POLICY BRIEF 19

Irrigation Equity: Impacts, Sources and Strategies

Introduction

The contribution of irrigation to India's agricultural production is estimated to vary from 10 to 80%[1]. Public irrigation impacts on rural poverty through increase in productivity, which gets enhanced by its catalytic role in stimulating additional private investment in irrigation. Higher government expenditure on irrigation, at the margin, by billion rupees at 1993 prices would raise 7400 poor people above the poverty line besides adding 0.56% to the total factor productivity (TFP) growth rate in Indian agriculture[2]. Irrigation investment has contributed over 10% to TFP growth, over and above the contribution to output growth that irrigation makes as a conventional input[3]. While water requirement for all uses, projected up to 2050, barely matches the utilizable water resources from all sources[4], the efficiency and equity in the use of irrigation water particularly from surface flow systems remains a major source of concern to the planners and policy makers.

Equity and Poverty

India's Tenth Five Year Plan (X FYP) targets an economic growth of 8% per annum. For realizing this, agriculture sector has to grow in excess of 4% per annum. This is critically dependent on the utilization of existing idle capacity particularly in irrigation sector[5]. The 1990s witnessed decline in irrigated area coverage by surface irrigation systems. Deferred maintenance has crippled the capacity of created irrigation infrastructure to perform to its optimum potential in spreading the water equitably and efficiently.

Poor productivity of water (Fig.1)[6]; under-utilization of area irrigated; non-utilization of full irrigation potential created; heavily subsidized surface and ground water irrigation; all contribute to the sub-optimal growth of irrigated agriculture across states. Consequently, in several states like Andhra Pradesh, Haryana, Uttar Pradesh, Tamil Nadu, Rajasthan, Orissa and Madhya Pradesh, consolidation/restructuring programmes have been taken up[7]. The primary social development goal is to ensure equitable distribution of irrigation water with maximum efficiency in its use through modernized assets, rehabilitated infrastructure and institutionally strengthened turned-over systems.

Land and water are critical assets for rural livelihood security. Water is scarcer than land in most of the India's surface irrigation commands. The percentage of rural poor comes down from 54% of the population in the landless group to 40% in sub-marginal holdings with less than 0.5 ha land. Even small availability of irrigation, sufficient to irrigate one-fifth of the land area in sub-marginal holdings, can further bring down poverty to 27%[8]. Furthermore, marginal impact of irrigation on poverty incidence falls with higher irrigated area share, implying the effectiveness of extensive irrigation in reducing poverty. Improving equity in irrigation water distribution will therefore be a win-win situation. For instance, besides achieving equitable water delivery and efficient water use, higher crop productivity, intensity and income are realized following the irrigation management transfer (IMT) in many gravity, tank and lift systems in Maharashtra, Gujarat and Tamil Nadu[9] as well as in Orissa[10].

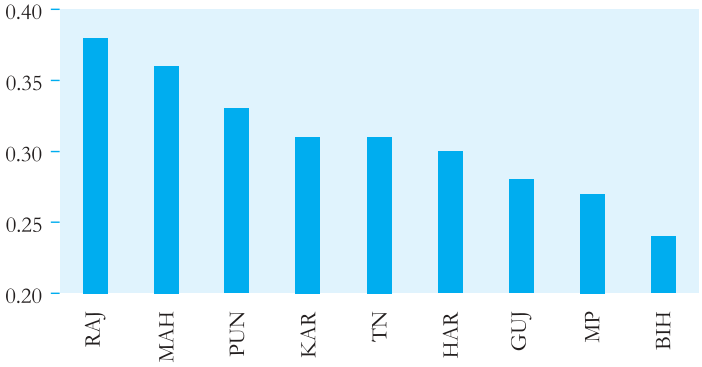

Fig.1 Water productivity, food grain equivalent, kg/m³

Equity Analysis

Inequity in irrigation development can arise from within and across the regions or states. Cross-sectional database was drawn from all India report on agricultural census for the years 1970/71, 1976/77, 1980/81, 1985/86, 1990/91 and 1995/96 compiled by the Ministry of Agriculture, Government of India. Farm size and state wise data are standardized to five categories namely, less than 1 ha, 1-2 ha, 2-4 ha, 4-10 ha and more than 10 ha for assessing inequity. This study covers 16 major states and nine small states and union territories.

Using Theil's information theoretic measure, spatial and temporal analysis of inter-farm size inequity in irrigation distribution was done; and further, it was decomposed into 'between' and 'within states'. Rawlsian criterion distributes the irrigation water according to lexicographic ordering starting from the smallest farm holdings, by fulfilling their needs, followed by the next smallest and so on[11]. When every farm-size group receives exactly the amount of water they are supposed to receive, then the value of Rawlsian distribution (R) will be zero. Theil's information theoretic measure is applied to estimate the levels of unfairness in distribution using Rawlsian notion of fairness in distribution as the benchmark for comparison[12].

Temporal Impact

The temporal status of irrigation equity across farm size household categories (Fig.2) highlights (i) Theil's measure of equity in the current distribution of flow and lift irrigated areas (TMI-FL) and

(ii) Theil's measure of equity in flow and lift irrigated areas expected under Rawlsian distribution (TMIR-FL) of canal water.

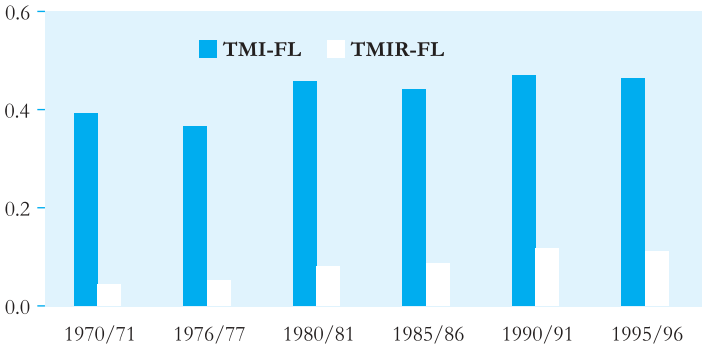

Fig.2 Temporal equity index for flow & lift irrigation, India

Equity index for the current distribution of flow and lift irrigated areas for India (TMI-FL) indicates mixed trends during 1970s to 1990s, declining marginally within decades and increasing marginally between decades. This is mainly attributed to lack of consistency in the water resource development policies pursued[11]. During this period, inequity in the current distribution of flow and lift irrigated areas for the country has gone up by around one-fifth. The inequity in water distribution on one hand fails to irrigate part of the land, gives insufficient supply to some part of the land and often causes damage to some lands due to over irrigation and consequent problems of water-logging and salinity. Currently, in 40% of the irrigated farm holdings owning less than 0.5 ha, equitable access to irrigation water is critical for reducing poverty to 27%. Failing which, realizing India's X FYP target of overall reduction of poverty ratio to 10% by 2012 shall remain an uphill task.

Adopting a discriminatory policy of distributing canal irrigation water in favour of small holders by Rawlsian approach, reduced the irrigation inequity across farm sizes substantially by over 3/4th as compared to that of current distribution. With 62% of the irrigated farms owning less than 1 ha, their participation in irrigation water management can promote equity in water distribution.

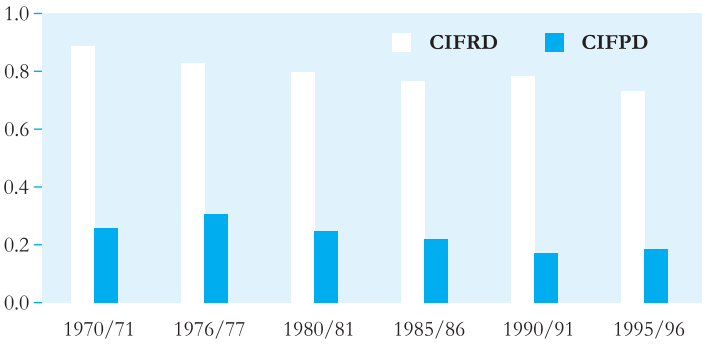

Fig.3 Temporal equity index for canal irrigation, India

The temporal status of canal irrigation equity across farm sizes in India (Fig.3) explains the deviation of current canal irrigation distribution from (i) Rawlsian distribution (CIFRD) and (ii) proportional distribution (CIFPD). Current canal irrigation distribution deviates substantially from Rawlsian distribution. Comparison of TMIR-FL and CIFRD indicates the scope for reducing the irrigation inequity substantially in canal irrigation systems. In proportional distribution, water gets allocated in proportion to farm area. Deviation of current canal irrigation distribution from proportional distribution has declined consistently during 1971-96. The emerging questions from the foregoing analysis, are; (i) How efficiently the proportional distribution of irrigation water is enforced spatially and (ii) What are the sources for the distributional inequities? In answering them lies the pathway for future strategies.

Spatial Impact

The spatial status of inequity in the distribution of flow and lift irrigated areas by states (Fig.4) for the latest available year (1990/91) brings out (i) current levels of inequity (TMI-FL); and (2) expected inequity with Rawlsian distribution (TMIR-FL) of canal water.

Wide inter-state variation in inequity exists in the current distribution of flow and lift irrigated areas. Maximum inequity was observed in Kerala and least in Gujarat. This depends on the level of surface and ground water development and other watershed related conservation programmes for conserving *insitu* rainfall, which interacts with each other to determine the inequity in the distribution of irrigated area.

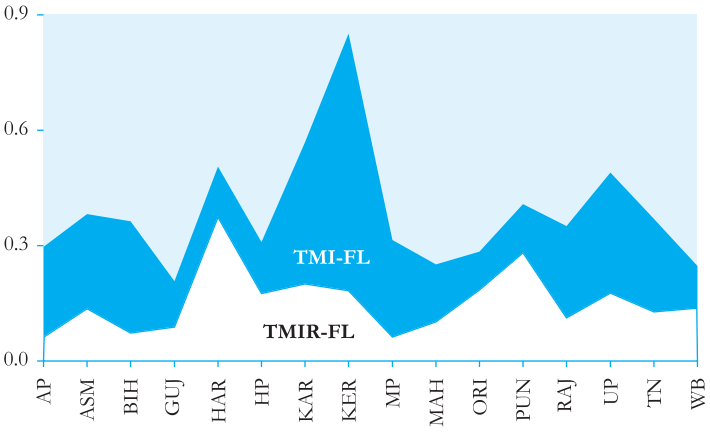

Fig.4 Spatial equity index for flow and lift irrigation, 1990/91

Following the Rawlsian distribution brought down the inequity levels significantly across states. Least inequity in Madhya Pradesh and maximum inequity in Punjab and Haryana are observed. If most of the water potential is already exploited as in the case of Punjab, then the existing distribution of farm area and not the distribution of irrigated area *per se* will determine the irrigation inequity levels. The spatial irrigation equity index reveals the deviation of actual distri-bution of canal-irrigated area from proportional distribution policy (Fig.5). The magnitude of unfairness in the existing canal water distribution is high in states like Maharashtra, Andhra Pradesh, Bihar, Rajasthan, Gujarat, Assam, Kerala, Madhya Pradesh and Orissa.

The deviation of actual distribution of canal irrigated area across farm sizes from the proposed proportional distribution in 1990/91 highlights differing realization of the targeted irrigated area distribution under proportional distribution policy. The physical condition of the irrigation system and enforcement of proportional distribution policies play an important role in these inter-state differences. Physical degeneration of irrigation infrastructure with no user involvement in the irrigation system management makes the implementation of proportional distribution of water, less effective. At least eight of these states have gone for irrigation infrastructure rehabilitation as a part of

major water sector consolidation/restructuring programmes during 1990s to enhance the productivity of water through equitable distribution of water.

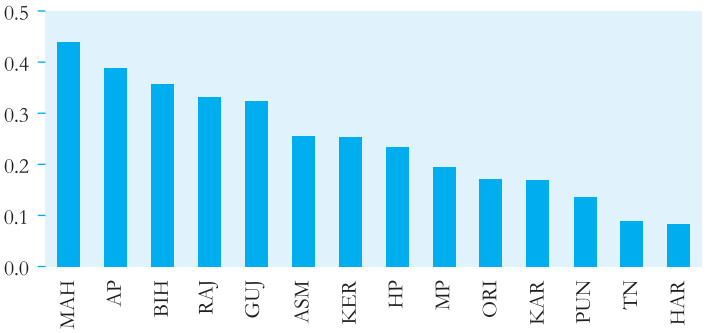

Fig.5 Spatial equity index for Rawlsian distribution, 1990/91

Sources of Inequity

Inequity in irrigated area distribution emanates from two sources; one, inequity in the distribution of irrigation development across states and two, inequity in the distribution of irrigated area across farm sizes within the state.

Decomposition of inequity in selected irrigation attributes is done to estimate both the sources of inequity namely; 'within the states' (WISTS) and 'between the states' (BESTS) for 1971-91 (Table. 1).

Inequity in net irrigated area has gone up during 1971-91 and contribution of WISTS variation in the distribution of net irrigated area has come down from 81.5% to 73.2%. Canal irrigated area retained its inequity levels during this period, but the contribution towards the inequity from WISTS has come down from 75% to 60.1%. Despite this reduction, the share of WISTS in overall inequity is still high. More potential exists to bring down the inequity in the distribution of canal irrigation water

Table.1 Temporal analysis of sources of irrigation inequity

Irrigation attributes	1970/71		1990/91	
Net irrigated area by	Mean Inequity	WISTS (%)	Mean Inequity	WISTS (%)
Canals	0.331	75.0	0.317	60.1
Tanks	0.208	35.2	0.231	18.9
Wells	0.302	36.4	0.423	30.4
Tube wells	0.379	26.1	0.407	34.9
Total	0.298	81.5	0.324	73.2
Flow irrigated area	0.304	76.6	0.302	61.5
Lift irrigated area	0.360	46.4	0.405	45.4

by targeting efficient inter-farm allocations. Source wise inequity estimated for the net irrigated area by tanks, wells and tube wells revealed an increased inequity in 1991. But major source for this inequity comes from BESTS variations in the distribution of tank, well and tube well irrigation facilities. BESTS variation accounted for 65% to 81% of the estimated distributional inequity levels in these irrigation sources. It should be noted that most of these irrigation sources are location specific as determined by the agro-climatic and ground water hydrology characteristics. Incase of all flow-irrigated area, intra-state contribution to the overall inequity has come down from 76.6% to 61.5%. Relatively, the scope for reducing inequity in flow-irrigated area exists more within the states than for lift-irrigated area.

Strategies and Responses

For comparing the relative equity performance of irrigation sources, inequity index of non-canal irrigated area (NCIA) and canal irrigated area (CIA) is estimated for 1991 (Fig.6).

An index value of less or more than unity indicates better performance of NCIA or CIA respectively in promoting equitable distribution of irrigation benefits across the farm sizes. In states like Maharashtra, Madhya Pradesh, Gujarat, Orissa and Andhra Pradesh, canal irrigated area provides better option for improving the overall equity in irrigation distribution. Over 60% of the current inequity in canal irrigation distribution is coming from within the states source. Therefore, equitable distribution of irrigation water among the farm categories within the state assumes greater significance in these states to reduce overall inequity in irrigation distribution. States like Rajasthan, Kerala, Punjab, Haryana and West Bengal registered less than unity value for the index during 1991. Relatively, distribution of NCIA has contributed more for

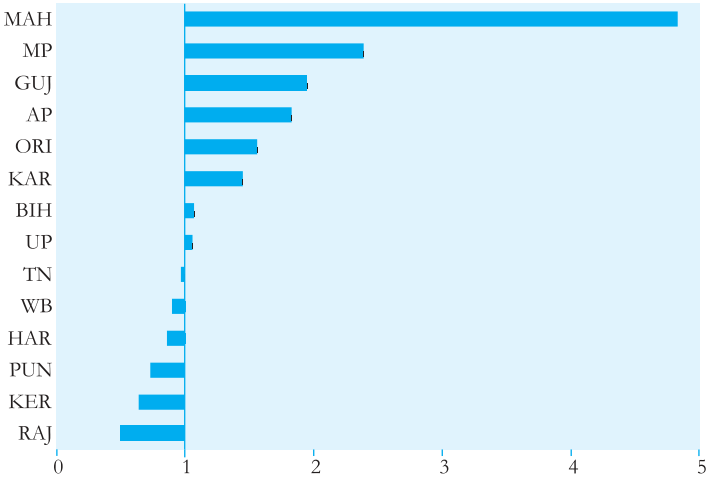

Fig.6 Spatial relative equity index, 1990/91

improving the equity in irrigation distribution as compared to that of CIA in these states. Around 3/4th of the inequity in NCIA distribution has come from within the states, once again highlighting the necessity of targeting the equitable distribution of irrigation among the different farm categories within the state. This calls for spatially differentiated strategies by states and irrigation sources to specifically target distribution of irrigation benefits equitably. Moving towards a decentralized, people oriented and demand driven water management with user involvement is the only way to address the irrigation inequity within the state.

Institutional Reforms: Several states have responded to the inequitable distribution in irrigation sector. Participatory irrigation management (PIM) has evolved in phases; (i) studying outlet based water user organizations for maintaining the micro-systems (1975-85), (ii) piloting PIM in irrigation projects (1985-90), and (iii) turning over irrigation systems, distributaries/ minors to the users (1990s). Since then, despite several policy initiatives taken (Box.1) towards IMT, matching legal and institutional changes is found wanting.

Water Rights: With increasing competition for the scarce water, establishing secure water rights regime has become critical. Both internal water rights within the user group as well as external water rights of the group to be exercised against every one outside the group has to be recognized in law and rules framed for equitable access to irrigation water[15].

Box.1 Participatory Irrigation Management (PIM)

With National Water Policy (2002) emphasizing on PIM, countrywide initiatives followed. Several states have enacted exclusive legislation or amended their irrigation acts for enabling PIM. Over 41000 Water User Associations are formed covering 86.8 lakh ha of land. Turning over of systems' management is achieved in varying degrees and positive outcomes are emerging. In Orissa, 2345 pani panchayats are formed covering 46% of surface irrigation potential and irrigation management is transferred to 62% of them. Following PIM, crop diversification to floriculture and vegetables in Ghodahada and Bhaskel and increased cropping intensity in Pitamahal and Salia irrigation projects are observed[10]. In Andhra Pradesh, 70% of the maintenance and rehabilitation works got implemented directly by farmers[13]. However, fully turned over systems and hence potential impacts of IMT are yet to be realized. Increased irrigated area, water use efficiency, water charges and recovery are reported following IMT in Maharashtra[14]. Even 10% improvement in the utilization of harnessed water resources would translate in to 14 m ha of additional irrigated land.

Accountability: As a sequel to water rights, accountability for delivering water to the user groups has to be defined and responsibility fixed by transforming the irrigation department into an irrigation service provider.

Functionality: The functions of fully empowered Water Users Associations (WUAs) include acquisition, distribution and efficient utilization of water, maintenance and repairs of irrigation infrastructure, fixation and collection of water charges and conflict resolution. Further to make these user groups functionally sustainable and economically viable and binding, they have to become the focus of intervention for technology development, farm extension, marketing and credit.

Integration: WUAs also need to be linked with local institutions for extending their role beyond water management. Apex committee of pani panchayats is represented in the District level procurement committee in Orissa for facilitating direct paddy marketing to Orissa State Civil Supplies Corporation. Such linkages could be institutionalized for accessing credit, technology, extension and market.

Regulation: Substantial proportion of the irrigation related investments in the states are funded by GOI. This provides necessary leverage for regulating secured water rights based on accountable and functional institutional set up effectively interfacing with rural development institutions for enhancing equity and efficiency in irrigation water utilization.

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