CHAPTER 8

CONCLUSIONS AND POLICY IMPLICATIONS

Indian agriculture has undergone a major transformation after the advent of groundwater irrigation especially after the Green Revolution. With the introduction of high yielding varieties, water intensive cropping pattern and technology intensive agricultural pricing policy paved the way for the extensive use of groundwater for irrigation. Role of irrigation in agriculture shifted form a risk reducing agency to a production augmenting technology. The farmers increasingly shifted to groundwater irrigation as tube-wells were the most profitable and efficient source of irrigation because of its flexibility and reliability as an irrigation water source which increases the input use rising the yields and economic returns. Disillusioned with the efficiency of public tube-wells, the farmers have resorted to private extraction of groundwater through privately owned pump sets which has grown exponentially while investment in public tube-wells has remained flat (World Bank 1998, pp. 10). In 1950, groundwater accounted for less than a fifth of India's irrigated land and at present more that 60 percent of India's irrigated lands receive groundwater irrigation (Shah, 1998 and Shah *et al,* 2003).

Along with the expansion of area under groundwater irrigation, its intensive use began to show alarming signs of over exploitation during the 1980's and 1990's especially in states heavily dependent on groundwater (World Bank 1998). Incessant lowering of water table has ecological implications of natural resource depletion and future sustainability of agriculture, economic implications in terms of rising cost of cultivation in order chase the falling water table with successive technology adoption and continuous tube-well deepening and also social marginalization and deprivation of many small and marginal farmers who remain deprived of the use of this productive resource on account of not having enough capital to harness groundwater. Groundwater is, thus, becoming critical to the productivity of Indian agriculture and income and livelihood of millions of farmers.

Despite the importance of groundwater to agricultural productivity, and despite the signs of degradation of the resource, groundwater has received scant attention from social scientists. Initial studies were preoccupied with the reasons of groundwater development, its superiority to other sources of irrigation, efficacy of groundwater irrigation and its contribution to productive gains in agriculture. Distribution of these productive gains was

not discussed as an issue. The signs of over-exploitation took a shift in the perspective of the study on groundwater. Focus was laid on condition of the resource, local institutions for allocation and recharge of groundwater and link between electricity prices and groundwater use. However, socio economic implications of unequal access to groundwater resource with increasing depletion have received scant attention in the literature. Although a few studies are devoted towards this aspect, they are mostly case studies from Gujarat and south India. Emerging crisis of rural economy of Punjab on account of groundwater depletion has been mainly focused around the extent of groundwater depletion and economic and ecological unsustainability of water intensive rice-wheat cropping pattern. The present study tries to look at the other important consequence of groundwater depletion which rises due to unequal access of this scarce resource mainly in terms of social marginalization and rising income differences in the groundwater dependent rural economy of Punjab. The issues on accessibility to groundwater irrigation are studied comparing three different irrigation systems at different levels of groundwater depletion. It shows how contemporary concerns originate in social and institutional arrangement that made possible the rapid private investments in groundwater. While issues of economic accessibility is studied in light of changing profitability and investment to harness groundwater, social accessibility is determined by institutional mechanisms and terms of exchange of groundwater from the resource rich tube-well owners to the resource poor small and marginal farmers.

8.1 Summary and Conclusion

The initiation of Green Revolution in India saw enormous increase in food grain production especially wheat and rice and Punjab became the food basket of the county increasing both area and production of these two crops replacing area under pulses, oilseeds and coarse cereals. It has been observed in the study that, as the irrigation infrastructure is improving, the trend in the cropping pattern has been shifting towards the specialization of these two crops. Although all the districts in the state have undergone crop specialization, the central belt has the maximum dominance of rice-wheat cropping pattern. Coupled with this shift in cropping pattern, there has been a complete shift in the structure of irrigation in Punjab from surface irrigation to groundwater irrigation as tube-wells are more reliable and efficient source of irrigation. The secondary based district level analysis reveals a high spatial correspondence between these two phenomena of crop specialization and increasing

groundwater exploitation. It is further strengthened by the empirical estimates of comparative trend of the rising water demand in agricultural sector on account of increase in area under water intensive rice crop in Punjab which is largely being met by the exploitation of groundwater. This indicates a huge pressure on the groundwater resource of the state as greater quantity of groundwater is mined out than the recharge leading to continuous groundwater depletion translated to falling of water tables.

These alarming signs of over-exploitation of groundwater have thrown the rural economy of Punjab into severe economic crisis in terms of stagnation and decline in yield levels and increase in cost of cultivation, which has shown its ramifications in declining profit margins in agriculture endangering the economic sustainability of agriculture in the state. The analyses also reveals that the net returns for rice are typically lower than wheat in the study area. The cost of cultivation of rice is much higher than that of wheat as rice is a labour intensive crop. In the absence of a norm of electricity pricing applicable for use of groundwater on volumetric basis, the cost of diesel was imputed and added to the cost of cultivation to reassess the profitability of wheat and rice given a hypothetical scenario where electricity subsidy is withdrawn by the government and the farmers use diesel pumps to extract groundwater for irrigation. Under the new assumption of the farmers having to pay for water in proportion to its use, the net-returns to both rice and wheat declines by 383 percent and 19 percent respectively. While net returns to wheat still remain positive but for rice it becomes negative. The decline in net returns also positively corresponds to groundwater depletion. In the mixed irrigation system of Tohl Kalan, on an incurred cost of Rupee 1, rice gives a negative return of (-) 42 paisa while it gives (-) 70 paisa in the groundwater depleted village of Ballab-e-Darya. For wheat, the corresponding figures of net returns are Rs. 1.60 in all the irrigation systems irrespective of their levels of depletion of groundwater. Thus it can be rightly stated that rice cultivation is only profitable under the state subsidy of free power in agriculture and is continued even under conditions of depletion.

An analysis of net returns for the different crop combinations reveal that the most profitable wheat-rice combination gives negative returns while the traditional wheat-maize becomes much more remunerative when (imputed) diesel prices are added to the cost of cultivation. Thus, farmers continue to favour rice over other alternatives as maize even under depleted

groundwater conditions only because of electricity subsidy which artificially reduces the cost of cultivation. The procurement prices of the crop, which is nearly equal to the market price, and is additionally free from price fluctuations unlike the market price is an additional reason for the farmers allocating land in favour of this crop.

One of the important findings that come out of the cost of cultivation and profitability analysis is that sustained depletion of groundwater increases inequality in terms of farm incomes in the rice–wheat cropping pattern across different landholding classes and further marginalizes the land-poor cultivators. It is noted that on an average, net returns for the larger holdings are significantly higher compared to the smaller ones and this pattern is more visible in areas with depleted groundwater situation. This is supported by higher inequality within different farm-size groups in net returns of rice in the groundwater depleted village of Ballab-e-Darya compared to the other two villages in the sample. This signifies that the cost of the natural resource depletion is disproportionately borne by the resource poor farmers as they are unable to invest capital in changing technology and hence remain excluded from its beneficial ambit of groundwater irrigation.

Persistence of a negative groundwater balance result in further lowering of water table which in turn renders the existing water lifting technology obsolete making the irrigation system less reliable. The intensive exploitation of groundwater through the wells led to the drying up of the shallow wells and thus to maintain the volume of the water draft, centrifugal pumps were introduced for lifting groundwater in the state. With consistent rise in groundwater draft due to subsidized electricity pricing, even centrifugals lost its desired irrigation efficiency with further deeper water levels and therefore, an alternate technology was tried out by some selective farmers known as the submersible technology[277]. Submersible adoption was only restricted to the rich farmers who are generally owners of large and medium landholdings and who have enough savings to invest in this emerging technology which is not only costly in terms of initial investments and its operating and maintenance costs[278] are also high. Observations in the field suggest that installation of deeper submersible tube-wells by the few elite result in drying up of the shallower

[277] In Submersible pumps the pump and the motor are closely coupled and the whole unit is placed below the ground level.

[278] The cost of repairing the pump and fixing of the motors during motor burn outs due to voltage fluctuations is much costlier than the centrifugals.

neighbouring tube wells powered by centrifugal pumps owned by primarily the smaller land-holders due to over lapping radius of influence of the two wells.

It is a well established fact that the access to good quality reliable irrigation is important as it not only reduces risks faced by the rain fed agriculture, it increases the quantum of production and net income of the farmer. The institutional arrangement of groundwater irrigation, which is known as an efficient mode, needs to be such that there is equity in access to it. Ethically, being a common pool resource, the rights to access this resource should be equal to all. But the rights to accessibility of this resource are guided by two factors, "proportionate equality" and "prior appropriation". There is inherent inequality in groundwater accessibility as the groundwater rights are adhered to the land rights, which make the land owners de facto owners of the groundwater pumped out from water extraction machines fitted on their land. Since the land distribution is skewed in favour of large farmers, there is inherent inequality in ownership and access to groundwater. The same is reiterated in the study, where empirical evidences show a positive correlation between the ownership of wells, depth of wells and sole ownership of wells to the land holding sizes. The small and marginal farmers unlike the large farmers by virtue of having lesser surplus capital neither adopt the changing water technology nor can they compete with the large farmers in chasing the falling water table. Thus, in a way the proportionate inequality leads to prior appropriation of the resource leading to greater inequity.

With greater accessibility of groundwater resource, the large farmers also devote larger proportion of area to rice cultivation and gain enormously from the government support of high MSP and free agriculture electricity. The small and marginal farmers in the completely groundwater dependent irrigation system facing problems of water depletion have either dry wells or have low water yields. Consequently, they suffer from low productivity of rice and are often forced to grow maize instead of rice. Thus while in the mixed irrigation systems, the farmers who lose in the race of chasing water tables resort to canal irrigation, in rural areas dependent solely on groundwater, the farmers either buy water or change their crop combination. Thus, the resource rich by virtue of having de facto ownership of groundwater resource have access to this precious resource both for cultivation and sale. As a result, large farmers accumulate surplus from the resource poor through the sale of a resource that is

technically owned by the community. The investment made to access this resource is often more than recovered from the sale of water.

The gap between the "haves" and "have-nots" in the de facto ownership of groundwater resources is bridged by the institution of groundwater markets where the tube-well owners sell water to the farmers who do not have wells, or their wells have dried up or give low water yields. Some scholars believe that groundwater markets are vehicles of poverty alleviation as it provides water to all farmers even without ownership of wells and others feel it as a medium to generate surplus through exploitation of natural resource. The markets develop as more people involve in sale and purchase of water. In other words, the markets spread when there are more number of buyers and sellers and that is, when there is greater demand and supply for water. This study observes that the groundwater markets develop and mature with increasing demand for water which increases as water table falls and resource poor can not compete with the large farmers in the deepening of wells. It is further seen that as scarcity rises the unstandardised labour transactions are replaced by the standardised cash or land lease contracts. As water table recedes further, the number of buyers increases and while the number of water sellers reduce significantly. This leads to an increase in the monopoly of water sellers with depletion as they (sellers) can bid any price for water and the terms of transaction of water trade gets dictated by the sellers as the demand for water sale rise.

The impact of reliable access to groundwater in the groundwater market is studied by comparing the cropping pattern, yield of crops and net returns of both buyers and sellers. It was noticed that in all these aspects the sellers perform much better than the buyers and also devote a much larger area to the most profitable as well as the most water intensive rice crop compared to the water buyers. Thus, these empirical findings prove that the groundwater markets do not provide equal access to reliable irrigation across all farmers and the water sellers gain much from water selling and the cost of cultivation of buyers steeply rise as they have to buy water from water extraction machine owners who pump out water free of (recurring) cost with free agriculture electricity from the government.

Besides the economics of water buying and selling, there is hidden exploitation in the groundwater markets which leads to further deprivations. In the initial stage of groundwater market, water is exchanged with farm labour in which the buyer is expected to do all kinds

of labour as and when required by the seller. Land and labour linkages were common in rural economy but the groundwater dependent rural economies show linkages of the three most important components of agricultural production – land, labour and water. This bilateral bargaining between the buyer and the seller is subjected to personal affinities and kinship ties and thus the degree of exploitation varies from one buyer to the other. But with falling water tables the unstandardised terms of transactions change into standardised cash contracts which are either seasonal or hourly. It was noticed that with rising water scarcity, the sellers leased in buyers' land for the Kharif season when the scarcity is felt acutely because of rice cultivation. In the groundwater depleted village, 15 percent of the water transactions were done in such land lease contracts. The terms of tenancy in such cases are favourable for the water-lords and the rent in the study area is often as low as 6,000 to 8,000 rupees per season. This contract also implicitly include the understanding that that the tenant (water- lord) is going to give water to the land owner free of cost in the rabi season when wheat is grown for self consumption. In these contracts, all the inputs are provided by the landowners and the water is provided by the tenant and the grain produced is equally divided between the two. This implies that water has become the most important input in agriculture surpassing the importance of land which is implicit in the fact that the bargaining power in the production decision remains with the (de facto) owner of water and that of the land. It was also noticed that with further lowering of water tables, the water-lords deter giving water in the rabi season and impose a yearly lease in contract on the buyers. It was noticed that reverse tenancy is more prevalent in the groundwater depleted region where 35 percent of the households leasing out land were that of small and marginal farmers'. It was seen that in this land – labour – water interlinkages, credit also gets its place when the buyers mortgage their leased in land to the water sellers who are more than often large farmers. The debt burden of the water buyer rises to enormous extent and the ultimate form of such exploitation is a situation where the small and marginal farmers are compelled to sell out their land at distress prices to the larger farmers who started out as water sellers in this process. These farmers often turn into landless labourers from cultivators.

It has been argued by the proponents of groundwater markets that markets for groundwater are means of solving the problem of indivisibility in groundwater investments. But there are other means of solving these problems like group owned tube-wells and public tube-wells. Group owned tube-wells were common phenomena in the study villages but nowhere in

Punjab, the public tube-wells are functioning and are virtually nonexistent. The group ownership has many problems and conflicts are very common among the partners regarding spacing and timing of turns for irrigation, selection of crops, investment in changing and maintaining the pump and successive deepening. Successful functioning of the joint wells needs compatibility and adjustability among the shareholders but when there is scarcity, joint rights invariably come into conflict leading to unreliable irrigation supply effecting crop yield. So it is noticed that many farmers in order to avoid these conflicts increasingly resort to groundwater markets to buy water rather than investing in joint wells.

Although the farmers of Punjab are well aware of the impending danger of groundwater depletion and future sustainability of their agriculture, both farmers large and small, invoke state as a means out of the impending water crisis. They envisage the state as a regulator or facilitator to collective action to limit groundwater use. In the discussions with the farmers, it was found out that the farmers both large and small are well aware of the fact that rice cultivation is the sole cause of groundwater depletion but all of them felt that individual farmers shifting out of this profitable crop will not solve the problem of groundwater depletion of the state, so the state should give incentive for growing other crops so that all the farmers can collectively decide to shift out of rice cultivation. Many farmers also consider it the state's role to enhance supply by providing alternative surface water irrigation. Farmers point out that the state sponsored canal water is available at far lower cost, albeit having lower reliability and quantum than private groundwater sources. The farmers of this region do not consider sustainability of groundwater to be their concern, but that of the state.

Even with free electricity in agriculture, majority of the farmers, especially owing large landholdings and owning submersible pumps are dissatisfied with the electricity supply which is erratic and supply hours are considered to be much lower than required[279]. The dissatisfaction is there to such an extent that many farmers especially who own deep tube wells and devote greater area under rice cultivation are willing to pay electricity tariff for a more regular and sufficient duration of electricity supply[280]. This is rational, given that the farmers who have already invested substantial capital in installation of deep submersible

[279] It is about 6 to 8 hours per day in peak season on rice transplantation.

[280] However the farmers do not want to pay according to metered tariffs but agree to pay flat charges for electricity consumption.

tube-wells can also afford to pay flat charges on electricity usage if supply hours are extended to greater amount.

Moreover, there are no direct short term costs to groundwater depletion. Once a well owner has sunk a tube-well, the costs of lowering the pump by length of pipe are minimal. For example in Gharinda, wells are drilled to 350 feet, even though the current water level is 60 feet. If the equipment does not fail, the well owners can continue to access water for many more years without spending money on well deepening. For example if the water continues to fall at about 10 feet per year, the Gharinda farmers can pump using existing equipment for another 29 years! In the long term, the cost of new capital equipment may be severe, but in the short term, well owners are insulated from the cost of depletion. Moreover, the running cost of the wells is nil as agriculture electricity is free in Punjab which implies that if it continues to remain free, the same farmers in Gharinda will continue to get water supply for 29 years without investment except that in the maintenance of the pump. For the same very reason when asked about the coping strategies in face of depletion, most of the large farmers plan to deepen their existing tube-wells or dig more tube-wells in advance. Since such an action needs a lot of capital, the small and marginal farmers talk of coping with reduced yields, changing of cropping pattern to maize and fodder, lease out land or altogether sell out their land and shift to other occupation.

8.2 Conclusions and Policy Implications

The policy design revolving around food security of the country in the sixties encouraged the "grain revolution" through subsidised input use and high procurement prices. Punjab became the food basket of the country with increasing area under rice and wheat which was encouraged by the subsidization of inputs like fertilizer and HYV seeds and expansion of infrastructure like irrigation, road network, regulated markets and electrification of villages. The modern agricultural practices of HYV technology ushered in the shift from canal irrigation to tube-well irrigation as it was a more reliable and flexible source of irrigation. Thus, Punjab had undergone simultaneous shift to groundwater irrigation and wheat-rice cultivation complimenting each other in both increasing cost of cultivation with the use of modern water extraction machines and huge profits by the stable income through productive HYV seeds. The initial increase in cost was cushioned by the gains from highly productive HYV and it was also supported by the state by providing high MSP for these two crops to

protect the farmers from market instability and subsidised electricity to reduce the tube-well irrigation cost.

These policies were initiated in the mid sixties to gear towards grain production to make India self sufficient in food grain production, built up the buffer stock and procure grains for the public distribution system. Although India was able to achieve self sufficiency in food grain production, the policy of high procurement prices also led to the emergence of agro climatically misfit cropping pattern. Water intensive rice crop began to gain acreage even in the semi arid tracts of north western India creating huge pressure on the groundwater resource of the region. Without any consideration of the natural resource depletion and future sustainability of agriculture, these policies continue till after forty years of its initiation rather it has been strengthened through further subsidization by supplying free electricity to help in groundwater irrigation which is the main determinant of rice cultivation in the state.

The agricultural stagnation in the state particularly after eighties is much debated and agricultural diversification has been suggested as a remedy which was further strengthened by the Johl committee report on crop diversification. Before the crop diversification could substantially increase in the state, the policy announcement of free electricity to agricultural use in mid nineties further geared the farmers towards crop specialization increasing the cultivation of rice. From the market side, the high costs of production have led to the wheat and rice production in Punjab becoming either marginally competitive or non competitive in the international market[281]. A wheat grower in Punjab was obtaining lower net returns per hectare after incurring higher costs per hectare on modern inputs. The present study also reiterates the same finding of lowering net returns in face of depletion and it further goes onto prove that rice is struck harder with impending depletion when not only the inequality increase with water depletion but its cultivation is economically viable only with state sponsored free electricity in agriculture. Thus, the farmers who loose access to this subsidy on account of inability to invest in continuous technology upgradation and deepening of wells also shift out of cultivation or resort to rain-fed maize cultivation. The continuous depletion of this common pool natural resource has made the farmers further ecologically

[281] Vasant. P. Gandhi (1997), "Technology, Cost Reduction and returns in agriculture: A Study of Wheat and Rice in Punjab". *Vikalpa*. Vol. 22, No. 2, April-June. pp. 121.

handicapped and socio economically impoverished in the face of declining profitability of the major crops.

It is pertinent here to note that skewness of ownership of land could not be corrected by land reforms due to many socio-political reasons, but the present study imply that this skewness in land distribution leads to proportionate inequality and facilitate prior appropriation of the common pool resource of groundwater to such an extent that it seizes the land rights of the small and marginal landholders on the one hand and on the other also assists the process of surplus accumulation by the large landlords. With no well defined right of groundwater, the rights of the resource poor to this scarce resource is not protected and with out access to water they are forced out of farming and pushed into further deprivation and impoverishment.

At present the government is only concerned with subsidization of electricity which only helps the tube-well owners to pump out water free of cost. On the contrary, the farmers who are in real need of this subsidy are devoid of ownership of deep tube-wells as they can not meet the expense of the lumpy investments in the water extraction machines and many of such farmers lose and in future will lose access to groundwater when they will fail in the competitive tube-well deepening in conditions of continuous groundwater depletion. It is quite disappointing to see that the canals which are a "non class biased" irrigation source[282] are drying up in subsequent years without any maintenance further endangering the irrigated agriculture of non tube-well owners. It is important to appreciate the fact that the seepage from the canals helps in groundwater recharge which also indirectly benefits the tube-well irrigators.

In the absence of a clear legislative framework, state's indirect forms of regulation of groundwater have led to miserable consequences on farmers. Regulations stipulating minimum space between wells have become an opportunity for graft, and have served to exclude the least well connected and the poorest. Limits to access to formal credit for drilling wells and for applications for new electricity connections have suffered the same fate. The power of cheap electricity as a vote getter has left successive state governments

[282] Although the distribution of canal water varies in the head reach and tail reach but it has no correlation with the investment capacity of farmers. The availability of irrigation water from the canals is subjected to the location of the farms with respect to the canals.

helpless to raise tariffs, shift away from the flat rate structure to finally free agriculture electricity in Punjab which has encouraged further wasteful use of groundwater.

TABLE – 8.1
COMPARISON OF GROUNDWATER IRRIGATION AND ELECTRICITY SCENARIO IN PUNJAB AND OTHER STATES OF INDIA

Indicators	Punjab	Haryana	Tamil Nadu	Andhra Pradesh	West Bengal	Gujarat	Source
Level of development of groundwater (%) in 2004	145	109	85	45	42	76	CGWB, 2006
Number of over exploited blocks (%) in 2004	103 (74.6)	55 (50.9)	142 (37.0)	219 (19.8)	0 (0)	31 (16.8)	CGWB, 2006
Normal average rainfall in mm	780	615	995	561 - 1113	2074	1243	CGWB, 2006
Nature of aquifer	Alluvial	Alluvial	hard rock	Hard rock	Alluvial	Alluvial & hard rock	CGWB, 2006
Number of electric tube-wells (%age to total) in 2001	73.3	63.1	82.5	93.5	8.2	54.5	GOI, 2003
Flat tariff (Rs/HP/year) for 2007	Free	420	Free	Free	1760 - 2160	850	Mukherji, *etal*

Groundwater today has bound the state and farmers in a curious relationship of mutual dependence. It is increasingly being debated by the academicians that the electricity tariffs in most of the groundwater dependent agricultural states of India are fixed as a tool to appease farmers and have a successful way of mobilizing vote banks through out India. The adaptation of electricity tariffs to regulate groundwater depths is completely missing in the Indian scenario which is well documented in the relationship between the electricity tariffs and the level of groundwater over-exploited in different states of India (table – 8.1). States with higher levels of groundwater over-exploitations have either free electricity or very cheap flat rates of electricity in agriculture. The two striking examples are that of Punjab and West Bengal. Punjab having 75 % of over-exploited blocks with a much lower average rainfall[283] has free agricultural electricity whereas West Bengal with no over-exploited blocks and also with abundant rainfall has much higher electricity tariffs. While West Bengal is a traditional rice growing belt on account of higher rainfall and alluvial soil, the shift towards rice cultivation in semi arid Punjab was on account of Green Revolution package and successive policy directives towards grain production. The cheap and subsequent free power tariff has led to extensive groundwater depletion in the state with no price signals to the farmers for this natural resource degradation. The argument for the continuation of subsidised electricity in agriculture was to provide farmers with sufficient returns in agriculture overlooking the fact of groundwater depletion. But contrary to this, in

[283] Rainfall is an indirect indicator for seepage and hence groundwater recharge.

West Bengal, a state with much smaller landholding sizes and higher relative poverty in rural areas, the farmers are burdened with a much higher electricity tariffs which discourages them to go in for tube-well irrigation[284].

Thus, the likely changes in the organization of electric power sector hold considerable implications for patterns of water use in Punjab. A central goal of electricity reform should be to enable independent operation of the sector and to insulate decisions about electricity tariffs from political influence. To regulate groundwater use in the state, the state should certainly stop free electricity to farmers and shift to prices based on units of electricity consumed. The quality of electricity provided will improve with more stable and longer duration of electricity supply. This reform can be only successful with greater financial accountability, efficient technical operation, better monitoring of electricity use and effective collection of revenues. This will have two most important repercussions on the farming community. Firstly, with volumetric pricing, the well owner will have immediate incentive for more efficient and more careful irrigation reducing the pressure on groundwater over draft. Secondly, this higher electricity tariff will be passed on to the buyers. The tradition of unstandardised labour transactions for water trade will convert to cash transactions and all the seasonal cash based transactions will shift to hourly cash based contracts and the water rates are likely to go up[285]. But it is also noteworthy to mention that where the exchange is institutionalized, as in the groundwater depleted village of Ballab-e-Darya, the magnitude of increase in water price for the village will depend on local norms of legitimate price increases, and on the local power differentials between the buyers and the sellers. In the long run, the farmers and communities will adjust water investments and institutions in response to the shift in the electricity provision. The immediate response to the high price will be first to judiciously use water and consequently will also lead to a less water intensive cropping pattern and a shift away from rice cultivation.

Along with electricity pricing, there is also a greater need to separate the minimum support prices and procurement prices which at present are same in Punjab. There is an urgent need to divert procurement of food grains (especially rice) considerably towards eastern India

[284] Tube-well irrigation becomes essential for the cultivation of boro rice which is cultivated in the winter season when rainfall is much lower in West Bengal.

[285] In Hoshiarpur, where the water tables are at much greater depth, there is only hourly cash based water trade and the water rates are as high as seventy to eighty rupees per hour.

which is the traditional area of rice cultivation[286]. This will reduce the water stress in north western India and help in replenishing groundwater. The current argument of providing minimum support to benefit small and marginal farmers do not hold true in the current situation of groundwater depletion. It has been seen that the farmers who can afford to grow rice are the wealthy farmers with large landholdings and deep submersible pumps. The resource poor on account of no or very less water supply have shifted to maize cultivation or have sold out their land. In other words, in face of water depletion, farmers not only lose access to groundwater but effectively also lose access to state subsidy on electricity and MSP. Most of the small and medium farmers report to continue to grow wheat even without state provision of MSP as they grow it for self consumption and not for profit maximization by selling it in the market. Thus, MSP should be directed towards less water intensive crops like oilseeds and pulses to an agro-climatically suited MSP driven crop shift towards a sustainable agriculture.

There is no denying the fact that the government is investing a lot of money to support the farmers in groundwater irrigation but since the electricity subsidy is not targeted it doest not benefit all sections of farmers. A critical stage has emerged where it is critical to rethink on the government investments in groundwater irrigation and overhaul the policies established to regulate groundwater irrigation considering both inter in intra generational sustainability of groundwater irrigation. Like volumetric pricing of irrigation water leads to parsimonious use of water, targeted subsidies for setting up of tube-wells for smaller farmers, individually or to groups of small/marginal farmers will lead to greater accessibility to groundwater irrigation to all. It will benefit the farmers of the completely groundwater dependent societies to access irrigation water and will also reduce the monopoly and exploitation of the water lords. The pricing for the water pumped out from the wells can be also lower for oilseeds and pulses compared to rice on the lines of Vaidyanathan Committee recommendations on canal water pricing. This would also make way for the state taking direct responsibility for ground water depletion along with intervening in the equity issue on groundwater utilization.

[286] Vaidyanathan, suggest that water balance can be achieved by finely balancing the crop production and simultaneous trade direction in a region. The best solution towards this is that the water scarce regions need to import water intensive crops and export less water intensive crops to retain natural base and sustainability of agriculture.

In response to depletion, the farmers could potentially organize to increase supply or decrease their use[287]. With high density of farmers in Punjab, the scope for disputes, and the ability of parties to come together to forge collective institutions is far smaller, and the temptation to free-ride much larger. Moreover, the farmers facing groundwater depletion do not have the benefit of an effectively functioning judicial system and while they do wield political power, it is difficult to imagine farmers collectively establishing water districts without explicit supporting legislation. Thus, the need for the hour is also to set up legislative framework and define and delineate groundwater rights to provide effective action towards groundwater utilization and conservation.

The discussions above suggests that the power sector reform coupled with MSP regulation will result in more efficient use and potentially slow down the rate of groundwater depletion in Punjab. However a long term solution to groundwater depletion rests in creative and effective direct regulation of groundwater though defining rights to groundwater through affective legislation. The challenge is to establish a broad framework which addresses the problem of depletion while enabling the local institutions to play a positive role within a broader regulatory context to positively affect the livelihood of those which continue to be shaped by dependence on groundwater.

8.3 Research Gaps and Future Directions

Being a relatively new field of study, certain glaring gaps have remained in the way the issues of accessibility to groundwater irrigation have been studied. First, there has been a regional bias, in the study of conditions of access and inequality and it has been better studied in the water scarce regions of Gujarat and peninsular India. Punjab, in spite of facing acute problems of groundwater depletion, the region remains understudied in this aspect. Second, there has been a lack of historical perspective in groundwater market research. Questions such as 'is there a stage-wise progression in the development of groundwater markets from one of underdevelopment to that of competitive markets?', and 'if yes, is such a progression smooth and unilinear?', 'does it have any correspondence with groundwater resource depletion?', 'does depletion and rising scarcity leading to increase in demand (rising number of water sellers) lead to equal distribution of groundwater irrigation through

[287] N. K. Dubash (2002). "Tube well Capitalism: and Groundwater Development an Agrarian Change in Gujarat". Oxford University Press. New Delhi. pp.248.

competitive market or it leads to increase in monopoly of water sellers?' These questions have at best remained hypothetical but needs more empirical testing for theory formulation. Third, the relation between development of groundwater markets and level of agricultural development has remained imperfectly understood. Only Shah (1997) and Dubash (2002) have presented a simplified stage wise linear model of groundwater-led agrarian transformation, much along the contours suggested by Rostow (1961), but its main limitation is that it does not explicitly include agrarian relation as a constraining factor. Fourth, the role of 'power' has been widely used to formulate theories on labour and credit markets. However, in the study of water markets, not much attention has been paid to the question of power in rural society; if at all, the formulation has been very naïve and the water sellers have been depicted as 'water lords'– those who exert absolute power over water buyers to extract surplus. Only Lewis (1989) observed that even water buyers can have power over the water sellers. More work needs to be done in understanding the relative power of water sellers and water buyers and how this in turn shapes water markets. Finally, unlike other rural markets, such as labour and credit, there has so far been no attempt at formulating a general theory of groundwater markets. Thus, the current mode of functioning of groundwater market still leaves a lot of unanswered questions such as 'why do several modes of water contracts coexist under seemingly similar conditions and why do they respond differently to similar sets of incentives and disincentives?'.