

Secret of Gujarat's Agrarian Miracle after 2000

TUSHAAR SHAH, ASHOK GULATI, HEMANT P, GANGA SHREEDHAR, R C JAIN

Semi-arid Gujarat has clocked high and steady growth at 9.6% per year in agricultural state domestic product since 1999-2000. What has driven this growth? The Gujarat government has aggressively pursued an innovative agriculture development programme by liberalising markets, inviting private capital, reinventing agricultural extension, improving roads and other infrastructure. Canal-irrigated South and Central Gujarat should have led Gujarat's agricultural rally. Instead it is dry Saurashtra and Kachchh, and North Gujarat that have been at the forefront. These could not have performed so well but for the improved availability of groundwater for irrigation. Arguably, mass-based water harvesting and farm power reforms have helped energise Gujarat's agriculture.

1 Gujarat's Agricultural Growth since 2000

Never known for agrarian dynamism, semi-arid Gujarat has clocked exceptionally high and relatively steady rate of growth of 9.6% per year in its agricultural state domestic product (SDP) in the early years of the new millennium (Gulati et al 2009). This is in sharp contrast to the rather mediocre growth rate of 2.9% per year in the national GDP from agriculture and allied sectors. It is also in contrast to Gujarat's own highly volatile agricultural performance during the decades before 2000. Gujarat's economy has been outperforming the rest of the country since 1990. However, this has been largely because of rapid industrial growth. Agriculture has never been an important part of the Gujarat growth story. Over the long term, Gujarat's agriculture grew faster than Indian agriculture as a whole since 1970. However, year-to-year fluctuations in Gujarat's agricultural growth rates were so violent that for years, researchers have bemoaned indifferent agricultural growth performance as a drag on Gujarat's overall growth in economic and human development terms (Dholakia 2002; Hirway 2000; Mathur and Kashyap 2000; Bagchi et al 2005).

Against this gloomy backdrop, Gulati et al (2009) found that in the new millennium, Gujarat's agriculture has not only bucked its own past trend but also the national trend. They reported that "agriculture in Gujarat after 2000 seems to have picked up dramatically, recording average annual growth rate of 9.6% during 2000-01 to 2006-07" (p 4). In their preliminary analyses of state-level trends, Gulati et al (2009) observed that the main sources of Gujarat's agricultural growth post-2000 have been the massive boom in cotton production, the growth in the high value sector comprising livestock and fruits and vegetables, and the rise in wheat production.

Table 1 (p 46) provides a bird's eye view of the annual rates of growth of the value of output in different crop groupings before and after 2000. Two striking aspects are noteworthy. First, annual growth rates of all crops, except paddy, have significantly accelerated after 2000 compared to before. Indeed, in wheat and pulses, the growth rate nearly doubled, and, in cotton, it jumped over 3.5 times. The growth rates accelerated as fast, or faster, for cash crops like potato and banana; these had a relatively small weight in the area cultivated but a disproportionately large weight in the value of output. Livestock output, particularly milk, too experienced an acceleration in growth rate. The only major crop where growth rate decelerated was paddy. The second aspect of the Gujarat story has to do with the fluctuations. The coefficient of variation (cv) for all crops and crop groups has been lower in the period after 2000 than before. This makes it important to explore the sources of stabilising influences in Gujarat agriculture.

Tushaar Shah (*T.Shah@cgiar.org*) is at the International Water Management Institute, Colombo. Ashok Gulati, Hemant P and Ganga Shreedhar are at the International Food Policy Research Institute. R C Jain is at the Central Groundwater Board, New Delhi.

Table 1: Annual Average Growth of Major Sectors and Crops: Gujarat (1992-93 to 2005-06)

Sectors	1992-93 to 1999-2000	CV	2000-01 to 2005-06	CV
Total foodgrains	7.3	4.2	11.0	3.4
Total cereals	8.6	3.7	11.0	3.2
Total pulses	5.3	6.9	11.7	4.0
Paddy	12.0	1.6	8.6	3.9
Wheat	12.8	4.0	23.1	2.3
Maize	10.3	3.5	15.9	4.9
Total cash crops (excluding cotton)	10.5	4.3	19.2	2.8
Cotton	10.5	3.9	36.1	1.1
Total others	3.3	3.2	0.4	7.2
Total fruits and vegetables	8.6	2.9	14.4	0.5
Banana	2.5	9.6	12.1	1.6
Potato	5.8	4.4	11.1	1.7
Livestock	5.0	0.7	6.6	0.8
Milk	4.9	0.7	6.9	0.9
Total agriculture and livestock	5.4	3.9	11.2	1.8

Source: Gulati et al (2009).

Table 2 highlights the rapidly changing composition of Gujarat's agrarian economy with cash crops expanding their share at the expense of foodgrain crops. Table 3 summarises the rapid growth in key aggregates since 1999-2000. The claims Gujarat leaders are making are tall indeed, especially for the most recent years: agricultural income of farmers in Gujarat has grown the fastest in the country at an annual rate of 13% since 2004-05; the area under food crops jumped from 36.6 lakh hectares in 2004-05 to 47.11 lakh hectares in 2007-08; total foodgrain production has improved by 55% from 51.53 lakh metric tonnes (MT) in 2004-05 to 79.95 lakh MT in 2007-08. Though it is early days, even in the 2009 drought, Gujarat's kharif sowing – at 82.5 lakh hectares – is higher than the 2008 kharif.¹ No matter how one looks at the data, post-2000 Gujarat agriculture has experienced rapid growth as well as enhanced stability – both of which together make the state's experience look like a miracle.

Table 2: Changing Composition of Gujarat's Farm Economy

Crops	% Share in Gross Value of Output of Agriculture and Allied Sectors	
	TE* 1999-2000	TE 2006-07
Total foodgrains	15.8	12.9
Cotton	9.4	15.6
Cash crops other than cotton	27.4	25.8
Fruits and vegetables	9.9	12.5
Total livestock	22.7	22.4
Total others	14.8	10.8
Total	100.0	100.0

*TE refers to Triennium Ending.
Source: Gulati et al (2009).

Table 3: Growth in Key Aggregates

	1999-2000	2005-06**	2007-08 (Forecast)
Aggregate cotton output (million bales)	2.15	6.87	8.28
Aggregate wheat output (million MT)	1.1	2.32	3.84
Milk output (million MT)	5.26	6.96	7.91
Value of output of milk and major crops (Rs crore) at 1999-2000 prices	21,730	36,953	NA
Value of output of milk and major crops per hectare (Rs) at 1999-2000 prices*	22,876 (19,191)	37,510# (32,576)	NA
GSDPA per farmer (Rs) at 1999-2000 prices##	37,683.6	67,316.3	NA

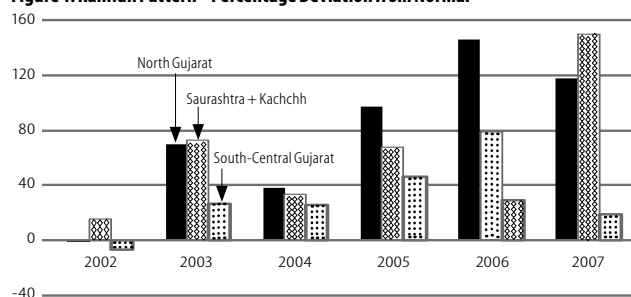
* Figures in parentheses are values calculated on the basis of selected crops and milk.
Per hectare value for 2005-06 is based upon net sown area estimates for 2003-04, the last year for which state net sown area figures are available.
** The value of output data and gross state domestic product in agricultural and allied activities published by the Central Statistical Organisation (CSO) is for the period 1999-2000 to 2005-06.
Based on total number of landholdings data from the Agricultural Census 2001 (<http://agcensus.nic.in/cendata/StateT1table1.aspx>), assuming no change between 1999-2000 and 2005-06.

What is driving this breakneck growth? Is it a succession of good monsoons? Or better market opportunities? Or the Sardar Sarovar irrigation project? Or the things the farmers and the government of Gujarat have done? This paper attempts to unlock the secret of Gujarat's agricultural growth miracle in recent years. If the miracle is caused by acts of god – like favourable monsoons – or other exogenous factors, it is of relatively little policy interest. However, if government policy drivers are behind the miracle, the Gujarat story acquires great significance for the lessons it offers to other governments about how to kickstart rapid agricultural growth.

2 Exogenous Drivers of Agricultural Growth

Several exogenous factors have helped Gujarat's exceptional agricultural growth performance after 1999-2000. Much of Gujarat – especially the drought-prone regions of Saurashtra, Kachchh and North Gujarat – have received above-normal rainfall during all these years. During 2002, when almost all of India experienced shortfall in rainfall precipitation, Gujarat too faced an overall shortfall. However, drought hit only the central and southern parts, which are covered by canal irrigation. The drought-prone regions all had above or near-normal rainfall as shown in Figure 1.

Figure 1: Rainfall Pattern – Percentage Deviation from Normal



Also helpful has been the market environment. The highly remunerative minimum support prices (MSP) for cotton, wheat and other crops announced by the central government have provided strong incentive to farmers to increase production. For Gujarat farmers, of particular significance has been the high MSP for cotton since the Cotton Corporation of India has a sizeable procurement operations in the state. Export demand for cotton has been strong, too. During recent years, Gujarat has emerged as India's largest cotton-producing state and a major cotton supplier to China.

The spontaneous emergence – and wildfire growth – of “illegal” local production of Bt cotton seed by relatively unknown entrepreneurs was for long viewed with concern by the central authorities. The Gujarat government, however, expressed its inability to bring these informal seed producers under control even as it kept paying lip service to the need to do so. It cannot be anybody's case that this development has been an unmixed blessing. Indeed, unregulated development of Bt cotton seed industry has brought into the fray many fly-by-night operators who sell fake seeds and bring farmers to ruin. However, it is also true that Gujarat's cotton boom has been aided in no small measure by the availability of reasonably priced quality Bt cotton seed.

Despite the threat of fake seeds, farmers from faraway Punjab throng to North Gujarat where Mansa town has emerged as the Bt cotton seed production hub. Indeed, a train bringing hordes of Punjab farmers from Jalandhar to Mehsana is now popularly called “Bt cottonseed express”.

The Gujarat government tolerated local Bt cotton seed manufacturers in early years because they undercut Monsanto whose seeds were found to be prohibitively expensive at Rs 1,600 per packet. But gradually, local producers too began to charge high prices. To regulate these, the state government first used moral suasion with seed producers, and when that failed, imposed a ceiling of Rs 750 per packet to ensure that farmers got seeds at a reasonable price. Since then, Bt cotton seed production in Gujarat has increased rapidly. The steep fall in the price of Bt cotton seed from Rs 1,600 to Rs 650 for a 450 gm packet has helped spread the expansion of Bt cotton cultivation in Gujarat (Gupta 2008).²

These exogenous factors however cannot explain the Gujarat agricultural miracle. After the 2002 drought, monsoons have been kind to most parts of India, except in 2009. The high MSP of wheat, cotton and other crops were available to farmers in all the states. Even the Bt cotton revolution spread in all cotton-growing states like Maharashtra, Andhra Pradesh and Punjab. The overall economic boom that India has enjoyed should have generated a demand pull for farm products all through the country. Yet, it was only Gujarat which experienced rapid acceleration in agricultural growth during these years. This led us to hypothesise that Gujarat’s agricultural boom is likely driven by Gujarat-specific drivers, which may include policy initiatives of the government of Gujarat.

3 Policy Drivers of Agricultural Growth

Although widely lauded for adopting an aggressive industrial policy that has made Gujarat a much-favoured destination for investment, the Bharatiya Janata Party (BJP) government has actually devoted a great deal of energy and resources to accelerating agricultural growth in the state through a broad spectrum of policy initiatives. These can be grouped into five categories:

Improved Market Access: This cluster includes all measures the government took to improve farmers’ access to better markets, enhance their margins and in general strengthen forward linkages. Gujarat was amongst the early states to amend the Agricultural Produce Marketing Committee (APMC) Act to enable farmers to directly sell their produce to wholesalers, exporters, industries and large trading companies without having to operate through *arhatias* or commission agents. It also allowed large players to establish spot exchanges. The amendment also helped create conditions conducive for the spread of contract farming. The government also encouraged large corporates to establish retail chains and source their requirements directly from farmers. Gujarat government has also pursued aggressive policies to promote diversification to high value crops, especially fruit and vegetables, and spices and condiments. For example, it began offering farmers direct capital subsidy of Rs 2.5 lakh to set up green houses, besides 25% relief in electricity duty.³ These measures have produced some outcomes. For example, between 2000-01

and 2005-06, Gujarat’s horticulture production increased by 108% (Government of Gujarat 2009a).

Technical Support, Extension and Credit: This cluster includes government initiatives to strengthen backward linkages in terms of extension, research support, and input supply. Here, Gujarat government did some remarkable things, with the political class leading from the front. Like elsewhere in India, the agricultural research and extension system in Gujarat has deteriorated. The old, World Bank-induced “training and visit” (T&V) system is all but defunct. The BJP government took several initiatives to revive farm extension, technical and credit support to farmers. It unbundled the monolithic Gujarat Agricultural University into four independent universities with significant increase in resources and autonomy provided to each of them. The scientists of the revitalised agricultural universities were then mobilised to reinvent the defunct T&V agricultural extension model.

Gujarat evolved its annual month-long *Krishi Mahotsav* campaign as a unique extension model that brought agricultural scientists, extension staff, agro-industries, input suppliers, cooperatives, banks, local and state-level political leaders together on a platform to exchange knowledge and information on the latest technologies and market opportunities. Large exhibitions organised in all the agricultural university campuses and district towns are widely attended by thousands of farmers. A *Krishi Rath* – complete with audio-visual equipment, posters, models and accompanied by scientists and administrators – visits every village of the state. Scientists give some lectures but also undertake soil health tests and give soil-health cards to the farmers detailing the soil composition, and the best possible crops for the soil type. They also carry out vaccination of the cattle, distribute kits on agriculture, animal husbandry, and horticulture to the five poorest farmers in the village.⁴ Gujarat officials recount several effects of the reinvented extension model. For instance, they argue that in using chemical fertilisers, Gujarat farmers have moved wholesale from a 13:7.5:1 nitrogen-phosphorous-potassium composition to a 6.5:3.5:1, thereby reducing cost, optimising production and improving net income.⁵ The farm credit system too has been revitalised. Agricultural loan disbursements in Gujarat have clocked 22-25% annual growth rate, thanks to supportive government policies. In the three years ending 2006-07, for example, agricultural loan disbursements in Gujarat doubled from 4,735 crore in 2003-04 to 10,468 crore in 2006-07.⁶

Canal Irrigation: A major priority for all governments in Gujarat since Indian independence has been irrigation development. Under the British Raj, the Gujarat part of the erstwhile Bombay state received little or no public irrigation investment. As a result, after becoming a state in 1959, successive Gujarat governments have devoted substantial budgetary resources to construction of major and medium canal irrigation projects. By far the largest such project is the Sardar Sarovar Project (SSP) on Narmada – called the “lifeline of Gujarat” – which has been mired in controversies and disputes. Gujarat has, however, raised the SSP dam height to 121.5 metres; and there is enough water in the dam to irrigate 1.8 million hectares as originally planned. However, SSP

irrigation development is stuck because of the slow pace of command area development. The main and branch canals are nearly complete. However, the government is facing major road blocks in acquiring land for creating the network of distributaries, minors and sub-minors. As a result, against a target of 1.8 million hectares, the ssp is irrigating only 80-100 thousand hectares mostly in the Narmada, Bharuch and Vadodara districts. Despite ssp's lacklustre progress, several large canal irrigation systems – Mahi, Ukai-Kakrapar, Karjan, Damanganga – provide a network of canals mostly in Central and South Gujarat, which have over 70% of Gujarat's command areas.⁷ While Gujarat has surpassed other states in many fields of agricultural policy, management of large irrigation projects remains an area with much scope for improvement and innovation.

Management of the Groundwater Economy: While ssp remains a distant dream and progress in canal irrigation is, in general, lukewarm, the Gujarat government has undertaken some unconventional initiatives in managing the groundwater economy, the mainstay of its irrigated agriculture. For one, the government has enthusiastically made common cause with farming communities in undertaking decentralised rainwater harvesting and groundwater recharge work. This movement had started as a mass movement in the late 1980s. However, the BJP government under Keshubhai Patel as well as Narendra Modi lent strong government support to communities and non-governmental organisations (NGOs) to expand this work in a participatory mode under the Sardar Patel Sahakari Jal Sanchaya Yojana. The scheme performed best in Saurashtra and Kachchh regions; but for the state as a whole, by December 2008, nearly 5,00,000 structures were created – 1,13,738 check dams, 55,917 bori bandhs, 2,40,199 farm ponds, besides 62,532 large and small check dams constructed under the oversight of the Water Resources Department of the Government of Gujarat – all in a campaign mode.⁸

Then, Gujarat also pioneered a new programme to popularise micro-irrigation technologies in groundwater irrigated areas. While the government of India offers an annual subsidy of all of Rs 400 crore to promote micro-irrigation for the whole country, the Gujarat government created the Gujarat Green Revolution Company (GGRC), a special purpose vehicle (SPV) for promoting micro-irrigation, with an initial funding of Rs 1,500 crore to be replenished as needed. GGRC developed a subsidy-loan scheme which is by far the best offered by any state to adopters of micro-irrigation. As a result, the spread of micro-irrigation technologies is more rapid in Gujarat than other states during recent years.

Finally, a reform that has had by far the most far-reaching impact on Gujarat's agriculture is Jyotigram Yojana, which was designed, ironically, to ration power supply to farmers and provide 24/7 three-phase electricity to non-farm rural users (Shah and Verma 2008). Most Indian states charge subsidised flat tariff for farm power supply; some like Punjab, Tamil Nadu and Andhra Pradesh, provide free power. However, the quality of farm power supply is very poor; farmers seldom get power according to a pre-announced schedule; power comes with frequent interruptions and very low voltage. In Andhra Pradesh, the utility is unable to control illegal connections; as a result, every farmer on

a feeder gets power with low voltage. Because they get subsidised or free power, farmers do not complain about quality; but poor quality of farm power supply remains a major speed breaker for agricultural growth and a bane for rural society.

The way out, it is suggested by many, is to meter farm connections, charge farmers based on power consumed, and provide them 24/7 three-phase power supply. However, farmers have forcefully resisted such proposals because of a variety of reasons. Since 2000, International Water Management Institute (IWMI) has been suggesting a second best solution: (a) ration farm power supply to fit irrigation demand schedules; (b) provide power ration against a fixed, preannounced schedule; and (c) overcome farmer resistance by offering to farmers uninterrupted power supply of full voltage.

During 2003-06, Gujarat government implemented Jyotigram Yojana with the aim of providing 24/7 power supply to villages. However, this could not be done without effective rationing of farm power supply. This led the government to invest Rs 1,200 crore in separating agricultural feeders from non-agricultural feeders throughout Gujarat. This done, Gujarat government began rationing farm power supply. During the past two years, Punjab has also fully separated farm from non-farm feeders; Andhra Pradesh, too, has done it in most districts. However, Gujarat follows all three IWMI recommendations: it provides farmers a rationed power supply but the power that Gujarat farmers get is 430-440 voltage, with few interruptions and is provided on a strict schedule. Farmers in Punjab and Andhra Pradesh get rationed power but of poor quality, with many interruptions and on uncertain schedules.

Road and Other Infrastructure: Gujarat has always been ahead of other states in investing in the road network since the 1960s. One reason why rural roads in many parts of Gujarat are good is the rise of dairy cooperatives which sent trucks to collect milk from the villages twice daily. These provided a push for improving rural road connectivity. Indeed, many dairy unions contributed to road construction; the National Dairy Development Board too once gave a large loan to the Gujarat government to construct/resurface rural roads. Today, Gujarat has 37.77 km of roads per 100 sq km and a road density of 1.35 km per sq km. Some 98.7% of Gujarat villages have road connectivity, and 77% of rural roads are surfaced.⁹ The government claims that while Gujarat invested Rs 3,484 crore on roads during the 40-year period during 1960-2001, it has invested Rs 4,783 crore during seven years from 2001 to 2007. Whether these claims are credible or not, Gujarat appears to have amongst the best-maintained road networks in the country today. And as International Food Policy Research Institute (IFPRI) and Asian Development Bank (ADB) studies have shown, good roads are the best building blocks for a rapidly growing agriculture (Fan et al 2008; ADB 2005).

4 Hypotheses

To explore what the role of each of these policy drivers has been, we decided to unpack Gujarat's growth story and undertake a district-level analysis. To this end, we divided Gujarat districts into four agrarian socioecologies as outlined in

Table 4: Four Agrarian Socioecologies of Gujarat

Regions	Districts	Features
Tribal areas	Dahod, Panchmahal and Dangs	First or second generation crop and dairy farmers; low level of economic enterprise; rainfed farming; semi-arid to humid climate.
North Gujarat	Ahmedabad, Gandhinagar, Patan, Mehsana, Banskantha, Sabarkantha	Enterprising farmers; Groundwater is the main source of irrigation; deep, alluvial aquifer system that is overexploited; highly developed dairying and dairy cooperatives.
Canal districts (South and Central Gujarat)	Anand, Kheda, Vadodara, Bharuch, Surat, Narmada, Navsari, Valsad	Humid and water-abundant part of Gujarat; large areas under canal irrigation systems such as Mahi, Ukai-Kakarapar, Karjan, Damanganga, Sardar Sarovar; conjunctive use of groundwater and canal water through farmer initiative; alluvial aquifers that are amply recharged by surface irrigation; enterprising farmers; strong dairy cooperatives.
Saurashtra and Kachchh	Amreli, Bhavnagar, Junagadh, Jamnagar, Porbandar, Rajkot, Surendranagar, Kachchh	Arid to semi-arid climate; groundwater the main source of irrigation; hard rock aquifers have poor storativity; open dugwells are the main source of irrigation; feudal culture; poor dairy cooperatives. Agriculture dependent mostly on monsoon; early withdrawal of monsoon the bane of kharif crop.

Figure 2: Four Agrarian Socioecologies of Gujarat

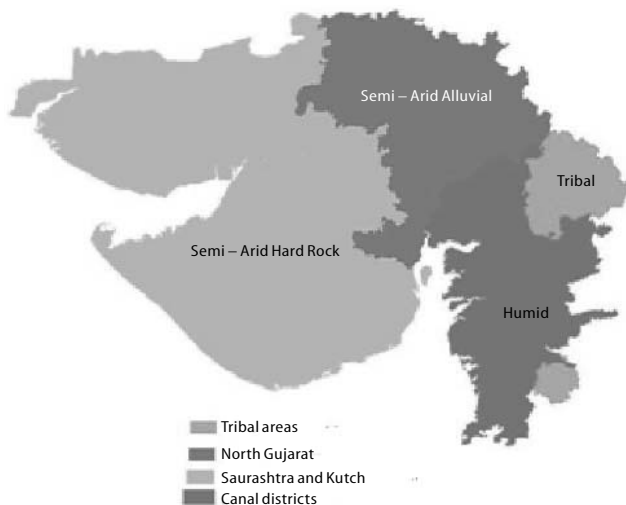


Table 4 and Figure 2. The four regions differ from each other in several respects: socio-economic, cultural, hydrological, geological and institutional.

Then, we postulated that the increase in the SDP from the agriculture and allied sectors is a product of changes in four variables: (i) shift from low-value crops to high value crops (C); (ii) increase in the value of crop yield per hectare (Y); (iii) increase in the gross cropped area (GCA) (A); and (iv) improved farm-gate prices and margins (M).

We then hypothesised that different policy drivers contribute to agricultural growth by influencing one or more of C, Y, A and M. For example, all initiatives we grouped under “market access” promote agricultural growth primarily through direct impact on M; and crop diversification would work chiefly through changing C, and so on. These hypotheses are set out in columns 2 and 3 in Table 5. The number of ↑ sign assigned suggests our expectation of the quantitative impact of the policy driver on the variable concerned.

We assumed that while some of the policy drivers work state-wide, others may not. Thus, “market access”, “roads and infrastructure”, “technical support, extension and credit” are implemented in the entire state. As a result, their impacts should be felt everywhere. However, some other interventions are, by their nature, confined to one or more of the four regions. For example, if “canal irrigation” underwent major reforms or received large investments, its impact would be strongly felt on agricultural performance of central and southern districts where much canal irrigation is located. On the contrary, had improved performance of public irrigation systems been a major driver of Gujarat’s agrarian growth, we should *not* expect to see a large impact in North Gujarat, Saurashtra and Kachchh, which have only a small share in Gujarat’s canal irrigation area. “Decentralised groundwater recharge” activities are concentrated in Saurashtra and Kachchh. Micro-irrigation too has spread more in Saurashtra and Kachchh, and North Gujarat.¹⁰ “Farm power reform” too affects the latter two regions far more than canal-dominated and tribal districts where agriculture is far less dependent on electric tubewells. It is against this background that we undertook a disaggregated analysis of Gujarat’s agricultural performance to isolate the policy drivers most responsible for the rally.

5 Disaggregated Analysis

Disaggregated analysis was carried out using district-level crop area, production and yield (A-P-Y) data (Government of Gujarat 2008, 2009a) and the value of output data for various crops at the state level (Government of India 2006, 2008). The value of output from a particular crop at the district level was computed from the value of output at the state level in proportion to the contribution of the district to the overall state production of that crop. A basket of 14 crops including milk has been used for the analyses.¹¹ This basket accounts for 75.8% of the value of output from agriculture and allied sectors for the state as a whole but only 61.2% of the GCA. This could not be helped because no A-P-Y data is reported on a large number of minor crops which together account for nearly 39% of the GCA.

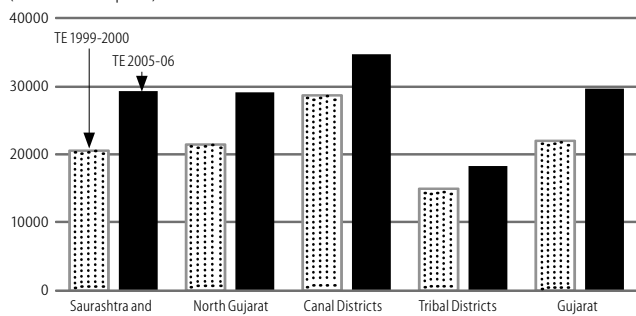
To begin with, we examined trends in aggregate land productivity by computing the value of (selected) crop and milk output per hectare at 1990-2000 prices.¹² Figure 3 (p 50) shows that for Gujarat as a whole, the productivity of farm lands – captured by the value of crops and milk per hectare – increased by 34.8% in

Table 5: Influence of Government Efforts on Value of Output

Drivers of Gujarat’s Agrarian Boom		C = crop choice	Regions Likely to Be Affected			
1	2	3	Canal Districts	Tribal Districts	North Gujarat	Saurashtra and Kachchh
		Y = yield per hectare A = cropped area M = farmer margins	4	5	6	7
1.1	Market access	M	↑↑↑	↑↑↑	↑↑↑	↑↑↑
1.2	Crop diversification	C	↑↑↑	↑	↑↑	↑↑
2.1	Technical support, extension and credit	Y	↑↑↑	↑↑↑	↑↑↑	↑↑↑
3.1	Large-scale irrigation	C/Y/A	↑↑↑	↑	↑	↑
4.1	Decentralised groundwater recharge	C/Y/A	↑	↑	↑	↑↑↑
4.2	Micro-irrigation	C/Y/M	↑	↑	↑↑	↑↑↑
4.3	Farm power reform	C/A	↑↑	↑	↑↑↑	↑↑↑
5.1	Road and other infrastructure	M	↑↑↑	↑↑↑	↑↑↑	↑↑↑

the triennium ending (TE) 2006 compared to TE 2000. However, the productivity increase was not uniform across the four regions (Figure 3). In the canal-irrigated Central and South Gujarat, output per hectare increased by 20.9%. In tribal districts, the increase was 22.5%. The increase in North Gujarat was 35.5%. The highest increase by far – 43.6 % – was in Saurashtra and Kachchh.

Figure 3: Increase in Land Productivity: Value of Crop and Milk Output Per Hectare (Rs at 1999-2000 prices)



Another major contributor to the Gujarat agricultural growth story is the rapid increase in the GCA. During the 1990s, Gujarat had experienced nearly 8% decline in the GCA (Figure 4). Between TE 2002 and TE 2008, the state increased GCA by over a million hectare, or more than 19%. Year-to-year comparison (not shown in Figure 4) suggests that since 2000, the state has been adding around two lakh hectares per year to the GCA.

Figure 4: Gujarat – Increase in GCA (lakh hectares)

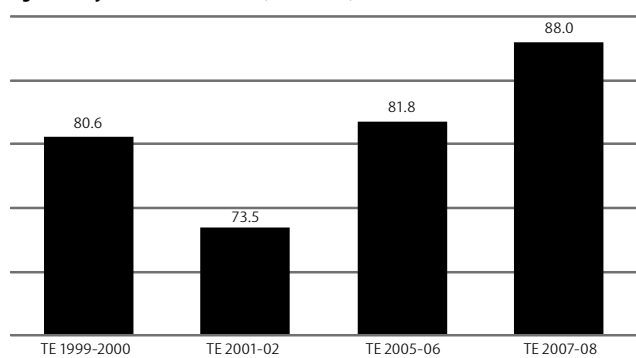
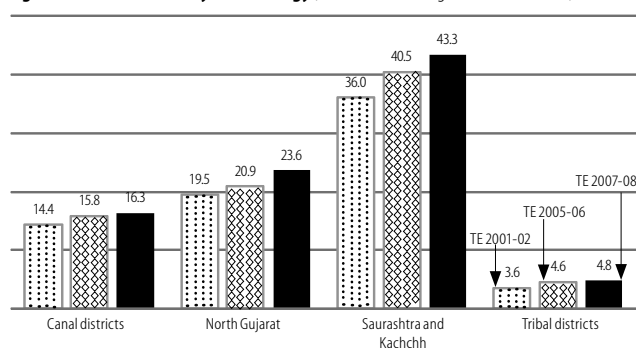


Figure 5: Increase in GCA by Socioecology (lakh hectares averaged for the triennium)

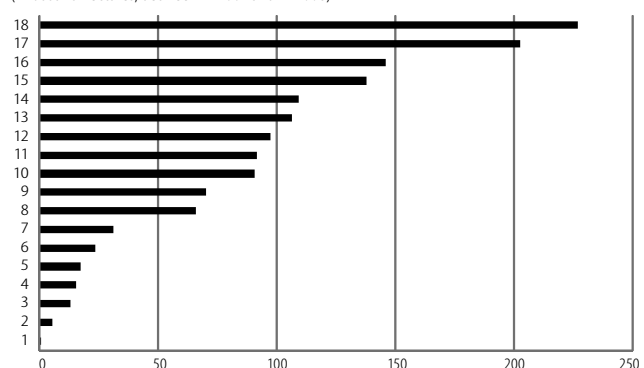


Almost all this increase is occurring in Saurashtra and Kachchh, and North Gujarat as Figure 5 shows. These together have added 12 lakh hectares to their GCA between TE 2002 and TE 2006. Tribal districts have increased their land productivity

by 22% and GCA too by 33%. However, South and Central Gujarat have not shown much increase in the GCA. In many canal-irrigated areas, the GCA is virtually stagnant. Figure 5 also shows that the increase in the cropped area in Saurashtra and Kachchh and North Gujarat appears to be a long-term trend rather than a one-off event.

This general picture is also evident in Figure 6 which shows absolute increase in GCA in Gujarat districts between 2001 and 2008. Between them, Rajkot, Porbandar and Junagadh districts in Saurashtra have added over four lakh hectares to their GCA during this period. In contrast, canal-irrigated districts of Central and South Gujarat such as Vadodara, Valsad, Navsari and Surat are at the bottom in terms of increase in GCA.

Figure 6: Increase in Gross Sown Area under 14 Crops (Thousand hectares, between TE 2002 and TE 2008)



(1) Valsad + Navsari* (2) Surat (3) Dangs (4) Mehsana+Patan+Gandhinagar* (5) Vadodara (6) Kachchh (7) Bhavnagar (8) Surendranagar (9) Bharuch+Narmada* (10) Amreli (11) Jamnagar (12) Anand+Kheda* (13) Panchmahal+Dahod* (14) Ahmedabad + Gandhinagar* (15) Sabarkantha (16) Banaskantha+Patan* (17) Junagadh+Porbandar* (18) Rajkot. (* areas computed taking into account districts as existing prior to their reorganisation).

We noted at the outset that rapid expansion in the area under Bt cotton and wheat accounts for the bulk of the increase in Gujarat's agricultural GDP post-2000. Figures 7a and 7b show recent provisional data reflecting trends that began at the start of the new millennium. The more recent four years have witnessed: (a) hardly any expansion in state-wide kharif foodgrains area; (b) a significant decline in rainfed cotton area; and (c) seven lakh hectare increase in rabi foodgrain area of which wheat accounted for 5.4 lakh hectares; and (d) 6.4 lakh hectares increase in the area under irrigated cotton, most of it Bt cotton.

Figure 7a: Gujarat – Increase in Cultivated Area (lakh hectare)

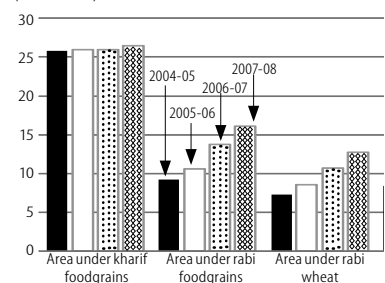
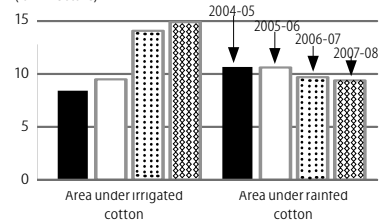


Figure 7b: Gujarat – Increase in Cultivated Area (lakh hectare)



Most of the expansion in Bt cotton area as well as the area under rabi wheat has occurred in Saurashtra and Kachchh, with North Gujarat following suit as Figures 8 and 9 (p 51) show. Tribal

districts show no particular trend either way in the area under rabi wheat and irrigated Bt cotton. However, even canal-irrigated Central and South Gujarat districts show hardly any increase in the area under irrigated cotton or rabi wheat.

Figure 8: Distribution of Expansion in Irrigated Cotton Area ('000 hectares)

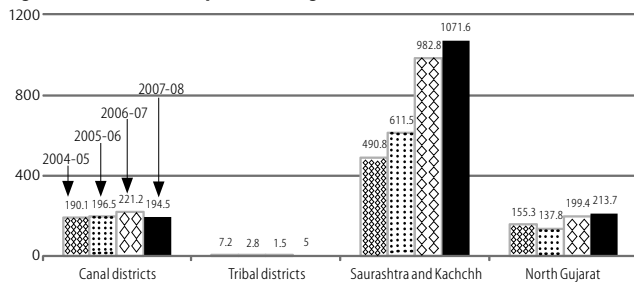
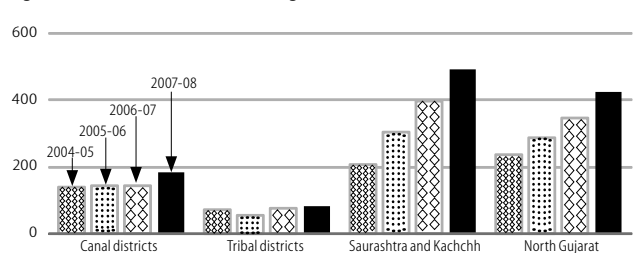


Figure 9: Distribution of Growth in Irrigated Wheat Area ('000 hectares)



This is surprising because 50 years ago, South and Central Gujarat were the heartland of India's cotton economy with some of India's most renowned cotton cooperatives located in and around Surat and Bharuch districts. Today, these districts are, however, more or less marginalised from the cotton economy and their place has been taken up by Saurashtra and North Gujarat. Again, North Gujarat always had a significant wheat cultivation. However, a new development has been the significant expansion of wheat cultivation in Saurashtra and Kachchh, which expanded their wheat area by 150% over the four years. It is not surprising, as Figures 10 and 11 show that the top 10 talukas in terms of cotton and wheat production in Gujarat in 2007-08 were mostly from Saurashtra and Kachchh, and then from North Gujarat.

Figure 10: Gujarat's Top-10 Talukas in Cotton Production (Thousands of bales in 2007-08)

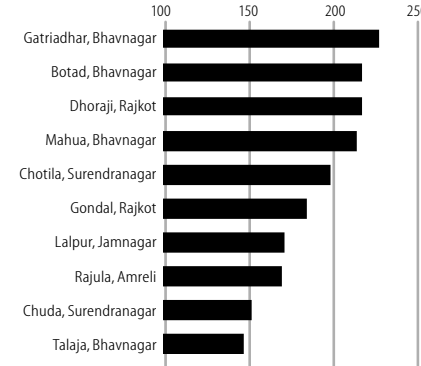
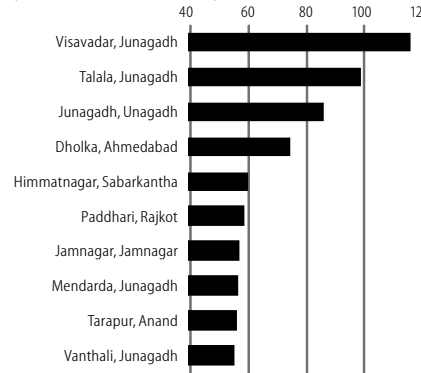


Figure 11: Gujarat's Top-10 Wheat Producing Talukas (Thousands of tonnes in 2007-08)



All the data about the regional patterns of agricultural growth in Gujarat suggest that the arid and semi-arid districts of Saurashtra and Kachchh, and North Gujarat have forged ahead of Central and South Gujarat in agrarian performance post-2000. In 1991-92, Saurashtra and Kachchh had a 31% share in Gujarat's value of (selected) field crops and milk; this share, after some fluctuations has steadily soared post-2000 to 49% in 2007-08. During this period, tribal districts maintained their share; but the share of South and Central Gujarat declined from 32% in 1999-2000 to 23% in 2007-08. North Gujarat too suffered an erosion of its relative share, from 30% to 25%, although in absolute sense, it grew its agriculture at respectable rate.

6 Assessment

Was it a massive productivity boom that fuelled Gujarat agrarian upsurge? Not so, it seems. Was it big gains in the size of the kharif crop aided by a succession of good monsoons? Not so. Massive increases in rabi wheat cultivation, and a phenomenal expansion in Bt cotton area and yield seem to have been the prime drivers of the Gujarat growth story. Central and South Gujarat posted mediocre growth in agricultural productivity (y), virtually no growth in GCA (A), hardly any diversification to high value crops (C) and little increase in farmer margins (M). In contrast, the irrigated Bt cotton and rabi wheat boom in Saurashtra and Kachchh, and North Gujarat significantly increased y, A, C and M in this region. Table 6 (p 52) summarises the relative significance of the four drivers in the four agrarian socioecologies of Gujarat.

What explains the unprecedented dynamism shown by Saurashtra and Kachchh, and North Gujarat in agricultural performance? Clearly, the rise of Bt cotton supported by a high MSP for cotton offered a big opportunity. But could Saurashtra and Kachchh, and North Gujarat have exploited this opportunity as brilliantly during the 1980s as they did post-2000? We believe it is doubtful. The expansion in Bt cotton is matched by expansion in irrigated cotton; this suggests that Bt cotton benefits hugely from four to five supplemental irrigations provided at critical points of crop growth. Gujarat increased its cotton yield over sixfold from 175 kg per hectare in 2001-02 to 798 kg per hectare in 2008-09, higher than the world average yield of 787 kg per hectare in 2007-08 (Damor 2008) because of the combined effect of Bt cotton and irrigation in Saurashtra and Kachchh and North Gujarat.¹³ In these regions, the Bt cotton and wheat revolution are not likely to have been possible but for the investments made by the government and the communities in check dams, percolation ponds, farm ponds and such other groundwater recharge structures. Thus, a succession of good monsoons, investment in groundwater recharge, improved quality of power supply post-Jyotigram and support to micro-irrigation – all of which were more evident in Saurashtra and Kachchh, and North Gujarat but not elsewhere – helped these regions ride on the Bt cotton and wheat boom.

To explore the relationship between value of crop and milk output per hectare of net cropped area and various irrigation conditions, we ran simple linear regressions of the value of crop and milk output per district on the area under canal irrigation, groundwater irrigation and under rainfed conditions across

Table 6: Components of Agricultural Growth in Four Agrarian Socioecologies of Gujarat

	% Increase in the Value of Crop and Milk Output Per Hectare TE 1999-2000 to TE 2005-06*1	A Growth in GCA TE 1999-2000 to TE 2007-08**	C % Increase in GCA under Cash Crops TE 1999-2000 to TE 2007-08***2	M Improved Farmer Margins ³	Compound Annual Growth Rate of the Value of Output of Crops and Milk (%) ⁴ 1991-92 to 1998-99 1999-2000 to 2005-06	
Canal districts	23.9 (30,967)	2.4 (15.8)	11.9 (39)	√√	3.7	5.2
North Gujarat	36.6 (24,913)	5.9 (22.3)	16.1 (45)	√√√	5.5	8.7
Saurashtra and Kachchh	47.8 (21,297)	14.9 (37.6)	18.5 (81)	√√√	13.3	21.4
Tribal districts	21.7 (23,898)	3.3 (4.6)	3.7 (6)	√√	8.1	10.7

* Figures in brackets are Rs in TE 1999-2000. ** Figures in brackets are lakh hectares in 1999-2000.
 *** Figures in brackets are % of GCA under cash crops in TE 1999-2000.
 (1) Since the district-wise area sown for kharif, rabi and summer is not available, the net sown area is taken as the sown area under selection of crops minus area under rabi wheat.
 (2) Crops under cash crop category are cotton, oilseeds (groundnut, seasm, castor, rapeseed and mustard), sugarcane, potato and onion. The food crops consist of rice, wheat, bajra, maize and jowar.
 (3) We could not get crop-wise value added figures to track the changing margins in different crops. Therefore, we are indicating our impression of the trends here. Our key assumption is that rapid growth in Bt cotton in North Gujarat, Saurashtra and Kachchh has greatly improved farmer's margins during recent years because of export boom as well as remunerative prices announced by Gol and massive procurement by the Cotton Corporation of India.
 (4) $\ln Y = b_0 + b_1 t$ where the dependent variable Y is total annual output from selected crops and milk from the region.
 Source: Author's calculations. Data in column A is from government of Gujarat (2003).

different districts. The results are reported in Table 7. The third equation shows the 2004-05 relationship at current prices and suggests that adding a rain-fed hectare to a district would add an average of Rs 17,090 to its value of crop and milk output. In contrast, a hectare of groundwater irrigated area would add Rs 37,174; and a hectare of canal and groundwater irrigated area

Table 7: Irrigation and Land Productivity: Results of Regressions with District-Level Data

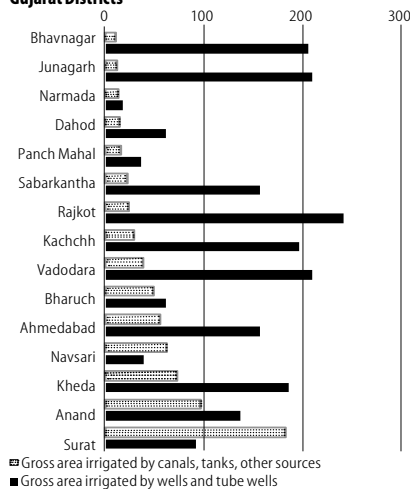
Dependent Variable	Intercept	Canal Areas under Conjunctive Use (Hectares)	Area under Groundwater Irrigation (Hectares)	Rain-fed Area (Hectares)	R-square	Adjusted R-square
1 Value of district-level crops* and milk output (Rs) 2000-01 @ 1999-2000 prices	-5,91,11,916	68,969 (4.9)	30,196 (5.19)	4,067 (1.46)	0.71	0.67
2 Value of district-level crop and milk output (Rs) 2004-05 @ 1999-2000 prices	-15,72,52,555	63,040 (4.14)	32,223 (4.09)	16,168.90 (4.39)	0.80	0.77
3 Value of district-level crop and milk output (Rs) 2004-05 @ current prices	-32,89,07,296	83,993(4.38)	37,174(3.75)	17,090(3.69)	0.76	0.73

*Crops included in the calculation include paddy, wheat, cotton, groundnut, banana, sugarcane, potato, onion, bajra, maize, jawar, sesamum, castor, rapeseed and mustard.
 Figures in parantheses are t-ratios

would add Rs 83,993 to the district's value of crop and milk output. The last needs emphasis; there is not a single taluka in Gujarat's canal commands which is irrigated exclusively by gravity flow from canals. The rule is conjunctive use of surface and groundwater.

This is also evident in Figure 12 which shows Gujarat districts in ascending order of their gross area irrigated by gravity flow irrigation from canals, tanks and other

Figure 12: Ground and Surface Water Irrigation in Gujarat Districts

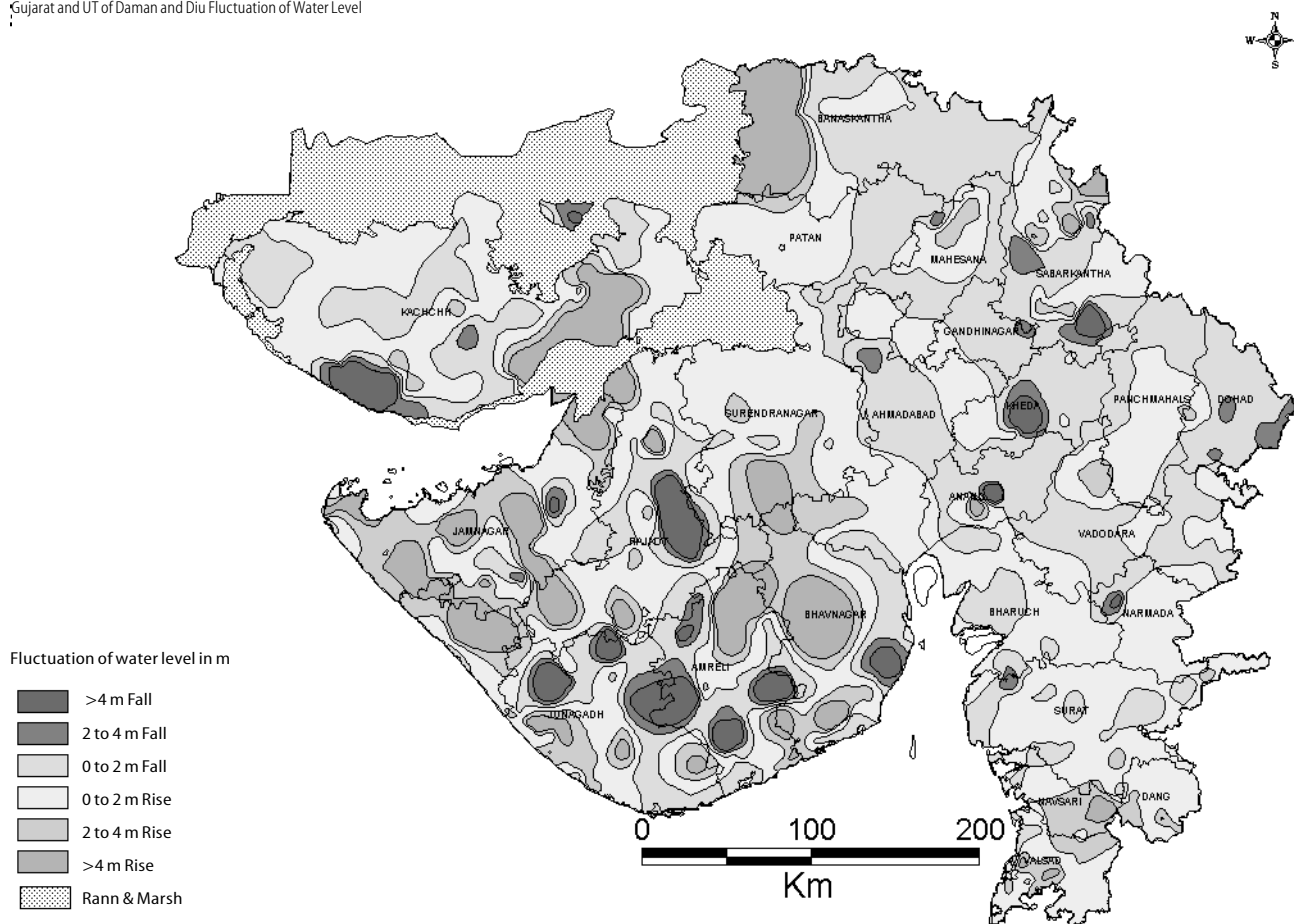


sources. The chart also plots district-wise gross area irrigated by open wells and tubewells. The chart shows that: (a) wells and tubewells are by far the dominant source of irrigation everywhere in Gujarat; (b) in districts with little canal irrigation, groundwater is the only source of irrigation; (c) however, even in districts with a large presence of canals, groundwater wells are a dominant mode of irrigation. Surat is the only district where the gross area irrigated by canals exceeds the area irrigated by wells and tubewells. The key role surface water bodies increasingly play here is not of direct gravity flow irrigation but of sustaining the groundwater irrigation economy by recharging the aquifers. A Government of Gujarat Taskforce on Managed Aquifer Recharge (MAR) estimated that while the expansion in groundwater irrigation in Saurashtra and Kachchh, as well as North Gujarat has over the past four decades created an accumulated groundwater deficit of nearly 30 billion cubic metres (BCM), well and tubewell irrigation in Central and South Gujarat has created virtually no groundwater deficit on account of the continuous recharge provided by surface water bodies (Government of Gujarat 2009b). This raises important questions about the potential to improve the management of water resources in Gujarat.

Table 8 (p 53) uses the results of our 2004-05 regression to make working estimates of the productivity of land as well as irrigation water stored in large dams, aquifers and small-scale rainwater harvesting structures in Gujarat. The results are instructive. The Gujarat's 37.9 BCM of dam storage feeds the canal systems and supports conjunctive use of ground and surface water over a net area of 6,50,000 hectares (gross area of 7,35,000 hectares). This yields a very high land productivity of Rs 83,994 per hectare but a very low water productivity of Rs 144 crore per BCM. In contrast, a smaller 11.5 BCM storage of groundwater wets a four times larger area, and generates incremental land productivity of Rs 37,500 per hectare but a much larger water productivity of Rs 884 crore per BCM. The small water harvesting structures – check dams, tanks, percolation ponds – represent even smaller total storage and low land productivity; but these return extremely high water productivity of Rs 4,327 crore per hectare BCM. Arguably, decentralised mass movement for water harvesting on a large scale is not only augmenting the productivity of rain-fed farming but also contributing substantially to groundwater recharge. On this front, there are indications that Gujarat is setting an example for the rest of the country. When groundwater levels are dropping in large parts of the country, Gujarat is the only state whose groundwater balance has turned positive during the recent years. Figure 13a (p 53) and Figure 13b (p 54), based on the analyses of

Figure 13a: Monsoonal Changes in Groundwater Levels in 2000 (May 2000 to November 2000)

Gujarat and UT of Daman and Diu Fluctuation of Water Level



a sample of observation wells by the Central Groundwater Board show that around 2000, groundwater tables recorded a decline even during post-monsoon in much of Saurashtra, Kachchh and North Gujarat; in 2008, the situation was reversed. Since groundwater tables were rising post-monsoon, farmers in these parts were able to use groundwater irrigation to expand rabi wheat cultivation and irrigate Bt cotton.

The comparison in Table 8 needs to be handled with care. For one, the three forms of storages are not independent. Thus, rainwater harvesting structures provide irrigation but also contribute to groundwater storage, as does canal irrigation. Then,

small surface structures dry up long before large reservoirs and groundwater aquifers; in times of drought, small surface structures are least helpful and groundwater storage is the last resort. From this point of view, spreading surface water storage over a larger area and converting a part of it into aquifer storage has great merit. For example, a BCM of canal water whose productivity in South Gujarat is Rs 144 crore can generate six times the return if converted into groundwater storage through aquifer recharge in tubewell-irrigated North Gujarat.

There are also other strong reasons why Gujarat should boldly consider alternative uses of its surface storage. Over recent decades,

much of Saurashtra and Kachchh, as well as North Gujarat have sustained their agriculture by depleting their aquifers. The Gujarat government's taskforce on managed aquifer recharge estimated that most of Gujarat's accumulated groundwater deficit of some 30 BCM is concentrated in these regions (Government of Gujarat 2009b). Around 2008, over 8,00,000 electric tubewells pumped some nine BCM of groundwater for irrigation, mostly in Saurashtra and Kachchh, and North Gujarat. The taskforce also estimated that Saurashtra and Kachchh, and North Gujarat account for

Table 8: Productivity of Land and Storage Water in Gujarat Agriculture

1	2	3	4	5	6	7
Type of Water Storage	Nature of Irrigation	Volume of Water (BCM)	Gross Area Served (Thousand Hectares)	Value of Crop and Milk Output (Rs Crore)	Gross Land Productivity (Rs/hectare) (Rs 2004-05 at Current Prices)	Gross Storage Water Productivity (Rs Crore/BCM)
Large government dams	Canals and wells/ tubewells	37.9 (including SSP)	650	5,460	83,994	144
Groundwater storage	Wells and tubewells	11.5	2,736	10,171	37,174	884
Decentralised water harvesting structures	Supplemental irrigation to rain-fed crops	2.5	6,330	10,818	17,090	4,327
Total		51.9	9,716	26,448	27,222	510

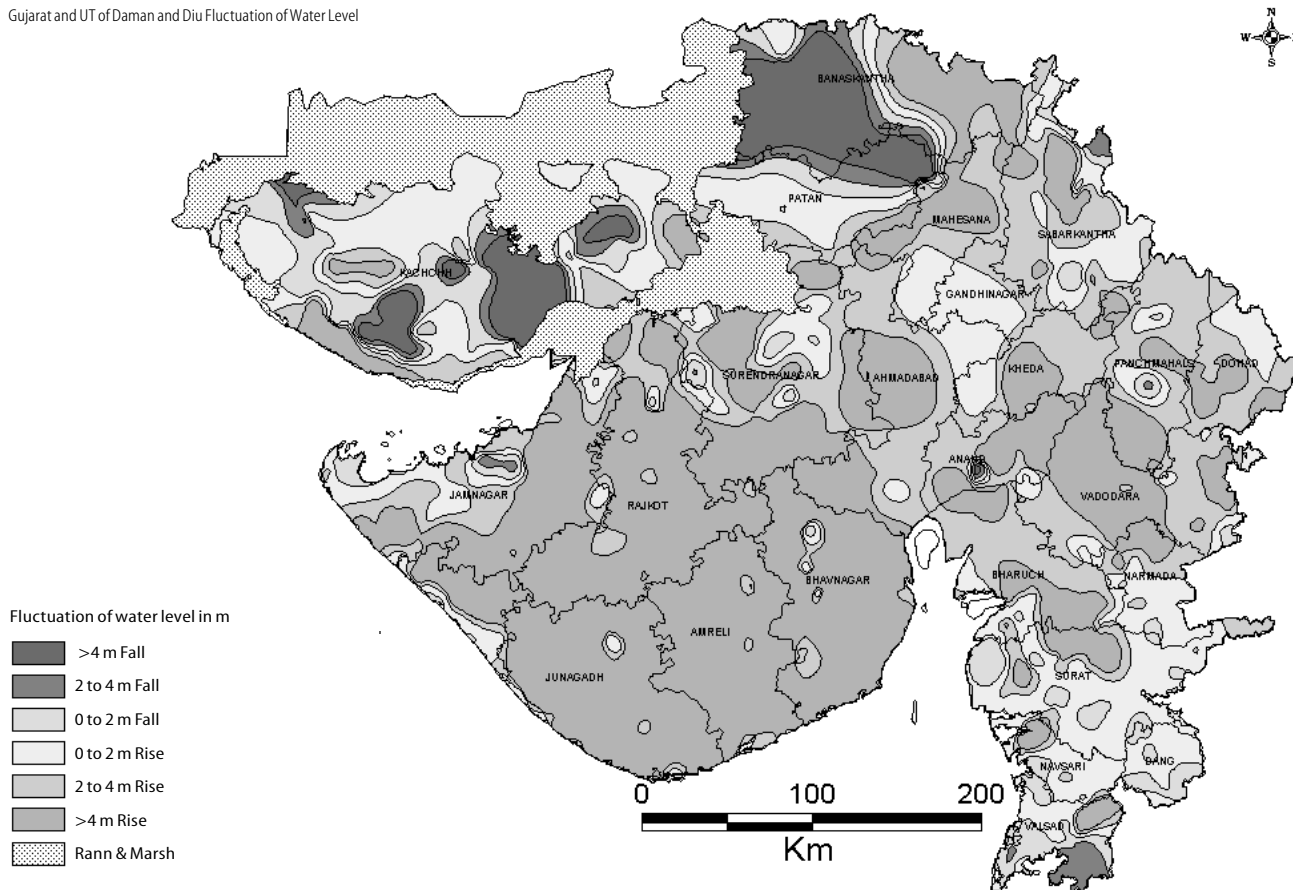
Column 6 is based on the third regression reported in Table 7.

Total value of crop and milk output (column 5) was computed as a product of the relevant land productivity figures and the net area served by canals, groundwater and rain. Average productivity of water (column 7) was computed by dividing gross crop and milk output for each of the three categories of areas by the volume of water diverted for irrigation from large dams, aquifers and small water harvesting structures (column 3).

Source: Government of Gujarat 2007, 2009b.

Figure 13b: Monsoonal Changes in Groundwater Levels in 2008 (May 2008 to November 2008)

Gujarat and UT of Daman and Diu Fluctuation of Water Level



75% of the total of 1,200 crore kWh of electricity that Gujarat uses for groundwater extraction; and this can be curtailed by three-quarters if groundwater levels throughout this region could be raised to eight metres below ground level through an aggressive programme of managed aquifer recharge using surplus flood waters of the rain as well as a portion of the surface storage, which anyway serves just 6-7% of Gujarat’s farming areas of around 10 million hectares.

7 Summary and Conclusion

Never known for agrarian dynamism, Gujarat has charted out a new course for its agricultural economy which has posted an impressive 9.6% rate of growth since 1999-2000. In terms of the value of output per hectare of net cropped area, Gujarat still has a lot of catching up to do with traditionally agrarian states like the Punjab, leave alone plantation economies like Kerala. Even so, the rapid strides Gujarat agriculture has made deserve deeper study simply because most Indian states have found it difficult to achieve even the modest Plan target of 4% agricultural growth per year. This paper analysed the drivers of Gujarat’s agricultural growth through disaggregated analyses of performance of four distinct agrarian socioecologies of Gujarat, viz, South and Central Gujarat, tribal region, North Gujarat, Saurashtra and Kachchh.

In interpreting these regional trends, we have taken the view that public policies and investments and private enterprise and

initiative have come together to create Gujarat’s agricultural miracle. Excellent road networks, government initiatives to reform agricultural marketing institutions, a reinvented agricultural research and extension system, and improved infrastructure have laid the ground for rapid growth. The role of the private sector in ushering in the Bt cotton revolution cannot be overstated.

With all these, the spectacular rally in the agricultural economies of Saurashtra, Kachchh and North Gujarat, remains a conundrum. Our hypothesis – which needs a more comprehensive probe – is that it is doubtful if Saurashtra and Kachchh, and to lesser extent, North Gujarat, would have benefited as much as they have done in the absence of the mass-based water harvesting and groundwater recharge movement. During the relatively good monsoons between 2003 and 2008, the vast corpus of check dams, percolation ponds, boribunds and farm ponds increased the availability of groundwater that made rabi irrigation on such vast scale possible. Rationing of farm power supply post-Jyotigram brought about a certain order and discipline in the extraction of groundwater, but the improved quality and reliability of farm power supply also made it possible for farmers to make ambitious plans to grow Bt cotton and wheat on a large scale. Promotion of micro-irrigation, too, must have helped irrigation of Bt cotton and horticulture crops.

Improving the agricultural marketing environment, Krishi Mahotsavs, agricultural diversification, improving road and other

infrastructure – all these areas in which Gujarat government has made major strides must continue. Tribal agriculture needs attention, as does South and Central Gujarat which are ideally placed for taking advantage of favourable public policies, market reform and private initiatives.

The success of agriculture in Gujarat in recent years has been founded on groundwater irrigation. If Gujarat fails to manage its groundwater, its agrarian gains will evaporate. Therefore, Gujarat must do a major rethink on its water resources strategy. Rational planning and utilisation of water storage is critical to sustaining the tempo of agricultural growth Gujarat has generated. For now, Gujarat's large government dams store over

25 BCM of water but spread it only on a meagre 6.5 lakh hectares. In contrast, farmers use 11.5 BCM of groundwater storage to irrigate over 27.5 lakh hectares. The groundwater-irrigated agriculture in North Gujarat, Saurashtra and Kachchh is steadily building up an accumulated groundwater deficit that imposes high energy costs on the state and is also rushing towards unsustainability. Gujarat must consider spreading its large reservoir storage on a much larger area as a strategy of securing its agricultural future. One way of doing this is to use a portion of the surface storage for "groundwater banking", an idea which is well-tested in Australia and the US but whose time has come in Gujarat as well.

NOTES

- 1 Accessed 23 May 2008: <http://www.indianexpress.com/news/krushi-mahotsav-a-mix-of-fun-and-learning-for-gujarat-farmers/313402/0>
- 2 Accessed 15 September 2009: <http://business.outlookindia.com/inner.aspx?articleid=2161&editionid=58&catid=2&subcatid=973>
- 3 Accessed 18 April 2007: <http://www.financialexpress.com/news/apmc-act-amendment-boosts-contract-farming-in-gujarat/196958/>
- 4 Krishi Mahotsav does things on a grand scale. In 2006, for example, guidance provided by agricultural scientists reached an estimated 14,50,655 farmers; personal counselling was provided to 6,74,416 farmers; guidance by APMC was made available to 1,66,615 farmers; 1,42,711 agriculture kits, 1,36,773 horticulture kits, 1,00,000 animal husbandry kits, and 98,827 Kisan Credit Cards were distributed. All-village employment scheme was implemented in 10,172 villages; 11,123 self-help groups were created; 48.8 lakh cattle were vaccinated; and e-grams status was accorded to 6,074 villages. Accessed 5 April 2008: www.supportgujarat.org/GujaratProgressSummary.pdf
- 5 Accessed 23 May 2008: <http://www.indianexpress.com/news/krushi-mahotsav-a-mix-of-fun-and-learning-for-gujarat-farmers/313402/2>
- 6 Accessed 6 June 2007: <http://www.financialexpress.com/news/Gujarat-doubles-farm-lending-in-2006-07/200912>
- 7 According to the Government of Gujarat's data on area irrigated by different sources (2003-04) 72.3% of the area irrigated by canal is in the districts of South and Central Gujarat. North Gujarat and Saurashtra and Kachchh have about 14% each of the total area under canal irrigation in Gujarat.
- 8 Accessed 24 March 2007: http://guj-nwrws.gujarat.gov.in/pdf/check_demo_240309.pdf
- 9 Accessed 16 December 2008: <http://www.rnbgujarat.org/achievements.htm>
- 10 For instance during the period 2007-09 about 55% of the area covered under micro-irrigation was in Saurashtra and Kachchh and about 28% was in North Gujarat with the top four districts in terms of area covered under micro-irrigation being Junagadh, Banaskantha, Sabarkantha and Rajkot. Based on data from GGRC, accessed 7 December 2009: <http://203.77.203.14/ggrchome/fmRptDistrictWiseApplicationReportHectare.aspx>
- 11 The basket includes wheat, rice, bajri, maize, jawar, groundnut, castor, rapeseed and mustard, sesame, cotton, sugar cane, potato, onion, and milk.
- 12 Increase in value of output per hectare is a product of increase in physical output per hectare, of change in cropping patterns towards high value products and change in real prices of agricultural products. Our surrogate is thus only a partial indicator of the true land productivity.
- 13 Accessed 23 June 2009: <http://www.indiastat.com/agriculture/2/commercialcrops/17188/cotton/17205/stats.aspx>

REFERENCES

- ADB (2005): "Assessing the Impact of Transport and Energy Infrastructure on Poverty Reduction", ADB, DFID, JBIC and World Bank.
- Bagchi, A K, P Das and S K Chattopadhyay (2005): "Growth and Structural Change in the Economy of Gujarat, 1970-2000", *Economic & Political Weekly*, 40(28): 3039-47.
- Damor, Kalpesh (2008): "Gujarat Cotton Yield May Cross World Average", *Business Standard*, 8 October.
- Dholakia, R H (2002): "Economic Reforms and Development Strategy in Gujarat", Working Paper, Indian Institute of Management, Ahmedabad.
- Fan, S, A Gulati and S Thorat (2008): "Investment, Subsidies and Pro-poor Growth in Rural India", *Agricultural Economics*, 39(2): 163-70.
- Government of Gujarat (2003): "Season Crop Reports: 1991-92 to 2002-03".
- (2007): "Irrigation in Gujarat", Directorate of Economics and Statistics.
 - (2008): "Twenty-fifth Survey Report on Estimates of Major Livestock Products 2007-08", Director of Animal Husbandry, Gandhinagar.
 - (2009a): "District-wise Area, Production and Yield in Gujarat State Based on Final Forecast Reports for the Year 2004-05 to 2008-09", accessed 30 September, http://agri.gujarat.gov.in/hods/dir_agriculture/download/dist_apy_0409.xls.
 - (2009b): "First Approximation Report to Increase Groundwater Resources Through Artificial Recharge in Gujarat State", Narmada, Water

Resources, Water Supply and Kalpsar Department, Gandhinagar.

- Government of India (2006): "State-wise Estimates of Value of Output from Agriculture and Livestock: 1990-91 to 2002-03", CSO, Ministry of Statistics and Programme Implementation, New Delhi.
- (2008): "State-wise Estimates of Value of Output from Agriculture and Allied Activities with New Base Year 1999-2000 to 2005-06", CSO, Ministry of Statistics and Programme Implementation, New Delhi.
- Gulati, A, T Shah and G Shreedhar (2009): *Agriculture Performance in Gujarat since 2000: Can Gujarat Be a 'Divadandi' (lighthouse) for Other States?* IWMI and IFPRI, New Delhi.
- Gupta, A (2008): "Modified Yarn", *Outlook Business*, 18 October. Accessed 15 September 2009: <http://business.outlookindia.com/newolb/article.aspx?101597>
- Hirway, I (2000): "Dynamics of Development in Gujarat: Some Issues", *Economic & Political Weekly*, 35(35): 3106-20.
- Mathur, N and S P Kashyap (2000): "Agriculture in Gujarat: Problems and Prospects", *Economic & Political Weekly*, 35(35): 3137-46.
- Shah, T (2009): *Taming the Anarchy: Groundwater Governance in South Asia*, Resources for the Future, Washington DC.
- Shah, T and S Verma (2008): "Co-management of Electricity and Groundwater: An Assessment of Gujarat's Jyotigram Scheme", *Economic & Political Weekly*, 43(7): 59-66.

Economic & Political WEEKLY

CD-ROM 2006

The digital version of *Economic and Political Weekly* is now available for **2006** on a single disk.

This electronic edition contains the complete content of all the issues published in 2006. The **CD-ROM 2006** comes equipped with a powerful search as well as utilities to make your browsing experience productive. The contents are indexed and organised as in the print edition, with articles laid out in individual sections in each issue. Users can browse through the sections or use the sophisticated search facility to locate articles and statistics of interest.

Price for **CD-ROM 2006** (in India)

Individuals – Rs 285 (Rs 250 plus postage and handling charges of Rs 35)

Institutions – Rs 535 (Rs 500 plus postage and handling charges of Rs 35)

International – US\$ 40 (including airmail postage)

Also available 2003, 2004 and 2005 on three separate CDs, individual CD price as above

Any queries please email: circulation@epw.in

To order the CD-ROMs (please specify the year) send a bank draft payable at Mumbai in favour of *Economic and Political Weekly*. The CDs can also be purchased on-line using a credit card through a secure payment gateway at epw.in.

Circulation Manager,
Economic and Political Weekly

320, 321, A to Z Industrial Estate, Ganpatrao Kadam Marg, Lower Parel, Mumbai 400 013, India