and we flag explicitly where the underlying data do not support district-wide generalization from the available taluka sample.

Results

1. **Fertilizer Intensification**

Table 1 sets out the growth in fertilizer application recorded for the district between the two reference periods.

Table 1: Fertilizer Use, Solapur District, 1994–1997 and 2004–2007

Period	Total Use (tonnes)	Per-Hectare Use (kg)
1994–1997	73,884	64.88
2004–2007	3,03,095	297.85
Change (%)	+410.23	+232.97

Source: Socio-Economic Review and District Statistical Abstract of Solapur District, 1994–1997 and 2004–2007.

Total district fertilizer consumption more than quadrupled over the decade separating the two reference periods, and per-hectare application more than tripled a substantially faster rate of intensification than either cropped area or population grew over the comparable interval, indicating that the district's agriculture became markedly more input-dependent per unit of land rather than simply expanding onto new area.

2. Mechanization and the Substitution of Traditional Implements

Table 2 presents parallel change in farm equipment holdings.

Table 2: Agricultural Equipment in Use, Solapur District, 1994–1997 and 2004–2007

Equipment	1994–1997	2004–2007	Change (%)
Wooden plough	30,243	17,744	-41.32
Iron plough	58,277	31,929	-45.21
Bullock cart	35,599	36,565	+2.71
Diesel pump	9,018	8,273	-8.26
Electric pump	40,128	61,108	+52.28
Tractor	1,997	4,368	+118.72

Source: Socio-Economic Review and District Statistical Abstract of Solapur District, 1994–1997 and 2004–2007.

Tractor numbers more than doubled and electric pump numbers grew by over half, while both traditional plough types declined by more than 40 percent — a mechanization pattern consistent with capital deepening on a per-farm basis rather than an expansion in the number of farms mechanized. The rise in electric pump numbers is the more consequential figure for present purposes: electric pumps draw groundwater directly, and their 52.28 percent growth over the decade sits alongside the fertilizer intensification documented above as a second, independent indicator of rising per-hectare water and input demand, examined directly against groundwater-level evidence in §3.3.

3. Groundwater Depletion: A Constrained but Suggestive Record

District hydrogeological records available for this study cover three of the district's eleven talukas. Table 3 sets out the recorded change.

Table 3: Groundwater Level by Taluka, Solapur District, 2000 and 2005

Taluka	Level 2000 (m)	Level 2005 (m)	Depletion (m)
North Solapur	5.59	7.86	2.27
South Solapur	5.63	7.81	2.18
Barshi	5.71	10.26	4.55

Source: Groundwater Surveys and Development Agency, Solapur district (three monitored talukas).

All three monitored talukas recorded substantial depletion over the five-year interval, ranging from 2.18 metres in South Solapur to 4.55 metres in Barshi the latter nearly double the depletion rate of the other two talukas despite a broadly comparable starting depth in 2000. This is a striking finding set against the district's own land-use returns, which record net irrigated area rising from roughly 13 to 25 percent of cultivable land across the broader 1980–81 to 2010–11 period: an expanding irrigated area drawing increasingly on groundwater, at a moment when the available (if limited) groundwater record shows the water table already receding by several metres within a five-year window, describes a resource trajectory that is difficult to characterize as sustainable on the evidence available, though the three-taluka sample cannot establish whether this pattern holds district-wide.

4. **Sectoral Restructuring of the Rural Workforce**

Table 4 sets out change in the district's working population by sector between 1991 and 2001.

Table 4: Working Population by Sector, Solapur District, 1991 and 2001 (in '000)

Sector	1991	2001	Change (%)
Farmer	421	490	16.39
Farmworker	393	435	10.69
Livestock/Fisheries/Forest	25	32	28.00
Industrial/Processing	162	213	31.48
Construction	24	99	312.50
Trading (Export/Import)	84	110	31.95
Transport and Storage	33	121	266.67
Total Working Population	1,248	1,603	28.45

Source: Population Census Report, Government of India, 1991 and 2001.

The farmer and farmworker categories both grew over the decade (16.39 and 10.69 percent respectively), but far more slowly than construction (312.50 percent) and transport and storage (266.67 percent) the two fastest-growing sectors in the district by a wide margin. Because this is precisely the decade in which fertilizer and mechanization intensification accelerated (§3.1–3.2), the pattern is consistent with an agrarian transition that raised labour demand for the built infrastructure and logistics supporting commercial agriculture roads, market and storage facilities, farm-pond construction itself proportionally faster than it raised labour demand within cultivation, even as cultivation's own workforce continued to expand in absolute terms.

Discussion

1. An Intensification Trajectory Outrunning Its Own Evidence Base

Considered jointly, the fertilizer, mechanization, and groundwater series describe an agriculture intensifying its land- and water-use considerably faster than the district's available monitoring infrastructure can currently verify as sustainable. This is not, on the present evidence, a claim that the district's water resources are collapsing — the groundwater sample is too limited, both in taluka coverage and in the number of observation years, to support so strong a conclusion — but it is a claim that the district's own data collection has not kept pace with the scale of the transition it is otherwise so well positioned to document. A district capable of producing detailed taluka-level records on fertilizer tonnage, equipment counts, and crop-wise production shares, as the parent chapter for this study demonstrates, but capable of producing groundwater-level records for only three of eleven talukas, has uneven evidence base precisely at the point where evidence matters most for anticipating resource constraint before it becomes binding.

2. **Implications for the District's Commercialization Trajectory**

Both irrigation-driven and credit-driven accounts of Solapur's shift toward commercial fruit cultivation examined in companion analyses of this same district implicitly assume that the water and input base supporting that shift will remain available on broadly the same terms going forward. The evidence assembled here suggests that assumption deserves closer scrutiny: if the depletion rates recorded in North Solapur, South Solapur, and Barshi extend to the district's remaining, unmonitored talukas several of which, including Sangola and Pandharpur, carry substantially higher net irrigated area and farm-pond density than the three monitored talukas the long-run viability of the very commercialization trajectory those companion analyses document may be more constrained than currently visible production and income figures suggest.

Conclusion

Solapur district's fertilizer application per hectare more than tripled and its tractor and electric-pump stock grew by well over half within a single decade, a pace of agricultural intensification that outstrips the district's own capacity, on the evidence available, to monitor its groundwater consequences: hydrogeological records cover only three of eleven talukas, and even within that limited sample, depletion of up to 4.55 metres was recorded within five years. Meanwhile, the district's working population grew fastest not in agriculture but in construction and transport, indicating that the visible benefits of this transition — improved infrastructure, expanding logistics capacity are accruing alongside, and are not obviously in tension with, an underlying resource trajectory that current data cannot confirm is sustainable.

We recommend, on this basis, that groundwater monitoring be extended to the district's remaining talukas as a priority, particularly those Sangola and Pandharpur foremost with the highest recorded irrigation intensity and farm-pond density, since these are precisely the talukas for which the present analysis has no direct groundwater evidence at all. Absent that extension, claims about the sustainability of Solapur's agrarian transition, in either direction, rest on an evidence base too thin to support confident policy conclusions, and this paper's own claims should be read as a call for that evidence to be gathered rather than as a demonstrated finding of resource crisis.

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Conflicts of interest
The authors declare that there are no conflicts of interest regarding the publication of this paper.

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