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Institutions for Agriculture and Rural Development: A Case Study of Water Institutions in India

Rathinasamy Maria Saleth

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NABARD Research and Policy Series No. 9/2022

कृषि और ग्रामीण विकास के लिए संस्थान: भारत में जल संस्थानों पर केस स्टडी
Institutions for Agriculture and Rural Development: A Case Study of Water Institutions in India

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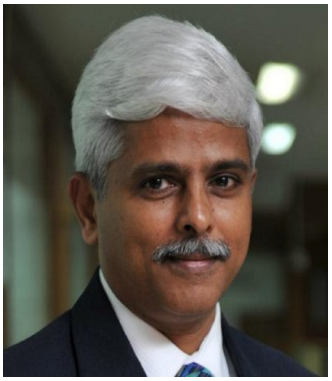
ISBN 978-93-5680-364-0

Published by
Department of Economic Analysis and Research
National Bank for Agriculture and Rural Development
Plot No. C-24. 'G' Block, Bandra-Kurla Complex
Bandra (E), Mumbai –400051

Printed at
Image Impression
Mumbai

Foreword



There is a vast body of research available on topics related to agriculture and rural development in the academic world. But, most of it is in the technical realm and not in a form which could feed into the policy. Research must first lead to better understanding of a subject and then into a robust policy, wherever it can, so that it touches the multitude of Indians across the length and breadth of our country through better public policy and efficient services. Discussion with my colleagues on this issue lead to this new series "Research & Policy". We wish that this series will provide the breadth and depth of research into an area topped up by a lucid presentation for the policymakers.

I am happy to present the ninth publication in this series on "Institutions for Agriculture and Rural Development" written by Dr. Rathinasamy Maria Saleth.

I wish this new series acts as a bridge between the researchers and policymakers.

P. V. S. Suryakumar
Deputy Managing Director

Preface

Agriculture sector proved a silver lining in the pandemic period registering a positive growth in the covid times. Yet it faces various structural challenges to be addressed to make it profitable. For, the majority of the population is still dependent on the sector. As we all know, investing in research is one of the best strategies to address problems of agriculture. Equally important is to communicate the research findings to policy makers to design and tweak policies that matter. During one of our meetings with Shri P. V. S. Suryakumar, our DMD, we had loud thinking if we can commission a few review papers on select themes. We thought that it is appropriate to request veteran scholars who spent prime of their life on a given research theme to attempt such a work where they will distil their understanding and the research done on the theme in a short paper. Duly encouraged by DMD and our Former Chairman, we wrote to a dozen eminent scholars. And the response was overwhelming resulting in Department of Economic Analysis and Research (DEAR), the research wing of NABARD, initiating the "Research and Policy" series. The motivation is, thus, to get a few handles from research that can help effective policy intervention. This series will be useful to policymakers and researchers alike.

The "Research and Policy" series is an attempt to get a glimpse of hardcore research findings in a capsule form thereby making it more effective and communicative to policymakers. The group of researchers who agreed to prepare a review of research have spent their life in the field of agricultural research. Our purpose here, as we communicated to them, was not just to get literature survey but to get researcher's heart and their experience which they gained during their long passionate innings. The paper is expected to highlights various issues, policy relevance, prescription, and suggestion for future papers on the themes of interest to NABARD.

On one hand, Indian agriculture is confronted with issues ranging from economic viability to environmental sustainability, while on the other, it is on a path to usher under promising technological and institutional opportunities. In light of this, the current paper titled "Institutions for Agriculture and Rural Development: A Case

Study of Water Institutions in India", written by Dr. Rathinasamy Maria Saleth, Honorary Professor, Madras School of Economics, Chennai assumes importance. Dr. Saleth has a distinguished academic career, with research interests in water resource management, agricultural policy, institutional change, and impact assessment.

The paper begins by reviewing various agricultural and rural institutions, their current status, issues they face, and how they can be strengthened to achieve the desired objectives. It then describes their interdependence and how inter-linkages between them can significantly impact their individual and collective performance. While discussing various institutions, the author thoroughly reviews and evaluates water institutions, emphasising their importance for agricultural and rural development. Furthermore, the paper examines the structure of water institutions from a micro and macro perspective before concluding about the institution's performance.

In bringing this series as planned, we would like to express our sincere gratitude to Dr. G. R. Chintala, Former Chairman, NABARD for his inspiring leadership, unstinted support and guidance. We also wish to express our sincere thanks to Shri P. V. S. Suryakumar, DMD, for being the inspiration and the driving force behind the publication of this first of its kind series. We are grateful to the authors of this series who agreed to write on themes relevant to NABARD in such a short period of time. Indeed, it has been a great privilege for us.

I also acknowledge the contributions of the officers of DEAR, NABARD especially Dr. Vinod Kumar, GM; Dr. Ashutosh Kumar, DGM; Smt Geeta Acharya, Manager; Ms Neha Gupta, Shri Vinay Jadhav, Assistant Managers, and others who coordinated with the authors and the editor to bring out the series as envisaged.

Thanks are due to Dr. J. Dennis Rajakumar, Director, EPWRF and his team for their contribution in copy editing and bringing uniformity to the document.

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Acknowledgement

This paper would not have been possible but for the invitation and support extended under the 'Research and Policy' Series by the Department of Economic Analysis and Research (DEAR), National Bank for Agriculture and Rural Development (NABARD), Mumbai. I thank the leadership for this thoughtful and timely research documentation initiative that has immense implications for both theory and policy in the realm of agriculture and rural development.

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Abbreviations

AERS	Agro-Economic Research Schemes
APMC	Agricultural Produce Market Committee
ARES	Agricultural Research and Extension System
BCR	Benefit-cost Ratio
CAD	Command Area Development
CGWB	Central Ground Water Board
CWC	Central Water Commission
e-NAM	National Agricultural Market
e-NWR	Electronic Negotiable Warehouse Receipts
ER&D	Education, Research and Development
FPOs	Farmers Producer Organisations
GCA	Gross Cropped Area
GDP	Gross Domestic Product
GIA	Gross Irrigated Area
GVA	Gross Value Added
ha	Hectares
ICAR	Indian Council for Agricultural Research
IDA	Institutional Decomposition and Analysis
IMT	Irrigation Management Transfer
IRR	Internal Rate of Return

(Contd.....)

Abbreviations *(Concluded)*

KBJNL	Krishna Bhagya Jal Nigam Limited
mha	Million Hectares
MKVDC	Maharashtra Krishna Valley Development Corporation
NABARD	National Bank for Agriculture and Rural Development
NIA	Net Irrigated Area
NSA	Net Sown Area
NWDA	National Water Development Agency
NWB	National Water Board
NWC	National Water Commission
NWRC	National Water Resources Council
PPP	Public Private Partnership
RBOs	River Basin Organisations
RRBs	Regional Rural Banks
SHGs	Self-Help Groups
WDRA	Warehousing Development and Regulatory Authority
WUAs	Water User Associations

Executive Summary

A careful review of the literature on Indian agriculture suggests that the root cause of most of its problems — ranging from low productivity and value addition to viability and sustainability — can be traced to the institutional structure within which the sector currently operates. Obviously, therefore, setting right the institutional foundation of Indian agriculture is indispensable not only for meeting its challenges but also for gaining on the new opportunities emerging on the trade and technology fronts. In this respect, reforming the institutional structure of agriculture, especially its resource-related components such as water institutions, is relatively more critical given the predominant role that irrigated agriculture plays in the overall sectoral growth and performance. Despite its importance, the subject of agricultural institutions in general and water institutions in particular continues to remain as one of the less studied areas.

Admittedly, there are notable studies covering one or few components of agricultural and rural institutions, such as land tenure, land tenancy, credit institutions, extension systems, market structures, and farmer producer societies. But studies addressing the whole gamut of agricultural institutional issues within a rigorous and unified framework are almost non-existent. Similar is also the case with resource-related institutions such as water institutions. Most studies here also have a selective or restricted focus by covering a single or set of water institutional components (for instance, water rights, water markets, water pricing and water organisations like water user associations and river basin organisations) rather than tackling water institutions as a whole within the same analytical setting. The lack of unified treatment of institutions in both contexts is mainly due to many conceptual and analytical challenges involved in bringing together the large and diverse sets of institutions within a common analytical and methodological framework.

Departing from existing studies and developing a unified methodological framework, the present paper has made an attempt to rigorously evaluate water institutions as a special case of agricultural and rural institutions in India. The methodological framework is developed using an institutional decomposition and analysis approach. This approach relies on the fact that although institutions operate intrinsically as an organic system, they can be decomposed or unbundled in three stages with different

levels of analytical details. First, at a broader level, the 'institutional structure' can be can be distinguished from the 'institutional environment'. Institutional structure (or governance structure) is characterised by an intricate interplay of various legal, policy, and organisational components, and their respective sub-components. Institutional environment (or governance environment), in contrast, is characterised by the physical, social, economic and political milieu within which the institutional structure evolves and operates. Second, the institutional structure is unbundled into three 'institutional components', namely, legal, policy and organisational. And, third, the three core institutional components are, in turn, unbundled to identify their underlying 'institutional aspects'. While this unbundling exercise can go much deeper even to the point of being exhaustive, here it is confined by identifying policy-wise the more relevant and performance-wise more critical institutional aspects.

The methodology with a detailed three-stage-based analytical decomposition can both be generalised and specialised to suitably evaluate institutions at various scales and contexts. Given its objective and scope, this paper, however, has applied the detailed methodology only for a comprehensive review and evaluation of water institutions taken as a whole. In the larger context of agricultural and rural institutions, however, the methodology is applied only to cover their institutional structure while excluding their institutional environment from coverage in line with the scope of the paper. Again, for the purpose of simplification, even their institutional structure is unbundled not in terms of its legal, policy and organisational components, as done in the case of water institutions, but in terms of its core institutional segments covering broader functional areas such as:

1. Land tenure and tenancy
2. Organisational modes of farm production, processing and marketing
3. Agriculture research and extension system
4. Rural credit and financial institutions
5. Agricultural market institutions
6. Resource management institutions, especially water institutions

While the detailed methodology is applied for the review of water institutions, the remaining components of agricultural and rural institutions are reviewed in more

generic and functional terms. Although the review of the latter is rather monolithic without much disaggregated details, the key legal, policy and organisational aspects are highlighted as much as possible in all relevant contexts.

Within the stage-based methodological framework, all the six segments of agricultural and rural institutions are not only functionally inter-connected but also structurally linked. This is because the institutional environment of water institutions will cover all the remaining components of agricultural and rural institutions. Alternatively, or at the same time, water institutions also remain a critically very important resource-related dimension of agricultural and rural institutions. In view of these structural and functional linkages, the detailed analytical review and evaluation of water institutions, which is the main objective of this paper, also requires a review and evaluation of other segments of agricultural and rural institutions, operating as part of the institutional environment of the former.

Relying on the methodological framework and structural rationale outlined above, and using secondary materials and relevant data available on the subject, this paper provides a comprehensive review of the core components of agricultural and rural institutions, and an analytically in-depth review and evaluation of water institutions in the Indian context. Despite their differential depth and details, these two reviews are brought together within the same methodological framework in line with both the analytics of institutions, and the objective and scope of this paper. On the whole, the review and evaluation presented in this paper have important implications for both theory and policy in the realm of water institutions in particular, and agricultural and rural institutions in general.

Before highlighting key results and implications of the review and evaluation presented in this paper, it is useful to recognise some of the major limitations within which they were derived.

First of all, while agricultural and rural institutions are many and diverse, institutional components or segments reviewed here are only a few core ones that matter the most for overall sectoral performance. Although each of these institutional components deserve as much detailed treatment as done for water institutions, they were reviewed briefly without going much deeper on their unique legal, policy and organisational components, and their constituent aspects.

Second, the institutional environment of agricultural and rural institutions was not covered except for the limited inkling on the same while describing the physical and economic challenges of agricultural sector.

Third, even though the review of water institutions is very detailed and comprehensive covering their institutional structure and environments, it cannot be considered either complete or exhaustive as the institutional aspects covered here are only a few dominant ones that determine the performance of water sector.

And, finally, the review performed here treated institutional components and aspects as if they are independent and operate in isolation. While this is assumed for analytical convenience, the review did not go deep enough to unravel the intrinsic operational and functional linkages among institutional components and aspects. With proper methodological refinement and empirical specification, these linkages can be captured, and can even be quantified with suitably generated objective and subjective data.

Keeping these limitations as caveats, some key results along with their implications are highlighted here. To begin with, from an overall perspective, there is an urgent need to strengthen and reorient the institutional foundation of Indian agriculture. But the subject continues to remain as one of the less studied aspects in extant literature in the country. This paper has made an attempt to address this important research and methodological gap in current literature. Hopefully, the methodology developed and institutional review presented in this paper could open up some new frontiers in institutional research in the agricultural, rural and resource-related areas. From a functional and conceptual perspective, it is necessary to note that in the particular context of agricultural and rural sector, the distinction between institutions and infrastructures is often blurred because institutions play key infrastructural functions, and infrastructures play key institutional functions. On similar ground, it is often difficult to establish a clear-cut distinction between agricultural institutions and rural institutions. On this rationale and for analytical convenience, agricultural and rural institutions and infrastructures are conceptualised as single institutional entity.

Turning to the specific segments or components of agricultural and rural institutions, land tenure and tenancy arrangements play many key roles ranging from land productivity, technology adoption and economic viability to land access

equity, rural credit eligibility and farm investment capacity. Historically speaking, land tenure underwent significant changes, thanks to land reforms in regions like Kerala and West Bengal, land consolidations programmes in regions such as Punjab and Haryana, and tenant-to-owner conversion programmes in most states, except Bihar and Uttar Pradesh. Baring these cases, land tenure structure changed more by the natural process of land fragmentation than by any deliberate reform efforts. The results of two Agricultural Census of 1995-96 and 2015-16 show a distressing trend: while total holdings in the country increased from 116 million to 146 million, the corresponding area has declined from 163 million hectares (mha) to 158 mha. As we disaggregate the total holdings and area by farm groups, we find that marginal farmers share 69% of the total holdings, but account for only 24% of the total area. In contrast, farms with over two hectares (ha) share only 14% of the total holdings, but share about 53% of the total area. Such an extreme pattern of land inequality and increasing farm fragmentation explain why farm productivity is declining, and their economic viability is deteriorating.

Regarding tenancy, land leasing, either fully or partially, account for just 3% each in the total holdings and the total area, with the rest remaining fully-owned and self-operated. Across farm groups, although the relative share of smaller farmers increased both in land leasing and in self-cultivation, the increase in land leasing is more dramatic. While their share in self-cultivation increased from 62% to 68% in the total holdings, and 17% to 24% in the total area, the same in land leasing rose from 58% to 77% in the total holdings and from 19% to 39% in the total area. But the reverse is the case for farms exceeding 2 ha. The implication is that small and unviable holdings also dominate in both categories of self-operated and leased farms during these two census periods. While distributing the ever-shrinking category of waste lands can be an option, it cannot be expected to make much dent on landlessness problem, though it can be a tool for promoting corporate farming in select areas. Changes related to land ceiling and contract farming, while appearing to be marginal, are critical not merely for promoting private investment in agriculture but more so for overcoming the limitations of farm fragmentation through flexible production-cum-marketing models.

New institutional models allow a mix of decentralised arrangements in spheres such as production and aggregation, and centralised arrangements in spheres such as input procurement, processing, value addition and marketing. These models can,

therefore, counter the negative effects of unviable holdings and enable smallholders to gain from scale economy and collective bargaining benefits. Earlier models of cooperative farming failed to achieve such an integration. But those which emerged in recent years (for example, Anand-pattern cooperatives for milk, edible oils and vegetables) have succeeded in linking decentralised production with centralised processing, value addition and marketing. On the contract farming front, the most interesting and successful case, that is considered to be dawn of modern contract farming in India, is the 'PepsiCo model', which was first experimented in 1989 in Punjab, but has now expanded to many other regions. Thanks to its effectiveness and conducive policy environment, this model now covers 25 crops in over 105 locations, mainly in states such as Punjab, Tamil Nadu, Andhra Pradesh, Haryana and Maharashtra. Recent studies have confirmed the major impacts of contract farming on farm productivity, income and employment. In view of its ground level impact and larger sectoral roles, especially in catalysing private farm investment and technology transfer, contract farming has also received a major boost from recent government policies. But contract farming policy has also to be counter-balanced with suitable safeguard provisions such as the model contract as proposed in the 2007 National Policy for Farmers.

Other newly emerged organisational forms include rural self-help groups (SHGs) and farmers producer organisations (FPOs). Although not all SHGs are directly involved in farm production, most of them can support farm production through their roles in micro-credit, women's empowerment and natural resources management. As of 2016-17, there were 85.77 lakh SHGs federated across regions and supported by strong linkages with formal financial and development institutions, including the National Bank for Agriculture and Rural Development (NABARD). Given their functional roles and spatial coverage, SHGs can be developed to serve as a strong institutional framework for linking financing, production and marketing. The FPOs, which emerged since the early 2000s, aim to link production, processing and marketing among smallholders. Most FPOs are also formally registered as farmer producer societies or companies. As of 2015-16, there were 2000 FPOs created under various government schemes and externally funded projects. By 2020, as many as 4,465 additional FPOs were created against the target of 10,000 FPOs to be created by 2027-28. Impact studies conducted in multiple locations suggest that FPOs have improved price realisation (22%) and cost savings (31%) among member farmers.

But FPOs impact varies significantly across states. While improved price realisation varied from 7.5% in Madhya Pradesh to nearly 45% in Kerala, income increase varied from 13.5% in Odisha to 25% in Rajasthan. No doubt, FPOs certainly have positive effects, but more research is needed to generalise their impact

Regardless of the choice of institutional options, the focus should mainly be on the integration of various farm operations so as to maximise income and employment benefits of both decentralised small-scale production, and the efficiency and scale economic gains of centralised large-scale processing and marketing. Since most models are suitable largely for the economically important commercial crops, it is uncertain how they are going to benefit smallholders, who are focused on food crops, especially in remote areas. In any case, the ideal strategy is not the one that prioritises one model or the other, but rather a suitable configuration of different models to suit different crops, regions and contexts. Finally, but more importantly, the long-term viability and sustainability of these integrated models depend on strong upstream and downstream institutional and infrastructural systems. This calls for major investment in rural infrastructures as well as a stronger articulation of functional linkages with other agricultural institutions, especially those related to credit, extension and marketing systems.

While public investment in agro-economic research schemes (AERS) witnessed a rapid growth in India, especially in the aftermath of the Green Revolution, which led more to size expansion rather than performance improvement. Over time, AERS tends to become less flexible and adaptive to respond well to changing client needs and market conditions. Changing economic environment, pressing funding constraints and emerging new challenges have forced policy makers and funding agencies to seek new avenues and options for improving the functional response and the overall performance of ARES. Since inefficiencies of AERS originate more from size expansion, unwieldy and bureaucratic organisational structure, and lack of competition, most of these options are focused on setting right its institutional foundation. The main thrust of institutional reforms is to shift the focus from system expansion to performance improvement. The performance of AERS can be enhanced significantly by increasing its managerial efficiency, accountability and adaptability. Other options include promotion of decentralisation, creation of semi-autonomous regional research arrangements, and involvement of universities and private research groups.

Significant progress has been recorded in decentralising both crop-specific research programmes and regionally-spread AERS organisations. But, in terms of funding and organisational control, public AERS is still highly centralised. One option to address such centralisation is to reorganise bodies such as Indian Council for Agricultural Research (ICAR) at least by four main regions. On the technical side, reform options also include a reframing of the research agenda and priority matrix so as to shift the focus from traditional cereals towards crops with deficit supply and export potential, and from mere crop productivity to postharvest and resource conservation aspects. There is also a need for the AERS to go beyond its conventional role of just developing and delivering only production-oriented technologies and extension services. For better meeting client needs, production oriented services are to be delivered together with economic information on market prices, supply situations and climate conditions. Such an integrated delivery requires flexibility and locations specificity, as well as functional collaborations with relevant agencies to quickly gather required information.

As AERS in India has become institutionally more diverse — thanks to the increasing roles of private companies, universities, research agencies, non-governmental bodies and foreign companies, it can no longer be equated just with public system alone. During the past few decades, for instance, private sector companies have introduced about 122 crop varieties. Their share in the total seed production has also increased from 57% in 2017 to 65% in 2021. Besides bringing additional investment, technologies and skill inputs, the private sector also creates not only healthy competition but also functional complementarity with the public sector. The private sector, for instance, has added many new crop varieties, particularly in neglected products such as vegetables, millets and fodder crops. The increasing collaboration that private AERS has with foreign companies also facilitates technology transfer as well as access to seed markets in other countries of Asia and Africa. There is an obvious need for raising the level of private investment in agricultural education, research and development given the declining public investment on the same as a percentage agricultural gross value added (GVA). Collaboration of universities with the private sector can be much more productive, highly innovative and less costly for technology development.

The rural credit institutions contribute to agricultural performance, both directly through their roles in the provision of key farm inputs and also indirectly by

facilitating the performance and impact of other components of agricultural institutions. Their role has expanded tremendously over the years. Farm credit as a ratio of agricultural GVA increased from 10% in 1999-2000 to about 52% in 2017-18. In absolute terms, rural credit increased from Rs. 5 trillion in 2011-12 to Rs. 13 trillion in 2017-18. But this growth does not mean farm credit is either adequate in relation to demand, or efficient and equitable in terms of impact. Reform options to address these issues are not new, and some of them were also implemented with some notable success. While there has been notable progress in terms of inclusion, further progress is needed to improve equity in rural credit, as 50% of the farm households are still outside the ambit of formal credit. For this, we need to promote rationalisation and a more targeted provision of credit to currently excluded groups such as small farmers and other poor groups.

On the operational side, there is more scope now for expanding third-party intermediation, and thereby, reducing risks and transaction costs of rural credit. Such credit mediation is not limited only to traditional players such as voluntary agencies, and those entities involved in the areas of technology, input supply, marketing and processing such as cotton and sugar mills, agro-processing units, etc. It now also includes newly emerging institutional options such as contract farming, SHGs, FPOs, etc. Notably, the service area approach promoted by NABARD for the grassroots level coordination and linking of various development activities related to infrastructure and technology with credit programmes should be extended to district and state levels, as it is where most decisions on infrastructure and technology are being made. Merging Regional Rural Banks (RRBs) with the cooperatives is advocated for improving their viability, but the reality is that a healthy institution cannot emerge by merging two sets of poorly performing institutions. Apart from the changes in the lending policy aimed at improving the financial viability, a number of operational and institutional changes are indispensable to enhance the viability and performance of the formal rural credit system as a critical component of rural institutions.

There is a need to promote a healthier credit delivery system with multiple players and pluralistic institutions to promote competition and complementarity. With its increasing diversity and sophisticated transformation, private rural finance system — covering traditional actors, private banks, rural SHGs and gold loan institutions — has already grown strong enough to pose significant competition and also add

complementarity with public rural credit sources. Since its scale of operations is likely to increase over time, the private system has to be eventually brought into some formal regulatory framework, especially given its predominant focus on the bottom line and exploitative tendencies. Thanks to the concerted efforts towards inclusion and on the equity fronts, formal institutional sources are able to meet 72% of the total credit requirement of farmers and only 28% is now accounted by non-institutional sources. Notably, public and private sector banks meet only 41% of the credit needs of small and marginal farmers. In terms of regional disparity in farm credit, not only does the share of states in the total credit vary from 0.5% to 10%, but also it is disproportionate to their share in agricultural output. This means that despite notable progress on the inclusion front, there is still much scope for further progress.

Agricultural marketing institutions create the overall incentive environment by setting prices and determining the relative income share of farmers, traders, consumers and myriad other players operating in transport, storage, processing and value addition spheres. Marketing institutions are not monolithic, but form as an integrated ecosystem covering many institutions, activities and actors involved in the entire spectrum from farm gate to final consumption. Since any change in marketing institutions is likely to have wider repercussions, it needs to be done carefully to judiciously balance the varying interests of conflicting groups. From an organisational perspective, agricultural marketing involves 7,320 Agricultural Produce Market Committees (APMCs) operating across all states, which cover both 2,477 principal markets and 4,843 sub-market yards regulated by their respective principal markets. Despite many legal, policy and procedural regulations, these markets remain archaic, isolated and localised mainly because of the dominance of vested interest groups and the existence of many trade barriers. The resultant isolation and missing linkages among state level markets make them inherently inefficient and rigid with limited competition but higher transaction costs.

Considering the challenges involved in physically integrating the regionally fragmented agricultural markets, the union government attempted the digital route by introducing electronic-based National Agricultural Market (e-NAM) programme in 2016. As to its progress, e-NAM platform has covered so far 1,000 APMCs from 18 states and 3 union territories with a total registered user base of 1.66 crore farmers, 1.31 lakh traders, 73,151 commission agents and 1012 FPOs, and a total commodity

coverage of 150 products. Despite its early stage, e-NAM is certainly an important institutional innovation with tremendous potentials to promote transparency, competitiveness and digital integration of several functions such as auction, payment and delivery logistics. But how far such potentials can be actually realised still depends on the same traditional systems of APMCs and related delivery networks, which are assigned to provide backend physical support for all virtual trade transactions under e-NAM portals. Without some fundamental changes in the overall structure of agricultural markets, e-NAM cannot be expected to deliver all the intended benefits.

The most significant, yet controversial, legal initiatives ever undertaken in Indian agricultural sector pertain to the three interrelated legislation on agricultural marketing passed by the union government in 2020. Under ideal conditions and with suitable safeguards, these legislations could radically transform agricultural marketing with innumerable benefits to all stakeholders with barriers-free trade, assured market, better price and lower transaction costs through diversified trading options, multiple market channels, intense competition and expanded trade volume. But most of these expected benefits depend critically on how intense is the competition among traders, and how reliable is the price setting process. When traders are numerous and relatively uniform in size, the competition is likely to be more intense and price setting to be fair. However, in reality, agricultural markets in India are being dominated by a very few and large players with disproportionate control over supply chains, finance networks and infrastructural systems. Without additional regulations to counter these oligarchic tendencies, these legislations would have caused more problems than solutions to famers, small traders and other players in current market ecosystems. Although the legislations were recently withdrawn in November 2021, improved regulations that address most of the limitations of their earlier versions can be enacted with proper consultations with all stakeholders, including the states that have concurrent responsibility in the agricultural sector.

There are important inter-linkages among the components of agricultural institutions with considerable implications for their individual as well as collective performance. For instance, credit institutions perform better when land tenure system is dominated by economically viable holdings conducive for obtaining and repaying productive farm investment. Even when land holdings are individually unviable, institutional arrangements in the production spheres such as SHGs, FPOs and various

forms of contract farming can still ensure a better performance of credit institutions essentially by neutralising the limitations of the land tenure system. This means that linkages among the components of agricultural institutions have the ability not only to enhance the performance of other components, but also to counter or neutralise the limitations of some other components. Similar arguments can also be equally valid in the context of other components of agricultural institutions such as agricultural research and extension system and agricultural marketing structure. Since the former is central to ensuring technical performance and the latter is critical to ensure economic performance of agriculture, their status and performance can set the direction and magnitude of the performance of all components of agricultural institutions.

The performance implications of institutional inter-linkages are much deeper extending to water institutions and beyond. A case in point is the effects of tenure on the performance of water institutions. While it is true that water institutions are likely to perform poorly in areas with fragmented holdings, this can be countered with suitable institutional arrangements such as user associations and group-based allocation. On the other spectrum, better performing credit, extension and marketing systems are likely to enhance both the institutional and economic performance of water institutions, and vice versa. Admittedly, some of the institutional linkages and their performance implications argued here have been addressed in the current literature, though using institutional variables but from general and somewhat non-institutional perspectives. Examples in this respect include not only studies evaluating rural credit, extension system and marketing by factors such as farm size, tenancy system, organisational forms, etc., but also those assessing the impacts of water markets by farm size groups, energy pricing and water right regimes, etc. Evaluating these and other aspects of inter-linkages truly from an institutional perspective represent a potential area for future research in the realm of agricultural and water institutions.

Turning now to some of the major results of the review of water institutions, although the review of water institutions is performed with much more analytical details than agricultural institutions, it cannot be considered exhaustive. Despite the selective and eclectic nature of review of institutional structure related to water, we are able to cover both its macro and formal components, as well as its informal and grassroots counterparts. The overall performance of water institutions has also been tentatively evaluated using objective, though indirect performance criteria, developed

with readily available data. Our review and evaluation of water institutions do lead to a few interesting observations with considerable implications for both institutional economics theory and water sector reform strategies. To begin with, the present structure of water institutions in India, as reviewed in terms of some of their major institutional components and aspects, shows that it is far removed from the mature system that is actually required to meet the present and future challenges of the water sector. This observation is reinforced further by a less than expected performance of water institutions, as evaluated indirectly in terms of the overall physical, financial and economic performance of the water sector.

On the legal side, there are a number of realistic legal proposals for initiating specific legislations for different water sources and spheres of water management, though most of which still continues as proposals. However, important amendments and new initiatives undertaken in areas such as inter-state water disputes, union-state relationships and public-private partnerships deserve appreciation. But political will is still lacking at both levels of governments to go for more substantive changes within the legal sphere. Although there are notable changes in water policy, they are more in the nature of good intentions than in the form of concrete actions. Even though changes are observed in the context of water pricing and cost recovery aspects, they can be characterised more as token than as substantive to have any real impact. Regarding private sector participation, the intention is sincere, and progress is very significant. Although it is confined mainly to a few economically attractive areas such as urban water supply and water development projects at present, the increasing financial challenges of the water sector is likely to result in more and more private sector participation and private investment. While there is a proposal for creating a national water framework law and its associated water regulatory authority, it should be generally more focused on the general direction and guidance for states than for any centralised control. Since water is a state subject and given the need to reflect region-specific requirements, it is better for the states to take these legal initiatives, though the union government also has to play both persuasive and catalytic roles.

On the organisational side, however, a number of concrete changes have occurred with a considerable impact on the structure and performance of water institutions, especially at its lower and middle echelons. These include not only irrigation management transfer (IMT), water user associations (WUAs), river basin organisations

(RBOs) and water development corporations, but also the water and pumpset rental markets, as well as various forms of localised water-based contracts. At the macro level, currently, there are serious proposals to merge and realign national organisations involved in the water sector with a view to ensure a national perspective on all matters connected to the water sector. Many states are also now willing to open the water sector to private investment and management with a view to improve both physical performance and financial sustainability. All these and other changes observed in the legal, policy and organisational spheres of water institutions are indicative of the fact that water institutions are not static but undergoing varying levels of changes. Despite their differential magnitude and regional variations, these changes do provide some form of observational evidence for the fact that the transaction cost theory of institutional change is working. That is, the reform benefits (or, the opportunity costs of inaction) are exceeding the corresponding economic and political transaction costs of undertaking such institutional reforms. But the fact that these institutional changes are uniform, neither across institutional components nor across water sub-sectors, suggests that both opportunity and transaction cost vary considerably by institutional and sectoral contexts.

The nature, extent and coverage of institutional changes also indicate the powerful effects that exogenous factors (such as economic liberalisation policies, political forces, influence of international financial and research institutions, and natural calamities like droughts) have on opportunity and transaction costs of institutional change within the water sector. Notably, the initiatives undertaken initially involved only the transaction cost-wise easier and ceremonial options, as they involved declaration of water policy, constituting committees and marginal legal amendments. However, those undertaken in recent years involved politically difficult and substantive options like administrative reforms, IMT, RBOs, autonomous corporation and private sector participation. But India is yet to move to the stage of embarking on real reforms such as review of the union-state relation in water sector, declaration of an exclusive and state-specific water laws, creation of practical water rights system at various levels, administrative reforms for water sub-sectoral coordination, staff resizing, etc. Understandably, these reform options involve heavy economic and political transactions costs. Although these costs are lower than the potential performance benefits in real terms, the differential weights assigned by political leaders and water sector stakeholders often distort the transaction cost calculus.

While India has to go a long way to set right its water institutional structure, the changes observed so far do signify that India is on the threshold of ushering in a substantive phase of institutional reform. This observation is based on four factors. First, although the observed changes are slow, partial and inadequate, their direction and thrust are on desired lines. Second, the nature and tenor of these changes — both already observed and those proposed — indicate a clear commitment of the union and state governments to move ahead with the process of institutional change. This commitment is likely to be strengthened further by the additional pressures from factors, both endogenous and exogenous to the water sector. Third, as the already initiated reforms begin to yield benefits, strengthen pro-reform constituencies and reduce the technical and political costs of transacting additional reforms, the incentive balance within the institutional transaction cost framework is likely to move toward further reforms. And, finally, although institutional change is very slow, the path dependency properties of institutional change will ensure that it is costlier to go back than to go ahead within the reform path. The reform process, which can be delayed, can neither be stopped, nor be reversed.

While the prospects for undertaking higher level reforms are brighter for India, there is an indispensable need for a clear and long-term strategy for reform implementation. In this respect, some of the key insights from cross-country analyses of water institutional reforms can be used to develop a reform design and implementation principles. These principles involve the issues of timing to strategically exploit the synergetic effects of exogenous factors, scale related effects of institutional inter-linkages (that is, links between WUAs and pricing policy and WUAs and volumetric allocation), and institutional sequencing and packaging (like undertaking easier reforms first and implementing the related programmes together). As the transaction cost declines and political balance improves when we move on the institutional change continuum, it is prudent to pursue a logically linked sequential reform strategy wherein water sub-sectors and institutional components are prioritised in terms of their performance impact, facilitative roles for downstream reforms and political acceptability. Since such a strategy can exploit better the synergies from both institutional inter-linkages and exogenous factors with proper timing, packaging and sequencing, it has a better chance of success, that too, with the least social cost and political opposition.

Institutions for Agriculture and Rural Development: A Case Study of Water Institutions in India

1. Context and Setting

Indian agriculture is at a crossroad, facing persisting socio-economic problems and pressing environmental challenges on one side and promising technological and institutional opportunities on the other. The negative impacts of traditional economic concerns such as stagnant productivity and social and regional inequalities are getting increasingly magnified by the eroding economic viability of farming due to rising costs, falling prices and narrowing margins. Even the very physical viability and sustainability of agriculture itself are also being threatened by the rapid deterioration of the agricultural resource base due to the widespread occurrence of aquifer depletion, water salinity and land degradation across most of the agriculturally important regions. Meanwhile, the situation also gets further complicated by the likely, but uncertain, impacts of the recently proposed farm policies and legal changes, particularly on the vast majority of smallholders as well as farm-dependent rural and urban communities. Amidst all these unfavourable trends on the economic and environmental fronts, there are also immense opportunities on the technological and institutional fronts. These opportunities range from adopting new modes of farm production and linking production with value addition and marketing to promoting efficient and resource-saving technologies and incentive-oriented and equity-based institutional arrangements.

In order to beneficially exploit existing and emerging opportunities within the agricultural sector, what is needed is a radical reorientation of the agricultural strategy from its narrow focus on mere productivity and production to quality and value addition by linking not only the agricultural resource and input systems with production but also the latter with processing, value addition and marketing. Obviously, practical translation of this strategy requires huge investments on infrastructure, technology, extension and human capital. Since the public sector may be unable to fully meet such a huge quantum of investment, there is a need to attract private investment, which, in turn, requires the creation of strong incentives within the agricultural sector. Such economic incentives—not just for private sector but also for all stakeholders within agriculture, especially the farmers—cannot be created

in a vacuum but requires major changes in the institutional structure within which agriculture is operating at present. This structure covers the institutions related not only to the input, production and marketing spheres but also to the resource spheres, especially land and water.

While institutional changes are certainly critical for enhancing economic incentives and equitable distribution of benefits among all stakeholders within the agriculture sector, there are a horde of fundamental questions requiring answers. To begin with: what are institutions? How are they to be conceptualised and analytically evaluated to understand their environment and structure? What are the key features and challenges of Indian agriculture? How do they provide the rationale and justification for undertaking institutional reforms? Which are the major agricultural institutional components that are to be reoriented? What is their current status and what are their challenges and changes? How they are functionally inter-linked and operationally connected? Is it possible to evaluate the performance of institutions? And, finally, what are the theoretical and policy implications of the whole review and analysis?

Relying on analytical approaches and materials and data from extant literature on the subject, this paper attempts to address the above raised questions by: (a) developing a conceptual and analytical framework useful for the review and evaluation of institutions in general and agricultural institutions in particular; (b) taking agricultural institution as a whole—but focusing on its five major institutional components such as land tenure, production mode, research and extension, credit system and marketing structure — to provide a focused review of their status and challenges; (c) treating water institutions as a special case of agricultural institutions to provide a relatively more in-depth review of the analytical structure and economic performance; and (d) concluding with the implications and options for setting right water institutions in particular and agricultural institutions in general and also with the limitations and caveats for this paper.

2. Objectives and Scope

There is a consensus on the need for strengthening and reorienting the institutional foundation of Indian agriculture. But the subject continues to remain as one of the less studied aspects in the extant literature. Past studies dealing with agricultural

institutions cover only one or two institutional components (like land tenure, extension systems, producer societies, marketing structures and credit institutions). Studies addressing the whole gamut of agricultural institutional issues within a unified framework are very rare. Such selective and restricted coverage is also common even in the context of resource-related institutions such as water institutions. Most studies here also focus, again, on a single or set of institutional components (for instance, water rights, water markets, water user associations and water pricing policy) instead of tackling water institutions as a whole within the same analytical setting. Such a lack of unified treatment of institutions is mainly due to many conceptual and analytical challenges of bringing together a large and diverse sets of institutions within the same analytical and methodological framework.

There are notable exceptions in the context of both agricultural institutions as well as in the context of irrigation institutions in particular and water institutions in general. There are few studies that deal with agricultural institutions within a relatively larger setting (Sheilla Bhalla, 1977; Rao, 1992; Saleth, 2000; Shah and Sah, 2002; Pal *et al*., 2003; Ames and Witwer, 2016; Misra, 2020; Chintala, 2021). But admittedly, these studies vary considerably in terms of their sectoral focus, institutional coverage, analytical rigor and empirical details. Similarly, in the particular context of water institutions, there are also some notable attempts of institutional analysis within a larger setting and more comprehensive analytical framework (Ostrom, 1990; Ostrom, Gardner, and Walker, 1994; Saleth and Dinar, 2003 and 2008; Saleth, 2004). There are also studies that focus on institutional reforms from the perspective of irrigation sector in particular and water sector in general (Svendsen and Gulati, 1995: Mitra, 1996; Saleth, 1996; Swain and Das, 1999; Vaidyanathan, 1999; Gandhi and Crase, 2009).

The present paper aims to review and evaluate some of the major agricultural, rural and resource-related institutions (that is, water institutions) to bring them together within a common analytical framework using a hybrid approach. In this approach, the review of select set of agricultural institutions is presented along with an in-depth analytical review of water institutions—taken as a special case of agricultural institutions—as integral parts of the same analytical framework. The inter-linkage between the review of these institutional components is created by analytically treating agricultural institutions as part of the institutional environment or contextual setting

of water institutions. While this will be clearer in the subsequent methodological section, let us specify the objectives and scope of this paper. The specific objectives are:

(1) to define the conceptual, analytical, and methodological framework underlying the institutional review and analysis as attempted in this paper;

(2) to set the context and background for the review of agricultural institutions with an overview of Indian agriculture to highlight its major challenges along with their institutional underpinnings;

(3) to review the status, issues and reform options with respect to a selected set of major agricultural institutions, that is, land tenure, modes of production, research and extension, rural credit institutions, and marketing institutions;

(4) to present an in-depth analytical review and evaluation of water institutions as a special case of the resource-related dimensions of agricultural institutions; and

(5) to highlight implications for theory and policy for promoting institutional changes within the water sector in particular and agricultural sector in general.

From an overall perspective, the above-mentioned objective (1) covers the analytical and methodological framework, and (2) provides the overall sectoral context and institutional setting, and constitutes the actual core of this paper. The paper is also organised in a similar structure.

As to the coverage and scope of the study, a few key aspects deserve attention. First, although institutions and infrastructures are conceptually distinct in view of their operational linkages at the field levels, they are difficult to be separated, especially in agriculture and resource-related settings. In many contexts, therefore, the review of institutions will necessarily involve infrastructures, and *vice versa*. Second, as noted already, institutional issues facing Indian agriculture in general and water sector in particular are evaluated at two levels focusing respectively on (a) review and evaluation of five major agricultural institutions and (b) comprehensive analytical review and evaluation of water institutions as a special case of agricultural institutions.

Although institutional review and analysis at these two levels form part of the same analytical framework from a methodological perspective, the same differ considerably from the viewpoint of the scope and coverage of this paper. This is because the institutional analysis to be attempted at the first level is based rather on a very brief and general overview, whereas the same at the second stage is based on a relatively more comprehensive and rigorous review. Finally, even when considering a single sector (agriculture/rural) and sub-sector (water), the institutional landscape is still too vast and diverse to be captured within this paper. On practical ground, therefore, this paper covers only a few selective but key institutions in the context of both agricultural and water institutions.

3. Analytical Framework and Methodology

Conceptually speaking, institutions are entities defined interactively by a configuration of legal, policy and organisational rules, conventions and practices that are structurally linked and operationally embedded within a well-specified socio-economic and political setting. While some of these institutions are informally evolved over time, most of them are formal and purposely created. Unlike informal institutions, formal institutions comprise largely of legal, policy and organisational components, and can be changed by deliberate policies and by factors, both endogenous and exogenous to the institutions themselves. Formal institutions can be analytically decomposed or unbundled to better understand their internal structure and embedded character. In this respect, institutions can be broadly decomposed at two levels.

(1) Institutions, taken as a whole, can be decomposed into institutional structure (or, governance structure) and institutional environment (or, governance framework) (see Williamson, 1975; North, 1990).

(2) The institutional structure, in turn, can be unbundled not only to distinguish their constituent institutional components and their underlying institutional aspects, but also to trace the structural and functional linkages evident among their institutional components and aspects.

The institutional environment is characterised by the overall cultural, historical, political, socio-economic, legal and physical setting of a given region, sector or country. While evaluating institutions in sectoral and sub-sectoral contexts, it

will also include inter- and intra-sectoral institutions of relevance as well. The exact coverage and components of the institutional environment are, therefore, not fixed but change with the evaluation context. For example, for the evaluation of agricultural institutions, the institutional environment will also include *inter alia* other macro and sectoral institutions connected with agriculture as well. Similarly, while evaluating water institutions, the institutional environment will also include agricultural, environmental and other-resource institutions. The institutional structure that operates within such an overall setting, on the other hand, is characterised by the interactive roles of legal, policy and organisational components and their constituent aspects. The institutional structure can be unbundled into three broader but specific 'institutional components', namely, laws, policies and organisations. These components, as discussed later in section 6, can also be unbundled further into their constituent 'institutional aspects'. Since the institutional structure is embedded within the institutional environment, the evolution of the former is invariably conditioned by changes in the latter.[1] Let us now apply this institutional decomposition approach to develop the analytical and methodological framework needed for the review and evaluation of agricultural institutions in general and water institutions in particular.

3.1 Agricultural Institutions: Environment and Structure

Agricultural institutions, taken as a whole, can also have their own institutional environment and distinct institutional structure. The institutional environment for agricultural institutions includes not only the macro level socio-economic, legal, political and physical setting, but also the rural and other inter-sectoral and resource-related institutions such as those related to trade, industry, water, forest and environment. Even though rural institutions are often clubbed with agricultural institutions, the former actually form part of the institutional setting for the latter. However, since the entire process of production, distribution and consumption of final output critically depends not only on agricultural institutions *per se* but also on the inter-connected roles of other rural and resource-related institutions, the latter need to be considered as an integral part of agricultural institutions themselves.[2]

As noted already, the analytical delineation of what constitutes institutional environment and what constitutes institutional structure is neither fixed nor water-

tight, but depend on the scope and objective of institutional analysis. For instance, if the focus of the analysis is on a specific institutional component, say land tenure, then all other agricultural institutions (example those related to production, extension, credit, marketing, etc.), 'resource-related institutions' (example, those related to water, forest, etc.), and other national and macro level institutions (example, national laws, policies and organisations having an effect on land and agriculture) will all form part of the institutional environment. The institutional structure of land tenure will, then, cover only those institutional components and elements (example, tenancy, land ownership pattern, land-related laws and rules, land-related organisations, etc.), which together characterise land tenure institutions. However, if the focus is on agricultural institutions as a whole, all components of agricultural institutions, including land tenure and resource-related institutions, will then form part of the institutional structure, and all other macro and sectoral institutions noted above will form part of the institutional environment.

Since the main aim of this paper is to review and evaluate water institutions as a special case of agricultural institutions, an overall review of agricultural institutions has to form part of its scope, especially to set the overall institutional environment of the former. As per the institutional decomposition approach, a review of agricultural institutions needs to cover both their institutional structure (covering agricultural and resource-related institutions) and institutional environment (covering macro and sectoral institutions). However, since the review of the latter will take the paper beyond its present scope, the review attempted here covers only the institutional structure of agricultural institutions, particularly focusing on the major institutional components. Note that the institutional environment of agricultural institutions is excluded from coverage only for analytical simplification. But its potential effects need to be kept in mind while reviewing and evaluating the institutional structure of agricultural institutions.

While the institutional structure of agricultural institutions consists of many institutional components, only six major institutional components are selected for review and analysis for the purpose of this paper. They are:

(1) Land tenure and tenancy,

(2) Organisational modes of farm production, processing, and marketing,

(3) Agriculture research and extension system,

(4) Rural credit and financial institutions,

(5) Agricultural market institutions, and

(6) Resource management institutions.

Although these institutional components are different and operate in various spheres, they are functionally and operationally inter-linked to generate one or more common outcomes. However, it is technically possible to analytically decompose and evaluate all legal, policy and organisational aspects underlying each of these components of agricultural institutions. Since undertaking such a detailed analytical review of all components of agricultural institutions within a single analytical framework involves a large canvas far beyond the scope of this paper, the feasibility of such an in-depth and systematic analytical review is only demonstrated by taking water institutions — the main sub-component of resource-related institutions — as a special case of agricultural institutions. While the other five components are reviewed in composite and generic form, such a review will be analytically linked with the systematic review of water institutions by treating these five components as part of the institutional environment of water institutions.

3.2 Water Institutions: Environment and Structure

Like all institutions, water institutions also have their own environment and structure. Water institutional environment is characterised by factors related to the overall physical, social-economic, cultural, political and institutional setting of a given country/region. The water institutional structure, on the other hand, is defined interactively by three institutional components, that is, water law, water policy and water administration or organisations. Obviously, therefore, water institutional structure can be decomposed into these three interrelated components.[3] These institutional components cover both formal and macro-level arrangements as well as informal and micro level arrangements such as those reflected in local customs, conventions and informal contracts. For obvious reasons, institutional decomposition performed here cover only formal and macro-level institutions, which can be changed by deliberate reform policies.

Though institutional decomposition looks analytically straightforward, it is rather challenging in operational or practical contexts, unless considerable simplification and selectivity are allowed. In this sense, therefore, formal institutional components (and also their informal counterparts to some degree) can be decomposed to highlight some of the constituent institutional aspects (Saleth and Dinar, 1999 and 2003). For example, water law can be decomposed to highlight its key institutional aspects such as (a) inter-governmental responsibility, (b) water rights and (c) accountability provisions and mechanisms. Similarly, water policy can be unbundled to highlight aspects such as (a) project selection criteria, (b) cost recovery, (c) water pricing and (d) user participation and privatisation. Likewise, one can unbundle the organisational component of water institutions to focus on aspects such as (a) organisational structure, (b) financing and management, (c) regulatory mechanisms and (d) conflict resolution arrangements. It is this form of institutional unbundling that serves as the analytical framework for the review and evaluation of water institutions.

The three key features of this institutional decomposition and analysis (IDA) framework can be noted.[4] First, it is neither detailed nor exhaustive in covering all institutional aspects underlying each of the institutional components. Nevertheless, it is still able to capture most of the major institutional aspects, which are key for the overall institutional performance. Second, the unbundled institutional components and institutional aspects are treated as independent entities only for the purpose of analytical convenience. In reality, however, there are functionally nested and operationally connected organic linkages both within and across the institutional components and institutional aspects.[5] Finally, when institutional unbundling goes to minute levels with finer details, that is, beyond institutional aspects and its defining elements, the exercise will be able to identify the complete anatomy and configuration of rules underlying each and every institutional aspects.

3.3 Hybrid Approach for Unified Institutional Analysis

The main reason for the persistence of partial and disaggregated analysis of institutions in general and agricultural institutions in particular is the methodological challenge of bringing together a large set of diverse institutions within the same or common analytical framework. These institutions, though large in number and diverse in nature, share the same theoretical foundation and functional principles

from an institutional economics perspective.[6] Yet, from a practical and operational perspective, it is rather a daunting, if not impossible, task to bring all of these diverse institutions together within the same analytical framework. If it is possible to develop such a unified framework to cover and evaluate together, for instance, the whole gamut of agricultural, rural and resource-related institutions, it could then be ideal and more realistic to analytically capture and evaluate their operational connections and performance effects. Such an analysis is useful to design and implement comprehensive reform strategies that would exploit well the strategic linkages and synergies.

A unified analytical framework for institutional analysis can be developed using a hybrid approach relying on certain assumptions concerning coverage and analytical adjustments. First, the analytical decomposition of both agricultural and water institutions can identify and prioritise institutional components that are to be brought together within the same analytical framework. Since only key institutional components and aspects are included, the analytical framework is also kept at a manageable, yet comprehensive level. Second, within such an analytical framework, the review and evaluation of agricultural institutions is also organised in a two-stage process involving different sets of institutions and levels of analysis respectively. The first stage covers the review of only five major components of agricultural institutions. At this stage, the review is brief, and highlights only major institutional issues and reform options related to each of these five selected institutional components. The second stage, in contrast, covers an in-depth analytical review and evaluation of water institutions both as a critical component of agricultural institutions and as the major part of resource-related institutions having the most direct impact on the effectiveness and performance of agricultural institutions in particular and the agricultural sector in general. The review at this stage is relatively more comprehensive and analytically more rigorous based on the institutional decomposition framework.

In short, the hybrid approach overcomes the methodological challenges involved in developing a unified analytical framework needed for an institutional analysis in this paper by: (a) using the same institutional decomposition approach for both agricultural institutions and water institutions; (b) presenting the generic review of five major components of the institutional structure of agricultural institutions followed by the systematic and in-depth review of water institutions within the same compar-

ative setting; (c) treating the review of agricultural institutions as part of the institutional environment of water institutions; and, (d) focusing on a single operational domain or resource sector, that is, water, to cover all underlying institutions and their components together within the same analytical framework. It is this hybrid approach that underpins the generic methodology that is being used in this paper. Within this methodological framework, this paper attempts to perform institutional analysis relying essentially on theoretical arguments, and empirical and anecdotal results from the available literature and secondary sources.

4. Status and Challenges of Indian Agriculture

Having outlined the objectives, scope and methodology, let us set the background and context for the review of agricultural and water institutions by providing a quick overview of the current status and key challenges facing Indian agriculture.

4.1 Status and Features

Agriculture contributes to about 17% of the gross domestic product (GDP), but shares about 55% of the total workforce in the country. In terms of land resources, the key input for agriculture, India has a cultivable area of about 180 million hectares (mha), representing only 55% of its total geographic area of 327 mha. In view of certain binding limits and constraints, the land area actually being used for agricultural production—known as the net sown area (NSA)—is only about 141 mha, representing 78% of cultivable land and 43% of the total geographical area (Government of India, 2020). The net irrigated area (NIA), that is, NSA under various forms of irrigation, is only about 69 mha.[7] This means only 48% of the area under cultivation is being irrigated, with the rest being largely rainfed with uncertain production prospects. Given a cropping intensity of 142%, the gross cropped area (GCA) works out to be 198 mha and gross irrigated area (GIA) to be 98 mha.

Regarding irrigation sources, 65% of the irrigated area is under groundwater irrigation with the rest under various forms of surface irrigation such as canals, tanks, river lifts and small water bodies. The growth of groundwater irrigation is phenomenal, increasing from mere 1% during 1960-61 to 65% at present. Such a growth is driven largely by Green Revolution technologies, private investment in wells and pumps and public investment in rural electrification. Of the total groundwater used in India,

irrigated agriculture alone accounts for 90%. Groundwater irrigation is supported by over 27 million irrigation wells — more than 50% of them are bore wells or tube wells, while others are open wells spread mostly in the hard rock areas of southern India.[8] These wells and other lift water sources are fitted with 31.5 million pumpsets.[9] From the perspective of supply control and use efficiency, groundwater irrigation is obviously much more efficient as compared to surface irrigation. But it is relatively costly and also frequently susceptible to power uncertainties and aquifer depletion.

Turning to cropping pattern, it is dominated by cereals, oilseeds and pulses. While cereals (rice, wheat, pearl millet, sorghum and maize) account for 52% of the cropped area, oilseeds and pulses account for 21%. These are followed by cotton and sugarcane (9%), vegetables and fruits (7%) and others (11%). Notably, rice and wheat — the main staples of India — together account for 74% of the total area under cereals or 39% of the total cropped area. These two cereals together with sugarcane also dominate in terms of irrigated area with a 80% share. Since irrigation accounts for over 80% of the total water resources in the country, this means these three crops account for 64% of the total water use at the national level. As such, any attempt to improve water management has to necessarily focus on the water allocation and their use in the context of these major crops.

4.2 Constraints and Challenges

The total production of foodgrains (covering wheat, rice, pulses, and coarse cereals) was 298 million tons (mt) in 2019-20. Although this represents a 5% increase over the previous year, their production is being plateaued due to almost static productivity levels of most food crops. While India has certainly achieved food self-sufficiency from a supply perspective, the same is difficult to be claimed from a demand perspective in view of persisting poverty and malnutrition[10] and the growing demographic pressures.[11] Notably, what is achieved is not food self-sufficiency but essentially grain self-sufficiency because of the persisting supply gaps in key items such as pulses and oilseeds. Besides, the self-sufficiency is not only partial but also achieved with considerable real and environmental costs. The production has also been very resource intensive, cereal centric and regionally biased, raising major sustainability concerns both from an economic and ecological perspective. This is due to escalating cost of inputs, increasing stress on the limited resource base of

agriculture, especially water and land resources, and lack of diversification in terms of crops, agricultural enterprises, farm sub-sectors and rural occupations.

Moreover, the ability to enhance agricultural production is constrained both by the limited scope for area expansion due to environmental and practical constraints and also by the productivity and viability problems from increasing farm fragmentation. Although area expansion is extremely difficult, there is a substantial scope for expanding gross sown area by enhancing cropping intensity. However, there are also serious constraints on this front because of the increasing economic non-viability of farming itself under current conditions of input and output prices and long-term ecological and sustainability implications of soil fertility loss from intensive-farming. This is especially so given the increasing farm fragmentation. The average holding size declined from 2.28 ha in 1970-71 to 1.50 ha in 1995-96 and further to 1.08 ha by 2015-16.[12] With farm fragmentation and population pressure within agriculture, the number of farms in India has more than doubled from 71 to 145 million between 1970-71 and 2015-16.

4.3 Diagnosis and Strategies

While a critical review of our agrarian economy would reveal many more constraints and challenges than those discussed above, from a general perspective, however, all these diverse problems can broadly be captured under the following seven categories:

(1) Structural imbalances in terms of crops, regions and social groups;

(2) Stagnation in productivity and output growth;

(3) Economic non-viability of farming due to escalating input costs and low and fluctuating crop prices;

(4) Deteriorating resource base of agriculture due to widespread groundwater depletion and land degradation from salinity and soil erosion;

(5) Increasing labour shortage and declining labour absorption;

(6) Insufficient investment and low value addition potential; and

(7) Binding institutional and infrastructural constraints.

Diagnosis of all these agricultural challenges—ranging from plateauing of productivity to economic viability to binding resource constraints—points towards productivity growth and value addition as the main pathways for realising the food, livelihood and income goals of the agricultural sector. The strategy to achieve the sectoral goals are not static, but has evolved over the years (Ames and Witwer, 2016). For instance, during the years immediately following independence, the focus was on strengthening local institutions under community development programmes and land tenure system through land consolidation and land sharing through voluntary donations. But the focus shifted to irrigation development and land reforms during the initial planning period.

During the Green Revolution period, the focus was sharply on new crop and farm technologies, though irrigation continued to receive priority through canal irrigation expansion and extensive groundwater development. Considerable expansion of rural infrastructures has also occurred during this period through public and private investment. Such infrastructure cover not only irrigation and power sectors but also key areas as varied as farm input delivery, agricultural research and extension, agricultural credit, marketing, storage, processing and value addition, and rural road and transport. Most of these infrastructures have also played key institutional roles besides their intended infrastructural functions. Taken together, they did create powerful economic incentives and supportive environment to enhance productivity, diversify production and raise the income levels for almost all rural groups.

While institutions such as land tenure, agricultural extension system, marketing structure and water organisations received considerable attention both in research and policy, they were considered essentially for their roles in supporting technological solutions. Their fundamental institutional roles in setting right the overall incentive environment within the agricultural sector were not considered in practical policies, though the incentive effects of land tenure and tenancy (especially share-cropping) have remained as the main themes in economic literature, especially those pertaining to the developmental process of developing countries. But agricultural institutions play many and much larger roles in the context of resource allocation and use, technology choice, input use pattern, capital formation and income distribution. Since they open up the overall production possibility frontier of agriculture and expand, and thereby, the productivity of all inputs including resources, technologies and infrastructures,

they are indispensable for both achieving and sustaining productivity growth and welfare gains in the agricultural sector.

Realising the critical significance of institutions, agricultural strategy is now shifting more and more towards the institutional dimension of agriculture. Institutional reforms are needed to improve the institutional foundation of the resource, input, production, value addition and marketing spheres of the agricultural sector. Effective agricultural institutions are critical not only for meeting the long-term sectoral challenges but also for achieving the immediate goal of doubling farmers' real income. The institutional underpinnings of the income goal will be clear when we look closely at the seven strategic elements specifically identified for this purpose. They are:

(1) Improving crop productivity;

(2) Raising livestock productivity;

(3) Efficient resource use or saving production cost;

(4) Increasing cropping intensity;

(5) Diversifying towards high-value crops;

(6) Enhancing real prices received by farmers; and

(7) Shifting from farm to non-farm occupations.

Obviously, all these strategic elements are closely linked with agricultural institutions as defined broadly to cover rural and resource-related institutions as well as agricultural and rural infrastructures. Since these institutions can simultaneously link agricultural growth with value addition on one hand and value addition with income distribution and poverty alleviation on the other, they are critical for achieving not only the targeted income goal but also for the overall welfare and sustainability of the agricultural system itself.

5. Review of Major Agricultural Institutions

The institutional foundation of agriculture remains too weak and outdated, particularly in relation to the emerging challenges and new opportunities facing

the sector. Institutional constraints jeopardize not only productivity, efficiency and sustainability goals but also the ability of farmers to benefit from the opportunities opened up by new knowledge, technologies and market prospects.[13] With the emergence of a new development paradigm centered on productivity, value addition and sustainability, there is a need not only for rejuvenating traditional institutions and infrastructure such as land tenure, extension systems and resource management institutions, but also for creating new institutions and sophisticated infrastructure such as new modes of production, processing and marketing and modern systems for ensuring quality and phyto-sanitary standards of farm products.

Land tenure and tenancy arrangements require urgent reform with a view to preserve scale economies and to enhance land and labour productivity. Improved organisational modes for organising and linking production, processing, value addition and marketing within an integrated framework are essential to enable farmers to realise and share the full economic benefits of higher production. In predominantly smallholder agriculture, economic benefits from value addition cannot be fully realised without a strong production-marketing-processing interface necessary to promote a system of decentralised production and aggregation but centralised processing and marketing. Institutional options for realising such an integrated system have to be identified and promoted. In addition, legal changes in the sphere of land tenure and tenancy, water allocation, use and management, plant variety protection, etc., have also to be initiated to create a proper institutional environment both conducive and strong enough to incentivise the new modes of farm production and distribution.

While policy changes both at the macro level and at sectoral level are likely to generate considerable endogenous pressures for institutional changes within agriculture, it is important to pursue deliberate policies to reform and strengthen the institutional foundation of the sector. Such reforms are necessary not only in the immediate economic context but also for the long-term sustainability of the agriculture sector in particular and rural economy in general. The reforms required are many, vast and varied. But some of them are more urgent than the others partly because of their central roles and partly because of them leading to solutions on many related fronts. In this respect, as listed already, the major components of agricultural institutions requiring reforms are:

(1) Land tenure and tenancy,

(2) New organisational modes to link production, processing, and marketing,

(3) Agriculture research and extension system,

(4) Rural credit and financial institutions,

(5) Agricultural market institutions, and

(6) Resource management institutions.

Of these six components, the first five are quickly reviewed in this section to highlight their respective status, issues and reform options. As to the sixth component, it is reviewed relatively more rigorously in the subsequent section by taking water institutions as a special case of the resource management component of agricultural institutions. It can be noted that since agricultural institutions are treated as part of the institutional environment of water institutions, the review of the first five components of agricultural institutions presented here is structurally linked with the detailed analytical review of water institutions to be presented in the next section. With these points in mind, let us review each of the five major components of agricultural institutions.

Table 1: Land Tenure: Pattern of Farm Holdings, 1995-96 and 2015-16

Sl. No.	Farm Holding Categories	Farm Holdings (million)				% Share of Farm Holding			
		1995-96		2015-16		1995-96		2015-16	
		Nos	Area (ha)	Nos	Area (ha)	Nos	Area	Nos	Area
1	Marginal (< 1 ha)	71.18	28.12	100.25	37.92	61.58	17.21	68.45	24.03
2	Small (1-2 ha)	21.64	30.72	25.81	36.15	18.73	18.81	17.62	22.91
3	Semi-medium (2-4 ha)	14.26	38.95	13.99	37.62	12.34	23.85	9.55	23.84
4	Medium (4-10 ha)	7.09	41.40	5.56	31.81	6.14	25.34	3.80	20.16
5	Large (> 10 ha)	1.40	24.16	0.84	14.31	1.22	14.79	0.57	9.07
6	All Categories	115.58	163.35	146.45	157.82	100.00	100.00	100.00	100.00

Note: Total may not tally due to rounding errors.

Source: Ministry of Agriculture & Farmers Welfare, *All India Report on Agriculture Census*, Government of India, New Delhi. Accessed at the http://agcensus.dacnet.nic.in/nationalholdingtype.aspx

5.1 Land Tenure and Tenancy

Before discussing the institutional issues related to land tenure and tenancy, it will be instructive to present the changing patterns in land ownership and tenancy arrangements across farm size categories between the two latest agricultural census respectively for 1995-96 and 2015-16. Table 1 shows the number and area distribution of farm holdings across farm size groups for the two periods. While all farm holdings increased from 116 million to 146 million, the corresponding area has, however, declined from 163 mha to 158 mha. As we disaggregate this change by farm size groups, we can see the area decline to occur only among groups owning over 2 ha. But small and marginal farms, in contrast, saw an increase both in numbers and area.

In terms of the relative share of farm groups in total holdings and area, although marginal holdings have a 69% share in the total holdings, they have a just 24% in the total area. In contrast, farms with over 2 ha with only a 14% share of the total holdings have about 53% share in the total area. Such a pattern of land ownership indicates not only extreme inequality in the access to land but also increasing tendency towards farm fragmentation and unviable farm holdings. In terms of individual vis-a-vis joint

Table 2: Land Tenancy: Pattern of Farm Holdings, 1995-96 and 2015-16

(Percentages)

Sl. No.	Farm Holding Categories	Fully Owned and Self-Operated				Fully/Partially Leased-in+others			
		1995-96		2015-16		1995-96		2015-16	
	Nos	Area	Nos	Area	Nos	Area	Nos	Area	
1	Marginal (< 1 ha)	61.67	17.16	68.32	23.73	58.24	19.33	76.81	39.42
2	Small (1-2 ha)	18.62	18.72	17.62	22.84	22.91	21.91	16.33	24.25
3	Semi-medium (2-4 ha)	12.34	23.88	9.66	24.10	12.13	22.53	3.75	9.91
4	Medium (4-10 ha)	6.15	25.44	3.83	20.33	5.45	21.71	2.20	12.58
5	Large (> 10 ha)	1.21	14.80	0.57	9.00	1.27	14.52	0.91	13.84
6	All Categories	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note: Total may not tally due to rounding errors.

Source: Ministry of Agriculture & Farmers Welfare, *All India Report on Agriculture Census*, Government of India, New Delhi. Accessed at the http://agcensus.dacnet.nic.in/nationalholdingtype.aspx

ownership, during 2015-16, jointly-owned holdings are very low both in numbers and area relative to individually-owned holdings across all farm size groups. Individually-owned holdings account for more than 83% in respect of the total holdings and total area in the case of all farm size groups, except large farms, where individually-owned farms account for 75% of the total holdings and 69% of the total area.

Regarding tenancy, irrespective of farm size groups, land leasing — either fully or partially — account for just 3% of both total holdings and total area with the rest remain fully-owned and self-operated. However, when we compare the relative share of farm groups in both categories between 1995-96 and 2015-16, the relative share of small and marginal farmers in land leasing has increased over time. As can be seen in Table 2, among marginal farms, the share of self-operated holdings has increased from 62% to 68% in the total holdings and 17% to 24% in the total area. However, the same for leased holdings rose from 58% to 77% in the total holdings and from 19% to 39% in the total area. But the reverse is the case for farms exceeding 2 ha. The overall implication is that smaller and unviable holdings also dominate in both categories of self-operated and leased farms during the two census periods.

Turning to the major institutional issues surrounding land tenure and tenancy, the performance of various measures of land reforms ranged from the modest success to clear disappointment, depending on regions, reform components and time periods (Joshi, 1975; Rao, 1992; Nadkarni, 2002; Deshpande, 2003). While land redistribution programmes have been relatively more successful in states such as West Bengal and Kerala, the programmes involving conversion of tenants into land owners were very effective in most states except Bihar and Uttar Pradesh. Land consolidation programmes, which actually preceded land reforms, have been quite successful in the north-west region of India such as Punjab and Haryana. Since land consolidation programmes countered serious problems associated with fragmented and scattered plots, they did create one of the necessary conditions for the success of the subsequently implemented Green Revolution programmes during the 1960s.

In the current socio-political context, however, the scope for direct land redistribution is almost impossible. Since tenancy legislations tend to foreclose options for the landless to have access to farm land as tenants, the only other way for them to have some form of access is mainly through the distribution of the

ever-shrinking category of unused and waste lands. Even from a large perspective, as noted already, land resources available for agriculture itself is on the decline due to population growth, farm fragmentation, land degradations and land conversions for non-agricultural purposes. The key issue now, therefore, is how to use available resources most efficiently, and it is here that land-related institutional issues such as tenure and tenancy reforms, labour-based production contracts, contract farming and new modes of organising farm production assume significance.

There is considerable pressure for relaxing land ceilings and reviving land leasing activities. While there is an agreement on the need for ceiling relaxations, the approach and rationale for the same differed between then and now. For instance, in the past, the argument for land ceiling relaxation was for promoting farm entrepreneurship, reaping technology-related scale economies and ensuring economic viability of farming (Dandekar, 1994; Johl, 1995). But, now, the same is for promoting corporate farming by domestic and multinational agro-industrial groups, and thereby, for promoting private investment, technology development and value-added supply chains within the agricultural sector. It is true that corporate farming could convert agriculture into a more technology and capital-intensive business proposition with obvious productivity and export benefits. Corporate farming can also entail serious negative socio-economic consequences as they can magnify the already serious problems of landlessness and unemployment. These negative effects can, however, be mitigated to some extent when corporate farming is promoted through land leasing rather than outright land sales, and such a promotion is also coupled with a policy of expanding income from the rural non-farm sector, especially in processing, value addition and marketing spheres. This could also pave the way for contract farming as an alternative to corporate farming, which could generate most of the benefits, but without the negative effects of the latter.

Land ceiling relaxation without proper qualifications and safeguard provisions may be a politically incorrect and socially inappropriate policy. Besides, ceiling relaxation cannot be economically justifiable as there are no evidences for increasing return to scale in Indian agriculture (Vyas, 1994; Ray, 1996). However, as noted already, land ceilings can be relaxed in the case of both corporate farming based on land leases from smaller farmers as well as wasteland development with corporate investment. Already, states like Karnataka and Maharashtra have taken positive

initiatives in this direction. Care is, however, needed to ensure that this provision is not misused by resorting to convenient and fictitious classifications of otherwise productive lands as wastelands. It is also desirable to insist that the wastelands coming under ceiling relaxation are used for mainly high-value agricultural products, including horticultural items. While ceiling relaxation for wasteland is justifiable on economic grounds, it may not be soon the equity front as this policy can foreclose the option of distributing wastelands among the poor, unless there is significant labour absorption, especially through formal labour contracts. It is, therefore, important to look for means to transfer some benefits of the corporate farming initiatives to the rural poor of the concerned areas.

On the other side of the spectrum, given the faster rate of land fragmentation, there is also a need to introduce a floor limit for landholdings (Ray, 1996). While this is certainly a desirable step to arrest the proliferation of non-viable holdings, unlike land ceiling provisions, floor limits are difficult to implement by legislative means in a democratic polity. One way out here is to revive and legalise land lease markets, which were partially deactivated by land reform legislations. Land leasing activities, though legally banned in many contexts, do occur regularly across the country. It is, therefore, more practical to legalise them with adequate safeguards against exploitative practices. While such a legalisation may lead to reverse tenancy (Vyas, 1994), it can also be beneficial, especially in the context of corporate farming. Corporate farming through land leasing can avoid land alienation problems, assure periodic lease income and promote farm and non-farm employment through an enhanced prospects for large scale farm mechanisation and value addition.

Besides the land tenure-related institutional issues highlighted above, there is also an urgent need to modernise the outmoded system of land records as well as to revise the official land values for land registration purposes. Since land values in the open market are several-fold higher than the outdated official land value, the suggested revision could yield considerable revenue through higher stamp duties. Such additional revenues could be used for the purpose of modernising land records, especially through computerisation and information technologies. The digitalisation of land records has already been implemented with significant positive impacts across many states.[14] Besides their roles in raising and improving administrative efficiency, these initiatives enabled online access to most land-related information and services,

promoted transparency and reduced delay and corruption. To sustain and enhance such benefits, however, additional reforms are needed to enhance the responsiveness of the organisational systems governing current land and revenue administration.

5.2 New Modes of Farm Production and Marketing

As shown in previous section, small and non-viable holdings dominate Indian agriculture. In view of their inherent institutional and economic limitations, they are unable to withstand economic challenges and benefit from technological and trade opportunities, unless they are organised under new modes of farm production and marketing so as to benefit from scale economies and collective bargaining. For achieving productivity growth and reaping the economic benefits of value addition, the new organisational forms need to integrate production, aggregation, processing, value addition and marketing into a single, though possibly a spatially dispersed, system. Such organisational models need necessarily to allow a mix of decentralised arrangements in some spheres (example, production and aggregation) and centralised arrangements in other spheres (example, input procurement, processing, value addition and marketing).

Unfortunately, cooperative farming systems of the types experimented in the 1960s and 1970s were an unqualified failure (Vyas, 1994; Ray, 1996). But recent studies suggest cooperative farming performs well with significant positive impacts in some specific contexts and regions (Singh, 2016 and 2019; Agarwal, 2010 and 2018). On the other side of the spectrum, corporate farming of the type currently being proposed — based either on land ceiling relaxation or land leasing arrangements — can achieve the integration of production, value addition and marketing. However, problems such as land alienation and marginalisation associated with corporate options make it an unacceptable alternative. Obviously, therefore, feasible options to fit well with the current conditions need to be found midway between these two extremes. What is needed are some feasible institutional options to bring together decentralised production and aggregation, and centralised input procurement, processing, value addition and marketing within the same organisational setting.

One option being actually practiced in the case of cotton and sugar production relates to the 'command area approach' (Ray, 1996). There are also other models of micro level contract farming system, where middlemen traders contract farmers to produce

specific commodities in one area and sell the produce to processing units elsewhere.[15] Another, but more familiar, case relates to the Anand pattern cooperative system, which is considered as an unqualified success in the case of milk on a national scale and also in the case of edible oils and vegetables, particularly in the context of Gujarat. Another interesting case relates to the highly successful PepsiCo model, first practiced in 1989 in Hoshiarpur district, Punjab, but later expanded to other regions. In fact, this experiment is considered as the dawn of modern contract farming in India (Swain, 2016).

One notable feature of the PepsiCo model is that since quality and uniformity of output are crucial for processing purpose, farmers are also provided with quality seed and constant extension services. With a conducive policy environment and increasing demand for processed products in recent years, this particular model of farming has now been extended to a variety of crops from traditional to high-value ones like tomatoes, potatoes, chili, gherkins, basmati rice and cotton, and also to seed production. This form of contract farming is being practiced in over 105 cases involving more than 25 crops (Swain, 2016). Although various forms of contract farming are operating across all states, most of them are located in the agriculturally most advanced states such as Punjab, Tamil Nadu, Andhra Pradesh, Haryana and Maharashtra.

In recent years, contract farming is also getting a new thrust through both government policies and grassroots level initiatives. For instance, national policies such as the New Agricultural Policy of 2000 and the Food Processing Policy of 2004 have visualised contract farming as a main vehicle to promote private investment and technology transfer, and at the same time, ensure assured market and reduced postharvest losses. Contract farming is also viewed as a means to strengthen the supply chains and reduce transaction costs. The National Policy for Farmers declared in 2007 has also proposed a model of contract, including a code of conduct, to meet commodity-specific requirements. Studies confirm the significant impacts of contract farming on farm productivity, income and employment (Kumar, 2006; Kumar and Prakash, 2008). However, since the feasibility of contract farming is highly circumscribed in terms of crops, farm groups and farming conditions, it cannot be considered either as a panacea or as a universal solution to address the problems of different crop and regions.

Besides contract farming, some new organisational forms have also emerged in recent years thanks to the initiatives of community organisations, government agencies and funding bodies. Though incipient and still evolving, they have significant poten-

tial for influencing farm production, marketing and input supply (Ames and Witwer, 2016). Important ones among them are the rural self-help groups (SHGs), which are playing an important role in areas such as micro-credit, women's empowerment and natural resources management. Despite their limited direct role in farm production, SHGs are instrumental in generating a participatory ethos and cooperative outlook in the farm sector and rural areas. It is estimated that as of 2016-17, there were 85.77 lakh SHGs organised into federations with larger spatial coverage and also with considerable financial linkages (APMAS, 2017; Kumra and Sharma, 2018; Singh, 2019). Although not all of them are directly involved in farm production activities, most of them support farm production through their financial leverages. Yet, many of these SHGs, when developed properly, could provide a strong institutional framework for linking financing, production and marketing.

The other form of farm organisation with considerable institutional potential for growth and impact relates to the farmer producer organisations (FPOs), which have emerged especially since the early 2000s. These FPOs, which try to link production, processing and marketing among its members, cover mainly the small and marginal farmers. Most of these FPOs have also been formally registered as farmer producer societies or companies. By 2015-16, there were about 2,000 FPOs created under various programmes of the Department for Agricultural Cooperation. Recently, the Department of Agriculture and Farmers Welfare has launched a major scheme for the formation and promotion of 10,000 FPOs by 2027-28. Under this scheme, a total of 4,465 new FPOs have been created as of 2020. The state-wise distribution of these FPOs is shown in Table 3. Regarding their impact and performance, a recent sample-based study conducted by PricewaterhouseCoopers reveals that FPOs have significant positive impacts on both price realisation and cost savings among member farmers. For instance, output sales through FPOs resulted in a 31% reduction in marketing costs and 22% increase in the price realised by the farmers.

Since 28% of the members purchased inputs collectively, there was net savings in input costs to the tune of Rs. 1384/acre (Ministry of Agriculture and Farmers Welfare, 2021). Similar positive impacts of FPOs are also reported by another impact study undertaken by the National Bank for Agriculture and Rural Development (NABARD) in select states such as Kerala, Madhya Pradesh, Orissa and Rajasthan. The results of this study show that the increase in prices received by FPO members ranged from 7.5%

Table 3: State-Wise Distribution of Farmers Producer Organisations in 2020

Sl. No.	State	Number
1	Andhra Pradesh	147
2	Arunachal Pradesh	15
3	Assam	87
4	Bihar	221
5	Chandigarh	1
6	Chhattisgarh	32
7	Delhi	7
8	Gujarat	108
9	Haryana	257
10	Himachal Pradesh	7
11	Jammu & Kashmir	10
12	Jharkhand	70
13	Karnataka	195
14	Kerala	53
15	Madhya Pradesh	237
16	Maharashtra	1950
17	Manipur	26
18	Meghalaya	1
19	Mizoram	4
20	Nagaland	6
21	Orissa	177
22	Puducherry	1
23	Punjab	13
24	Rajasthan	114
25	Tamil Nadu	241
26	Telangana	119
27	Tripura	8
28	Uttar Pradesh	654
29	Uttarakhand	14
30	West Bengal	184
	Grand Total	4959

Source: Ministry of Agriculture and Farmers Welfare (2021).

in Madhya Pradesh to 45% in Kerala. Correspondingly, the increase in the income of FPO members ranged from 13.5% in Odisha to 25% in Rajasthan. Notably, FPOs have also helped farmers to reduce their dependence on informal credit sources (Chintala, 2021). While there are evidences for the positive effects of FPOs, further research is still needed to identify the conditions for their effectiveness and sustainability as a viable institutional option.

Regardless of the institutional options selected, the main emphasis has to be on linking input supply, production, aggregation, processing, value addition and marketing so as to combine the income and employment benefits of decentralised small-scale production with the efficiency and scale economic gains of a centralised large-scale processing and marketing network. Certainly, all area-based contract farming model are effective in linking production, processing and marketing, and enhancing both farm income and income share of farmers. But organisational models based on contract farming and FPOs could also be equally effective in most contexts. Since most models are relevant mainly in the case of the most important commercial crops, it is not clear how they are going to benefit most smallholders who are focused on food crops, especially in remote areas. In any case, the ideal option choice is not to promote one or two models but rather a suitable configuration of different models to suit different crops, regions and contexts.

Moreover, there are also important questions on the viability and sustainability of these models under conditions of increasing infrastructural bottlenecks, fluctuating prices and uncertain economic conditions. In view of these challenges, these models depend clearly on the effectiveness of their linkages with farm credit and agricultural extension systems both at the production and at the processing and marketing stages. Besides, these models based mostly on private sector or organised farm groups, need considerable public infrastructural investment, particularly in creating networks of aggregation, processing, storage centres for collection, grading and processing, value addition and delivery units. Understandably, therefore, the facilitative roles of both upstream and downstream institutional and infrastructural aspects need to be considered while formulating policies for promoting new organisational modes for farm production.

5.3 Agricultural Research and Extension System

Realising the goal of doubling farm incomes requires simultaneous improvements both in physical productivity and economic value-added within agriculture. In both cases, agricultural research and extension system (ARES) plays central and indispensable roles. Although irrigation and soil quality form the necessary conditions for productivity growth, it is only an effective and accessible ARES that can ensure the sufficiency conditions for the same. This essentially is through their roles in develop-

ing and delivering technologies and extension services, which are critical not only for enhancing the biological yield but also for overcoming resource limitations, climate uncertainties and plant diseases. Past research has clearly established the high rate of return from ARES investment (Schultz, 1964; Hayami and Ruttan, 1975), which remained as the major reason for a rapid growth of AERS investment witnessed in developing countries, including India. The AERS investment has, in fact, increased at an annual rate of 6% during 1960-85 (Anderson *et al.*, 1994). Although the growth rate of AERS investment declined in developed countries, it was still relatively higher in developing countries.[16]

Unfortunately, the growth in AERS investment led more to size expansion than performance quality. This is actually the case with the Indian AERS at present. Due to the agricultural expansion, stagnating productivity, deterioration of agricultural resource base and changing trade environment, the AERS is now facing new challenges. The increasing demand placed on the system is in sharp contrast with the lack of flexibility, institutional innovations and adaptive response to changing market conditions and client needs. The pressing funding constraints on one side and emerging future challenges on the other have forced policy-makers and funding agencies to seek new avenues and options for improving the functional response and the overall performance of ARES. Since inefficiencies originate more from an expanding size and unwieldy nature of the organisational structure of ARES, most of these options have an obvious focus on setting right its institutional foundation. The institutional options revolve around improving the managerial efficiency of public component of ARES, increasing its linkages with private sector and farm groups and enhancing their flexibility and adaptive response to changing conditions (Byerlee and Alex, 1998).

The organisational and managerial reforms within the public research system are long overdue. Notably, the gains from such reforms can be realised with a relatively limited investment as these reforms relate mainly to "streamlining research priorities, reforming the management and incentive system, and involving a broader range of institutions and groups in the research process" (Byerlee and Alex, 1998: 16). Other options, which would involve significant additional investment, include the promotion of decentralisation, creation of semi-autonomous regional research arrangements and the involvement of universities and private research groups. The prospects for these

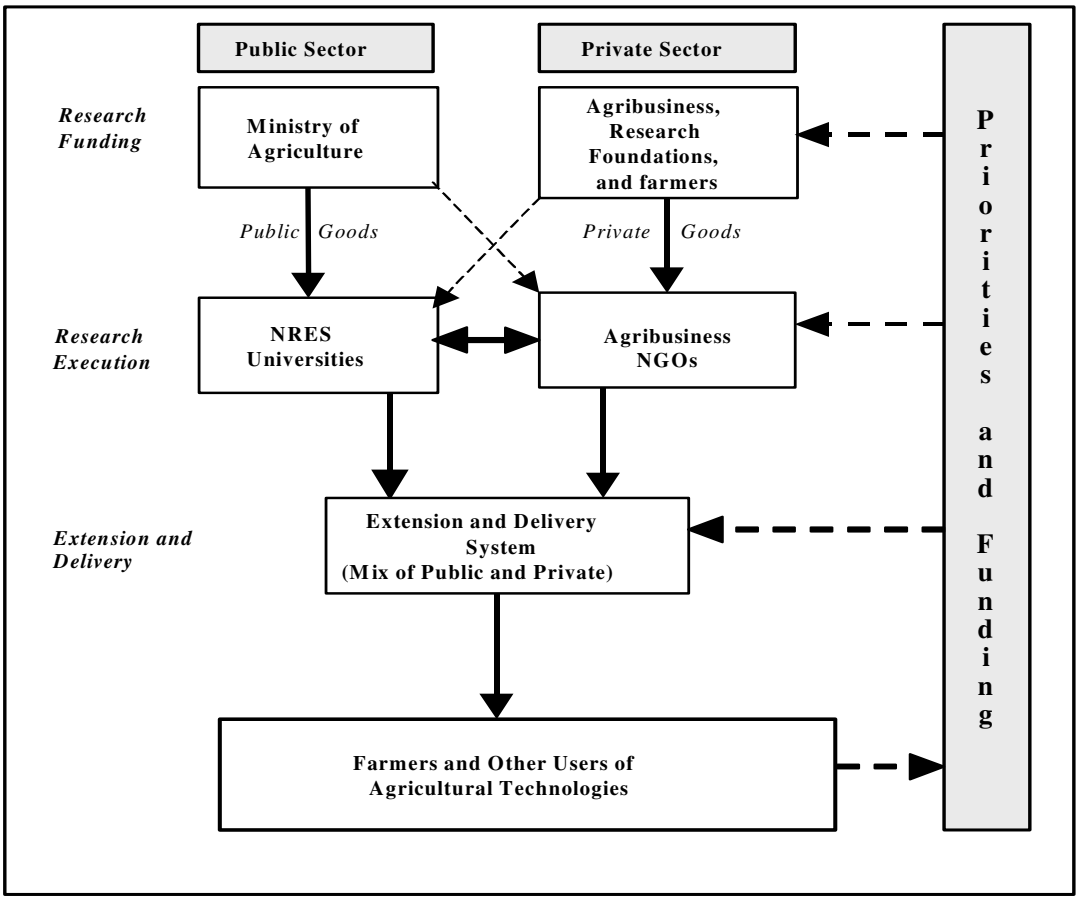
options are brighter from a technical perspective, especially given the closely connected network of research bodies and highly skilled and experienced scientific manpower. Unfortunately, such technically feasible reforms face practical challenges in terms of unwillingness and resistance within existing bureaucratic circles. But the growing magnitude of the social costs of inaction and increasing pressures from researchers, farming community, funding agencies and international technical and donor agencies are gradually turning the political tide in favour of undertaking ARES reforms.

The main thrust for institutional reforms in the context of Indian ARES is obviously to shift the focus from system expansion to performance improvement. Policy makers do recognise that the performance of ARES can be raised considerably by increasing its managerial efficiency, accountability and adaptability, as well as by articulating stronger links between public and private activities of agricultural research and extension. The AERS in India can no longer be equated just with public research system alone in view of the institutionally diverse system existing at present with the increasing roles of universities, private companies, research agencies, non-governmental bodies and foreign companies. Multiple organisations and players are involved in different facets of the ARES such as funding, research, extension and delivery of extension services and inputs. Such an emerging and institutionally pluralistic paradigm of ARES is depicted Figure 1.

The conventional view places an exclusive reliance on public research system where the role of private sector, especially in the delivery of some of the agricultural inputs such as seeds, fertilizer and pesticide, remains largely unconnected, but operates in parallel with the public research and extension system. In contrast, the new paradigm underlines institutional plurality and structural linkages among public and private systems. With the increasing role of private sector, the collaboration between private and foreign companies is also growing, especially in seed production. Private sector expansion and foreign collaborations generate many positive benefits. Besides bringing additional investment, technologies and skill inputs for research, they also add many new crop varieties, especially in neglected cases such as vegetables, millets and fodder crops.

During the past few decades, for instance, private sector companies in India have introduced about 122 crop varieties.[17] In recent years, the share of private companies in the total seed production has increased from 57% in 2017 to 65% in 2021 (Manida

Figure 1: AERS Structure and Linkages: An Institutional Perspectives



and Nedumaran, 2020). Besides, they also create the much needed competitive environment to promote efficiency and reduce costs. Seed production by private sector with foreign collaborations has serious implications for trade and balance of payments because Indian imports of seeds and plant materials are substantial and increasing over time.[18] Table 4 lists some of the predominant private sector companies involved in agricultural research and seed production in India, along with their focus crops and foreign collaborations.

Private sector involvement is also increasing in the extension sphere in recent years. For instance, as noted earlier, in the case of the PepsiCo model, which was implemented in tomato production in Punjab, extension is a part of the package of support extended to farmers in the contract farming arrangements. With the

Table 4: Illustrative List of Foreign Collaborations in Seed Sector

Sl. No.	Indian Firms	Foreign Firms	Product
1.	Bejo Sheetal Seeds	Bezo Zadan BV Pvt.Ltd.(F)	Hybrid seeds
2.	Bharat Pulverishing Mills	Nova Seeds USA(F)	Oilseeds, pulses, Vegetables.
3.	Bilt Treetech	Plantex Australia(T)	Propagation of Trees, Shrubs, Flowers.
4.	Bisco Seeds Tech.Pvt.Ltd.	Agripro Biosciences USA(T)	Hybrid seeds
5.	Cargil Seeds	Cargill USA	Hybrid seeds
6.	FCL Agrotech	Contro Coop.Yugoslavia	Hybrid seeds
7.	Harrison Malyalam FRG(T)	Agri Saatan Vegetables Semynio Statzucht FRG(T) Green Tek, Holland(T)	Hybrid seeds, HYV Hybrid HYV Vegetables Plant Tissue-culture
8.	ITC Agrotech Ltd.	Continental Grains Australia(T)	Hybrid seeds
9.	Maharashtra Seeds Co.	Seedtec Hybrid USA(T)	Sunflower
10.	Maharashtra Seeds	Hybridi Asgrow Seeds Co.USA(T) Zeneca U.K.	Hybrid Vegetable Seeds Hybrid seeds
11.	Nath Seeds Pvt.Ltd.	Dobi Gon & Co.USA(T) K.Z. Gebroaders Sluis Holland(F)	Hybrid Sunflower Hybrid Vegetable Seeds
12.	Omega Agseed (India) Pvt.Ltd	Agseeds Pvt.Ltd. Australia(F)	Improved Seeds
13.	Phi Biogen Pvt. Ltd.	Poineer Overseas Corporation(F)	Hybrid seeds
14.	Poineer Overseas Corpn.	Poineer Overseas Corporation (USA) Subsidiary	Hybrid seeds
15.	Raunaq International	Centro Coop and University of Agriculture, Novisat, Yugoslavia	Hybrid seeds
16.	Sandoz	i)Zaadunio BVP Holland(T) ii)Northrup King Co. USA Plantlets.	HYV Seeds HYV Seeds and
17.	SPIC	Poineer Overseas Corpn.USA(F)	Hybrid seeds
18.	Welcome Seed	NRI Cases, UK(F)	Vegetables seeds
19.	Wimco Ltd., Bombay	Hilleshoh AB Sweden(F)	Seeds and seedlings for forestry

Notes: (F) stands for technical collaborations with foreign equity.
(T) stands for technical collaboration only.

expansion of private sector, there is also a need for diversifying funding sources both within and beyond the border. With diverse players and funding sources in the AERS arena, not only the availability of financial resources and skill inputs would increase (McMohan, 1992; Byerlee and Alex, 1998), but also the resultant competition will induce the best, the most cost-effective and the client-oriented research outputs and extension services. Besides integrating public and private segments of AERS, there is also a need for organisational and agenda decentralisation to facilitate specialisation, location-specificity, competitiveness and client responsiveness. It is only such reform options that can improve the productivity and efficiency of the entire system.

One of the key tasks of AERS reforms relates to the reframing of the research agenda and priority matrix so as to shift the focus (a) from traditional cereals towards crops with deficit supply and export potential and (b) from mere crop productivity to postharvest and resource conservation aspects. Importantly, the AERS research agenda should also be integrated and dovetailed with the broad goals of agricultural and rural development policies. Private AERS is particularly strong in horticultural crops, bio-technologies and production of non-cereal hybrid seeds and pesticides. Its increasing collaboration with foreign companies also facilitates technology transfer and access to seed markets in other countries of Asia and Africa.

Public AERS, on other hand, has strong linkages with international organisations related to crop breeding, livestock research and resource conservation. It is in this respect, stronger linkages between public and private segments of AERS are mutually beneficial and socially desirable. While there are undeniable benefits from public-private linkages within AERS, realising such benefits would not be that easy in view of many legal and institutional bottlenecks. Till these constraints are removed with proper changes, it will be better to rely on various forms of contract-based arrangements with private sector and universities for undertaking specific research components.

On the decentralisation front, significant progress has already been achieved in terms of both crop-specific research programmes and also regionally spread AERS organisations (for instance, All-India coordinated research programmes for different crops, and research centers and field stations for different crops operating in various parts of the country). But in terms of funding and organisational control, however, public AERS is still highly centralised. In this context, it is necessary to consider reorganising of bodies such as the Indian Council of Agricultural Research

(ICAR) by four main regions. Moreover, university-based research activities, which are now under the funding control of the ICAR, need more autonomy to undertake research with funding support from the private sector. Collaboration of universities with the private sector can be much more productive, highly innovative and less costly for technology development. There is an obvious need for raising the level of private investment in agricultural education, research and development (ER&D), given the declining public investment on agricultural ER&D relative to agricultural income/ gross domestic product (GDP).[19]

In terms of diversification, AERS system should go beyond its conventional roles of developing production-oriented technologies and extension services. For better meeting the current needs of farmers, the production-oriented services are best delivered together with the provision of price, market and climate information. Such an integrated delivery requires not only flexibility and locations-specificity but also functional collaborations with relevant agencies to quickly gather related information. Finally, from an overall perspective, since the research system is becoming more complex and diverse, enhanced coordination is necessary to improve operational efficiency and to avoid duplication and resource wastage. This is achieved to some extent within the public research system through all-India coordinated projects for promoting specialised research in specific crops or activities. But what is needed more than such an activity-specific coordination are the system-wide coordination and integration by articulating stronger linkages among the activities of both the public and private segments of AERS, including farmer organisations and non-governmental agencies (Glendenning *et al.,* 2010).

5.4 Rural Credit and Financial Institutions

Farm credit is important as a facilitative or mediating input to raise agricultural productivity and rural income. Many studies have clearly established the positive relation between the easy availability of farm credit and agricultural productivity in India (Desai, 1994; Das, Senapati, and John, 2009; Bhalla and Singh, 2010; Narayanan, 2015; Reserve Bank of India, 2019). In line with such positive impact, rural credit in India is increasing consistently over the years. For instance, farm credit as a ratio of agricultural GDP increased from 10% in 1999-2000 to about 38% in 2012-13 and further to about 52% in 2017-18 (Reserve Bank of India, 2019). As can be seen in Table 5, in terms of absolute amount, rural credit has increased from Rs.

Table 5: Credit Flow to Agriculture during 2011-19

(Rs in billion)

Category	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Production Credit (Short-term)								
Co-operative Banks	818	1,026	1,136	1,304	1,438	1,319	1,383	1,428
Regional Rural Banks	474	560	707	893	1,016	1,050	1,195	1,257
Commercial Banks	2,669	3,150	3,642	4,157	4,199	4,526	4,971	4,838
Sub-total (A)	3,962	4,735	5,484	6,354	6,653	6,895	7,550	7,522
Investment Credit (Medium/Long-term)								
Co-operative Banks	61	86	64	81	95	109	120	96
Regional Rural Banks	70	77	120	132	177	182	214	240
Commercial Banks	1,017	1,175	1,633	1,886	2,230	3,472	3,801	4,710
Sub-total (B)	1,149	1,339	1,817	2,099	2,502	3,763	4,135	5,046
Both Credits (Short + Medium + Long-term)								
Co-operative Banks	880	1,112	1,200	1,385	1,533	1,428	1,504	1,523
Regional Rural Banks	545	637	827	1,025	1,193	1,232	1,410	1,497
Commercial Banks	3,686	4,325	5,275	6,044	6,430	7,998	8,772	9,548
Sub-total (A+B)	5,110	6,074	7,301	8,453	9,155	10,658	11,685	12,568

Source: Government of India (2019a).

5 trillion in 2011-12 to Rs. 12.6 trillion in 2018-19 (Government of India, 2019a). But such growth in farm credit indicates neither its adequacy in relation to demand, nor its performance in terms of efficiency and equity in delivery. Moreover, credit delivery also suffers not only from endogenous issues such as insufficient loan amounts due to standardisation and delayed loan processing because of staff inadequacy and lengthy procedural requirements and also inefficient crop insurance, bottlenecks in market access and lack of price risk management (Bhaskaran, 2017).

Suggestions for institutional reforms in rural credit systems are not new, as this has been the agenda of many committees and expert groups since long. Specific measures to be undertaken in this respect have already been detailed by both the Khusro Committee (Reserve Bank of India, 1989) as well as the Narasimham Committee (Government of India, 1991). As we have argued earlier, on the operational side, rationalisation and a more targeted provision of credit especially to small farmers and other poor groups are crucial to change the present system, where large farmers are the major beneficiaries and 50% of the households are outside the ambit of formal credit.

For minimising the high transaction costs and loan recovery problems, small farmers can be organised as SHGs for group lending purposes (Vyas, 1994). Such SHGs, which have now seen a tremendous expansion in rural areas, could serve both as an organisational basis and also as an additional source for the expansion and delivery of micro-credits in agriculture.[20] On the institutional side, while there is a demand to merge Regional Rural Banks (RRBs) with the co-operatives for improving their viability, researchers do not favour such mergers as a healthy institution cannot emerge by merging two sets of sick institutions. Therefore, a multi-agency-based credit delivery system (that is, RRBs, cooperatives, commercial banks, etc.) should continue, as competition among them can improve the overall efficiency of the system.

An important suggestion that has implications for both the operational aspects of credit institutions relate to the role of third party intermediation between small farmers and credit institutions (Vyas, 1994: A62). The voluntary agencies and other entities in the areas of technology, input supply, marketing and processing like the sugar mills, agro-processing units, etc., could play such an intermediary role. In this respect, various contract farming options discussed in the previous section have also some implications for the credit delivery system. More importantly, the service area approach promoted by NABARD to coordinate various development activities related to infrastructure and technology with credit programmes at the grassroots level should be extended to district and state levels, as it is here that all crucial decisions on infrastructures and technologies are being made.

Apart from the changes in the lending policy aimed at improving the financial viability, a number of operational and institutional changes are indispensable to enhance the viability and performance of the formal rural credit system as a critical component of rural institutions. More importantly, the traditional perception of informal rural credit sources as unorganised money lenders/farmers is also becoming increasingly irrelevant, as they are transforming fast into more organised forms like rotation finance, chit funds and pawn brokering.[21] This is especially so due to the tremendous growth of rural SHGs in agricultural credit and rural financing in recent years (Kumra and Sharma, 2018; Singh, 2019). Today, private rural finance system—covering both traditional actors, private banks, rural SHGs and those centered on gold loans—has already grown strong enough to pose significant competition and also add complementarity with public rural credit sources. Since their scale of operations are

likely to increase further with new developments, they need to be eventually brought into some form of formal framework to support and regulate them. However, given its predominant focus on the bottom line, it is highly uncertain how far such a private system will help smaller farmers, especially in the absence of the helping hands of formal public rural credit institutions and rural SHGs focused on agriculture.

In recent years, special initiatives were undertaken to promote financial inclusion. Besides concerted efforts by public and private sector banks on this count, targeted programmes such as the Prime Minister People's Wealth Scheme of 2014 are also being implemented to improve financial access and inclusion among small and marginal farmers with considerable effect in minimising their dependence on informal sources. As per NABARD's *All India Rural Financial Inclusion Survey Report 2016-17*, in terms of average farm loan taken, the institutional sources meet 72% of the credit requirement and non-institutional sources account for 28% (NABARD, 2018). However, public and private sector banks meet only 41% of the credit needs of small and marginal farmers. Another dimension relates to regional disparity in farm credit. The relative share of states in the total credit varies from 0.5% to 10%, and in some states (example, Bihar, Chhattisgarh, Jharkhand and West Bengal), the credit shares are not proportionate to their share in agricultural output (Reserve Bank of India, 2019). This means that despite notable progress on inclusion front, there is still a scope for further progress.

5.5 Agricultural Marketing Institutions

Agricultural marketing institutions assume critical importance for creating the overall incentive environment in terms of both setting prices and determining the relative income share of farmers, traders, consumers and myriad others operating in transport, storage, processing and value addition spheres. In view of multiple players and operations involved in the long process between farm output and final consumption, marketing institutions are not a monolithic institutional system, but comprises of many inter-connected institutions and infrastructure doubling as institutions. These institutional components are operating in inter-connected areas such as aggregation, transport, storage, processing, value addition and delivery system. They form an integrated ecosystem of many activities and players involved in the entire spectrum from farm gate to final consumption. Since changes in marketing

institutions are likely to have a wide ranging impact over the entire spectrum, market reforms are not that simple but need to balance varying and often conflicting interests of various groups.

Despite the challenges of market reforms, agricultural markets are being regulated to ensure fairness, operational efficiency and transparency, and to avoid conflicts and misuses (Acharya, 2004). Agricultural markets are regulated under the Agricultural Produce Market Committee (APMC) Act passed by different states during the 1960s and 1970s. These state-specific acts allow states to notify commodities to be covered and divide the state as different market areas to be governed by their respective market committees. Currently, there are 7,320 APMCs operating across states. Of them, 2,477 are principal markets and 4,843 are sub-market yards regulated by their respective APMCs (Government of India, 2016).

Notwithstanding formal regulations and other oversight provisions, considerable informality and control by vested interests persist in these markets, making them inefficient and somewhat archaic and bureaucratic. Dominance of interest groups and implicit barriers are evident in localised market yards. The transaction costs vary, but generally remain very high, across these markets due to varying levels of taxes, market fees, commissions and other charges.[22] But the most serious problem with state level markets pertains to their relative isolation and lack of operational linkages with other state markets. Such fragmented markets curtail farmers' ability to sell their produce beyond state boundaries. Even though APMC licensed commission agents and traders have the ability to sell agricultural produce across state markets, they are not able to do so in practice due to various economic constraints and logistic bottlenecks.

To integrate the regionally fragmented agricultural markets, the union government introduced digital and electronic-based National Agricultural Market (e-NAM) programme in 2016. This programme aims to develop a virtual national level market through electronic trading portals coupled with backend physical support through APMCs, other retails yards and delivery networks. This programme has the potential to promote transparency, competitiveness, efficiency, wider participation by all stakeholders and digital integration of various market functions such as auction, clearing and settlement, payment gateways and delivery logistics (Shalendra and Jairath, 2016).

In terms of progress, e-NAM platform has covered so far about 1,000 APMCs from 18 states and 3 union territories. With this, e-NAM platform has a registered user base of 1.66 crore farmers, 1.31 lakh traders, 73,151 commission agents and 1,012 FPOs, and covers 150 commodities including cereals, oilseeds, fibers, fruits and vegetables (Ministry of Agriculture and Farmers Welfare, 2020). Notably, e-NAM platform also has a FPO module under which FPOs can declare their collection centres as deemed market or sub-market yards. Notably, warehouses accredited by Warehousing Development and Regulatory Authority (WDRA) can also make similar declarations. Besides, these warehouses can also issue negotiable electronic warehouse receipts (e-NWR) that can be traded in the market and used for pledging with banks for getting advances.[23]

The most recent, but somewhat controversial, institutional reforms in the sphere of agricultural marketing relate to three ordinances passed by the union government on June 5, 2020. They are: (1) Farmers' Produce Trade and Commerce (Promotion and Facilitation) Ordinance, (2) Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Ordinance, and (3) Essential Commodities (Amendment) Ordinance.[24] Objectively speaking under ideal conditions these legislations have tremendous potential to benefit farmers with more diversified trading options and additional market channels beyond APMC market yards. With an integrated, expanded and barrier free inter-state trade, they can also ensure better prices through more intense competition. Also, since these legislations provide a boost to the e-NAM, they are likely to reduce the overall transaction costs thanks to the speed, ease and scale of doing agricultural marketing. Moreover, with pre-production agreements on prices and other services, farmers will be able to transfer price and market risks, access technologies and inputs, and eliminate transport and marketing costs. As such agreements can be extended up to five years, both sides can benefit from long-term planning and performance incentives.

Unfortunately, most of the benefits expected of these legislations depends critically on the validity of some of the fundamental assumptions concerning the nature and intensity of anticipated competition among traders and the dependability of price setting process that can be expected under these legislations. If traders are numerous and relatively uniform in size, it is more likely for the competition among them to be more intense and for the farmers to get better agreement and price deals. But, if

there is going to be only very few and large players with considerable market power and control over the supply chains, finance and infrastructures, famers may not be guaranteed the expected benefits, though other goals such as market expansion, market integration, value addition, etc., may be achieved at the expense of farmers, small traders and other players within the current market ecosystems.

To avoid their negative effects such as price rigidities and uncertainties associated with market distortions due to oligopolistic tendencies and excessive control over finance, infrastructures and supply chains, these legislations need to be strengthened with regulatory mechanisms to ensure fair price process, regulate unfair practices and eliminate market dominance by a few. Unless these steps are taken, the market reforms under the latest legislations are likely to be counterproductive with more adverse effects on farm sector. Partly considering these negative effects and partly for political reasons, all three legislations have been now withdrawn by the union government. As a result, the future of institutional reforms in agricultural marketing remains uncertain, and with that, all problems in the sphere of agricultural marketing continue to persist.

6. Water Institutions: Status and Reform Options

Having completed the review of the major components of agricultural institutions, let us turn to a more systematic analytical review and evaluation of water institutions, which form the core objectives of this paper. As per our methodological framework, agricultural institutions are treated—both analytically and structurally—as part of the overall institutional environment of water institutions. In this respect, the review of major components of agricultural institutions presented in the preceding section actually forms a key part of the review of the institutional environment of water institutions that will be presented in this section. It is to be noted here that unlike most other components of the institutional environment of water institutions that are to be reviewed here, agricultural institutions can be changed through purposive sectoral policies and also as an indirect consequence of other macro policies. Given the close institutional and functional linkages that agricultural sector has with the water sector, the goal of improving the overall performance of agricultural sector, therefore, requires reforms to reorient not only agricultural institutions on the lines argued in the preceding section but also water institutions on the lines to be argued in the current section.

It is true that water institutions go beyond agricultural sector in so far as they also cover institutions connected with other non-agricultural sectors, especially urban and rural water supply. However, since more than 80% water resources go for irrigation and since most part of agricultural GDP comes from a small segment of irrigated agriculture, water institutional reforms are particularly critical for agricultural development in particular and rural development in general. Moreover, water institutions also have powerful reinforcing roles in improving the overall effectiveness and performance of other components of agricultural institutions thanks to their efficiency and productivity effects. Notably, since land inequality is being reinforced by unequal water access, water institutional changes have the potential to counter even land inequality. Similarly, the overall performances of production modes, AERS, credit institutions and marketing systems are also closely linked with the productivity and efficiency effects of the institutions governing water sector. It is in view of such fundamental functional connections that water institutions are considered as a special case of the resource-related dimensions of agricultural institutions. With these contextual and preliminary aspects in mind, let us look at the current status and challenges of the water sector in India.

As in the case of agricultural sector, the water sector in India is also at a crossroad of old challenges and new opportunities. The challenges are well known, and are related mainly to financial crisis, physical deterioration, poor economic performance and the negative ecological effects of aquifer depletion in groundwater regions and waterlogging and salinity in canal areas. The opportunities, though not as obvious as the challenges, are basically related to the emergence of both endogenous and exogenous pressures for change in the way the water sector is currently financed, regulated and managed. The endogenous pressures are basically those related to the physical, financial and performance problems internal to the water sector itself, whereas the exogenous pressures come from other sectors, especially fiscal reforms and macroeconomic policies, which demand fiscal responsibility, improved efficiency and better cost recovery within the water sector.

As water sector is approaching fast its ultimate expansion potential, and budget and ecological constraints limit the scope for further expansion, there is now a severe pressure for improving the economic and financial performance, particularly by exploiting the hidden irrigation and investment potential within the water sector.

It is recognised very clearly that all water sector problems are essentially the direct outcomes of the defects within the current institutional framework governing water resource development, allocation, use and management. While there are strong pressures for change, political economy constraints, though getting gradually relaxed, continue to drag reform initiatives at various levels. Besides, there are also many legal and technical challenges for undertaking institutional reforms in a large and diverse country such as India, that too, operating within a federal structure.

This section relies on the analytical and methodological framework outlined in section 3 so as to provide a systematic analytical review of water institutions, focusing first on their institutional environment, and then, on their institutional structures. The latter will cover not only the macro/formal institutional arrangements but also their micro/informal counterparts. The section will also evaluate the overall performance of water institutions using select but simple criteria. Regarding its scope, as noted already, the review and evaluation will be more eclectic rather than exhaustive in terms of its coverage of legal, policy and administrative or organisational aspects governing water sector. The emphasis will be on the key water institutional components, and the aspects that are critical for sectoral performance and also receive attention in current policy debates on water reforms. Although micro/informal institutions are covered, the major focus will be on formal institutional arrangements operating at national and regional levels.[25] This is because formal and macro level institutions are more amenable for purposive reforms than their informal and micro level counterparts, which are obviously influenced by many local, non-economic and subjective factors operating beyond the policy realms.

6.1 Water Institutional Environment: An Overview

The institutional environment of water institutions in India is characterised by the interactive roles of its history, constitutional framework, socio-economic conditions, political arrangements, and finally, the physical setting of the water economy itself. As noted earlier, agricultural institutions also form part of this institutional environment, and they have been already reviewed. Here, we will provide a terse overview of other components of the institutional environment of water institutions. As noted already, these components, unlike the components of agricultural institutions reviewed in previous sections, are exogenous and outside the scope of purposive policies.[26]

6.1.1 General Setting

Besides its economic roles, water resources also play strong spiritual and cultural roles within the long historical traditions of India. Its present administrative and judicial systems were shaped by a strong central Asian and Persian influence during the Mughal period and by British and common law principles during colonial period. However, it is the British, who fine-tuned the efforts by unifying the diverse systems within a centralised administrative and judicial system, though largely from a revenue perspective. With such a consolidation of the centralised system and the spread of marketisation, the rich tradition of community-centered local institutions lost their relevance and largely disappeared over the years (Sangal, 1991; Sengupta, 1993). At the macro political level, the British did also shape a multi-party democratic system based on the parliamentary form of governance operating with a modern Constitution that defines a federal structure by demarcating the respective responsibilities of union, state and local governments. But this system underwent considerable changes over the years.[27]

6.1.2 Socio-Economic Setting

Turning to economic setting, despite many constraints and challenges, includ-ing the recent pandemic, the Indian economy is still able to have an average annual growth rate of around 6% with the current per capita income reckoned at $ 2,191.[28] While India did achieve remarkable economic and social progress over the years, it still faces significant problems. Food self-sufficiency was achieved since the early 1970s and self-reliance on most industrial products were realised at least since the early 1980s. Strident progress is being recorded in education, infrastructure, international trade and information and communication technologies, which have led remarkable socio-economic transformation even in rural areas.

Yet, the Indian economy still remains largely rural with a large segment relying on agriculture and exposed regularly to monsoon uncertainties. Although the share of agriculture is only 17% of GDP, its share in the total workforce is reckoned at 55% (Government of India, 2020). Agricultural dependence of the Indian economy is actually much deeper than the labour share because of the significant reliance of other economic sectors on the performance of the agricultural sector. Poverty has certainly declined over the years—from 56% during 1973-74 to 41% during 1984-85, to

33% around 2000, and finally to 19% in 2021 (Planning Commission, 1993; Saleth *et al.*, 2003; World Economic Forum, 2021). But, as noted earlier, poverty does persist in various hidden forms such as malnutrition, stunting and wasting. These issues point to the necessity of ensuring food security from both its supply and demand perspectives. Obviously, the water economy plays a critical role in meeting these and other challenges of the agricultural sector in particular and the rural economy in general.

6.1.3 Physical Setting

As to the physical setting, being a vast and monsoon dependent country, the water resource potential in India displays wide variations over time and across space.[29] On the supply side, India has an average annual rainfall of 3,880 billion cubic meter (bcum) during 1985-2015, which is spread across a catchment area of 3.22 million square kilometers (or 322 mha). The total catchment area in the country is broadly divided into 21 river basins or basin systems. From an overall perspective, the total water resource potential available for use in the country is estimated to be about 1,999 bcum (Central Water Commission, 2019). The basin-wise distribution of water resource availability can be seen in Table 6.

Regarding groundwater, its annual recharge at present is estimated to be 436 bcum, of which only 398 bcum can be technically and economically extractable. Groundwater resources that are actually being extracted and used at present is about 245 bcum, representing 62% of the extractable groundwater limit (Central Groundwater Board, 2021). As in the case of surface water, there are also formidable constraints for enhancing groundwater extraction and use beyond the current levels. This can be seen clearly in Table 7, where extraction increased marginally just by 4% during 2004-20.

In terms of utilisation of the total water resource availability, only 1,122 bcum (that is, 690 bcum from surface sources and 432 bcum from groundwater sources) can actually be utilised under current economic and technological conditions. But the actually developed water resources at present stand only at about 644 bcum, representing about 57% of the utilisable water resources potential. From an irrigation perspective, the ultimate irrigation potential that can actually be developed from this utilisable water resource potential is estimated to be 140 mha.[30] As to the progress in the realisation of irrigation potential over time, it was only 16% in 1951, but increased

Table 6: Basin-wise Pattern of Water Resources Availability in India in 2019

(bcum)

Sl.No.	Basins	Area ('000 km2)	Annual Water Resource Availability (bcum)		
			Mean	@ 90% Confidence	Total
1	Godavari	312.81	117.74	12.08	117.74 ± 12.08
2	Krishna	258.95	89.04	5.84	89.04 ± 5.84
3	Cauvery	81.16	27.67	1.67	27.67 ± 1.67
4	Subarnarekha	29.20	15.05	1.41	15.05 ± 1.41
5	Brahmani-Baitarani	51.82	35.65	2.91	35.66 ± 2.91
6	Mahanadi	141.59	73.00	7.42	73.00 ± 7.42
7	Pennar	55.21	11.02	1.98	11.02 ± 1.98
8	EFR between Mahanadi & Pennar	86.64	26.41	3.28	26.41 ± 3.28
9	EFR between Pennar & Kanyakumari basin	100.14	26.74	3.22	26.74 ± 3.22
10	Minor Rivers draining to Myanmar (Burma) and Bangladesh	36.20	31.17	2.66	31.17 ± 2.66
11	Indus	321.29	45.53	2.87	45.53 ± 2.87
12	Ganga	861.45	509.50	18.93	509.50 ± 18.93
13	Brahmaputra	194.41	527.28	19.6	527.28 ± 19.60
14	Barak and Others	41.72	86.67	6.56	86.67 ± 6.56
15	Mahi	34.84	14.96	1.84	14.96 ± 1.84
16	Sabarmati	21.67	12.96	1.95	12.96 ± 1.95
17	Narmada	98.80	58.21	5.81	58.21 ± 5.81
18	Tapi	65.15	26.24	2.48	26.24 ± 2.48
19	WFR Tapi to Tadri	55.94	118.35	6.04	118.35 ± 6.04
20	WFR Tadri to Kanyakumari	56.18	119.06	6.17	119.06 ± 6.17
21	WFR off Kutch, Saurashtra & Luni	321.85	26.93	2.66	26.93 ± 2.66
	All Basins	3227.02	1999.20	43.70	1999.20 ± 43.70

Note: EFR indicates east flower rivers; WFR indicates west flowing rivers.
Source: Central Water Commission (2019).

to over 67% at present. Utilisation beyond this level is going to be extremely difficult, if not impossible, in view of various physical, financial and political constraints.

On the demand side, the pressure is growing rapidly with the expanding irrigation needs of 98 mha of GIA in particular and 198 mha of GCA in general, and the rising

Table 7: Groundwater Resources Availability and Utilisation in India: 2004-20

Sl. No.	Particulars	2004	2009	2011	2013	2017	2020
1	Annual Groundwater Recharge (bcum)	433	431	433	447	432	436
2	Annual Extractable Groundwater Resource (bcum)	399	396	398	411	393	398
3	Annual Groundwater Extraction for Irrigation, Domestic & Industrial uses (bcum)	231	243	245	253	249	245
4	Stage of Groundwater Extraction (%)	58	61	62	62	63	62

Source: Central Groundwater Board (2021).

domestic water use needs of over 1.39 billion people. As a result, India's water requirement is projected to increase from 694-710 bcum in 2010 to 784-850 bcum by 2025, and further to 973-1,180 bcum by 2050 (Government of India, 2000). With a widening supply-demand gap due to economic expansion and demographic growth, there is a continuous decline in per capita water availability. For instance, the per capita water availability, which was about 5,178 cubic meters (cum) in 1951 has declined to 1,486 cum at present, and it is expected to decline further in the future (see Table 8). While non-irrigation demand is likely to quadruple over the years, the intrinsically agrarian nature of Indian economy will tend to orient the water sector more and more towards its irrigation sub-sector.

From an infrastructural perspective, canal irrigation sector is supported by about 5,745 storage units consisting of not only larger dams but also myriad smaller tanks and other water bodies, as well as the vast and complex networks of water distribution canals and channels necessary for water conveyance from storages systems to farm field levels. The total storage capacity of the larger dams alone is reckoned at 258 bcum, representing about 37% of the total utilisable surface water resources at present (Central Water Commission, 2019). As noted already, groundwater irrigation, in contrast, is made possible through 27 million wells (50% of them were dug wells) and over 31.5 million pumpsets spread across the country.[31] Unlike canals systems, groundwater irrigation is developed largely by the private investment of millions of farmers spread across the country, though public investment in rural electrification and credit support for irrigation assets did facilitate such private investment in groundwater development.

Table 8: Trends in Water Availability/Capita in India: 1951-2051

Year	Population (million)	Water/Capita/Year (cum)	Remark[d]
1951	361	5178	
1955	395	4732	
1991	846	2210	
2001	1027	1820	
2011	1211	1651	Water Stressed
2015	1326[a]	1508[c]	Water Stressed
2021	1345[b]	1486[c]	Water Stressed
2031	1463[b]	1367[c]	Water Stressed
2041	1560[b]	1282[c]	Water Stressed
2051	1628[b]	1228[c]	Water Stressed

Notes: a. Projected from 2011 census.
b. Population figures for 2021 to 2051 are as projected by Planning Commission (http://planning commission.nic.in/aboutus/committee/strgrp/stgp_fmlywel/sgfw_ch2.pdf).
c. Water/capita from 2015 are calculated from its 2017 estimate.
d. This is only as per the Falkenmark Water Stress benchmark of 1700 cum, but not as the absolute water barrier norm of 1,000 cum.

Sources: Government of India (2009) and National Commission on Integrated Water Resources Development Report (1999).

Although water supply in urban and rural areas is provided by semi-autonomous water supply undertakings, municipalities and local governments, individual-households and privately managed water supply companies also play an equally important role. Finally, institutions related to other related resources involved in water resource development and utilisation as well as those related to general economic and sectoral management also form part of the water institutional environment. These include the land, forest and agriculture-related as well as national level institutions (example, land tenure and tenancy, inheritance laws and forest and environment acts, agricultural pricing policies, and trade policies and international agreements). While some of these major institutions directly related to agricultural sector were already reviewed in the previous section, other macro institutions noted above are obviously excluded from coverage because they go beyond the present scope of this paper.

6.2 Water Institutional Structure: Macro Perspective

The review of formal and macro level components of water institutional structure is organised within the analytical framework based on institutional decom-

position. As described in section 3.2, this analytical framework unbundles water institutions into three institutional components — water law, water policy and water administration. These institutional components are, in turn, decomposed to distinguish and highlight their constituent institutional aspects.[32] Notice also that all these institutional components and aspects are formal and macro in nature. Informal and micro level institutions such as customs, norms, etc. are not covered, as it is difficult, if not impossible, to bring them within our present analytical framework. This fact plus the already noted eclectic coverage are among the important caveats for the ensuing review of the select set of institutional components and their constituent institutional aspects of the formal and macro segment of the water institutional structure.

6.2.1 Water Law

Water law paves the legal foundations for the water institutional structure. It provides the full legal backing for water policy as well as the operational framework and enforcing power for water organisations and related regulatory arrangements. Although India does not have any separate and exclusive water law, water-related legal provisions are dispersed across various irrigation acts, national and state level laws, constitutional provisions, court decisions, customary laws and various penal and criminal procedure codes. There are also realistic proposals for the unification and simplification of irrigation acts (example, Jacob and Mahesh, 1976) as well as for the creation of an exclusive domain of water law covering both the domestic and international dimensions (Singh, 1991 and 1992; Cullet, *et al.,* 2011). Unfortunately, such proposals have not yet received the attention they deserve either from researchers or from policymakers.

Although there are no proposals for undertaking sector-wide legal reforms, there are some initiatives for legal changes in isolated or specific areas. For instance, a National Water Framework Bill drafted by the Union Ministry of Water Resources in 2016 contains provisions for an overarching national scale legal framework with principles for protection, conservation, regulation and management of water as a vital and stressed natural resource. Besides, in accordance with the National Water Policy (NWP) of 2012, the union government has also prepared and circulated a River Basin Management Bill in 2018 and also passed in 2019 both the Inter-State River Water Disputes (Amendment) Act and the Dam Safety Act. These proposals and acts have

considerable implications, both for the water law regime and for the water policy and water organisational domains.

Besides the legal aspects directly connected with the water sector, legal provisions related to agriculture, land, forest and environment including water quality and pollution, also have significant implications for the legal dimensions of water institutional structure. Since most of the water-related legal provisions were enacted in the past during an era of water surplus, they are not obviously suitable to meet the challenges of the current era characterised by increasing water scarcity and water conflicts among users, uses, sectors and regions. While it is true that there were periodic changes in some of these existing water-related legal provisions, especially during the post-independence period, they are too weak and marginal to enable the development of a strong enough legal system capable of meeting both the emerging and future challenges within the water sector. While water law covers a wide area, the review here focuses only on a few but key aspects that have the most immediate implications for the overall functioning and performance of both water institutions and the water sector.

6.2.1.1 Inter-governmental Responsibility

Inter-governmental responsibility is an important legal aspect specifying the respective domains and responsibilities of the different governance layers within the water sector. The legal provisions in this respect are derived from the overall constitutional division of powers between union and state governments, as provided in the Indian Constitution of 1952.[33] As per Entry 17 in the State List under Seventh Schedule of the Constitution, it is the states that have the legal, policy and administrative jurisdictions over water resources found within their borders. However, the powers of the states are subject to Entry 56 in Union List that allows the union government to regulate and develop inter-state rivers and river valleys, especially when this is expressly declared by Parliament as a matter of public interest. The union government also has regulatory roles in the water sector vide Article 252 related to inter-state water projects as well as in terms of the Forest Conservation Act of 1980, which requires the states to get clearance from union government for executing ecologically sensitive water projects.

More importantly, the union government also has an important role in resolving inter-state water disputes as per the provisions under Article 262 of the Constitution.

It is in pursuance of this Article that the Parliament has enacted the Inter-state Water Disputes Act of 1956, and it is under this Act that a number of tribunals were set up to resolve water disputes among the states.[34] Since the Act has failed to specify the authority that will implement its decision and the time limit for tribunal decision, it was amended twice: first in 1980 for authorising the union government to establish the implementation authority, and then, in 2002 to specify a six-year time limit for tribunal decisions (Salman, 2002; Richards and Singh, 2002). In 2019, another bill was also introduced to add clarity and improve the effectiveness of water tribunals. Besides these legal provisions, the union government can also acquire legislative powers on water when two or more states desiring to have uniform water legislations request it after getting due approval from their respective assembly (Jacob and Singh, 1972).

Despite these legal provisions as well as other administrative and financial leverages of the union government, the final legislative powers are still with the states. While this arrangement is good to address state-specific concerns, there are also serious problems with the current division of power in the water sector that constrains the union government from having a more proactive role in water matters. As a result, the union government, even when it is politically strong, is unable to have the level of impact required to initiate and guide institutional reforms within the water sector both at the national and state levels. To be true, such an inability of the union government can be explained as much by constitutional provisions as by political risks in getting embroiled in highly sensitive inter-state water conflicts.

6.2.1.2 Water Rights

The issue of water rights as a mechanism for allocation and accountability assumes policy importance with increasing water scarcity and conflicts — both at the macro level of regions and sectors, and at the micro level of communities and individual users. Unfortunately, India does not have any explicit legal framework for specifying practicably enforceable water rights, even though various acts have a basis for defining some form of rights for both surface and sub-surface water resources. For instance, even as early as the British period, legislations enacted in India during 1859-77 have recognised customary water rights of individuals and groups. However, a radical shift occurred with the Easement Act of 1882 that made all rivers and lakes the absolute right of the state.[35] While state's absolute rights can affect the develop-

ment and managerial aspects of water, from the perspective of water use, it is actually the *de facto* control over water by actual users at the ground level that is more important for water allocation and use.

Individual rights to both surface water and groundwater are recognised, but only indirectly through land rights. For instance, as per the 'dominant heritage' principle implied in the Transfer of Property Act IV of 1882 and the Land Acquisition Act of 1894, a land owner can have a right to groundwater, as it is considered as an easement intrinsically connected to the dominant heritage, that is, land.[36] In the case of canal water, on the other hand, the rights for its access are limited only to those owning or having access to land located within the canal command areas. But these rights are only use rights, not ownership rights, because irrigation acts prevent moving canal water to areas outside canal commands. Under conditions of unequal land ownership and income pattern, the legal provisions of linking the access to groundwater and surface water indirectly with land ownership tend to turn the *de facto* control of over water resources essentially to the better endowed persons, accentuating and perpetuating rural inequality (Saleth, 1996; Kumar and Saleth, 2018).

The Model Groundwater (Control and Regulation) Bill of 1992, which was formulated and circulated by the union government for the consideration of the states, though postulates a kind of groundwater permit system, fails to set withdrawal limits (Government of India, 1992a). While the bill did induce some legal initiatives in states like Karnataka, Maharashtra and Tamil Nadu, it has not received any serious consideration from other states. Even though the bill was circulated again among the states in 1997 and 2002 with some notable revisions, it was not successful in inducing any other states to adopt the same or consider it as a basis for developing the framework for groundwater regulation.

Recently, another bill, known as the Groundwater (Sustainable Management) Bill of 2017 was drafted by the Ministry of Water Resources [subsequently renamed in as Ministry of Water Power (or *Jal Sakthi*) in 2019] and circulated the same among states for its possible adoption with suitable adjustments. Notably, this bill integrates recent legal developments, especially the decentralisation reforms initiated in the 1990s, recognition of water as fundamental right and regulation within a public trust framework (Cullet *et al.,* 2011; Cullet, 2018). While this and other initiatives are sig-

nificant, they are not capable of addressing the core requirements for developing the kind of water rights-based legal system that is actually required for sustainable development and use of water resources in India. As a result, the control over water at the ground level is governed by a *de facto* system of rights as determined by factors such as land ownership, farm size and its location, the depth and number of wells, pumping capacity and economic power (Saleth, 2017).

6.2.1.3 Accountability Provisions and Mechanisms

The two-way process of accountability, that is, the individuals' accountability to each other and to the community or society, and *vice versa* could not be operationalised until a legal rights system is defined in the first place (Singh, 1992). When the law defines individual water rights, it in effect defines not only the legal boundaries but also the physical and economic boundaries of each individual's acts and their effects on others in the context of water use. By relating rights with duties, such boundaries could be legally handled with a reasonable level of quantification. The individually defined volumetric water rights system, for instance, helps to trace externalities, assign payment responsibilities, minimise inter-personal conflicts and achieve the legally grounded notion of two-way accountability.

Equally important is also the issue of accountability of executives and officials to the state and to the people. As most irrigation and water-related acts in India 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 evident in penal codes and other civil/criminal procedures (Singh, 1991). While some of these provisions can be used to penalise users for acts such as non-payment of water charges or illegal water diversions, there are no corresponding provisions for penalising officials for their failure to supply water at the right time or in the required quantity. The poor recovery of water charges and illegal diversions and uses of water observed widely across the country clearly suggest that these penal provisions against users are ineffective partly due to the practical problems involved in their monitoring and enforcement and partly due to their political implications. As a result, the penal provisions are hardly used in practice as instruments to enforce accountability.

Although legal provisions are necessary to infuse accountability and responsibility, they are not sufficient as their operational effectiveness depends on the kind of accountability mechanisms postulated within water laws. The accountability mechanisms currently available are both formal such as the statutory, legislative and judiciary-based mechanisms as well as informal such as the decentralised, local and people oriented mechanisms (Devi, 1992; Cullet, *et al*., 2011). Of them, while the formal mechanisms are costly in terms of both money and time, the informal mechanisms such as water user associations (WUAs) and stakeholder-based basin organisations are more accessible and responsive. As such, user-based mechanisms are better to ensure accountability and dispute resolution quickly, that too with least financial and social costs.

6.2.2 Water Policy

Water policy relates to the declared policy statements as well as the intended approaches of the union and state governments for water resource planning, development, allocation and management. It includes statements not only on the overall policy framework but also on specific policy issues such as project selection, water pricing and cost recovery, user participation and private sector involvement. Notably, since both the general and specific policies within the water sector are also influenced often by other sectoral policies related to agriculture, public finance and basic needs, the former cannot be dealt with in isolation of the latter. For instance, the need for attaining food self-sufficiency and consolidating the productivity gains from the Green Revolution has led to the implementation of large irrigation projects, rural electrification programmes and liberal credit policies. Moreover, political considerations, macroeconomic necessities and environmental concerns including natural calamities (example, floods and drought) also have a strong influence on water sector policies. Here, the review covers only a few key aspects underlying the water policy component of water institutions.

6.2.2.1 National Water Policy

Although the need for a national water policy was felt for quite some time, the immediate factor that prompted the National Water Policy (NWP) of 1987 was the unprecedented drought of 1987. It is for this reason that the NWP focused mainly on the use efficiency and conservation of water, particularly in the agriculture sector. For instance, the main goal of the NWP was to promote "conjunctive use of water from sur-

face and sub-surface sources, supplemental irrigation, and water-conserving crop pattern and irrigation and production technologies" (Government of India, 1987). It has called for raising the canal water rates and promoting user participation in canal management. While the diagnosis of the NWP is right, its prescriptions fail to address the serious economic and institutional vacuum within which the water sector is operating. Although the NWP has recognised the need to limit individual and collective water withdrawals, it has failed to identify the institutional mechanisms necessary for defining and enforcing such physical limits. Unfortunately, the NWP declared in 2002—being almost a repeat of its earlier version—has also failed to address the major economic and institutional issues. But this policy is still significant because of its explicit recognition of the role of private sector participation and the need for a paradigm shift from water development to performance improvement (Government of India, 2002). On similar lines, several states (like Andhra Pradesh, Karnataka, Madhya Pradesh, Tamil Nadu and Uttar Pradesh) have also come out with their own water policy statements, displaying more or less the same flaws of their national level counterpart.

The NWP declared in 2012 (Government of India, 2012) is significant for many bold and progressive ideas. It emphasised water both as human rights and also as an economic resource to be managed with equity and efficiency. It argued for developing a National Water Framework Law, establishing a Water Regulatory Authority, empowering water user associations (WUAs) with legal powers and block or group water rights system, recognising water as an economic good, setting priority for water for drinking and food security, requiring minimum flow for ecological purpose, and benchmarking water uses for water footprints and water auditing. While the system of volume-based block water rights managed by WUAs are being experimented in selected irrigation projects in Maharashtra, the other ideas proposed in the NWP of 2012 are yet to be translated into any practical programmes with observable ground level impacts.

Meanwhile, the union government plans to come out with a new NWP. A committee for this purpose has already been set up in November 2019. While the new NWP is yet to the released, considerable debate is ongoing about its focus and coverage. The proposed policy appears to focus more on issues such as river restoration, water quality and national level policy framework than on core issues such as accountability, water rights and organisational reforms. However, it is clear that a National Bureau of Water Use Efficiency is likely to be set up. Although national level

perspective on water matters is important, incorporating state and local level considerations is also crucial. Since the cooperation of states is indispensable for making necessary changes both in constitutional division of responsibility and in state water laws, building consensus among states within the constitutional framework is an essential precondition for an effective and successful translation of NWP into actually implementable programmes with ground level impacts.

6.2.2.2 Project Selection Criteria

During the pre-independence period, since the British treated irrigation projects as purely a commercial proposition or revenue-yielding activity, project selection policy was based on the economic criteria of internal rate of return (IRR).[37] After independence, however, there was a shift in approach. Instead of treating them as purely commercial propositions, irrigation projects were viewed as instruments for fostering socio-economic development, especially by augmenting farm income, employment and food production. Consequently, the IRR, which was initially lowered to 3.9% in 1949, was altogether abandoned in 1958, and in its place, a rather liberal benefit-cost ratio (BCR) was used as the project selection criterion. While the Gadgil Committee of 1964 recommended a BCR of 1.5, the Irrigation Commission of 1972 (GOI, 1972) allowed a BCR of just 1 for projects in drought-prone areas.

Notably, in 1983, following the suggestion of the Public Accounts Committee, the BCR was replaced by the IRR as the project selection criterion and the accepted IRR was 7% for projects in drought-prone and water-scarce areas and 9% for others. Admittedly, the reinstatement of IRR is welcome. But the minimum levels stipulated are far lower than the prevailing interest rates. Besides, there are also cases where this project selection criterion was seldom applied or its requirements were often compromised. As a result, although there are clear policies for project selection, they are not strictly applied in the case of most water projects for obvious political and socio-economic reasons. Since water is the dividing line between prosperity and poverty in many contexts, applying strict economic criteria for water development is clearly difficult in such extreme situations.

6.2.2.3 Cost Recovery Policy

Regarding cost recovery in the context of irrigation projects, successive finance commissions (since the Fifth Finance Commission) have insisted on the recovery of

not only the full operation and maintenance (O&M) expenses but also a proportion of the interest on irrigation investment. While the Fifth Finance Commission suggested this proportion to be 2.5%, the two subsequent Finance Commissions have lowered this to just 1%. Although the Eighth and Ninth Finance Commissions were satisfied with just the recovery of the O&M costs, the Tenth Finance Commission reverted back to the stance of the Sixth and Seventh Finance Commissions, that is, the recovery of full O&M costs plus 1% capital costs.[38] Unfortunately, such a cost recovery policy, despite its widespread approval, was never implemented as it involved not only an upward revision in water rates but also a radical change in the method of determining them. With the continuation of unreasonable cost recovery policies, water rates remain too low to recover even the operating costs of canal irrigation systems. Table 9 provides data on the level of investment, working expenses and gross receipts in major and medium irrigation projects during 2000-14.

Table 9: Cost Recovery Status of Major and Medium Irrigation Projects: All-India Level during 2000-14

(Rs in billion)

Year	Capital Outlay		Working Expenses (WE)	Gross Receipts (GR)	Cost Recovery (GR as % of WE)
	During the Year	End of the Year			
2000-01	68	782	88	8	8.6
2001-02	76	858	82	7	7.92
2002-03	102	960	88	8	8.86
2003-04	145	1,105	63	10	16.65
2004-05	177	1,284	70	13	18.01
2005-06	220	1,504	82	12	14.54
2006-07	265	1,690	96	15	15.67
2007-08	309	1,999	119	20	17.19
2008-09	362	2,361	122	19	15.61
2009-10	321	2,682	149	24	15.76
2010-11	323	3,005	174	26	14.96
2011-12	339	3,344	187	39	20.8
2012-13	361	3,709	213	31	14.65
2013-14	366	4,052	219	43	19.84

Note: Some figures in columns (3) and (4) remain incompatible due to state level accounting adjustments.

Source: Central Water Commission (2017).

As can be seen, cost recovery in terms of the percentage of working expenses covered by gross receipts, though gradually increasing over the years, still cover just about 20% at the national level. Across states, the relative cost recovery status displays considerable variations (Central Water Commission, 2017). For instance, for the 2013-14 period, cost recovery has been less than 7% in states such as Andhra Pradesh, Bihar, Kerala, Tamil Nadu, Punjab, and West Bengal, whereas the same had a range of 17 to 26% in states such as Madya Pradesh, Maharashtra, and Uttar Pradesh. In contrast, while Orissa had a recovery rate of 81%, states such as Chhattisgarh, Jharkhand, and Gujarat showed a recovery rate of more than 100% of the working expenses. Thus, barring a few cases, cost recovery in most states is very low, requiring radical improvement through more realistic water rates and other charges.

6.2.2.4 Water Pricing Policy

While poor financial performance led to the recognition of the need for revising water rates, widespread political pressures led to a delay in their implementation. The main reason why farmers resist higher water rates is the general perception of water as a public good. But the 1972 Irrigation Commission has articulated, for the first time since independence, the private good characteristics of canal water. The commission has also suggested that water rates have to be revised to cover at least 5% of gross income in the case of food crops and 12% in the case of commercial crops (Government of India, 1972). Despite the recommendation of this and several subsequent commissions and committees, the water charges actually recovered from farmers continue to form only a fraction of both the actual O&M costs and the water productivity levels (that is, the difference between the productivity levels of irrigated and rainfed lands). For instance, recovered water charges, as a proportion of O&M costs, vary from 4.02% in Uttar Pradesh to 73.33% in Orissa, whereas the same as a proportion of water productivity vary from 0.28% in West Bengal to 5.19% in Maharashtra (Government of India, 1992b).

While the cost recovery role of water pricing policy was emphasised by many expert groups and statutory committees, the Jakhade Committee of 1987 has underlined the resource use efficiency function of water pricing policy. The Committee has suggested that if the method and level of water rates are such as to capture and convey scarcity value of the resource, they can both induce efficiency and ensure full cost recovery at the same time. Since such pricing is not possible for various practi-

cal and political reasons, subsequent committees settled for water rates that will, at least, recover the full operational costs (Government of India, 1992b). But the actual water rates observed in most states (with the exception of states such as Chhattisgarh, Jharkhand, Gujarat and Orissa) are not able to recover even full operational costs (Central Water Commission, 2019).

The currently prevailing water rates for flow or canal irrigation across states are shown in Table 10. The range of water rates reported for different states captures crop and project-specific variations in water rates within each state. Water rates have remained unrevised for long in most cases. Only states such as Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Orissa and Punjab have revised water rates during 2002-2014. As a result, water rates in most states are too low to expect any effect

Table 10: Prevailing Water Rates for Flow Irrigation across States-2021

Sl. No.	States	Rates (Rs/ha)		Effective Since	Status as on
		Minimum	Maximum		
1	Andhra Pradesh	148.20	1,235.00	01-07-1996	24-11-2011
2	Assam	150.00	751.00	30-03-2000	12-03-2014
3	Bihar	74.10	370.50	14-11-1995 & 26-11-2001	08-02-2010
4	Chhattisgarh	123.50	741.00	15-06-1999	22-10-2014
5	Gujarat	160.00	300.00	01-01-2007	18-11-2011
6	Haryana	24.70	197.60	27-07-2000	04-04-2013
7	Himachal Pradesh	28.17		01-04-2009	03-02-2010
8	Jammu & Kashmir	93.90	2,999.92	01-04-2015	14-02-2014
9	Jharkhand	74.10	370.50	14-11-1995 & 26-11-2001	13-01-2009
10	Karnataka	37.05	988.45	13-07-2000	20-05-2013
11	Kerala	37.00	99.00	18-09-1974	06-02-2009
12	Madhya Pradesh	50.00	960.00	01-11-2005	12-04-2013
13	Maharashtra	238.00	6,297.00	01-07-2003	02-04-2009
14	Odisha	28.00	930.00	05-04-2002	05-01-2010
15	Punjab	123.50		12-11-2014	05-03-2015
16	Rajasthan	29.64	607.62	24-05-1999	18-02-2014
17	Tamil Nadu	2.77	61.78	06-11-1987	04-03-2002
18	Uttarakhand	35.00	474.00	18-09-1995	18-12-2006
19	Uttar Pradesh	30.00	474.00	18-09-1995	05-03-2013
20	West Bengal	37.06	123.50	06-04-1977	03-02-2010

Note: Bihar and Jharkhand revised water rates for wheat crops in 2001, but the rates for other crops remained unrevised since 1995.

Source: Central Water Commission (2021).

either on cost recovery or water use decisions. As can be seen from Table 10, the range of water rates across states varies from Rs. 3/ha to Rs. 62/ha in Tamil Nadu, and from Rs. 238/ha to Rs. 6,300/ha in Maharashtra. Although some states (like Andhra Pradesh, Karnataka, Madhya Pradesh and Tamil Nadu) have revised water rates up to three times, the revised rates have failed to play their dual roles, as the bases rates are too low. In 2019, although Punjab has increased water rates, such increase is applicable only for non-irrigation uses of water. Since the increases in water rates effected by most states are too low to perform even their cost recovery role, they cannot be expected to have any significant influence on water allocation and use efficiency.

In any case, the levels of water rates, though important, are only necessary but not the sufficient conditions for an effective water pricing policy. Water rates under current water pricing policy cannot be expected to play the dual roles, unless the rate revisions form part of institutional and technical arrangements needed for establishing a system of water rights, volumetric distribution, group-based allocation and local management (Government of India, 1992b; Saleth, 1996; Palanisami, Reddy, and Malik, 2015). While volumetric allocation is not a new idea,[39] introducing volumetric pricing system, will not be that easy given the myriad financial, technical and practical challenges involved in installing water metering devices essential for volumetric pricing, especially on a national scale. More than these technical conditions are also the legal and organisational preconditions needed to specify and enforce a clear water rights system through effectively functioning local organisations such as WUAs and basin level stakeholder bodies (Saleth, 2017; Chaudhuri and Roy, 2019).

6.2.2.5 User Participation and Privatisation

The policy towards user participation in irrigation management has evolved since the initiation of the Command Area Development (CAD) programme in 1974. The CAD programme was implemented to expand the utilisation of the already created irrigation potential under various irrigation projects by leveraging farmers' support. User participation under the CAD programme was ephemeral and ineffective due to *ad hoc* attempts and paternalistic attitude of the bureaucracy. But the financial crisis and physical deterioration of irrigation systems have forced the irrigation agencies to consider farmer groups as indispensable partners in irrigation management. Having recognised the role of farmer groups in outlet level water allocation, fee collection and system maintenance, the policy of promoting user participation was formulated and

implemented across almost all major states in the country, though with varying levels of progress and field level impact (Brewer *et al.,* 1999; Badatya and Mohapatra, 2010; Gandhi *et al.,* 2020).

Although user participation received policy attention since 1974, the major thrust for this policy occurred with the large-scale irrigation management transfer (IMT) programme of Andhra Pradesh and Madhya Pradesh in 1997 and 1999, respectively. In undivided Andhra Pradesh alone, 10,000 WUAs were created covering almost the entire surface irrigated area of 4.8 mha (Badatya and Mohapatra, 2010). Under its Farmers' Participation in Irrigation Management Act of 1999, Madhya Pradesh has transferred the outlet management responsibilities of all surface irrigation schemes to 1,470 legally constituted and formally elected WUAs. Of them, 466 were in major, 158 in medium, and 846 in minor schemes. After seeing these two big-bang reforms and their impact, other states have also subsequently implemented the IMT programme with suitable adaptations and by enacting necessary legislations. In many new and up-coming projects (such as Narmada and Sardar Sarovar projects), it is also categorically specified that water will be distributed not to individual farmers but only to organised WUAs. Today, WUAs are not only growing but also operating beyond canal commands, especially in groundwater areas with notable success despite the challenges.

The Table 11 shows the state-wise pattern of WUAs and their area coverage. Most of the WUAs are concentrated only in few states. For instance, just six states such as Andhra Pradesh, Gujarat, Haryana, Orissa, Tamil Nadu and West Bengal, account for over 70% of WUAs. Similarly, only eight states such as Andhra Pradesh, Chhattisgarh, Gujarat, Karnataka, Maharashtra, Orissa, Rajasthan and Tamil Nadu account for about 75% of area coverage. Despite such an uneven development across regions, the WUAs did have considerable impact in terms of cost recovery, water saving, additional irrigation and improved agricultural performance. Results from Gujarat and Madhya Pradesh show that WUAs are instrumental for a 20% water saving. In Madhya Pradesh alone, thanks to an improved water use efficiency effected through IMT, irrigated area is reported to have increased from 6 lakh ha to 30 lakh ha during 2009-14. The IMT is also slated as the main source for the Gujarat agrarian miracle with a 11% annual growth of agriculture during 2000-10 (Central Groundwater Board, 2019). Recent research on the subject has also documented similar results, though varying, in other contexts (Reddy, 2009; Bassi *et al.,* 2010; Saleth and Amarasinghe, 2010).

Table 11: Water Users Association: State-wise Distribution and Area Coverage - Circa 2014

Sl. No.	Name of State	WUAs Formed		Area covered		Area/WUA
		Number	Share (%)	('000 ha)	Share (%)	(ha)
1	Andhra Pradesh	10,884	12.01	4,179.25	23.42	383.98
2	Arunachal Pradesh	43	0.05	10.97	0.06	255.12
3	Assam	847	0.93	95.02	0.53	112.18
4	Bihar	80	0.09	209.47	1.17	2,618.38
5	Chhattisgarh	1,324	1.46	1,244.56	6.98	940.00
6	Goa	84	0.09	9.54	0.05	113.57
7	Gujarat	8,278	9.14	662.99	3.72	80.09
8	Haryana	8,490	9.37	1,616.27	9.06	190.37
9	Himachal Pradesh	1,173	1.29	140.56	0.79	119.83
10	Jammu and Kashmir	383	0.42	32.79	0.18	85.62
11	Karnataka	2,787	3.08	1,418.66	7.95	509.03
12	Kerala	4,398	4.85	191.22	1.07	43.48
13	Madhya Pradesh	2,062	2.28	1,999.64	11.21	969.76
14	Maharashtra	2,959	3.27	1,156.22	6.48	390.75
15	Manipur	69	0.08	29.40	0.16	426.09
16	Meghalaya	159	0.18	20.17	0.11	126.86
17	Mizoram	390	0.43	18.23	0.10	46.74
18	Nagaland	24	0.03	3.44	0.02	143.33
19	Orissa	20,794	22.95	1,757.71	9.85	84.53
20	Punjab	4,845	5.35	610.29	3.42	125.96
21	Rajasthan	1,994	2.20	1,144.45	6.41	573.95
22	Tamil Nadu	7,725	8.53	935.66	5.24	121.12
23	Uttar Pradesh	802	0.89	318.69	1.79	397.37
24	West Bengal	10,000	11.04	37.00	0.21	3.70
	Total	90,594	100.00	17,842.21	100.00	196.95

Notes: (a) The above data are compiled from state level information. Reported number of WUAs in cases such as Bihar relate to federated WUAs at main canal levels.

(b) While WUAs are not reported for Sikkim and Tripura, those for Telangana, Jharkhand and Uttarakhand are included in Andhra Pradesh, Bihar and Uttar Pradesh, respectively.

Source: 1. Ministry of Water Power (undated): "Status of participatory irrigation management (PIM) in India policy initiatives taken and emerging issues", Accessed at http://jalshakti-dowr.gov.in/sites/default/files/CADWM_Status_of_PIM.pdf

2. Badatya and Mohapatra (2010).

Regarding private sector participation in water sector, the inevitable shift in policy was prompted essentially by the growing magnitude of financial crisis in the public irrigation system due to the obvious factors of declining irrigation investment and poor financial performance of canal water projects (Saleth, 1999; World Bank, 2011 and 2014). The New Economic Policy of 1991, which itself came as an immediate response to the then prevailing economic crisis, has also created a tremendous pressure on the water sector (as well as other economic sectors) to improve its fiscal performance and also to explore alternative financial sources for funding water projects. Notably, the Union Ministry of Water Resources had also constituted a high-level committee in 1995 with a specific mandate to look into the legal, economic and technical questions related to the privatisation of public irrigation projects and the promotion of private investment in the water sector. The report submitted by this committee had favoured a gradual, selective and stage-wise process for the privatisation of irrigation sector (Government of India, 1995).

At the state level, there has been a more realistic and practical approach towards water privatisation policy. For instance, Madhya Pradesh has constituted a committee to look into the issue of sharing the primary benefits (water supply) and secondary benefits (power generation, tourism, aquaculture and horticulture) between the government and the private parties involved in project construction and management. This committee has recommended that the primary benefits should be retained by the government, but the secondary benefits can be given to private investors (Government of India, 1995). Maharashtra, on the other hand, has gone a step further in terms of offering better incentive for private investors by allowing them a 6% share in the total water storage in addition to the full rights on all the secondary benefits from the projects (Saleth, 1997). The NWP of 2002 and 2012 have also encouraged the policy of promoting private corporate sector as a potential partner for water resources development and management.

Recently, the government has come out with a list of potential opportunities for private sector investment in various sub-sectors of water and sanitation. These opportunities along with their expected investment levels are shown in Table 12. Although there is an urgent need and considerable scope for private investment in the irrigation sector, most private investment that has occurred so far are confined essentially to urban water supply sector. Also, such private investment in urban water supply

Table 12: Opportunities for Private Sector Investment in Water and Sanitation Sectors: 2021

Sector	Opportunities/ Projects	Investment Potential ($ billion)
Irrigation Sector	806	176.28
Water Supply and Treatment	499	102.97
Sewage Treatment and Disposal	397	9.26
Solid Waste Management	135	2.16
Total	1,837	290.67

Source: Department for Promotion of Industry and Internal Trade, India Investment Grid, Ministry of Commerce, Government of India. Accessed at https://indiainvestmentgrid.gov.in/sectors/water-and-sanitation

takes the form of public private partnership (PPP) mode. These PPP projects are not only few but also growing only marginally since the 1990s. As of 2011, there were 15 PPP projects. The service coverage of these projects and other forms of institutional arrangements involving private sector has increased from about 0.3 million people in 2003 to over 8.5 million people by 2011 (World Bank, 2011 and 2014). As to the overall impacts of this institutional arrangement, the results can be said to be at the most only mixed.

6.2.3 Water Organisation

Water organisation covers the administrative, organisational, financial and managerial structures, including the regulatory apparatus, conflict resolution mechanisms and training and capacity building, which are directly connected with various aspects of water resources planning, development, allocation, use and management. Despite considerable variations in the names and structures of water administration across states, there are a few common features such as their centralised and bureaucratic character, dispersed organisational responsibilities and weak functional linkages. Some of these shared traits become apparent, as we review the overall structure of water administration or organisation both at the national and state levels. The review here, as in the case of other two components of water institutional structure, will focus only on a few selected organisational elements related particularly to spatial layers of water organisations, financial and management structures, regulatory arrangements and conflict resolution systems. Although some of these aspects seem to relate to legal and financial issues, the focus here will be more on their organisational functions.

6.2.3.1 Organisational Framework

The general organisational framework of the Indian water sector can be briefly described by highlighting the key actors playing different roles both at the national and state levels. The Union Ministry of Water Power (formerly Ministry of Water Resources), which has evolved from the erstwhile Department of irrigation under the Union Ministry of Agriculture, is the national organisation that is responsible for the overall planning and management of the water resources in the country. The agencies such as Central Water Commission (CWC), Central Groundwater Board (CGWB) and the National Water Development Agency (NWDA) — all under the Ministry of Ministry of Water Power — provide the overall technical and policy support in the realm of surface water, groundwater and water planning and development at the national level. Corresponding ministry or department with similar organisational structure exists for each state to carry out these functions at state level.

The research and training supports are provided by organisations such as the Water and Land Management Institutes (name differs in some states), agricultural universities and other research institutions located across states. In the past, the erstwhile Planning Commission used to provide project clearance and approve financial allocation to various water projects in different states at the national level. But now these functions are spread across various bodies such as the National Institution for Transforming India Commission (NITI Aayog), Ministry of Water Power, etc. Other union government agencies influencing the water sector in one way or the other include the ministries of agriculture, environment and forests, and housing and urban development.

There are also important organisational arrangements to achieve inter-state and union-state policy, technical and operational coordination. These include national level policy organs, technical agencies and operational, executing and monitoring bodies. National level organs include the National Water Resources Council (NWRC) set up in 1983 and the National Water Board (NWB) set up in 1990. The NWRC is an important policy organ in the Indian water sector, as this apex body is chaired by the prime minister, and includes the union minister of water resources, the chief ministers and the lieutenant governors of all states and union territories. It is the NWRC that formulates and declares the national water policy. The NWB—considered as the executive arm of NWRC—is chaired by the secretary of the MOWR,

and includes the chief secretaries of all the states/union territories, secretaries of concerned union ministries as well as the Chairman of CWC. It is the NWB that is responsible for monitoring and reporting on the progress in operationalising the national water policy.

Technical agencies include national organisations with state/regional level representations such as CWC, CGWB and NWDA. Each of these has responsibilities for different functions and water sub-sectors such as surface water, groundwater and water planning and development. Besides, for water-related data collection and dissemination, the National Water Informatics Centre has also been established as part of the National Hydrology Project. The operational bodies like river management boards, which were created under the River Boards Act of 1956, are charged with the responsibility of coordinating water allocation among concerned states in the context of few important inter-state rivers.[40] There are also river management boards or authority for individual basin level such as the Godavari River Management Board and Krishna River Management Board constituted as part of the Andhra Pradesh Reorganisation Act of 2014. Unlike most other river boards, the Cauvery Water Management Authority (along the Cauvery Water Regulation Committee) was constituted in 2018 at the instance of the Supreme Court. Although these boards or authorities are designed to be autonomous, in practice, they are highly susceptible to interferences and influences.

With the government change in 2014, many of the existing water-related organisational arrangements are being reviewed and reconsidered for possible recasting. Apart from changing the names and reorganising, or merging some of the existing ministries and other organisational arrangements, there are not many substantive changes, except for a few notable ones. One of them relates to the National Water Framework Bill of 2016, which was prepared by the then union Ministry of Water Resources following the recommendations of the NWP of 2012. This proposed draft Bill is currently under circulation among states for their comments. So far, only nine states (that is, Gujarat, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh) have responded with comments on the draft Bill. While not much development has happened on this Bill till now, it seems the union government will be trying its best to make it a law as early as possible.

Another notable development has been the constitution of the Committee on Restructuring the CWC and CGWB at the instance of the Ministry of Water Resources in 2016. This Committee, which has taken a largely macro perspective of water administration at the national level, has recommended the creation of a National Water Commission (NWC) as the apex facilitation organisation with an overarching nationwide mandate for water policy, data and governance. Notably, as per the organisational design proposed by the committee, the NWC will subsume all current water-related organisations such as CWC and CGWB, as well as a few additional organisations proposed to be created anew under one umbrella, that too, as an organ under the administrative and financial control of the Ministry of Water Resources (Central Groundwater Board, 2016). While the centralisation tendencies underlying these recent proposals can be appealing as an architecture for unified control at the national level, they may be counter productive and self-defeating when dealing with the ground level realities of water resource management at the state level (Kumar *et al.,* 2016). Also, since the autonomy of NWC is critical for its appeal as a neutral body to all states, it should be independent from direct ministerial control.

Despite the diversity of organisational arrangements at the national and river basin levels, the actual implementation at the ground level occurs through state level water organisations. The state level water administration is known variously as the Irrigation Department, Public Works Department and Water Resources Department in different states. It is these state level organisations that are responsible for the planning, construction and maintenance of water projects and also for the development, delivery and management of water supply till the farmgate. The administrative systems responsible for water pricing and cost recovery also differ across states partly due to historical reasons and partly for administrative convenience.[41] The main department handling the water sector also has its own research and training facilities in some states. Despite differences, water administration in all states share the same limitations, that is, diffused administrative and functional responsibilities inapt for developing an integrated approach conducive for an efficient use of water resources.

Since water management responsibilities are often with ministries dealing with public works, internal transport or public health, they are clubbed with activities such as road construction and port management. But activities that are actually to

be aligned or integrated (example, surface water and groundwater management and irrigation and domestic water supply) are often dispersed across departments or ministries. This problem is addressed only partially by some organisational reforms (including river basin organisations - RBOs) undertaken in some states such as Andhra Pradesh, Haryana, Tamil Nadu, Orissa, Madhya Pradesh and Uttar Pradesh. Despite the creation of RBO in many states, for all practical purpose, the spatial structure of water administration in most states is still based on administrative boundaries and projects rather than on any well-defined hydro geological boundaries.

On water quality, pollution control boards operating usually under the ministry of environment and forests, both at the national and state levels, have the responsibility for water quality aspects. Local governments such as municipalities and *panchayat* unions also play an important role in drinking water supply, as do the user and stakeholder groups in the irrigation sector. In terms of observed organisational reforms, there are many noteworthy trends across states. As discussed already, the most important trend in this respect relates to IMT programme because of its implications for changing lower echelons of water administration that is close to the point of actual water allocation and use. Besides the creation of WUAs under IMT programme, some notable changes can also be observed at the middle level management structure of water organisations, which are important for inter-sectoral and inter-regional water allocations.[42] Though notable and significant, these organisational changes cannot be sufficient to break the dominant bureaucratic character of water administration. As far as the Indian water sector is concerned, therefore, organisational reforms continue to remain as an unfinished agenda.

6.2.3.2 Financing and Management

Our focus here is not on financing and management *per se*, but rather on key organisational issues surrounding them. Since water is a state subject, it is the states that are responsible for financing, cost recovery and management of all irrigation and water supply-related activities within their respective jurisdictions. They finance water development schemes by their own revenue, their share in centrally collected revenue proceeds and borrowings from financial and funding institutions both within and outside the country. In recent years, as noted earlier, many states are trying to mobilise funds from various forms of PPP arrangements for funding urban water projects. Besides, for developing larger water development projects, some states such

as Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra and Uttar Pradesh have also tried to mobilise financial resources from the private corporate sector as well as from the general public through an innovative practice of issuing deep discount water bonds.

Notably, Karnataka and Maharashtra have also created autonomous corporations for the specific purpose of tapping public funds for water development projects with notable success (Saleth, 1999). In 1994, Karnataka has formed the Krishna Bhagya Jal Nigam Limited (KBJNL) under the Companies Act for mobilising public funds for developing the Upper Krishna project. Thanks to the high return (about 17.5%) and government guarantee, the water bonds issued by the KBJNL during 1995-99 have fetched an unexpected sum of Rs. 23 billion. Similarly, Maharashtra has floated the Maharashtra Krishna Valley Development Corporation (MKVDC) in 1996. It also promised a 17.5% return on water bonds payable half yearly with a maturity period of six years for the first 50% of value and of seven years for remaining value. Besides, water bonds also had an up-front discount of 2.5% on face value. As a result, the first public issue of MKVDC undertaken in July 1996 has fetched a sum of Rs. 4.28 billion against the original target of Rs. 1.5 billion. Encouraged by this response, Maharashtra now has plans to mobilise over Rs. 36 billion through MKVDC over a period.[43]

In addition to its efforts through MKVDC, the Government of Maharashtra is also trying to tap direct investment from the private corporate sector. For instance, in 1996, it invited private bids for 52 irrigation projects worth Rs. 150 billion. On similar lines, the governments of Andhra Pradesh, Gujarat and Madhya Pradesh have also tried to tap the private sector both for construction and modernisation of few water projects (Government of India, 1995). Interestingly, in its Agricultural Policy Resolution of 1995, the Government of Karnataka even indicated its willingness to grant financial autonomy to irrigation department by converting it into a corporation and making farmers co-owners of the irrigation structure with 'water equity shares' (Government of Karnataka, 1995).[44]

With low and declining cost recovery in the water sector, many states will be increasingly forced to rely on private and public sources of funds. This will be more so also due to the declining support from the union government. Although union government plays a significant role in water sector investment through various programmes, including CAD and accelerated irrigation development programmes, its support

is declining over the years. For instance, in the total plan expenditure of the union government, the share of irrigation sector alone has declined from 23% in the 1950s to just 7% in recent years. While state governments can access resources from international and national funding agencies such as the World Bank, Asian Development Bank and NABARD, the available resources will not be sufficient to meet the actual investment needs of their respective water sectors. As a result, states have not only to look for innovative ways to attract external resources but also to undertake financial reforms to raise the level of resources from within the water sector itself.

6.2.3.3 Regulatory and Enforcement Mechanisms

Regulatory and enforcement mechanisms are inter-related, and can be both in *de jure* and *de facto* forms. While India has a relatively sound technical information base and expertise in water-related aspects, their utility at the practical level of regula-tion is extremely limited due to the lack of organisational arrangements necessary for regulation, enforcement and monitoring at the ground level. The top-down approach, which is inevitable in any centralised administrative set up, and the attendant in-ability to tap locally available informal institutional potential (example, water-related local customs, water sharing conventions, and informal monitoring and enforcement mechanisms) constrains effective enforcement of even well-conceived policies.

While well spacing norm prohibits new wells within a radius of 200 meters (m) in most parts of India, the norm can be as high as 680 m in areas with deep tube wells and serious depletion (Shah, 1993). Similarly, there are also depth restrictions, especially for deep tube wells. For instance, in Gujarat, as per the Bombay Irrigation (Gujarat Amendment) Act of 1976 (1979), tube well depth was limited to 45 m, particularly for the Mehsana region. Later, the limit was not only raised to 100 m but also made applicable to most parts of Gujarat. Since these spacing and depth restrictions take effect only when a farmer applies for concessional loan/well permit/electric connection, they restrict mostly the poor farmers (Dhawan, 1990). While a restricted power supply policy provides some regulatory respite, it is of little consequence in the face of large pumps and multiple wells. The effectiveness of regulations based on power tariff and supply policies is severely undermined both by the availability of diesel pumpset options and also by the inelastic nature of power demand to tariff changes in certain range.[45] Groundwater markets, which are essentially *de facto* in nature, are found to improve efficiency and equity in water use (Shah, 1993). But they could, nevertheless,

accentuate inequality and aquifer depletion under the current legal and institutional regimes without water rights or quotas by reinforcing the *de facto* control of groundwater by resource-rich farmers (Saleth, 1996 and 2017; Mukherjee and Biswas, 2016; Kumar and Saleth, 2018).

In the case of surface water resources, neither the usual policies based on water charge/supply manipulation, nor the new ones based on rotational water supply are likely to generate sufficient impact effective enough to enforce discipline in canal water use. The WUAs can certainly enhance cost recovery and improve system maintenance. But they cannot be able to generate incentives powerful enough to induce water users to enhance their water use efficiency, unless they operate within the framework of a legally established but locally managed system of group/individual-specific water quotas.[46] Recent research on volumetric allocation in different resource and regional contexts suggests that an institutional system to define and enforce individual and group level water limits are essential for achieving use efficiency, cost recovery and sustainability goals (Saleth, 1996; Kumar 2005; Kumar and Saleth, 2018; Chaudhuri and Roy, 2019; Parween *et al.*, 2021).

6.2.3.4 Conflict Resolution Mechanisms

Various arrangements exist for resolving conflicts at different levels. Such mechanisms range from tribunals, river management boards and RBOs at regional and basin levels to *panchayats* and WUAs at local and field levels. Water use prioritisation specified in the NWP and implied in the constitution can provide a general framework for resolving inter-sectoral water allocation conflicts. For instance, the constitutional provisions relating to fundamental rights to life (and clean environment) are often used as a basis for assigning top priority for drinking and domestic uses as well as irrigation and ecological water needs. But for a more effective solution, prioritisation needs to go with quantification of entitlements (that is, water rights or quotas), and such quantification should be done within appropriate hydro geological and organisational contexts.

Unfortunately, since the issue of quantification of entitlements is often left to administrative or political decisions, indecisiveness becomes the hallmark in many contexts. However, for the practical establishment of water entitlements—whether for sectors, regions or individual users—the most preferred arrangement requires

both the physical context of river basins or water projects and the organisational context involving stakeholder networks or user groups. In the case of inter-state (or inter-regional) water conflicts, the frequently relied on arrangement in the past involves negotiated agreements for developing and sharing water among the concerned states/regions.[47] But when there are technical or practical difficulties in reaching a negotiated settlement, the concerned parties can rely on the tribunal established by the union government under the provisions of the Inter-state Water Disputes Act of 1956 and its amendments in 1980 and 2002, or approach the Supreme Court.[48] As the pressure for renegotiating existing agreements builds up with the increasing water scarcity and conflicts, the role of tribunal mechanism is likely to increase in the future. Although tribunal awards settle disputes by quantifying the water claims of contesting parties, they do involve a lengthy process to reach a final settlement. Even the six-year time limit specified by the 2002 amendment is too long given the urgency and gravity of water disputes in many cases.[49] Since the implementation of tribunal awards can also be contested in the Supreme Court, it is crucial to provide legal binding to final awards. Although market or negotiation-based arrangements are not tried much in India, there is considerable potential for applying them. States can be encouraged to purchase and sell water either on a payment basis or on a barter basis (that is, exchange of water for power or foodgrains). There are also cases such as the Krishna water transfer for Chennai city for which Tamil Nadu has paid for the entire project costs in advance, which is an implicit payment for water to be received.

Regarding the mechanisms for resolving water-related conflicts at the micro level, there are a few traditional and informal village level institutions (example, tank-level organisations in Tamil Nadu). By rejuvenating these informal institutions as well as by strengthening the formal institutional arrangements such as the *panchayat* institutions and WUAs, it is possible to build a more effective and accessible conflict resolution mechanisms at the grassroots level. However, the middle level conflicts across communities within a river basin or canal system (example, upstream verses downstream users, or head-end verses tail-end users) and those conflicts between irrigation and water supply are still rampant for want of proper forums for resolving differences. The organisational arrangements forming part of the bureaucracy (example, divisional engineer or district collector) not only remain inaccessible for all, but also turn out to be artificial as free expression of mutual concerns becomes difficult.

Basin or system level stakeholders' association involving user groups and officials can be a very useful forum for promoting both conflict resolution and accountability.

6.3 Water Institutional Structure: Micro Perspective

Although colonial policies and post-colonial expansion of government bureaucracy have severely eroded most of the local and indigenous water institutions, India still presents a rich variety of locally managed water-related institutions, especially in water-scarce regions of Bihar, Maharashtra, Rajasthan and Himachal Pradesh (Datye and Patil, 1987; Sengupta, 1993; Keremane *et al.*, 2006). These institutions are in the form of informal customs and conventions for water sharing as well as community-based organisations for allocation enforcement and water management. Although these institutions remain largely independent of formal water institutions and operate only at the periphery of the formal water sector, they can still provide very valuable insights for designing the kind of institutional mechanisms that are needed for filling the organisational vacuum existing at the lower and middle echelons of water management structures. Beside the traditional arrangements, new forms of informal arrangements for sharing water and irrigation service have also emerged in recent years, especially in groundwater regions. These include the rental markets for irrigation assets, groundwater markets and myriad other forms of water-based contracts. As these informal institutions — both the traditional and the emergent ones — have significant implications for the operation and performance of formal institutions, they deserve to be reviewed.

6.3.1 Localised Institutions

Despite the fact that the legal system in India has not formally specified any water rights system, there are evidences for the operation of rudimentary water rights systems capable of being developed into a formal water rights system. Informal water rights — both for individuals and groups — have existed in India since ancient times (Siddiqui, 1992), and continue even today, *albeit* in a much weaker form, in many tank irrigation systems of south India (Vani, 1992). Even the Britishers did recognise customary water rights based on long time continuous water use by individuals and communities. Interestingly, some of the south Indian irrigation systems have informal and prioritised water rights not for individuals, but for different distributaries or command segments (Vaidyanathan, 1985).

The 200-year-old *Phad* system operating in the Panijhra River area of the Dhule district and the *Pani Panchayat* system being practised in parts of Purandhar taluk of Pune district, Maharashtra have the potential for developing into well-defined and user-managed water rights systems (Datye and Patil, 1987).[50] However, in recent years, innovative local level self-governing water institutions such as *Pani Panchayats* are on the decline for various economic, social and institutional reasons (Keremane, *et al*., 2006). In the deltaic regions of Orissa and West Bengal as well as in parts of Bihar and Madhya Pradesh, there exists an officially-granted non-transferable long-term water lease system, which was designed specifically for encouraging farmers to use more surface water (Government of India, 1976).

More important and interesting is the *Shejpali* (water distribution roster) system being practised in the canal commands of western Maharashtra even today. Although this system is not enforced to the extent that it should have been in recent years, it does show another form of institutional potential for developing a formal water rights system in canal regions. Under this system, the canal authorities will issue water passes on the basis of an application from farmers in the command on a first-come, first-served basis. The duration or validity of these water passes varies from six years to a single crop season, depending on location and crops being cultivated. Notably, these water passes also have priority and their priority varies somewhat directly with their duration (Gandhi, 1981; Rath and Mitra, 1989). Unfortunately, these passes lack quantification nor transferability, which mean their non-use automatically amounts to their forfeiture. But for their volumetric specification and non-transferability, the water pass system close resembles the water permit system being practised in most of the mid-western states of the United States.

6.3.2 Rental Markets for Irrigation Assets

Although rental market for irrigation assets (such as wells, pumpsets and conveyance structures) and water markets in groundwater regions seem to be overlapping, they differ fundamentally in terms of the assumption concerning the nature of underlying legal rights over water. For instance, if groundwater is considered as a common property (as the NWP actually does), groundwater markets tend to become just rental markets for irrigation assets, since water will not need payment as it is a common resource. But if groundwater is treated as easement connected to land rights (as the Easement Act actually does), the situation becomes entirely different. Besides,

there is also the question of which resource, whether water or irrigation asset, has a higher scarcity value in terms of either relative scarcity or practical contributions to productivity. Irrigation assets assume economic value due to non/under-investment on them by some farmers and over-investment on the same by others due to their differential farm size and economic capacity.

Since rental markets for irrigation assets allow farmers to irrigate their farms by renting the irrigation assets from their neighbours, they contribute both to equity in water use and better utilisation of irrigation assets. As per National Sample Survey data, about 10% of the total pumpsets in India are actually involved in pumpset rentals (National Sample Survey Organisation, 1984 and 1985). Since 63% of these rentals occur with dug wells/tube wells permanently fitted with electric pumps, it seems that the majority of rentals also involve water transfers as well. This is actually the case in the Indo-Gangetic and hardrock states dominated respectively by deep tube wells and dug wells, or open wells. Since the rest of rentals occur in contexts involving other water sources where pumps can be physically moved with little cost, they seem to occur independently of water transfers. Such rentals occur particularly in deltaic states such as Bihar, Orissa and West Bengal (Saleth and Thangaraj, 1993; Saleth 2012).

The expanding phenomenon of pumpset rentals is also an indication of the existence of surplus pumping capacity, particularly in the case of diesel pumpsets. In conditions where irrigation assets account for 16% of the rural assets and up to 40% of the private fixed capital formation in agriculture (Saleth and Thangaraj, 1993; Saleth 2012), the underutilisation of irrigation assets is a serious issue. The informal institution of rental markets has emerged essentially as a response of farmers to specifically address this problem. This phenomenon also brings forth certain conceptual and institutional implications. For instance, when there is the physical movement of pumpsets from one water source or location to another, they are just pure pumpset rentals as there is no water transfer between farms.[51] But in the hard rock and Indo-Gangetic regions, pumpsets, which are mostly electricity-based, are likely to be permanently installed with dug wells/tube wells, pumpset rentals necessarily involve water transfers. In this case, rental activity is institutionally linked with groundwater markets (Saleth, 2004). In view of the fundamental technical and institutional linkages between groundwater markets and rental markets, the expansion of groundwater markets

in recent years also indicates a similar expansion of, either explicit or implicit, rental markets as well (Saleth 2012 and 2014).

6.3.3 Groundwater Markets

Despite their localised, fragmented and uneven nature across regions, groundwater markets are growing in magnitude and gaining significance. While water selling practices in India are traced to the 1920s, more systematic documentation of this phenomenon started only since the late 1960s. Their characteristic features are that they occur without any formal water rights system and involve no sacrifice of self-irrigation. As noted above, there are both a conceptual issue (that is, whether the sellers are selling water or excess pumping capacity) and also an economic question (that is, the opportunity costs are undefined when there is no sacrifice of self-irrigation). While there is no systematic national scale estimate for the magnitude of water selling, based on studies in Gujarat and Uttar Pradesh, Shah (1993) has projected that the area irrigated through groundwater markets can be as high as 50% of the total GIA under private lift irrigation.

Understandably, there are considerable regional variations in the extent of area covered by groundwater markets. While the area irrigated through groundwater markets is estimated to be 80% for north Gujarat (Shah, 1993), the corresponding figure for Uttar Pradesh is about 60% (Shankar, 1992). But in Vaigai basin, Tamil Nadu, the area under purchased water was reckoned to be no more than 30% of the total irrigated area (Janakarajan, 1993). In contrast, there are also studies which report no water selling at all in their respective sample areas (Shah, 1993). Considering regional variations and potential bias involved in area/sample selection in most studies, it is more reasonable to consider the area under the influence of groundwater markets to be about 6 mha, representing just 15% of the total area under groundwater irrigation (Saleth, 1998 and 2014).

Coming to the dominant technical and institutional features of water markets, although their geographic locus is limited by the physical characteristics of the groundwater aquifer and farming system, their size is often enlarged by an elaborate underground pipeline network. But, to be realistic, such market expansion is confined to a very few regions, and often leads to unbalanced market structure because it adds more buyers than sellers to the market. Since buyers are mostly small farmers,

they have a weak bargaining position.[52] In view of the monopolistic or oligopolistic tendencies in these markets, not only are there price and non-price discriminations but also the water rates are several times higher than pumping cost. The root cause for the sub-optimality of these groundwater markets lies not so much in their economic and organisational aspects but in the legal and institutional vacuum within which they currently operate. A legally instituted and locally managed water quota system defined within an ecologically consistent overall withdrawal limit could provide more powerful economic incentives for water use efficiency and accountability, and could also eliminate inequity while magnifying the positive benefits of water markets (Saleth, 1996; Kumar 2005; Parween *et al.*, 2021).

6.3.4 Water-Based Contracts and Conventions

There are a variety of water-based tenancy contracts. Although these contracts are often treated as part of groundwater markets, they need to be differentiated as they involve the use of other resources such as land, labour, capital and related farm inputs that are governed by their own separate sets of institutions. For instance, two distinct types of water-based contracts are reported in Kheda district, Gujarat. They are: (a) a two-party contract where water sellers provide irrigation and share 50% of the cash expenses (except labour costs), and claim 50% of the output and (b) a three-party contract where water seller, land owner and labourer share equally the cash expenses as well as crop output (Shah, 1993). Similarly, in Karimnagar district, Andhra Pradesh (presently Telangana), water sales occur as a part of different contractual arrangements such as labour contracts, crop sharing contracts, and crop and input sharing contracts. These contracts represent not only an institutional evolution of crop sharing within the context of groundwater markets but also an institutional linkage between groundwater markets and other rural input/output markets.

Apart from these water-based tenancy contracts, the pricing methods are also accompanied by certain informal conventions and contractual obligations with considerable implications for water use efficiency and risk sharing (Kolavalli and Atheeq, 1990). For instance, although the area-based method involving crop shares provides lesser incentive for water conservation than the method involving hourly rates, it allows risk sharing between buyers and sellers. It also involves some informal contractual obligation for sellers to provide irrigation for the whole season. Besides, in the case of both area-based and per use irrigation rates, there are also mutually agreed upon

conventions (example, the level or intensity of irrigation constituting 'full irrigation') to avoid conflicts and water over use. Since water sharing contracts also lead to input/output selling contracts, there are also evidences for inter-linked input and output markets in rural areas (Janakarajan, 1993). As groundwater markets mature, they seem to be getting more and more linked with other rural institutions.

6.4 Evaluating the Performance of Water Institutions

The overall performance of water institutions does not depend only on the individual effectiveness of the legal, policy and organisational components, and their underlying institutional aspects. It also depends on their joint performance as determined by the strength and effectiveness of the structural and functional linkages among these institutional components and aspects. Besides these internal and structural features, the overall performance of water institutions also depends on changes in the general institutional environment within which they evolve and operate. While the performance of water institutions can be evaluated within our institutional decomposition-based analytical framework, the empirical translation of the same, especially with objective information, presents a major challenge. However, this approach is amenable for empirical application by using perception-based judgmental information collected from a carefully selected sample of a cross-section of water sector stakeholders.[53]

When it is not possible to obtain the required level and quality of perception-based data due to the lack of time and resources, one can rely on the learned and balanced judgments of the researchers themselves. In this respect, the key aspect to be considered can be the overall progressiveness of water institutions as captured in terms of variables such as adaptive capacity, amenability for innovation, openness for change and ability to tackle emerging and future water sector challenges (Saleth and Dinar, 1999 and 2003).[54] As we reflect on these criteria over our brief description of the structure of Indian water institutions both at the micro and macro levels presented in the previous section, it is possible to derive a few general and qualitative results. For instance, we see the micro level institutions (example, groundwater markets) are relatively more responsive to changing local needs, whereas their macro level counterparts continue to lack the required extent of flexibility as changes are resisted by factors like bureaucratic obstacles, political constraints and path-dependency restrictions.

Even within formal institutional components, water policy is relatively more responsive as compared to water law and water administration. But policy changes (example, water policy statements by the union and state governments) are more in the nature of declaration of intentions or expression of aspirations rather than as attempts at practical implementation. Thus, policy changes are politically easy to accomplish but operationally difficult to be implemented to actually deliver the intended economic benefits. Although policies related to more substantive aspects such as water pricing and inter-regional water transfers have changed to some extent, such changes are rather marginal and incremental rather than fundamental in nature. Similarly, in the sphere of water administration, changes involving just renaming or administrative reorganisations and mergers are mostly superficial in nature. But changes involving substantive aspects such as reforming an over-sized bureaucracy and functionally unbalanced staffing pattern, creation of stakeholder-based basin organisations, and making water-related departments financially and functionally autonomous have not been observed much both at the union and state levels.

From another perspective, water institutional performance can be indirectly evaluated by using water sector performance as a proxy. While the performance criteria applicable at the project and system levels are relatively more rigorous (Bos, 1997; Burt and Styles, 1997), those needed for evaluating the performance of water sector as a whole can mostly be indicative rather than conclusive.[55] By recognising this fact, it is possible to follow a simple, yet practically meaningful, approach for evaluating the overall performance of the water sector in terms of three gaps: the physical gap, financial gap and economic/incentive gap (Saleth, 1996).[56] The physical gap in water sector can be evaluated both in terms of the gap between water resource potential and its utilisation, and also in terms of the gap between water demand and water supply.[57] The financial gap can be captured simply by comparing cost recovery with supply costs in terms of either operating expenses or operating expenses plus a nominal interest on irrigation investment. Although capturing the economic/incentive gap is extremely difficult, it can be approximated in terms of the gap between the average value of water and the average water rate being charged.[58]

The utilisation gap is already indicated in an earlier section as part of our discussion on the water institutional environment. The demand-supply gap that has already assumed serious proportions at local and regional contexts is also growing at

the aggregate level. In the particular context of irrigation sub-sector, the demand gap is very serious as the actual irrigation potential created so far is only about 97 mha as against the GSA of 198 mha. Notably, even if the estimated ultimate irrigation potential of 140 mha is fully developed, India will still continue to have the irrigation gap as the GSA is expected to grow further to 210 mha by 2025. The problem is going to be complicated further by the declining share of irrigation caused by increasing demand pressures from other sectors. From the perspective of institutional performance, what all these forms of physical gap suggest is the fact that current institutions, particularly those related to inter-basin transfers, inter-sectoral allocations and conflict resolution are too weak to fill these gaps.

The financial gap in the water sector can be approximated by the difference between the total investment costs and total revenue in the canal irrigation sector. As per the latest information, total investment in canal irrigation is estimated to be Rs. 4,052 billion at current prices (Central Water Commission, 2019). Even if we assume a modest rate of 6% to account for both interest and depreciation, the annual financial cost of providing canal irrigation provision comes to about Rs. 243 billion. As against this interest cost and annual operating costs of Rs. 218 billion, annual gross receipts from canal sector are estimated to be just Rs. 43 billion (Central Water Commission, 2019). This means that annual revenue from canal sector is covering less than 10% of the total cost of irrigation service provision. Such a large financial gap actually signifies the opportunity costs of poorly performing institutional aspects involved in canal water sector such as water pricing and cost recovery policies, as well as the underlying inefficiency of public and user-based organisations involved in collecting water and related charges.

Besides the financial gap, there is also an economic/incentive gap since water charges remain far below the economic value of water. In addition to their negative effects on the financial side, the low and uneconomic water rates also lead to an incentive problem causing widespread water use inefficiency. The incentive gap can be approximated by the gap among water productivity, supply cost and water rates. In the context of canal regions, water productivity was reckoned in the range of Rs. 714/ha – Rs. 5,812/ha, whereas water rates were only in the range of Rs. 6/ha - Rs. 1,000/ha (Government of India, 1992b). As noted in Tables 9 and 10, the water rates observed across states even at present will not be able to reflect either the productivity nor the supply costs of water services. For instance, the average cost of creating a hectare of

irrigation in canal areas is reckoned to be Rs. 3/ha – Rs. 5 lakh/ha, whereas even the maximum water rates observed, that is, Rs. 6,297/ha (Central Groundwater Board 2016; Central Water Commission, 2021) cannot even cover the interest rate on the investment/ha. The incentive gap, therefore, indicates not just the poor performance of pricing and cost recovery policies but also the absence of institutional conditions necessary for volumetric allocation such as the water rights system and its legal and organisational requirements.

7. Concluding Remarks

A careful review of the literature on Indian agriculture suggests that the root cause of most of its problems, ranging from low productivity and value addition to viability and sustainability, can be traced to the institutional structure within which the sector is currently operating. Obviously, therefore, setting right the institutional foundation of Indian agriculture is indispensable not only for meeting the challenges but also for gaining from the opportunities emerging on the trade and technology fronts. In this respect, reforming the institutional structure of agriculture, especially its resource-related components such as water institutions, is relatively more critical given the predominant role irrigated agriculture plays in the overall sectoral growth and performance. Despite its importance, the subject of agricultural institutions in general and water institutions in particular continues to remain as one of the less studied areas in current research in India.

Admittedly, there are notable studies covering one or few components of agricultural and rural institutions (example, land tenure, land tenancy, credit institutions, extension systems, market structures and farmer producer societies). But studies addressing the whole gamut of agricultural institutional issues within a rigorous and unified framework are almost non-existent. Similar is also the case with resource-related institutions such as water institutions. Most studies here also have a selective or restricted focus by covering a single or set of water institutional components (example, water rights, water markets, water pricing and water organisations such as WUAs and RBOs) rather than tackling water institutions as a whole within the same analytical setting. The lack of unified treatment of institutions in both contexts is mainly due to many conceptual and analytical challenges inevitable in bringing together the large and diverse sets of institutions within a common analytical and methodological framework.

Departing from existing studies and developing a unified methodological framework, the present paper has made an attempt to rigorously evaluate water institutions as a special case of agricultural and rural institutions in India. The methodological framework is developed using an institutional decomposition and analysis approach. This approach relies on the fact that although institutions operate intrinsically as an organic system, they can be decomposed or unbundled in three stages with different levels of analytical details. First, at a broader level, the 'institutional structure' can be distinguished from the 'institutional environment'. Institutional structure (or, governance structure) is characterised by an intricate interplay of various legal, policy and organisational components and their respective sub-components. Institutional environment (or, governance environment), in contrast, is characterised by the physical, social, economic and political milieu within which the institutional structure evolves and operates. Second, the institutional structure is unbundled into three 'institutional components', namely, legal, policy and organisational components. And, third, the three core institutional components are in turn unbundled to identify their underlying 'institutional aspects'. While this unbundling exercise can go much deeper even to the point of being exhaustive, it is confined by identifying the policy-wise more relevant and performance-wise more critical institutional aspects.

The methodology with a detailed three-stage-based analytical decomposition can both be generalised and specialised to suitably evaluate institutions at various scales and contexts. Given its objective and scope, this paper has applied the detailed methodology only for a comprehensive review and evaluation of water institutions taken as a whole. In the larger context of agricultural and rural institutions, however, the methodology is applied only to cover their institutional structure while excluding their institutional environment from coverage in line with the scope of the paper. Again, for the purpose of simplification, even their institutional structure is unbundled not in terms of its legal, policy and organisational components, as done in the case of water institutions, but only in terms of its core institutional segments covering broader functional areas such as:

(1) Land tenure and tenancy.

(2) Organisational modes of farm production, processing, and marketing.

(3) Agriculture research and extension system.

(4) Rural credit and financial institutions.

(5) Agricultural market institutions.

(6) Resource management institutions, especially water institutions.

While the detailed methodology is applied for the review of water institutions, the remaining components of agricultural and rural institutions are reviewed in more generic and functional terms. Although the review of the latter is rather monolithic without much disaggregated details, the key legal, policy and organisational aspects are highlighted as much as possible in all relevant contexts.

Within the stage-based methodological framework, all the six segments of the agricultural and rural institutions are not only functionally inter-connected but also structurally linked. This is because the institutional environment of water institutions will cover all the remaining components of agricultural and rural institutions. At the same time, water institutions remain as the critically very important resource-related dimension of agricultural and rural institutions. In view of these structural and functional linkages, the detailed analytical review and evaluation of water institutions requires also a review and evaluation of other segments of agricultural and rural institutions, operating as part of the institutional environment of the former.

Relying on the methodological framework and structural rationale outlined above and using secondary materials and relevant data available on the subject, this paper has provided a relatively comprehensive review of the core components of agricultural and rural institutions followed by an analytically in-depth review and evaluation of water institutions in the Indian context. Despite their differential depth and details, these two reviews are brought together within the same methodological framework. On the whole, the review and evaluation presented in this paper have important implications for both theory and policy in the realm of water institutions in particular, and agricultural and rural institutions in general.

Before highlighting key results and implications of the review and evaluation presented in this paper, it is useful to recognise some of the major limitations within which they were derived.

First of all, while agricultural and rural institutions are many and diverse, institutional components or segments reviewed here are only a few, which matter the most

for overall sectoral performance. Although each of these institutional components deserve as much detailed treatment as done for water institutions, they were reviewed only briefly without going much deeper on their unique legal, policy and organisational components and their constituent aspects.

Second, the institutional environment of agricultural and rural institutions was not covered except for the limited inkling on the same when describing the physical and economic challenges of agricultural sector.

Third, even though the review of water institutions is very detailed and comprehensive covering well its institutional structure and environment, it cannot be considered either complete or exhaustive as the institutional aspects covered here are only a few, though they are the dominant ones in determining the performance of water sector.

And, finally, the review performed here treated institutional components and aspects as if they are independent and operate in isolation. While this is assumed for analytical convenience, the review did not go deep enough to unravel the intrinsic operational and functional linkages among institutional components and aspects. With proper methodological refinement and empirical specification, these linkages can be captured and even be quantified with suitably generated objective and subjective data.

Keeping these limitations as caveats, let us highlight some key results along with their implications. To begin with, from an overall perspective, there is an urgent need to strengthen and reorient the institutional foundation of Indian agriculture. But the subject continues to remain as one of the less studied aspects in extant literature in the country. This paper has made an attempt to address this important research and methodological gap in current literature. Hopefully, the methodology developed and institutional review presented in this paper could open up some new frontiers in institutional research in the agricultural, rural and resource-related areas. From a functional and conceptual perspective, it is necessary to note that in the particular context of agricultural and rural sector, the distinction between institutions and infrastructures is often blurred because institutions play key infrastructural functions and infrastructures play key institutional functions. On similar ground, it is often difficult to establish a clear-cut distinction between agricultural institutions

and rural institutions. On this rationale and for analytical convenience, agricultural and rural institutions and infrastructures are conceptualised as single institutional entity.

Turning to the specific segments or components of agricultural and rural institutions, land tenure and tenancy arrangements play many key roles ranging from land productivity, technology adoption and economic viability to land access equity, rural credit eligibility and farm investment capacity. Historically speaking, land tenure underwent significant changes thanks to land reforms in regions such as Kerala and West Bengal, land consolidations programmes in regions such as Punjab and Haryana, and tenant-to-owner conversion programmes in most states, except Bihar and Uttar Pradesh. Baring these cases, land tenure structure changed more by the natural process of land fragmentation than by any deliberate reform efforts. The results from two latest Agricultural Census covering respectively 1995-96 and 2015-16 show a distressing trend. While the total holdings in the country increased from 116 million to 146 million, the corresponding area has declined from 163 mha to 158 mha. As we disaggregate total holdings and area by farm groups, we find that the marginal farmers share 69% of the total holdings, but account for only 24% of the total area. In contrast, farms with over 2 hectare share only 14% of the total holdings, but account for about 53% of the total area. Such an extreme pattern of land inequality and increasing farm fragmentation explain why farm productivity is declining and economic viability is deteriorating.

Regarding tenancy, land leasing — either fully or partially — account for just 3% both in the total holdings and in the total area, with the rest remain fully-owned and self-operated. Across farm groups, although the relative share of smaller farmers increased both in land leasing and in self-cultivation, the increase in land leasing is more dramatic. While their share in self-cultivation increased from 62% to 68% in the total holdings and 17% to 24% in the total area, their share land leasing rose from 58% to 77% of the total holdings and from 19% to 39% in the total area. But the reverse is the case for farms exceeding 2 hectare. The implication is that small and unviable holdings also dominate in both categories of self-operated and leased farms during the two census periods. While distributing the ever shrinking category of waste lands can be an option, it cannot be expected to make much of a dent on the landlessness problem, though it can be a tool for promoting corporate farming in

select areas. Changes related to land ceiling and contract farming, though appear to be marginal, are critical not merely for promoting private investment in agriculture but more so for overcoming the limitations of farm fragmentation through flexible production-cum-marketing models.

New institutional models allow a mix of decentralised arrangements in spheres such as production and aggregation, and centralised arrangements in spheres such as input procurement, processing, value addition and marketing. These models can, therefore, counter the negative effects of unviable holdings and enable smallholders to gain from scale economy and collective bargaining benefits. Earlier models of cooperative farming failed to achieve such an integration. But those that emerged in recent years (example, Anand-pattern cooperatives for milk, edible oils and vegetables) have succeeded in linking decentralised production with centralised processing, value addition and marketing. On the contract farming front, the most interesting and successful case pertains to the PepsiCo model; first experimented in 1989 in Punjab, and now expanded to many other regions. Thanks to its effectiveness and conducive policy environment, this model now covers 25 crops in over 105 locations mainly in states such as Punjab, Tamil Nadu, Andhra Pradesh, Haryana and Maharashtra. Recent studies have confirmed the major impacts of contract farming on farm productivity, income and employment. In view of its ground level impacts and larger sectoral roles, especially in catalysing private farm investment and technology transfer, contract farming has also received a major boost from recent government policies. But contract farming policy has also to be counterbalanced with suitable safeguard provisions such as the model contract as proposed in 2007 National Policy for Farmers.

Other newly emerged organisational forms include rural SHGs and FPOs. Although not all SHGs are directly involved in farm production, most of them can support farm production through their roles in micro credit, women's empowerment and natural resources management. As of 2016-17, there were 85.77 lakh SHGs federated across regions and supported with strong linkages with formal financial and development institutions including NABARD. Given their functional roles and spatial coverage, SHGs can be developed to serve as a strong institutional framework for linking financing, production and marketing. The FPOs, which emerged since the early 2000s, aim to link production, processing and marketing among smallholders.

Most FPOs are also formally registered as Farmer Producer Societies or Companies. As of 2015-16, there were 2000 FPOs created under various government schemes and externally funded projects. By 2020, 4,465 additional FPOs were created as part of the 10,000 FPOs planned to be created by 2027-28. Impact studies conducted in multiple locations suggest that FPOs have improved price realisation (22%) and cost savings (31%) among member farmers. But impacts vary significantly across FPOs by states. For instance, improved price realisation varied from 7.5% in Madhya Pradesh to nearly 45% in Kerala. Similarly, income increase varied from 13.5% in Odisha to 25% in Rajasthan. While FPOs certainly have positive effects, more research is needed to generalise their impacts.

Regardless of the choice of institutional options, the focus should mainly be on the integration of various farm operations so as to maximise both the income and employment benefits of decentralised small-scale production, and the efficiency and scale economic gains of centralised large-scale processing and marketing. Since most models are suitable largely for the economically important commercial crops, it is uncertain how they are going to benefit smallholders focused on food crops, especially in remote areas. In any case, the ideal strategy is not the one that prioritises one model or the other, but the one that promotes configuration of different models suitable to different crops, regions and contexts. Finally, the long-term viability and sustainability of these integrated models depend on strong upstream and downstream institutional and infrastructural systems. This calls for major investment in rural infrastructures as well as a stronger articulation of functional linkages with other agricultural institutions, especially those related to credit, extension and marketing systems.

While public investment in AERS witnessed a rapid growth , especially in the aftermath of Green Revolution, the investment growth led more to size expansion than to performance improvement. Over time, AERS have tended to become less flexible and adaptive to respond well to changing client needs and market conditions. The changing economic environment, pressing funding constraints and emerging new challenges have forced policy makers and funding agencies to seek new avenues and options for improving the functional response and the overall performance of ARES. Since inefficiencies of AERS originate more from size expansion, unwieldy and bureaucratic organisational structure and lack of competition, most of these options are focused on setting right its institutional foundation. The main thrust

of institutional reforms is to shift the focus from system expansion to performance improvement. The performance of AERS can be enhanced significantly by increasing its managerial efficiency, accountability and adaptability. Other options include promotion of decentralisation, creation of semi-autonomous regional research arrangements and involvement of universities and private research groups.

Significant progress has been recorded in decentralising both crop-specific research programmes and regionally-spread AERS organisations (example, the all-India coordinated research programmes for different crops; research centres and field stations for different crops operating in various parts of the country). But, in terms of funding and organisational control, public AERS is still highly centralised. One option to address such centralisation is to reorganise bodies such as the ICAR by four main regions. On the technical side, the reform options also include a reframing of the research agenda and priority matrix so as to shift the focus from traditional cereals towards crops with deficit supply and export potential, and from mere crop productivity to postharvest and resource conservation aspects. There is also a need for the AERS to go beyond its conventional role of just developing and delivering only production oriented technologies and extension services. For better meeting client needs, production oriented services are to be delivered together with economic information on market prices, supply situations and climate conditions. Such an integrated delivery requires both flexibility and location-specificity, as well as functional collaborations with relevant agencies to quickly gather the required information.

As AERS has become institutionally more diverse thanks to the increasing roles of private companies, universities, research agencies, non-governmental bodies and also foreign companies, it can no longer be equated just with the public system alone. During the past few decades, for instance, private sector companies have introduced about 122 crop varieties. Their share in the total seed production has also increased from 57% in 2017 to 65% in 2021. Besides bringing additional investment, technologies and skill inputs, the private sector also creates not only healthy competition but also functional complementarity with public sector. Private sector, for instance, has added many new crop varieties, particularly in neglected cases such as vegetables, millets and fodder crops. The increasing collaboration that private AERS has with foreign companies also facilitates technology transfer as well as access to seed markets in other countries of Asia and Africa. There is an obvious need for raising the level

of private investment in agricultural education, research and development given the declining public investment on the same relative to agricultural GDP. Collaboration of universities with the private sector can be much more productive, highly innovative and less costly in technology development.

Rural credit institutions contribute to agricultural performance both directly through their role in the provision of key farm inputs and also indirectly by facilitating the performance and impact of other components of agricultural institutions. Their role has expanded tremendously over the years. Farm credit as a ratio of agricultural GDP increased from 10% in 1999-2000 to about 52% in 2017-18. In absolute terms, rural credit increased from Rs. 5 trillion in 2011-12 to Rs. 13 trillion in 2017-18. But this growth does not mean farm credit is either adequate in relation to demand, or efficient and equitable in terms of impact. Reform options to address these issues are not new, and some of them were also implemented with some notable success. While there has been notable progress in terms of inclusion, further progress is needed to improve equity in rural credit as still 50% of the farm households are outside the ambit of formal credit. For this, we need to promote rationalisation and a more targeted provision of credit to currently excluded groups such as small farmers and other poor groups.

On the operational side, there is more scope now for expanding third-party intermediation and reducing the risks, and thereby, the transaction costs of rural credit. Such credit mediation is not limited only to traditional players such as voluntary agencies and those entities involved in the areas of technology, input supply, marketing and processing such as cotton and sugar mills, agro-processing units, etc. It also includes now newly emerging institutional options such as contract farming, SHGs, FPOs, etc. Notably, the service area approach promoted by NABARD for the grassroots level coordination and linking of various development activities related to infrastructure and technology with credit programmes should be extended to district and state levels, as it is where most decisions on infrastructures and technologies are being made. While merging RRBs with the cooperatives is argued for improving their viability, the reality is that a healthy institution cannot emerge by merging two sets of poorly performing institutions. Apart from the changes in the lending policy aimed at improving the financial viability, a number of operational and institutional changes are indispensable to enhance the viability and performance of the formal rural credit system as a critical component of rural institutions.

There is a need to promote a healthier credit delivery system with multiple players and pluralistic institutions, both to promote competition and complementarity. With its increasing diversity and sophisticated transformation, private rural finance system — covering both traditional actors, private banks, rural SHGs and those centered on gold loans — has already grown strong enough to pose significant competition and also add complementarity with public rural credit sources. Since its scale of operations is likely to increase over time, the private system has to be eventually brought into some formal regulatory framework, especially given it predominant focus on bottom line and exploitative tendencies. Thanks to concerted efforts on the inclusion and equity fronts, formal institutional sources are able to meet 72% of the credit requirement of farmers with only 28% accounted by the non-institutional sources. Notably, public and private sector banks meet only 41% of the credit needs of small and marginal farmers. In terms of regional disparity in farm credit, not only does the share of states in the total credit vary from 0.5% to 10%, but also it is disproportionate to their share in agricultural output. This means that despite notable progress on the inclusion front, there is much scope for further progress.

Agricultural marketing institutions create the overall incentive environment by setting prices and determining the relative income share of farmers, traders, consumers and myriad other players operating in transport, storage, processing and value addition spheres. Marketing institutions are not a monolithic, but form as an integrated ecosystem covering many institutions, activities and actors involved in the entire spectrum from farm gate to final consumption. Since any change in marketing institutions is likely to have wider repercussions, it needs to be done carefully to judiciously balance the varying interests of conflicting groups. From an organisational perspective, agricultural marketing involves 7,320 APMCs operating across all states, which cover both 2,477 principal markets and 4,843 sub-market yards regulated by their respective principal markets. Despite many legal, policy and procedural regulations, these markets remain archaic, isolated and localised mainly because of the dominance of vested interest groups and the existence of many trade barriers. The resultant isolation and missing linkages among state level markets make them inherently inefficient and rigid with limited competition but higher transaction costs.

Considering the challenges involved in physically integrating the regionally fragmented agricultural markets, the union government attempted the digital route by in-

troducing an electronic-based National Agricultural Market (e-NAM) programme in 2016. As to its progress, e-NAM platform has covered so far 1,000 APMCs from 18 states and 3 union territories with a total registered user base of 1.66 crore farmers, 1.31 lakh traders, 73,151 commission agents and 1,012 FPOs, and a total commodity coverage of 150 products. Despite its early stage, e-NAM is certainly an important institutional innovation with tremendous potential to promote transparency, competitiveness and digital integration of several functions such as auction, payment and delivery logistics. But how far such potentials can be actually realised still depends on the same traditional systems of APMCs and related delivery networks, which are assigned to provide back-end physical support for all virtual trade transactions under e-NAM portals. Without some fundamental changes in the overall structure of agricultural markets, therefore, e-NAM cannot be expected to deliver all its intended benefits.

The most significant, yet controversial, legal initiatives ever undertaken in Indian agricultural sector pertain to the three interrelated ordinances on agricultural marketing which were later legislated by the union government in 2020. Under ideal conditions and with suitable safeguards, these legislations could radically transform agricultural marketing with innumerable benefits to all stakeholders with barriers-free trade, assured market, better price and low transaction costs through diversified trading options, multiple market channels, intense competition and expanded trade volume. But most of these expected benefits depend critically on how intense is the competition among traders, and how reliable is the price setting process. When traders are numerous and relatively uniform in size, the competition is likely to be more intense and price setting to be fair. However, in reality, agricultural markets in India are being dominated by very few and large players with disproportionate control over supply chains, finance networks and infrastructural systems. Without additional regulations to counter these oligarchic tendencies, these legislations are likely to cause more problems than solutions to famers, small traders and other players in current market ecosystems. Although the legislations were recently withdrawn in November 2021, hopefully, an improved versions that address most of the limitations of their earlier versions can be enacted with proper consultations with all stakeholders, including the states that have concurrent responsibility in the agricultural sector.

There are important inter-linkages among the components of agricultural institutions with considerable implications for both their individual and collective

performance. For instance, credit institutions perform better when land tenure system is dominated by economically viable holdings conducive for obtaining and repaying productive farm investment. Even when land holdings are individually unviable, institutional arrangements in the production sphere such as SHGs, FPOs and various forms of contract farming can still ensure a better performance of credit institutions essentially by neutralising the limitations of the land tenure system. This means that linkages among the components of agricultural institutions have the ability not only to enhance the performance of other components but also to counter or neutralise the limitations of some other components. Similar arguments can also be equally valid in the context of other components of agricultural institutions such as agricultural research and extension system and agricultural marketing structure. Since the former is central to ensuring technical performance and the latter is critical to ensure economic performance of agriculture, their status and performance can set the direction and magnitude of the performance of all components of agricultural institutions.

The performance implications of institutional inter-linkages are much deeper extending to water institutions and beyond. A case in point is the effects of tenure on the performance of water institutions. While it is true that water institutions are likely to perform poorly in areas with fragmented holdings, this can be countered with suitable institutional arrangements such as user association and group-based allocation. On the other spectrum, better performing credit, extension and marketing systems are likely to enhance both the institutional and economic performance of water institutions, and *vice versa*. Admittedly, some of the institutional linkages and their performance implications argued here have been addressed in the current literature, by using institutional variables but from general and somewhat non-institutional perspectives. Examples in this respect include not only studies evaluating rural credit, extension system and marketing by factors such as farm size, tenancy system, organisational forms, etc., but also those assessing the impact of water markets by farm size groups, energy pricing and water right regimes, etc. Evaluating these and other aspects of inter-linkages truly from an institutional perspective represent potential area for future research in the realm of agricultural and water institutions. Such research can both be descriptive and analytical and even be quantitative by suitably adapting the methodology presented in this paper.

Although the review of water institutions is performed with much more analytical details than agricultural institutions, it cannot be considered exhaustive. Despite the selective and eclectic nature of the review of water institutional structure, we are able to cover both its macro and formal components, as well as its informal and grassroots counterparts. The overall performance of water institutions has also been tentatively evaluated using objective, though indirect performance criteria, developed with readily available data. Our review and evaluation of water institutions do lead to a few interesting observations with considerable implications for both institutional economics theory and water sector reform strategies. To begin with, the present structure of water institutions in India, as reviewed in terms of some of their major institutional components and aspects, shows that it is far removed from the mature system that is actually required to meet the present and future challenges of the water sector. This observation is reinforced further by a less than expected performance of water institutions, as evaluated indirectly in terms of the overall physical, financial and economic performance of the water sector.

On the legal side, there are a number of realistic legal proposals for initiating specific legislations for different water sources and spheres of water management, though most of which continues still as proposals. However, important amendments and new initiatives undertaken in areas such as inter-state water disputes, union-state relationships and PPP deserve appreciation. But political will is still lacking at both levels of governments to go for more substantive changes within the legal sphere. Although there are notable changes in water policy, they are more in the nature of good intentions than in the form of concrete actions. Even though changes are observed in the context of water pricing and cost recovery aspect, they can be characterised more as token than as substantive to have any real impact. Regarding private sector participation, the intention is sincere and progress is very significant. Although it is confined mainly to a few economically attractive areas such as urban water supply and water development projects at present, the increasing financial challenge of the water sector is likely to push for more and more private sector participation and private investment. While there is a proposal for creating a National Water Framework Law and its associated Water Regulatory Authority, it should be viewed to be more for general direction and guidance for states than for any centralised control. Since water is a state subject and given the need to reflect region-specific requirements, it is better that the states take these legal initiatives, although the union also has persuasive and catalytic roles.

On the organisational side, a number of concrete changes have occurred with considerable impact on the structure and performance of water institutions, especially at its lower and middle echelons. These include not only IMT, WUAs, RBOs and water development corporations but also the water and pumpset rental markets, as well as various forms of localised water-based contracts. At the macro level, currently, there are serious proposals to merge and realign national organisations involved in the water sector with a view to ensure a national perspective on all matters connected to the water sector. Many states are also now willing to open the water sector to both private investment and management with a view to improve physical performance as well as financial sustainability. All these and other changes observed in the legal, policy and organisational spheres of water institutions are indicative of the fact that water institutions are not static but undergoing varying levels of changes. Despite their differential magnitude and regional variations, these changes do provide some form of observational evidence for the fact that the transaction cost theory of institutional change is working. That is, the reform benefits (or, the opportunity costs of inaction) are exceeding the corresponding economic and political transaction costs of undertaking such institutional reforms. But the fact that these institutional changes are neither uniform across institutional components nor across water sub-sectors suggests that both the opportunity and transaction costs vary considerably by institutional and sectoral contexts.

The nature, extent and coverage of institutional changes also indicate the powerful effects that exogenous factors (example, economic liberalisation policies, political forces, influence of international financial and research institutions, and natural calamities such as droughts) have on the opportunity and transaction costs of institutional change within the water sector. Notably, the initiatives undertaken initially involved only the transaction cost-wise easier and ceremonial options (example, declaration of water policy, constituting committees and marginal legal amendments). However, those undertaken in recent years involved politically difficult and substantive options (example, administrative reforms, IMT, RBOs, autonomous corporations and private sector participation). But India is yet to move to the stage of embarking on real reforms like review of union-state relation in the water sector, declaration of exclusive and state-specific water laws, creation of practical water rights system at various levels, and administrative reforms for water sub-sectoral coordination, staff resizing, etc. Understandably, these reform options involve heavy economic and political transactions costs. Although these costs are lower than the potential perfor-

mance benefits in real terms, the differential weights assigned by political leaders and water sector stakeholders often distort the transaction cost calculus.

While India has to go a long way to set right its water institutional structure, the changes observed so far do signify that India is on the threshold of ushering in the substantive phase of institutional reform. This observation is based on four reasons. First, although the observed changes are slow, partial and inadequate, their direction and thrust are on desired lines. Second, the nature and tenor of these changes — both already observed and those proposed — indicate a clear commitment of the union and state governments to move ahead with the process of institutional change. This commitment is likely to be strengthened further by additional pressures from factors, both endogenous and exogenous to the water sector. Third, as the already initiated reforms begin to yield benefits, strengthen pro-reform constituencies and reduce the technical and political costs of transacting additional reforms, the incentive balance within the institutional transaction cost framework is likely to move toward further reforms. Finally, although institutional change is very slow and steady process, the path dependency properties of institutional change will ensure that it is costlier to go back than to go ahead within the reform path. As such, the reform process, though can be delayed, can neither be stopped nor reversed.

While the prospects for undertaking higher level reforms are brighter for India, there is an indispensable need for a clear and long-term strategy for reform implementation. In this respect, some of the key insights from cross-country analyses of water institutional reforms can be used to develop reform design and implementation principles. These principles involve the issues of timing to strategically exploit the synergetic effects of exogenous factors, scale-related effects of institutional interlinkages (example, links between WUAs and pricing policy and WUAs and volumetric allocation), and institutional sequencing and packaging (example, undertaking easier reforms first and implementing related programmes together). With the transaction cost declining and the political balance improving as we move on the institutional change continuum, it is prudent to pursue a logically linked sequential reform strategy wherein water sub-sectors and institutional components are prioritised in terms of their performance impact and facilitative roles for downstream reforms and political acceptability. Since such a strategy can exploit better the synergies from both

institutional inter-linkages and exogenous factors with proper timing, packaging and sequencing, it has a better chance of success with the least social cost and political opposition.

Notes

1. Since the institutional structure is embedded within the institutional environment, the evolution of and changes in the former is invariably conditioned by changes in the latter. This does not, however, mean that there is only a one-way flow of effects between the two, as changing institutional structure also influences the institutional environment or governance framework.

2. This applies even to agricultural and rural infrastructures since the distinctions among institutions and infrastructures are often blurred in cases like agricultural extension, marketing and rural credit.

3. Such decomposition is not arbitrary, but has a strong theoretical basis and analytical similarity with the institutional analysis and development (IAD) framework developed by Ostrom (1990) and Ostrom *et al.* (1994). The IAD framework characterises institutions in terms of three hierarchically related categories of rules: constitutional-choice rules, collective-choice rules and operational rules. As we take a deeper look at these categories of rules, it will become apparent that they can be approximated respectively by laws (legal rules), policies (guidelines) and organisations (operation and management). For, laws are the outcome of constitutional choice, and policies are the results of a collective choice through the political process, whereas the operational rules come into play when the laws and policies are operationalised by the administrative mechanisms involved in their implementation, monitoring and enforcement.

4. Unlike the IAD framework of Ostrom (1990) and Ostrom *et al.* (1994) that can evaluate mainly micro institutions, the IDA framework is useful to evaluate macro institutions (Saleth and Dinar, 2003 and 2008).

5. For instance, within the water law component, the aspects of water rights, conflict resolution and accountability are interrelated as do the aspects of pricing, cost recovery and user and private participation within water policy component.

Note that water policy is a political translation of water law (or, water law is a legal representation of policies either with political consensus or withstood the test of time) and water organisation is the implementation and enforcement arm for both water law and water policy, displaying their operational linkages and nested character.

6. They share the common function of defining the action set, action boundary and incentive environment, though in different sectoral contexts and operational spheres involving different, but often intersecting sets of players.

7. Of the total NIA, 44.79 mha is from groundwater sources, 17.43 mha from canal and tank sources, and 7.26 mha from other sources (example, river-based lift or run-off the river irrigation). Overall, groundwater-based irrigation dominates with a 65% share in the total NIA (Central Water Commission, 2021:19).

8. See Central Groundwater Board (CGWB) at the http://cgwb.gov.in/AQM/NAQUIM.html

9. Of them, electric, diesel and solar-based pumpsets account for 20 million, 8.8 million and 2.7 million, respectively. Notably, solar pumpsets were just 0.2 million in 2018 (International Energy Agency, 2022).

10. As per the Global Nutrition Report (2016), India ranks low at 114 on under-5 stunting and 170 on prevalence of anaemia. Anaemia affects 50% of the women and 60% of the children in the country (https://globalnutritionreport.org/documents/9/English_full_report.pdf).

11. Indian population is reckoned at 1.39 billion in 2021. Although its annual growth rate keeps on declining from 1.74% in 2001 to just 0.97% in 2020, the real annual addition to population (about 14 million) is still very high given the very large population base (Government of India, 2020).

12. Farm fragmentation is still more serious in densely populated and intensively cultivated states such as Kerala, West Bengal, Bihar and eastern Uttar Pradesh, where the average farm size is less than one hectare and, in certain parts, it is less than even 0.5 hectare (Mondal, 2006 Agricultural Census, 2015-16, http://agcensus.dacnet.nic.in/nationalholdingtype.aspx).

13. For instance, land tenure-related problems such as farm fragmentation constraints the use of technologies and making gains from scale economies. Similarly, publicly-funded and managed research and extension system, though successful in raising productivity in the case of few selected crops, has not been that successful in the context of both input use efficiency and resource conservation as well as the productivity of dryland crops like coarse cereals, oilseeds and pulses (Vyas, 1994). The processing and marketing systems also display similar bias with an excessive focus on wheat, rice, pulses and oilseeds, but a relative neglect of fruits and vegetables.

14. For instance, in Tamil Nadu, most land records, including patta transfers, field measurement books and encumbrance certificates can be accessed online at low cost through state-managed Common Service Centres and privately-managed centres of Village Level Entrepreneurs. These centres also have enhanced, easy and hassle-free access to other revenue department services (example, income, community, death and legal heir certificates), while also creating employment opportunities for rural youth with computer education.

15. This variety of contract farming is observed in Tiruchirappalli district, Tamil Nadu, where traders from Kerala contract farmers here to produce nendran variety banana and transport the output back to Kerala, where it is supplied to chip making firms (Saleth, 1995).

16. While the annual growth of research expenditure in developing countries has been 3.7%, it was only 1.7% in developed countries during 1981-91. Even in absolute terms, the research expenditure on agriculture in developing countries was 15% more than that in developed countries (Pardey *et al*., 1991; Alston *et al*., 1997).

17. These include 55 varieties of vegetables, 39 varieties of millet, 13 varieties of cotton, four varieties of fodder crops, nine varieties of oilseeds and two varieties of pulses (Singh *et al*., 1990).

18. For instance, between 1988-89 and 1993-94, the import of seeds and plant materials has increased from about 14 million tonnes (mt) to 62 mt, and the level of import has been as high as 428 mt during 1991-92 (Government of India, 1994). Currently, Indian seed industry is worth Rs. 180 billion, and India

exported seed to the tune of Rs. 10 billion in 2020 (Federation of Seed Industry of India, 2020).

19. For instance, investment on agricultural ER&D as a percentage of gross domestic product (GDP), which was 0.81% in 2005-06 declined to just 0.68% in 2014-15 (Government of India, 2019b).

20. It is estimated that there were 85.77 lakh SHGs in India in 2016-17 (which was more than double their number in 2006-07) with 40 million borrowers. Of them, 79.03 lakh had savings accounts with rural banks and 46.72 lakh had bank accounts under the SHG-Bank Linkage Program of NABARD operating since 1992 (Kumra and Sharma, 2018; Singh, 2019).

21. This means the usual way of classifying rural credit sources as formal and informal will not be as relevant as the categorisation of public and private sources.

22. For example, the market fee ranges from 0.8% in Vashi APMC, Mumbai to 2% in Galla Mandi APMC, Indore. The rate of commission charges varies across APMCs for different commodities: from 6%-10% for perishables to 2%-3% for non-perishables (Government of India, 2016).

23. These WDRA-accredited warehouses turned as sub-markets include: 23 in Andhra Pradesh, 14 in Telangana, 138 in Rajasthan and 14 others have been declared as deemed market by their respective state governments. Meanwhile, Gujarat, Madhya Pradesh, Punjab and Uttar Pradesh have amended their respective acts to facilitate warehouse-based trade (Ministry of Agriculture and Farmers Welfare, 2020).

24. For full version of these ordinances, see the website of Ministry of Agriculture and Farmers Welfare at https://agricoop.nic.in/en/actsandrules/agricultural-marketing. For a summary of salient features, see the Documentation Section of the Indian Journal of Agricultural Economics, 2020, 75(2): 241-244

25. In the case of water institutions in countries such as India, the formal/macro level institutions are related mostly to canal-based surface irrigation system, though most informal/micro institutions are related largely to groundwater system. Formal institutions also govern water supply and water quality as well. While the focus here is only on formal/macro institutions related to irrigation

sector, one can generalise this approach to institutions in other sectors and to cover micro level institutions as well.

26. It is important to note that the same set of exogenous components can also be considered as part of the institutional environment of agricultural institutions when reviewing the latter.

27. While the Constitution provides for a federal structure, the recent legal, economic, and political changes at the national level (example, goods and service tax laws, strong union government, etc.) tend to create a strong centralisation tendency, making state and local governments financially more dependent and economically weak.

28. In terms of purchasing power parity, this was equivalent to $7,333 as per the IMF World Economic Outlook, April 2021.

29. For instance, the average annual precipitation varies from 130 millimeters (mm) in the Rajasthan desert to 11,000 mm—the world's highest rainfall—in the Assam Mountains. Notably, three-fourths of rainfall in India is received just in four months during June-September.

30. The ultimate irrigation potential comprises of 73.7 mha from surface sources (58.47 mha from major and medium irrigation schemes and 17.34 mha from minor irrigation schemes) and 64.09 mha from groundwater sources. The surface potential is unevenly distributed, as 75% is shared by only nine states (Uttar Pradesh, Bihar Andhra Pradesh, Madhya Pradesh, Maharashtra, Odisha, Gujarat, Haryana and Punjab). While groundwater potential is distributed widely across states, Uttar Pradesh and Bihar still dominate with a lion's share (Central Water Commission, 2021).

31. For figures on wells, see the website of Central Groundwater Board at http://cgwb.gov.in/AQM/NAQUIM.html. For figures on pumpsets, see International Energy Agency (2022).

32. For more details on this framework, see Saleth and Dinar (2003 and 2008), and for recent instances of its empirical applications, see Araral and Wang (2015) and Chopra and Ramachandran (2021).

33. This constitutional division of power creates three lists of sectors/activities/jurisdictions. These are the Union List where the union government has exclusive power [Article 246(1)], the State List where the state governments have exclusive powers [Article 246(2)], and the concurrent List where both union and state governments exercise powers [Article 246(3)].

34. Under this Act, the union government has so far set up five tribunals, and the three of them have come out with amicable decisions (Krishna in 1976, Godavari in 1979 and Narmada in 1979). These include also the tribunal dealing with the politically most sensitive Cauvery river dispute where only an interim award was given, and even that is strongly contested by one of the concerned states.

35. This position got consolidated further with the Madhya Pradesh Irrigation Act of 1931, and it also cast its shadow over subsequent irrigation and water supply acts enacted even in the post-independence period. But a number of public interest litigations have led both the Madras High Court in 1936 and the Bombay High Court in 1979 to declare that government's sovereign rights did not amount to absolute rights (Singh, 1991).

36. As we will see later, this provision not only constrains groundwater markets, which have emerged spontaneously in many parts of India, where water is sold apart from land but also excludes those without land to have any access to groundwater.

37. The actually used IRR was linked to prevailing interest rate in the London money market as irrigation development was often funded with borrowed funds. As a result, the IRR was also periodically revised, that is, from 4% till 1919 to 5% during 1919-21 and to 6% after 1921 (Sangal, 1991).

38. This kind of cost recovery policy has also been supported by the Irrigation Commission in 1972, the Jakhade Committee in 1987 and the Committee on Pricing Irrigation Water in 1992.

39. Volumetric allocation is not new as it was tried twice—in 1854 and in 1917 in the Ganga Canal—during the British period. Although the idea was abandoned because of its impracticality given the technology of that time, it has received

periodic attention even during the post-independence period, especially since the Taxation Enquiry Committee of 1953.

40. River boards, as legal and bureaucratic arrangements, may not be confused with the stakeholder-based river basin organisations that are being advocated in recent years.

41. For instance, in Haryana, Punjab, Uttar Pradesh and West Bengal, water rate assessment is done by the water-related department, whereas the collection is done by the revenue department. But, in Andhra Pradesh, Karnataka, Kerala, Orissa and Tamil Nadu, both functions are performed by the revenue department. This administrative problem is due to the fact that in the case of most old irrigation projects in these states, there are no separate water charges but only a higher land revenue assessment for irrigated lands.

42. It would be rather naïve to believe that WUAs and RBOs would be alone sufficient to ensure the overall performance of water institutions and water sector performance. However, from the perspective of institutional change as a long and sequential process, these initiatives are important as necessary steps to initiate change process in water institutional structure, and hence, water sector performance.

43. Since a high credit rating of these bonds has led to over subscription, the KBJNL has revised down the return to 14.25% in July 1998. But, in real term, even this lowered rate is still high given the declining bank interest rates. More importantly, there is also the looming doubt as to the long-term ability of the KBJNL and MKVDC both to servicing and to repay the amount collected through these bonds. Much depends on whether such a financial burden will create pressure for improving their commercial viability and financial performance.

44. The other states where this sort of change is more likely to take place in the near future are Haryana, Rajasthan and Tamil Nadu (Gulati and Mainzen-Dick, 1996).

45. The kink in power demand emerges from the gap between energy cost and the net value of output per unit of power. As long as this gap is substantial and can also be manipulated by crop choice, farmers will not reduce power consump-

tion and hence, their power demand will be insensitive to power tariff changes (Saleth, 1997).

46. Clearly, the need and urgency of such water rights system are directly related to the transaction or social costs of water scarcity, water use inefficiency and water conflicts. Such a system may not be needed in water surplus regions. If individualised water rights are created with less cost, they can provide incentives and serve as instruments for encouraging water development and use. This is the main reason for the introduction of an officially granted non-transferable long-term individual water lease system in the deltaic regions of Orissa and West Bengal and also in parts of Bihar and Madhya Pradesh—all of them are known for water underutilisation (Government of India, 1976).

47. There are about 58 independent water-related agreements among states concluded in the past—39 related to joint projects and 19 related to sharing of river waters—and all of these are under heavy pressure for renegotiation due to the increasing water requirements of concerned parties.

48. Under this Act, the union government has so far set up five tribunals, and the three of them have come out with amicable decisions (Krishna in 1976, Godavari in 1979, and Narmada in 1979). These include also the tribunal dealing with the politically most sensitive Cauvery River dispute where only an interim award was given, and even that is strongly contested by one of the concerned states.

49. For instance, in the case of the Cauvery basin, the inability or unwillingness of Karnataka to deliver the required volume of water (due to rainfall failure in Cauvery catchments) has seriously disturbed rice cultivation in most parts of the Cauvery delta in Tamil Nadu during several crop seasons. Such crop loss, farmers' unrest and brewing political animosity between the two states with its implications for the stability of the then national government indicates what could be the magnitude of the economic loss and political damages, when tribunal decision takes a long period or when such a decision is not respected by either party.

50. Notably, under the Pani Panchayat system, the water share of users is based not on the farm size but on water needs. Since water needs are calculated at about half an acre worth of irrigation per person, the allocation criterion is divorced

from land ownership, but linked closely with family size (Singh, 1991; Vani, 1992).

51. In their survey of few West Bengal villages, Kolavalli and Atheeq (1990) report such pure pumpset rentals where diesel pumpsets are leased on a seasonal basis with the lease rate per crop season varying between Rs. 1,200 and Rs. 1,500.

52. For instance, a typical water sale-purchase matrix in Uttar Pradesh reveals that the demand side is dominated by smaller farms with less than two acres, as they account for 81% of the total area under purchased water (Shankar, 1992).

53. See Saleth and Dinar (2003) for the exposition of the theoretical justification of this approach and its empirical application using subjective and judgmental information from 127 water experts from 34 countries around the world. This methodological framework has also been empirically applied in different national and international contexts with suitable adaptations (Araral and Wang, 2015; Chopra and Ramachandran, 2021).

54. Criteria developed to capture these aspects have been empirically used to evaluate the performance of water institutions in a variety of settings and contexts (Saleth and Dinar, 2003 and 2008; Araral and Wang, 2015; Chopra and Ramachandran, 2021).

55. Even with well-defined objective criteria, water sector performance cannot be evaluated in all its dimensions since performance inevitability involves crucial subjective and qualitative aspects such as the smoothness of water transfers and the adaptive ability of water institution. For instance, while proxies like the number of water conflicts can be used, it is not clear, for instance, how one can factor into the evaluation the relative seriousness of such conflicts.

56. The underlying goals of three performance criteria are the physical and economic sustainability of the resource system, financial viability of the water sector, and economic efficiency of resource use, respectively.

57. Since the first gap indicates the physical sustainability of the resource system and the second one captures the economic sustainability of the water sector, these gaps together suggest the sustainability performance of the water system in a given context.

58. Note that the physical gap is evaluated for the water sector as a whole, whereas the other two gaps are evaluated only in the context of irrigation sub-sector. But this need not be a limitation as irrigation dominates water sector with a share of up to 80% of the total water withdrawals in India.

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