INFRASTRUCTURE DEVELOPMENT AND STRENGTHENING FOR SUSTAINABLE LAND AND WATER RESOURCES USE AND MANAGEMENT

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1. Introduction

The macro economic constraints of early nineties left with us a little option but to accept the new policy initiatives. Naturally, the policy was tuned towards Structural Adjustment Programme followed by a massive process of liberalisation. It cannot be denied that these changes took place under the suggestions from IMF and World Bank. During the first phase, reforms were much slower than envisaged and therefore the results were not dramatic. In either cases, the critics had indicated that the results of the New Economic Policy would not be dramatic owing to the structure of the markets and market imperfections that exist in the country. In addition to these, the reforms were slow in achieving quick results because of the low level of infrastructural development. Therefore, the pre-requisite of success of the reform was placed at the doorstep of infrastructural positivism. Certainly, market and domestic reform processes should have backed this.

It was soon realised that during the second phase of reforms, we need to take infrastructural sector seriously keeping in view the required sustainability of the rate of growth. This was a tedious task as the investment in infrastructure comes mainly from public sources and therefore there was an urgent need of allocating larger resources for the infrastructural sector. The difficulty in finding such resources was well known. Attracting private investment in infrastructure was a far cry and it required demonstrated profitability in the sector. This was a difficult task and failure of ENRON was a clear indicator of incapability of private sector in getting infrastructure

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development on growth path. The failure was more due to institutional interface with polity than economic viability. Therefore, that does not reflect on the necessity of infrastructure in the development process. It is well explained in the literature that infrastructure can be an engine of growth or rather the most important shift parameter in the growth curve. A good number of constraints will dominate even after infrastructural development is accomplished. Land and water resources are the major resources to be dealt and converted into productive inputs for the purpose of sustainable development. These two important resources are double edged resources. These can spur a very good growth pattern but at the same time can disturb the environment and ecology to a large extent. Therefore, sustainability of resource use becomes an important component along with infrastructural development. The emerging scenario therefore requires managing of land and water as crucial resources for agricultural sector along with other infrastructural development.

This paper tries to review the process of infrastructural development as reflected by the historical trends in the country. We have argued on a theoretical plain the infrastructure as the shift parameter. The sustainability of land use is dealt in the following section. We have argued that the land use pattern requires a careful planning for sustainability and least environmental externalities. The final section looks into the water resources and its impact on sustainability.

2. Importance of Infrastructure

Having realised the importance of infrastructure to achieve faster rate of economic growth, the Government of India as well as the State Governments have ventured into making heavy investment in agricultural infrastructure especially from the First Five-Year Plan onwards. The major focus of infrastructural investment has been on irrigation, transportation, electric power, agricultural markets, etc and these not only contributed to the agricultural growth at the macro level but also to wide disparity between different regions in terms of agricultural growth. Since the responsibility of providing infrastructure is with the state which aims at rapid growth of agricultural production for attaining other kinds of developmental goals such as poverty alleviation, there exists a tendency among the decision-makers to invest heavily in those areas where there is a potential for fast agricultural growth. This is also supported by the financial resources available with the concerned governments.

Therefore, the bias in decision-making and the financial strength of different governments also determine the level of infrastructure in different regions, leading to imbalance in the agricultural growth as well as regional development. This being the case, the major objective of the present paper is to highlight the role of infrastructure in accelerating agricultural development. This will facilitate the policy makers to take up some normative measures to address issues in infrastructural development.

One of the central questions in the economic growth paradigm is how different factors of production contribute to aggregate output. This contribution is made by income earned by the factors of production, which, in a perfectly competitive economy, will equal their marginal value products in the absence of externalities. This has important policy implications in terms of appropriate level of investment in different sectors, since the market will tend to provide capital in response to price signals, which reflect private benefits and ignore externalities. If there are large externalities, there is a need for government intervention to achieve more efficient allocation of resources, though government intervention itself has its own costs. The fact that infrastructure services are often provided by the public sector means they are often not priced at all, or are rationed, and we have difficulty even in estimating the private productivity of infrastructure capital.

The strong positive correlation between the level of infrastructure and the economic development has been a well-established fact in the development economics literature. In Keynesian macroeconomic model, the income or the output in the economy derives also from the level of investment made in the economy. It should be noted that out of all the four factors contributing to income of a nation namely, consumption expenditure, investment expenditure, government expenditure and net income from abroad, income from investment comes both from investment expenditure especially by private individuals as well as from government spending. Though the income in the Keynesian model refers to short-term income, usually measured on annual basis, the investment made also includes long-term investment such as investment in basic infrastructural facilities. Since the model is based on the notion that there is a direct positive correlation between income and the investment, investment in infrastructure is economically justified.

While discussing different stages of growth of the economy, Rostow (1960) argues that expansion and improvement of the transport and the infrastructure is considered as a necessary pre-condition for capital formation and increase in the production and productivity. Given the fact that the investment in infrastructure impacts positively on economic development, the supply of the infrastructure has to match with the demand for it so that no dis-equilibrium arises – which ultimately results in any imbalances between and within a region.

The theory of infrastructure derives mainly from the public goods theory in economics. The investment on basic infrastructure generates lot of benefits that posses the characteristics of public goods. Two major characteristics are worth mentioning here: (a) 'non-excludability' character which implies that nobody in the 'user group' can be excluded from consuming the benefits from the infrastructural facilities unless or until a strict enforcement is enacted to exclude certain individuals. Even if somebody can be excluded through enforcement from utilising the benefits, the transaction cost of doing so would be a costly option and therefore, the decision would be economically non-viable. For example, it would be a costlier option to prevent a farmer in the downstream of a newly constructed irrigation dam from utilising the groundwater recharged by dam; and (b) 'non-rival' consumption of the benefits in the sense that the consumption of the benefits by one individual does not result in affecting the consumption of same benefits by another individual unless or until a negative externality problem such as water pollution arises. For example, consumption of the service provided by water and utilised by a particular agent (say, industry utilising the disposal service of the river) does not affect the consumption of another service utilised by some other agent (say, farmer utilising water for irrigation purpose) unless they are encountered with excess level of water pollution. Hence, infrastructure is a social capital that positively affects larger society, in the absence of externality.

A considerable number of studies have been done to understand the relationship between different kinds of infrastructural indicators and economic development, in different parts of the world. The following table summarises the findings of some of these studies.

Table-1: Summary of Infrastructure Studies

Author	Focus/Relevance	Key findings
Aschauer (1989).	Evaluates the effect of public investment on the growth of private inputs, and in turn, the effect of input growth on output growth. Author views public capital and private capital as substitutes in production.	Increase in public investment expenditure of $1 billion is found to crowd out between $1 to $1.5 billion of private investment expenditure. Author interprets this to mean that firm managers appear to take directly into account the availability of public capital for use in private production.
Aschauer (1990)	Considers the relationship Between aggregate productivity and stock and flow government-spending variables.	The nonmilitary public capital stock is more important in determining productivity than is either flow of non-military or military spending.
Aschauer (1998)	Looks at the role of public infrastructure capital in economic growth of 46 developing countries. Develops and empirically implements a growth odel. In growth model, output depends on private capital, human capital, and public capital.	Finds empirical support for the importance of infrastructure provided, an efficient financing system exists.
Cummings et al. (1986)	Use late 1970s panel data set of dollar value of investment in SMSAs to study the responsiveness of wages to municipal infrastructure.	Measure of responsiveness is -.035. Survey findings of this variable range from -.037 to -.04.
Deno (1988)	Considers effect of infrastructure on growth path of regional private manufacturing.	Finds water and sewers have the largest effect in expanding regions, while highways have the largest effect in declining regions.
Diamond (1990)	Uses "denison growth accounting approach" to examine evidence on the contribution that public capital expenditure makes to the growth of developing countries.	Concludes that while current private capital expenditures for directly productive purposes exert a positive influence on economic growth, public capital expenditure appears to exert no influence.

(Contd)

Ethier (1982)	Discusses economies of scale in regional factors and their contribution to international trade.	Suggests exports may depend on regional efficiency.
Ford & Poret (1994)	Examine the relationship between infrastructure and economic development. Utilize data for 12 OECD countries.	The study finds weak support for Aschauer's hypothesis that boosting infrastructure investment promotes economic growth. In particular, the regression results are not sufficiently robust to provide much support for the policy of a sharp rise in infrastructure investment.
Fox & Murray (1990)	Focus on startup and relocation of business establishments within county areas of Tennessee in response to presence of infrastructure.	Long-run policy, as evidenced through providing infrastructure, is an important accommodating factor for economic activity. The rate of new-firm entry is higher where interstate highways are present, but the responses are small.
Garcia-Mila (1989)	Estimates real GNP components, including government purchases.	Concludes that state and local purchases have positive multiplier effect while military purchases do not.
Garcia-Mila, McGuire (1992)	Find that with every dollar of education spending output increases by 16.5 cents.	Investigate the productive contribution of publicly provided Goods and services, highways, and education in particular. Output increases 4.5 cents for every dollar increase in highway spending.
Glomm & Ravikumar (1992)	Build a growth model with Infrastructure as an external input into private production functions.	Show that public infrastructure negatively affects the cost function.
Harmatuck (1996)	Examines the influence of transportation infrastructure on economic development.	Finds the aggregate output response to net nonmilitary public investment is about .03.
Holtz-Eakin & Schwartz (1994)	Examines the role of infrastructure in a "structural model of economic growth".	Find little support for dramatic productivity boost from increased infrastructure outlays. In a statistical specification designed to provide an upper bound for the influence of infrastructure, the authors estimate that raising the rate of infrastructure investment would have had a negligible impact on annual productivity growth between 1971 and 1986.

(Contd)

Holtz-Eakin And Lovely (1996)	Study productivity and economies of scale of public infrastructure. Also consider returns to variety.	Find public capital elasticity of manufacturing output is .637. Public capital elasticity on non-manufacturing output is .360. Find productivity effects only in manufacturing sector. In the non-manufacturing sector, infrastructure may increase the number of firms (variety) and, thus, output.
Hulten & Schwab (1991)	Consider the possibility of Over investment in infrastructure.	Note that correlation between growth and public capital exists but suggest no causation.
Hulten & Schwab (1997)	Discuss the role of the bond Market on financing infrastructure growth.	Conclude public investment reduces private costs.
Lynde & Richmond (1991)	Illustrate the cost reducing effect of public capital on the private sector.	Find that the marginal product of public capital is positive and that constant returns to scale is supported when public capital is included in the production function.
Martin & Rogers (1995)	Consider model with increasing returns to scale with various infrastructure types.	Find that regional policies affecting domestic firms leads to high growth, while policies subsidizing international firms cause domestic firms to exit the market.
Morrison & Schwartz (1992)	Examine the relationship between state infrastructure and productive performance.	Find that infrastructure investment does provide a significant direct benefit to manufacturing firms and thus augments productivity growth.
Munnell (1990)	Explores "significant contribution" of public capital investment on national output, productivity, growth, and international competitiveness at the state and regional level.	Concludes that those states that have invested in infrastructure tend to have Greater output, more private investment, and more employment growth. Author's findings suggest that public investment comes before the pickup in economic activity and serves as a base.
Nadiri & Mamuneas (1991)	Consider the productivity of public capital and research and development using a production function with these inputs.	Find positive effect of infrastructure investment on growth, at the same time that infrastructure investment is declining.

(Contd)

Neill (1996)	Uses a growth model to study the responsiveness of output to growth.	Suggests that output's responsiveness to infrastructure should determine optimal infrastructure investment.
Nijkamp (1986)	Focuses on the role of infrastructure in a regional development strategy. Uses different statistical techniques and a so-called quasi-production function to show importance of infrastructure.	The extent to which infrastructure contributes to regional development varies over time and depends on the overall level of economic welfare. The statistical results demonstrate a high degree of correlation among successive infrastructure indicators. Also, the results demonstrate that densely populated industrialized areas tend to have higher network infrastructure endowment than peripheral, agricultural, and less densely populated areas.
Rubin (1990)	Reviews infrastructure/ productivity issues.	Finds a weak link between growth and Infrastructure and recommends caution in developing public policy that "pumps" money into infrastructure.
Shah (1992)	Using data from Mexico to construct a production function that mirrors circumstances in developing countries with imperfect markets, credit rationing, and price controls, examines the effect of infrastructure on output.	Finds an infrastructure elasticity of output equal to .046.
Stover (1987)	Discusses infrastructure's effect on the supply of housing using pooled data on 64 MSAs from 1973 to 1982. Also measures private costs of infrastructure.	Finds housing quality variables sensitive to a number of infrastructure variables.
Wylie (1996)	Studies aggregate growth attributable to infrastructure changes in Canada from 1946 to 1991; also considers marginal productivity of inputs.	Finds marginal product of labor is .54. Marginal product of capital is .213, and marginal product of infrastructure is .248. All are diminishing.

Source: Fox and Porsa (undated).

In summary, a reasonable conclusion is that infrastructure and agricultural output are complements, at least in part because improved infrastructure allows the combination of all firms to reach a higher optimal level of output. The somewhat inconsistent findings in the research can be attributed to several factors. The aggregate nature of data used in the studies mixes industries (including agriculture) where infrastructure is complementary with industries where infrastructure is substitutable with labor. Another is the studies use widely different methodologies and databases. Also, researchers define substitutes and complements in different ways. Infrastructure is found to have a positive effect on agricultural output and employment. Since this relationship is well established and has implication on the regional imbalances, it is essential to look into the trends in infrastructural development across states in the country vis-à-vis agricultural growth. There are a few states/regions which could derive benefits out of the growth of infrastructure but the regions left out are obviously the areas requiring larger investment and policy attention. Further it becomes necessary to test the hypothesis linking infrastructure to quality and structure of growth.

3. Infrastructure Development in India:

Let us first look at the basic infrastructural facilities in India that are closely correlated with the human development. It should be noted that in India, there exists lot of variation in terms of access to sanitation facilities both within the states as well as across the states. As per the 1991 population census, only around one fourth of the households in this country had toilet facilities. The situation in rural areas was worse with only around 10 percent of the households having access to wastewater discharge facilities in the premises of their households. A wide variation in the access to sanitation facilities has been found across different states in the country. The sewage water contaminating the local drinking water sources, in many cases, further causes deterioration of the existing health related problems among the rural poor and urban slum dwellers. According to World Health Organisation, around 70 percent of the common diseases in developing countries are caused mainly by the contaminated water. The underlying policy implication is that provision of good quality drinking water and sanitation facilities itself will improve the health status of the people tremendously and therefore, the existing health policies should be expanded to cover the negative

consequences of not providing good quality drinking water and sanitation (See Table-2).

Table-2: Infrastructure Availability for Weaker Section: 1991.

	Scheduled Caste			Scheduled Tribe			Others		
	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban
Percentage of Households having safe drinking water	63.60	59.84	80.59	43.21	41.11	65.71	64.10	56.40	81.99
Percentage of Households having Toilet facilities	11.16	5.15	38.28	7.22	4.10	40.68	28.63	11.52	68.33
Percentage of Households having both Safe Drinking Water and Toilet facilities	8.61	3.35	32.34	3.35	2.02	28.16	22.13	6.73	57.92

Source: Census of India: 1991.

One of the questions often confronted by the policy-makers is to arrive at the process of getting out of 'low-level equilibrium trap' that challenges sustainability as well as efficiency of many of the water supply and sanitation programmes. This low level of equilibrium trap is characterised by lower generation of revenue, which leads to poor quality services. This in turn leads to low level of preferences, which thereby causes to low level of willingness to pay and finally leads to low level of revenue. Many of the studies conducted by donor agencies found that reliability of water supply and sanitation services play an important role in achieving the sustainability of these services. However, the sustainability as such depends on the availability of the financial resources to the implementing agencies. Apart from the schemes that are sponsored by the international donors, implementation of other schemes depends mainly on their own resource base and therefore, the policy makers have to find out new sources of revenue. One of the major sources of revenue is the user-fees collected from the users. However, it is found that the existing level of user fee in many cases is *not* adequate to cover even the cost of providing these services.

However, the sustainability, equity and equality of provision of basic infrastructural facilities depend mainly on one particular aspect namely, efficiency. Efficiency is a driving force that, to some extent, helps to achieve equity and equality especially in the area of access to basic amenities such as health care facilities, water

supply, sanitation, etc. For instance, when financial efficiency is achieved through increased tariff rate, more number of users including the poor of the society could be covered by the services which will maximize the overall benefits. When it comes to the question of payment to the service enjoyed by the users, the policy makers always encounter with a question namely, whether the poor should also pay for the services so that the equity and equality in payment should be achieved. This is a subjective question which falls beyond the purview of economics. Moreover, the government intervention with the underlying welfare state principal should ensure that the poorer section gets the benefits of the services in an equitable manner. However, one of the important questions that we need to ask is whether or not the poor is willing to pay for the basic services that they enjoy. The answer to this question comes clearly from the findings of empirical studies in the area of water supply, sanitation and health conducted during the past three decades in various developing countries especially by the World Bank and other organizations. The findings of these studies suggest that the willingness to pay for basic services are not influenced by the income and therefore, even the poorer section of the society is also willing to pay for the services they enjoy. This means that there are so many other factors which influence the households' willingness to pay and the policy makers have to take into account these factors while formulating policies on provision of local public goods. The factors influencing the household's willingness to pay includes reliability of the service, level of education, nature of the service at present, gender, etc. Hence, the question of equity concerns are very much embedded in understanding the preferences of the households for different levels of services of basic amenities.

In the case of infrastructural facilities that directly impact on the agricultural development at the regional level, the following table highlights the level of provision of some of the important infrastructural indicators.

Table-3: Important Infrastructural Indicators in Major States in India.

Major States	Railway Route (in KM)	Road length (in Kms. 1997)	Total Villages Electrified (1996-97)	% of villages having any communication facilities (1991).	Total Number of Animal Operated Implements (1992)	No. of Wholesale Markets (2000)	No of Cold Storage (2001)
Andhra Pradesh	5135	178012	26565	56.82	78858	861	200
Assam	3442	68418	18999	25.7	21929	35	13
Bihar	5362	88352	47832	20.5	88846	813	203
Gujarath	5312	90896	17927	86.75	40241	396	327
Haryana	1548	28164	6759	75.69	14666	284	201
Himachal Pradesh	269	30193	16635	44.3	12377	35	17
Jammu & Kashmir	96	21446	6301	NA	15483	NA	18
Karnataka	3024	144012	26663	67.24	86917	473	102
Kerala	1050	145704	1384	99.78	2400	NA	163
Madhya Paradesh	5965	200137	67496	19.7	133876	616	186
Maharashtra	5459	361893	40412	63.42	23682	857	385
Orissa	2309	262703	32825	16.14	50135	144	75
Punjab	2139	64352	12428	59.84	11773	675	390
Rajasthan	5926	129674	33554	33.2	46614	410	87
Tamil Nadu	4188	206503	15822	77.51	27938	270	111
Uttar Pradesh	8889	255467	87079	20.72	158113	645	1129
West Bengal	3760	75435	29271	26.49	59039	555	386

Source: Computed from various sources.

An analysis of various agricultural infrastructure indicators such as railway route length, road length, villages electrified, different types of communication facilities, number of agricultural animal operated implements, fertiliser consumption per hectare, pesticides consumed, etc, has been made to analyse the relative performance of different states in India (Table-3). The analysis reveals that there exists a disparity between different states in terms of level of infrastructure. In otherworlds, different states perform differently in terms of various kinds of infrastructural indicators. Since there is a strong empirical evidence to show that the level of infrastructure determines the economic development of a particular region, the regional disparities in the food production and employment generation that contribute to overall development can be attributed to lack of or adequacy of infrastructural development. Though, in absolute terms, the

performance of some of the states in terms of many of the infrastructural indicators is relatively superior to other states, there exists lot of scope for improving the infrastructural provision in the agricultural sector in these states. Since the agricultural sector in the states contributes around 37 percent of the gross domestic product (GDP) and half of the rural population in the state depends on the agricultural sector, infrastructural bottlenecks can be a major constraint in alleviating the overall poverty in the state. Keeping this in mind, the state government has to continue to invest in rural infrastructural facilities. Apart from this, the government should develop necessary institutions to attract private investment in some of the areas where there is a scope for the private sector to play a role. Having argued for enhancing the level of agricultural infrastructure in the state, we then went on to analyse the infrastructural adequacy or inadequacy in different districts of Karnataka so that one could derive some policy conclusions about which district and infrastructure indicator need immediate attention.

4. Land Resources and Sustainability

Land is the major natural resource in any developing nation and India is not an exception. Equity and equality in land distribution is one of the main objectives of land policy since independence. Land policy in India has been under discussion even prior to independence and especially following the infamous Deccan Riots. One of the important issues on which the peasants backed the independence movement was the land to the tiller policy promised by the then Congress party. In order to keep the promise Congress Party appointed a Committee, under the Chairmanship of Late Shri J C Kumarappa to look in to the problem of land distribution. The Kumarappa Committee gave its report and it was during that time the discussions on land reforms began world over in different countries. There were three important issues confronting the policy makers then. First, land was concentrated in the hands of a few and there was a proliferation of intermediaries who had least interest in self-cultivation of land. Naturally leasing-out land was a common practice. This had affected efficiency as well as distribution. Second, the tenancy contracts were expropriative in nature and the tenant exploitation was ubiquitously prevalent. Land market did not provide open access. Third, the records of land were in extremely bad shape giving rise to large

number of litigations. All these factors reflected inequity in ownership and access to land resources.

Historically, India's land revenue system emerged from the Mughal rule, the only rulers then who had control over larger area of the country. Over the years land policy manifested through two different administrative regimes namely the Mughal System and the British Indian administrative system. Therefore, India had a curious admixture of different processes in land administration. Akbar's attempt to replace the system of assigning revenue of specified areas to officers as their pay by cash salaries, had a very limited success and totally lapsed during the following regimes. (Dharmakumar, 1970). Two important players dominated the agrarian relations namely the *ryot* (peasant) and the *Zamindar* (land master) and the State dealt with these to the advantage of optimising revenue. As Sir John Shore explained, "The relation of a *zamindar* to government and of a *ryot* to *zamindar* is neither that of a proprietor nor a vassal but a compound of both. The former performs acts of authority unconnected with property rights. The latter has rights without real property and the property of one and the rights of the other are in a measure held at discretion." (Quoted in Dharmakumar, 1970; p. 13). During the Mughal period land policy was formulated in clear terms, as land was the major source of revenue. Land policy was more synonymous to land revenue policy. The Adilshahi in the Deccan region of the country and the Mughals from Delhi established a systematic network of land revenue collection through various designated officers. *Marathas* followed this system in western India. In the South the kingdom of Vijayanagaram, Mysore State and the governments of Travancore and Cochin had the Ryot*wari* system in line. Despite the four variants the land policy and revenue system had worked effectively for quite some time till the British came into power in the country. The British rulers continued with the existing land revenue policy and procedures with a few but significant modifications. British India had typically areas with different agrarian relations and the shades ranged from a complete feudalistic production relations to the *Ryotwari* system (peasant proprietorship). From the north beginning with the Awadh and the *Khalasa* system of land policy in Punjab to the *Zamindari* and *Mirasdari* systems of Central and the *Ryotwari* of the south. Each of these systems dictated a differential emergence of land policy across the country during British regime and surprisingly even in independent India. A review of various document reveal various shades of the

emergence of land policy in the country across the provinces (states). This indicates a myriad of the agrarian relations in India, varying from peasant proprietorship to a pure land-lord serf kind of relationship. At the time of independence India had a major challenge to set right the agrarian structure as promised during the struggle of independence. Therefore, the first task before the first Indian parliament was to address the land policy. The driving force of this policy frame was to ensure equitable distribution and free access to land market. Keeping in tune with this theme, the Constitution of India while recognising the need to bring about land reforms in the country provided under Article 39 of the following:

i. That the ownership and control of the material resources of the country should be so distributed as best to serve the common good, and
ii. That the operation of the economic system does not result in concentration of wealth and means to production to the common detriment.

This particular article of the Indian Constitution was the basis for thinking on the redistribution of land and consequently land reforms in the country. Under the Constitution of India, the States are assigned responsibility of land administration and land reform, whereas, at national level the Department of land resources in the central Ministry of Rural Development has a mandate to address land administration and land policy issues.

Broadly there are three significant phases that mark the changes in the land policy in India. Though the theme changed during the five decades the core issues are still revolving around the just distribution of land resources. Land reforms and community development came more or less together and these interventions were meant to provide means of production to the millions of poor who were either lacked access to resources or did not have the required know-how to use them. Initially policy was focussed more on bringing under efficient cultivation the land that was left unused. Reforms focussed on taking away the land rights of the intermediaries who held large share of the land resources. Close on the heels were the tenancy reforms that began on the hypothesis of 'tenant efficiency' and an expected increase in the capital formation due to tenancy legislations. In addition to these economic goals, the tenancy reforms were taken as an intervention to provide the right to land to the

tenant who were always at a receiving end. Access to cultivated land was the focus. Thus abolition of intermediaries and tenancy reforms formed the first phase of reforms. The ceiling on land holding followed this. These were addressed to reduce the concentration of wealth in the hands of a few and providing means of living to others. Second important intervention came in the form of the area-based programmes like Drought-prone area Programme and Desert Development Programme. Both the programmes focussed on augmenting the land resources in these ecologically fragile regions and to provide employment opportunities to the inhabitants. The third important land policy intervention came from the policy emphasis on soil and water conservation through a massive watershed development programme. This programme ran parallel to the Wasteland Development Programme that intended to restore the ecology and environment in drought prone areas.

Abolition of intermediaries was taken to bring under cultivation the unused land and providing access to land to the landless. This component of the reform was quite successful but could not eliminate the intermediaries who were unrecorded. Therefore, the success was confined to only selected regions. The major aspects of tenancy reforms included security of tenure, termination of tenancy, resumption for personal cultivation by the landlord, regulation of rent, and confirmation of ownership rights. Various state laws were enacted between 1960 and 1972. These differed across the states and territories. Owing to the diverse and complicated nature of social and agrarian structure in the countryside, no uniform legislations could be enacted across the states in the country. The consensus on the policy of tenancy reforms favoured neither complete expropriation of landlordism nor favoured interest of the tenants. In the national guidelines the following measures were communicated to the state governments for incorporating in the State level legislation:

- Security of the tenancy to be conferred on the actual cultivator.
- Fair rent to be fixed between 1/4th and 1/5th of the gross produce.
- Landowners may be permitted to cultivate land for the personal use.
- The surrender of the tenancy rights with mutual consent.
- In respect of some of the area, the landlord tenant nexus to be ended and the tenant cultivator be brought directly under the contact with the state.
- The disabled persons, the defense personnel and such exemptions be provided.

- The term personal cultivation be clearly defined if land were to be resumed for cultivation.
- The correct the record of tenancy and abolishing oral tenancy all together.

Table 3.1 shows the changes in land leased in by various groups of cultivators. During the three decades, it can be observed that the concentration of leasing land is higher in the higher size classes. This provides empirical evidence to the reverse tenancy hypothesis. But overall, the incidence of tenancy has reduced. The experience across States however differs significantly.

Table 3.1:Changes in Leasing of Land in India: 1961 to 1991

(Percent of total)

Sl No	Farm category	1961 – 62		1970 - 71		1980 – 81		1990 - 91	
		No of Holdings	Area	No of Holdings	Area	No of Holdings	Area	No of Holdings	Area
1	Marginal	24.1	16.6	27.0	18.9	14.4	9.7	9.3	8.7
2	Small	25.1	14.0	27.8	14.6	17.9	8.5	14.9	8.5
3	Semi-Medium	23.6	11.7	24.8	11.7	15.9	7.3	12.2	7.4
4	Medium	20.5	9.6	20.9	8.7	14.5	6.6	13.1	6.9
5	Large	19.5	8.3	15.9	5.9	11.5	5.3	16.7	11.4
6	All Sizes	23.5	10.7	25.7	10.6	15.2	7.2	11.0	8.3

Source: National Sample Survey Organisation of India, Report No 407 of 48th Round, 1995 pp. 28-29.

Table 3.2: Distribution of Operational Holdings and Area: All India

(Percent of total)

Sl. No	Category of Holding	1970 – 71		1980 - 81		1985 – 86		1990 - 91	
		No of Holdings	Area	No of Holdings	Area	No of Holdings	Area	No of Holdings	Area
1	Marginal (Less than 1 ha)	50.6	8.9	56.4	12.1	57.8	13.4	59.4	15.0
2	Small (1 to 2 ha)	19.1	11.9	18.1	14.1	18.4	15.6	18.8	17.4
3	Semi-Medium (2 to 4 ha)	15.2	18.5	14.0	21.2	13.6	22.3	13.1	23.2
4	Medium (4 to 10 ha)	11.2	29.7	9.1	29.6	8.2	28.6	7.1	27.1
5	Large (Above 4 ha)	3.9	30.9	2.4	23.0	2.0	20.1	1.6	17.3
	Total (No. of holdings in Millions Area in ha. Million)	70.5 (100.0)	162.1	88.9 (100.0)	163.8 (100.0)	97.2 (100.0)	164.5 (100.0)	106.6 (100.0)	165.5 (100.0)

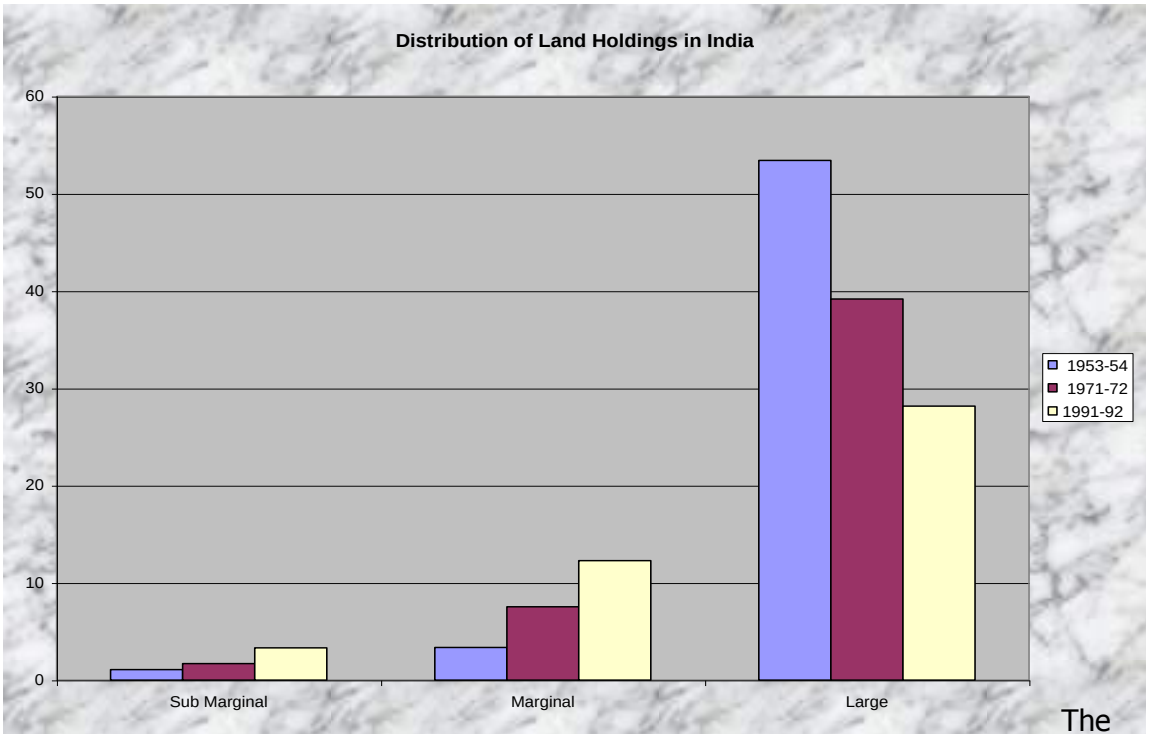
Source: Agricultural Statistics at a Glance, Directorate of Economics and Statistics, Govt. of India, For various years.

Table 3.3:Trends in Distribution of Operational Holdings in Rural India: Major States

(Area % to total)

States	*Sub-Marginal Holdings*	*Marginal Holdings*	*Large Holdings*
Andhra Pradesh	2.96	14.58	21.41
Assam	7.50	26.74	5.28
Bihar	8.27	20.74	11.62
Gujarat	1.29	5.82	44.27
Karnataka	1.12	8.44	34.76
Kerala	23.24	30.03	4.63
Madya Pradesh	0.67	6.03	35.04
Maharashtra	0.75	5.91	38.81
Orissa	3.83	18.27	9.92
Punjab	1.21	4.99	37.69
Rajasthan	0.83	4.73	55.62
Tamil Nadu	7.55	21.39	9.28
Uttar Pradesh	5.39	19.57	10.90
West Bengal	11.83	28.15	1.52
All India 1953-54	1.07	3.36	53.41
1971-72	1.69	7.53	39.17
1991-92	3.32	12.28	28.16

Source: Report on Landholdings (4 &5) 8th Round1953-54, NSS Report No. 66, Report on Some Aspects of Landholdings; 26th Round 1971-72, NSS Report No. 215. Report on Some Aspects of Operational Holdings (1); 48th Round, 1991-92, NSS Report No. 407.



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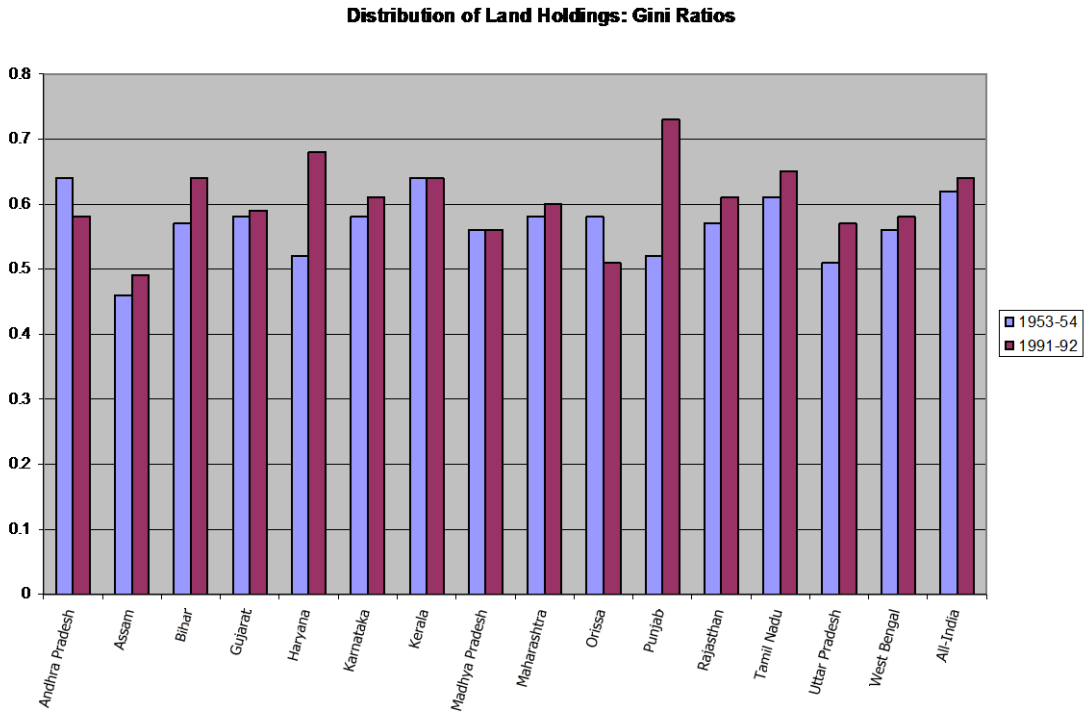
Land distribution at the time of independence was extremely skewed and 53 percent land was held by 7 percent large holdings, whereas 28 percent of sub-marginal and marginal holdings owned about 6 percent area (see the figure giving distribution). The land distribution even within the States was also quite skewed and that can be seen from the Lorenz ratios of 1952-53. The ceiling on land holding was felt essential out of three economic compulsions. First, there was a strong argument about inverse size-productivity relationship. Thereby hinting that the aggregate production efficiency gets hampered due to land locked under large holdings. Second, it was believed and supported with evidence that large holders of land leave land fallow thereby leaving land unused. Third, there were large population of land based poor who wanted to have land as an economic resource for their livelihood. The surplus land could be distributed to such poor people. Finally the general position in favour of the ceiling was based only on the concentration of social justice and equity and not on the grounds of increasing production and developing agriculture.

The ceiling laws were enacted and enforced into phases first beginning at 1960 and the second at 1972. The loopholes that existed in the first phase of legislations were corrected during the second phase. Among the major loop holes that existed in the ceiling acts of various states included the high ceiling limits, retrospective transfers, large number of exemptions, and the basis of fixation of ceiling limits. The national guidelines were prepared during the Chief Minister's conference held in July 1972. But all the states modified or used their own laws which were enacted earlier. Probably the guidelines were too flexible and accommodative to cover the variations in the state specific legislations. Among various factors that featured the debate were the definitions of family, transfers, and standard holding, ceiling area and exempted categories. All these matters complicated the process of implementation.



The distribution of land holdings as reflected by the index of inequality (Gini Ratios) indicates increased inequality between 1953-54 and 1991-92. This is certainly due to the fact that large holdings are declining at a fast rate. But at the same time there is tremendous increase in the marginal and sub-marginal holdings. Abolition of intermediaries and Ceilings on the land holdings have contributed to this trend significantly. One can however note the differential impact across the states. Therefore, the Gini ratios are different in the magnitude as well as direction of change. The state legislations more or less conformed to the national guidelines so far as fixation of the ceiling limits and distillation of surplus land are concerned.

Table 3.4:Ceiling Limits on Land Holdings of Different States

(In hectares)

States	Irrigated Land with Two Crops	Irrigated Land with one Crop	Dry Land
Andhra Pradesh	4.05 to 7.28	6.07-10.93	14.16-21.85
Assam	6.74	6.47	6.74
Bihar	6.07 to 7.28	10.12	12.14-18.21
Gujarat	4.05 -7.28	6.07-10.93	8.09-21.85
Haryana	7.25	10.9	21.8
Himachal Pradesh	4.05	6.07	12.14-28.83
Jammu&Kashmir	3.6-5.06		5.95-9.20
Karnataka	4.05-8.10	10.12-12.14	21.85
Kerala	4.86-6.07	4.86-6.07	4.86-6.07
Madhya Pradesh	7.28	10.93	21.85
Maharashtra	7.08	10.93	21.85
Manipur	5	5	6
Orissa	4.05	6.07	12.14-18.21
Punjab	7	11	20.5
Rajasthan	7.28	10.93	21.85-70.82
Tamil Nadu	4.86	12.14	24.28
Sikkim	5.06		20.23
Tripura	4	4	12
Uttar Pradesh	7.3	10.95	18.25
West Bengal	5	5	7
Ceiling Suggested in National Guidelines of 1972	4.05-7.28	10.93	21.85

Source: Agricultural Statistics at a Glance-2001, Ministry of Agriculture and Cooperation, Govt of India, New Delhi

The entire emphasis of Ceiling on land holding was to detect surplus land which was above economic holding size, acquire that and redistribute it among the landless who require such economic base. However, among the measures taken for efficient utilisation of land resources this component failed on both counts namely acquiring the surplus land and as the acquisition was meagre the distribution was also insignificant. A government document accepts that "It is widely recognised that the chief reason for the poor implementation of land reforms has been the lack of political will. It would not be surprising to expect so, if we appreciate the realities of the rural situation and development of Indian politics" (quoted in Rao, 1990). Even the micro level studies noted that land tribunals' functioning was not very transparent and doubts were raised about the functioning of the non-official members (Thimmaiah and Aziz, 1983). Despite the limited success in redistribution of surplus agricultural land, ceiling laws have

succeeded in keeping a check on concentration of land in the hands of a few. The surplus land distributed does not form even 2 percent of the total net operated area. Large number of experts now agree that implementation of ceiling laws especially possession and redistribution of surplus land is no longer an option for engendering social equity.

4.1 Land: Poverty and Policy Issues

The nexus between the land policy initiatives and growth is quite clear. Though one cannot implicate one to one correspondence between land policy and growth the available evidence is significant enough to suggest such nexus. A paper by Besley and Burgess gave a robust evidence of a link between poverty reduction due to tenancy reforms and abolition of intermediaries. They also inferred that land reforms also benefited the landless (Besley and Burgess, 2000). In this context VM Rao's observation is quite pertinent. He wrote "This identification is based on three premices about the role of land reforms and common lands in the emerging development strategy. First, they have to serve as a link helping integration of growth policies with poverty alleviation programmes. Such integration is necessary to focus the development strategy as a whole - and not merely the individual schemes and programmes - on the rural labourers and poor. Second, at the ground level, land reforms and improved access to common lands need to be part of a package of measures specifically designed to the requirement of different sub-groups of rural labourers and poor. Third, the ultimate goal of land reforms and other structural reforms is to promote the emergence of a viable and modernised peasantry consisting of small farmers and providing as much room as possible for the landless to enter the peasant sector" (Rao, 1990). Therefore, land policy though looks distanced from the direct impact on the rural poverty has a significant influence on it.

Land policy intervention and their perceived impact can be located in five different perspectives. The process of land distribution and land access policies have a poverty alleviating impact. But the intensity depends upon the process of implementation. Equity or conflict resolution is another dimension of land policy. It was noted that this goal is achieved to a large extent. The other three aspects namely

environmental management, sustainable economic growth and production efficiency show mixed impact (see table 3.6).

Table 3.5: Policy Interventions and Their Perceived Impact

Policy Interventions	Poverty Alleviation	Conflict Management/ Equity	Environmental Management	Sustainable Economic Growth	Production Efficiency
Abolition of Intermediaries	Neg	Sig	Par	Sig	Sig
Tenancy Reforms	Sig	Sig	Neg	Par	Sig
Ceiling on Size of Holding	Sig	Sig	Neg	Sig	Par
Consolidation of Holdings	Neg	Neg	Par	Par	Sig
Computerisation of Land Records	Neg	Sig	Neg	Neg	Par
Drought prone Area Development Programme and Desert Development Programme	Par	Neg	Sig	Sig	Par
Waste Land Development	Par	Neg	Sig	Sig	Rar

Note: impact levels are perceived as Sig - Significant, Par - Partial, Neg - Negligible

The policy interventions in India's Land Policy during the last five decades could be seen from the point of view of their impact on various parameters. These were looked from the point of view of the impact on alleviation of poverty, conflict management and equity, sustainable economic development, environmental impact and production efficiency. It was noted that the interventions have varying impact across the States and depending up on the agrarian situation. Among the policy options discussed in the recent past roll back land ceiling laws assumed prominence. It is argued that the ceiling limits do not provide for a viable land size for a family. As there are no limits on investment in other sectors why agriculturist should face a restriction on increasing the size of holding. Economically viable size of holding is the crux of present crisis. But given the present political and administrative climate in the country this seems to be a difficult option. Where efficiency of small and large farms is found more or less equal, it is necessary to allow size of holding which can generate the investable capital in agriculture sector. The second policy option discussed strongly in a countrywide debate is the desirability of making legal the agricultural tenancy and renting in land. Among the arguments put forth the pro-poor impact of legalising the tenancy has gained ground. It is felt that majority of the beneficiaries will be smaller marginal farmers. Presently there's no protection to the tenant as well as to the landlord.

4.2 Towards a Land Policy and Land Use Monitoring Framework

i. The concept of land reforms may have to be reviewed in line with the concepts of New Economic Policy. Although abolition of tenancy has been ideal among the land reform instruments, it is debatable whether the tenancy can ever be entirely abolished even when the man-land ratio in agriculture is favourable for its abolition. Variety of circumstances may necessitate its continuance to some extent in all situations. Even if the redistribution of land is carried out, every rural family cannot possibly be given a piece of land sufficient to provide subsistence. In the short run, only a realistic course of policy is to recognise the inevitability of some tenancy and to legalise and promote the most productivity oriented form of tenancy and not to attempt to outlaw it. Empirical research is required to determine the precise manners in which alternative tenancy arrangements effect input use and productivity.

ii. The classification and maintenance of land records of rights should be given high priority and land records should be constructed before any field level investment planning is taken up in the micro-watersheds. The land use planning recognises the capability of land resources for alternative uses, but their social benefit-cost calculations vary depending on the ownership. For this reason, a clear demarcation of biosphere reserves, production forests, community lands, urban green belt and private level on a priority basis.

iii. The State Land use Boards are organised in some of the states but these do not function effectively as a coordinating and supervising agency of the State Government in ensuring land resources management, development, and conservation. The Land Use Boards should have technical and managerial staff of proven ability to prepare annual action plans for training of extension personnel and coordinate different departmental activities in the implementation of the action plans for agricultural development. The Boards should also function as a regional resource centre for management of the Production Management Information System (PMIS) at the State level.

iv. The Panchayat Raj Institutions should be the grass-root agency for developing the operational (investment) plans for promoting the desired land use at the micro-watershed level.

v. It is necessary to decentralise land revenue administration and the social development programmes like drinking water, primary education, and health care to a constitutional self-government closer to the people. For this purpose adequate financial autonomy has to be ensured to the proposed on Panchayat Raj Institutions and an adequate law and order machinery that should go with it if it is to function effectively as a constitutional third tier of government for micro-ecology development through land use planning.

vi. For effective land use, capability classification of the FAO system of land evaluation has to be preferred to USDA system. The land use survey organisation should be decentralised to district or even taluk level to suggest most appropriate land use and a data card maintained for each holding.

vii. Environmental protection laws which relate to acts as cutting trees should be made more stringent and the growth of the appropriate species on land should be supported by incentives in favour of growing the recommended crop or trees and disincentives for departures from recommended land use. Such a package of incentives and disincentives should be carefully worked out.

viii. The watershed development programme should be implemented in three phase namely resource conservation, resource development and resource utilisation with human interface. The programme should ensure farmers participation in the development activities including in its financial components. This will ensure equity and access to better quality of land resources.

ix. Instead of Govt. incurring the expenditure on development of wastelands, the responsibilities should be left to the farmers under the technical prescription of the Department of Agriculture. If the farmers do not undertake the presented advises, it has got to be undertaken by the Department and the cost should be treated as a loan at nominal interest rate.

5. Irrigation and Sustainability

Irrigation constitutes the main component of water use in rural areas. The question of access, equity and equality in water resources gets directly to the use of irrigation water. Though area under irrigation has increased considerably over the years in India, an important issue of who is benefited among the farmers from irrigation expansion is not adequately addressed covering relatively larger period. In order to make proper planning for irrigation development in the future, there is a need to find out answers to the questions such as: Has the expansion of irrigation benefited small farmers? Have the inter-class differences in irrigation widened or narrowed? What is the regional (state) distribution of irrigation by farm size? Keeping this is in view, an attempt is made in this section to find out the irrigation development by farm size. Agricultural Census of India has been publishing source-wise irrigation data by farm size once in five years since 1970-71. Currently data are available for five time points: 1970-71, 1976-77, 1980-81, 1985-86 and 1990-91. These data provide good basis to ascertain access and equity in distribution of irrigation.

5.1 Surface Irrigation Development by Farm Size:

Though the area under irrigation has increased significantly since independence, the growth rates in the expansion are not the same across different size group of farmers. In view of this, we have made an attempt to analyse the development of irrigation across different sources by farm size. Development of surface sources like canals and tanks by farm size is the major source of irrigation. Area under canal and tank irrigation by farm size for five time points is presented in Table 4.1. Our aim here is not only to find out the growth of irrigation by farm size but also to study the inter-class variation over years. Canal irrigation, which is predominantly controlled by the government agencies, has increased from about 12.17 mha in 1970-71 to 15.67 mha by 1990-91, with a growth rate of 1.27 percent per annum at the national level. However, the growth is not the same among different size class of farmers. While the area under canal irrigation increased at a rate 3.24 percent per annum among the marginal farmers, the same declined at a rate of 1.15 percent among the large farmers. In fact, the growth of canal irrigation is inversely related with farm size between 1970-71 and 1990-91. The marginal size group has not only

gained considerably in terms of growth of area under canal irrigation but also gained in terms of percentage to total canal area when compared with the other groups. This disproves the common argument that the canal irrigation benefits mostly the large and resourceful farmers. But such disapproval has to be read with the fact that holding size is always small in the assured irrigated area. The inter-class difference in area under canal irrigation has declined only marginally between 1970-71 and 1990-91, which is shown by coefficient of variation (CV).

Unlike canal irrigation, tank irrigation, which is a user-friendly and low cost source of irrigation, has declined at a rate of 0.85 percent per annum between 1970-71 and 1990-91, at the national level. However, tank area has increased at a rate of 1.22 percent per annum among the marginal farmers during this period. Except in the group of marginal and small farmers, the area under tank irrigation has declined among all other size groups. Since the reliability of tank irrigation has declined over the years due to various reasons, farmers belonging to semi-medium, medium and large, who are relatively rich, may have gone to other sources like groundwater irrigation. As a result, area under tank irrigation may have declined among these groups of farmers. Since the marginal farmers are poor and they cannot afford to have other sources like groundwater, their area under tank has been increasing over the years, despite persistent decline in area under tank irrigation at the national level.

5.2 Groundwater Irrigation Development by Farm Size:

The growth of area under groundwater irrigation is entirely different from the growth pattern seen in surface irrigation sources. Not only the total area under groundwater irrigation has increased considerably between 1970-71 and 1990-91 but a positive growth has been seen across all size group of farmers (see, Table 4.2). Area under groundwater irrigation is seen to have increased at a rate of over 5 percent per annum among the marginal and small size groups, whereas the same increased only at a rate of 2.87 percent and over one percent respectively among the medium and large size group. A uniform growth of groundwater irrigation taken place across different size of farmers has also reduced the inter-class variations considerably between 1970-71 and 1990-91.

While looking at the area under groundwater irrigation separately by wells and tube-wells, we could see different kind of growth pattern among various categories of farmers. Although area under tube-wells has increased considerably among all categories of farmers over the last twenty years, the same trend is not seen with area under well (dug) irrigation. Area under wells registered a marginal increase of 0.94 percent per annum among the marginal size group, while the same recorded a negative growth of 0.20 percent among the large size group during the period 1970-71 to 1990-91. We have expected that due to rapid expansion of tube-well technology, area under wells would have declined among all categories of farmers. However, against our expectation, it increased at a rate of nearly 2.50 percent per annum among the small and semi-medium category of farmers. Though there are differences in growth rate between wells and tube-wells, not only the area under groundwater (wells + tube-wells) has increased over 5 percent per annum among the marginal and small category farmers, but their share in the total groundwater area has also increased considerably during the last twenty years period considered for the analysis.

5.3 Net and Gross Irrigated Area by Farm Size:

After having analysed the source-wise development of irrigated area by farm size, we have made an attempt to study the trends in net and gross irrigated area. Table 4.3 presents the net and gross irrigated area by farm size for all five time points. It is clear from the table that net irrigated area recorded a growth rate above 3 percent per annum among the marginal and small size category of farmers during the period 1970-71 to 1990-91. However, at the same time, net irrigated area recorded a negative growth of 0.13 percent per annum among the large size farm category. As observed in canal and groundwater area, the growth of net irrigated area is found to be inversely related with the size of farm in net irrigated area between 1970-71 and 1990-91. The share of irrigated area of marginal and small farmers to total net irrigated area has also improved considerably during this period. The growth pattern of gross irrigated area across farm size is similar to the pattern observed in the net irrigated area. The only major difference between the net and gross irrigated area is that the growth of gross irrigated area recorded at a rate 0.68 percent per annum among the large size category, but it was found to be negative in the net irrigated

area. This indicates increase in cropping intensity among the larger size of holding compared to the other groups.

Apart from analysing the absolute area under irrigation by farm size, there is also a need to compare the irrigated area in relation to cultivated area. In fact, percentage of irrigated area to net sown area or gross cropped area is considered to be one of the appropriate indicators for judging the irrigation development by farm size. Table 4.4 presents percentage of irrigated area to net sown area by farm size for all five time points. It is evident from the table that percentage of NIA to NSA is inversely related with farm size in all five time points. While the NIA to NSA was

Table 4.1: Area Under Canal and Tank Irrigation by Farm Size: 1970-71 to 1990-91

Major Size Classes	Canals					ACGR (%)	Tanks					ACGR (%)
	1970-71	1976-77	1980-81	1985-86	1990-91		1970-71	1976-77	1980-81	1985-86	1990-91	
1. Marginal (< 1 ha)	1769 (14.53)	2234 (18.43)	2696 (18.76)	3095 (20.49)	3348 (21.37)	3.24	737 (21.00)	742 (23.25)	941 (28.24)	805 (28.92)	940 (31.79)	1.22
2. Small (1-2 ha)	1991 (19.14)	2268 (18.71)	2656 (18.48)	2865 (18.96)	3061 (19.54)	2.17	668 (19.03)	627 (19.64)	742 (22.27)	636 (22.84)	682 (23.06)	0.10
3. Semi-medium (2-4 ha)	2714 (26.09)	2909 (24.00)	3360 (23.38)	3514 (23.26)	3645 (23.27)	1.49	800 (22.79)	730 (22.87)	753 (22.60)	638 (22.92)	654 (22.12)	-1.00
4. Medium (4-10 ha)	3477 (33.42)	3197 (26.37)	3778 (26.29)	3775 (24.99)	3851 (24.58)	0.51	828 (23.59)	732 (22.93)	636 (19.09)	509 (18.28)	503 (17.01)	-2.46
5. Large (>10 ha)	2221 (21.35)	1515 (12.50)	1883 (13.10)	1858 (12.30)	1762 (11.25)	-1.15	477 (13.59)	361 (11.31)	260 (7.80)	196 (7.04)	178 (6.02)	-4.81
All Total	12172 (100.00)	12123 (100.00)	14373 (100.00)	15107 (100.00)	15667 (100.00)	1.27	3510 (100.00	3192 (100.00)	3332 (100.00)	2784 (100.00)	2957 (100.00)	-0.85
CV	27.94	27.04	25.29	24.51	26.26		19.95	25.37	37.87	40.85	47.25	

Notes: ACGR - Annual Compound Growth Rate is 1990-91 over 1970-71; CV – Coefficient of Variation;
Figures in brackets are percentage to total area.

Source: GOI, *All India Report on Agricultural Census* (various years), Ministry of Agriculture, Government of India, New Delhi.

Table 4.2: Area Under Groundwater Irrigation by Farm Size: 1970-71 to 1990-91

(Area in '000 ha)

Major Size Classes	Wells					ACGR (%)	Tube-wells					ACGR (%)	Total Wells					
	1970-71	1976-77	1980-81	1985-86	1990-91		1970-71	1976-77	1980-81	1985-86	1990-91		1970-71	1976-77	1980-81	1985-86	1990-91	ACGR
1. Marginal (<1 ha)	842 (12.63)	806 (13.06)	858 (12.25)	885 (15.41)	1015 (11.17)	0.94	677 (13.98)	1270 (21.24)	1793 (18.59)	2579 (19.54)	3319 (22.59)	8.27	1519 (13.20)	2076 (17.09)	2651 (15.92)	3464 (18.29)	4334 (18.23)	5.38
2. Small (1-2 ha)	975 (14.62)	904 (14.65)	1036 (14.79)	1136 (19.78)	1611 (17.73)	2.54	742 (15.32)	1142 (19.10)	1698 (17.60)	2457 (18.61)	3013 (20.51)	7.26	1717 (14.92)	2046 (16.84)	2734 (16.42)	3593 (18.97)	4624 (19.44)	5.08
3. Semi-Medium (2-4 ha)	1459 (21.88)	1390 (22.53)	1647 (23.51)	629 (10.95)	2311 (25.43)	2.33	1159 (23.94)	1519 (25.40)	2341 (24.27)	3266 (24.74)	3555 (24.20)	5.76	2618 (22.74)	2909 (23.94)	3988 (23.95)	3895 (20.56)	5866 (24.67)	4.12
4. Medium (4 -10 ha)	2036 (30.53)	1973 (31.98)	2254 (32.18)	2035 (35.43)	2845 (31.31)	1.69	1535 (31.70)	1553 (25.97)	2661 (27.58)	3526 (26.71)	3442 (23.43)	4.12	3571 (31.02)	3526 (29.02)	4915 (29.52)	5561 (29.35)	6287 (26.44)	2.87
5. Large (>10 ha)	1357 (20.35)	1097 (17.78)	1210 (17.27)	1058 (18.42)	1305 (14.36)	-0.20	729 (15.06)	496 (8.29)	1154 (11.96)	1373 (10.40)	1364 (9.28)	3.18	2086 (18.12)	1593 (13.11)	2364 (14.20)	2431 (12.83)	2669 (11.22)	1.24
All Total	6669 (100.00)	6170 (100.00)	7005 (100.00)	5743 (100.00)	9087 (100.00)	1.56	4842 (100.00)	5980 (100.00)	9647 (100.00)	13201 (100.00)	14693 (100.00)	5.71	11511 (100.00)	12150 (100.00)	16652 (100.00)	18944 (100.00)	23780 (100.00)	3.69
CV	35.16	38.04	39.94	46.35	41.25		38.32	35.72	30.42	31.80	30.74		35.77	31.90	32.53	29.92	29.97	

Notes: ACGR - Annual Compound Growth Rate is 1990-91 over 1970-71; CV - Coefficient of Variation;

Figures in brackets are percentage to total area.

Source: GOI, *All India Report on Agricultural Census,*(various years), Ministry of Agriculture, Government of India, New Delhi.

Table 4.3: Area Under Net and Gross Irrigation by Farm Size: 1970-71 to 1990-91

(Area in '000 ha)

Major Size Classes	Net Irrigated Area						Gross Irrigated Area					
	1970-71	1976-77	1980-81	1985-86	1990-91	ACGR (%)	1970-71	1976-77	1980-81	1985-86	1990-91	ACGR (%)
1. Marginal (<1 ha)	4393 (15.09)	5606 (18.79)	6872 (18.67)	8062 (19.92)	9457 (20.69)	3.91	5390 (15.09)	6693 (18..88)	8467 (17.88)	10659 (20.03)	13215 (21.43)	4.59
2. Small (1-2 ha)	4741 (16.29)	5425 (18.18)	6618 (17.98)	7656 (18.92)	9085 (19.88)	3.31	5833 (16.33)	6419 (18.11)	8193 (17.31)	9970 (18.73)	12075 (19.58)	3.71
3. Semi-Medium (2-4 ha)	6604 (22.69)	7133 (23.91)	8713 (23.67)	9684 (23.93)	10971 (24.00)	2.57	8147 (22.81)	8622 (24.32)	11201 (23.66)	12821 (24.09)	14505 (23.52)	2.93
4. Medium (4 -10 ha)	8332 (28.63)	7980 (26.75)	9873 (26.83)	10360 (25.60)	11286 (24.69)	1.53	10231 (28.64)	9447 (26.65)	13158 (27.79)	13551 (25.46)	14866 (24.11)	1.89
5. Large (>10 ha)	5037 (17.31)	3693 (12.38)	4727 (12.84)	4700 (11.62)	4905 (10.73)	-0.13	6116 (17.12)	4268 (12.04)	6325 (13.36)	6227 (11.70)	6998 (11.35)	0.68
All Total	29107 (100.00)	29837 (100.00)	36803 (100.00)	40462 (100.00)	45704 (100.00)	2.28	35717 (100.00)	35449 (100.00)	47344 (100.00)	53228 (100.00)	61659 (100.00)	2.77
CV	28.15	27.80	27.06	27.20	27.89		28.33	28.62	28.50	27.04	25.78	

Notes: ACGR - Annual Compound Growth Rate is 1990-91 over 1970-71; CV - Coefficient of Variation;
Figures in brackets are percentage to total area.
Source: GOI, *All India Report on Agricultural Census,* (various years), Ministry of Agriculture, Government of India, New Delhi.

43.6 per cent among the marginal size farmers, the same was found to be only half of this amount among the large size category in 1990-91. The size effect certainly plays a dominant role. The same trend is observed at all other four-time points as well. However, the growth in share of irrigated area is almost positively related with the farm size. For instance, while the growth of percentage of irrigated area recorded a growth rate of 2.78 percent among the large size category, the same was only 1.28 percent per annum among the marginal size farmers between 1970-71 and 1990-91.

Table 4.4: Percentage of Net Irrigated Area to Net Sown Area.

Size Class	1970-71	1975-76	1980-81	1985-86	1990-91	ACGR (%)
1. Marginal (< 1 ha)	33.8	37.5	40.2	42.8	43.6	1.28
2. Small (1-2 ha)	27.9	30.6	32.7	34.3	35.7	1.24
3. Semi-Medium (2-4 ha)	25.2	26.6	29.3	30.7	32.8	1.33
4. Medium (4-10 ha)	20.4	20.3	24.2	26.1	29.7	1.90
5. Large (> 10 ha)	13.0	12.4	16.3	18.8	22.5	2.78
All Size Class	21.4	23.2	26.9	29.4	32.6	2.13
CV	32.64	37.74	31.46	29.38	23.61	

Notes: ACGR - Annual Compound Growth Rate is 1990-91 over 1970-71.
CV - Coefficient of Variation.
Source: GOI, *All India Report on Agricultural Census* (various years), Ministry of Agriculture, Government of India, New Delhi.

This is entirely different from the results arrived using (absolute) area under irrigation. On the whole, what is clear from the above is that though the growth of area under irrigation across different sources is inversely related with the farm size category, the growth of percentage of irrigated area to net sown area is positively associated with the farm size category. In other words, access to the sources of irrigation has been free, however distribution generates the problems about equity. The access as well as equity in irrigation is governed mainly by the ownership of land and land based assets. However, as irrigation brings down the economic viability threshold on the scale of land holding, the small and semi-medium farmers get larger benefits.

5.4 Irrigation Expansion by Farm Size Across States:

Access, equity and the impact of irrigation varies across regions in the country. From the policy view point it is pertinent to analyse these aspects across states. Since the agro-climatic conditions in each state are different, the results arrived at the national level in respect

of irrigation expansion by farm size may not be the same with the states. Therefore, we have made an attempt to study and compare the irrigation development by farm size across the states by taking data covering two time points: 1970-71 and 1990-91. Our main objective here is to study the growth pattern of different sources of irrigation by farm size. Table 4.5 presents state-wise and source-wise area under irrigation by farm size for two time points mentioned above. Looking first into the growth pattern of canal irrigation by farm size across the states, it is seen that out of 15 states considered for the analysis, except five states (Jammu and Kashmir, Kerala, Punjab, Tamil Nadu and West Bengal), the growth of canal irrigated area is inversely related with the farm size in all other states between 1970-71 and 1990-91. Both in Punjab and Tamil Nadu, which have relatively more area under canal irrigation, the area under canal irrigation declined at a rate of over 3 and 6 percent per annum respectively among the marginal size category.

The growth pattern of tank irrigation is not uniform across different farm size groups and states. Since tank irrigation is an important source in South Indian states, a specific look at Andhra Pradesh, Karnataka and Tamil Nadu provides some clues. Even in these three states, the growth pattern of tank irrigation is found to be different. The growth of area under tank irrigation is found to be inversely related with the farm size in Andhra Pradesh, but a mixed growth pattern is seen across farm size in Tamil Nadu. One thing is clearly emerging out from Table 5 is that the area under tank irrigation recorded a positive growth in majority of the states among the marginal farmers category between 1970-71 and 1990-91, as noticed at the national level.

Unlike tank irrigation, a positive rate of growth in area under total well irrigation is observed across farm size in most of the states, as observed at the national level. The growth rate of total well irrigation is inversely related with the farm size in almost all the states, except in Orissa and Punjab. While the growth rate of total well irrigation is positively related with the farm size in Punjab, the same has declined in all categories of farm size, except semi-medium, in Orissa.

Table 4.5: Statewise and Sourcewise Area under Irrigation by Farm Size : 1970-71 and 1990-91

(Area in '000 ha)

State	Farm Size	1970-71							1990-91							ACGR : 1990-91 over 1970-71						
		Canal	Tank	Well	T.well	Total well	NIA	GIA	Canal	Tank	Well	T.well	Total well	NIA	GIA	Canal	Tank	Well	T.well	Total well	NIA	GIA
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
1. Andhra Pradesh	< 1 ha	277	209	39	5	44	547	653	586	365	147	66	213	1208	1506	3.82	2.83	6.86	13.77	8.20	4.04	4.27
	1-2 ha	270	182	51	6	57	526	626	444	279	203	73	276	1043	1252	2.52	2.16	7.15	13.31	8.21	3.48	3.53
	2-4 ha	329	218	80	10	90	665	793	436	268	243	93	343	1090	1289	1.42	1.04	5.71	11.80	6.92	2.50	2.46
	4-10 ha	369	259	120	14	134	799	956	328	213	226	100	266	911	1053	-0.59	-0.97	3.22	10.33	3.49	0.66	0.48
	> 10 ha	185	217	110	11	121	533	635	80	70	90	40	462	295	326	-4.11	-5.50	-1.00	6.67	6.93	-2.91	-3.28
	Total	1430	1085	400	46	446	3070	3663	1874	1195	909	372	1560	4547	5426	1.36	0.48	4.19	11.02	6.46	1.98	1.98
	CV	24.27	12.73	44.29	40.23	43.78	19.21	19.40	50.31	45.62	34.56	31.93	30.69	39.54	41.82							
2. Bihar	< 1 ha	146	15	53	50	103	414	484	406	49	84	315	399	1137	1194	5.25	6.10	2.33	9.64	7.01	5.18	4.62
	1-2 ha	141	13	39	43	82	368	435	194	23	44	196	240	599	702	1.61	2.89	0.60	7.88	5.52	2.47	2.42
	2-4 ha	211	26	55	69	124	551	651	262	36	52	249	301	758	929	1.09	1.64	-0.28	6.63	4.53	1.61	1.79
	4-10 ha	254	32	46	76	122	588	709	168	19	42	154	196	482	696	-2.05	-2.57	-0.45	3.59	2.40	-0.99	-0.09
	> 10 ha	155	19	20	46	66	324	403	40	6	15	31	46	113	188	-6.55	-5.60	-1.43	-1.95	-1.79	-5.13	-3.74
	Total	907	105	213	284	497	2245	2682	1070	133	237	945	1182	3089	3709	0.83	1.19	0.54	6.20	4.43	1.61	1.63
	CV	27.19	37.65	33.14	25.98	25.39	25.67	25.31	62.68	61.92	52.23	56.56	55.36	60.72	49.98							
3. Gujarat	< 1 ha	11	2	23	3	26	41	43	38	1	71	42	113	157	184	6.39	-3.41	5.80	14.11	7.62	6.94	7.54
	1-2 ha	19	2	54	7	61	85	90	72	2	184	88	272	359	412	6.89	0.00	6.32	13.49	7.76	7.47	7.90
	2-4 ha	38	4	130	14	144	193	203	113	3	324	139	463	602	692	5.60	-1.43	4.67	12.16	6.01	5.85	6.32
	4-10 ha	72	7	315	21	336	428	454	115	5	463	146	609	758	880	2.37	-1.67	1.94	10.18	3.02	2.90	3.36
	> 10 ha	37	5	232	9	241	289	306	25	2	133	34	167	201	239	-1.94	-4.48	-2.74	6.87	-1.82	-1.80	-1.23
	Total	177	20	754	54	808	1036	1096	363	13	1175	449	1624	2077	2407	3.66	-2.13	2.24	11.17	3.55	3.54	4.01
	CV	66.45	53.03	81.01	64.28	79.21	75.62	75.88	57.18	58.33	67.22	58.35	63.92	62.33	61.91							
4. Haryana	< 1 ha	27	0	5	19	24	52	71	97	0	1	122	123	223	405	6.60	0.00	-7.73	9.74	8.51	7.55	9.10
	1-2 ha	60	0	11	40	51	113	152	163	0	2	198	200	368	586	5.12	0.00	-8.17	8.33	7.07	6.08	6.98
	2-4 ha	149	0	23	99	122	277	374	292	0	7	389	396	698	1210	3.42	0.00	-5.77	7.08	6.06	4.73	6.05
	4-10 ha	366	0	40	206	246	624	836	479	0	4	509	513	1003	1565	1.35	0.00	-10.87	4.63	3.74	2.40	3.18
	> 10 ha	331	0	21	148	169	511	680	275	0	1	263	264	540	664	-0.92	0.00	-14.12	2.92	2.26	0.28	-0.12
	Total	933	0	100	512	612	1577	2113	1306	0	15	1481	1496	2832	4430	1.70	0.00	-9.05	5.45	4.57	2.97	3.77
	CV	83.00	0.00	66.90	75.13	73.34	78.52	78.16	55.87	0.00	84.98	52.03	52.10	53.40	54.62							
5. Jammu & Kashmir	< 1 ha	116	1	0	1	1	120	138	72	1	0	1	1	110	158	-2.36	0.00	0.00	0.00	0.00	-0.43	0.68
	1-2 ha	64	0	0	0	0	66	77	58	1	82	1	83	170	125	-0.49	0.00	0.00	0.00	0.00	4.84	2.45
	2-4 ha	59	0	0	0	0	60	74	57	1	0	1	1	86	122	-0.17	0.00	0.00	0.00	0.00	1.82	2.53
	4-10 ha	24	0	0	0	0	24	29	24	0	0	0	0	35	52	0.00	0.00	0.00	0.00	0.00	1.90	2.96
	> 10 ha	3	0	0	0	0	4	5	6	0	0	0	0	7	13	3.53	0.00	0.00	0.00	0.00	2.84	4.89
	Total	266	1	0	1	1	274	323	217	3	82	3	85	408	470	-1.01	5.65	0.00	5.65	24.87	2.01	1.89
	CV	81.21	223.61	0.00	223.61	223.61	81.26	79.12	63.01	91.29	223.61	91.29	217.05	78.42	63.31							
6. Karnataka	< 1 ha	52	50	15	0	15	128	154	130	53	35	12	47	251	290	4.69	0.29	4.33	0.00	5.88	3.42	3.22
	1-2 ha	73	60	24	0	24	174	212	181	63	20	26	46	332	451	4.64	0.24	-0.91	0.00	3.31	3.28	3.85
	2-4 ha	106	81	40	0	40	254	313	235	69	116	39	155	515	601	4.06	-0.80	5.47	0.00	7.01	3.60	3.32
	4-10 ha	139	91	62	0	62	324	396	253	66	152	45	197	578	665	3.04	-1.59	4.59	0.00	5.95	2.94	2.63
	> 10 ha	97	45	56	0	56	220	287	83	25	79	25	104	238	273	-0.78	-2.90	1.74	0.00	3.14	0.39	-0.25
	Total	467	327	197	0	197	1100	1362	882	276	402	147	549	1914	2280	3.23	-0.84	3.63	0.00	5.26	2.81	2.61
	CV	35.43	30.40	51.07	0.00	51.07	34.13	34.24	40.28	32.47	68.42	43.99	60.57	40.58	38.89							

Table: 4.5 contd…

State	Farm Size	1970-71							1990-91							ACGR : 1990-91 over 1970-71						
		Canal	Tank	Well	T.well	Total well	NIA	GIA	Canal	Tank	Well	T.well	Total well	NIA	GIA	Canal	Tank	Well	T.well	Total well	NIA	GIA
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
7. Kerala	< 1 ha	21	14	11	1	12	58	78	34	27	48	2	50	140	204	2.44	3.34	7.64	3.53	7.40	4.50	4.92
	1-2 ha	228	7	7	1	8	48	70	22	10	235	1	236	285	88	-11.03	1.80	19.21	0.00	18.44	9.32	1.15
	2-4 ha	27	5	6	1	7	52	76	18	7	13	1	14	51	61	-2.01	1.70	3.94	0.00	3.53	-0.10	-1.09
	4-10 ha	10	3	3	0	3	20	29	9	4	5	0	5	23	30	-0.53	1.45	2.59	0.00	2.59	0.70	0.17
	> 10 ha	2	0	1	0	1	5	7	1	3	5	1	6	13	16	-3.41	0.00	8.38	0.00	9.37	4.89	4.22
	Total	288	29	28	3	31	183	260	84	51	306	5	311	512	399	-5.97	2.86	12.70	2.59	12.22	5.28	2.16
	CV	166.23	90.74	68.70	91.29	69.75	62.59	61.79	74.99	95.91	161.39	70.71	158.97	111.02	93.77							
8. Madhya Pradesh	< 1 ha	61	7	24	1	25	97	99	183	12	93	9	102	315	327	5.65	2.73	7.01	11.61	7.28	6.07	6.16
	1-2 ha	86	14	41	2	43	147	151	264	18	294	25	319	646	611	5.77	1.26	10.35	13.46	10.54	7.68	7.24
	2-4 ha	148	23	90	2	92	274	281	390	26	407	55	462	965	1016	4.96	0.61	7.84	18.02	8.40	6.50	6.64
	4-10 ha	232	44	202	3	205	508	528	490	36	638	135	773	1447	1492	3.81	-1.00	5.92	20.97	6.86	5.37	5.33
	> 10 ha	175	41	189	3	192	439	451	287	21	366	131	497	930	965	2.50	-3.29	3.36	20.78	4.87	3.82	3.88
	Total	702	129	546	11	557	1465	1510	1614	113	1798	355	2153	4303	4411	4.25	-0.66	6.14	18.97	6.99	5.54	5.51
	CV	48.97	63.18	75.60	38.03	74.80	60.97	61.44	36.90	40.02	54.77	83.06	57.25	48.72	50.00							
9. Maharashtra	< 1 ha	17	15	28	0	28	70	78	77	18	127	0	127	263	300	7.85	0.92	7.85	0.00	7.85	6.84	6.97
	1-2 ha	28	27	54	0	54	121	133	117	28	0	1	1	204	557	7.41	0.18	0.00	0.00	-18.08	2.65	7.42
	2-4 ha	47	44	123	0	123	233	257	116	28	410	2	412	616	684	4.62	-2.23	6.20	0.00	6.23	4.98	5.02
	4-10 ha	75	64	277	0	277	440	484	70	22	406	2	408	540	602	-0.34	-5.20	1.93	0.00	1.96	1.03	1.10
	> 10 ha	54	45	257	0	257	371	405	12	5	118	0	118	145	162	-7.24	-10.40	-3.82	0.00	-3.82	-4.59	-4.48
	Total	221	195	739	0	739	1235	1357	392	101	1061	5	1066	1768	2305	2.91	-3.24	1.82	0.00	1.85	1.81	2.68
	CV	51.28	48.07	77.43	0.00	77.43	64.02	63.77	54.81	47.02	87.48	100.00	87.43	59.61	47.79							
10. Orissa	< 1 ha	113	27	2	2	4	154	3	199	26	2	1	3	246	350	2.87	-0.19	0.00	-3.41	-1.43	2.37	26.87
	1-2 ha	158	22	6	3	9	201	3	226	27	3	2	5	283	390	1.81	1.03	-3.41	-2.01	-2.90	1.73	27.55
	2-4 ha	116	37	2	2	4	165	3	218	32	5	1	6	281	355	3.20	-0.72	4.69	-3.41	2.05	2.70	26.96
	4-10 ha	105	37	2	3	5	152	3	110	22	4	1	5	153	189	0.23	-2.57	3.53	-5.34	0.00	0.03	23.02
	> 10 ha	22	26	0	2	2	54	1	20	9	1	0	1	33	36	-0.48	-5.17	0.00	0.00	-3.41	-2.43	19.62
	Total	514	149	12	12	24	726	13	773	116	15	5	20	996	1320	2.06	-1.24	1.12	-4.28	-0.91	1.59	25.99
	CV	48.29	22.93	91.29	22.82	53.93	37.64	34.40	57.12	37.50	52.70	70.71	50.00	53.64	56.55							
11. Punjab	< 1 ha	74	0	23	58	81	156	248	39	0	0	104	104	144	275	-3.15	0.00	0.00	2.96	1.26	-0.40	0.52
	1-2 ha	123	0	31	110	141	266	416	85	0	1	205	206	294	554	-1.83	0.00	-15.78	3.16	1.91	0.50	1.44
	2-4 ha	269	0	51	267	318	581	899	199	0	1	552	553	761	1486	-1.50	0.00	-17.85	3.70	2.81	1.36	2.54
	4-10 ha	528	0	63	528	591	1127	1697	474	0	1	992	993	1489	2855	-0.54	0.00	-18.71	3.20	2.63	1.40	2.64
	> 10 ha	391	0	25	295	320	718	1024	384	0	0	578	578	975	1887	-0.09	0.00	0.00	3.42	3.00	1.54	3.10
	Total	1385	0	193	1258	1451	2848	4284	1181	0	3	2431	2434	3663	7057	-0.79	0.00	-18.80	3.35	2.62	1.27	2.53
	CV	67.78	0.00	45.53	73.30	68.52	67.77	66.55	79.64	0.00	91.29	72.26	72.21	73.84	73.82							
12. Rajasthan	< 1 ha	14	17	71	2	73	105	119	46	10	104	30	134	194	251	6.13	-2.62	1.93	14.50	3.08	3.12	3.80
	1-2 ha	34	26	125	4	129	194	215	100	16	214	51	265	388	462	5.54	-2.40	2.72	13.57	3.67	3.53	3.90
	2-4 ha	104	41	243	9	252	405	444	244	24	432	91	523	802	975	4.36	-2.64	2.92	12.26	3.72	3.48	4.01
	4-10 ha	341	51	411	18	429	834	904	633	29	702	133	835	1511	1903	3.14	-2.78	2.71	10.52	3.39	3.02	3.79
	> 10 ha	469	26	905	10	915	817	912	401	11	440	51	491	909	1172	-0.78	-4.21	-3.54	8.49	-3.06	0.53	1.26
	Total	962	161	1755	43	1798	2355	2594	1424	90	1892	356	2248	3804	4763	1.98	-2.87	0.38	11.15	1.12	2.43	3.09
	CV	105.02	42.21	95.73	72.43	94.32	72.51	72.17	83.75	45.98	61.08	57.59	59.82	67.24	68.13							

Table: 4.5 contd…

State	Farm Size	1970-71							1990-91							ACGR : 1990-91 over 1970-71						
		Canal	Tank	Well	T.well	Total well	NIA	GIA	Canal	Tank	Well	T.well	Total well	NIA	GIA	Canal	Tank	Well	T.well	Total well	NIA	GIA
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
13. Uttar Pradesh	< 1 ha	482	89	416	519	935	1604	1804	1052	22	48	2083	2131	3279	5271	3.98	-6.75	-10.23	7.20	4.21	3.64	5.51
	1-2 ha	514	72	364	504	868	1532	1747	797	55	64	1719	1783	2686	3949	2.22	-1.34	-8.32	6.33	3.66	2.85	4.16
	2-4 ha	665	68	409	656	1065	1873	2161	767	11	59	1621	1680	2503	3533	0.72	-8.71	-9.23	4.63	2.31	1.46	2.49
	4-10 ha	631	42	298	633	931	1661	1927	522	5	37	1087	1124	1677	2151	-0.94	-10.09	-9.91	2.74	0.95	0.05	0.55
	> 10 ha	216	11	60	191	251	500	573	98	1	10	188	198	303	450	-3.87	-11.30	-8.57	-0.08	-1.18	-2.47	-1.20
	Total	2508	282	1547	2503	4050	7170	8212	3236	94	218	6698	6916	10448	15354	1.28	-5.34	-9.33	5.04	2.71	1.90	3.18
	CV	35.32	53.99	47.56	37.09	39.58	37.47	37.66	55.60	115.59	49.26	54.93	54.57	55.10	59.91							
14. Tamil Nadu	< 1 ha	991	236	125	8	133	597	817	255	287	211	48	259	816	872	-6.56	0.98	2.65	9.37	3.39	1.57	0.33
	1-2 ha	201	180	162	9	171	557	758	182	1	211	37	248	439	624	-0.50	-22.87	1.33	7.32	1.88	-1.18	-0.97
	2-4 ha	208	182	199	12	211	606	814	163	111	200	37	237	517	586	-1.21	-2.44	0.03	5.79	0.58	-0.79	-1.63
	4-10 ha	165	151	190	13	203	523	689	119	70	147	31	178	369	411	-1.62	-3.77	-1.27	4.44	-0.65	-1.73	-2.55
	> 10 ha	56	55	77	5	82	196	250	43	25	45	12	57	126	136	-1.31	-3.87	-2.65	4.47	-1.80	-2.18	-3.00
	Total	1621	804	753	47	800	2479	3328	762	494	814	165	979	2267	2629	-3.70	-2.41	0.39	6.48	1.01	-0.45	-1.17
	CV	116.50	41.44	33.36	34.14	33.34	34.46	35.77	51.46	114.74	43.60	40.14	42.73	55.14	51.93							
15. West Bengal	< 1 ha	94	52	3	5	8	172	224	90	66	41	473	514	856	1534	-0.22	1.20	13.97	25.54	23.14	8.35	10.10
	1-2 ha	127	59	4	9	13	219	277	88	0	53	382	435	685	1216	-1.82	0.00	13.79	20.61	19.19	5.87	7.68
	2-4 ha	162	69	4	12	16	265	326	61	38	42	273	315	538	858	-4.77	-2.94	12.48	16.91	16.07	3.60	4.96
	4-10 ha	101	43	1	9	10	165	203	17	11	16	90	106	174	249	-8.52	-6.59	14.87	12.20	12.53	0.27	1.03
	> 10 ha	4	2	0	1	1	27	10	0	0	0	2	2	3	5	0.00	0.00	0.00	3.53	3.53	-10.40	-3.41
	Total	488	225	12	36	48	848	1040	256	115	152	1220	1372	2256	3862	-3.17	-3.30	13.54	19.26	18.25	5.01	6.78
	CV	60.17	57.46	75.69	59.25	59.20	52.66	57.98	80.21	124.43	71.49	80.57	78.88	78.65	83.08							

Notes : ACGR - Annual Compound Growth Rate in percent; T.well – Tubewells; NIA - Net Irrigated Area; GIA - Gross Irrigated Area; CV - Coefficient of variation
Source : GOI, *All India Report on Agricultural Census* (various years), Ministry of Agriculture, Government of India, New Delhi

Although there are differences in growth rates of each source of irrigation across farm size in different states, the growth rate of net irrigated area (NIA) and gross irrigated area (GIA) show an uniform pattern in majority of the states. Except in Jammu and Kashmir, Kerala and Punjab, the growth rates of net as well as gross irrigated area are inversely related with farm size in all other states. Unexpectedly, both in Jammu & Kashmir and Punjab, the growth rate of net irrigated area as well as gross irrigated area are positively associated with the farm size. In Kerala, no clear trend is observed between the growth of irrigated area and the farm size.

On the whole, the following points emerge out from the analysis of irrigation development by farm size carried out using Agricultural Census data covering five points of time - 1970-71, 1976-77, 1980-81, 1985-86 and 1990-91:

- In absolute term, the growth of area under all major sources of irrigation recorded relatively at a higher rate among the marginal size group when compared to all other group of farmers between 1970-71 and 1990-91.
- The growth rate of area under all major sources of irrigation is found to be inversely related with the farm size between 1970-71 and 1990-91. This is observed even in area under groundwater irrigation, which is a costly source of irrigation.
- The share of area of marginal and small farmers in the total area of all the major sources of irrigation has improved considerably between 1970-71 and 1990-91. At the same time, the share of medium and large farmers has declined in all the major sources of irrigation.
- The growth rate of both net as well as gross irrigated area is found to be inversely related with the farm size between 1970-71 and 1990-91.
- The percentage of net irrigated area to net sown area is found to be much higher among the marginal and small size group when compared to the medium and large size group in all five-time points. However, the growth of percentage of net irrigated area to net sown area is found to be positively related with the farm size.
- As observed at the national level, the growth rate of all the major sources of irrigation is found to be inversely related with the farm size in majority of the states between 1970-71 and 1990-91. The same trend is observed in net and gross irrigated area as well. However, both in Jammu and Kashmir and Punjab, the growth rate of net as well as gross irrigated area is found to be positively associated with the farm size. Surprisingly, in Tamil Nadu, both net as well as gross irrigated area registered a negative growth rate in all size groups except marginal group between 1970-71 and 1990-91.

6. Conclusions

In a long term development perspective, the access and distribution of resources assumes great importance. Market mechanism is one of the tools of distribution but the end result of such over dependence on the market may not be yield socially desirable results. Such process may not also be welfare augmenting. This process has always the danger of increasing concentration of resources in the hand of a few. Therefore, policy intervention on the part of the state is required. In a similar vein even over-dependence on the state may also cause severe inefficiencies. Therefore, the policy initiatives have to be planned keeping in view the positive impacts of these institutions. The sustainability of agricultural development stems out of provision of basic infrastructure and use of land as well as water resources in environmental friendly development design. The problem of resource use gets compounded by the property rights as well as the interface between different resources and development. Access, equity and availability of infrastructure determines the use of resources jointly with technological capabilities. The development scenario during last five decades has caused more problems in the environmental sustainability of development though it has solved the problems of food security. In the coming decades therefore we need to concentrate on using infrastructure in a more judicious manner especially in the context of land and water so as to minimise negative externalities and achieve an higher growth path. This is feasible if we keep in view the access, equity and equality in distribution of these resources. The paper argues exactly these points through an elaborated empirical analysis. We have pointed out the existing problems in access, present distribution pattern and the constraints in distribution. The paper finally offers suggestions for an equitable and welfare augmenting resource distribution in the context of the human resources, land and water resources.

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