WELLS AND WELFARE IN THE GANGA BASIN:
ESSAY ON PUBLIC POLICY AND PRIVATE INITIATIVE

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Wells and Welfare in the Ganga Basin: Essay on Public Policy and Private Initiative

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Eastern India is home to nearly 88m. or a third of India's rural poor; but it has over 1/4th of India's usable groundwater resource; and less than 1/5th of it is developed. Stimulating groundwater development is not only central to kick-starting the region's Green Revolution, and creating livelihoods for its poor but also to addressing its syndrome of extensive water-logging and flood-proneness. This essay analyses how public policies designed to promote groundwater development over the past 50 years have failed in their promise, and how initiative by private agents can deliver the development the region needs so direly. The essay outlines a strategy with five components: first, Eastern India needs to scrap its existing minor irrigation programs run by government bureaucracies which guzzle up funds but deliver little minor irrigation; second, while the electricity supply environment is in total disarray, innovative ideas need to be piloted to test alternative approaches to efficient metering and collection of electricity dues from millions of small users; third, programs are needed to improve the unacceptably efficiency of electric as well as diesel pumps; fourth, there is need to promote smaller than 5 hp diesel pumps and improved manual irrigation technologies such as the treadle pumps; finally, above all else, East Indian states need to reform their pump subsidy schemes on the lines that Uttar Pradesh has done so as to ameliorate the pump capital scarcity which lies at the heart of the problem.

Wells and Welfare in the Ganga Basin: Essay on Public Policy and Private Initiative

1. Backdrop.

Eastern India, especially the 15 eastern districts of Uttar Pradesh and the entire states of Bihar, West Bengal and parts of Orissa comprise a significant chunk of the Ganga-Meghna-Brahmaputra (GMB) basin that encompasses, in addition, all of Bangladesh and the terai areas of Nepal. The problem this paper deals with—and the strategy outlined to respond to it—in the East India context applies with equal force to the terai areas of Nepal as also much of Bangladesh. The GMB basin has fertile lands, but very high population pressure (at over 830 for Bangladesh and over 600 for Eastern India in 1991 compared to 285 for India as a whole) and, according to some estimates, the basin is home to 500 million of the world's poorest people.[1] The region is marked by high dependence of its predominantly rural population on smallholder agriculture and wage labour. In 1991, in Bihar and Eastern UP, the proportion of the population dependent on agriculture was 79% compared to 66.7% for India as a whole. While Western Uttar Pradesh, Haryana and the two Punjabs (Indian and Pakistan) underwent massive agrarian transformation during the 1960's, agrarian growth in the Eastern areas of India remained stagnant. District-wise analysis of agricultural growth in India by Bhalla and Singh shows that during 1963-93, the productivity/male agricultural worker crossed the Rs 10000 barrier in much of India; but most of Eastern India was not a part of it. The only region of Eastern India, which seems to be crossing the barrier is Eastern Uttar Pradesh (UP).

Eastern UP, the western-most part of Eastern India and the GBM basin, is an interesting study because it has just managed to break out of its agrarian stagnation. It is interesting also because, its transformation over the past 15 years is energized largely by the rapid—and much needed--development of small-scale groundwater irrigation; and offers critical lessons about how the rest of the basin can trigger off its belated Green Revolution. The present analysis of Eastern India—with particular focus on Eastern Uttar Pradesh--is quintessentially a study in political economy and practical policy. It is about how major public policy initiatives have actually impeded groundwater development rather than expediting it, and how the agrarian transformation in Eastern UP has come about largely through spontaneous techno-institutional responses of a multitude of private economic agents aimed at countering or coping with the powerful propensity of well-intentioned public policy initiatives to degenerate over time and become counter-productive. The overarching argument is that the seeds of an effective strategy for groundwater-led agricultural development for all of Eastern India—and the GBM basin—lie in the lessons offered by the experience of Eastern Uttar Pradesh. In sections 2,3,4 and 5, our focus then is on learning lessons from Eastern Uttar Pradesh. In section 6 and 7, we explore their implications for Eastern India as a whole.

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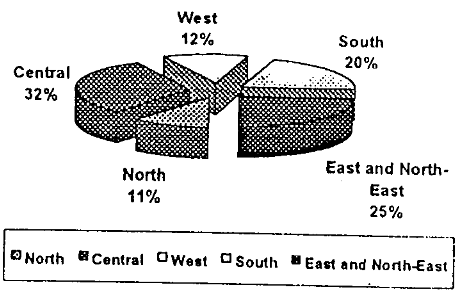
[1] These estimates seem plausible: Eastern India's 3.48 lakh square km is 10.6% of India's total area but its 260 m people are over a 4th of the Indian population. Add to this Bangladesh's 280 m, and we already have over 500 m.

2. *Groundwater Resources of Eastern India*

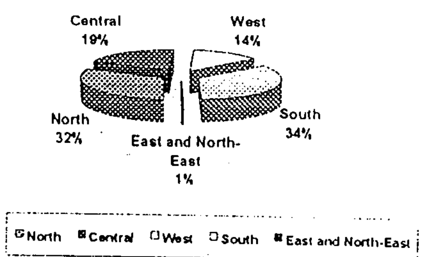
Eastern and North Eastern India has abundant surface as well as groundwater resources. Figure 1, based on estimates prepared by India's Central Groundwater Board (which have recently been revised upward), suggests that of the total usable recharge of 325 cubic km for India as a whole, 25%, or over 80 km^3 is available to Eastern and North Eastern India. These figures exclude 16 districts of eastern Uttar Pradesh. If these were included, eastern India's groundwater resource would increase further to 92 km^3. Less than 1/4th of this resource is in use at present.

Figure: 1 Regional Distribution of India's Usable Groundwater Recharge of 325 km. sq



Uttar Pradesh (UP)'s own groundwater resources are abundant; its surface irrigation potential is estimated at some 13-14 m ha; but groundwater irrigation potential is estimated at over 20 m ha, taking the total irrigation potential to 33-34 m ha.[2], [3] All of UP falls in the piedmont zone of the Himalayas skirted by an artesian belt under free-flowing conditions extending from Jammu and Kashmir in the west to Tripura in the east. 'The hydrological environment and groundwater regime conditions in the Indo-Ganga-Brahmaputra basin indicate the existence of enormous fresh groundwater reservoir at least down to 600 m or more below land surface. Bestowed with high incidence of rainfall, this groundwater reservoir gets replenished every year, the average annual recharge throughout the GBM basin ranging from 50-75 cm. Apart from the vertical recharge, substantial recharge occurs through horizontal absorption of water through the Bhabhar zone, a 10-20 km wide strip of highly pervious formation in the Himalayan foothills through which all Himalayan rivers must pass. The alluvial aquifers to the explored depth of 600 m have transmissivity values from 250 to 4000 m^2/d and hydraulic conductivity from 10 to 800 m/d. The well yields range up to 100 liters/second and more but yields of 40-100 lps are common...' (GOI 1996:3). Overall, then, while peninsular India is crying out for effective control of groundwater over-exploitation, the need of Eastern UP, as indeed of the rest of the Eastern India, is to step up the utilisation of abundant groundwater resource for wealth creation and poverty alleviation. Of India's 7063 blocks, 599 are dark. Figure 2 shows that only 1% of these are in Eastern and North Eastern India. Similarly, figure 3 sets out the distribution of

Figure: 2 Regional Distribution of India's 599 'Dark' Blocks with over 85% Groundwater Development



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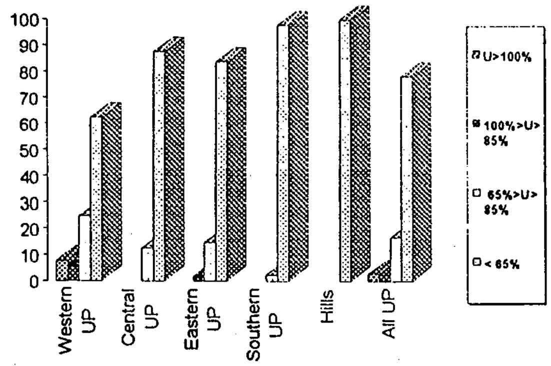
[2] The state's annual average precipitation is 33 mham; after making allowances for evaporation losses, the share of other states, requirements of industry, commercial and domestic users and others, it has a surface irrigation resource potential of 14-15 mham and total groundwater resource estimated at 8.5 m ham which is nearly 1/5th of the all-India potential estimated at 43.18 m ham (GOI 1996:9). After allowing 15% of the gross recharge for non-agricultural uses, the net recharge available for irrigation is 7.74 mham. Because of its inefficiency, surface water is estimated to be capable of irrigating 13.7 m ha (with a delta of well over 1 meter). In contrast, UP's groundwater resource can irrigate around 20.3 m ha (with a delta of 0.38 m), taking the ultimate irrigation potential of the state to 34 mha.

[3] The UP state groundwater department monitors groundwater levels through a network of 4000 hydrograph stations including 500 shallow piezometers located through out the state except the hill areas (GoUP 1996b).

white, gray and dark blocks in different sub-regions of Uttar Pradesh. For UP as a whole, less than 2.5% of the blocks are designated dark; and nearly 4/5th are denoted as white, offering much scope for tapping unutilised irrigation potential. Eastern UP offers even greater promise: 289 of its 345 blocks (84%) are white; 50 (14%) are gray and just 6 (2%) are designated dark. The problem of over-development is more acute in Western UP where groundwater irrigation has developed more rapidly than in other parts of UP over the past two decades.

If anything, this already abundant groundwater recharge of Eastern UP is only further augmented by newly developed canal irrigation. A good deal--in point of fact, nearly 1/4th-- of Uttar Pradesh's groundwater recharge is contributed by canal irrigation according to the estimates by the State Groundwater Department; however, this proportion is probably even higher for, water losses through seepage are estimated to be 75% in many systems with unlined canal distributary network. In this flood-prone region, flood waters too contribute to recharge as do the shallow water tables to which recharge gets added.

Figure 3: Uttar Pradesh: % Distribution of Blocks according to Level of Groundwater Utilisation in relation to available net recharge



All in all, the available irrigation potential-estimated using generous delta values, is 1.33 times the state's 1991 gross cropped area of 25.5 mha, offering ample scope for raising the state's overall average cropping intensity from the present 148% to 200%, or even more, since the bulk of the unutilised potential is in groundwater. Already, 6 out of the 13.7 mha potential of surface irrigation is utilised; but only 6 mha of the 20.3 mha (gross) of available groundwater potential is used, leaving room to bring over 14 m ha more under groundwater irrigation. The potential for further groundwater development is even greater further east-ward, as in North Bihar and North Bengal where the available recharge is as great or greater but its utlisation is far lower than in Eastern UP.

3. The Case for Stimulating Groundwater Development in Eastern India

There are compelling reasons for stimulating rapid and fuller development of groundwater resources in Eastern India: first, it can be important part of a strategy for correcting the regional imbalance in the development of the East versus the West; second, it can be a direct response to the region's rural poverty; third, undeveloped, the region's groundwater accentuates its flood-proneness and water-logging.

Eastern India constitutes the bulk of India's 'poverty square'. It is largely rural, predominantly agricultural, and has a high population density. As a microcosm of Eastern India, this east-west development dichotomy is apparent in Uttar Pradesh, too. While Western UP forged ahead in Green Revolution in the 1960s and '70s, eastern UP lagged behind in most respects (see table 1). The region needs a strong push in its agricultural sector to promote wider spread of the HYV technology, more crops under irrigated conditions, cropping pattern diversification in favour of high value crops, and a large summer crop which is by and large non-existent.

A major hypothesis—which has survived three decades and several failures to clear macro-level empirical tests—is that the rise of Green Revolution in Punjab, Haryana and Western Uttar Pradesh was fueled by the tubewell revolution that preceded it in these states; and that its refusal progress east-ward from Lucknow, which divides Western from Eastern India in the north is explained by the inadequacy of groundwater development in the East (Dhawan 1982). Several reasons explain this: [a] many studies—including macro-level—have shown unmistakable evidence that fertilizer use is directly and significantly related to tubewell irrigation(see, e.g., GOI 1985) ; [b] numerous micro-level studies based on sample surveys show that pump-irrigated farms perform much better compared to those irrigated by any other source in terms of cropping intensity, input use and yields[4]; (see, e.g., Dhawan 1985) and [c] by common observation, this difference is obviously explained by the superior *quality* –in terms of reliability, timeliness, adequacy -- of irrigation that tubewells offer compared to other sources (Chambers, Saxena and Shah 1987; Shah 1993). As far back as in 1985, a study group constituted by India's Planning Commission to explore agricultural strategies in Eastern India noted that 'one major

*Table: 1 East and West: Regional Disparities in Agrarian Performance in Uttar Pradesh, India**

	Eastern UP	Wester UP
Population/sq. km 1991	614	602
GW potential as % of Gross Recharge (1990)	75	67
Gross Irrigated Area as % of GCA	46.9	76.7
% of total irrigated area served by canals(89-90)	29.3	23.4
% of irrigated area served by tubewells (89-90)	63.2	68.8
% of all farm-holdings in <1 ha (marginal)	81.3	65
Average size of the marginal holding (ha)	0.32	0.4
Fertiliser Use 80-81 (kg/ha)	48.87	57.6
Fertilizer use 89-90(kg/ha)	80.92	100.53
Wheat Yield 80-81 (kg/ha)	14.62	19.4
wheat yield 89-90 (kg/ha)	18.1	24.52
Paddy Yield 80-81(kg/ha)	9.11	14.08
Paddy yield 89-90 (kg/ha)	16.13	21.73
Area under Summer crop as % of GCA	2.01	4.42
Area under cash crops as % of GCA 1980-81	10.06	26.85
Area under cash crops as % of GCA 1989-90	10.37	31.61
Gross income per ha of Net Sown Area 88-89	8872	11612

* Source: GoUP (1996)

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[4] Regression equations on survey data typically have low coefficients of determination and large values for the intercept --representing the weight of the omitted variables-- and indicating some specification problem. Production functions based on a survey of 380 farmers in Gorakhpur, Basti, Deoria, Siddharthnagar, and Maharjganj districts of Eastern UP conducted by the Shah, Indu and Paleja (1997) showed following results:.

Paddy: $q_p = 4.840 \, . F_p^{0.269} . L_p^{0.128} . H_p^{0.050}$ $\quad R^2 = 0.204$
[15.3]** [4.29]** [2.68]** [1.203]

Wheat: $q_w = 4.873 \, . H_w^{0.155} . L_w^{0.124} . H_w^{0.137}$ $\quad R^2 = 0.325$
[9.059]** [2.877]** [2.972]** [3.292]**

Where, subscripts p and w refer to kharif paddy and rabi wheat, q refers to output/acre (kg); F refers to fertilizer use/acre (kg). L is hired labour/acre(person days) and H refers to hours of pump irrigation used per acre. R^2 is unacceptable and the intercept term unusually large; t-ratios and the elasticities, however, are significant. The coefficient for irrigation hours was large and highly significant foe wheat, that for kharif paddy was small and insignificant, presumably because kharif paddy in Eastern UP is predominantly rainfed. The sum of the elasticities for fertiliser, labour and pump irrigation hours is much less than unity-- 0.416 for wheat and 0.447 for paddy, suggesting steeply increasing returns to the scale and scope for beneficial intensification of the use of all the inputs.