Ind. Jn. of Agri. Econ.
Vol. 60, No.1, Jan.-March 2005

PRESIDENTIAL ADDRESS

Price and Non-Price Reform in Indian Agriculture: A Re-examination and Some Reflections*

Kanchan Chopra†

I

INTRODUCTION

At the outset, I wish to state how honoured I feel to be invited to preside over the 64th Conference of the Indian Society of Agricultural Economists. I thank the Society for providing me this opportunity to place my thoughts before the wider community of agricultural economists. In this address, I shall revisit the theme of the relative significance of price and non-price factors in Indian agriculture but with a focus on the post-1991 period. I shall attempt to link this underlying concern with issues that have been at the forefront of the agricultural policy in the last decade: namely, the relative significance of subsidies and investments in infrastructure and the factors governing the access of relatively disadvantaged sections of the community to this infrastructure. The first question asked is: Does a withdrawal of subsidies on canal and groundwater irrigation reduce access of the small farmer more than it does the large farmer? I then argue that non-price; institutional reform, is at the root of providing a large part of this access, in particular in situations where a large number of social contracts are based on institutions other than the market. An attempt is then made to evaluate recent attempts at institutional reform, in the agricultural and related sectors, in particular that initiated in a centralised fashion. Some of the questions asked are: What has been the record of institutional change related to the land and water sector in the last ten or more years? What is the role and record of water users associations or joint forest management committees? What role can private entrepreneurship play in this context?

The argument with respect to the relative significance of price and non-price factors is next extended to the case of agricultural exports from India. In a world that is getting increasingly connected, the country needs to develop an export niche of its own. While we need to be price competitive in order to do this, the emerging trends indicate that both price and quality issues are important. Non-tariff measures are put in place by importing countries. Drawing on recent work done for the horticultural,

* Presidential Address delivered at the 64th Annual Conference of the Indian Society of Agricultural Economics, held at Tamil Nadu Agricultural University, Coimbatore - 641 003 (Tamil Nadu) on December 15, 2004.

† Professor, Institute of Economic Growth, Delhi - 110 007.

plantation, dairying and aquaculture sectors, I shall focus on the role of these factors in determining export demand.

Finally, in the last part of my talk, I shall pose a few questions, which provide directions, hopefully for further research, which integrates the agricultural sector with development and environment issues, both national and international.

II

REFORMING AGRICULTURE THROUGH APPROPRIATE PRICING: WITHDRAWAL OF SUBSIDIES AND ISSUES OF EQUITABLE ACCESS TO INPUTS

The period since 1991 has seen a fall in public sector capital formation in agriculture. It recorded the lowest ever share in 2000-01, falling to 23.5 per cent of the total agricultural capital formation (Gulati and Bathla, 2002; Rao and Gulati, 2005). Simultaneously, subsidies for agriculture, open or hidden have increased. Subsidies on fertiliser, irrigation, electricity and credit have increased from 44 per cent of the combined plan expenditure in 1983-84 to 83 per cent in the early nineties. The level of input subsidies was higher in the post-reform period. In 1989-90, the level of farm subsidies on power, fertiliser and irrigation at 1981-82 prices stood at Rs. 53 billion they nearly doubled, reaching Rs. 104 billion in 1999-2000.[1]

A large number of studies on subsidies in Indian agriculture have been undertaken in particular in the last decade or so, asking for their phased withdrawal. The strongest case for a progressive removal of subsidies continues to be based on the increasing burden they constitute for the exchequer at a time when fiscal deficits need to be contained. The distributive impact of subsidies remains a major question in the minds of policy makers. Will the small and marginal farmer be affected more adversely than the large farmer by the withdrawal of subsidies?

In this connection it is interesting to review the discussion following from a paper of the Ministry of Finance, which made estimates of the financial burden imposed by the major subsidies in 1997. It drew a distinction between public goods, merit goods and non-merit goods in examining the magnitude of subsidies and their burden on the government. Adopting the above classification, it was then argued that *non-merit goods* do not justify subsidisation. However, it was later pointed out that the classification was somewhat biased and that a significant part of the goods classified as non-merit did in fact have significant externality impacts.[2] Such an assessment strengthens the lurking argument that any reduction in subsidies will harm the small and marginal farmers and hence be politically incorrect. Using available data and information on input use by farmers with different holding sizes, a small exercise is carried out below in an attempt to respond to this issue. It examines subsidies given to irrigation water (both surface and ground water irrigation) *with the explicit objective of determining whether their phased withdrawal will impact the small and marginal farmer more than it will the large farmer.*

Consider the case of two cultivators with different land holding sizes. If irrigation water is supplied, say, by canal irrigation at a subsidised price, the subsidy has, like any other price change, an income effect and a substitution effect. The real income of the two cultivators increases with the result that they can demand more of the subsidised input. Simultaneously, a substitution effect also takes place. More of irrigation water will be used relative to other inputs such as for instance, labour. Differences in the impact of the subsidy on the two cultivators depend on the relative value of the income and the substitution effect in the two cases. Assuming that the cultivators' only income is from agriculture, the increase in real income in the two cases depends on the relative landholding and the productivity per unit land. Taking note of the fact that the farmers have different productivities per unit of land, this income effect may not be proportional to the relative size of the land holdings. The substitution effect also adds to the demand for the subsidised input relative to that for others. A cheaper access to water is expected to result in a substitution of water for labour or other factor inputs such as energy. The extent to which this takes place depends on the differential access to other inputs. Small farmers may substitute water for labour and larger farmers water for energy. Such substitution between inputs is in evidence when water is subsidised. Labour intensive maintenance of water channels is neglected and more water saving innovations is not adopted. The nature of substitution differs in the case of different categories of cultivators. It shall depend on their relative resource endowment. Further, a continued subsidy of certain inputs shall, in all cases, act as a disincentive to innovations to substitute for it in the long run. Higher levels of use of the input by all categories of cultivators are expected, and an extended subsidy regime shall imply higher use levels in the long run as well.

The impact of a change in price of an input, consequent to the withdrawal of subsidy, on its use by different sets of producers can be estimated by setting up and estimating demand functions for the inputs.

A typical demand function for input ‘i’ by household ‘j’ is set up thus:

$$D(i, j) = f(P_{ij}, ACC_{ij}, L_j, TR_j) \quad \ldots (1)$$

where $D(i, j)$: demand for input ‘i’ by household ‘j’,

P_{ij} : price of input ‘i’ paid by household ‘j’,

ACC_{ij} : Access to input ‘i’ of household ‘j’,

L_j : Land owned/operated by household ‘j’.

TR_j : Technical input requirements of crop mix grown by household ‘j’.

The above specification states that levels of use of an input are impacted by price, access, land holding size and the technical requirements of the crop mix grown. Whereas the price variable is easily understood, others may need some explanation. Access is one such factor. For inputs such as fertiliser, the variable, $ACC_{i,j}$ can be interpreted as distance from outlet and quality of the transport infrastructure. For inputs such as canal irrigation and power, which are perceived to have characteristics of public goods, access depends on location in a canal command or within the ambit of a power grid. Further, access to groundwater is a function of ability to invest in

extraction of water or the ability to hire services of tubewells, tractors or other agricultural machinery which in turn depends on resources such as income, represented in this specification by Lj.

The variable Lj land owned or operated also determines the level of demand. The significance or otherwise of this variable may be a pointer towards the presence of a differential impact of subsidy on different size class of cultivators. The input demand function specified above can be estimated for households belonging to the specified group (small and marginal farmers, for instance) and in general for the complete set of households to arrive at differential demand for subsidised inputs. The results can then be used to assess the distributional impact of the subsidy being considered.

TRcj, the next explanatory variable, indicates the average input requirements of the crop mix grown by the cultivators in a region: it may for instance stand for optimal water or fertiliser requirement of crops grown.

This specification with land ownership category as an additional variable is also more appropriate keeping in view the nature of data available. It shall have the following specification:

$$Dij = f (Pij, ACCij, Lj, TRcj) \quad \ldots. (2)$$

with Lj as the holding size category. The variation in response of demand for each of the variables is then examined to determine whether or not the small and marginal farmers are impacted differently by price increases consequent to a withdrawal of subsidy.

II.1. Access to Ground and Surface Water Irrigation

The input demand function, which determines demand for irrigation, as approximated by irrigated area as percentage of gross sown area, has the following explanatory variables:

- Price of irrigation water. This is measured, in the case of surface irrigation by per hectare irrigation charges. For ground water irrigation, it is approximated by the cost per unit of power used, assuming that this is the major component of the variable cost.
- Technology related factors in this case approximated by adoption of improved seeds for crops grown.[3]
- Access to irrigation, as approximated by location in or outside a canal command.
- Size of holding measured either by holding size or by a dummy variable.

State level analysis for the five-size class of holdings is undertaken using data from NSS (1997-98) and Cost of Cultivation Surveys. Data on irrigation charges per hectare (for surface irrigation) are averages of crop-specific charges weighted for the proportion of area under the crop to total gross cropped area in the state. Data on power price (a surrogate for the one significant factor impacting variable cost of groundwater irrigation) is obtained from State Electricity Boards and is assumed to

vary only across states. Variation in price of both surface irrigation water and power is high. Also, irrigation charges for surface water with an average of Rs. 748 per hectare are at higher levels as compared to 1991-92. It is also to be noted that power price on an average is Rs. 35.88 per unit, with a high degree of variation from 0 in some states to Rs. 151.26 per unit in others. On an average, 66.23 per cent of the gross cropped area is irrigated and 63.31 per cent of the area is under improved seeds.

We use different specifications of the model to determine, in alternative ways, the impact of technology, price and land-ownership variables on the area irrigated, both by groundwater or by surface water.

In the first specification, two separate equations are estimated for groundwater irrigation and for surface irrigation. In the equation relating to groundwater, the proportion of irrigated farms located outside canal commands is taken as one of the explanatory variables and assuming that these are ground water irrigated, the price of power, a complementary input is taken as one of the independent variables. In a similar fashion, the surface water equation takes location within canal commands and surface irrigation charges as the two independent variables. Further, three equations each are estimated for groundwater and surface water irrigation to correspond to the total sample, the sub-set of large and medium farmers and of small and marginal farmers. The linear specification, found to give the best fit is used.

Table 1 gives the results for three estimates corresponding to the complete sample including all size classes of holdings, the larger holdings and the smaller holdings. Since both power price and location outside canal commands are taken as explanatory variables, this set of equations explains the situation mainly with respect

TABLE 1. GROUNDWATER IRRIGATION: DEPENDENT VARIABLE: GROSS IRRIGATED AREA/GROSS CROPPED AREA: 1997-98

(1)	Coefficient (2)	T-statistic (3)	Prob. (4)	Adjusted R^2 (5)
		All size-classes		
C	0.1162	1.5218	0.133	0.7228
Improved seed	0.0050	4.9494	0.000	
Non-canal	0.4468	8.0346	0.000	
Power price	-0.0010	-2.3795	0.0203	
Holding size	-0.0007	-0.2132	0.8318	
		Larger holdings		
C	0.1175	1.1148	0.2721	0.7145
Improved seed	0.0053	4.2104	0.0002	
Non-canal	0.3845	5.3826	0.000	
Power price	-0.0012	-1.9769	0.055	
Holding size	0.0017	0.3165	0.7533	
		Smaller holdings		
C	0.0846	0.6196	0.5416	0.7127
Improved seed	0.0047	2.6595	0.014	
Non-canal	0.5678	6.02339	0.000	
Power price	-0.0009	-1.24442	0.0140	
Holding size	-0.02672	-0.5287	0.6020	

to tubewell irrigated areas. It is found that the technology variable, approximated by use of improved seeds, the locational variable and the power price variable are all significant in determining the ratio of irrigated area to gross cropped area. Holding size does not seem to be significant, however. This is true for all three sets implying that both for the set of seventy holdings and within each subset, the holding size are not an important determinant of access to ground water irrigation.

The above analysis suggests that access to technology in the absence of access to canal irrigation shall substantially increase groundwater irrigation. It will result, presumably in more private investment in tubewells. Further, in areas outside of canal commands, an increase in power tariff will affect the spread of groundwater-based irrigation adversely. *However, the adverse impact shall be felt more or less uniformly by holdings belonging to different size groups. The small and marginal farmers are not likely to be particularly adversely impacted due to the smallness of their holdings per se.*

Regression results analysing factors that are likely to affect the proportion of irrigated area to sown area as they operate in the context of surface irrigation are given in Table 2. The explanatory power of the model is less (43 to 44 per cent) as compared to the corresponding model in the case of groundwater irrigation (71 to 72 per cent). However, the direction of the results is similar. Adoption of better technology as exemplified by the adoption of improved seeds and location in canal command are the important factors determining the proportion of area irrigated. In this instance, both irrigation charges and holding size turn out to be insignificant in determining the variation in the dependent variable. Further, this is uniformly true, whether we pool the data from holdings of all size classes or we consider small and larger holdings in separate sub-groups.

TABLE 2. CANAL IRRIGATION DEPENDENT VARIABLE: GIA/GCA: 1997-98

Variable	Coefficient	t-statistic	Prob.	Adjusted R^2
(1)	(2)	(3)	(4)	(5)
		All farms		
C	-0.09858	-0.9510	0.3451	0.446
Improved seed	0.008697	5.7217	0.0000	
Canal command	0.26952	3.4211	0.0011	
Irrigation charges	-6.38 E-06	-0.1259	0.9001	
Holding size	0.000293	0.05674	0.9549	
		Larger farms		
C	-0.06725	-0.47336	0.6387	0.431995
Improved seed	0.008773	4.772927	0.0000	
Canal command	0.192212	1.99053	0.0540	
Irrigation charges	-1.30 E-05	-0.201358	0.8415	
Holding size	0.00335	0.4386	0.6635	
		Smaller farms		
C	-0.25228	-1.2986	0.2069	0.4233
Improved seed	0.009288	3.190346	0.0041	
Canal command	0.475066	3.235844	0.0037	
Irrigation charges	6.40E-06	0.073732	0.9419	
Holding size	-0.03579	-0.49756	0.6235	

It can be concluded that for increasing area under surface irrigation, technology and location in a canal command are the important policy variables. *In other words, if access were ensured in terms of appropriate location in canal commands and improved technology were to be made available (in the form of improved seeds, for example), an increase in irrigation charges is not likely to have an adverse effect on access to irrigation. This holds uniformly for all categories of farmers, large medium, small and marginal.* A large number of micro-studies have found that relative location, at the head or the tail is also significant in determining access to irrigation. Whereas such in-depth micro observation is outside the framework of the present study, policy formulation exercises need to take account of both kinds of studies.

II.2. An Alternative Specification

Further, it is seen from analysis of data for 1991-2,[4] that the impact of variables relating to price, technology and holding size on fertiliser use suggests some degree of inter-dependence between the use of fertiliser and the proportion of area irrigated as a proxy for adoption of new technology. Similarly, the decision of the farmers on the proportion of area to be irrigated is impacted by technology adoption as approximated by the use of improved seeds, as illustrated by the analysis of NSSO data of 1997-98. In such a situation of interdependence, it seems appropriate to use a simultaneous equations model to examine the factors affecting input use. Ideally, a three-equation model with technology, fertiliser use and adoption of irrigation would have been most appropriate. However, the two-equation specification we have selected has been determined partly by the data availability. Using the data for 1997-98, the simultaneous equation specification gave interesting results. We discuss these.

The 1997-98 data set from NSSO is used to set up a simultaneous equation model with technology adoption (as exemplified by the use of improved seeds) and irrigated area as the two endogenous variables. The exogenous variables are:

- Holding size,
- Price of power, as proxy for cost of groundwater irrigation,
- Canal water charges,
- Area located in canal command[5]
- Area not located in canal command,
- Road density in the state.

Table 3 gives the results of the simultaneous equation model based on 1997-98 data the results of the simultaneous equations model for 1997-98 also corroborate those of the earlier ones. The adoption of better technology is facilitated by the presence of more area under irrigation and vice versa. None of the exogenous variables postulated to impact improved seed adoption as proxy for technology turn out to be significant.

TABLE 3. 3SLS ESTIMATES OF SIMULTANEOUS EQUATIONS MODEL: 1997-98

Endogenous variables	Area under improved seed/GCA	Irrigated area/GCA
(1)	(2)	(3)
Area under improved seed/GCA		0.0088
		(2.333)
Irrigated area/GCA	48.65	
	(6.554)	
Exogenous variables		
Sales-points	0.0055	
	(0.4191)	
Holding size	0.4284	-0.0025
	(1.1271)	(-0.7103)
Price of power	-	-0.0009
		(-1.693)
Canal irrigation charges	-	-3.49E-05
		(-0.561)
Non-canal location		0.4344
		(4.677)
Canal command location		0.129
		(1.61)
Road density		-1.522E-05
		(-0.307)
R bar **2	0.35	0.657

Further, holding size is also not a significant variable determining irrigated area. Location both within and outside of canal commands is significant, capturing the effect for canal and groundwater access, respectively.

Further, of the price variables, canal irrigation charges are not significant. Power price is marginally significant at the 10 per cent level. An increase in it would impact ground water irrigation negatively whereas increased canal water charges do not have a similar impact on irrigation by canals.

To sum up, this exercise investigates into the likely effects of a withdrawal of irrigation subsidies on the small and marginal farmers. Both single equation and simultaneous equation models are used to analyse data for 1997-98. For surface water, adoption of better technology *as exemplified by improved seeds and location in canal command are the important factors determining proportion of area irrigated by a holding. Irrigation water charges and size of the holding are insignificant. This is uniformly true for the set of small, large and all holdings.*

The results obtained from Ordinary Least Squares (OLS) regressions for ground water based irrigation suggest that access to improved seeds (as a technology representing parameter) increase groundwater irrigation. Better technology shall presumably result in more investment in tubewells and hiring of tubewell water. *It is also found that a withdrawal of subsidy and a consequent rise in power tariff will have an adverse effect on spread of ground water irrigation. However, the adverse effect will be felt more or less uniformly by holdings of different size groups. Small and marginal farmers are not adversely impacted due to the smallness of their holdings per se.*

The results of the simultaneous equation model corroborate the above findings with the adoption of better technology being facilitated by the presence of more area under irrigation and this being accompanied by higher levels of fertiliser use. By way of conclusion, it can be said that,

- Policy must concentrate on providing equitable access for smaller farmers to location with respect to canal irrigation.
- Increases in canal irrigation charges shall not reduce use of irrigation by smaller farmers, provided they are located in canal commands.
- Power price increases shall result in a decreased access to groundwater irrigation by all farmers; here again smaller farmers are not more adversely affected.

III

NON-PRICE ASPECTS OF REFORM AND EQUITY: INCOMPLETE CONTRACTS AND THE ROLE OF INSTITUTIONAL CHANGE

The above analysis leads us to conclude that increases in canal irrigation charges shall not reduce use of irrigation water by smaller farmers, provided their holdings are located in canal commands. If equity is indeed its prime concern, policy reform must therefore concentrate on providing access for smaller farmers to location within canal commands. In other words, increased access to irrigation infrastructure is an important component of reform in the case of irrigation water. Access to inputs is based on both sets of factors, those captured in the price-based information and those operational outside of it. It may be noted for instance, the preference for tubewell over canal water for paddy cultivation in Punjab, right from the early seventies.[6]

In other words, we can ensure that price reform does not hurt the poor if the institutions through which access is attained focus on non-price factors such as timely availability of water and location within canal commands to all. This is especially important as non-price aspects of access are not defined as a part of the contract which citizens enter into when they obtain inputs, e.g., irrigation water from public sector institutions. In this case, as in so many others, a "set of formal rules, informal norms of behaviour, conventions and their enforcement characteristics" govern completion of the contracts.[7] This comprehensive vector of formal and informal rules is the institutions that determine how well and how equitably an economy is run.

Institutions as thus defined are different from organisations, which are the agents that play by the rules to win the game (North, 1990). Organisations can include political bodies (governmental departments, political parties), economic bodies (firms, family farms), social bodies (clubs, churches), educational bodies (schools, universities) and more recently non-governmental organisations (WWF, IUCN). But the link between players and rules is not a direct one-way link. Players through their influence do and can change the rules of the game. It is this dynamic nexus between

rules and players that influence power, rent capture and exclusion among the various players.

Institutions evolve when it is in the interest of agents involved in the game. If, for instance, complete markets do not exist, various institutions other than markets evolve. Their evolution implies that the transaction costs of change are less than the inefficiencies of the existing structures. Thus Arrow (1997) maintains: "absent contingent markets may be replaced by long term relations. Actual futures and contingent price will be replaced by expectations of futures prices and quantities." This shall result in a kind of equilibrium of expectations that drive the consumer and producer behaviour in a situation where prices do not give perfect signals. Aoki (2000) too presents institutions as a kind of equilibrium indicating phenomenon and then asks the question: how do they evolve? In other words, how do we move from one set of institutions to another?

At times, only a new framework of rules or “institutions” can ensure the completion of contracts to ensure access to resources by smaller farmers. When economies want to change the rules of the game, it is often because earlier rules have proved inefficient[8] or because they do not take account of newly emerging realities. However agents bound by the existing ways of doing things take some time to move away from them since a cost is involved in the evolution of new governance or resource-supply structures. Such a cost attached to changing the rules of the game is often referred to as "transaction cost". Some exogenous individual or group must undertake to bear this cost in a situation where asymmetry with respect to capabilities exists between endogenous stakeholders such as, for example, the service-provider and the consumer. It is often the service provider who has the right to decide with respect to contingencies not written into the contract. The irrigation departments, for instance, may ignore maintenance of its water structures and cause unforeseen costs to the farmers. Also the users do not have similar capabilities for initiating change towards a different set of “rules of the game” in this case water distributing rules. Somewhat paradoxically, the poor who are the least well endowed with such capabilities; also bear the coping costs of not moving away from the existing rules.

It is in such situations that the outside agencies need to intervene and introduce new institutions. Such agencies, which function as catalysts, are often individuals or non-governmental organisations (NGOs).[9] However, at times policy reform initiated by governments may also enable the introduction of such institutional change. We examine below examples of such institutional change initiated at more macro levels by the centralised government agencies in India. These initiatives comprise an exogenously initiated institutional change in which the State ostensibly sets up a structure where it shares power with multiple non-state entities.

III.1. Water User Associations

The participatory irrigation management strategy in Andhra Pradesh is a top-down approach initiated and implemented by the government. It was initiated at a

bigger scale and had more political, financial legal and administrative backing than any attempts by a few NGOs could have had. It was based on the realisation that the existing usage of water was "inefficient, wasteful and inequitable."[10] Water User's Associations (WUAs) were created as the primary organisational units of irrigation water users with the objective of maintaining the physical infrastructure and resolving conflicts over water distribution. The initial cost in terms of setting up a legal structure for water users associations (WUAs), of holding elections to nearly 10,000 WUAs in 1997 and training for their office-bearers were borne by the government. These were the first phase of transaction costs of change to a different institution. The objective was "to systemise water distribution and to improve the terminal level of supply channels by decentralising their upkeep and maintenance through shifting responsibility to organised groups of users."[11] In other words, institutional change was initiated as a means of improving access.

Some evaluations of this experiment are now available. One study claims that the WUAs and the Distributary Committees (DCs) were successful "in initiating the long overdue and urgently required repairs to the irrigation structures…. A wide range of construction activity which was need based is being carried out on a scale never heard of earlier" (Jairath, 2001). Another study (Nikku, 2003) also corroborates that there was an increase in the area that received irrigation water in the first two years as a result of repairs like cleaning of canals and weed removal. However, "the ability to institute water distribution according to well established rules has proved difficult to achieve". Further, their ability to collect water cess and to prevent illegal withdrawals of water is yet to be established.

On the other hand, the irrigation department officials felt that their work had increased due to the initiation of this programme and the mandatory interaction with the WUAs. This may be a temporary feature. It is expected that eventually a part of the work of the government department would be taken over by the DCs and WUAs. Such a shift may also not find favour with the employees of the irrigation departments who would rather not work under the "control and accountability" regime of the WUAs.

The study by Nikku (2003) maintains "five years after the formation of WUAs, though the awareness level has increased, yet the participation of the members in the WUA activities has not occurred". The leadership comes predominantly from the village elite, big farmers and active party workers. Water distribution and access to water continue to be governed by political pressure and is primarily an activity of "push and pull". Sharing rules for water are still not framed.

It can be concluded that: Initially the elections to and formation of WUAs led to enthusiastic beginnings with much "need based" maintenance and repair activity on canals; WUAs have not yet been able to evolve rules of water sharing and influence access to water; This is sometimes due to the domination of the local elite in leadership structures; and At others, it is the consequence of conflicts with policies with respect to water releases determined at the state level.[12]

III.2. Watershed Development Guidelines

"Guidelines for Watershed Development" issued by the Ministry for Rural Areas and Employment in 1994 (Government of India, 1994) were intended to introduce a measure of local participation and strengthen institutions for the development of an entire watershed, taking into consideration the land capability, site conditions and needs of the local people. Watershed development was seen as a vehicle for rural development, bringing together the concerns of watershed land under different agencies such as the forest department, the revenue department as also privately owners, village bodies and communities with rights of access. By way of institution building, these guidelines provided for setting up of watershed development teams and for entry point activities, training programmes and community organisation. Funds were set apart for such activities prior to the initiation of investment activity in watersheds which was to take up 75 per cent of the total amount allocated, with the rest being allocated to institution building. The principle again was that upfront transaction costs were borne by the state. This is a good beginning though issues with regard to departmental jurisdiction and co-ordination across departments may still exist (Vaidyanathan, 1999).

Early studies reported some but indifferent success. Kerr *et al.* (1998) concluded that the benefits of watershed development have been negligible by and large except for a few success stories where participatory approaches played a significant role. Landel-Mills (1998) obtained inconclusive evidence while focusing on the economic returns from watershed development. As stated by Kolavalli (1999), social organisation cannot be hastened by providing a centralised push in the form of financial resources. Time is of the essence. He maintained that as experimentation proceeds, some of these issues should resolve themselves.

A recent study (Sarvanan, 2002) examined community-based watershed management in the three states of Himachal Pradesh, Uttar Pradesh and Madhya Pradesh. In spite of differing agro-climatic conditions and property rights situations, some commonalities were found. "Activities were confined to government land that provided immediate benefit through employment for the poor. The second set of activities targets the needs of individual households through delivery-based activities…… Community based activities involve mobilising the community for action… Efforts to address these are limited, as they involve convincing people to resolve their differences, share their land and mobilise people for increased contribution. Ignoring community based activities is also advantageous to the people as they receive employment and generate funds for the village through watershed works, without any conflicts within the community."

III.3. Joint Forest Management (JFM)

Any assessment of significant government initiated institution building initiatives in India in the nineties is incomplete without a reference to joint forest management.[13] The JFM originated in the failure of a centrally driven policy in the past and its

consistent criticism, coupled with the success of a few peoples' driven initiatives. It was a kind of "centralised decentralisation", creating a partnership between the forest department and the people through the setting up of committees for forest protection. In most states, the joint committees were set up as a consequence of a *dictat* from the central Ministry of Environment and Forests in 1990. The shared resources were aimed at poverty alleviation for local communities coupled with conservation of forests. At present, about 11 to 13 per cent of the forest land in the country is under some variant of the JFM programme.

In some states such as West Bengal and Orissa, the JFM has been successful (Kadekodi 1997), the debate on their performance continues. Kapoor and Saigal (2001) refer to the need for establishing the right linkages between Forest Protection Committees and Panchayati Raj institutions. Places such as Dewas and Harda in Madhya Pradesh where JFM was introduced with great expectations have been studied by individual researchers who find that implementation fails to ensure equity.

Unfortunately, the dominant purpose of the JFM strategy seems to continue to be perceived as one of protection and not conservation. In the case of forest resources the department/state continues to be the sole owner with people being involved at best as partners without any ownership rights over the assets concerned. The resource is not at the disposal of the community and the state continues to exercise the right to choose the beneficiaries to whom use rights are to be granted, and also reserves the right to withdraw the benefits extended. Some researchers conclude that JFM has remained more a form of co-opting villagers into the agendas of the stakeholder who is perceived to be the more powerful, within and outside the state. Sundar (2001), for instance, argues that the decentralisation implicit in JFM has made no effort to take into account pre-existing traditional institutions of forest management. Another initiative in the context of rural governance, the PESA (Panchayat Extension to Scheduled Areas Act, 1996) is seen by her as more inclusive of pre-existing tradition and customs of the tribal societies. She concludes that the main structures of government continue to be perceived as non-transparent and non-participatory, even as they seek to create pockets of devolution.

Some commentators (Sarin, 2001) see a regression in such forms of intervention in the context of some regions. Whereas pre-existing structures (such as Van Panchayats in Uttaranchal) gave the status of "right-holders" to local communities, they have now been reduced to the position of "beneficiaries" of JFM. The lesson to be derived seems obvious. In a large country like India, interventions need to take regional variations in pre-existing institutional bases into consideration and not aim at "centralised" drafting of "decentralised participatory governance".

III.4. Private Initiative and Institutional Change: Groundwater in Eastern India

Eastern India has over one-fourth of India's usable groundwater resources; and less than one-fifth of it is developed. Several public policy initiatives have attempted to correct this situation. The first phase in the 1950s and 1960s focused on

government and NGO initiatives for organising the poor for collectively managing an irrigation asset through an extensive and vigorous public tubewell programme. These groups functioned, at different levels of efficiency, till the mid-eighties when they were subsumed under the World Bank tubewell programme. By 1990, there were 30,000 large PTWs (public tubewells) constructed with World Bank support. However, this programme started incurring huge losses by the mid-1990s. Different reasons have been given for their failure. Kolavalli and Shah (1989) blamed insufficient and erratic water supply, inadequate conveyance systems, operator absenteeism, failure of the *osrabandi* (distribution) system, and poor maintenance as the main reasons. Pant (1989) also found organisation design failure to be an important factor. Palmer-Jones (1995) held that DTW technology was not appropriate for the region.[14]

In the next phase, the changing institutional scenario led to the emergence of an active pump-irrigation market. Interestingly, the number of private tubewells increased rapidly once a World Bank PTW command covered an area. Private water sellers then made deep inroads into the commands of both the community tubewells and the PTWs. Shah (2001) maintains that

> *"Athough pump irrigation markets appear to have wrecked public and collective irrigation institutions that focused on securing irrigation access for the poor, ironically it was the poor water buyers who disowned PTWs and community tubewells to turn to private water markets because of their superior and more reliable-even if costlier-irrigation service."*

However, the cost of such access may have been high. It is estimated that irrigating wheat and paddy with purchased tubewell water is 20 times more costly than canal irrigation.

Subsequently, the high cost of tubewell irrigated agriculture due partly to the erratic power supply in Eastern Uttar Pradesh led farmers to examine diesel pumps as an option. The institution of "diesel pump dealers" gave a fillip to the pre-existing Free Bore Scheme (FBS) initiated in the eighties to encourage small farmers to go in for shallow tubewells, which till then had not taken off due to the high transaction costs of obtaining the subsidy.[15] The dealer bore the transaction costs of getting the subsidy from the government. Procedural adjustments made it possible for the banks to pay the dealer for the diesel pump; the subsidy was adjusted in the farmers account whereas the balance treated as a loan, is repaid by the farmer in instalments over 3 or 5 years. In other words, spontaneous market responses of a multitude of private economic agents produced the social welfare that public programmes failed to produce. It must be added however that the subsidy scheme was in place and changes in the delivery mechanisms for credit were agreed to by the state. *In other words, the evolution of new institutions of private dealers in groundwater pumps, helped to reduce the transaction costs associated with obtaining credit and permission of different kinds. The lesson truly is one of the successes of a joint initiative, with the*

resources being contributed by the state in accordance with the delivery mechanisms (identified by the dealers), which minimised the transaction cost of access to the subsidy borne by the beneficiaries.

III.5. Constraints to and Opportunities for Institutional Reform

To recapitulate, limited success seems to have come to efforts at large-scale, while government directed replication of experiments deemed to be successful at smaller scales. Though the overall experience with watershed development under the new participatory approach shows that the immediate results are positive in terms of a rise in water tables, in crop yields and in employment and income (Rao, 2000), there is uncertainty about their overall sustainability and their ability to hold different social groups together. Studies confirm that this is true even for the Participatory Irrigation Management Transfer programme in Andhra Pradesh.[16] The performance of Irrigation Management transfer in other countries also points towards similar uncertainties (Perry *et al.,* 1997). In India, the performance of joint forest management, an institutional reform which has been in operation for more than twelve years now does not inspire much confidence, in particular in the context of empowerment of the poor or of equity related reform. On the contrary, the perception by private entrepreneurs of an opportunity in the case of groundwater exploitation in Eastern Uttar Pradesh led to their bearing the transaction costs of change and linking investors to the credit markets. What do these studies lead us towards in the context of institutional change to support reform?

The direction suggested seems to be one of evolution of innovative institutions. Earlier suggestions in this direction have maintained …. "the third alternative is to vest right to exploit and allocate water with local communities with the state confining itself to defining the principles and procedures for community management" (Vaidyanathan, 1999).

Carrying this argument forward, the innovative institutions now being conceived of require iterative interaction between the state, communities, individuals and private entrepreneurs. The state sets in place policy options and then examines the assumptions and implications of each option. During the initial experiments, civil society institutions or private entrepreneurs identify the reasonability of these assumptions and the implications of the options in view of potentials of groups or individuals. With such inputs, gaps can be filled by other institutions which may exist or may emerge. Such a process shall lead to adaptive policy making in a process where there is constant exchange of information between differentially powered agents at any level of the decision process[17] (Adams *et al.,* 2002).

IV

GLOBALISATION OF INDIAN AGRICULTURE AND THE ROLE OF PRICE AND NON-PRICE FACTORS IN AGRICULTURAL EXPORTS

The importance of assessing carefully the relative significance of price and non-price factors extends to the international arena as well. In the era of globalisation of the Indian economy, the creation of a niche for Indian agricultural exports is vital. A great deal of the focus in this context is on the price-competitiveness of our exports (see Gulati *et al.*, 1994; Gulati and Kelley, 1999). Calculations of Nominal Protection Coefficients and domestic resource costs are depended upon to determine the export-competitiveness of Indian agricultural exports.[18] Such estimates are significant in so far as they provide a necessary condition for exports to take place.

It is our contention that a mix of price and non-price factors determines the rate at which a country is able to take advantage of more readily available export markets. Even when price competitiveness in international markets exists, other constraints may arise, both on the supply and demand side.[19] Note that agricultural exports witnessed an annual growth rate of 15.6 per cent in the six years before 1995 but in the post-WTO period there was an annual decline of 5.6 per cent after 1995. Compared to India, the developing countries as a whole have witnessed a much smaller decline in post WTO period and have maintained their market share[20] among other things, were non-price factors at work?

On the export demand side, non-tariff measures are to be reckoned with when prevailing assessments of health and environmental risk due to quality differences differ across countries. Such issues are particularly significant in the context of agricultural exports. Whenever processes of production, use of inputs or packaging methods result in unacceptable environmental standards, importing countries are bound to specify import requirements through notifications. These are perceived as "non-tariff barriers" by developing country exporters but as "import requirements" or non-tariff measures" by the importers. This contestation itself indicates that a large part of the struggle for market access lays in factors outside of the price related issues.

The agreement on technical barriers to trade, on sanitary and phyto-sanitary measures and the process and production methods, within the Uruguay Round, point towards the scope which exists within the current trade policy dispensation for countries to use the existing provisions to prevent the import of goods perceived as not satisfying predetermined environmental standards. Some recent studies carried out in India have attempted to evaluate the effect of these measures.

A study of the poultry industry is illustrative (Mehta and Nambiar, 2004). Relative prices are favourable for export, productivity has undergone a sea change with the introduction of hybrids produced through pure lines and an infrastructure is in place. Plants, being newly set up are certified to be following international standards of hygiene. However, the fledgling egg-processing industry which did well

initially fell into crisis in June 1997, one of the major reasons being the setting up of new pesticide residue standards by EU in particular. Studies which have attempted to set up indices to measure the changes in restrictions and notifications for import find that these have spread geographically and become more stringent over time.

Kadekodi and Mishra (2003) attempt to capture defining characteristics of the regulations. Four characteristics are identified.[21] Finally, "general stringency" is selected as a kind of "catch-all" variable. Two aspects of this variable, its intensity and changes in the degree of intensification over time are then quantified. Year wise rank values and factor scores are estimated for tea for the period 1980 to 1999. It is found that the stringency of regulations is increasing over the period using both indicators. Between 1992 and 1994, we also observe a jump in the index as well as the factor score for environmental regulations.

Kadekodi and Agarwal (2004) also estimated factor scores for non-price environmental regulations[22] based on six indicators and studied tea and cutflower exports. Using a gravity model, the impact of factor scores for environmental regulations on the ratio of exports to developed countries to those to developing countries is studied. The factor scores had a negative and significant effect on the dependent variable, indicating thereby that they were significant when a product is exported primarily to developed countries. Further, on examining the six indicators, which went into the factor score index, the pesticide residue index was found to be significant. Both these findings support those of an earlier study by Chopra and Agarwal (1999), which also built up an index of non-tariff barriers for different importing country groups.[23] They found that, for the period, 1991-96, non-tariff barriers turn out to be significant in the case of tea and some horticultural products such as mango and onion. It is reported that these measures are significant when major importing countries differ in levels of development and hence the level of imposition of these restrictions. Further, it can be argued that the manner in which these non-tariff measures are restrictive cannot entirely be captured by quantitative techniques. A case-by-case study of the restrictions imposed and their implications shall also be illuminating.[24]

Mehta *et al.* (2002) report preliminary findings from their study on selected processed food exports from India. Among others, the Indian seafood industry is studied. It is found that compliance costs for processing unit's increase with more stringent measures. Moreover issues of changing standards at short notice cause considerable harassment and high transaction costs to exporters. Countries vary in their requirements and support with latest information as well as financial support to address rising costs of compliance needs to be given to exporters.

On balance, most studies agree that the agricultural exports reveal a higher burden of environmental regulations in the short run, in particular if they are exporting to developed countries. Further, if exports are to other developing countries, the burden of these regulations is not high. Information gaps exist and importing countries tend to introduce new regulations at short notice. These issues

come in the way of taking advantage of the price competitiveness of Indian agricultural exports, in particular, for horticultural, marine products such as shrimp and products from the dairying industry. More research into these issues is needed. It seems in essence to be an issue of the creation of appropriate international institutions to complement the WTO and to ensure market access on the basis of an even playing field.

On the supply side, the constraints to agricultural exports are well understood. Some degree of spatial specialisation may be necessary. Changing cropping patterns in the 1990s already point out towards the arid and semi-arid parts of the country specialising in horticulture and dairying based exports (Ray, 1998). Alagh (1999) suggests the following four phases that are required to build up a supply chain for export-oriented agriculture: (a) The agro-climatic regional, state and sub-regional strategies earlier developed have now been operationalised at the district level. Plans exist in a recent pilot exercise from the Planning Commission. (b) The projects that have been developed have high economic rates of return but need tying up at the level of private investment in agro-processing and land-development and rural credit machinery both in the banking and co-operative sectors. (c) A new small farmer agribusiness project: speeding up and (d) Agro-climatic (region-specific plans need to be tied up with the decentralisation introduced by the 73rd and 74th Constitutional amendments).

Once again these recommendations would need the growing emergence of innovative partnerships between private entrepreneurs, enabling legal structures and possibly group-based credit schemes.

V

INSTITUTIONS TO COMPLEMENT THE MARKET: NATIONAL AND INTERNATIONAL.

The next phase of reform in the agricultural sector, both within the domestic economy and in its relationships with the world economy is indeed of institutional reform. We postulate that in a situation of differential input and market access, the emergence of innovative institutions is an essential condition for sustainability of the reform process and a more equitable distribution of growth resulting therefrom. This is well understood now. Note for instance, the following:

"However, non-price factors such as public investment in infrastructure, technological change, human development and institutional reforms are at least as important as incentive prices, in inducing effective supply response" (Rao and Gulati, 2005).

Setting in place the social framework for such change is not, however easy. In a wider context, Sen (1999) maintains that institutions and freedoms are central to the complex nexus of peoples' resource endowments, functioning, capabilities and choice and their movement out of poverty. But institutions are by themselves created by individuals or groups. As people move from transforming their resources or

endowments to functioning, their ability to do so is influenced by the freedom available that in turn are determined by the institutions.

Complexity arises when some individuals or groups can influence the institutions in a manner that gives them an advantage in transforming their resources to functionings by excluding others from the process. This link then creates differentiated levels of freedom and subsequently forces some individuals or groups to be disadvantaged vis-a-vis others who are able to capture rents by influencing the institutions underlying the provision of freedoms. This happens when freedoms are private goods that are available in differentiated measures to different persons in the society.[25] This is true for both

- The poor within a developing country context of access to public infrastructure such as irrigation and
- Exporters from developing countries who have limited access to the changing information and knowledge with respect to their markets.

The inter-relations are many and complex. This implies that as agricultural economists, we need to study more carefully how institutions change, an area I believe has not received as much attention as it should within the profession. Such a direction shall move the discipline into a position of greater integration with the social sciences, notably sociology and law and increase its policy relevance.

VI

LOOKING AHEAD: OTHER COMPELLING ISSUES FOR RESEARCH

Meanwhile, there is increasing realisation of the significance of a systems approach to the study of agriculture. The behaviour of complex systems is being studied to examine the linkages between physical and social systems and commonalities in the behaviour of the two. There exists in India, a tradition of work in this area. However, there may be more need to link this work with a study how agricultural systems in India may be impacted by exogenous factors operating at international levels.

One such factor is the patterns underlying the operation of international markets, in particular the volatility in commodity prices that may result. In the context of globalisation and integration with world markets, this is an important area to examine.

Another exogenous factor is global climate change. It is postulated in a study of projected impacts of climate change (Fischer *et al.*, 2002) that it will have mixed and geographically varying impacts on crop production. Developed countries substantially gain production potential, while many developing countries lose. In some 40 poor developing countries, with a combined current population of 2 billion, production losses due to climate change may drastically increase the number of undernourished, severely hindering progress against poverty and food insecurity. Further, tropical agriculture is expected to be impacted considerably. A recent study,

at the International Rice Research Institute, found that rice yield fell by 10 per cent per 1ºC rise in mean nighttime minimum temperature (Peng *et al*., 2004). Excessive heat may harm the flowering process of rice. Wheat producing capacity of South Asia is postulated to decrease by 10 to 15 per cent in different scenarios leading up to 2050.

China and India are of crucial importance in this process, both as drivers of change and as countries, which may feel the impact, even though to a lesser extent than Sub Saharan Africa. In another context, Butler (2004) hypothesises that China will be more insulated from climate change effects than India due primarily to slower population growth, greater climatic range which may help buffer the effect, more even distribution of opportunity, education and nutrition and capability to generate "effective demand" to import grain.

Some may consider these postulations to be exaggerated and alarmist. Be that as it may, I believe that we, the community of agricultural economists in India need to pay more attention to the results from regional models of scenarios of climate change and their effects on agriculture than we have done hitherto. Some of the parameters emerging from them can provide critical inputs into how we relate to world agricultural markets and systems here and now.

NOTES

1. For a survey of the studies, see Gulati and Narayanan (2003).

2. See EPW Research Foundation (1997) for details of the possible bias in classification. This paper estimated that 51 per cent of the Rs. 87,386 crores of subsidies estimated for the non-merit goods and services clearly fell outside this category, consisting as they did of social and economic services.

3. The assumption is that adoption of better quality seeds constitutes technological change since it usually requires changes in other inputs and higher outputs.

4. See Chopra (2004) for details.

5. Recent empirical studies reiterate further that deprivation identified as getting less water than entitlement depends on relative location within the canal command. Tailenders are more deprived than farmers in the head reach. See for instance Vashishtha (2003).

6. See Chopra (1982) for detailed econometric analysis of the reasons for the preference.

7. See North in Menard (2000) for details.

8. A large part of the structural reform programmes arising out of fiscal deficit problems fall in this category.

9. See examples of such interventions and an analysis of their contributions in Chopra and Gulati (2001) and Chopra *et al.*, (1990).

10. Note on the Andhra Pradesh farmers management of irrigation systems Act of 1997 (Government of Andhra Pradesh, 1997).

11. See Jairath (2001) for details.

12. See Nikku (2003) for a discussion of conflicting priorities of the State Government with respect to water use for electricity as against irrigation.

13. An extensive literature on this exists. The intention here is not to review that literature but to focus on it as an instance of a centrally driven initiative for institutional change, deemed to have been successful at smaller scales.

14. For the detailed study on which this section is based, see Shah (2001).

15. A study in 1984 by the Society for Prevention of Wasteland Development concluded that even if all the paperwork of the small farmer were perfect, the decision on his application under the FBS took 11 months and scores of visits to different offices.

16. In addition to the studies discussed above, see Raju (2000).

17. Similar findings are reported from a four year international study attempting an assessment of major response options in the context of ecosystems and human well-being. See the website www.millenniumassessment.org

18. See, for instance, a recent study by Chand (2005) which estimates these coefficients for India's major agricultural exports.

19. See Bhattacharya (1996) for instances of these.

20. See Table 7.2 page 116 of Ramesh Chand (2002).

21. These are: kind of regulation, state of regulation, level/limit of the residual/concentration specified and stringency of regulation.

22. The range of policy instruments includes direct regulatory instruments such as prohibitions, product standards etc., compulsory information requirements, financial instruments and voluntary agreements by producers.

23. The index was based on data on individual country regimes with respect to GATT coverage for agriculture, extent of preference to regional trading partners, technical measures including SPS standards, seasonal concessions, pesticide residue, membership of multilateral environmental agreements and eco-labeling.

24. See the discussion in Centre for International Trade, Economics and Environment (1998). See also Sampson (1999) for a possible framework for further development of policy in the area of trade and environment.

25. See Chopra and Duraiappah (forthcoming) for a discussion of the problems in institution building in fragmented, unequal societies.

REFERENCES

Adams, W.M.; Dan Brockington, Jane Dyson and Bhaskar Vira (2002), *Analytical Framework for Dialogue on Common Pool Resource Management*, University of Cambridge, Cambridge, U.K. (mimeo.).

Alagh, Y.K. (1999), "Agricultural Trade and Sustainable Development", *Indian Journal of Agricultural Economics*, Vol. 54, No.1, January-March, pp. 1-5.

Aoki, M. (2000), "Institutional Evolution as Punctuated Equilibria", in C. Menard (Ed.) (2000), *Institutions, Contracts and Organisations: Perspectives from New Institutional Economics*, Edward Edgar, U.K.

Arrow, K.J. (1997), "The Place of Institutions in the Economy: A Theoretical Perspective" in Y. Hayami and M. Aoki (Eds.) (1997), *The Institutional Foundations of East Asian Economic Development*, Macmillan, London, U.K., pp. 39-48.

Butler, Colin (2004), *Climate Change, Food Security and Human Security*, Paper presented to Chinese Academy of Agricultural Sciences, Beijing, China, September.

Centre for International Trade, Economics and Environment (1998), *Ratchetting Market Access*, Jaipur, India.

Chand, Ramesh (2002), *Trade Liberalisation, WTO and Indian Agriculture*, Mittal Publications, New Delhi.

Chopra, Kanchan (1982), "Alternative Sources of Irrigation and Land Use Patterns in the Punjab", *Indian Journal of Agricultural Economics*, Vol. 37, No. 2, April-June, pp. 170-188.

Chopra, Kanchan (2004), "Withdrawal of Subsidies from Irrigation and Fertiliser: Impact on Small and Marginal Farmers," Paper written for the seminar on *India's Economic and Social Development: National and International Perspective*, held on November 16-17, 2004 at Hyderabad.

Chopra, Kanchan; G.K. Kadekodi and M.N. Murty (1990), *Participatory Development: People and Common Property Resources*, Sage Publications India Pvt. Ltd., New Delhi.

Chopra, Kanchan and R.N. Agarwal (1999), *Environmental Regulations as Trade Barriers for Developing Countries: The Case of Some Indian Agricultural Exports*, Discussion Paper Series No. 7/99, Institute of Economic Growth, Delhi.

Chopra, Kanchan and S.C. Gulati (2001), *Migration, Common Property Resources and Environmental Degradation: Interlinkages in India's Arid and Semi-Arid Regions*, Sage Publications India Pvt. Ltd., New Delhi and London.

Chopra, Kanchan and Anantha Duraiappah (forthcoming), "Operationalising Capabilities in a Segmented Society: the Role of Institutions", in F. Comim (Ed.) (forthcoming), *Operationalising Capabilities*, Cambridge University Press, Cambridge, U.K.

EPW Research Foundation (1997), "Distorted Perceptions, Government Subsidies and Fiscal Crisis", *Economic and Political Weekly*, Vol. 32, No. 22, May 31, pp. 1234-1235.

Fischer G.; M. Shah, H. van Velthuizen and F.O. Nachtergaele (2001), *Executive Summary Report: Global Agro-ecological Assessment for Agriculture in the 21st Century*, International Institute of Applied Systems Analysis. http://www.iiasa.ac.at/Admin/INF/recent-

Government of Andhra Pradesh (1997), *Note on Management of Irrigation Systems Act*, Irrigation and CAD Department, Hyderabad.

Government of India (1994), *Guidelines for Watershed Development*, Department of Wasteland Development, Ministry of Rural Areas and Employment, New Delhi.

Gulati, A.; Anil Sharma, Kailash Sharma, Shipra Das and Vandanna Chhabra (1994), *"Export Competitiveness of Selected Agricultural Commodities"*, NCAER, New Delhi.

Gulati, Ashok and Tim Kelley (1999), *Trade Liberalisation and Indian Agriculture*, Oxford University Press, New Delhi.

Gulati, Ashok and Seema Bathla (2002), *Capital Formation in Indian Agriculture: Trends, Composition and Implications for Growth*, National Bank for Agriculture and Rural Development, Mumbai.

Gulati, Ashok and Sudha Narayanan (2003), *The Subsidy Syndrome in Indian Agriculture*, Oxford University Press, New Delhi.

Jairath, J. (2001), *Water User Associations in Andhra Pradesh: Initial Feedback*, Concept Publishing Company, New Delhi.

Kapoor, N. and S. Saigal (2001), "Forest Protection Committees and Panchayati Raj Institutions: in Search of Linkages", *INFORM*, Vol. 1, No. 2.

Kadekodi, Gopal K. (2001), Valuing Community Labour: Why Not?, Paper for JFM Workshop on "Policy Implications of Knowledge with respect to Common Pool Resources in India", Institute of Economic Growth, Delhi.

Kadekodi, G.K. and A. Mishra (2003), *"Trade Related Environmental Regulations: Some Lessons from India"*, Paper read at seminar on Energy and Environment held at India Gandhi Institute of Development Research, Mumbai.

Kadekodi, G.K. and M.M. Agarwal (2004), *Environmental Regulations and Indian Exports of Cut-flowers, Leather and Tea*, Paper presented at Seminar on WTO Negotiations: India's Post-Cancun Concerns, held at Jawaharlal Nehru University, New Delhi, October.

Kolavalli, S. (1999), "Scaling up Participatory Approaches: Evidence from a Large Survey" in J. Farrington (Ed.) (1999), *Participatory Watershed Development: Challenges for the 21st Century*, Oxford University Press, New Delhi.

Kolavalli, S. and N. Shah (1989), *Management of Public Tubewells in U.P.*, Indian Institute of Management, Ahmedabad.

Kerr, J.; G. Panagare, V. Lokur-Panagare, P.J. George and S. Kolavalli (1998), *The Role of Watershed Projects in Developing Rainfed Agriculture in India*, Study prepared for ICAR, World Bank, Washington, D.C., U.S.A.

Landel-Mills, N. (1998), *Cost-Benefit Analysis: A Useful Tool for Evaluating Watershed Development Projects*, Paper prepared for National Workshop on Watershed Approaches to Wasteland Development, New Delhi.

Mehta, Rajesh and R. J. Nambiar (2004), *"International Food Safety Regulations and Processed Food Exports: A Case of Indian Poultry"* Paper presented at Seminar on WTO Negotiations: India's Post-Cancun Concerns held at Jawaharlal Nehru University, New Delhi, October.

Mehta, Rajesh; M. Saquib and J. George (2002), *"Addressing Sanitary and Phytosanitary Agreement: A Case Study of Selected Food Products in India*, Discussion Paper No. 39/2002, Research and Information Systems for Non-Aligned and other Developing Countries.

Menard, C. (2000), *Institutions, Contracts and Organisations: Perspectives from New Institutional Economics*, Edward Edgar, U.K.

Nikku, B. R. (2003), "Irrigation Reforms, Institutions and Livelihoods: Opportunities and Challenges: Case of Andhra Pradesh, South India" in Kanchan Chopra, C. H. H. Rao and Ramprasad Sengupta (Eds.) (2003), Water *Resources Sustainable Livelihoods and Ecosystem Services*, Concept Publishing Company, New Delhi.

North, Douglas (2000), in C. Menard (Ed.) (2000), *Institutions, Contracts and Organisations: Perspectives from New Institutional Economics*, Edward Edgar, U.K.

Palmer-Jones, R. (1995), *Deep Tubewell Technology in South Asia*, Norwich, Unpublished draft for the Ford Foundation.

Pant, Niranjan (1989), *Water Distribution and Management in New Design Tubewells in Eastern U.P.*, Centre for Development Studies, Lucknow.

Perry, C.J.; Michael Rock and D. Seckler (1997), *Water as an Economic Good: A Solution or a Problem*, Research Report No. 14, International Irrigation Management Institute,

Peng S.; J. Huange, J.E. Sheehy, R.C. Laza, R. Visperas, X. Zhong *et al.* (2004), *"Rice Yields Decline with Higher Night Temperature from Global Warming"*, Proceedings of the National Academy of Science, Vol. 101, No. 27, pp. 9971-9975.

Rao, C.H.H. (2000), "Watershed Development in India: Recent Experiences and Emerging Issues" *Economic and Political Weekly*, Vol. 34, No. 45, November 4.

Rao, C.H.H. and Ashok Gulati (2005), "Emerging Perspectives and Major Policy Issues in Indian Agriculture " in C.H. H. Rao, B.B. Bhattacharya and N.S. Siddharthan (Eds.) (2005), *Indian Economy and Society in the Era of Globalisation and Liberalisation*, Academic Foundation, New Delhi.

Sampson, G. P. (1999), "Trade, Environment and WTO: A Framework for Moving Forward" in *Bridges Between Trade and Sustainable Development*, CUTS, Jaipur, India.

Sarin, M. (2001), "From Right Holders to Beneficiaries?", in *Community Forest Management, Van Panchayats and Village Forest Joint Management in Uttarakhand*, CIFOR Paper (mimeo.).

Sarvanan, V.S. (2002), "Institutionalising Community Based Watershed Management in India: Elements of Institutional Sustainability", *Water Science and Technology*, Vol. 45, No. 11, pp. 113-124.

Sen, Amartya (1999), *Development as Freedom*, Knopf Press, New York.

Shah, Tushar (2001), *Wells and Welfare in the Ganga Basin: Public Policy and Private Initiative in Eastern Uttar Pradesh, India*, Research Report No. 54, International Water Management Institute, Colombo, Sri Lanka.

Sundar, Nandini (2001), "A Sociological Perspective on Devolution in Natural Resource Management", Paper for Workshop on *Policy Implications of Knowledge with Respect to Common Pool Resources in India*, September, Institute of Economic Growth, Delhi.

Vaidyanathan, A. (1999), *Water Resource Management: Institutions and Irrigation Development in India*, Oxford University Press, New Delhi.

Vashishtha, P.S. (2003), *Tailenders and other Deprived in an Irrigation System in Haryana*, Research Study No. 2003/1, Agricultural Economics Research Centre, University of Delhi, Delhi.