Investing in the Development Curriculum

A teaching and research paradigm for national development[1], .

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[1] A detailed argument appeared in the journal *Current Science, vol. 102, no. 11June 2012, pg. 1510*.

Organization of the talk

- The demands of development and the supply.
- The development curriculum and action research
  - the Development Research Institute (DRI)
  - the Development Professional (DP)
- The proposal– MoRD Fellowships
- Outcomes and the way forward.
- The knowledge and skills–case study

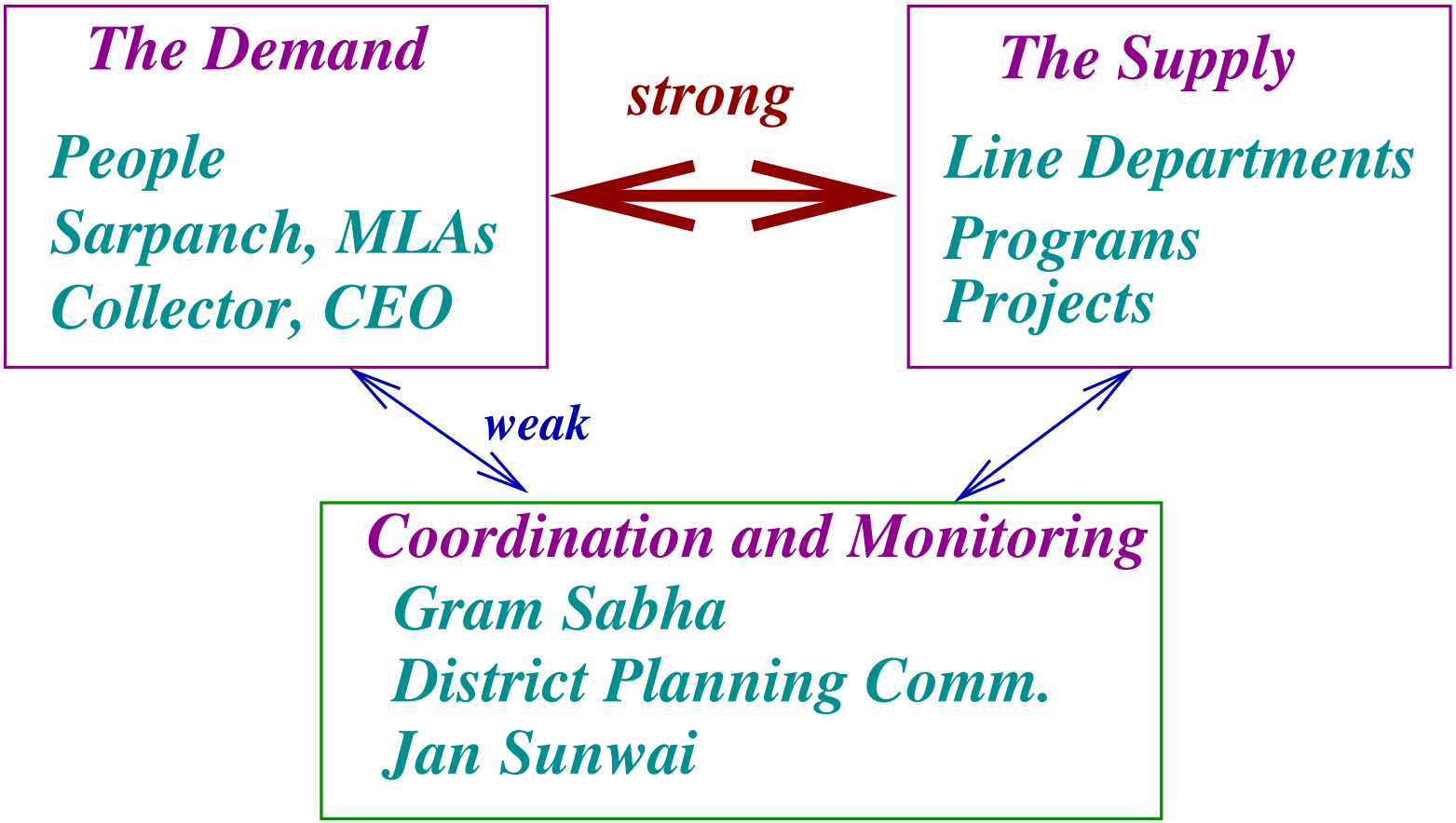
The Development Demand

- Increasing aspirations
  - *sadak, bijlee,paani*-engineering services
- Scarce Resources
  - *climate change*-added unpredictability
- Rising Inequalities
  - asset and skill poverty, livelihoods
- **Wealth creation as well as wealth redistribution**

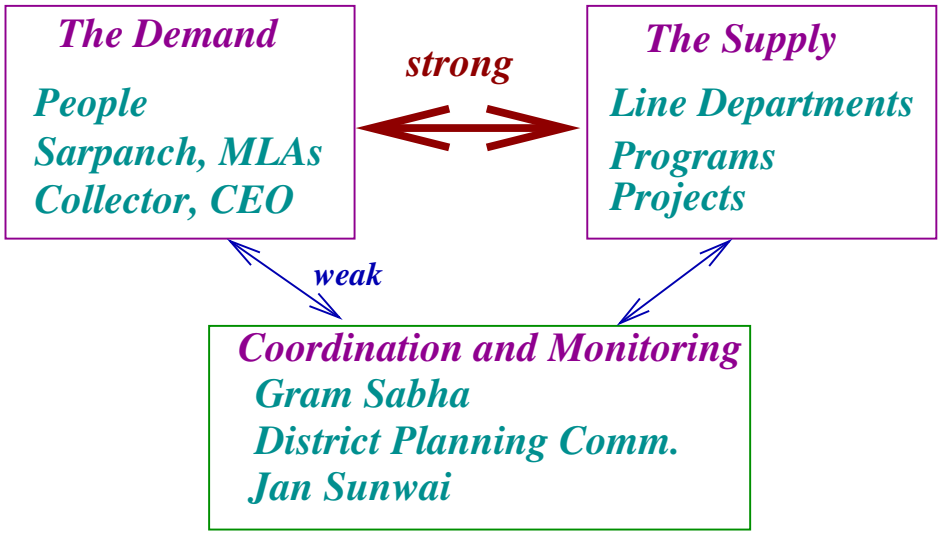
Governance under stress

- capacity technical and applied social sciences skills
- outcome orientation , stress on planning coordination
- R&D needs for both day-to-day and long-term

The Governance Structure



The current status



- The Supply : Poor capacity to deliver
  - poor morale, poor conditions, poor institutional structure
- The Demand: Poor capacity of monitor
  - distracted by poverty, failing education system, failing resources

- The Monitor: Poor outcome, poor skills
  - no independent capacity, infrequent meetings, no new kowledge

Development and Education

- The development sector poses important problems worthy of research and active engagement of research and educational institutes.

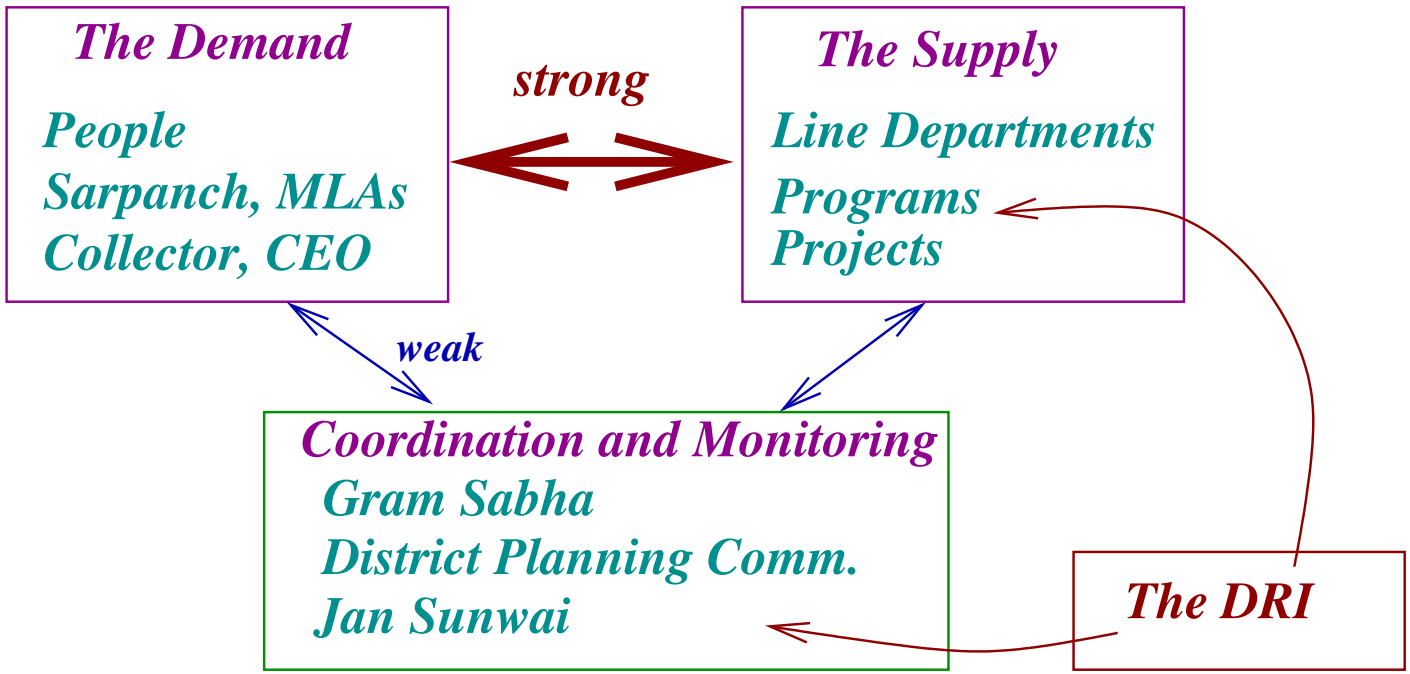
- Current set of companies may not have sufficient incentives to address these problems.
- These companies also do not have the need for the 5,00,000 p.a. or so engineering aspirants.

- The training of engineers is biased to employee-training and not towards skills needed to particpate in the developemnt sector.
- The research, if at all, does not match development demands.

Thus there is a supply-demand mismatch in both the corporate and the development sector!

The Development Research Institute

- University/Institutional participation in regional development problem —formulation and solution.
- Curriculum modification to allow students to take projects with local content and a focus on R&D for regional needs.
- University as an important mediator.



The response

A curriculum for engineers in knowledge formation

- Remedial–field, stake-holder and outcome driven.
- Intellectual– the socio-economic discourse, inter-disciplinarity
- Developmental–the bottom 80%, core sectors of water, energy, food etc.
  - CSOs, NGOs, SHGs, MLAs, state agencies, and also those beneath the market and the state.

A supply-demand strategy

- knowledge products which deliver value
- *development professionals* trained in knowledge products
- positions in implementation agencies of state, companies, NGOs, district collector etc.,

Above all...

A pedagogy of the engineer who will grapple directly with society.

Centre for Technology Alternatives for Rural Areas

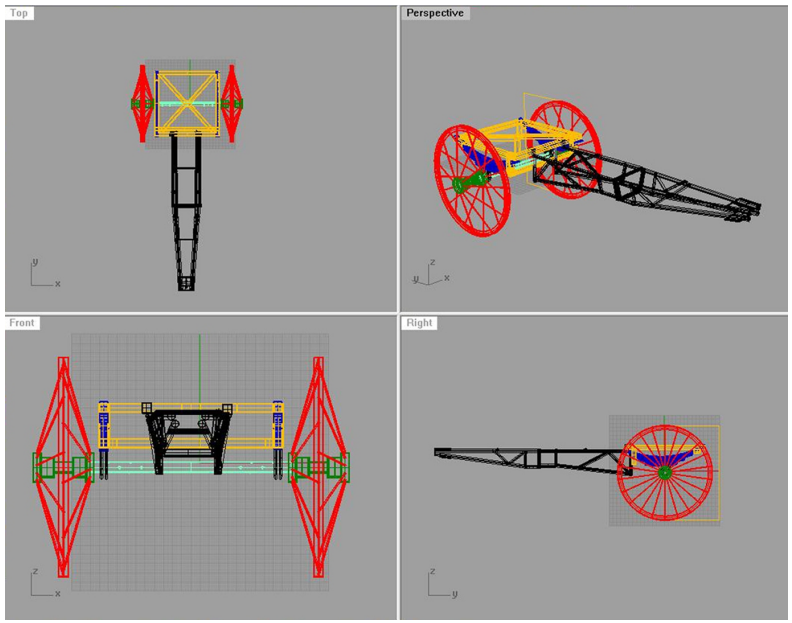
- An academic center of IIT-Bombay, started in 1985
- To study and to develop solutions for problems from rural India

Initial work:

- Agricultural machines and implements
- energy and drudgery saving devices

KVIC nodal center

- herbal oils extraction process
- Bio-diesel from waste oil



Later work

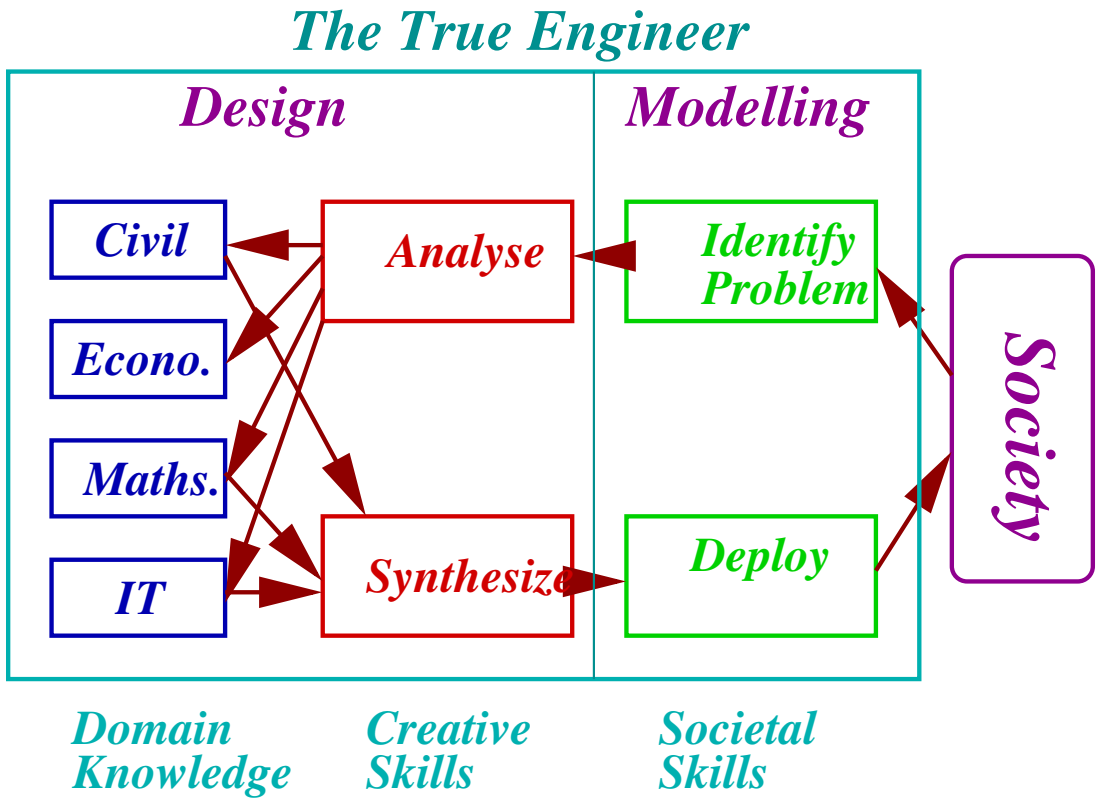
- 2005: Check-dam at Gudwanwadi, 85m, 20,000 cu.m. for Rs. 25 lakhs
- 2009: Vertical Shaft Brick Kiln in Narangi, Pen *taluka*

Department	$\Rightarrow$	End-Use	$\Rightarrow$	Stakeholders
Civil, CSE	$\Leftarrow$	Drinking Water	$\Leftarrow$	Gudwanwadi

The programs

Department $\Rightarrow$ End-Use $\Rightarrow$ Stakeholders

Civil, CSE $\Leftarrow$ Drinking Water $\Leftarrow$ Gudwanwadi



- 2007: M.Tech. program in Technology and Development
- 2010: TDSL-interaction with other departments and UGs

Core Faculty

- Anand Rao-Energy and Environment, Climate Change
- N. C. Narayanan-Water and Governance, Development Theory
- N. Shah-Food, Agriculture and Agro-Industry
- Priya Jadhav-Electricty, Energy
- Amit Arora-Agriculture, bio-mass systems.
- A. W. Date, Appropriate Tech.
- Milind Sohoni, Water, Optimization
- Om Damani, Water, modeling
- Puru Kulkarni Water, public systems

Adjunct Faculty (some):

- Bakul Rao -Environment Analysis and Assessment
- S. Wagle-Policy and Governance
- Prasad Modak-Environment
- Satish Agnihotri-Governance

The T&D core operational values

- Concrete beneficiary/stake-holder-the bottom 80%, households, hamlets, gram-panchayats, villages, towns and cities
- Basic areas-soil, water, energy, livelihoods, public health
  - end-user defined or demand-driven
- Concrete deliverable-as close to implementation as possible
  - solutions and knowledge-technology, policy, study, capacity

Objectives of the M.Tech./Ph.D. program

To produce the development practioner/innovator

- Analyse "development" situations and design solutions
- Build on grassroot understanding to work on national/global issues

Drinking water system for Boriwali GP (Karjat tal.)

Development problems demand:

- field-work and inter-disciplinarity
- creativity, innovation, honesty and hardwork

The design of courses

- Foremost learn the real Engineering loop: analyse, design, deploy, satisfy
- Accept Inter-disciplinarity
- Engage-with the unorganized sector, directly or through the State or the Market, if present. Through NGOs, CSOs
- Build discourse-through seminars, within courses
- Do Field work-sensitization, proofing, participative and beyond

Perspective

3-4 common courses

Skills

2-3 common courses

Sectors

Domain coursework and electives

Practice

Fieldwork and delivery specifics

The current M.Tech./Ph.D. in T&D

Coursework

- Perspective-philosophical nuts and bolts
  `Development Theory, Appropriate Technology, Policy and Governance`
- Sectors-the knowledge base
  `Water, Soil and Agriculture, Energy, Environment`
- Skills-to bring rigour to field work
  `Social Sci. Res. Meth, System Dynamics, Project Mgt. and Analysis`
- Field work- 10 week structured rural stay, field visits
- Two-Stage Project-Ideally
  - Ist Stage-Situation and alternatives-Appreciation
  - IInd Stage-Technology or Policy-Generation

Supervised Learning in Tech.and Dev. (TDSL)

- Unique opportunity for faculty members to float live development projects and for students to take them
- Guidance and Liaison from CTARA
- Objectives : extension, field study, entrepreneurship in the public space. Also pre-research

Course	TD390	TD490	TD491
Credits	6	6	12
Title	Study	Analysis	Design
Reporting	IIT	+stakeholders	+ stakeholder

- Since January 2011, 7th offering-extremely popular– 80 students this semester, 200+ students overall

Selected M.Tech. Projects

- Study and design of cages for aqua-culture
- Development of nutritional supplement for malnourished children
- Design enhancement and dissemination of improved cooking chulha in a village

- A process model for regulation in infrastructure development
- Analysis of groundwater regulation in various states of India

- Simulation of hybrid energy systems for village applications using HOMER
- Convergence of NREGS and Watershed improvement programs in Kerala
- Assessment of Herbal Initiatives in a Rural System

TDSL Sampler

- North Karjat Tal. Drinking water scheme -Design
- Rural Bio-gas Alternatives-Two case studies -Study
- The Anjap-Sugave multi-village scheme-a failure analysis-Analysis
- Transport provisioning in Karjat taluka -Study
- Incentives from Medical companies to retailers -Study
- Karjat City Development plan-Design

This semester-Devices for public hospitals, IT in education, water, energy, meters, GW policy, and so on.

- Budding consultants, entrepreneurs, researchers-Opportunities in the development agenda

Some pictures

Snapshots

Snapshots

Snapshots

Snapshots

Snapshots

The TDCC-The Consultancy Incubator

- to respond to consultancy and knowledge needs of civil society
- to liaison between student output, stake-holders and delivery
- to position CTARA with implementation, govt, agencies and to develop thematic output

- consolidation and standards for knowledge products
- to train other colleges in such products and programs
- to create a market for development

- Grow as number of projects grow- 1-2 people needed soon
- Yearly reports on expenditure and value generated-first economic and eventually financial viability

The Vision in Development Action

- IIT should be known for its excellence through delivery and engagement
  - innovative and creative projects which deliver
  - known not for who gets in but what comes out
- A pedagogy of engineering-colleges as local solution and knowledge providers
  - to develop courses, modules and projects
- An engagement and presence with government and implementation agencies, local bodies and civil society
- To intellectualize the role of the university/institute and to mediate on behalf of society

Foremost

To make engineering inclusive and social so as to deliver development

The long view

Plan : School of Technology and Development

- Collaboration with key departments
- graduate roughly 60-100 *development-enabled* engineers into the market.

Streams:

- Sectors, Programs and Projects
  - How do we improve outcomes? How do we design programs.
- Policy and Implementation.
  - How does grid influence growth.
  - Is Karjat taluka well-served in public transport?
- Innovation-in product, process and practice.
  - Can bio-gas be made cheaper and better?
  - Can we instrument for deeper GW monitoring?

CTARA – A Development Research Institute

- University/Institutional participation in regional development problem —formulation and solution.
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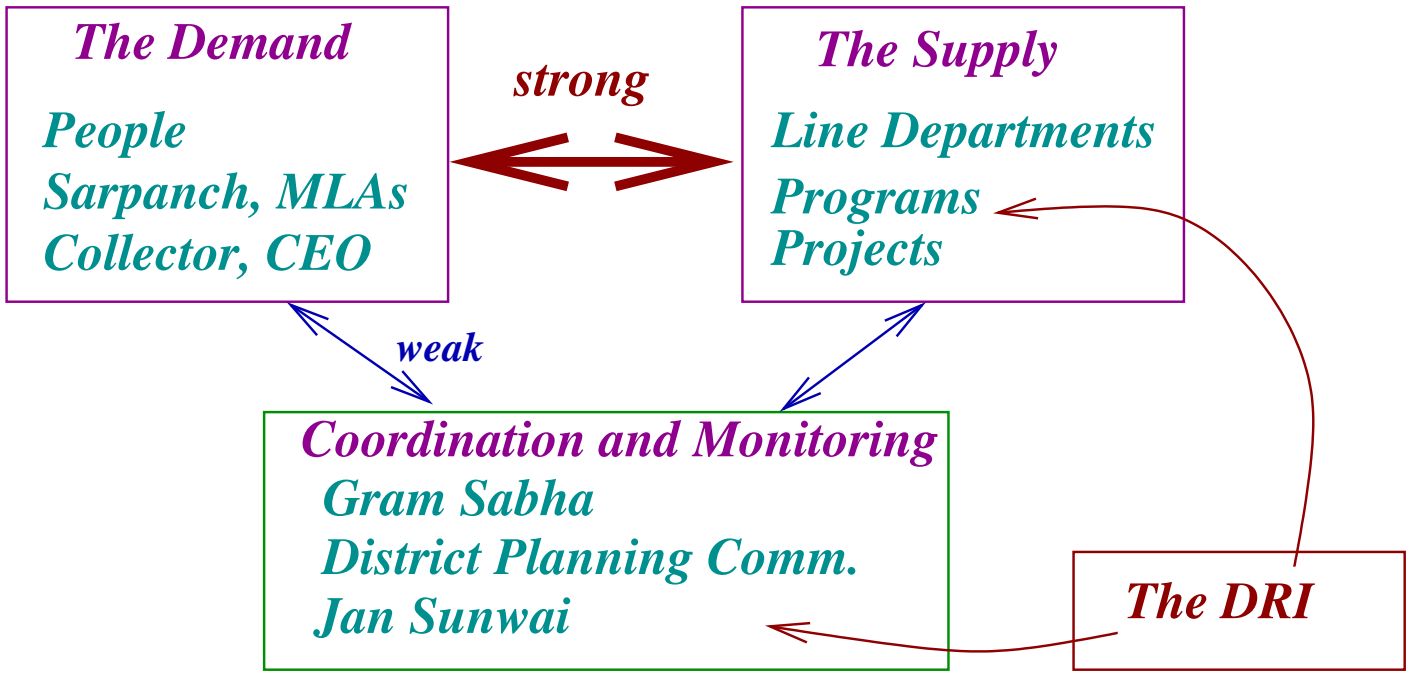
- University as an important mediator.



The Development Research Institute

- Broad research and teaching-both engineering and applied social sciences
- Commitment to excellence in R&D
- Interest in and knowledge of governance, development
- Flexible academic programs

Foremost

- Have a rigorous program to train the *development professional!*
- Recognize the importance of inter-disciplinarity and field work.
- Use the best tools and methods to further development.

The Development Professionals

- The District Development Coordinator:
  - reports to planning body and Collector
- The Program Coordinator:
  - reports to program manager
- Monitor, coordinate and improve outcomes
- Formulate medium/long term R&D and interact with DRI
- The Social Entrepreneur
  - innovate in the energy, food, water, etc. development sectors.
  - mentoring and access by DRI

Belief

- These positions *will* deliver value.
- Collaboration with DRI will bring efficiency and new knowledge and practices.

The Proposal

- 10 2-year MoRD/Development fellowships.
- Starting in IInd year M.Tech and continuing for one year in program office, field, state agencies.
- Rs. 13.00 lakhs each, includes both years, access to faculty time and facilities
- DRI to publicize with States
- DRI to assist in consultancy and R&D.
- 2 faculty positions and support-staff.

This will help ...

- incentivize the formation of DRIs
- define a new profession –Development Professional

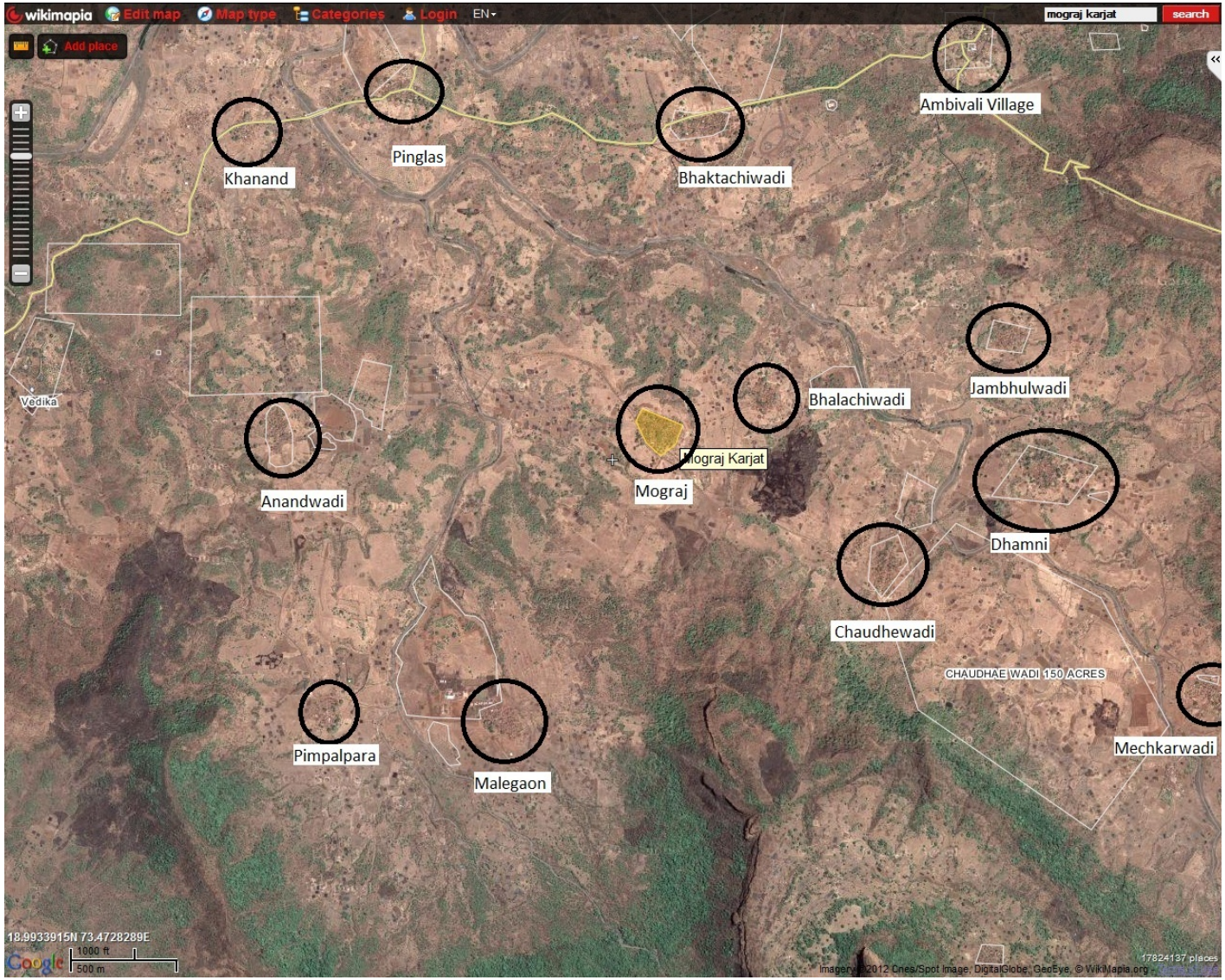
Long-term outcomes

- A profession alligned to development needs and a training to suit it.
- A multitude of DRIs–IIT Mandi, RIT Islampur and so on.
- A development discourse within engineering and applied social sciences academia
- **A betterment in the lives of our people.**

Thanks

Case studies from Drinking water

Mograj GP and habitations

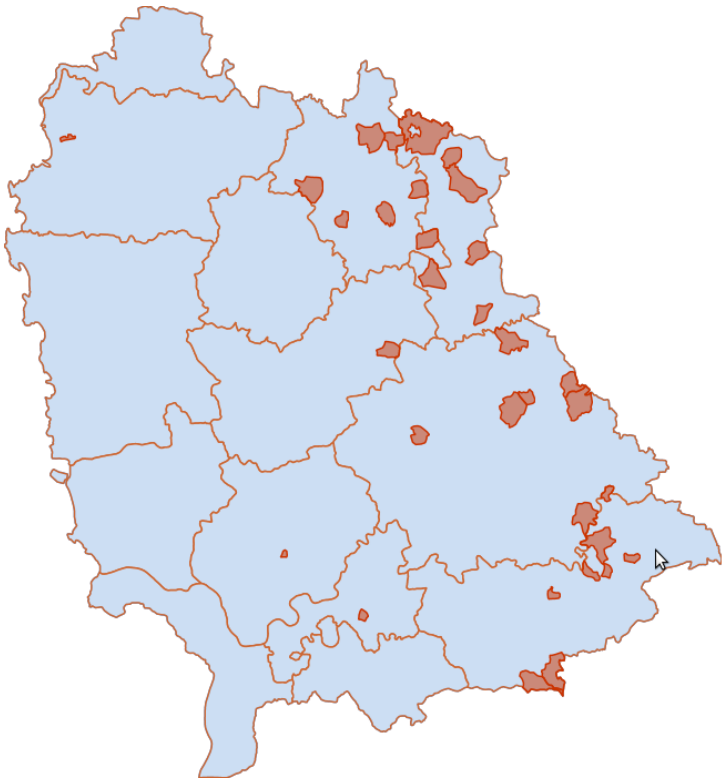


Mograj GP -according to DDWS and actual!

	VillageName	HabitationName	SchemeNameDP	SanctionYear	SchemeType	Estimated Cost	DateOfCommencement	sourceTypeCategory	TypeOf Source	locationWater Source	Satus as per CTARA survey as of March 2012
2	AMBIWADI T.	AMBIWADI T. KOTHAL KHALATI	PWSS AMBIVALI	2008-2009	Piped Water Supply Scheme	25.00000	31/03/2009	Surface Water	River		Functional
3		AMBIWALI	PWSS AMBIVALI	2008-2009	Piped Water Supply Scheme	25.00000	31/03/2009	Ground Water	Openwell	near village	Repeated
4	DHAMNI	CHOUDHARWADI	Chowdhariwadi handpump	2000-2001	Hand Pump	0.35000	14/01/2000	Ground Water	Deep Tubewell	near field	Functional
5		DHAMNI	DHAMANI DUGWELL	2005-2006	DUG WELL	0.35000	01/09/2005	Ground Water	Openwell	in village	Functional
6		MECHKARWADI	MECHKARWADI PWSS	2002-2003	Piped Water Supply Scheme	13.32000	30/05/2003	Ground Water	Openwell	NEAR VILLAGE	Functional
7		MECHKARWADI	MECHKARWADI PWSS	2002-2003	Piped Water Supply Scheme	13.32000	30/05/2003	Ground Water	Openwell	near village	Failed for one wadi
8		PACHKHADAKWADI	DHAMANI DUGWELL	2005-2006	DUG WELL	0.35000	01/09/2005	Ground Water	Openwell	near village	No data
9	KHANAND	BHALAYACHIWADI	BHALYACHIIWADI DUGWELL	2005-2006	DUG WELL	2.21000	20/04/2005	Ground Water	Openwell	in wadi	Functional
10		KHANAND	khanand pwss	2008-2009	Piped Water Supply Scheme	12.61000	12/06/2008	Surface Water	Pond		Not working
11		KHANAND	KHANAND VILLAGE TANK	2008-2009	DUG WELL	11.57000	07/12/2008	Ground Water	Openwell	Near village	Seasonal
12	MALEGAON T.	JAMBHULWADI	JAMBHULWADI HANDPUMP	2005-2006	Hand Pump	0.35000	20/04/2005	Ground Water	Deep Tubewell	in village	Functional
13		MALEGAON	malegaon pwss	2007-2008	Piped Water Supply Scheme	4.06000	30/03/2008	Ground Water	Openwell		Failed
14	MOGRAJ	ANANDWADI	MOGRAJ ANANDWADI PWSS	2003-2004	Combined Water Supply	8.27000	25/05/2003	Ground Water	Openwell	NEAR FIELD	Failed
15		BHAKTACHIWADI	BHAKTACHIWADI PWSS	2002-2003	Piped Water Supply Scheme	8.26000	30/05/2003	Ground Water	Deep Tubewell	NEAR VILLAGE	Failed
16		MOGRAJ	Mograj	2008-2009	Piped Water Supply Scheme	4.08000	30/03/2009	Ground Water	Openwell	near village	Failed
17		MOGRAJ	MOGRAJ WELL	2008-2009	DUG WELL	4.08000	07/12/2008	Ground Water	Openwell	Near village	Seasonal
18	PIMPALPADA	PIMPALPADA	pimpalpada pwss scheme	2008-2009	Piped Water Supply Scheme	4.44793	31/03/2008	Surface Water	Treated Surface Water		Failed
19		PIMPALPADA	PIMPALPADA WELL	2007-2008	DUG WELL	4.44000	31/03/2008	Ground Water	Openwell		No data
20	PINGLAS	PINGLAS	Pinglas WSS	1998-1999	Piped Water Supply Scheme	43.00000	26/04/2000	Surface Water	River		Failed
21											
22			Source: http://indiawater.gov.in								

- Recommendations: Technical review, watch the yield tests, protect source from comptetive users.

Tanker-fed villages



160 out of 1700 were tanker fed. 60 repeatedly so!

Largely in the 4 tribal talukas: *Jawhar, Mokhada, Murbad* and *Shahpur*.

Fraction of ST population.

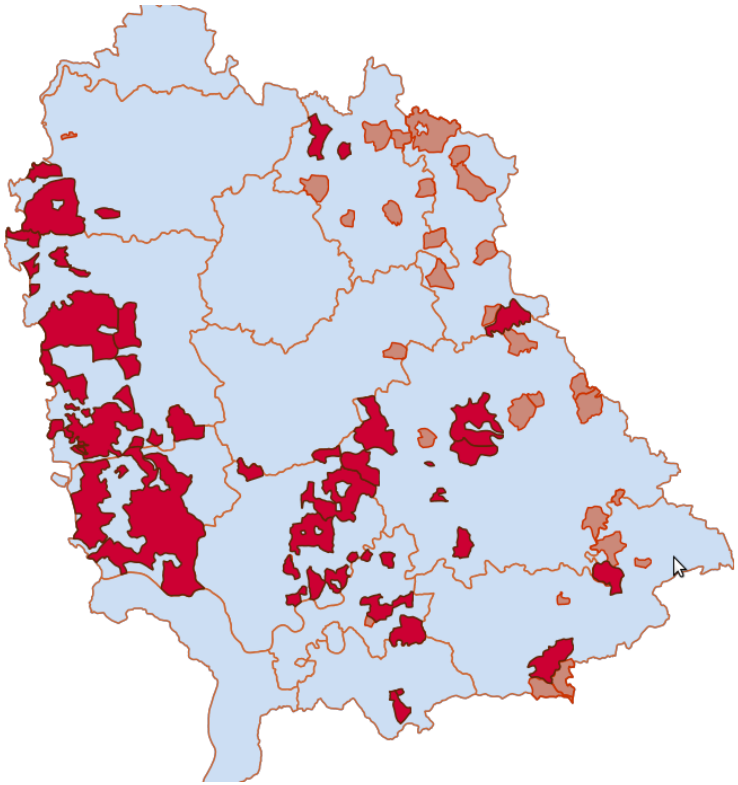
	Ja.	Mo.	Mu.	Sh.
Tanker	0.97	0.93	0.74	0.62
Taluka	0.97	0.91	0.24	0.35

Mean elevation (in *m.*):

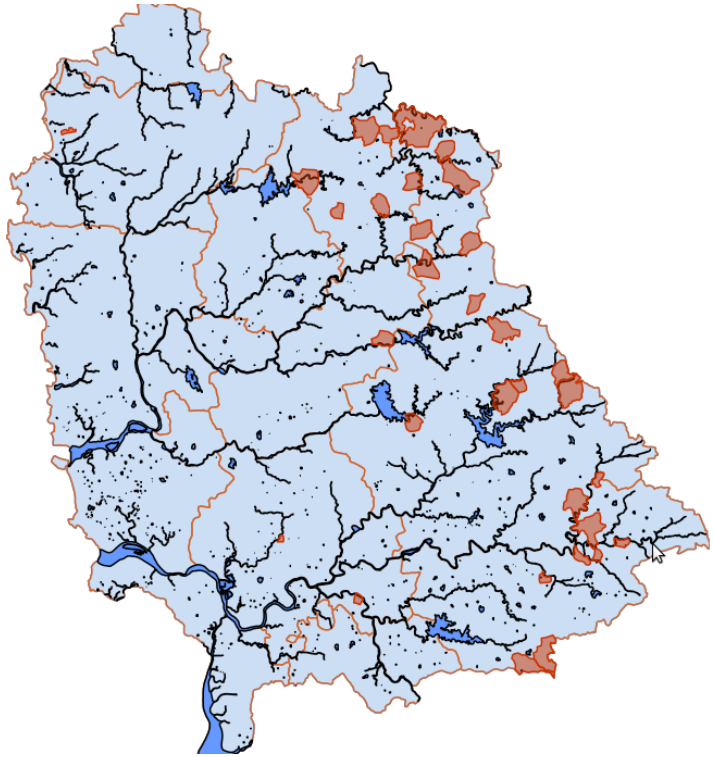
	Ja.	Mo.	Mu.	Sh.
Tanker	344	361	123	197
Taluka	320	350	126	132

More analysis

Location of large rural regional drinking water schemes



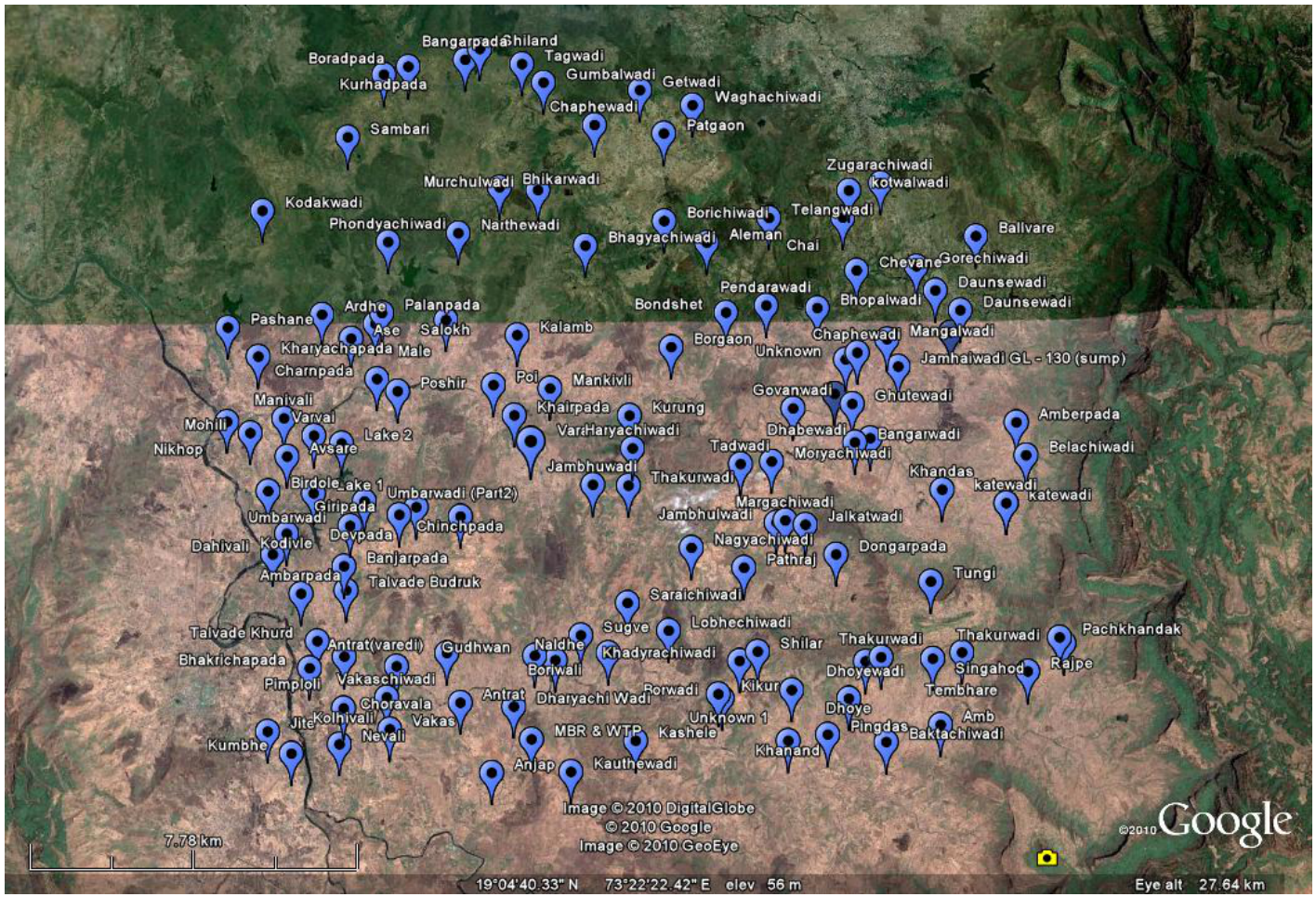
Location of rivers and lakes



Data from MRSAC, Census 2001, District administrative offices

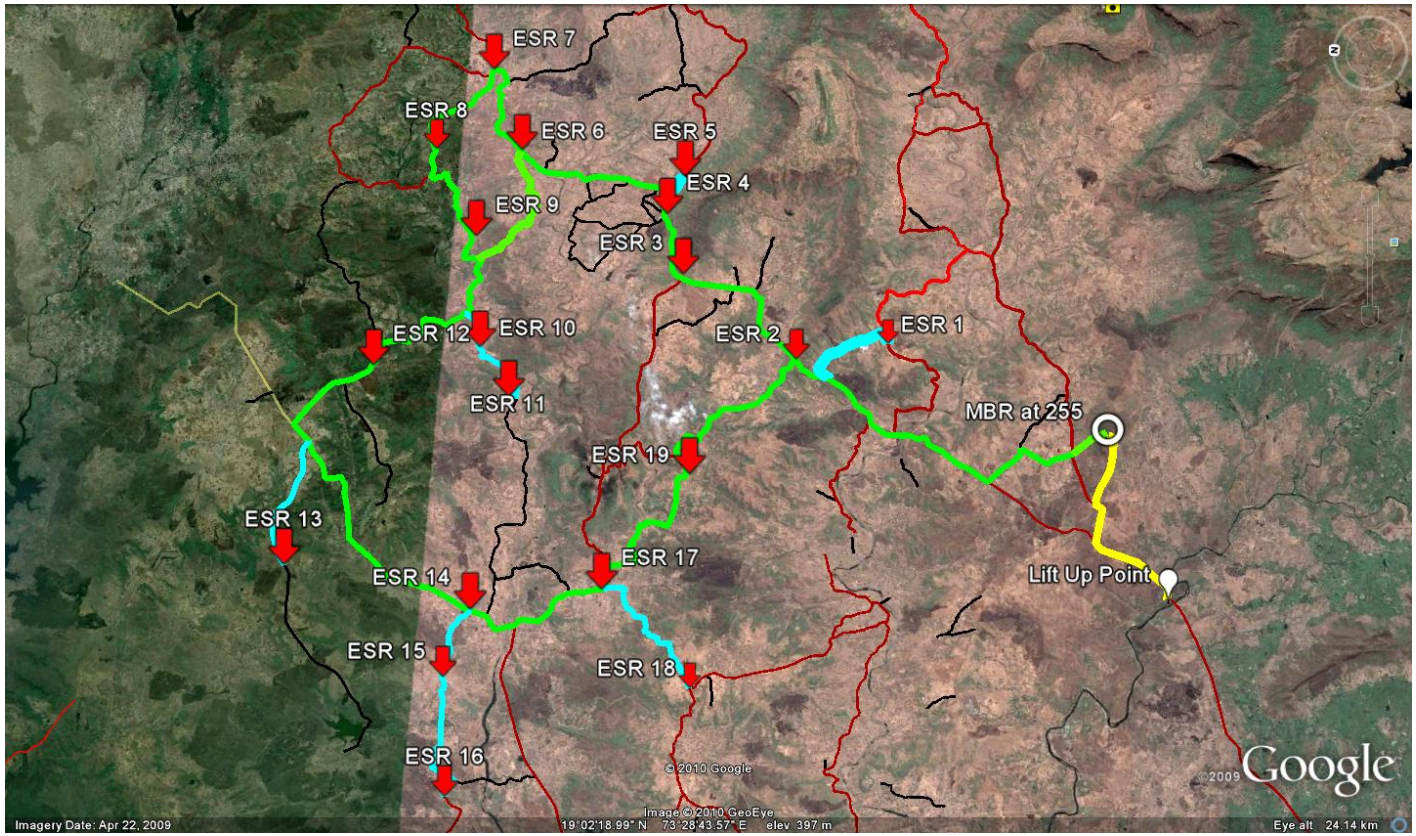
Applicable R&D with DRI

A Rural-Regional scheme design.



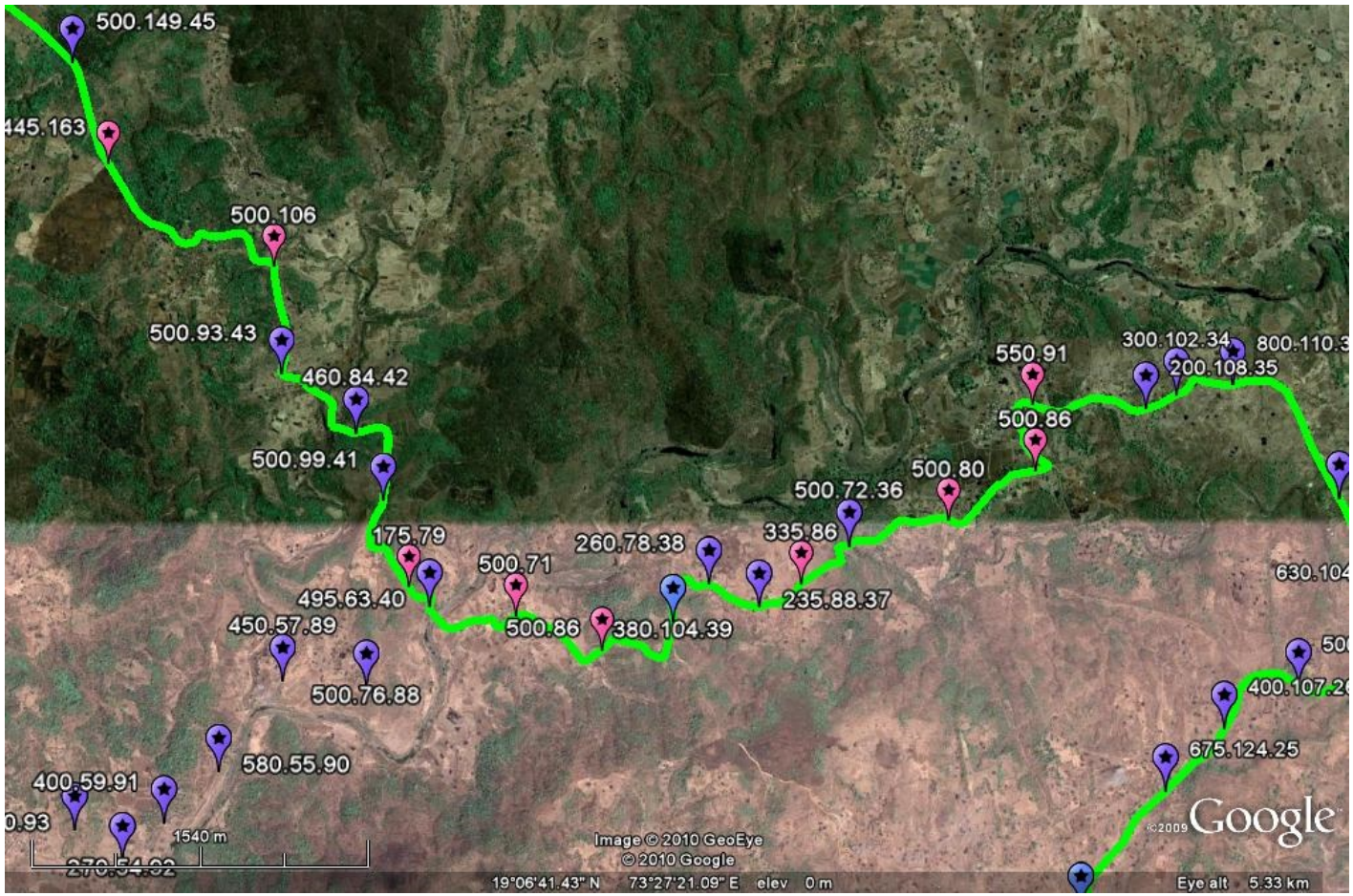
Latitude, longitude, elevation, population and growth rate.

The designed network



17 ESRs and a 2-loop network.

A close-up



Hundreds of nodes and edges. Pipes along roads.

Finally...

Estimated Net Investment for design population of 81,400.

200 lcpd	Rs.7051 per capita	Rs. 57 crores
40 lpcd	Rs. 2119 per capita	Rs. 17 crores

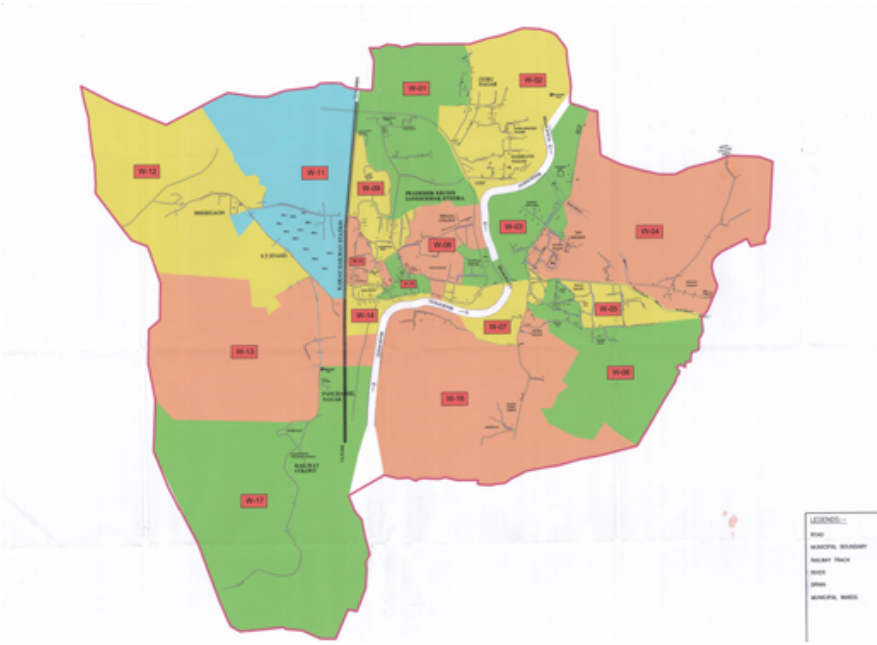
Energy costs(at Rs. 5 per unit, pumping efficiency 75%)

- 200 lcpd - Rs.400 per capita per annum
- 40 lpcd - Rs. 79 per capita per annum
- Energy cost per 1000 litre Rs. 4.56

Net investment for piped water at both norms of 40/200 lpcd to north Karjat is economically feasible.

Karjat City-a small taluka town in Maharashtra

- Request from Municipal Council to analyse City Development Plan.
- Ongoing work-water, sewerage, solid waste, municipal budget and so on.
- Skills: GIS, simulations, social and governance analysis



water system.

- 3 zones OK but higher capital costs, 1 zone poorly designed.
- Pump efficencies lower (51% , 60%) than standard (70%).
- financial stress-unmetered connection, commercial and residential
- competition with private bore-wells