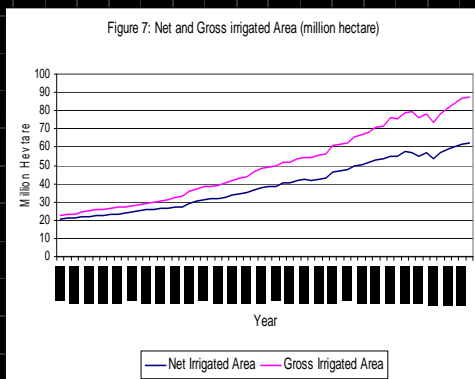




Sustainable Groundwater Management: The Role and Performance of Institutions in India

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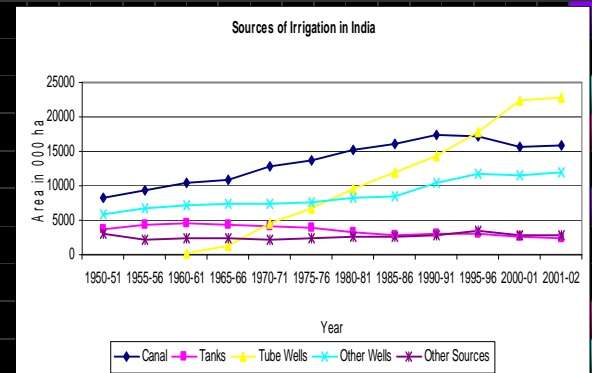
Growth of irrigated area, rapid but slowing



Overview

- Examined need and design of institutions for water resource management - groundwater
- There is a significant water crisis in India, particularly in groundwater
- This is not largely about physical or technical issues but about poor institutional development and design – institutional failure
- Water resource management and water institutions are complex
- Better design of institutional arrangements are urgently needed for a better future in water, agriculture and food in India

Groundwater dependence growing rapidly for agriculture



What are Institutions

- Institutions are broadly defined as humanly devised constraints that shape human interaction, North (1991)
- Institutions are now recognized as a major determinant of development
- Macro level institutions: formal institutions such as constitutions, laws and property rights, and informal institutions such as traditions and codes of conduct
- Micro level institutions: such as institutions of governance: including market or other modes of managing activities/ transactions and seeing economic activities through.
- The study focuses on micro level institutions in water i.e. local institutions in water
- The study applies concepts derived from
 - new institutional economics, and
 - management theories of governance
 - to study the performance of water institutions

Why institutions matter: New institutional economics foundations

- Frequently, activities focus only on transformation costs - and ignore transaction costs. But transaction costs are often huge and destroy performance.
- Good institutions seek to recognize and reduce transaction costs
- According to North (1997) the major challenge is to evolve institutions which:
 - Minimize transaction costs
 - Generate incentives which favor co-operative solutions, in which cumulative experiences and collective learning are best utilized
- The study has sought to identify operational features related to the theory/ literature – including works of Ostrom and Williamson, and examine if they are related to institutional performance

Some features of institutions identified based on new institutional economics

- Good institutions should demonstrate:
 - Clear Objectives**
 - Clear objectives or clarity of purpose, known/accepted by stakeholders
 - Reduces conflicts, increase congruence, and lowers transaction costs
 - Good Interaction**
 - Good interaction, brings formal and informal rules together.
 - Helps reduce transaction costs, promotes cooperative solutions using cumulative learning and experience
 - Adaptiveness**
 - Successful institutions show adaptiveness.
 - Through this the institutions can sustain and grow under varying environments keeping transaction costs low.
 - Appropriateness of Scale**
 - If scale/scope are too large, the transaction cost are too high.
 - If too small, they have too little external control and high external transaction costs.
 - Compliance**
 - Institutions ability to bring compliance to rules and processes
 - If not followed by large numbers, the institution is not meaningful, and transaction costs too high.

Pagan (2003, 2009), Crase and Gandhi (2009)

Some features of institutions identified based on management theories of good governance

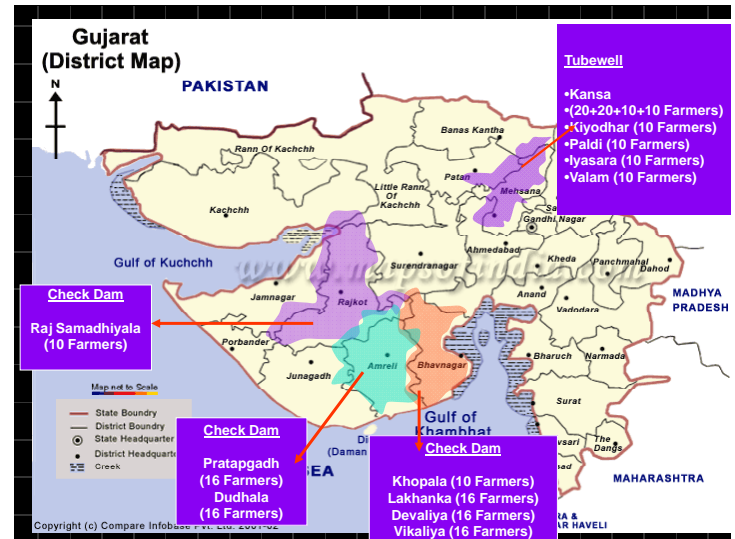
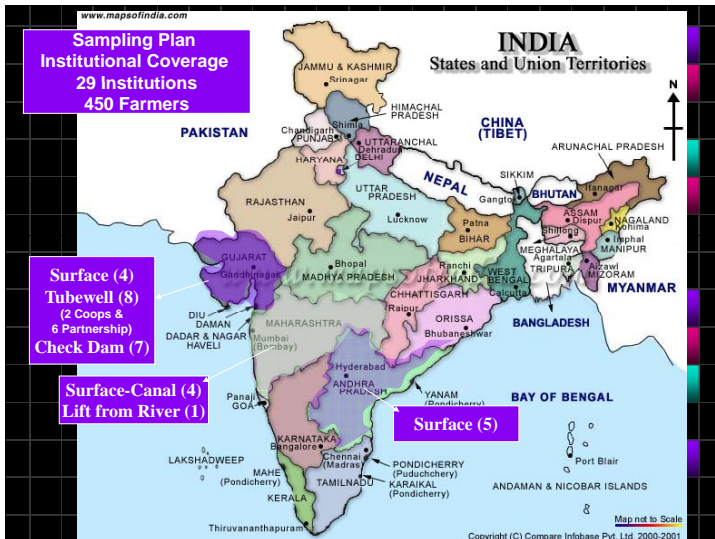
- Good institutions should adequately address/ meet:
 - Technical Rationality**
 - The main emphasize is on technical efficiency. Includes input-output efficiency, production technology, workflow, efficient use of means to accomplish ends.
 - Organizational Rationality**
 - Given division of labor, emphasis is on organizing well to achieve coordinated efforts. Sub-units/ sub-tasks need to be dove-tailed well for overall organizational performance.
 - Political Rationality**
 - Deals with concerns of fairness, justice, and consensual support/ acceptance of decisions. Important for institutions to work sustainably.

Nyström and Starbuck (1981), Ackroyd (2002), Crase and Gandhi (2009)

Goals expected of water institutions: What defines performance

- Addressing Scarcity**
 - Achieving water use that reflects the real scarcity of the resource and lead to its efficient use
- Addressing Equity**
 - Improving equity in the distribution of water
- Addressing the Environment**
 - Achieving development and utilization with least ill effects on the environment
- Addressing Financial Viability**
 - Ability to meet costs, generate returns, attract resources and investment

Goals> Inst. Features	Overall Performance	Scarcity	Equity	Environment	Financial Viability
Clear Objectives					
Good Interaction					
Adaptability					
Appropriate scale					
Compliance					
Technical Rationality					
Organizational Rationality					
Political Rationality					



Sampling household coverage

Table 4: Sampling Plan: Number of sample households

Sl. No.	Kind of Local Water Institution	Gujarat	Maharashtra	Andhra Pradesh	Total
1	Canal co-operatives	50	100	0	150
2	Water users associations	0	0	100	100
3	Tube-well co-operatives	40	0	0	40
4	Tube-well partnerships	60	0	0	60
5	Check-dam groups	100	0	0	100
	Total	250	100	100	450

Groundwater

- Tubewell Institutions

Irrigation Source

Sources	% Farmers
River	0
Open well	1
Tube well	97
Canal	1
Tank	0
Lift from Tank	1

Reliance on the Institution

Reliance	% Farmers
Very substantial	32
Substantial	68
Some	0
Very little	0
None	0
Total	100

Water Situation

Situation	% Farmers
Excess water	0
No scarcity	18
Occasional scarcity	21
Scarcity	57
Acute scarcity	4

Change in water availability over the years

Changes	% Farmers
Increase	0
No change	26
Decline	72
Sharp decline	2

Change in water quality over the years

Current Situation	% Farmers
Improvement	0
No change	33
Deterioration	66
Sharp deterioration	1

Addressing Scarcity

Scarcity					
Particulars	Strongly Agree	Agree	Partially Agree / Disagree	Disagree	Strongly Disagree / Disagree (No)
1. The institutions assesses the quantity of water available in a season/ year	5	4	3	2	1
2. The institution has processes for determining the allocation of this water to the farmers	69	31	0	0	0
3. The institution prices the water according to its scarcity value	62	38	0	0	0
4. The institution prices the water according to the crop	4	0	0	65	31
5. The institution prices the water according to the staff of the institution allocate and monitor the use	12	1	0	24	63
6. The staff of the institution allocate and monitor the use	59	37	0	0	4
7. The penalties for misuse/ abuse are enforced	10	4	5	36	45
8. The institution does good maintenance to prevent loss of water	60	18	7	9	5

Addressing Equity

Equity					
Particulars	Strongly Agree	Agree	Partially Agree / Disagree	Disagree	Strongly Disagree / Disagree (No)
1. The institution has processes for equitable distribution of the water among the farmers	5	4	3	2	1
2. There is proper distribution of water between small and large farmers	54	46	0	0	0
3. There is proper distribution of water between head, middle, and tail end farmers	51	48	1	0	0
4. Equitable allocation of water is monitored and enforced	53	46	1	0	0
5. Equitable allocation of water is monitored and enforced	7	34	45	13	1

Addressing the Environment

Environment					
Particulars	Strongly Agree	Agree	Partially Agree / Disagree	Disagree	Strongly Disagree / Disagree (No)
1. The activity of the institution is causing flooding/ water logging in some areas	5	4	3	2	1
2. The activity of the institution is causing flooding/ water logging in some areas	0	0	0	23	77
3. The activity of the institution is rapidly depleting ground water in the village	36	64	0	0	0
4. The institution is aware of and monitors such environmental harm/ depletion	0	0	1	53	46
5. The institution undertakes activities to reduce such environmental harm/ depletion	4	0	3	63	30

Addressing Financial Viability

Finance					
Particulars	Strongly Agree	Agree	Partially Agree / Disagree	Disagree	Strongly Disagree / Disagree (No)
1. The institution is financially viable	5	4	3	2	1
2. The institution is able to raise recurring payments from the beneficiaries	0	0	100	0	0
3. The institutions has penalties to encourage regular payment	14	86	0	0	0
4. The institutions has penalties to encourage regular payment	0	0	1	49	50
5. The institution is able to raise sufficient funding support from the government	0	0	0	48	52
6. The institution is able to raise funding from donors and public	0	0	0	41	49
7. Banking and financial institutions would be willing to invest in the institution	0	0	0	52	48

Assessment about the success of the institution

Success	%
Very successful	0
Successful	21
Satisfactory	79
Poor	0
Total	100.0

Groundwater - Rainwater Harvesting - Checkdam Institutions

Irrigation Source

Sources	No. of Farmers
River	0
Open well	100
Tube well	0
Canal	0
Tank	0
Lift from Tank	0

Reliance on Institution

Reliance	No. of Farmers
Very substantial	19
Substantial	81
Some	0
Very little	0
None	0
Total	100

Water Situation

Situation	No. of Farmers
Excess water	0
No scarcity	13
Occasional scarcity	35
Scarcity	52
Acute scarcity	0

Clarity of Purpose/ Objectives

	Strongly Agree	Agree	Partially Agree / Disagree	Disagree	Strongly Disagree
	5	4	3	2	1
1. This organisation has a clear set of objectives/ purpose.	66	33	0	0	0
2. The objectives of this organisation are clear to all members of the organisation.	54	45	0	1	0
3. The institution pursues and regularly makes plans towards achievement of these objectives	0	0	0	45	55
4. The objectives are well communicated and shared across the institution	0	0	0	33	67
5. Deviations from these objectives are not frequent.	0	2	98	0	0

Good Interaction

	Strongly Agree	Agree	Partially Agree / Disagree	Disagree	Strongly Disagree
	5	4	3	2	1
1. There is good interaction between the members of the institution	61	39	0	0	0
2. There is good interaction between the management and the members	68	32	0	0	0
4. There is good interaction between the staff and the members	65	35	0	0	0
5. There is good interaction within the managing committee.	56	44	0	0	0
6. There is good leadership to facilitate, improve and guide the interaction	40	60	0	0	0
7. There are regular meetings	0	0	0	40	60
8. There is good interaction between the institution and the government	0	0	99	1	0
9. This organisation helps members to settle disputes	0	0	0	43	56

Adaptiveness					
	Strongly Agree	Agree	Partially Agree / Disagree	Disagree	Strongly Disagree
	5	4	3	2	1
1. There are clear mechanisms for changing the rules of this organisation if the need arises.	34	65	0	1	0
2. The rules and systems of the organization are very rigid	0	0	0	67	33
3. There are processes for adapting the rules and systems according to the needs and setting	34	65	0	1	0
4. There is a regular review of the rules and systems of the institution	0	0	0	32	67
5. The management has the authority to adapt the rules and systems	55	45	0	0	0

Scale/ Size					
	Strongly Agree	Agree	Partially Agree / Disagree	Disagree	Strongly Disagree (No)
	5	4	3	2	1
1. The scale of the institution is too large – e.g. for proper control	0	0	0	52	48
2. The scale of the institution is too small – e.g. for viability	0	0	0	48	52
3. The scale of the institution is appropriate for efficient management	73	27	0	0	0
4. The systems of the institution are appropriate for the scale of operation	40	60	0	0	0
5. The higher level issues are appropriately addressed by higher level institutions	32	68	0	0	0

Compliance					
	Strongly Agree	Agree	Partially Agree / Disagree	Disagree	Strongly Disagree (No)
	5	4	3	2	1
1. Members are aware of and willingly follow the rules set down by this organisation	52	48	0	0	0
2. The management has enough powers to bring compliance to institutional objectives and rules	57	43	0	0	0
3. The institution uses its powers to bring compliance	32	68	0	0	0
4. The compliance to the rules is sufficient	60	40	0	0	0
5. There is external monitoring and enforcement for compliance	0	0	0	27	73
6. The institution is able to ensure fairness and justice	0	0	99	1	0

Assessment about the success of the institution	
Success	%
Very successful	56
Successful	44
Satisfactory	0
Poor	0
Total	100

Overall
-
Water Resource Institutions

Overall performance ratings

Table 3: Overall assessment of the performance/success of the institution by the respondents

Success of the institution		
Success	Rating	%
Very successful	4	16.7
Successful	3	26.0
Satisfactory	2	44.9
Poor	1	12.4
Total		100.0

Analysis : Governance and Performance

Table 4: Governance: Relationship between activity level and institutional performance						
	None	Passive	Active	Very Active	F-Statistic	Statistical Significance
Performance - Mean						
General Body ¹	1.26	1.48	2.26	2.58	60.96	***
Chairman	1.86	1.47	2.78	2.85	64.89	***
Managing Committee	1.88	1.50	2.78	2.87	64.45	***
Secretary	1.80	1.75	3.05	2.73	85.64	***

¹Significant at 10 percent; ** Significant at 5 percent; *** Significant at 1 percent. ns Not Significant. ¹ excludes the check-dam sample since it did not have a functional general body at the time of survey.

Table 5: Governance: Relationship between expertise and institutional performance							
	Strongly Disagree	Disagree	Partially Agree/ Disagree	Agree	Strongly Agree	F-Statistic	Stat. Signi.
Performance - Mean							
Management has the expertise to do a good job	2.03	1.65	1.84	2.95	3.41	77.28	***
The staff have the necessary expertise to do a good job	1.47	1.22	2.67	2.40	2.88	47.20	**

Analysis : Clear objectives and Performance

Clear objectives and institutional performance							
	Strongly Disagree	Disagree	Partially Agree/ Disagree	Agree	Strongly Agree	F-Statistic	Statistical Significance
Performance - Mean							
This organisation has a clear set of objectives/purpose.	1.23	1.33	1.50	2.44	2.99	42.29	***
The objectives of this organisation are clear to all members of the organization	1.36	2.00	1.65	2.56	3.14	57.10	***
The institution pursues and regularly makes plans towards achievement of these objectives	1.91	1.58	1.87	2.65	2.60	27.39	**

Analysis : Good interaction and Performance

Good interaction and institutional performance							
	Strongly Disagree	Disagree	Partially Agree/ Disagree	Agree	Strongly Agree	F-Statistic	Statistical Significance
Performance - Mean							
There is good interaction between the members of the institution	1.00	1.59	1.67	2.39	2.93	24.01	***
There is good interaction between the management and the members	1.35	1.58	1.86	2.37	3.02	30.83	***
There is good leadership to facilitate, improve and guide the interaction	1.35	1.57	2.34	2.75	2.95	45.71	***
This organisation helps members to settle disputes	2.34	3.41	2.53	2.13	2.53	18.53	**

Analysis : Adaptability and Performance

Adaptability and institutional performance							
	Strongly Disagree	Disagree	Partially Agree/ Disagree	Agree	Strongly Agree	F-Statistic	Statistical Significance
Performance - Mean							
The rules and systems of the organization are very rigid	2.40	3.04	1.92	2.03	2.56	24.74	***
There are clear mechanisms for changing the rules of this organisation if the need arises	1.41	1.75	1.93	2.66	3.31	67.59	***
The management has the authority to adapt the rules and systems	1.88	1.61	1.80	2.85	3.09	67.15	***

Analysis : Scale and Performance

Appropriate Scale and institutional performance							
	Strongly Disagree	Disagree	Partially Agree/ Disagree	Agree	Strongly Agree	F-Statistic	Statistical Significance
Performance - Mean							
The scale of the institution is appropriate for efficient management	1.19	1.50	1.65	2.52	3.03	54.37	***
The systems of the institution are appropriate for the scale of operation	1.25	1.55	1.57	2.64	3.05	53.73	***
The higher level issues are appropriately addressed by higher level institutions	1.93	2.11	2.56	3.52	3.41	88.40	***

Analysis : Compliance and Performance

Compliance and institutional performance							
	Strongly Disagree	Disagree	Partially Agree/ Disagree	Agree	Strongly Agree	F-Statistic	Statistical Significance
Performance - Mean							
Members are aware of and willingly follow the rules set down by this organisation	1.37	1.55	1.68	2.57	3.25	70.15	***
The institution uses its powers to bring compliance	1.39	2.25	2.47	2.73	2.96	50.69	***
The compliance to the rules is sufficient	1.86	1.88	3.22	2.79	3.09	65.44	***

Multivariate: Tobit analysis

Table 12: Explanatory Variables

Variable	Variable Description
x1	Intercept
x2	General Body Active
x3	Managing Committee Active
x4	Secretary Active
x5	The organization has been created by the government
x6	The rules of the organization are mainly determined by the government and not the members
x7	Management has the expertise to do a good job.
x8	The objectives of this organization are clear to all members of the organization.
x9	The institution pursues and regularly makes plans towards achievement of these objectives
x10	There is good interaction between the members of the institution
x11	There is good leadership to facilitate, improve and guide the interaction
x12	There are clear mechanisms for changing the rules of this organization if the need arises.
x13	The management has the authority to adapt the rules and systems
x14	The scale of the institution is appropriate for efficient management
x15	The higher level issues are appropriately addressed by higher level institutions
x16	The institution uses its powers to bring compliance
x17	The compliance to the rules is sufficient
x18	Check Dam Dummy
x19	Groundwater Dummy

Table 13: Tobit Regression Results I

Explanatory Variables	Dependent Variables		
	Institutional Performance or Success	Increase in Irrigated Area	Pricing of Water According to Scarcity
	Parameter estimates and significance		
x1	1.420091***	4.076893*	1.410308
x2	0.250914***	-0.069159	-0.066155
x3	0.187092**	0.265481***	0.099475
x4	-0.287871***	-0.04304	-0.015379
x5	-0.149422***	-0.25024***	-0.139544
x6	-0.09607	-0.057786	-0.118937
x7	0.234816***	0.084181	0.101575
x8	0.100343	-0.20820***	-0.255083
x9	0.268063***	-0.080258	-0.237644**
x10	-0.063359	-0.003387	0.475615***
x11	-0.169503***	0.239415***	0.211716
x12	-0.001211	-0.007377	0.29315**
x13	-0.090217	0.098452	-0.097824
x14	-0.170791***	-0.145137**	-0.333062***
x15	0.068449	0.076801	0.432666***
x16	0.163848***	0.03968	-0.254228**
x17	0.002516	0.111427*	0.417881***
x18	2.08165***	0.445611	-9.007202
x19	0.260732	0.215121	-0.416754

* Significant at 10 percent; ** Significant at 5 percent; *** Significant at 1 percent

Findings

- Governance very important: political and organizational rationality
 - Active general body, Active managing committee, Management expertise
- Strong government involvement negatively related
 - Organization created by the government, Rules determined by government
- New institutional economics and performance - strong relationship
 - Clear objectives-plans, Compliance-uses powers, Good interaction-leadership to facilitate
- Addressing Scarcity
 - Good interaction-between members, Compliance-sufficient, Scale-higher level issues, Adaptability-changing of rules, Clear objectives-to all-plans
- Addressing Equity
 - Compliance, Good interaction, -ve Created by govt., +ve Rules by govt.
- Addressing Environment
 - Scale-higher level issues, Good interaction, Compliance, Management expertise, -ve Created by government
- Addressing Financial Viability
 - Scale-higher level issues, Good interaction, Clear objectives-plans, Management expertise
- Impact on the poor and the village as a whole
 - Adaptability-changing rules, Management expertise, Secretary active, Compliance

Concluding Observations

- There is a great need to improve institutional development and design for water resource management in India
- New institutional economics and management theories of governance are quite useful in explaining the performance of water institutions
- **New Institutional Economics**
 - Clear objectives – overall performance
 - Good interaction – scarcity, equity
 - Adaptability – scarcity, benefits to the poor
 - Scale – environment, financial viability
 - Compliance – equity, scarcity
- **Governance**
 - Government – creation/ rules – negatively related; environment, equity - positive
 - Technical rationality – scarcity, financial viability
 - Organizational rationality – financial viability, overall performance
 - Political rationality – overall performance, equity
- Incorporating these features through laws, design-during-creation and training may help substantially to develop better institutions and improve the management of the water resource



Thank you