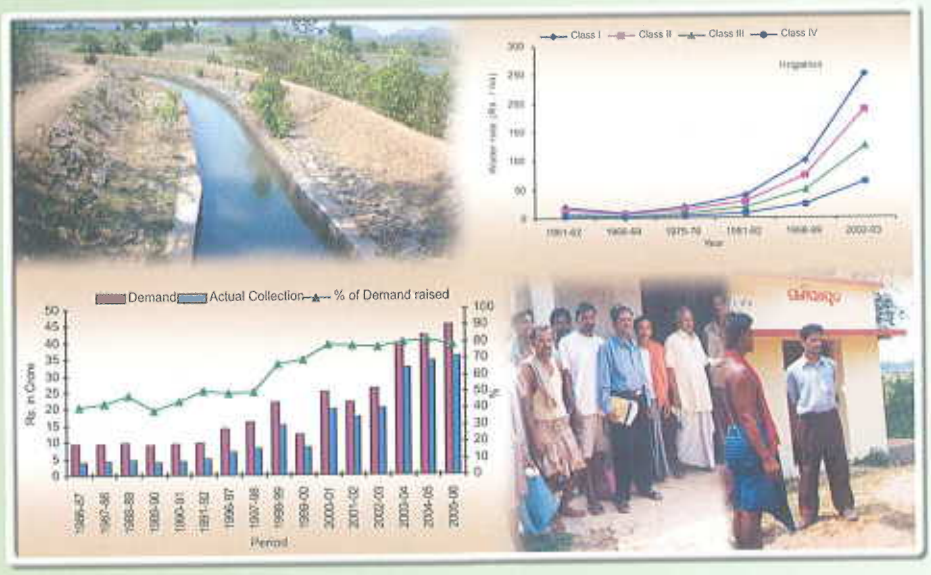
Research Bulletin 41

Institutional Arrangements and Linkage Mechanisms for Irrigation Management in Orissa

Souvik Ghosh, Ashwani Kumar and Prabhakar Nanda



WATER TECHNOLOGY CENTRE FOR EASTERN REGION
(Indian Council of Agricultural Research)
Chandrasekharpur, Bhubanexwar - 751 023, Orissa, India
2008

WTCER

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Publication No. 41

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Ghosh, Souvik; Kumar, Ashwani and Nanda, Prabhakar (2008). Institutional Arrangements and Linkage Mechanisms for Irrigation Management in Orissa. *Research Bulletin No. 41*. Water Technology Centre for Eastern Region (Indian Council of Agricultural Research), Bhubaneswar-751023, Orissa, India. P 42.

Published by
Director
Water Technology Centre for Eastern Region
(Indian Council of Agricultural Research),
P.O.: S.E. Railway Project Complex, Chandrasekharpur
Bhubaneswar-751023, Orissa, India.

Printed by
Capital Business Service & Consultancy
B-51, Sahid Nagar, Bhubaneswar-751007

Preface

Role of agriculture in the economic development and poverty alleviation continues to be paramount even in the era of economic liberalization and globalization. Water, a critical input in agriculture, is expected to emerge as key constraint to future agricultural growth and food security. Food grain production increased due to a tremendous expansion in irrigation and the use of high yielding varieties since mid-1960s onwards. Irrigation has also helped to reduce inter-annual fluctuations in agriculture output and vulnerability to drought. The development of irrigation schemes will reach its limits and total water demand will equal water availability by 2025. Most of the irrigation systems, whether large and small, are reported to have institutional problems relating to the distribution of water and its use efficiency. Research and development organizations have been playing pivotal role to generating technological interventions in the field of agricultural water management. However, the successes of any technological interventions depend on the institutional innovations and policy reforms in the water sector. Institutional innovations clearly have a vital role to play in reforming public sectors of irrigation management, developing linkage and partnership with the related water and agriculture sector organizations. In Orissa, institutional innovations have been taking place. However, Orissa's agriculture with a growth rate of just over one percent during last two decades need to focus on hastening further growth for food and livelihoods through improved management of water and land resources. Irrigation management is shifting from a culture of supply management to that of demand management. In this context, present study was conducted to study irrigation institutional arrangements and linkage mechanisms in Orissa. Analyses of the existing institutional arrangements that address irrigation management carried out following the institutional analysis framework that has included both theoretical and analytical frameworks. Theoretical framework explains irrigation institutional evolution and change over a period. Analytical framework involves institutional environment and institutional structure. The linkage mechanism between different institutional nodes of irrigation management is assessed identifying the opportunities for institutional linkages. The findings of this study are discussed in this bulletin. It is hoped that the information presented in this bulletin will be useful to the researchers, policy makers, irrigation managers and others who want to make further progress in their respective activities related to irrigation management and thereby benefiting the farmers.

The authors are grateful to the Director General, Deputy Director General (NRM), ICAR and Research Advisory Committee of the institute for their support in carrying out this research work. We express our sincere thanks to officials of Department of Water Resources, Government of Orissa and farmers of *Pani Panchayats* for their co-operation and responses during the study. Thanks are also due to all the colleagues and staff members of WTCER, Bhubaneswar for their help at the time of need.

AUTHORS

CONTENTS

ABBREVIATIONS

ACA	:	Additional Central Assistance
AIBP	:	Accelerated Irrigation Benefit Programme
AIP	:	Agricultural Intensification Programme
BCR	:	Benefit Cost Ratio
BKVY	:	*Biju Krushak Vikas Yojana*
CAD	:	Command Area Development
CADA	:	Command Area Development Authority
CWC	:	Central Water Commission
CWGB	:	Central Ground Water Board
DoA	:	Department of Agriculture
DoWR	:	Department of Water Resources
DPAP	:	Drought Prone Area Programme
EC	:	European Commission
FAO	:	Food and Agriculture Organisation
GDP	:	Gross Domestic Product
GSDP	:	Gross State Domestic Product
GWSI	:	Ground Water Survey & Investigation
IFPRI	:	International Food and Policy Research Institute
IMT	:	Irrigation Management Transfer
IRR	:	Internal Rate of Return
IWMI	:	International Water Management Institute
JBIC	:	Japan Bank for International Cooperation
KBK	:	Kalahandi Bolangir Koraput
LIP	:	Lift Irrigation Project
MIP	:	Minor Irrigation Project
MoWR	:	Ministry of Water Resources
MWS	:	Million Wells Scheme
NABARD	:	National Bank for Agriculture and Rural Development
NWDA	:	National Water Development Agency
NWP	:	National Water Policy
O&M	:	Operation and Maintenance
OCC	:	Orissa Construction Corporation
OLIC	:	Orissa Lift Irrigation Corporation
OWRCP	:	Orissa Water Resources Consolidation Project
PMU	:	Project Monitoring Unit
PP	:	*Pani Panchayat*
RIDF	:	Rural Infrastructural Development Fund
RVP	:	River Valley Project
SWP	:	State Water Policy
WALMI	:	Water and Land Management Institute
WRB	:	Water Resources Board
WUA	:	Water User Association

EXECUTIVE SUMMARY

Analyses of the irrigation institutional arrangements in Orissa are carried out following the institutional analysis framework that has included both theoretical and analytical frameworks. Theoretical framework explains irrigation institutional evolution and change. Analytical framework involves institutional environment and institutional structure. The linkage mechanisms between different institutional nodes of irrigation water management are assessed identifying the opportunities for institutional linkages.

In Orissa, irrigation institutional innovations have been taking place over the years. Three timelines comprising of organizational history, policy/act/rule and programmes/projects of state government as well as central government organisations involving directly or indirectly with irrigation management in Orissa are developed to understand the evolutions and changes of institutional arrangements over the time. Evolution of institutional innovations for irrigation management in Orissa has been started since 1958. All the organisations involved in development of water resources were brought under Water Resources Department during 1994 onwards and it has been the lead agency for water resources development in the state. Most of the reforms in water sector in the state have been taking place since 1990s. Agricultural water management has been shifting from a culture of supply management to demand management and resources construction to people's participation.

Irrigation institutional environment of Orissa is studied through analysis of irrigation and agricultural sector performance and their influences on economic development of the state in comparison to the average national scenario. In Orissa, annual investment in irrigation sector is remained consistently high with average annual outlay about Rs. 600 crores during the past years since 2000-01. Agricultural growth rate of the state is hovering around one percent. Inspite of increase in irrigation potential over the years, food grain production in Orissa has showed slow growth, as it is yet to reach the production level of 1989-90 (7.97 million tonnes) with 7.54 and 7.36 million tonnes of food grain production on 2001-02 and 2005-06, respectively. Although the expected growth rate of irrigated agriculture has not reflected; however, assured irrigation supply has increased rice area by 60% during dry season. An increase in rice area during dry season that is 100% irrigated, has resulted in higher production and productivity in last couple of years.

Irrigation institutional structure includes three components water law, water policy and water administration all of which are analysed. Existing legal and regulatory policies reinforce rather than regulate *de facto* control of groundwater by resource rich farmers and access of canal water by the farmers having land in command areas, ignoring the landless altogether that accentuates inequity. Organizational change (state management to farmers' management of irrigation system) has showed a favourable effect on policy dimensions such as water pricing and cost recovery. The total cost recovery from agriculture and industrial sectors has increased from Rs. 7.03 crore in 1996-97 to Rs. 35.64 crore in year 2005-06.

Spatial structure of water administration is based on administrative boundaries and projects rather than on any well-defined hydro-geological boundaries. Formal macro level institutions are related to canal-based surface irrigation systems, whereas most of the informal micro level institutions are mainly associated with groundwater and tank irrigation systems. Most of the functionaries of institutional nodes are confined at state level and reducing towards grass-root level. Majority of the actors are playing multiple roles.

Physical gap (gap between water resource potential and its utilization as well as water demand and supply), financial gap (gap between water sector investment and cost recovery), and economic gap (gap between average value of water and the water rate being charged) are evident.

The intra and inter institutional linkages in the context of irrigation water institutions in Orissa are assessed through structural linkage mechanisms / actor linkage map and matrix, conflict matrix and importance/influence matrix. The innovation of *Pani Panchayat* institution has diverted larger flow of information as well as initiative from Major and Medium Irrigation Department, Minor Irrigation Department, Command Area Development Authority (CADA), Orissa Lift Irrigation Corporation (OLIC) and Water and Land Management Institute (WALMI) towards it. There is multiplicity of functions of each institutional node as well as multiplicity of institutional nodes for certain function causing conflicts as well as complementarities. Linkage between the actors dealing with surface water is evident as it is in case of groundwater. However, for conjunctive use of both surface and groundwater, linkage between the actors of both sectors is important that seems to be missing. The typologies of existing linkages are largely restricted to structural and normative linkage rather than formative linkage. The formative linkage across the actors is a necessity for judicious management of irrigation water resources as a whole in the state. The vertical linkage mechanism is more prominent as compared to horizontal linkage at present institutional arrangements.

The functioning of irrigation sector is controlled by three institutional regimes: the administrative mechanism, formal village-level institutions and the Water User Associations (WUAs) / *Pani Panchayats*. The lack of horizontal integration and linkage between different levels makes it difficult to ensure efficiency of the irrigation system. There are evidences to show that multiple institutions (institutional thickness) are more effective than a single or few institutions. But, under conditions, where many institutions are loosely linked or intensely competing for the same space, multiple institutions are no guarantee for institutional effectiveness. There is implicit linkage between technologies and institutions, the effectiveness of technological development and application is itself critically influenced by the prevailing institutional arrangements. The performance of local level institutions (*Pani Panchayats*) is critically linked to the particular physical and social environment. This grass-root level institutional innovation has already made positive impact in irrigation management.

1. INTRODUCTION

Over the last four decades the policy agenda of agriculture has evolved significantly from an initial focus on increasing food production to concerns for the environment, poverty and stakeholder participation. It has been recognized that institutional innovations are not only central to the development of more efficient research and extension systems but also such developments underpin the wider process of technical and economic change (Hall *et al*, 2000). Irrigation management is shifting from a culture of supply management to that of demand management. It should be seen as a fundamental transformation in the management of water resources by changing rules, procedures and structures (physical and institutional), related to water rights, water delivery services, accountability mechanisms and incentives (FAO, 2003). In World Agriculture: Towards 2015/30 published by FAO, it has been mentioned that positive policy and institutional shifts that have direct impact on the governance of agricultural water management are imperative. IWMI (2000) has been focusing on best institutional and policy practices for water management in developing countries. Historically, increasing water demand has been met by developing new sources of water. However, the economic and environmental costs of developing new resources make this approach unsustainable. Instead, policy reforms and institutional interventions need to be focused for more efficient and equitable water supply (IFPRI, 2002).

Orissa is endowed with rich natural resources in the form of fertile land, plentiful surface and groundwater resources. But such resources have not been exploited adequately for income generation activities. As a result Orissa ranks very low among the Indian states in terms of per capita income and it has the highest proportion of population (47%) living below the poverty line (Economic survey 2001-02). It is believed that the poverty alleviation is possible only by sustainable increase in crop production through increased cropping intensity and productivity. Water, as an input to agriculture, is critical for it. Thus, the strategy in planning and managing water resources assumes greater importance. Annual investment in irrigation sector in Orissa is remained consistently high as compared to many other states. Scaled against ten major Indian canal commands by output impact per ha of irrigated area, Mahanadi command of Orissa ranked last. Also in output per unit of water in the above canal commands, Orissa is bottom of the list with 14 kg per ha cm (Selvarajan *et al*, 2001). Canals are the dominating source of irrigation. Low irrigation coverage and rice dominated cropping pattern are the unique features of Orissa agriculture. Agricultural growth in Orissa is averaged just over one percent per annum over the last two decades.

Institutional innovations clearly have a vital role to play in reforming public sectors of irrigation management, developing linkage and partnership with the related water sector organizations. The reforms related to the people's participation in irrigation water management and drainage measures have been major focus since last decade to address the problems related to operation and maintenance of irrigation systems and low irrigation efficiency (Tanwar, 1998). Despite some initiatives since mid nineties, impact of the reforms to date has been less than expected. There may have been some impact; however, extension, administrative and financial procedures have not witnessed any major change (Paroda and Mruthyunjaya, 2000). Institutional innovations have mostly been initiated by the private

sector and the public sector's response so far has not been satisfactory. Donor driven institutional initiatives cannot sustain long. Institutional analysis can assist to be aware of institutional issues, which could hinder or help a research initiative. It also identifies key partners and networks for research and development (Matsaert, 2002). Hence, it is worth to understand the evolution of reforms and to analyse existing institutional arrangements and linkage mechanisms for irrigation management. This kind of an institutional analysis is therefore important to have a feed back from present frameworks and to guide future interventions and designing new institutional strategies for effective water management.

To make the performance of Orissa agriculture better, institutional reforms in water sector are of paramount importance. Policies to reform the water sector in the state have been already evolving and how quickly and genuinely these institutional reforms are pursued to cover all sources and uses of water will determine future water and food security as well as poverty alleviation in the state. In this context, it is useful to reflect on the way the institutional set-ups have emerged and evolved and to understand the present institutional arrangements and linkage mechanisms for irrigation management in Orissa. The present study focuses on the nature and functioning of different organizations dealing with irrigation management, assessment of their institutional frameworks/interactions, typology of linkages through which knowledge and information flow and delineation of constraints to and opportunities for institutional linkages.

2. THE APPROACH

Institutional innovations for irrigation management refers to the understanding how governments, communities and entire farming communities change their habitual behaviour and institutional roles in managing irrigation resources for agriculture. To gain insights of this issue it requires a study on laws, rule-making, policies, water allocation, water rights, institutional arrangements, linkage mechanisms, information flow and interactions between different institutional nodes, and opportunities for institutional linkages.

Analyses of the existing institutional arrangements that address irrigation management in Orissa are carried out following the institutional analysis framework that has included both theoretical and analytical frameworks. Theoretical framework explains water institutional evolution and change. Analytical framework involves institutional environment and institutional structure (Saleth, 2004). The linkage mechanism between different institutional nodes of irrigation management is assessed identifying the constraints to and opportunities for institutional linkages.

3. IRRIGATION INSTITUTIONAL EVOLUTION AND CHANGE

The time lines are developed to explore the nature and evolution of institutional innovations for irrigation management in Orissa. It is accomplished through literature review (government institutions dealing with irrigation management and water user associations (WUAs) provided relevant information), secondary data collection and group discussions.

Timeline of organizational history of state government as well as central government organisations involving in irrigation management in Orissa is presented below to understand the irrigation institutions' evolutions and changes over a period of time :

Year	Evolutions of organisations for irrigation management
State Department of Water Resources :	
1958	Department of Irrigation and Power was created out of the erstwhile Public Works Department.
1962	Orissa Construction Corporation (OCC) was established.
1971	Minor (Flow) irrigation was taken out from the control of Revenue Department to form a new Rural Development Department.
1973	Orissa Lift irrigation Corporation (OLIC) that was under Irrigation Department transferred to Rural Development Department.
1975	Command Area Development (CAD) Programme started.
1980	Rural Development Department was abolished and Minor Irrigation sector merged with the Irrigation and Power Department.
1984	Water and Land Management Institute (WALMI) came into being as a component of the Office of the Engineer-in-Chief, Irrigation, Orissa.
1986	WALMI was registered under the Society Registration Act 1860 as an autonomous Organization.
1990	Rural Development Department was again created and Minor Irrigation sector tagged with it once again. Department of Power was separated. Central planning unit was created.
1993	The Water Resources Board (WRB) formed as the highest coordinating body on water planning and allocation between sectors and to provide guidance to the Department of Irrigation.
1994	The Department of Irrigation was renamed as Department of Water Resources (DoWR).
1996	The Directorate of Ground Water Survey & Investigation (GWSI) started functioning as an independent entity under the administrative control of DoWR. Project Monitoring Unit (PMU) was established as a registered society for rehabilitation of minor irrigation projects in Orissa with the aid from European Commission. Related activities of *Pani panchayat*/Water User Association started under four pilot projects - Ghodahada Project, Rushikulya Distributary No. 11 of Ganjam district and Aunli and Derjang Projects in Angul district.
Central Government Water Organisations in the State :	
1969	Central Flood Forecasting Division of Central Water Commission (CWC) was established at Balasore and subsequently shifted to Bhubaneswar in 1971.
1970	CWC's Eastern Gauging Division was created at Bhubaneswar.

1972	Central Ground Water Board, Eastern Region established. Orissa was under its jurisdiction having a State Unit Office functional at Bhubaneswar.
1983	CWC's Mahanadi Division was established at Burla, Sambalpur. National Water Development Agency (NWDA) established it's one of three Chief Offices (Chief Engineer, North) at Bhubaneswar.
1985	CWC's Central Flood Forecasting Division and Eastern Gauging Division were renamed as Bramhani-Subarnarekha Division and Eastern Rivers Division, respectively. Orissa was separated from the aegis of Central Ground Water Board, Eastern Region.
1986	Central Ground Water Board (CWGB), South Eastern Region was established at Bhubaneswar headed by Regional Director.
1989	CWC established Eastern River Circle at Bhubaneswar and brought Bramhani-Subarnarekha Division, Eastern Rivers Division and Mahanadi Division under it.
1995	Mahanadi and Eastern Rivers Organisation was started functioning at Bhubaneswar as a regional organisation of CWC headed by Chief Engineer with three wings namely Monitoring and Appraisal Directorate, Hydrological Observation Circle and Coordination headed by Superintendent Engineers. Hydrological Observation Circle comprises of Eastern Rivers Division and Mahanadi Division. Bramhani-Subarnarekha Division was merged with Eastern Rivers Division.
1997	NWDA Chief Offices (Chief Engineer, North) shifted to Allahabad and presently it's Investigation Circle and Investigation Division is functional at Bhubaneswar.

To reform the irrigation sector in the state, central and state government have been evolving policies, acts, rules, etc over the years, timeline of which is given below:

Year	Policies / Acts / Rules related to irrigation management
1919	Under the Govt. of India 1919 Act, Irrigation become a provincial subject and Govt. of India's responsibility in the field was confined to advice, co-ordination and settlement of disputes over right on water of Inter-Provincial rivers.
1956	River Boards Act is related to establishment of river board and concerned regulation or development of an interstate river valley or any specified part thereof.
1956	Interstate Water Disputes Act. It is a central act.
1959	Orissa Irrigation Act for management of irrigation in the state.
1961	Orissa Irrigation Rules for management of irrigation in the state.
1987	National Water Policy adopted.
1994	State Water Policy of Orissa formulated. Orissa Resettlement and Rehabilitation Policy. It aims at integrated development of displaced family and project affected persons.

2002	National Water Resources Council has adopted the revised National Water Policy as "National Water Policy - 2002". The Orissa *Pani Panchayat* Act - an act to provide for farmers' participation in the management of irrigation systems and for matters connected therewith or incidental thereto. This act has given *Pani Panchayat* a statutory status.
2003	*Pani Panchayat* Rule has been promulgated for effective implementation of *Pani Panchayat* Scheme.
2007	State Water Policy of Orissa prepared.

Different programmes have been implemented by the state and central government for water resources development and management in Orissa over the years. A timeline of few programmes is presented below :

Year	Programmes / Projects for irrigation management
1974-75	Command Area Development Programme started to reduce the gap between the irrigation potential created and utilized and to increase crop productivity in command areas.
1970s	River Valley Project (RVP) funded by Govt. of India implemented in the catchments of inter state river valley to combat land degradation problems and silt inflow into the reservoir.
1980s	Drought Prone Area Programme (DPAP), a centrally assisted scheme (center:state=75:25) implemented covering 47 blocks in Orissa.
1989	Ministry of Rural Areas and Employment launched Million Wells Schemes (MWS).
1996	*Pani Panchayat* (Water User Association) Scheme for participatory irrigation management implemented. Accelerated Irrigation Benefit Programme (AIBP) with loan assistance from Govt. of India (center:state=3:1) with a view to early completion of irrigation projects started. Orissa Water Resources Consolidation Project (OWRCP) under World Bank assistance initiated. Irrigation Scheme under Rural Infrastructural Development Fund (RIDF) with the loan assistance from National Bank for Agriculture and Rural Development (NABARD).
1997-98	Agricultural Intensification Programme (AIP) is being implemented by Department of Agriculture (DoA) with the main aim is to ensure efficient utilization of irrigation water.
2002	*Biju Krushak Vikas Yojana* (BKVY) launched with an outlay of Rs. 1000.00 crores to be spent during 2002-2005. This scheme is a happy marriage of participatory irrigation management with the promotion of minor and lift irrigation project.

4. IRRIGATION INSTITUTIONAL ENVIRONMENT AND STRUCTURE

Institutional environment (governance framework) is characterized by overall physical, cultural, socio-economic and political milieu. Institutional structure (governance structure) is determined by the interactive effects of the legal, policy and organization or administrative components and their constituent aspects.

Irrigation institutional structure includes three components water law, water policy and water administration. Irrigation institutional environment of Orissa is studied through analysis of performance of irrigation and agriculture sector. Irrigation institutional structure is studied on the basis of analysis of three institutional components (water law, water policy and water administration) and sub-components under each.

4.1 Irrigation Institutional Environment

Irrigation institutional environment of the state of Orissa can be characterized by the political and legal system, performance of irrigation and agricultural sector and their influence on economic development of the state in comparison to the average national scenario. Incase of irrigation institutional arrangement in Orissa, the formal macro level institutions are related mostly to canal based surface irrigation systems, where as most of the informal micro level institutions are mainly associated with groundwater and tank irrigation systems. Beside the irrigation institutions in the state, institutions related to other resources (agricultural, forest, environment) involved in water resource development and utilization as well as those related to general economic and sectoral management also form part of the irrigation institutional environment. These largely include agriculture related institutions.

4.1.1Water resource and irrigated area in Orissa

The estimated water resources of Orissa is one of the highest in the country that is in order of 11% of the country's total surface water resources. Runoff of rivers and streams available from their catchments in the territory of Orissa is assessed to be about 95 lakh ha m and allowing 50% cut, the runoff available from the rivers and streams flowing in the state from their catchments outside Orissa is assessed to be 37 lakh ha m. Thus the total runoff available is about 132 lakh ha m. The annually restorable groundwater potential is estimated to be about 19 lakh ha m. Therefore, the total water resources of the state for exploitation is 151 lakh ha m. If the yield from the catchments outside Orissa is excluded it comes to 114 lakh ha m. (Dalua, 1991).

The state has 65.59 lakh ha of cultivable land out of which 59 lakh ha can be brought under assured irrigation through different sources. It has also been assessed that 70.03 lakh ha m of surface water (from 11 river basins inside the state) can irrigate about 49.19 lakh ha of land and 19 lakh ha m of groundwater can irrigate 8.87 lakh ha (2.37 lakh ha through tubewell and 6.5 lakh ha through river lift) of land. Out of total potential of 49.19 lakh ha of land that can be irrigated through surface flow, major and medium irrigation projects account for 39.49 lakh ha leaving a balance of 9.7 lakh ha from minor (flow) irrigation schemes. The assessment of the potential of minor (flow) irrigation schemes reveal that in total 5882 number of schemes can be constructed to irrigate 9.87 lakh ha land in *kharif* and 1.92 lakh ha land in *rabi* season; however, 393 proposed schemes await investigation. It has been assessed that with available utilizable groundwater resources, there is ultimate scope for 10.17 lakh dugwells, 28400 filter point tubewells and 11000 to 12000 shallow, medium

and deep tubewells. Dug wells and filter point tube wells are taken up in private sector. On the other hand OLIC ensures setting up public sector lift irrigation projects (tubewells and river lift pump units).

It is evident from Table 1 that by the end of 9th plan (2001-02), 25.43 lakh ha of net irrigation potential was created through all sources that constitute 43.10% of estimated irrigable land. Irrigation potential to the extent of 11.91 lakh ha was created under major and medium irrigation projects. The total no. of minor irrigation projects (MIPs) in the state was 4804 by the end of 9th plan out of which 2768 were fully functioning, 751 were partially derelict, 1130 were completely derelict and 155 were ongoing projects. The potential created through minor irrigation (flow) constituted 17.92% of the total net irrigation potential created in the state upto 2001-02. Minor (lift) irrigation potential was raised to 3.39 lakh ha upto the end of 9th plan with 15,365 lift irrigation points (LIPs).

It was targeted to create additional irrigation potential of around 5.4 lakh ha from different sources during the 10th five-year plan (2002-07). As evident from Table 1, by the end of 10th Plan (March 2007), net irrigation potential of 21.92 lakh ha has been created through major, medium and minor irrigation projects by using surface and ground water resources. In addition to the above, 5.67 lakh ha of net irrigation potential created through unconventional sources like dug-well, water harvesting structures, small check dams, etc. It has been assessed that 31.30 lakh ha can be brought under irrigation through major and medium irrigation projects out of which 12.51 lakh ha of net irrigation potential has been created by the end of March 2007. Minor irrigation (Flow) project has its own importance due to low gestation, less investment and quick benefit. By the end of March 2007, irrigation potential of 5.19 lakh ha has been created. At present, minor irrigation organization is looking after construction, operation & maintenance of minor irrigation (flow) projects having ayacut above 40 ha. The MIPs below 40 ha are looked after by *Panchayati Raj* Department. Therefore, some of the MIPs earlier constructed having ayacut below 40 ha were transferred to *Panchayati Raj* Department. Further, some old MIPs which cannot be revived at all are also deleted from the account. At the end of 10th plan total no. of minor irrigation projects (MIPs) in the state is 3646 out of which 2082 are fully functioning, 844 are partly derelict, 540 are completely derelict and 180 are ongoing projects. Minor (lift) irrigation potential as on March 2007 is 4.22 lakh ha with 18028 LIPs out of which 9039 and 8989 are operable and defunct, respectively.

Table 1. Source wise net irrigation potential (area in lakh ha) in Orissa

Irrigation Source	Net irrigation potential	Irrigation potential created at end of 9th Plan (2001-02)	Irrigation potential created at end of 10th Plan (2006-07)
Major and Medium	39.49	11.90	12.51
Minor (Flow)	9.70	4.56	5.19
Minor (Lift)	9.81	3.39	4.22
Other Sources		5.58	5.67
Total	59.0	25.43	27.59

Source: Economic Survey, Directorate of Economics & Statistics, Govt. of Orissa.

In Orissa, gross irrigated area from surface irrigation sources accounts for about 65% of irrigation potential created. It is observed that irrigation potential of different irrigation sources is largely restricted to *kharif* season. *Rabi* irrigation potential is less than half of the *kharif* potential (Table 2). Minor irrigation (Flow) is mainly providing protective irrigation in *kharif*. Major and medium irrigation and lift irrigation sources have potential to provide irrigation in *rabi* season to more than 5 and 2 lakh ha area, respectively. Irrigation potential created under major and medium irrigation projects for *kharif* and *rabi* season during plan periods is shown in Fig. 1.

Table 2. Season wise irrigation potential (in lakh ha) by different irrigation sources

Year	Major & medium irrigation		Minor irrigation (Flow)		Lift irrigation		Total	
	Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
1998-99	11.18	4.70	4.39	0.70	3.24	1.94	18.81	7.34
1999-00	11.56	4.67	4.41	0.70	3.31	1.97	19.28	7.34
2000-01	11.76	5.00	4.50	0.70	3.36	2.02	19.62	7.72
2001-02	11.90	5.36	4.56	0.71	3.37	2.02	19.83	8.09
2002-03	12.05	5.36	4.64	0.71	3.47	2.08	20.16	8.15
2004-05	12.38	5.63	4.97	0.73	3.64	2.18	20.99	8.52
2005-06	12.50	5.63	5.19	0.71	4.21	2.34	21.90	8.68

Source: Economic Survey of different years, Directorate of Economics & Statistics, Govt. of Orissa.

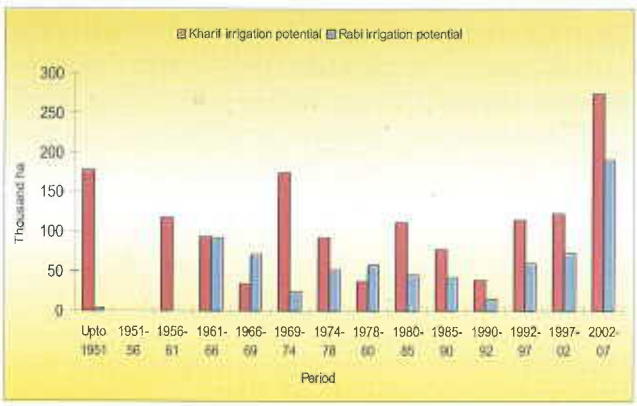

Fig. 1. *Kharif* and *rabi* irrigation potential created under major and medium irrigation projects during plan periods

Paddy is the predominant crop occupying 65% irrigated area to total irrigated area followed by vegetables (Table 3). During *kharif* about 61 lakh ha area is cultivated out of which about 19 lakh ha is irrigated (31%). Lack of assured irrigation compels majority of the farmers to keep their land fallow during *rabi* season. Only about 24 lakh ha area is put under cultivation during *rabi* season including the pulse crops grown in half of the total cultivated area mostly under residual soil moisture condition. Only 10.42 lakh ha area receives irrigation. Therefore, irrigation scenario in Orissa is mostly protective irrigation in *kharif* rather than productive irrigation in *rabi* season. However, irrigated area in *rabi* season has been doubled since the end of 9th plan (2001-02).

Table 3. Selected crop/season-wise irrigated area (in lakh ha) in Orissa

Crop	*Kharif*			*Rabi*				Annual			Total
	Total Area	Area Irrigated	%	Total Area	Area Irrigated	%	Total Area	Total Area	Area Irrigated	%	% of irrigated area to total area irrigated
Paddy	41.54	16.11	39	3.25	3.25	100		44.79	19.36	43	65.30
Other Cereals	4	0.36	9	0.3	0.29	97		4.3	0.65	15	2.19
Pulses	6.89	0.33	5	11.91	1.05	9		18.8	1.38	7	4.65
Oilseeds	4.54	0.21	5	3.7	0.91	25		8.24	1.12	14	3.78
Fibers	0.98	0.05	5					0.98	0.05	5	0.17
Vegetables	2.73	1.94	71	3.79	3.79	100		6.52	5.73	88	19.33
Sugarcane				0.37	0.37	100		0.37	0.37	100	1.25
Tobacco				0.04	0.04	100		0.04	0.04	100	0.13
Spices	0.72	0.23	32	0.74	0.72	97		1.46	0.95	65	3.20
Fruits							3.78	3.78			0.00
Total	61.4	19.23	31	24.1	10.42	43	3.78	89.28	29.65	33	100

Source: Directorate of Agriculture and Food Production, 2005-06, Govt. of Orissa.

Gaps between the irrigation potential created and utilized at the end of 9th plan was evident. It is mentioned below:

Cultivable area:	65 lakh ha
Net cultivated area:	59 lakh ha
Ultimate net irrigation potential:	59 lakh ha
Created net irrigation potential:	25 lakh ha
Net irrigated area:	16 lakh ha
Gross cultivated area:	79 lakh ha
Ultimate gross irrigation potential:	88 lakh ha
Created gross irrigation potential:	33 lakh ha
Gross irrigated area:	21 lakh ha

According to Orissa Agricultural Statistics (2005-06), the gap between potential created and utilized exists even at the end of 10th plan (Fig. 2).

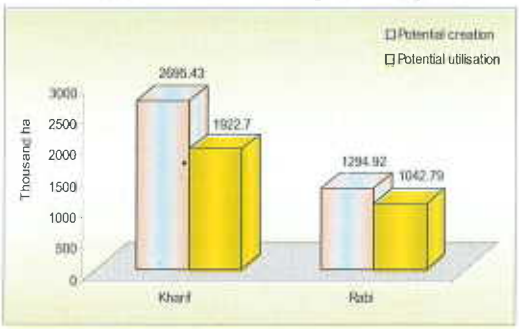

Fig. 2. Gap between irrigation potential creation and utilization

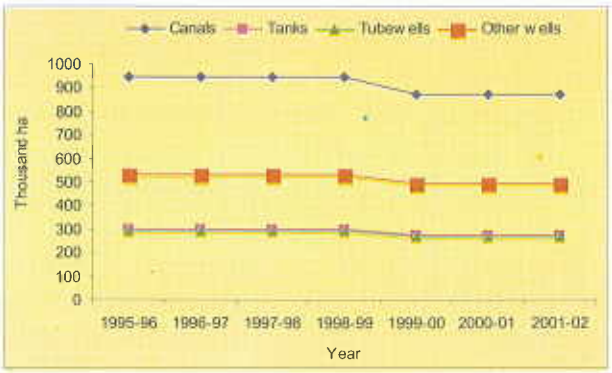

Fig. 3. Net area irrigated by major sources in Orissa

Despite annual expansion in the created potential and capital investments in irrigation sector in Orissa, the area irrigated by the major, medium and minor irrigation systems has been either stagnating or declining during 1990s (Fig. 3). In many irrigation commands, effective irrigated area has declined due to deterioration in the distribution infrastructure. Annual investment in

irrigation sector remained consistently high as compared to many other states during the past. Canals are the dominating source of irrigation in Orissa. The reason of low utilization of irrigation potential is attributed to many factors, but the main reason is attributed to defunct lift irrigation projects, minor irrigation projects and deterioration of distribution systems in the irrigated commands. Future growth in agriculture depends critically on better performance of irrigation infrastructure in the state.

4.1.2 Agricultural scenario in Orissa

Agriculture plays a dominant role in the state of Orissa and provides direct and in-direct employment to around 65% of the total work force as per 2001 census. During recent years annual average food grain production is about 72 lakh tonnes, out of which more than 90% accounts for rice production. Paddy is principal food crop of the State. The crop distribution as a % of gross cropped area includes paddy (76.4%), pulses (12.2%), oilseeds (5.2%), cash crops like sugarcane, potato, chilly (2.0%) and others (4.2%). The agriculture in Orissa is characterized by low productivity due to traditional agricultural practices, in-adequate irrigation infrastructure, small size of holding, and low investment/ capital formation in agriculture. Nearly 60% of the cultivable land is rainfed and exposed to the vagaries of monsoons. Out of the total number of operational holding, about 82% (40 lakh) is held by small and marginal farmers (as per last agriculture census 1995-96).

As evident from Fig.4, rice-fallow is the dominating cropping pattern covering more than half of the net sown area. About 80% of net sown area remains fallow during dry season, which is largely due to lack of assured irrigation facility. Pulse crops are grown under residual soil moisture condition to certain area that is about 10% of net sown area. Food grain production has been fluctuating over the years (Fig.5) showing either stagnation or slow

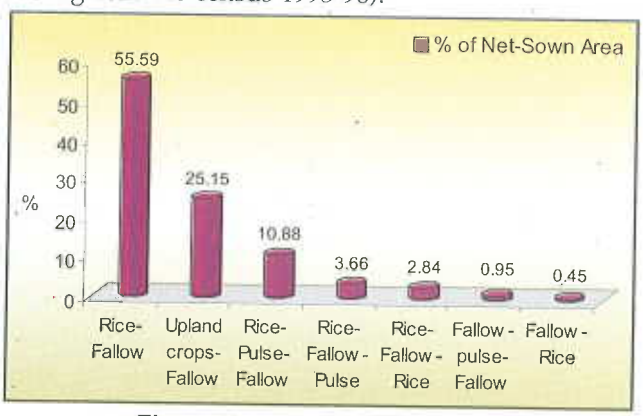

Fig. 4. Crop rotation in Orissa

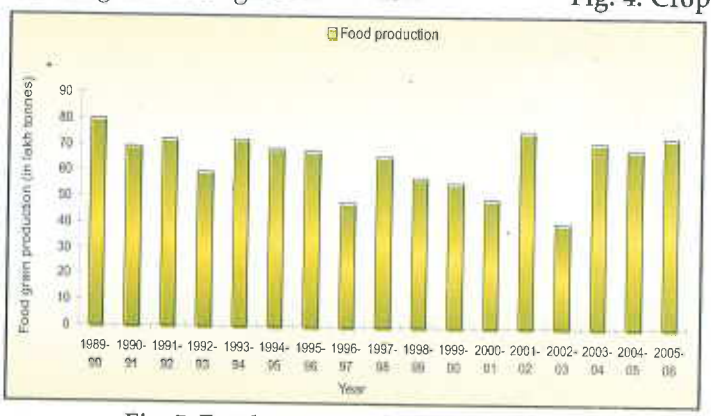

Fig. 5. Food grain production in Orissa

growth. In fact, production of food grain has not yet exceeded the level achieved during 1989-90 (7.97 million tonnes). Food grain production growth has been negative in the nineties. Food grain production in Orissa has showed low growth for a long period with 7.54 and 7.36 million tonnes of food grain production on 2001-02 and 2005-06, respectively.

Share of rice crop's area in food grain area in Orissa is fourth highest among the 16 major states at 82.9 %, against the national average of 35.8%. But rice productivity is lower at about 1.5 t per ha as compared to national average of 2.1 t per ha. Fertilizer consumption is also fourth lowest among the 16 major states at 40 kg per ha as compared to the national average of 90 kg per ha. Rice is the principal food crop occupying about 45 lakh ha. The *kharif* paddy area is 42 lakh ha, which consists of 8.5 lakh ha of high land, 18 lakh ha of medium and 15.5 lakh ha of low land. The entire *rabi* rice area of 3 lakh ha is irrigated and covered by high yielding paddy where as only 36% of *kharif* paddy area is under irrigation (Table 4).

Table 4. Area, production and productivity of *kharif* and *rabi* rice in Orissa

Year	Area in lakh ha			Production in lakh tonnes			Productivity in tonnes per ha		
	Kharif	*Rabi*	Total	*Kharif*	*Rabi*	Total	*Kharif*	*Rabi*	Total
2002-03	40.9	1.8	42.7	28.2	4.2	32.4	690	2352	759
2003-04	42.5	2.5	45.0	62.0	5.3	67.3	1459	2112	1496
2004-05	42.0	2.9	44.9	58.8	6.5	65.3	1401	2230	1455
2005-06	41.5	3.3	44.8	62.5	7.1	69.6	1504	2193	1554
2006-07	41.80	3.0	44.8	62.44	7.5	69.94	1491	2500	1559

Source: Padhee (2007), Director, Department of Agriculture, Govt. of Orissa

According to an estimate unveiled in Orissa State Water Policy 2007, there is a gap in food demand and production. Average farm size, irrigation coverage and fertilizer consumption are all below the national average. The cumulative impact of these factors is low productivity; a per hectare yield of food grains significantly below the national average. The gap between demand and production of cereals has been narrowed in recent years; however, it is stationary in case of pulses and oilseeds. Poor coverage of area under crop during *rabi* season due to lack of irrigation water availability has restricted the production of pulses and oilseed crops.

4.1.3 Irrigation and agricultural growth

Understandably water economy plays a critical role in the overall structure of state economy. Being a monsoon-dependent state, water resources availability in Orissa displays a wide variation across time and space. Notably a $3/4^{th}$ of rainfall is received just in four months during June-September. In Orissa, annual investments in irrigation sector remained consistently high (Table 5). In India since 1950, public investment of Rs. 88100 crore has been made to provide irrigation infrastructure with a 91 M ha irrigation potential. India's irrigation infrastructure is expanding by 1.8 M ha of irrigation potential with a public outlay of Rs. 7000 crore/annum. In Orissa, average annual outlay for irrigation sector was 619 crore for the triennium 2000'2. But, irrigation service often not matching with the crop water requirements over space and time, results in low productivity of crops and income to the farmers. Resultant dissatisfaction coupled with weak institutional linkage leads to

under assessment of demand for water rates as well as low recovery of whatever is assured. Progressive fall in the cost recovery increases revenue deficit causing adverse impact on operation and maintenance funding for irrigation systems led to fresher deterioration of its physical service. This has led to bring institutional reforms in term of implementation of participatory irrigation management programme since mid nineties.

Table 5. Irrigation investment (Rs. in crore) during plan periods (1951-2007) in Orissa

Plan period	Investment made for major and medium irrigation projects	Investment made for minor (flow & lift) irrigation project	Total investment
1st Plan (1951-56)	55.28	-	55.28
2nd Plan (1956-61)	20.00	1.65	21.65
3rd Plan (1961-66)	26.22	6.22	32.44
Annual Plans (1966-69)	20.44	7.95	28.39
4th Plan (1969-74)	20.89	18.88	39.77
5th Plan (1974-78)	70.63	31.00	101.63
Annual Plans (1978-80)	67.81	28.30	96.11
6th Plan (1980-85)	360.00	85.00	445.00
7th Plan (1985-90)	623.61	177.15	800.76
Annual Plans (1990-92)	404.74	103.50	508.24
8th Plan (1992-97)	2276.00	323.40	2599.40*
9th Plan (1997-02)			2382.59**
10th Plan (2002-07)	2334.02	427.54	2761.56***

* This amount is out of the total outlay of Rs. 3079.18 crore under irrigation and flood control sector

** Provisional expenditure under irrigation and flood control sector

*** This amount is out of the total outlay of Rs. 4109.21 crore under irrigation and flood control sector

Source: Economic Survey of different years, Directorate of Economics & Statistics, Govt. of Orissa.

Canals are the dominating source of irrigation. 30-60% of the canal command farmers don't get adequate and timely water supplies. Output/unit of water in Mahandi command of Orissa is reported 14 kg of ha-cm; second lowest productivity is of Jayakwadi command of Maharashtra (26 kg/ha-cm). The mismatch between growth of created potential and agriculture is evident. To meet the four percent growth rate of agriculture as targeted in 10th five-year plan, irrigated agriculture should have achieved growth rate of five percent assuming one percent growth rate for rainfed agriculture. Although the expected growth rate of irrigated agriculture has not reflected assuming that of rainfed agriculture is constant over the years, it is heartening to find that the rice area during *rabi* season has increased by 60% during past five years that is mainly because of assured irrigation. An increase in rice area during *rabi* season that is 100% irrigated has resulted in higher production and productivity in last couple of years. Therefore, utilization of irrigation potential has been reflecting enhanced agricultural production since recent years.

4.1.4 Influence of irrigation and agricultural performance on economy

Orissa comprises 4.7% of India's landmass and with 36.7 million people (2001 census), 3.57% of the population of the country. Nearly 87% of its population lives in rural areas. Agriculture dominates Orissa's economy. A comparison of per capita real GSDP for Orissa and per capita real GDP for India reveals that India has outgrown Orissa and more importantly during 1990s the disparity has further widened. Per capita real output annual growth rate for all India over the period of 1980-81 to 1999-00 was 3.4% while that of Orissa over the same period was only 1.9%. There is a strong link between the poverty reduction and output growth. The link is strong in case of agricultural growth; therefore, to reduce the poverty in Orissa, it will be crucial to lift agricultural growth.

Orissa's growth over last two decades has been below the national average. The main reason for this slow growth is because of slow agricultural growth. The statistics show no growth at all for Orissa during last decade that is an alarming sign given the dependence of Orissa's economic growth on agriculture. In fact, the agricultural growth of Orissa during 1981-82 to 1985-86 was higher than the national average; however, during the subsequent periods, agricultural growth in Orissa has been substantially lower than the national average (Table 6).

Table 6. Annual average growth rate (%) of GSDP and agricultural sector

Year	Orissa		India	
	GSDP	Agriculture	GDP	Agriculture
81-82 to 85-86	4.37	4.74	4.58	2.84
85-86 to 90-91	3.75	0.32	5.85	3.40
90-91 to 95-96	1.43	-1.72	5.34	3.24
95-96 to 99-00	4.33	-0.18	6.16	2.47
81-82 to 90-91	3.32	0.89	5.30	3.44
90-91 to 99-00	2.84	-0.98	5.58	2.59
2000-01 to 05-06*	4.45	1.02	8.00	3.00

* Provisional

Source: Economic Survey of different years, Directorate of Economics & Statistics, Govt. of Orissa.

The volatility of agriculture in Orissa is mainly attributed to low irrigation coverage, an erratic climate (deviations of rainfall of 20% or more every third year for the last 40 years) and a very high degree of dependence of any state on a single crop (rice). Given the water intensive nature of rice cultivation, such reliance on it when neither nature nor irrigation can be depended on for water is risky indeed. Looking at recent years, agriculture output declined every year during 1990s except 1991/92, 1993/94 and 1997/98. In fact in the nineties, agricultural output has not exceeded its 1989-90 level, in real terms. Even a rebound year like 1997-98 failed to reach 1989/90 levels. Food grain production growth has also been negative in the nineties. Mismatch between the growth of water and agriculture sector reflects on the development of state's economy that has been far below than national average.

Agriculture continues to be the mainstay of state's economy. The agriculture alone provides direct and indirect employment to around 65 percent of the total workforce of the state as per 2001 census. Nevertheless, the sector is continued to be characterized by low productivity. Nearly 62 percent of the cultivable land is rainfed and exposed to the vagaries of the monsoon. The per capita availability of cultivated land, which was 0.39 ha in 1950-51, has declined to 0.17 ha in 2001-02. Out of the total number of operational holdings of 39.66 lakh small and marginal farmers as per agricultural census 1995-96 hold 81.98 percent. Most of the small and marginal farmers do not have the means to make adequate investment in agriculture due to poverty. Although the contribution of agriculture to GSDP has significantly declined, the percentage of work force engaged in agriculture has remained somewhat unchanged. This implies that agriculture has been primary occupation without any perceptible increase in production. As the pace of industrialization in the state has yet to be taken off, agriculture continues to provide sources of livelihood to a significant segment of population. Therefore, agricultural growth holds the key to the overall development of a state by way of creating employment, generating income, providing raw materials to the industrial sector and last but not the least ensuring self-reliance in food production and food security.

4.2 Irrigation Institutional Structure

Water institutional structure is studied on the basis of three institutional components and sub-components:

1. Water law *(legal representation of the policies)*
   - Water rights
   - Accountability provisions and mechanisms
2. Water policy *(political transition of water law)*
   - Project selection criteria
   - Pricing and cost recovery
   - User and private sector participation
3. Water administration *(implementation arm for both water law and water policy)*
   - Organization structure and relative role of different organisations
   - Financial management
   - Regulatory mechanisms
   - Conflict resolution arrangements

4.2.1. Water law

It gives full legal backing to water policy operational framework and enforcing power for water administration including its regulatory arrangements. Orissa state does not have any separate and exclusive water law. However, there are water related legal provisions dispersed across Orissa irrigation act and rule, constitutional provisions and customary laws and various penal and criminal procedure codes. Besides the irrigation and ground water related laws with direct effect on water resources development, allocation and use,

there are also legal provisions with indirect but significant effects on the water sector. These provisions are related with other water related natural resources such as land, forest and environment; for example, Forest Conservation Act 1980 places major limits on the development of new as well as extension of old water resources development projects in ecologically sensitive areas.

The legal provisions related to inter-governmental responsibility in the water sector are derived from the overall constitutional division of power between the central and state governments as effected by the Indian Constitution of 1952. State Govt. has jurisdiction over water resources within its border (Seventh Schedule of Constitution). Central Govt. has regulatory roles in water sector related to inter-state water projects (Article 252) and important role in resolving inter state water disputes (Article 262). The final legislative powers are with the states as water related laws could be passed only by or with support of state legislature. Many of the water related legal provisions are enacted in past and they are not adequate to develop a legal system to meet the emerging challenges within the water sector.

4.2.1.1 Water rights

It is a mechanism for allocation and accountability. India does not have any explicit legal framework specifying water right so does the state of Orissa. However, various acts have a basis for defining some form of rights as mentioned below:

- British legislation in India during 1859-1877: It recognizes customary water rights of individuals and groups.
- Easement act of 1882: All rivers and lakes are the absolute rights of the state. From the perspective of water use, *de facto* control over water by actual users at micro level.
- Individual rights to both surface and ground water are recognized only indirectly through land rights.
- Land acquisition act 1894: A landowner can have a right to ground water as it is considered an easement connected to the dominant heritage i.e. land. Therefore, it legally excludes those without land to have any access to ground water.
- Orissa irrigation act 1959 and Orissa irrigation rule 1961: The Orissa irrigation act came into force in 1959 and the Orissa irrigation rules in 1961. The act covers the legal aspects related to construction and maintenance of irrigation works. It also prescribes the basic water rates to be made applicable to various classes of irrigation systems for which water is to be supplied. The Orissa irrigation rules were amended in 2002 for revision of basic water rates for various class of irrigation system and as well as for crops other than the basic cereal crops. Rates for water supplied for purposes other than irrigation works were also amended in 1998 to cover the industrial and municipal water supply. In the case of canal water, the rights to access are limited only to those having access to land in canal command areas and these rights are only use rights and not ownership rights, because irrigation act in Orissa (also in the case of other states) does not allow the moving of canal water to non-canal command areas.

- Orissa *pani panchayat* act 2002 and *pani panchayat* rule 2003 : The primary objective of this act is to ensure optimum utilization of water by farmers for improving agricultural production, to involve farmers' organizations in the management and maintenance of the irrigation system to ensure and dependable supply and distribution of water. The *pani panchayat* rule provides guidelines for formation, membership, duties and responsibilities of water users' associations.

- The model groundwater (control and regulation) bill 1992: It postulates ground water permit system but it fails to set the withdrawal limits. It has not received serious consideration in most of the states including Orissa and thus the control over groundwater at the field level is governed by *de facto* system of rights as determined by farm size, the depth and number of wells, pumping capacity and economic power.

Under conditions of unequal land ownership and income pattern, the practice of linking water indirectly with land and the fact of *de facto* control by better-endowed persons only accentuates inequity and water use efficiency.

4.2.1.2 Accountability provisions and mechanisms

The two-way accountability i.e. the individual's accountability to each other and to the state and *vice versa* could not be operationalzed while legal rights system is not defined in the first place.

Individual based water right system defines not only legal boundaries but also physical and economic boundaries of each individual's acts and their effects on others in the context of water use. It helps to trace externalities, assign payment responsibilities and minimize inter personal conflicts.

Equally important is the issue of accountability of the executives and officials to the people and state. Most irrigation and water related acts have indemnity clauses to protect the executives against the consequences of wrong or non implementation of stated policies; they do not provide enough incentives for the executives to be accountable either to the state or to the people.

The accountability of users is sought to be influenced by negative but indirect provisions, some of those can be used to penalize users for non-payment of water charges or illegal water diversions. However, no corresponding provisions to penalize officials for their failure to supply water at the right time or in the required quantity.

4.2.2. Water policy

Water policy relates to the declared statements as well as the intended approaches of the central and state governments for water resource planning, development, allocation and management. General and specific policies in water sector are also influenced by other sectoral policies related to agriculture, public finance and basic needs. Immediate factor that prompted National Water Policy (NWP) was unprecedented drought of 1987 with the following main goals:

- Promotion of conjunctive use of water from surface and sub-surface sources

- Supplemental irrigation
- Water conserving crop pattern and irrigation and production technologies
- Raising canal water rates and promoting user participation in canal management.

Although NWP has recognized to limit individual and collective water withdrawals, it has failed to define/identify the institutional mechanisms necessary for defining and enforcing such physical limits. National Water Policy 2002 is almost a repeat of earlier version with a paradigm shift from water development to performance improvement.

The Orissa state formulated its first State Water Policy in 1994 following the principle enunciated in the National Water Policy 1987. In the meantime, a number of developments have taken place; new information and knowledge have been generated and new issues and challenges have emerged in the field of development and management of water resources. The National Water Policy 1987 has been reviewed, updated and a new policy titled National Water Policy 2002 has been adopted by the Government of India. It was therefore felt necessary by the State Government to review the State Water Policy 1994. After due consideration, the State Government have prepared a new Water Policy called Orissa State Water Policy 2007 in keeping with the National Water Policy 2002. Orissa State Water Policy 2007 adopts following order of priority in water allocation:

- Drinking water and domestic use (human and animal consumption)
- Ecology
- Irrigation, agriculture and other related activities including fisheries
- Hydropower
- Industries including agro industries
- Navigation and other uses such as tourism

In view of the relatively low status of water resources development and majority of the population being poverty stricken, it has become necessary to address the issues relevant to the state within the framework of National Water Policy through a State Water Policy (SWP). The implementation of Orissa's Water Resources Policy is carried out by the Department of Water Resources (DoWR). The Water Resources Board (WRB), formed in October 1993, is the highest coordinating body on water planning and allocation between sectors and provides guidance to the DoWR. Representation on the Board covers the key water using Departments of Government (Secretaries of Water Resources, Urban Development, Industry, Rural Development, Agriculture, Energy, Environment, Fisheries, *Panchayati Raj*).

The diagnosis of the NWP as well as SWP is found as right but its prescriptions yet to address the serious economic and institutional vacuum within which the water sector is operating.

4.2.2.1 Project selection criteria

During pre-independence period project selection criteria was Internal Rate of Return (IRR), later on it became the productive and protective character. IRR guided productive irrigation

project where irrigation was provided throughout except during the canal closure period. Cost based considerations guided protective irrigation projects where irrigation is confined to a single season or to times of need.

After independence there have been many shifts in approach and project selection criteria:

- IRR of 3.9% was fixed as project selection criteria in 1949.
- IRR abandoned and Benefit Cost Ratio (BCR) introduced in 1958.
- BCR of 1.5 was adopted as recommended by Gadgil Committee, 1964.
- BCR of 1 was recommended by Irrigation Commission, 1972 for projects in drought prone areas.
- BCR was replaced by IRR. IRR of 7% in drought prone areas and 9% in other areas fixed following the suggestions of Public Accounts Committee in 1983.

4.2.2.2 Pricing and cost recovery

Water rates for supplying irrigation are normally fixed considering the annual cost of providing irrigation that consists of three elements: operation and maintenance (O&M) expenses, depreciation and interest of the capital invested. But a wide diversity of opinion exists regarding fixation of the rates. National Water Policy 1987 envisaged the water rates should cover annual O&M charges and a part of the fixed cost. National Water Policy 2002 stipulates that water charges should cover at least O&M cost of providing the service initially and a part of capital cost subsequently. It also prescribes subsidy to the poorer sections of the society in very abstract terms. Vaidyanathan committee (1992) recommended full recovery of O&M cost plus 1% capital cost during the initial phases. Work group (1994) for further study on Vaidyanathan committee report states that the irrigation water rate should cover full O&M costs within 5 years. 2nd Irrigation Commission (1972) recommended that water rate should cover the working expenses and interest on capital. Other recommendations by different commissions are as follows:

- 5th Finance Commission: A return of 2.5% of capital investment over and above the O&M cost
- 6th & 7th Finance Commission: Lowered the return from 2.5% to 1% of capital investment
- 8th & 9th Finance Commission: Recovery of O&M cost
- 10th Finance Commission: Recovery of full O&M costs plus 1% capital costs
- Pricing irrigation water in 1992: Recovery of O&M cost plus 1% capital cost plus a % of depreciation cost
- 11th Finance Commission: Rs 450/- per ha for utilised potential; Rs 150/- per ha for unutilised potential.
- 12th Finance Commission: Rs. 600/- per ha for major and medium and Rs. 400/- per ha for minor projects in case of utilised potential; Rs. 200/- per ha for major and medium and Rs. 100/- per ha for minor projects in case of unutilised potential is proposed by CWC for 12th Finance Commission.

The irrigation being a state subject, the pricing and cost recovery of irrigation water is referred to the states for enforcement. As per the Orissa State Water Policy, the cost of operation and management will be fully recovered from the beneficiaries. Water Rates and Cost Recovery Committee has been formed to fix and review water charges. The Committee recommends the water charges to Water Resource Board for approval. The water rates for irrigation use have been revised twice during 1998 and 2002. Water rates in Orissa are assessed on the basis of area irrigated and the types of crops grown and levied per unit area (ha) basis separately for *kharif* and *rabi* crops. *Kharif* crops are levied with a compulsory basic water rate on the basis of four classes of irrigation *viz.* Class I, II, III and IV with 28", 23", 18" and 9" depth of irrigation supply, respectively (Fig. 6). As per the latest estimate (2002-03), the water rate varies from Rs. 63.00 for class IV to Rs. 250.00 for class I category of irrigation, which is to be paid irrespective of its use. However, the water rate for *rabi* crops is not compulsory and payable on use and specific to the crops grown (minimum of Rs.28.00 for green gram and maximum of Rs. 930.00 for cannabis) as mentioned in Table 7. Water rate for flow irrigation in Orissa was very low till revised on 1998-99 irrespective of class of irrigation. Recent revision of irrigation water rate (2002-03) has made two-fold increase over the rate on 1998-99.

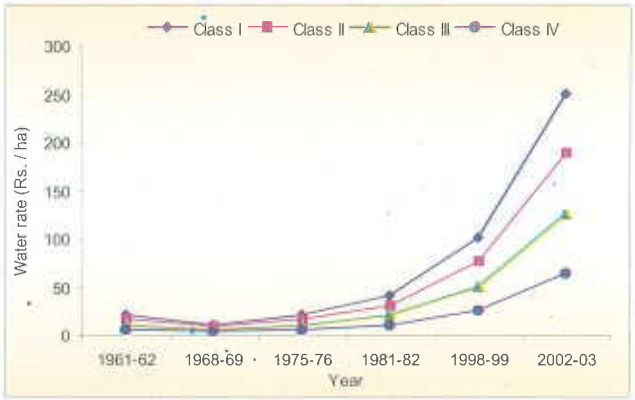

Fig. 6. Compulsory basic water rate for flow irrigation in *kharif* season in Orissa

The water rates for non-irrigation use have been revised during 1994 and 1998. Unlike irrigation water rate, the revision of water rate for industrial and other purposes has increased the rate marginally. It has led to collection of relatively lower amount of annual water tax from non-irrigation sector.

Financial estimate of irrigation sector in Orissa for the TE 2000'2 is found as follows:

Avg. annual plan outlay:	619 crore
Avg. O& M expenditure:	60 crore
Current water rate demand:	19 crore
Water rate collected:	15 crore
% of demand raised:	79%
Cost recovery:	25%

Current water rate demand from irrigation charges is much lesser than the potential demand. There is also gap between demand and actual collection; in fact, average collection is less than the demand raised (Fig. 7) leading to poor cost recovery of 25%.

Table 7.Water rates for crops grown during *rabi* season

Name of the crop	Rate per ha per year (Rs.)		
	1981-82	1998-99	2002-03
1. Paddy (*rabi* season)	88.96	225.00	450.00
2. Tobacco	83.40	210.00	420.00
3. Potato	55.60	140.00	280.00
4. Vegetable including peas	44.48	115.00	230.00
5. Onion	55.60	140.00	280.00
6. Wheat	33.36	85.00	170.00
7. Maize	27.80	70.00	140.00
8. Green gram	5.56	14.00	28.00
9. Groundnut	27.80	85.00	170.00
10. Orchards	66.72	167.00	334.00
11. Sugarcane	100.08	250.00	500.00
12. Jute	16.68	42.00	84.00
13. Fodder	27.80	85.00	170.00
14. Pulses	11.12	30.00	60.00
15. Cotton	55.60	140.00	280.00
16. Oil seeds	11.12	30.00	60.00
17. Betel vine	166.79	420.00	840.00
18. Pigeon pea	27.80	85.00	170.00
19. Sunhemp	38.91	100.00	200.00
20. Chilly	27.80	85.00	170.00
21. Taro	166.79	420.00	840.00
22. Millet	13.99	35.00	70.00
23. Mustard	11.12	30.00	60.00
24. Cannabis *(Ganja)*	185.33	465.00	930.00

Source: Department of Water Resources, Govt. of Orissa

Table 8.Water rates for non-irrigation uses

Purpose for which water is supplied	Unit	Rate (Rs.)		
		1981-82	1994-95	1998-99
1. Bricks or tile making	1000 nos.	0.25	5.00	6.00
2. Water used and consumed for in dustrial purpose	100000 gallons	20.00	200.00	250.00
3. Water temporarily used for industrial purpose and discharged back unpolluted or after purification into irrigation project from which the same has been drawn	100000 gallons	4.00	50.00	60.00
4. Bulk water supply to municipalities and other local authorities for drinking, washing, etc.	10000 cft.	5.00	25.00	30.00
5. Construction of buildings	100 cft.	0.15	3.00	4.00
6. For filling tanks	10000 cft.	5.00	-	30.00
7. For filling tanks mainly for drinking purpose	10000 cft.	2.50	-	15.00

Source: Department of Water Resources, Govt. of Orissa

Both collection of agricultural and industrial water rate is depicted in Fig. 8. Due to implementation of *pani panchayat* programme (1996 onwards) it became feasible to increase the water rate in the agriculture sector and collection of agriculture water rate has been increased from 3.40 crore in 1996-97 to 28.29 crore in 2005-06. Gap between agricultural water rate and industrial water rate collection widened since 2000 as it is increased upto 28 crore for the former while it remained about 8 crore in case of later. To increase the cost recovery from the industrial sector, adequate steps are to be taken. Installation of flow meters for metering the industrial water use is a potential option. DoWR may also consider for execution of fresh agreements with the industries towards collection of water rates.

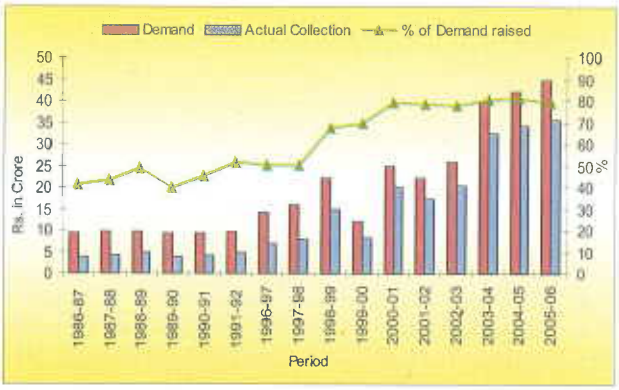

Fig. 7. Demand raised and actual collection of total water charges in Orissa

Prior to 1999, the cost recoveries from agricultural and industry sectors were done by Revenue Department. In 1999, the cost recovery of industrial sector was transferred to the control of Water Resources Department. The cost recovery from agriculture and industrial sectors has shown an increasing trend as total cost recovery has increased from Rs. 7.03 crore in the year 1996-97 to Rs. 35.64 crore in the year 2005-06.

Efforts are to be made to impose and collect more water rates from industrial sector for the use of water resources to have a proper operation and maintenance of canals. Organizational change (state management to farmers' management of irrigation system) showed a favourable effect on policy dimensions such as water pricing and cost recovery.

Some of the related points mentioned in the Orissa State Water Plan (2007) are as follows:

- Water rate should be proportional to incremental benefits.

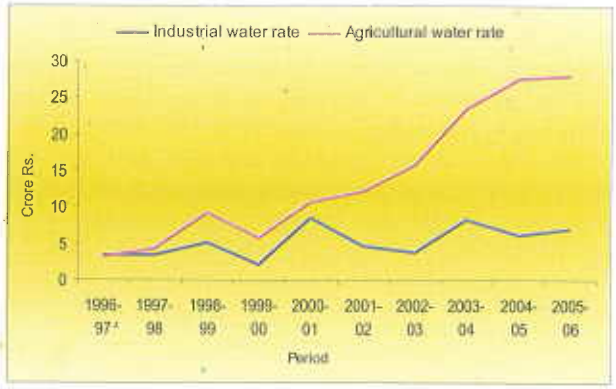

Fig.8. Collection of agricultural and industrial water charges in Orissa

- It should also take into account the ability of farmers to pay.
- Present water rate collection is based on quantity of area and type of crop.
- In order to address the problem of excess use of water and wastage, volumetric pricing of water has to be introduced.

- The farmer has to pay depending upon his decision regarding the water usages, and the rate and the total revenue vary from farmer to farmer, land to land, and also crop to crop, even in the same ayacut thereby creating a scope for financial incentive for his efficiency in water use.
- Orissa irrigation system is not equipped at present to switch over to volumetric basis of water rate. A gradual change over is recommended – the sooner is the better.
- Supply to *pani panchayats* may be made on volumetric basis. Volumetric water measurement is introduced on trial in some *pani panchayats* (Derjang medium irrigation project and Darpanarayanpur minor irrigation project) in Orissa.

4.2.2.3 User and private sector participation

Conforming to the policy guidelines of National Water Policy (1987) and State Water Policy of Orissa (1994), the government of Orissa has introduced the concept of *pani panchayat* for participating irrigation management (PIM) with a view to providing equitable, timely and assured irrigation. The concepts finally lead to transfer of tertiary irrigation networks (Minor/Sub-minors) to registered '*Pani panchayats*'. The responsibility of O&M of the reservoir/diversion weir (as the case may be) dam, spillways, sluices, primary and secondary distribution networks, etc. rests with the Department of Water Resources, where as the responsibility of O&M of the tertiary systems i.e. (Below minor/sub-minor) is with *pani panchayat*. This programme envisages making farmers to participate in the water resources planning and management and to hand over the system to the farmers for which suitable legislation has already been done. The Orissa *pani panchayat* act-2002 and Orissa *pani panchayat* rules-2003 are concrete steps in this direction (DoWR, Govt. of Orissa, 2004). The geographical extent of the participatory irrigation management programme covers the entire state comprising of about 17.00 lakh hectares of irrigation command under different irrigation systems.

Table 9. Status of *pani panchayats* under PIM programme in Orissa (2005-06)

Projects	Total target		Formed		Handed over	
	Number	Area covered (Lakh ha)	Number	Area covered (Lakh ha)	Number	Area covered (Lakh ha)
Major and medium	2559	11.17	1455	6.35	1125	4.96
Minor (flow)	1883	3.28	1005	1.92	775	1.50
Minor (lift)	11211	2.47	11211	2.47	10600	2.35
Total	15633	16.93	13671	10.76	12500	8.81

Source: Annual Report (2006-07), Department of Water Resources. Govt. of Orissa

4.2.3. Water administration

Water administration covers the organizational, financial and managerial structures including the regulatory apparatus and conflict resolution mechanisms.

4.2.3.1 Organization structure and relative role

The general organizational framework of the water sector can be described by highlighting the key actors playing different roles both in the state and centre through three levels of government:

- Central govt.: Ministry of Water Resources – overall planning and coordination (CWC, CGWB and NWDA provide the overall technical support)
- State govt.: Department of Water Resources - actual management of water sector in the state and is responsible for the construction, maintenance and management of water projects.
- Local govt.: *Pani Panchayat* (Village Council)

Spatial structure of water administration is based on administrative boundaries and projects rather than on any well-defined hydro-geological boundaries. Government of Orissa constituted the Water Resources Board, the apex body in water sector with Chief Secretary of the State as Chairman on 1993. The Water Resources Board has ten departmental Secretaries as Members and Engineer-in-Chief as Member- Secretary. The Board is the highest forum to ensure interdepartmental co-ordination and is involved in water planning and development processes such as formulation of state water policy, integrated planning of water resources, allocation of water resources to various water use sectors, prioritization of water resources development, environment management plan, etc.

All the organisations involved in development of water resources in Orissa were brought under Water Resources Department during 1994 onwards. It has been the lead agency for water resources development in the state, responsible for planning, developing and managing the states water resources for irrigation, bulk water supply, drainage and flood control, with direct responsibility for implementation of major, medium and minor irrigation projects, and their operation and maintenance as well as ground water exploitation. These organisations are:

- *Water Resources (Major & Medium Irrigation)* - responsible for implementation, monitoring, operation and maintenance of major and medium irrigation projects.
- *Minor Irrigation* - responsible for implementation, monitoring, operation and maintenance of minor irrigation projects.
- *Command Area Development Authority (CADA)* - responsible for multi-disciplinary activities of irrigated agriculture in the selected command areas, below the outlet.
- *Orissa Lift Irrigation Corporation (OLIC)* - responsible for implementation, monitoring, operation and maintenance of lift irrigation projects.
- *Directorate of Ground Water Survey & Investigation (GWSI)* - vested with the responsibility of survey, investigation and monitoring of groundwater resource of the state and also provides technical guidance on exploration / utilisation of groundwater resource to the user agencies and individuals, keeping in view of its long term sustainability.

- *Orissa Construction Corporation (OCC)* - carries out major works like tunneling, barrages and manufacture of gates as a public sector agency.
- *Water and Land Management Institute (WALMI)* - provides irrigation sector training to officers and staff of irrigation department.
- *WUA/Pani Panchayat* - assumes full responsibility for operation and maintenance of the minor/sub-minor and all structures turned over to it. It ensures construction/ maintenance and repair of all the watercourses, field channels, field drainage, water distribution, crop planning, collection of water rates, etc. in the area under its jurisdiction. It maintains its own fund to meet the operation and maintenance expenditure.

WUA is an association of all persons owning land within a hydraulically delineated portion of the command area ranging in size approximately from 300-600 ha in case of major / medium / minor irrigation project. It may be in respect of minor or sub-minor or direct outlets from the main or branch distributary of the project. In case of lift irrigation or minor flow irrigation projects the area is limited to project command area when the project command area is less than 300 ha.

Pani panchayat is in three tiers for medium and four tiers for major irrigation projects, as indicated below:

i. *Pani panchayat* at primary level consisting of several *chak* or outlet committees.

ii. Distributary committee at secondary level (major projects) as a federation of all the *pani panchayats* under the distributary.

iii. Project committee at project level as a federation of all distributary committees for major projects. Similarly for medium irrigation projects, a project committee at project level is a federation all the *pani panchayats*.

In case of minor irrigation having larger ayacut area it may be three tier otherwise it is two tiers i.e. at primary level consisting of several *chak* or outlet committees and at secondary level *pani panchayat*. Similarly in lift irrigation and small tanks around 40 ha. It is single tier i.e. *pani panchayat*.

Primary objectives are:

- To create awareness amongst farmers in the irrigated commands towards the benefits of formation of *pani panchayat*.
- To create a feeling of unity and brotherhood among fellow farmers.
- To create a feeling among the farmers to visualise the created irrigated potentials as their own rather than that of government.
- To build confidence amongst farmers regarding better returns once equitable, timely irrigation supplies are assured.

- To convince farmers for going for cash crops under crop diversification programme to get better returns on their investments.
- To arrange training and workshops at state, district, block and *panchayat* levels with the help of experienced resource persons on PIM.

Advantages envisaged are:

- Guarantee of getting full share of water through "Quota of water".
- Right for suggesting (Apex committee) improvements in the main system management, water delivery schedule etc. at the project level.
- Participation in operation, maintenance and management of the system.
- Freedom of deciding own cropping pattern within the allocated water.
- Timely maintenance for guarantee of drawing full allocated water.
- Concession in water fees for collective bulk water supply.
- Better service and amicable settlement of disputes in the use of water.
- Better assistance from Department of Agriculture in all aspects of crop husbandry.
- Own bank account for carrying out need-based maintenance.

Formulation and working procedure is as follows:

(a) *Pani panchayats* are formed on a three-tier system with two informal associations and one formal association on minor/sub minor basis comprising an ayacut ranging between 300-600 ha.

(b) *Chak* committee is formed taking farmers one each from high land, middle land and low land areas of an outlet. A representative from the *chak* committee will be a member of the executive body of the *pani panchayat.*

(c) Each beneficiary within the concerned minor/sub minor qualifies to be member of the concerned *pani panchayat.*

(d) For registration of *pani panchayat*, a minimum of 51% of the beneficiaries or beneficiaries possessing 60% of command is required to be members. To be eligible as a member in *pani panchayat*, a token money of Rs. 10 or as decided by, is collected as membership fee. Registration of the *pani panchayat* will be done along with necessary document like bye-law, general body resolution etc. depositing to the registering authorities.

A fund may be created in the form of share capital from the members of *pani panchayat* in order to take up maintenance work of canals or to attend any work of emergent nature. The authorized office bearers of the *pani panchayat* will spend this fund.

Functions and responsibilities of pani panchayat are:

a) The *pani panchayat* will assume full responsibility for operation and maintenance of the minor/sub-minor and all structures turned over to it. It will also ensure construction/maintenance and repair of all the watercourses, field channels, field drainage in the said area as covered under the agreement jurisdiction of it. For this

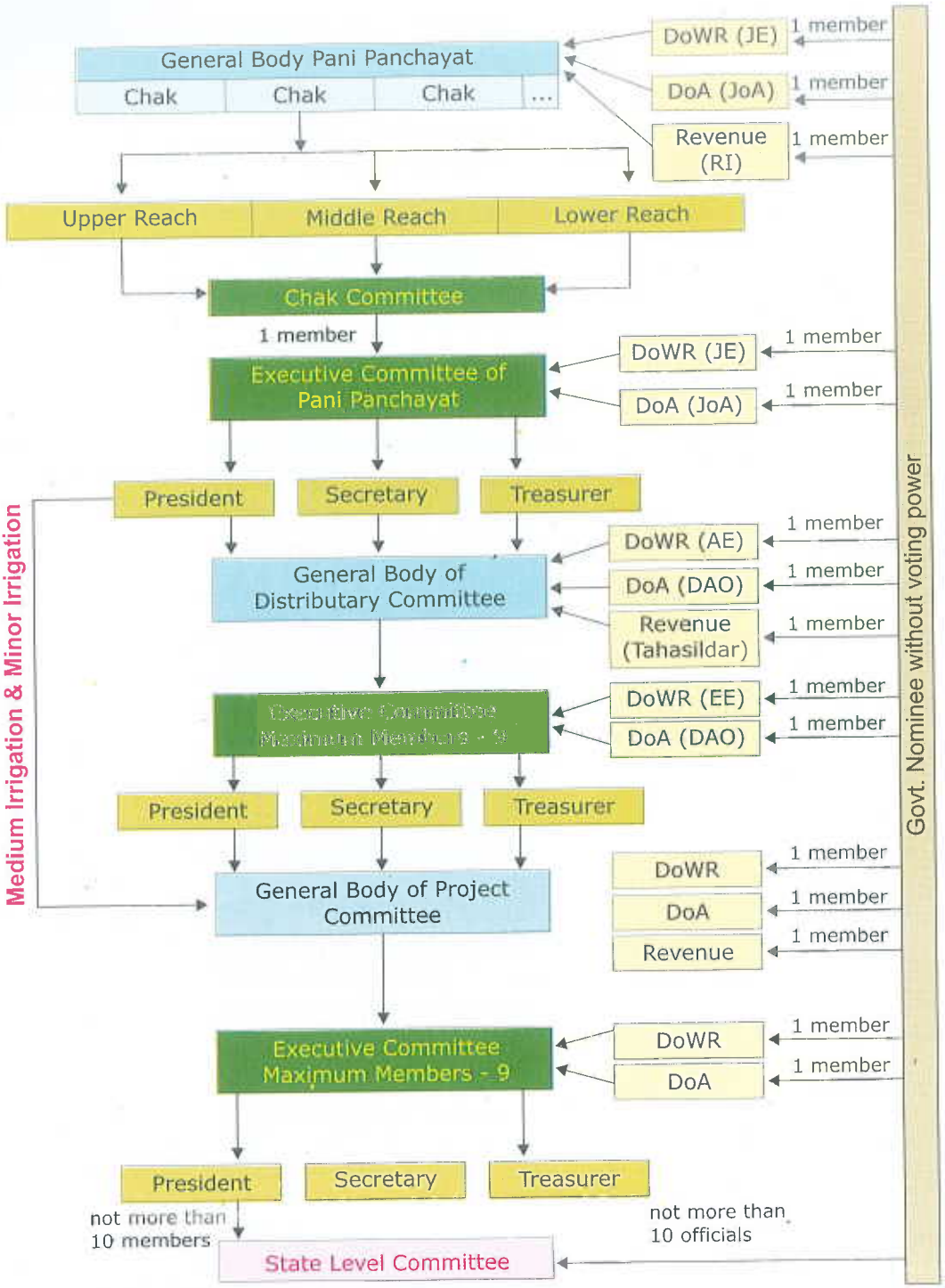

Fig. 9. Structural arrangements for *Pani Panchayat*

purpose, the *pani panchayat* will establish its own operation and maintenance fund (O&M fund) to meet the O&M expenditure. The following items of work are included in repair and maintenance work, namely:

i) Removal of silt from minor/sub-minor/water courses/field channels and field drains and proper upkeep of the same.

ii) Repair and maintenance of inspection path and service road to keep them in good condition.

iii) Removal of grass, shrubs and bushes from the canal embankments and beds.

iv) Repairs and maintenance of all structures in the distribution system handed over for O&M to keep them in good working condition.

v) Earth work to restore banks to proper shape and profile.

vi) Repairs to lining, painting, plastering, replacing damage portion, repairs to masonry and other structures, etc.

b) The *pani panchayat* will ensure construction, maintenance and repair of all the watercourses, field channels, field drains and other drains structure within the jurisdiction of it.

c) The *pani panchayat* will protect the entire system covered under the said area within its jurisdiction from any damage whatsoever.

d) The *pani panchayat* will undertake/suggest measures for improved water management at the level of minor/sub-minor.

e) The *pani panchayat* will receive water from the government and shall distribute it amongst the water users, whether members or non-members according to the requirement of their area under crop. It will observe economy and equitability in this regard. Wherever possible water shall be supplied on volumetric basis. It will organize better and improved water management methods at the farm level. It will decide for internal distribution of water.

f) The *pani panchayat* will have the right to decide its own cropping pattern within the allocated water.

g) The *pani panchayat* may ask for and obtain from the Department of Water Resources information on planned operation and maintenance activities in the entire system. It may also request and obtain assistance from the concerned Assistant Engineers of Department of Water Resources and the plan for operation and maintenance in the concerned distributaries/minors/sub-minors for proper asset management.

h) The *pani panchayat* may obtain permission from in Water Resources Department through the concerned Executive Engineer to utilize any unutilized land acquired by the government. The *pani panchayat* will notify to the project authorities promptly if there is any damage due to unforeseen natural calamities like earthquake, heavy rains, etc.

i) The *pani panchayat* will facilitate collection of water rates from the members/non-members of the association and establish its own fund in bank account.

Gap between prescribed and performed functions:

There is a gap between the prescribed and performed functions of *Pani panchayats* / WUAs. The gap is wider in case of the *pani panchayats* under major irrigation projects. The efforts under PIM are mainly based on the assumption that problem related to irrigation system at lower level of distribution could be set right by organization of farmers at the local level. However, it is felt that without changes in management of higher levels it is unlikely that local level farmers' organizations will be successful over time. Farmers can effectively manage the relatively smaller system like minor irrigation and lift irrigation where the system is fully turned over to the group following the concept of irrigation management transfer or participatory irrigation governance rather that the participatory irrigation management. In this context there is a need for policy intervention, which will give the farmers' association real decision-making power in managing the irrigation system as a whole system. There are successful evidences in case of minor and lift irrigation systems those are mostly farmer managed systems; however, unreliable water supply from the main system to the lower levels is a major problem that influences the functioning of *pani panchayats* under major and medium irrigation projects. Several socio-economic and political factors out side the water sector influence the irrigation management. The issues of rights are beginning to enter in the debate on Indian irrigation, and it needs a lot of attention.

4.2.3.2 Financial management

State is responsible for financing, cost recovery, management of all irrigation and water supply related activities.

State finance water development schemes from

- state revenue
- state's share centrally collected revenue proceeds
- borrowings from financial institutions within and outside the country

Central finance

- through central assistance
- undertaking the construction of projects of national importance
- implementing the centrally sponsored schemes such as CADP
- facilitates, approved and allocates external loans, aid to irrigation and other water supply schemes through concerned organizations including ministry of economic affairs and planning commission

An analysis of the budget of DoWR, Orissa for the recent past years provides an understanding of the priorities of the governments on certain sectors and relative importance in overall water resource / irrigation management in the state. Annual investment in irrigation sector is remained consistently high with average annual outlay of about Rs. 600 crores. Major and medium irrigation gets 70% of total budget followed by minor irrigation (about 18 %), flood control (about 8%) and command area development

(about 2%). Lift irrigation and ground water survey and investigation together gets about 1% of total irrigation sector budget. Plan outlay of major irrigation includes externally aided projects, non-externally aided projects, NABARD assisted projects, state plan projects and additional central assistance. Minor irrigation's plan expenditure meets under European commission, NABARD assisted projects including *Biju Krushak Vikas Yojana* (BKVY) and Additional Central Assistance (ACA) for KBK districts. Ground water survey and investigation mostly meets its plan expenditure under externally aided projects (Hydrology phase II). Minor irrigation, flood control and CADA also receive fund under central share of centrally sponsored plan. Funding sources of externally aided projects are World Bank and JBIC (Japan) while that of non-externally aided projects are Accelerated Irrigation Benefit Programme (AIBP) of Govt. of India including Rs. 10.00 crores for minor irrigation, NABARD, state's own plan, central share of centrally sponsored plan and ACA (KBK districts).

4.2.3.3 Regulatory mechanisms

Ground water sector:

There is regulation on spacing and depth of new wells, which takes effect only when a farmer applies for concession loan / well permit / electric connection; therefore, restrict to mostly poor farmers. Restricted power supply policy has little consequence in the event of large diesel pumps sets, multiple wells.

Surface water sector:

Usual policy based on water charge/supply manipulation does not enforce discipline on canal water use. However, initiatives under PIM programme since mid nineties through formation of *pani panchayats* and handing over the responsibility of system management at grass root level have showed enhancement in cost recovery and improving system performance.

Current legal and regulatory policies reinforce rather than regulate *de facto* control of ground water by resource rich farmers and access of canal water by the farmers having land in command areas ignoring the landless altogether.

4.2.3.4 Conflict resolution arrangements

Various arrangements exist to resolve conflicts at different levels. At higher level, there are about 58 independent water related agreements (39 related to joint projects and 19 related to sharing of river waters). Under inter state water disputes act 1956, central govt. has so far set up five tribunals. Although tribunals settle the disputes but six years time limit by the 2002 amendment is too long a time to settle disputes through tribunal decisions. Mechanisms for resolving water related conflicts at micro level are through traditional village level institutions/ WUAs/*pani panchayats*/*panchayats*. Middle level conflicts within a river basin or canal system (upstream users, down stream users or head end users, tail end users) are still rampant and in want of proper forums and resolutions mechanisms for resolving differences.

5. LINKAGE MECHANISMS BETWEEN DIFFERENT INSTITUTIONAL NODES OF IRRIGATION MANAGEMENT

The linkage mechanisms between different institutional nodes of irrigation water management are assessed identifying the opportunities for and constraints to institutional linkages. There are two dimensions to institutional linkages: institutional interface with the physical, socio-economic-political environment and linkages within institutional components (i.e. the structural linkages within and among the institutions). The first dimension relates to the institutional replicability and the second determines institutional effectiveness.

5.1 Institutional interface with the physical, socio-economic-political environment

As such, three institutional components in irrigation institution structure are themselves nested and linked both organically and operationally (Fig. 10). Institutional linkage function as a vehicle for conveying changes across institutional components.

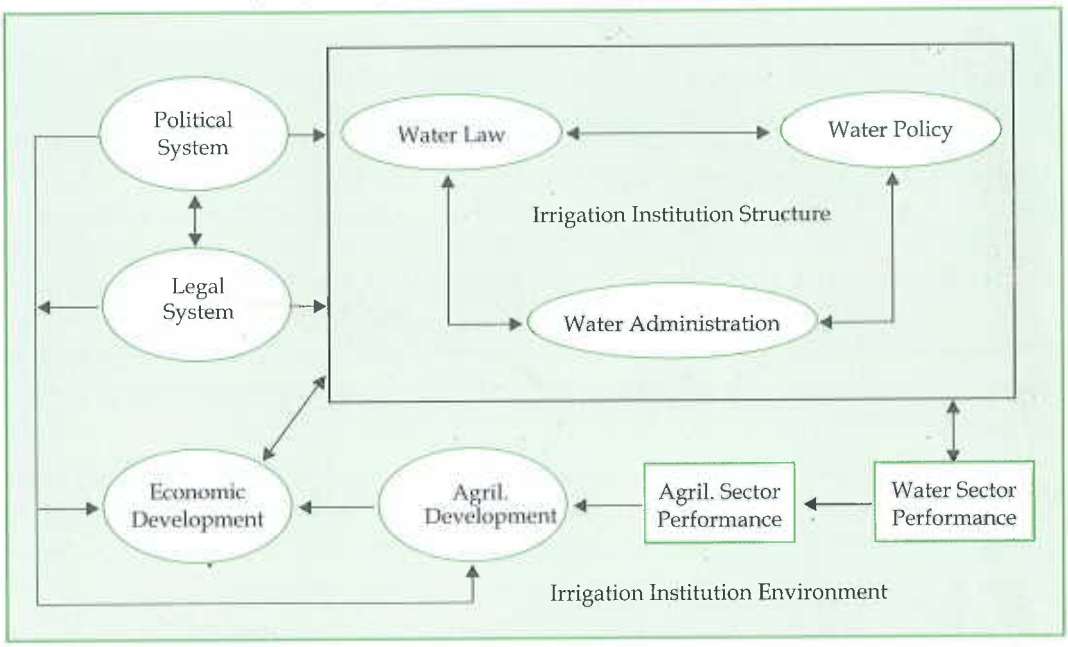

Fig. 10. Institutional components and linkages

To understand this link recent concept of irrigation management transfer (IMT) / participatory irrigation management (PIM) can be considered. IMT/PIM is an organizational change from state management to farmers' management of irrigation system, which has a favourable effect on policy dimensions such as water pricing and cost recovery. This kind of organizational change can also pave the way for technical and institutional changes like introduction of volumetric distribution procedure and the establishment of water right system. Organizational changes can be much more effective if it is coupled and corresponding changes in the legal and technical dimensions. Institutional linkages play a

Table 10. Conflict matrix: Competition and conflicts over fresh water

Who are they	Rural domestic users	Urban domestic users	Land owners / farmers	Industrialists	Water managers
How do they advance their claim	Basic necessity	Basic necessity	Food security / productivity	Growth of economy and employment	Scientific experts, Public good
Are they organized and homogeneous	Dispersed and highly stratified	Concentrated block	Farmers' group but segregated between large and small	Have large clout over central and state govts.	Cadre based organisation
What are their goals and interests	Access to safe drinking water	Access to safe drinking water	Reliable and adequate supply of irrigation water for agriculture	Reliable, cheap and sufficient water for industrial production and facilities for drain-out waster water	Efficient and reliable supply of water, conservation of water bodies and O&M of irrigation system
Do their interests clash with other claimants	With land owners, urban water users and industrialists	Rural water users-both farmers and domestic users	Industrialists, urban domestic users	Rural people, urban domestic users and pollution control boards	Farmers and users
Are they able to achieve their goal	No	Only poor urban slum dwellers suffer	Small farmers suffer	Secured water supply and able to bypass pollution laws	Yes

key role in determining both the individual and joint performance of water and agricultural institutional sector which influences economic development.

As the competition for fresh water is increasing, water allocation among different sectors and users is an important issue. Table 10 summarizes the competitions and conflicts over fresh water. It is common knowledge that landowners use maximum amount about 93% of total fresh water. However, landowners are not a homogeneous group and can be differentiated in terms of size of holding. Industrialists are the smallest group but have disproportionate influence over the governments and protect their interests by promoting the national cause of economic growth and employment and use their superior financial powers. The rural domestic water users by far the largest in number; but they are dispersed,

stratified and the weakest among all the claimants of fresh water resources. Although less water is required for domestic purpose, often collecting it needs walking a few miles. In several areas, agriculture receives sufficient water for irrigation but no water is available for domestic purpose. According to UNICEF, 1997, the high level of extraction of ground water for irrigation has reduced the water utilization for household purposes in the arid and semi-arid areas. National Water Policy and State Water Policy has given the primacy to drinking water followed by irrigation water but still to bridge these missing links. As the situation of fresh water resources is further tightened and the gap between supply and requirements widens, the competition and conflict over water would increase. The looser are poor farmers, urban poor and people living in remote rural areas who are unable to meet their basic needs. Under these circumstances the institutional interface should be able to meet the challenges and provide safe water for domestic users as well as meet the needs for irrigation water to enhance agricultural production.

5.2 Structural linkages among institutional nodes at different levels

The structural linkages within and among the institutions are very critical dimensions of institutional embeddedness. The linkages that receive attention are essentially in terms of the need for polycentric governance or distributed governance to bring together various stakeholders within a common institutional framework. The intra and inter institutional linkages in the context of irrigation institutions in the state of Orissa are presented through Fig. 11.

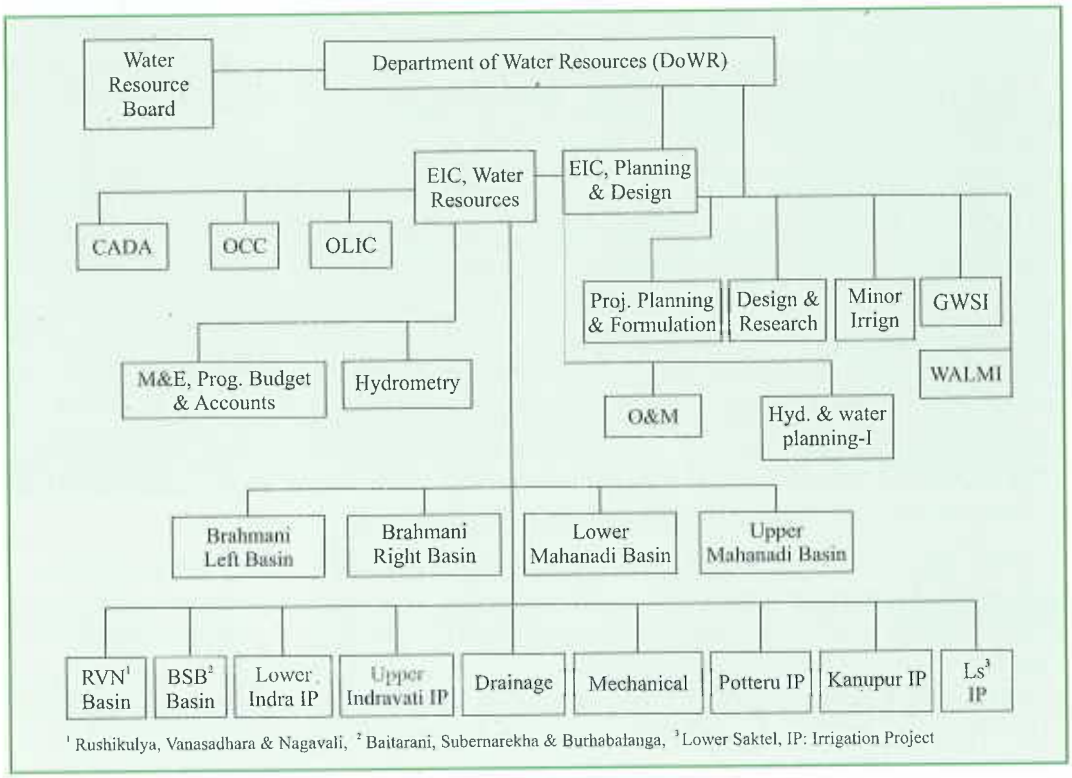

Fig. 11. Structural linkage mechanisms : Actor linkage map of DoWR, Orissa

Table 11. Actor linkage matrix shows flow of information between key stakeholders of irrigation water resources in the state of Orissa

	Major & medium irrigation	Minor irrigation	CADA	CWC	GWSI	OLIC	CGWB	WALMI	OCC	*PP*
Major & medium irrigation			--	--				--	--	--
Minor irrigation				--				--		--
CADA	--			--						--
CWC	--	--	--							
GWSI						--	--			
OLIC					--			--		--
CGWB					--					
WALMI	--	--				--				--
OCC	--									
Pani panchayat	--	--	--			--		--		

Actor linkage matrix is used to map flow of information between key stakeholders of irrigation water resources in the state of Orissa (Table 11). This matrix identifies all actors and shows the links between major actor and other actors in an innovation system. The cells in the matrix represent flows of information from the actors in the rows to actors in the columns. It is evident from the above-mentioned actor linkage map as well as actor linkage matrix that major and medium irrigation is the largest sector in the water institution structure of the state of Orissa followed by minor irrigation. Incase of water institutional arrangement in Orissa, the formal/macro level institutions are related mostly to canal based surface irrigation systems, where as most of the informal micro level institutions are mainly associated with groundwater and tank irrigation systems. The innovation of *pani panchayat* institution has diverted larger flow of information as well as initiative from major and medium irrigation, minor irrigation, CADA, OLIC and WALMI towards it.

It is revealing that there is multiplicity of functions of each institutional nodes as well as multiplicity of institutional nodes for certain functions (Table 12). Most of the functionaries of institutional nodes are confined at state level and reducing towards grass-root level. Majority of the actors are playing multiple roles and engaged in extension and training activities followed by monitoring & evaluation activities. Level of maintaining linkage mechanisms of different institutional nodes is presented in Table 13.

Linkage between the actors dealing with surface water is evident as it is in case of groundwater. However, for conjunctive use of both surface and groundwater, linkage between the actors of both sectors is important that seems to be missing. The typologies of existing linkages are largely restricted to structural and normative linkage rather than formative linkage. The formation of formative linkage across the actors is a necessity for

Table 12. Importance/Influence matrix showing institutional nodes/actors having influence/ importance on specific function

	Major & medium irrigation	Minor irrigation	CADA	GWSI	OLIC	WALMI	OCC	PP	CWC	CGWB
Water resources development	--	--	--		--		--		--	
Operation and maintenance	--	--	--		--			--		
Monitoring and evaluation	--	--	--	--	--	--			--	--
Research										
Extension/ Training			--			--				

Table 13. Level of maintaining linkage mechanisms of different institutional nodes under DoWR

Name of the institutional nodes	No. of Circle	No. of Division	Others
Design & Research	4	9	
Proj. Planning & Formulation	3	9	
Lower Mahanadi Basin	2	12	
Upper Mahanadi Basin	2	6	
Baitarani, Subernarekha & Burhabalanga Basins	3	12	
Upper Indravati Irrigation Project	2	11	
Rushikulya, Vansadhara, Nagavali Basins	2	12	
Drainage	2	8	
Brahmani Left Basin	2	10	
Brahmani Right Basin	2	11	
Lower Indra Irrigation Project	1	6	
Lower Suktel Irrigation Project	-	5	
Potteru Irrigation Project	-	3	
Kanupur Irrigation Project	-	3	
OLIC	4	18	
GWSI	-	10	5 water quality labs.

judicious management of water resources as a whole in the state. The vertical linkage mechanism is more prominent as compared to horizontal linkage at present. Vertical linkage is evident if we look at the levels of functioning and maintaining linkages in different institutional nodes of irrigation management in Orissa.

6. OPPORTUNITIES FOR INSTITUTIONAL LINKAGES

Irrigation sector has the inefficiency syndrome for two important reasons. First, the sector has not been able to generate the minimum expected returns from the investment made in the sector. This is mainly due to high operation and maintenance costs of the system. The second important reason for the inefficiency is indiscriminate use of water due to absence of proper information and guidance. Such information should be provided to water users by public institutions established for the purpose. However, those suffer from poor linkage mechanisms.

The functioning of irrigation sector is controlled by three institutional regimes. First is the administrative mechanism in the sector. The second institutional regime pertains to the formal village-level institutions. The third institutional regime refers to the WUAs / *pani panchayats*. The lack of horizontal integration and linkage between different levels makes it difficult to ensure efficiency of the irrigation system. WUAs are formed through the synthesis of physical, technical, social and economic parameters (Fig. 12). Policy and agency inducing such formations support these parameters, but all these act at different levels. Initially, the technical and physical parameters decide the formation. This is supported and reinforced by the other four components. In addition, the formation of an institution is decided mainly by the homogeneity of the community involved. The WUAs have strong link with the performance of the irrigation system and the condition of the resource, which, in turn, decide the sustainability of WUAs.

Irrigation management through the community participation requires fuller understanding of the social engineering in that particular region. Imposition of organizational structure may have occurred in the enthusiasm to transfer the irrigation management to the stakeholders. As it is evident from the number of *pani panchayats* formed in Orissa during the years since the inception of PIM in the state on 1995-96. PIM in India has followed two approaches – legislative and motivational. Andhra Pradesh and Madhya Pradesh first enacted legislation and opted for fast and extensive introduction of PIM, i.e. going in for a top-down approach. While Maharastra and Gujarat adopted motivational strategy, followed by legislation, i.e. a bottom–up approach. Orissa adopted in between approach – for certain period, bottom-up approach, i.e., motivational strategy; when attained certain level of momentum, adopted a top-down strategy, i.e.,

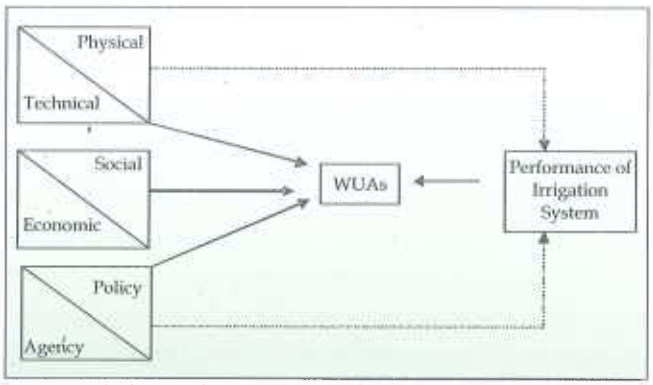

Fig. 12. Links in formation and performance of WUA

legislation. By 1997 it was feasible to form only 50 WUAs and by 2000 another 113 WUAs were formed with addition of 10 projects. However, by 2005-06 under major and medium irrigation projects another 914 WUAs were formed. If there is an imposition of sets of rules and organizational structure on the understanding of few selected experiences, it will face difficulty in enforcement mechanism. Perhaps because of this fact the *pani panchayats* in Orissa has been sporadically successful.

One aspect of intra and inter institutional linkages is institutional thickening. There are evidences to show that multiple institutions (institutional thickness) are more effective than a single or few institutions. But, under conditions, where many institutions are loosely linked or intensely competing for the same space (e.g. *Panchayats*, WUAs/*Pani panchayats*, Watershed committees, and various other committees), multiple institutions are no guarantee for institutional effectiveness.

The linkages / interface between institution and technology assume a special significance. Interestingly, there are scopes for important linkages between technology and institutions, both in terms of technology-induced reduction in transaction costs as well as in terms of institution-induced economic incentives for the adoption of technological innovations. The implication of this issue is another aspect that deserves attention. Both technologies and institutions induce a shift in the production frontier. Technology enters on the production sphere while institution enters into the allocation sphere of economic activities. Thus, technology adds resources through productivity change whereas institutions augment resources through allocation and use efficiency. This suggests having an implicit linkage between technologies and institutions, as it is the motive of efficiency that prompts technological change and in most cases, the effectiveness of technological development and application is itself critically influenced by the prevailing institutional arrangements. Other than these implicit and tangential linkages, institutions enhance resource-use efficiency.

Institutional linkages show the inter-relationship among various stakeholders as well as their rights and duties, objectives-both conflicting and synergetic and organizational potential. It brings together intricate linkages both among and between users and providers of the service, highlights the hierarchical nature of the rights and duties (i.e. the rights and duties of the users are defined within the rights and duties of the providers) and indicates the differing power relations and conflicting objectives. Since institutions are embedded within the socio-politico-economic environment and structurally linked with other institutional components, institutional change is an amalgam of concurrent changes in a number of institutional dimensions. Water resources governance and management seems to be in dire need of adequate institutional framework and linkages at meso level, as this is where the problems of multi-functionality and interest group interaction / negotiation

seem to play out most strongly, while the government and administration system is organized around poles of a centralized state and the village. The government of Orissa has initiated a major shift in its approach through *pani panchayat* as most appropriate institute for efficient water management and agricultural development. This reform process through an effective institutional linkage mechanism will pave the way for creating virtuous circle in Orissa's irrigation and agricultural sector (Fig. 13).

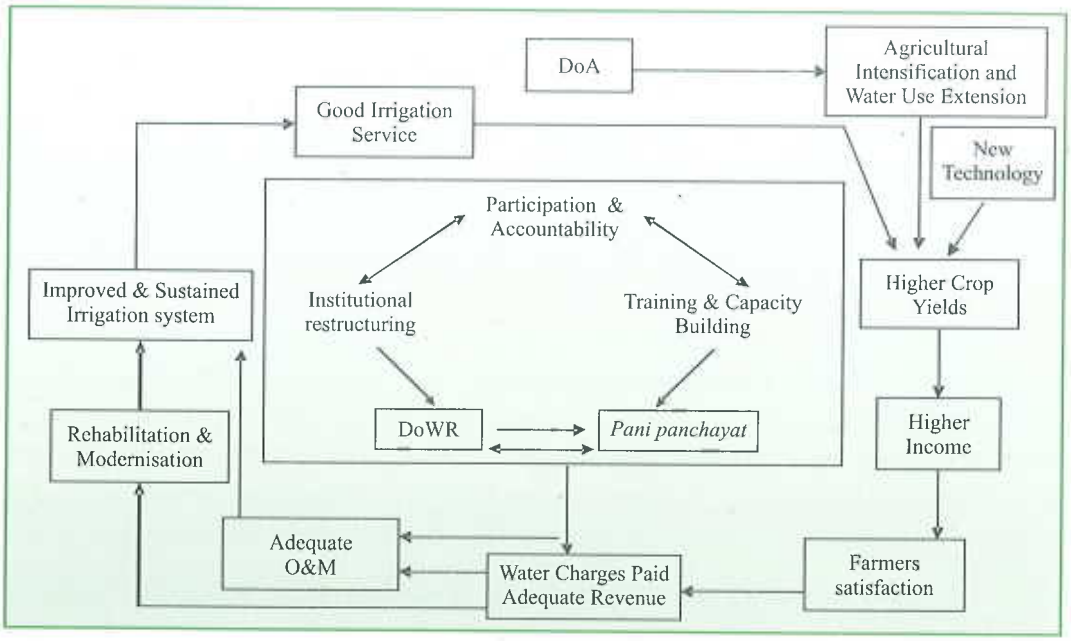

Fig. 13. Virtuous circle of Orissa's irrigation and agricultural sector

Irrigation Management Transfer (IMT): A step further

Orissa started a pilot European Commission (EC) aided MIPs, where concept of complete transfer of irrigation management to farmers was practiced for 48 MIPs covering 9157 ha. In this approach ownership rests with government. Authority and responsibility of system management transferred from Govt. to WUA. IMT is formalized though agreement between Govt. and WUA. Elements included are: inventory of infrastructure and equipments, services and membership, its role and jurisdiction.

Govt. adopted IMT to improve financial and physical sustainability of irrigation systems, to improve water management and agricultural productivity and cope with constraints on Govt. budget. While the farmers promoted IMT to improve quality of water services, gain control over irrigation systems, have freedom for crop selection, and gain control over levy and utilization of irrigation fees etc. This has become a true WIN-WIN situation.

IMT initiative is unique having many firsts:

- Government has excluded schemes from purview of State Irrigation Act
- Authorized WUAs to fix, collect water tax and utilize the revenue earned from water tax and other income generating activities for maintenance of their schemes.
- The WUAs are responsible for O&M of distribution systems meeting the expenditure from fund generated by them.
- Each scheme has been put to rigorous hydraulic testing through an independent agency and turned over to WUAs only after its general body was satisfied that canal systems could irrigate entire ayacut as per design.
- General body of each WUA has constituted a Social Audit Committee (SAC), independent of the WUA Management Committee, with members from the general body to ensure quality in construction works and transparency in transactions.

Farmers' satisfaction is achieved:

- Farmers of tail end of canals have expressed satisfaction over reduction of water shortage.
- Gap between the theoretical (potential created) and actual (utilized) ayacut has been reduced.
- Crop diversification has taken place.
- Number of water distribution related disputes and damages to canals have been reduced.
- Farmers themselves have been preparing operation and maintenance plan prior to each season.
- Govt. machineries from Department of Water Resources and Agriculture have geared up to provide technical support matching to O&M schedule.
- Better O&M has been observed.

Lessons learnt that IMT can be successful if:

- Farmers are mobilized to participate willfully without pressure or allurement, understanding that it is for them.
- Adequate hands on trainings are imparted to farmers on construction and O&M methods, finance and crop management, etc.
- Hydraulic testing generates confidence among farmers regarding functioning of canal system.
- Farmers are involved at all stages, i.e., planning to execution, along with Irrigation authorities.
- Govt. functionaries are involved as part of support system rather than big brother attitude or with a mind set of shifting responsibility as escapist.

7. CONCLUSION

Water resource management is by nature beyond the work of individuals and thus collective efforts by all farmers concerned through local level institutions is a potential option for effective water management and agricultural development. Organizational change (state management to farmers management of irrigation system) has been showing a favourable effect on policy dimensions such as water pricing and cost recovery (collection of water rate has increased from 3.40 crore in 1996-97 to 28.29 crore in 2005-06). Water entitlements in canal irrigation are singular, that is only refer to agricultural production and they are exclusive, that is only landholders in the command area can enjoy them. However, water as a common resource has other functions like domestic and industrial use. The act of *pani panchayat* does not consider the needs of the landless that may hamper social support; therefore, it needs to be revisited.

Present study identifies key partners and networks for research, development and extension activities related to irrigation water management. Analyses of irrigation institution environment and structure in the state of Orissa provide the impetus for future institutional innovations in the water sector. It also provides the feedback for future planning to bridge the gap between irrigation potential created and utilized as the future growth in agriculture depends critically on better performance of irrigation infrastructure in the state. Delineation of intra and inter institutional linkage mechanisms along with opportunities for establishing linkage mechanism provides the feedback for strengthening the water institutions to ensure efficiency of the irrigation system in the state.

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