Paper for Presentation

Determinants of Institutional Success for Water in India: Results from a Study across Three States

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Introduction

The management of water resources is extremely important for India's economy and agriculture and is currently facing many challenges. Substantial progress has been made on the physical and technical front, but institutional development has lagged seriously behind. Institutional organization and management in the given social, economic and political setting is becoming a major problem and is posing a serious challenge. The research presented here is based on a collaborative project undertaken between Indian and Australian researchers with the assistance of ACIAR to address the knowledge gap surrounding water institutions in India.

The distribution of rainfall is highly uneven in India. 8 per cent of the area receives very high/assured rainfall, and 20 per cent receives high rainfall. The rest of country is in the low, dry or medium rainfall range. Even within a year, the rainfall is highly concentrated. 74 percent is received in the southwest monsoon period of June to September. As a result of this skewed distribution, agriculture and the associated livelihoods must depend substantially on artificial methods of providing water.

Historically, before investments on irrigation by the government became an accepted practice in India, many emperors and local chiefs devised ways of storing water in ponds and tanks, (Singh 1991). During the British Rule in India the government started intervening to some extent in harnessing water resources. At the time of Independence, India had 22.5 million hectares under irrigation. By early 2000's a potential of nearly 90.0 million hectares had been reached.
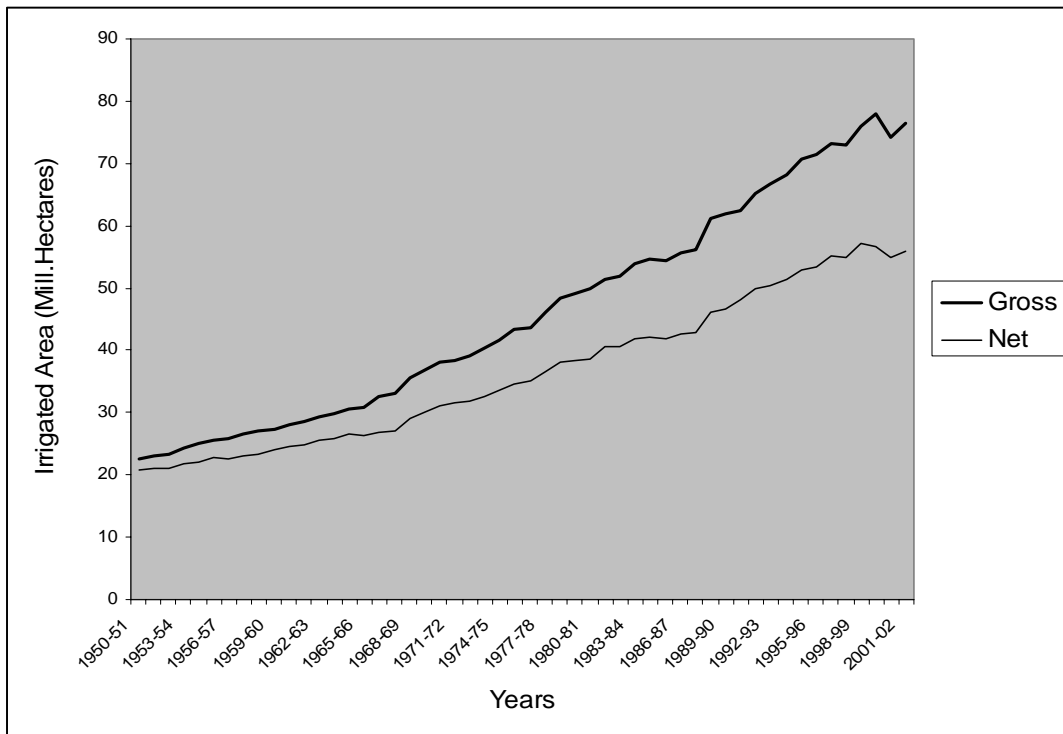
The figure below on the growth of irrigation potential over the planning periods, however, indicates that a large gap has emerged between the potential created and the potential utilized, and further between the potential utilized and the actual gross area irrigated, and the gap is widening, India (2000-). This is of significant concern and is believed to be substantially because of poor institutional development.

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Irrigation Potential Created, Utilized and the Actual Irrigated Area
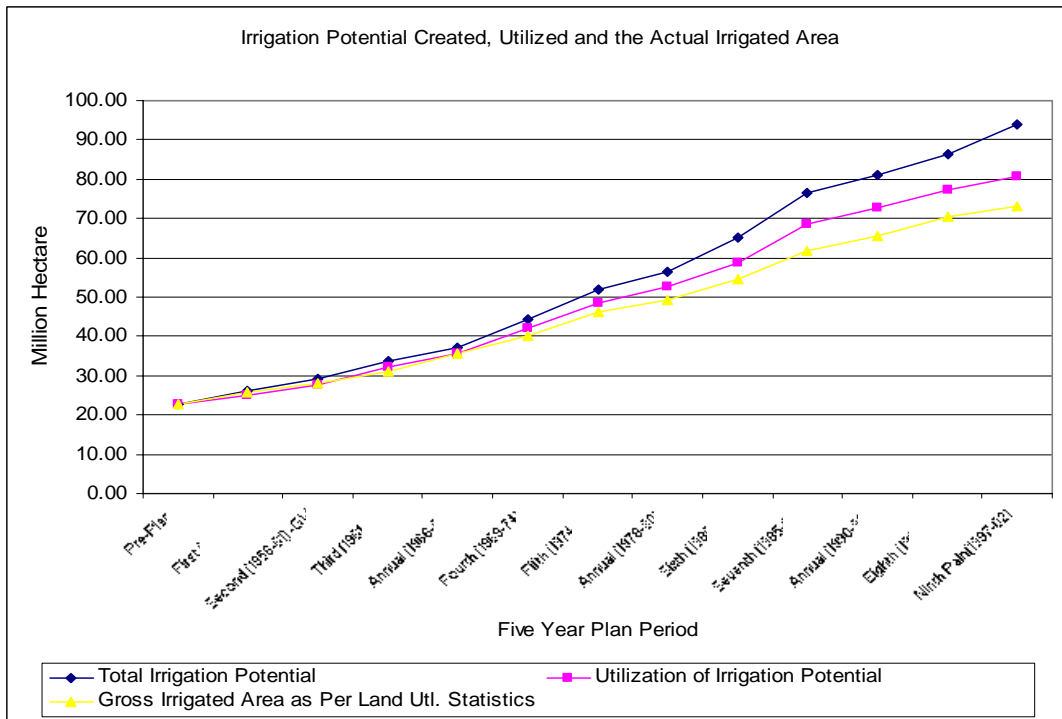
The figure below shows that there has been a fairly rapid growth in the irrigated area, both gross and net, India (2000-). However, the data indicates a notable slowdown in the early 2000s. This is indicative of the difficulties in sustaining the irrigation development including institutional difficulties.

India: Growth in Irrigated Area

The figure below shows the changing composition of irrigation by source and indicates that after mid 90s, tubewells have become the dominant source of irrigation, India (2000-). This is followed by canals and then other wells. Tank irrigation is showing a decline. It shows increasing dependence on ground water.

Sources of Irrigation in India

The figure below shows the composition of the total irrigated area by crop, India (2000-). It shows that the largest share of irrigated area is under rice, followed by wheat. The figure shows that the irrigated area under wheat was relatively small in mid 60s, but has risen sharply and has become almost equal to that of rice. Thus, most of the food grain production now depends on irrigation. Among the other crops, oilseeds hold the largest share, followed by sugarcane.

Total Irrigated Area under Major Crops

Emerging Institutional Problems

There has been serious concerns about unsatisfactory management, delivery and utilization of irrigation water, Brewer et.al. (1999). Following a large number of commissions and committees, command area development authorities (CADA) were set up to provide an integrated approach to development of irrigation, Singh (1991). This worked in some areas but farmers did not take to CADA with enthusiasm as it was seen as a government program imposed from the top. Following this, the government sought to give the responsibility for irrigation management to the farmers and a number of local institutions of different kinds were formed. Experience showed that this also often did not work effectively and a large number performed poorly or became defunct.

It has been realized from recent experience that getting prices right is not enough for water it hardy solves the problem. Farmers are willing to pay 2-3 times more, if the water provided is adequate and it is available at the right time. The problem lies in the implementation. Price recovery rates are often very poor and institutional arrangements for delivery and maintenance are weak, see Reddy (1998), Gandhi (1998). In surface water, tail reach is insufficient, water delivery is untimely, and maintenance is poor resulting in substantial losses and poor efficiency. Ground water too has been particularly difficult to control. The government is unable to control tube well development and the excessive draft of water, Shah (1993).

Large number of writers believe that water resource management in India is heading for a crisis unless policies and institutions are radically transformed, see Saleth (1996), Gandhi and Namboodiri (2002), Vaidyanathan (1999). This would require better design of water resource institutions including a water rights regime that can effectively limit and regulate the use of water. Worldwide experience indicates that managing water is difficult because of the basic nature of the water resource. Market failures are common in water. Markets are generally not enough for managing water and institutional control is required.

Managing water resources is very challenging because water is fugitive, lumpy and rife with externalities, Livingston (1993). Managing water involves large transaction costs and there are serious information deficiencies, see Crase, Dollery and Lockwood (2002), Herath (2002). Institutions need to designed to deal with the peculiarities of water, and to create the right incentives, controls and efficiencies. Many disappointing investments in water have resulted from institutional failure. There is a need to understand how rules combine with the local physical, economic and cultural environment to give the appropriate institutions, Ostrom (1992).

Some major questions that emerge in the Indian context are:

1. How can the institutions be designed so that the water use reflects the real <u>scarcity</u> of the resource and leads to its efficient use?

2. How can the institutions be designed so as to achieve an <u>equitable</u> distribution in the utilization of water?

3. How can institutions be designed to be <u>financially viable</u> so that the operation and investment are well financed and the necessary rates of investment are achieved?

4. How can institutions be designed so that the development and utilization takes place with least ill effects on the soil and the <u>environment?</u>

Conceptual Background

The new institutional economics studies follow different concepts and methods. One set of studies focus on transaction costs and property rights. It is said that when transaction costs are large, institutions matter. The logic of institutions also comes from the agency theory, in which the activity is divided into principals, who want to get things done, and agents, who do the things. Another set of inquiries is based on public choice and political economy concepts. This includes ideas such as the calculus of consent and logic of collective action. Some research is based on quantitative economic history. Another set of studies are based on concepts of cognition, ideology and path dependence, see North (1997), Olson and Kahkonen (2000).

In the new institutional economics literature, different kinds of institutions have been identified, see Williamson (2000). There are formal institutions, which have a foundation in the laws and structure of organized society. On the other hand, there also exist informal institutions which often spontaneously and dynamically develop in the society to address specific issues and problems.

There are macro level institutions, which are humanly devised rules or the rules of the game that structure interactions. These may include formal rules such as constitutions, laws and property rights, and informal rules such as traditions and codes of conduct. On the other hand, there are micro level institutions, which are institutions of governance such as market or other modes of managing activities/ transactions and seeing activities such as economic activities through, see Williamson (2000). In developing countries, both macro and micro level institutions are important and can play a crucial role. Many of the local institutions in water resource management examined in the study would fall under micro level institutions group.

A premise of new institutional economics is that real total cost of economic activities includes both transformation costs and transaction costs. Usually transaction costs are ignored, but they can be very large and can substantially reduce efficiency and effectiveness. Good institutions reduce transaction costs. According to North (1997), the major challenge is to evolve institutions in which:

1. The transaction costs are minimized

2. The incentives favor co-operative solution, in which cumulative experiences and collective learning are best utilised.

Based on the theory of new institutional economics and the empirical literature which has followed, some features of successful institutions have been identified (Pagan, 2003). These are summarized below.

1. Clear Objectives
   - Good institutions have clear objectives and show a clarity of purpose. The clarity of objectives among its stakeholders result in greater congruence, less conflict, and lower transaction cost.

2. Good Interaction
   - An important feature of good institutions is good internal interaction – this help in reducing transaction costs and obtaining cooperative solutions. Good institutions also show good interaction with other institutions, so that external transaction cost are also minimized.

3. Adaptiveness
   - Variations and change in the internal and external environment of the institution are common. In face of this, successful institutions demonstrate adaptiveness. Through this the institution can operate with lower transaction costs.

4. Appropriateness of Scale
   - Good institutions have appropriateness of scale with respect to their size and scope. If the scope/scale is too large, transaction cost become high. On the other hand, if the institution is too small, it would have very little control over its affairs.

5. Compliance Ability
   - Good institutions provide the required compliance ability. If the rules and processes of the institutions are not followed by a large section of the stakeholders, then the transaction costs expand, the institution cease to be meaningful and it fails.

Another set of concepts that are relevant in the context of institutional/ organizational effectiveness come from the management science of organizational design, Nystrom and Starbuck (1981), Ackroyd (2002). Good governance in organizations/ institutions requires the addressing of three rationalities:

1. Political Rationality
2. Organizational Rationality
3. Technical Rationality

Very briefly, technical rationality focuses on efficient conversion of inputs into outputs. This focuses on aspects such as the right technology and technical efficiency. When the organization involves a large set of activities,

division of labor is followed, and then organization's effectiveness depends not only on technical rationality but also on the ability to achieve the best coordination across the activities – this is the subject of organizational rationality. Further, in larger modern organizations which involve substantial human interaction, addressing issues of representation, fairness and justice become important. Thus, the organization needs to address political rationality and have mechanisms to take care of it. The table below summarizes this theory, and puts it in the context of development phases of an organization.

Organizational Rationality and Developmental Phases		
Form of rationality	*Purpose sought*	*Developmental phase*
Technical	Efficiency	Early growth of structurally simple organizations
Organizational	Coordination	Moderate maturity of structurally complex organizations
Political	Regime Maintenance and Justice	Full maturity of structurally complex organizations

Data

The study is based on data from the states of Gujarat, Maharashtra and Andhra Pradesh in India. All these states face significant water scarcity conditions and have attempted to address the situation through various means, including different institutional innovations and efforts. The study samples a variety of these local institutions in water resource management in these states. In the state of Gujarat, these include tube-well based co-operatives, tube-well based partnerships and check-dam groups. The tube-well co-operatives and partnerships have sought to address the problem of high investment requirements and operational costs of deep tube-wells, as ground water recedes, in addition to the distribution of the scarce available water amongst the participating farmers. The check-dam groups have sought to achieve better rain water harvesting and recharge of wells through investment and creation of check-dams in and around the village. In Maharashtra there is a history of development of irrigation co-operatives to manage the distribution of canal water by the farmers on their own, and some for lifting water from rivers. In Andhra Pradesh there has been a government initiative to form a large number of water user associations (WUAs) to manage the distribution of canal, village tank or pond water to the farmers.

Based on the information available from the government and academic institutions in each state, a set of diverse locations and local water institutions were selected in each state for study. The institutions were then studied through interviews and detailed institutional questionnaires for the institutions, as well as detailed household questionnaires for the beneficiaries of these institutions. In the state of Gujarat, which has largest diversity of water institutions, 19 such institutions were covered. At these locations, 250 beneficiary farm households were sampled. The distribution across types of institutions is given in the Table below. In the state of Maharashtra 5 canal or river-lift co-operatives were covered, and 100 beneficiaries were covered

through questionnaire survey. In the state of Andhra Pradesh 5 water user associations across major, medium and minor irrigation projects were investigated and a sample of 100 beneficiaries surveyed. The results reported here are based data from these 29 water institutions and 450 related/ beneficiary households.

The survey included a variety of questions related to the respondent profile, landholding, village setting, institutional association and activities, institutional performance, and a variety of questions related to institutional structure and function based on the frameworks of new institutional economics and governance, discussed above. The survey pertains to the 2004-2005 cropping year.

Sampling Plan: Number of sample households					
Sr. 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

Statistical Analysis: Analysis of Variance.

The analysis below seeks to examine the association between relevant variables/ responses and its statistical significance. The analysis of variance framework is used. The mean values of the analyzed variable across different groups and the statistical significance of the difference in the means are estimated.

The table below examines the association between the social cohesion in the village community and the institutional performance. The institutional performance is measured by the respondent opinion on the success of their institution – rating 1 to 4. The results below indicate that there is a positive association of performance with cohesion, which is statistically significant. Excellent cohesion is associated with the best performance.

Analysis of relationship between cohesion and institutional performance							
Cohesion	Excellent Cohesion	Good Cohesi	Some Conflict	Some Conflicts	Severe Conflict	F-Stati.	Stat. Sig.

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		on					
Cohesion-Mean	3.29	2.42	1.80	-	-	13.85	***

The tables below examine the differences in the participation level of the members in their institutions. They indicate that the differences are statistically significant across institution type, with tubewell partnerships showing the highest level of participation followed by checkdam groups. This is consistent with their grass-root development and close association. Among the states, Gujarat shows the highest level of participation followed by Andhra Pradesh.

Analysis of relationship between institution type and participation							
Institution Type	Check Dams Group	Tube-well Co-opera tives	Tube-well Partner ships	Canal Co-opera tives	Water User Asso-ciations	F-Statis tic	Statistical Signi ficance
Participation-Mean	1.99	1.65	2.10	1.62	1.69	14.45	***

Analysis of relationship between state location and participation					
State	Andhra Pradesh	Gujarat	Maharashtra	F-Statis tic	Statistical Significance
Participation-Mean	1.69	1.96	1.44	38.88	***

The table below indicates that the reliance on the institution differs significantly by state, with Gujarat showing the highest reliance followed by Maharashtra and then Andhra Pradesh. This is consistent with water scarcity across these states. The reliance also varies by institution type, but there is not much difference across institutions except for lower reliance shown in water user associations.

Analysis of relationship between state location and reliance on institution					
State	Andhra Pradesh	Gujarat	Maharashtra	F-Statistic	Statistical Significance
Reliance-Mean	2.99	4.26	3.91	69.39	***

Analysis of relationship between institution type and reliance on institution

Institution Type	Check Dams Group	Tube-well Co-operatives	Tube-well Partnerships	Canal Co-operatives	Water User Associations	F-Statistic	Statistical Significance
Reliance-Mean	4.19	4.30	4.33	4.03	2.99	33.28	***

The tables below examine the institutional performance in relation to various features. The results indicate that the institutional performance does not vary much between ground and surface water institutions. This indicates that there may be successes and failures almost equally in both. Even though institutions under excess water situation show greater success, this is followed by institutions under scarcity, indicating that there is a relationship with the need for the institution. However, acute scarcity is related to poor institutional performance. An increase in water availability is as expected related to institutional success. The institutional success rating does not vary significantly with the position of the respondent in the watershed: head, middle or tail. Check dam groups show the highest performance rating followed by canal cooperatives and then tubewell cooperatives. The institutional performance is indicated as the highest in Gujarat, followed by Maharashtra.

Analysis of relationship between source of water and institutional performance				
Source	Ground	Surface	F-Statistic	Statistical Significance
Performance-Mean	2.21	2.54	10.56	*

Analysis of relationship between water situation and institutional performance							
Water Situation	Excess Water	No Scarcity	Occasional Scarcity	Scarcity	Acute Scarcity	F-Statistic	Statistical Significance
Performance-Mean	3.50	2.28	2.63	2.64	1.26	23.09	***

Analysis of relationship between change in water availability and institutional performance					
Water Availability	Increase	No Change	Decline	Sharp Decline	F-Statistic	Statistical Significance
Performance-Mean	4.00	2.66	2.20	1.26	26.05	***

Analysis of relationship between location in watershed and institutional performance					
Location	Head	Middle	Tail	F-Statistic	Statistical Significance
Performance-Mean	2.25	2.23	1.99	4.22	ns

Analysis of relationship between institution type and institutional performance							
Institution Type	Check Dams Group	Tube-well Co-operatives	Tube-well Partnerships	Canal Co-operatives	Water User Associations	F-Statistic	Stat. Sign.
Performance-Mean	3.56	2.25	2.18	2.59	1.46	177.07	***

Analysis of relationship between state of location and institutional performance					
State	Andhra Pradesh	Gujarat	Maharashtra	F-Statistic	Statistical Significance
Performance-Mean	1.46	2.85	2.52	131.77	***

The tables below examine the association between governance and success. The activity level of the general body is found to be an important determinant. However, the results in this case are affected by the inclusion of check dam groups in the sample. These being largely one-time activities, indicate currently passive general bodies. However, if this is excluded from the sample, the results very clearly bring out a positive association with general body activity. Good governance provided by active chairmen, managing committees and secretaries are strongly associated with success. Moreover, active government officials are also strongly associated with success. The results indicate that where the management and the secretary have the expertise to do their jobs, the performance is significantly better. Thus, training would play a significant role. If the organization has been created by the government and the rules are determined by the government, then there is a significant reduction in the chances of success. Thus, direct government involvement does not seem to lead to successful institutions.

Governance: Analysis of relationship between role-activity and institutional performance						
	None	Passive	Active	Very Active	F-Statistic	Statistical Significance

	Performance – Mean					
General Body	1.26	3.14	2.26	2.58	84.10	***
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	***
Government Officials	2.19	2.08	3.36	3.47	76.47	***

Governance: Analysis of relationship between expertise and institutional performance						
	Strongly Disagree	Dis-agree	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	***

Governance: Analysis of relationship between role of government and institutional performance						
	Strongly Disagree	Dis-agree	Partially Agree/ Disagree	Agree	Strongly Agree	F-Statistic	Statistical Significance
Performance - Mean						
The organisation has been created by the government	2.36	2.52	3.46	1.67	1.47	153.50	***
The rules of the organisation are mainly determined by the government and not the members.	2.70	2.79	2.32	1.61	1.45	46.77	***

The tables below examine the relevance of new institutional economics fundamentals to the success of water institutions. Elements of the framework have been discussed above.

The tables below examine the association between success and clear objectives as well as good interaction. Results indicate the existence of clear objectives and their being clear to all members are strongly associated with institutional success. The regular pursuit of plans to achieve objectives shows a mixed performance but this is largely because of inclusion of check-dam groups in the samples, which is largely a one-time activity. Good interaction between the members and between the management and members are

positively associated with success. Good interaction with the government appears to be of even greater importance, with great success shown where this is very good. With respect to assistance in settling disputes, the result is mixed, perhaps because of the questionable effectiveness of this role played by the institution.

New Institutional Economics: Analysis of relationship between clear objectives and institutional performance							
	Strongly Disagree	Dis-agree	Partially Agree/ Disagree	Agree	Strongly Agree	F-Stat.	Statistical Significa nce
Performance - Mean							
This organisat-ion 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	2.39	3.14	1.87	2.67	2.60	20.42	***

New Institutional Economics: Analysis of relationship between good interaction and institutional performance							
	Strongly Disagree	Dis-agre e	Partially Agree/ Disagree	Agree	Strongly Agree	F-Stat.	Statistical Significa nce
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 interaction between the institution and the government	1.88	2.04	3.03	2.74	3.22	67.16	***
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	***

The tables below examine the association of institutional performance with the characteristics of adaptability, scale and compliance. The results indicate that where the rules of the organization are very rigid, the chances of success are significantly reduced. Clear mechanisms for changing the rules, and the authority to change the rules lead to greater success in the institutions.

Appropriate scale and systems of the institutions lead to substantially greater success in institutions. The results indicate that the appropriate handling of higher level issues, by higher level institutions is of the greatest importance in the matter of scale. This is associated with significantly greater success.

Where members are willing to follow the rules of the organization, the chances of success are substantially increased. The use of powers by the institutions to bring compliance shows mixed results, but, where compliance to the rules is sufficient, the success is better.

New Institutional Economics: Analysis of relationship between good interaction and institutional performance							
	Strongly Disagree	Dis-agree	Partially Agree/ Disagree	Agree	Strongly Agree	F-Stat.	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	***
There is a regular review of the rules and systems of the institution	2.41	2.67	2.45	2.55	2.44	1.00	ns

New Institutional Economics: Analysis of relationship between scale and institutional performance							
	Strongly Disagree	Dis-agree	Partially Agree/ Disagree	Agree	Strongly Agree	F-Stat.	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	***

New Institutional Economics: Analysis of relationship between compliance and institutional performance							
	Strongly Disagree	Dis-agree	Partially Agree/ Disagree	Agree	Strongly Agree	F-Stat.	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 Analysis: Factor, Regression and Tobit Analysis

The analysis above has examined the relationship with one explanatory factor at a time. A number of factors emerge with a significant association. Next, a multivariate approach with regression analysis is used to examine the determinants of various performance indicators.

Even though institutional performance can be measured by a single response of the farmer respondents on the institution's success, single responses are not available for the determinants such as technical rationality and clarity of objectives which have been discussed in the conceptual framework above. Responses have been collected on these through several different questions asked to the respondents, such as those shown in the analysis above. Factor analysis was carried out over these variables representing each of these determinants ranging from technical rationality to degree of compliance. Single factors were then extracted to represent each of these determinants.

The following multivariate function was then estimated for the determinants of success:

$S = f (x1, x2, ….. x14)$

Where:

S = Success response or Success index

$x1$ = Intercept

the following determinants related to governance theory estimated and extracted from the relevant questions through factor analysis

$x2$ = Technical Rationality
$x3$ = Organizational Rationality
$x4$ = Political Rationality
$x5$ = Government Involvement

the following determinants related to new institutional economics estimated and extracted from the relevant questions through factor analysis

$x6$ = Clarity of Objectives
$x7$ = Quality of Interaction
$x8$ = Adaptiveness
$x9$ = Appropriate scale
$x10$ = Compliance

and the following dummy variables to allow for differences across states (Andhra Pradesh = 0), and across institution types (ground water/tube wells = 0)

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x11 = Maharashtra dummy
x12 = Gujarat dummy
x13 = Check-dam dummy
x14 = Surface water dummy

The table below gives the results for the institutional success response of the respondents. These results would be affected to an extent by multicollinearity between the variables. A large number of determinants emerge significant and the R-square at 0.67 indicates that the model explains 2/3 of the variation in institution success. Among the governance variables, organizational rationality emerges as the most significant determinant indicating, for example, the importance of the managing committee and its activities. Government involvement is negatively related though this is not significant at the 95 percent level. Clarity of objectives, adaptiveness and appropriate scale also stand out as significant determinants indicating, among other things, the relevance of new institutional economics. Success is indicated to be greater in Maharastra and Gujarat, and in check-dam institutions.

Regression results for institutional success response				
	Variable	Parameter	t Value	Pr > |t|
		Estimate		
1.	Intercept	1.14807	5.01	<.0001
2.	Technical Rationality	-0.04166	-1.82	0.0699
3.	Organizational Rationality	0.04216	2.12	0.0348
4.	Political Rationality	0.00376	0.1	0.9189
5.	Government Involvement	-0.04214	-1.81	0.0705
6.	Clarity of Objectives	0.08209	3.16	0.0017
7.	Quality of Interaction	-0.01126	-0.78	0.4361
8.	Adaptiveness	0.08152	2.04	0.0415
9.	Appropriate scale	0.03907	1.98	0.0482
10.	Compliance	-0.02424	-1.03	0.302
11.	Maharashtra dummy	0.61535	2.27	0.0239
12.	Gujarat dummy	0.64778	2.35	0.019
13.	Checkdam dummy	1.47018	4.25	<.0001
14.	Surface water dummy	-0.1817	-1.16	0.2458
N=450 Rsq = 0.6724				

Since the dependent variable of success response ranges from 1 to 4, OLS regression assumptions strictly do not hold. To correct for this, estimation was carried out through a Tobit regression with truncation at both tails. The results are given below. The results are similar but the significance of many variables is affected. Clarity of objectives still emerges as a strong determinant.

Tobit regression results for institutional success response				
	Variable	Parameter	t Value	Pr > |t|
		Estimate		
1.	Intercept	0.807691	2.54	0.011

2.	Technical Rationality	-0.0539	-1.74	0.0826
3.	Organizational Rationality	0.035062	1.27	0.2055
4.	Political Rationality	0.044079	0.84	0.4007
5.	Government Involvement	-0.0538	-1.7	0.0886
6.	Clarity of Objectives	0.16318	4.17	<.0001
7.	Quality of Interaction	-0.01663	-0.81	0.4164
8.	Adaptiveness	0.070574	1.3	0.1941
9.	Appropriate scale	0.043212	1.53	0.1254
10.	Compliance	-0.00053	-0.02	0.9868
11.	Maharashtra dummy	0.736747	2.01	0.0443
12.	Gujarat dummy	0.651361	1.76	0.079
13.	Checkdam dummy	1.631906	3.34	0.0008
14.	Surface water dummy	-0.65503	-2.87	0.0041
N=450 Schwarz Criterion=962.96				

Response on the institutional performance has also been collected through a large set of questions on performance including on the objectives of scarcity, equity, finance, and the environment. Factor analysis was carried out over responses to 46 of these questions and a factor representing success was extracted from this analysis. This index was then used as an alternative dependent variable in place of the single respondent response on success of the institution. The estimates are given below and show somewhat different results. The Rsq of 0.9546 indicates very good explanatory power of the theory of governance and new institutional economics used here in explaining institutional performance. Organizational rationality once again emerges as very important, but the quality of interaction, and adaptiveness also emerge as important determinants, indicating the usefulness of this approach in explaining institutional performance.

Regression results for institutional success index				
	Variable	Parameter Estimate	t Value	Pr > |t|
1.	Intercept	40.77286	16.61	<.0001
2.	Technical Rationality	0.38615	1.57	0.1168
3.	Organizational Rationality	0.49278	2.31	0.0214
4.	Political Rationality	-0.97155	-2.45	0.0145
5.	Government Involvement	0.01566	0.06	0.9499
6.	Clarity of Objectives	-0.95335	-3.43	0.0007
7.	Quality of Interaction	0.47435	3.06	0.0023
8.	Adaptiveness	1.71118	4	<.0001
9.	Appropriate scale	0.31328	1.48	0.139
10.	Compliance	-0.18659	-0.74	0.4584
11.	Maharashtra dummy	16.25254	5.59	<.0001
12.	Gujarat dummy	18.58125	6.3	<.0001
13.	Checkdam dummy	-61.2637	-16.54	<.0001
14.	Surface water dummy	-2.01165	-1.2	0.2306
N=450 Rsq = 0.9546				

The table below provides results on addressing the objective of scarcity extracted by factor analysis from the relevant question responses. It shows the importance of quality of interaction and adaptiveness in addressing the objective of scarcity, apart from organizational rationality.

	Variable	Parameter Estimate	t Value	Pr > |t|
	Regression results for institutional index on addressing scarcity			
1.	Intercept	17.89226	10.9	<.0001
2.	Technical Rationality	0.11543	0.7	0.4829
3.	Organizational Rationality	0.2649	1.86	0.0641
4.	Political Rationality	-0.34272	-1.29	0.1961
5.	Government Involvement	0.11164	0.67	0.5032
6.	Clarity of Objectives	-1.13098	-6.08	<.0001
7.	Quality of Interaction	0.56014	5.41	<.0001
8.	Adaptiveness	0.96726	3.38	0.0008
9.	Appropriate scale	0.08702	0.62	0.5385
10.	Compliance	0.05185	0.31	0.758
11.	Maharashtra dummy	8.81743	4.53	<.0001
12.	Gujarat dummy	10.51907	5.33	<.0001
13.	Checkdam dummy	-30.3758	-12.26	<.0001
14.	Surface water dummy	1.95047	1.74	0.0825
N=450 Rsq = 0.9203				

The table below provides results on addressing the objective of equity extracted by factor analysis from the relevant question responses. It shows the importance of technical rationality, organizational rationality, and adaptiveness.

	Variable	Parameter Estimate	t Value	Pr > |t|
	Regression results for institutional index on addressing equity			
1.	Intercept	18.46037	16.97	<.0001
2.	Technical Rationality	0.22539	2.07	0.039
3.	Organizational Rationality	0.19914	2.11	0.0358
4.	Political Rationality	-0.56989	-3.25	0.0012
5.	Government Involvement	-0.03322	-0.3	0.7636
6.	Clarity of Objectives	0.23564	1.91	0.0567
7.	Quality of Interaction	-0.0813	-1.19	0.2366
8.	Adaptiveness	0.4884	2.58	0.0102
9.	Appropriate scale	0.13817	1.48	0.1408
10.	Compliance	-0.21668	-1.94	0.0524
11.	Maharashtra dummy	5.68088	4.41	<.0001
12.	Gujarat dummy	6.29879	4.82	<.0001
13.	Checkdam dummy	-18.0616	-11.01	<.0001
14.	Surface water dummy	-1.60869	-2.17	0.0308
N=450 Rsq = 0.9181				

The table below provides results on addressing the objective of financial viabilty extracted by factor analysis from the relevant question responses. It shows the importance of organizational rationality, adaptiveness and to an extent appropriate scale in addressing the objective of financial viability.

	Regression results for institutional index on addressing financial viability			
	Variable	Parameter Estimate	t Value	Pr > |t|
1.	Intercept	3.80417	4.53	<.0001
2.	Technical Rationality	0.01552	0.18	0.8536
3.	Organizational Rationality	0.25504	3.49	0.0005
4.	Political Rationality	-0.4907	-3.62	0.0003
5.	Government Involvement	-0.02437	-0.29	0.7751
6.	Clarity of Objectives	-0.18687	-1.96	0.0504
7.	Quality of Interaction	0.04796	0.91	0.3658
8.	Adaptiveness	0.37147	2.54	0.0114
9.	Appropriate scale	0.12384	1.71	0.0876
10.	Compliance	-0.15684	-1.82	0.069
11.	Maharashtra dummy	-3.94306	-3.96	<.0001
12.	Gujarat dummy	-2.94424	-2.92	0.0037
13.	Checkdam dummy	11.3009	8.92	<.0001
14.	Surface water dummy	-0.14063	-0.25	0.8064
N=450 Rsq = 0.8419				

The table below provides results on addressing the objective of the environment extracted by factor analysis from the relevant question responses. It shows the importance of organizational rationality, adaptiveness and appropriate scale in addressing this objective. Political rationality and government involvement often emerge with negative signs in this analysis.

	Regression results for institutional index on addressing the environment			
	Variable	Parameter Estimate	t Value	Pr > |t|
1.	Intercept	9.70824	11.33	<.0001
2.	Technical Rationality	0.06838	0.8	0.4258
3.	Organizational Rationality	0.29337	3.94	<.0001
4.	Political Rationality	-0.53375	-3.86	0.0001
5.	Government Involvement	-0.12928	-1.49	0.1378
6.	Clarity of Objectives	-0.04582	-0.47	0.6374
7.	Quality of Interaction	-0.07293	-1.35	0.1779
8.	Adaptiveness	0.59508	3.99	<.0001
9.	Appropriate scale	0.25675	3.48	0.0006
10.	Compliance	-0.22214	-2.53	0.0117
11.	Maharashtra dummy	-1.93824	-1.91	0.057
12.	Gujarat dummy	-0.94618	-0.92	0.3584
13.	Checkdam dummy	-4.92388	-3.81	0.0002
14.	Surface water dummy	-5.75796	-9.84	<.0001

N=450 Rsq = 0.7088

Concluding Observations

The study has sought to examine the nature and performance of local institutions in water resource management in India, using the new institutional economics framework, and theories of good governance emerging from management sciences. A number of determinants suggested by the new institutional economics framework emerge as important and relevant in determining institutional performance of water institutions. This includes clear objectives, good interaction, adaptability, scale, and compliance. These need to be addressed to improve the performance of existing institutions and develop better institutions for water resource management in India.

Issues of governance including the need to address technical rationality, organizational rationality and political rationality also emerge as important. Organizational rationality emerges as a consistently important determinant, indicating its relevance especially in a small farm agriculture setting. The management committee being active and management having the necessary expertise seem very important for institutional performance. Leadership and political rationality, often being projected as key element, do not emerge as exclusively critical. The results indicate that even if they are not the best, if the institutional structure and design are proper, institutions would frequently be able to achieve success.

Clarity of objectives and good interaction are found to be very important. However, direct involvement of the government in creating institutions and determining their rules in often negatively associated with success. Adaptability including adaptability of rules, and processes for adapting rules are also important determinants of success. The scale being appropriate and especially higher level issues being taken care of by higher level authorities are closely associated with good performance. Overall, good support emerges for new institutional economics, and governance theories in explaining institutional performance for water resource management in India.

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