

Groundwater Governance: Issues & Perspectives Regarding Model Bill Application in Punjab State

Kuldip Singh Takshi

Director, Water Resources & Environment Directorate
Punjab Irrigation Department, SCO 32-34, Sector 17-C, Chandigarh

Abstract: Punjab is predominantly an agrarian state having about 85% of geographical area under cultivation with an average cropping intensity of 189%. Agriculture is the backbone of state's economy and dependent on heavy requirement of water. About 80% of water resources available are used for agriculture. The other main sectors consuming water are industrial and drinking water supply. As the surfacewater availability is limited, there is heavy dependence on groundwater resources to meet the demand which has resulted in over-exploitation of groundwater resources in large parts of the State. Water table is falling rapidly in more than three-fourth of the state. Therefore, there is an urgent need to take suitable steps for arresting this trend, especially in the agriculture sector which is the largest consumer of groundwater resources in the state. In the present paper, several aspects of groundwater governance have been discussed in detail including the legislation aspects and its experiences in other states and countries. Legislation has been found to be neither acceptable nor successful. Corrective and suitable measures to control the demand, conserve and augment the groundwater resources needs to be implemented for its effective management. This paper attempts to address these issues and Govt. policies and give the suggestions, which are of the author itself, to debate on the issue and its advantages/disadvantages and affect on the users.

INTRODUCTION

Water, out of the all natural resources, is the most vital for human existence and for the development activities. With the growing requirements of water for diverse purposes, especially agriculture, water is becoming a scarce natural resource. Also, increasing water pollution due to rapid urbanisation, large scale industrialisation and use of fertilizers, insecticides and pesticides for increased agricultural production is causing water quality deterioration in both surface and groundwater and is affecting the net availability of fresh water for consumptive uses. In addition, the flow series data over the decades have shown reduction of mean flow in rivers, average annual rainfall has reduced in the last two decades and reports point out towards decrease in snow cover/glacier in the catchment area of rivers due to global warming, leading to decrease in surface water resources of the state. Thus, the dependency on ground water for irrigation, urban and rural population and industry has increased tremendously due to limited availability of surface water in the state and has resulted in over-exploitation of ground

water. The situation has further been aggravated by reduction in natural recharge to groundwater resources due to less rainfalls, taming and canalization of rivers and urbanization etc. As such, water is becoming the most critical resource issue of our lifetime and for the future generations. Therefore, conservation and optimum utilization of our water resources need not be over-emphasized.

Water is a State Subject, by virtue of Entry 17, List II (State List) of the Seventh Schedule of Constitution of India subject to Entry 56 of List I (Union List) of the same schedule, which empowers Union Govt. for regulation and development of inter-state rivers and river valleys in public interest, by virtue of a declaration to be made in this regard. The Indian Easements Act, 1882 links groundwater ownership to land ownership. Therefore, the legal position which emerges is that water, both surface and ground, is a State Subject under the Constitution of India and the Easements Act, 1882 vests groundwater ownership to land owners.

Punjab is predominantly an agrarian state having about 85% of geographical area under cultivation with an average cropping intensity of 189% (2004-05), highest in the country. Agriculture is backbone of state's economy and dependent on heavy requirement of water, the only natural resource available in the state. Over a century and half, the hard work of farmers in harsh summer conditions along with a Green Revolution, supported by Govt. investment and support for better irrigation system turned desolate new land, unlevelled fields and jungles into the most productive regions and *Punjab state becoming India's "Bread Basket"*. As the surface water availability is limited, there is heavy dependence on groundwater resources to meet the demand. This has led to over-exploitation of groundwater resources in large parts of the state. Ways and means to control the over-exploitation of groundwater resources have to be found in a manner which ensures the participation of land owners and are in the nature of correctives. Any coercive and penalizing measures will lead to unrest amongst the land owners.

HISTORICAL VIEW OF PUNJAB IRRIGATION AND AGRICULTURE

Pre-Eminent Position of Agriculture in Punjab

The state of Punjab occupies an extremely important place in agriculture in India. It is the country's largest grain producer and having world's best and efficient irrigation system. Economic development in Punjab has been led by agriculture. In India, the Green Revolution was launched with special focus on Punjab, which dramatically transformed Punjab's economy. Punjab led the country's Green Revolution of the 1960s and earned for itself the distinction of becoming India's "Bread Basket". From being an importer of food grain, India now produces surplus food. This achievement has been possible largely because of the contribution of Punjab. The enterprise and hard work of the Punjab's farmers coupled with the support of the State and Central Govt., have played a major role in the state's agricultural achievements.

Development of Irrigation in Pre-Historic Times/British Period

Irrigation had been practiced in Punjab since pre-historic times. The Persian Wheel became popular in the 13th century and 'Shah Nahar Canal' was built in 17th century extending irrigation benefit to Majha and Bist Doab regions. Initially villages were surrounded by forests, which were protected by most rulers to serve as hunting ground. Then, Punjab became a major beneficiary of British investment in irrigation works and development of canal colonies where peasants from the east and central Punjab

were resettled. A number of inundation canals found in working order were improved and extended to provide canal irrigation in many areas to utilize the vast potential available and the canal colonies were established to minimize the effect of drought during the British period as Punjab had faced five severe famines. The colonizers had to work hard as they faced a number of difficulties like desolate new land, harsh summer climate, inaccessibility to villages, unlevelled fields, main water channels under construction and no rails/roads to take produce to market etc. First the renovation of old canals and then new canals were introduced. Upper Bari Doab Canal (UBDC) in 1859 and Sirhind Canal System was operated in 1884. This transformed the so-called jungles into the most productive regions of Punjab. These canal colonies had the world's most extensive irrigation system and soon colonies became the main granaries of India as canal irrigation made possible assured agricultural produce and the average yield also increased considerably. Further, it enabled the farmers to opt for commercial crops, which could not otherwise be grown on un-irrigated land.

Development of Irrigation in Post-Independence Period

In the post-independence period, canal irrigation was further developed by the state gradually. Bhakra Dam on river Sutlej was completed in 1963. The waters of river Beas were tamed by constructing a Storage Dam at Pong (1974) and by partly diverting waters of river Beas into Bhakra reservoir through Beas-Sutlej Link (1977). Construction of Ranjit Sagar Dam on river Ravi has recently been completed in the year 2000. Bhakra Canal System was constructed from 1948 to 1963 and by 1966 net-sown area irrigated in Punjab had gone upto 54% against the national average of 19.5%. Out of this, 57.8% was canal irrigated, 41% was irrigated by wells/tubewells and remaining 2.7% by ponds, rivers and Persian wells. The total stretch of canals and distributaries, including minors, increased to approximately 14,500 km. and length of water courses to one lakh km. Further steps were taken for extension of cultivable land to rehabilitate migrants, consolidation of land holdings, promotion of tubewell irrigation where canals were not available and Multiple Cropping System which alongwith irrigation and power development, agriculture research and extension services and the strengthening of the co-operative credit structure had created crucial pre-requisites for the Green Revolution.

Reduction in Availability of Surface Waters

The allocation of surface water of its rivers, the Sutlej, Beas and Ravi, is limited to 14.54 MAF (which includes about 7.6 MAF of pre-partition utilization) out of total mean availability of 34.34 MAF based on 1921-60 Flow Series. Further, the data pertaining to surplus Ravi-Beas waters during the flow series 1981-2002 reveals that the mean flow has got reduced to 14.37 MAF instead of 17.17 MAF as assessed based on flow series 1921-60. The rainfall in Punjab state is very erratic and ranges between 250 mm in the extreme south-west to 1000 mm in the extreme north. However, the average annual rainfall of the state shows a decreasing trend as is clear from the data in Table 1. The average annual rainfall which was 739 mm in the year 1980 has decreased to 315 mm in the year 2002. Even various reports point out that the snow cover/glacier in the catchment area of rivers of the state is decreasing due to global warming. As such, the surface run-offs have decreased, which along with taming and canalization of rivers, consequent flood control and large scale urbanization have decreased the natural recharge to groundwater resources, putting an additional strain on the groundwater resources to meet the demand for agriculture.

Table 1. Vital statistics of Punjab state (Irrigated area)

Year	Net area sown ('000 Hec.)	% Net irrigated area to net area sown (%)	% Net area sown to total area of state (%)	Gross area cropped ('000 Hec.)	Gross irrigated area ('000 Hec.)	% Gross irrigated area to gross cropped area (%)	Cropping Intensity (%)	No. of tubewells (Lakhs)			Annual average rainfall (mm)
								Electric	Diesel	Total	
1	2	3	4	5	6	7	8	9	10	11	12
1960-61	3757	54	74.6	4732	2646.0	55.9	126	-	-	-	715.6 (1966)
1970-71	4053	71	80.5	5678	4242.5	74.7	140	0.91	1.01	1.92	672.3
1980-81	4191	81	83.2	6763	5781.3	85.4	161	2.80	3.20	6.00	739.1
1990-91	4218	93	83.8	7502	7054.8	94.0	178	6.00	2.00	8.00	754.6
1993-94	4214	93	83.7	7623	7238.0	94.9	181	6.69	1.81	8.50	653.4
1994-95	4210	94	83.6	7693	7319.4	95.1	183	6.84	1.76	8.60	623.4
1995-96	4136	95	82.1	7712	7336.2	95.1	186	7.00	1.75	8.75	794.2
1996-97	4234	95	84.1	7818	7461.4	95.4	185	7.25	1.70	8.95	583.2
1997-98	4239	94	84.2	7833	7485.0	95.6	185	7.35	1.75	9.10	710.0
1998-99	4173	95	82.9	7740	7442.3	96.2	185	7.45	1.70	9.15	477.5
1999-00	4243	94	84.3	7847	7544.8	96.1	185	7.55	1.70	9.25	390.8
2000-01	4250	95	84.4	7941	7663.8	96.5	187	7.88	2.85	10.73	391.9
2001-02	4254	95	84.5	7941	7666.6	96.5	187	8.21	2.88	11.09	462.8
2002-03	4224	95	83.9	7826	7598.0	97.1	185	8.45	2.88	11.33	314.5
2003-04	4201	96	83.4	7905	7686.7	97.2	188	8.56	2.88	11.44	459.5
2004-05	4200	96	83.4	7932	7692.2	97.0	189	8.80	2.88	11.68	375.2

Source: Statistical Abstract of Punjab (Geographical Area of Punjab = 50,36,200 Hectares)

Development of Agriculture

Punjab showed signs of rapid agriculture development. Between 1953-55 and 1963-65, the index of agricultural production of all crops experienced a growth rate of 4% compared to 2.2% at the all-India level. Between 1965-66 and 1970-71 the per hectare yield of wheat doubled from 1104 kg. per hectare to 2238 kg. Following the success of new technology in wheat in mid 1970s, a breakthrough was achieved in dwarf high yielding varieties of paddy. After wheat, paddy provided a major push to agriculture prosperity in the state. In the mid 1980s, except for the southern parts of Punjab, the state began to follow a 'wheat-paddy rotation' pattern in cultivation, and as a consequence Punjab became the 'Food Bowl' of the country. *It became the largest contributor to the central pool of procurement of food grains and made India, a country self sufficient in food grains.* With the MSP for wheat and paddy combined with the procurement system of the Union Govt., crop production was greatly supported. The Green Revolution has been backbone of Punjab's development which increased cropping intensity from 126% in 1960-61 to 185% in 1996-97 and 189% in 2004-05. Major shift in cropping pattern is observed during the period 1960-61 to 2004-2005. The area under rice, which is water intensive crop, showed a progressive increase since 1960 compared to other crops. The area under rice increased by 72% between 1960-61 and 1970-71 comparable with maize (70%), wheat (64%), bajra (68%) and groundnut (160%). However, the area under rice rose remarkably by 580% during 1970-71 to 2004-05 while area under wheat witnessed an increase by 52% during this period. On the other hand, area under maize which is a low water consuming crop, declined by 72% during the same period. The area under maize, which was higher as compared to rice by 44% and 42% during 1960-61 and 1970-71 respectively, got reduced by a great extent by 67% and 97% during 1980-81 and 2004-05 respectively as compared to the rice. Similarly, the area under groundnut and bajra which are also less water consuming crops has declined enormously by nearly 98% between 1970-71 and 2004-05. Thus, during the last four decades, it has been observed that there has been tremendous increase in area under high water intensive crops of rice (11 times), wheat (2.5 times) and a huge reduction in area under less water consuming crops of maize (1/2), Bajra (1/17th) (Table 2).

Green Revolution

The Green Revolution started in Punjab during the mid-sixties (1965-66) with the introduction of a new technology in agricultural production which consisted of a package of inputs, such as, high yielding varieties of seeds, chemical fertilizers, pesticides, insecticides, weedicides, machines like tractors, threshers, pump sets/motors, combine harvesters/reapers and others. The proper usage of these inputs required an assured irrigation system, a peasantry with the will and capacity to adopt the new technology and govt. willing to lend its support and investment. All these conditions were present in Punjab, which led to enormous agricultural production and helped the country in achieving self-sufficiency in food grains and Punjab to be proud "Food-Bowl" of the country. In the aftermath of Green Revolution, the net sown area as a percentage of the geographical area rose from 76% to about 85% during the period 1965-66 to 2004-05. The total food grain production has increased more than seven times from 3.389 to 25.662 million tonnes during this period. In order to increase the productivity and by bringing more and more area under wheat and paddy crops, the inputs have increased tremendously. The mechanical farming and tubewell irrigation have increased the capital cost of inputs. The number of tractors rose from 1248 in 1966 to 4,66,480 in 2004-05 and pump sets from 45,900 to 11,68,000. The use of N and NPK fertilizers has increased to more than seven times during

Table 2. Vital statistics of Punjab state (major food grains produced)

Year	Area under main food grains ('000 ha.)					Total of all food grains	Rice		Wheat			Use of fertilizers ('000 nutrients tonnes)					No. of tractors
	Rice	Maize	Bajra	Wheat	Wheat		Production ('000 m. ton)	Yield (kg./ha.)	Production ('000 m. ton)	Yield (kg./ha.)	N	P ₂ O ₅	K ₂ O	NPK			
1960-61	227	327	123	1400	3063	67	229	1009	1742	1244	5	-	-	5	1248 (1966)		
1970-71	390	555	207	2299	3928	174	688	1765	5145	2238	175	31	7	213	5281		
1980-81	1183	382	69	2812	4854	83	3233	2733	7677	2730	526	207	29	762	118845		
1990-91	2015	188	12	3273	5668	11	6506	3229	12159	3715	877	328	15	1220	289064		
1993-94	2179	194	15	3335	5856	10	7645	3507	13378	4011	947	245	7	1119	338494		
1994-95	2265	173	9	3311	5896	9	7662	3381	13542	4089	1014	256	15	1285	354378		
1995-96	2185	171	6	3221	5720	8	6843	3132	12510	3884	1020	227	16	1263	371720		
1996-97	2159	166	7	3232	5697	8	7334	3397	13687	4235	962	229	17	1208	387007		
1997-98	2281	165	8	3300	5875	8	7904	3465	12715	3853	1005	287	22	1314	398927		
1998-99	2518	154	5	3278	6060	6	7993	3152	14192	4332	1081	275	19	1375	411615		
1999-00	2604	163	5	3388	6252	5	8716	3347	15910	4696	1086	335	26	1447	423140		
2000-01	2612	165	6	3408	6277	4	9157	3506	15557	4563	1008	282	23	1313	434032		
2001-02	2487	165	7	3420	6152	4	8816	3545	15499	4532	1070	307	30	1407	442562		
2002-03	2530	153	7	3375	6132	5	8880	3510	14175	4200	1111	299	31	1441	450956		
2003-04	2614	154	8	3444	6287	4	9656	3694	14489	4207	1170	335	38	1543	459424		
2004-05	2647	154	7	3481	6347	4	10437	3943	14695	4221	1202	307	44	1553	466480		

Source: Statistical Abstract of Punjab (Geographical Area of Punjab = 50,36,200 Hectares)

1970-71 to 2004-05. The over-exploitation of land through intensive use of chemical fertilizers, keeping land under cultivation during most of the year and returning little biomass to it (instead burning paddy and wheat straw) has led to reduced fertility and deterioration in the quality of land. Also, the shift to high yielding varieties has made crop more prone to pests and diseases, leading to greater use of chemicals to control weeds and pests. Thus, the Green Revolution also saw an increased consumption of chemical inputs, i.e. fertilizers, pesticides and insecticides.

Thus, an increase in requirement of inputs and rise in prices of inputs have resulted in fast increase in cost of production which, along with not sufficient minimum support price (MSP) for crops, have led to a decline in returns from agriculture/income of cultivators affecting the poor and marginal farmers, having small land holdings in the state, who do not have enough cushion for adjustment. The availability of sub-standard pesticides/insecticides and fertilizers, indebtedness due to outrageous high rate of interest being charged by the commission agents lending money illegally and the policy of import of food grains are adding to the woes of cultivators.

As such, a large proportion (35.43% in 1995-96) of the cultivators are facing ruin and a crisis of existence. Since work outside agriculture is not available to such cultivators and many of them know no other type of work, a large number of such cultivators are trapped in agriculture and doomed to a miserable life. The farmers need to be supported materially, through human resource development and above all through the creation of an environment which ameliorates the uncertainties created by liberalization and globalization. So, keeping the hard work of farmers in view, it is important that measures are taken to secure sustainable agriculture development for which the sustainability of the irrigation system must be strengthened. Thus, the Green Revolution though played a pivot role in achieving self-sufficiency in food-grain production, but, at the same time is responsible for creating ecological imbalance and depletion of water table and soil fertility, despite the fact that Punjab has the country's most well organized and reliable irrigation system. The factors affecting groundwater decline need to be identified and corrective steps taken to arrest this trend.

GROUNDWATER SCENARIO

The groundwater table in the state is being observed since 1895. Prior to the introduction of the canal irrigation system on a large scale in the state, the water table was being balanced by the limited extraction of ground water by the animal driven Persian wheels and groundwater outflow to natural drainage lines. Consequent upon the introduction of irrigation by canals and induction of large scale canal waters in various tracts, the water table has behaved differently in different tracts, depending upon the native qualities and other features. However, a steady rise in water table was observed. The withdrawal from the ground water increased from mid-sixties onwards. However, since the 1970s, a significant increase in groundwater development has occurred in the agrarian state of Punjab. An unprecedented expansion in the number of irrigation tubewells has occurred in these regions based on improved drilling and pumping technology. In Punjab, farmers now apply irrigation water via private wells and pumps to supplement the government's canal irrigation systems, which is unable to meet the increased demand due to allocations of surface water resources from its rivers and increase in cropping intensity. The water table started declining in the sweet groundwater area of the state due to this. However, the rising trend is still continuing in the saline and brackish groundwater area in which ground water is not extracted on a large scale being unfit for agriculture.

Punjab's agriculture being highly intensive, thrives on heavy requirement of water. To sustain the practice of intensive cultivation, the state needs 52 MAF water, whereas it has only been allocated 14.54 MAF of its river water resources. To meet this wide gap the dependence is upon erratic rainfall and over-exploitation of groundwater resources. As a result, the groundwater resources are depleting very fast and groundwater level is sinking to extremely low depths making it more difficult and more expensive to use. At present agriculture sector is consuming 80% of available water resources of the state, as such, 79% area of state in north-western, central, southern and south-eastern parts is facing falling water table where ground water is generally fresh and fit for irrigation and 21% area is facing rising water table/water logging in south-western parts where water extraction is limited due to brackish/saline quality of ground water.

The latest Ground Water Resources Estimation of Punjab state carried out as per the latest Govt. of India Methodology GEC-1997 and approved by CGWB shows that out of the total 137 blocks of the state taken for study, 103 blocks are over-exploited where stage of groundwater development is more than 100%, five blocks are critical (90-100%), four blocks are semi-critical (70-90%) and 25 blocks are in safe category (less than 70%). Safe category blocks mostly lie in south-western districts, where ground water is generally brackish/saline and unfit for irrigation and in Kandi area, where extraction of ground water is less, because of deeper water table. It has been observed that the net groundwater availability is 0.21 MHam (17.33 MAF) and total draft is 0.31 MHam (25.24 MAF). The net groundwater availability for future irrigation development in the state is negative i.e. (-) 0.99 MHam (-8.01 MAF). The stage of development for whole state has been worked out as 145%.

The long-term study of water table data for the period 6/84 to 6/02 indicates that the maximum fall of 12.92 m is in Sehna block of Sangrur district followed by 10.85 in the Nakodar block of Jalandhar district. In about 53% area of the state, depth of water below ground level is less than 10 m, in 30% area, it ranges between 10 and 15 m and in 14% area, it is more than 15 m. The central part of the state is most affected by groundwater depletion.

Water is the life line of Punjab farmers as 80% of water resources available are used for agriculture only. The economy of the state, agriculture production, well being of farmers and their socio-economic development depends to a large extent on the availability of sufficient water. As such, the sustainability of the irrigation system, being largely supplemented through tubewells/ground water, needs to be strengthened for which ways and means need to be explored for its better management and consumptive use.

LEGISLATION HISTORY

A Draft Model Bill, named "The Ground Water (Control & Regulation) Act, 1970" was circulated to all States/UTs by Govt. of India, Ministry of Water Resources (MoWR), as early as in the year 1970. The objective was to guide the State Govts. in enacting legislation to empower themselves to establish Ground Water Authority vested with powers to regulate extraction and use of ground water in specified areas, as water is state subject and necessary legislation in the matter has to be enacted by the concerned State Govts./Union Territories Administration. The Model Bill was revised and re-circulated in 1992 and again in 1996. The small and marginal farmers were taken out of the purview of Model Bill, 1996 and provisions were made to exempt them from informing the proposed Ground Water Authority prior to sinking a well in their holdings. Moreover, manually operated devices were also excluded from the purview of this Act. Revision was again made and the "Model Bill to Regulate &

Control the Development & Management of Ground Water” was circulated in Jan., 2005 by adding Chapter III – “Rain Water Harvesting for Ground Water Recharge” for identifying the areas for recharge by the Authority, encouraging roof top rain water harvesting and promotion of mass awareness and training for the same.

The main thrust of all the Draft Model Bills sent by Govt. of India remained the same i.e. constitution of State Ground Water Authority (SGWA) which would identify the critical areas that are over-exploited (where exploitation is much more than natural recharge to ground water and depletion is quite high) and would notify such areas as “Notified Areas” for control and regulation of groundwater development. As per draft bill existing tubewell owners in Notified Areas would be required to get themselves registered with such Authority. For installation of any tubewells in such Notified Area, a permit would be required from such Authority and penalties can also be imposed for failure to comply with provisions of the Act.

In the meanwhile in pursuance of Hon’ble Supreme Court of India Order dated 10.12.1996 on a PIL, Central Government vide Ministry of Environment & Forests Notification dated 14.1.1997 constituted Central Ground Water Board (CGWB) as an Authority under Sub-section 3 of Section 3 of Environment (Protection) Act, 1986 for the purpose of regulation and control of groundwater management and development for a period of one year. The Authority was to function under Ministry of Water Resources with main function to regulate indiscriminate boring and withdrawals of ground water in the country and to issue necessary regulatory directions with a view to preserve and protect the groundwater in whole of India. The term of one year was substituted by five years vide notification dated 13.1.1998. However, vide notification dated 6.11.2000, the composition of the Authority with Chairman, CGWB as its Chairman, nine members and five special invitees was notified and the period of five years was omitted.

The CGWA has already notified 20 severely critical/over-exploited areas in the country (including Ludhiana city of Punjab) for regulation of groundwater development through concerned Deputy Commissioners/District Magistrates by enforcing prohibition on construction/drilling of new tubewells. Also, 32 critical areas (including five Blocks of Punjab) have been identified for registration of groundwater extraction structures in five States of the country. Recently additional 28 over-exploited areas have been identified in nine States (none in Punjab) for registration of groundwater extraction structures. It is mentioned in the notification that based on the outcome of registration, new areas for regulation and control of groundwater development and management will be identified i.e. upon notification of these areas the concerned Deputy Commissioners will be directed, under Section 5 of Environment (Protection) Act, 1986, to enforce prohibition of construction of new tubewells and resort to penal action in case of violation of directions of CGWA. *‘Water’ is a state Subject and vesting of complete central powers to order and action in a Central authority for regulation of groundwater management, without concurrence of the State concerned, is required to be reviewed.*

Implementation of Model Bill by States

Since 1970, Government of India, MoWR is requesting States/UTs to implement Model Bill by enacting groundwater legislation. It was also stressed by Government of India, that before attempting any such enactment, common people as well as farmers should be fully educated about the need of judicious regulation of ground water in this area of grave concern. However, as on 28.6.2005, out of 30 States and five UTs of the country, only seven have enacted and implemented the legislation and

three have passed the Bill but have not notified the same. *The reasons for non-implementation of the proposed legislation can be traced to serious implications connected with peculiar circumstances prevailing in each region and the need to exercise corrective steps instead of resorting to coercive measures.*

PUNJAB STATE'S ACTION

The Govt. of Punjab prepared the "Punjab Ground Water Control and Regulation Act, 1998 (Draft)" in line with Model Bill circulated by MoWR, Government of India. The Draft Act was approved by State Level Technical Advisory Committee (TAC) in its 4th meeting held on 19.3.1998. The approved Draft Act was then circulated to all the members of Punjab State Water Resources Committee (WRC) for comment before putting up to WRC for discussion. It was, however, observed that clarification was necessary on the issue of overlapping of functions between the Central Ground Water Authority (CGWA), under the Central enactment, and the proposed SGWA, under the State enactment, which was sought from MoWR, Govt. of India.

Ministry of Water Resources, Government of India, in March, 2003 has pointed out that "though Ground Water (Development, Protection, Management) Rules are likely to be finalized soon, yet, it is felt that the Punjab Govt. should not keep finalization of the Punjab Ground Water Control and Regulation Act, 1998 pending due to this reason as so many states like Andhra Pradesh, Goa, Tamil Nadu etc. have already enacted their respective Ground Water Regulation Act". It has also been intimated that the CGWA has already conveyed the opinion of the Department of Legal Affairs, Ministry of Law regarding the role of the CGWA vis-a-vis SGWA to the MOWR, Government of India, which is given as below:

"Though the States are competent to make their own laws and constitute State Authorities, the provision of Environment (Protection) Act, 1986 would override the State Enactment under Article 253. They have opined that for avoiding any possible conflicts, it may be better if, while enacting their laws and constituting their respective Authorities, the State Government keeps in mind the provisions of the Environment (Protection) Act, 1986 and powers and functions conferred on the Central Ground Water Authority".

However, the Govt. of India kept on insisting for enacting the proposed Model Bill by the States. A Draft Bill on the subject matter, as prepared by TAC, was put up before the Punjab State Water Resources Committee (WRC) in its 2nd meeting held on 25.8.2003 under the Chairmanship of Chief Secretary to Govt. of Punjab. *The committee observed that the proposed legislation was harsh on the users. They desired that a system of incentives and disincentives on optimum use of ground water be considered instead of adopting bureaucratic authority as a solution of falling water table. An Expert Group was constituted by the WRC to consider all issues and aspects of groundwater use and to prepare an Approach Paper in this regard.*

Expert Group studied various issues and aspects of the groundwater use and its problems in Punjab and deliberated upon various approaches available to remedy the same and prepared a Detailed Report recommending various options to achieve the objective of groundwater governance including an "Approach Paper for taking remedial measures". The Expert Group Report was considered in the 3rd meeting of the WRC held on 11.1.2005. The Committee observed that due evaluation of each of the suggested measures in terms of cost and benefits be carried out and the measures be prioritized alongwith exploring the possibility of funding from Govt. of India.

In the meanwhile, a meeting was held under the Chairmanship of Chief Secretary to Govt. of Punjab on 26.7.2005 regarding release of electric connection of tubewells in the Dark Blocks of the Punjab state and to check the declining groundwater resources. After detailed deliberations and going through the information on the subject, based on the criteria that the stage of development is > 125%, water table depth is >15 m and rate of fall >20 cm/yr, the 17 most critical Dark Blocks of the State, including five Notified Blocks by CGWA i.e. Moga-I, Moga-II, Sangrur, Mehal Kalan and Ahmedgarh, were identified, in Moga, Sangrur, Patiala and Jalandhar Distts. for taking the following measures to control over-exploitation of ground water and further to improve electricity scenario of the State.

1. Artificial recharge schemes to be taken up in the Critical Blocks.
2. Roof top harvesting be made mandatory in all buildings having an area of 500 sq. yards and above. Both the Departments of Housing & Urban Development and Local Govt. will issue necessary orders in this regard.
3. Housing and Urban Development Department and Local Govt. Deptt. to have schemes to tap the city rain water flowing through the storm water drains.
4. Suitable drainage policy be evolved for cleaning of drains wherever required so as to use these drains for natural groundwater recharge.
5. Electricity supply to be controlled in these blocks through Board by introduction of meters.
6. Crop diversification be implemented in these blocks so as to discourage paddy crop.
7. The Irrigation Deptt. to frame schemes for utilization of the available water in the flood plains.
8. To encourage modern means of irrigation, such as, sprinkler and drip irrigation.
9. To encourage modern methods of paddy plantation, which do not require flooding of the fields.
10. Re-modelling of canals to increase water allowance in these areas.

In addition to above, the state is also adopting various measures to manage, conserve and augment its water resources like contract farming, mass awareness, construction of check dams/low dams, artificial recharge schemes, provision of underground pipe conveyance distribution system at low dams, preventing early plantation of paddy by restricting electricity supply before 16th June, etc. The regular census of wells/tubewells is being carried out in the state and the number of groundwater extraction structures present in the state is well known. These figures are being used in calculating the groundwater draft in estimation of dynamic groundwater resources of the state as per latest methodology i.e. GEC-1997, circulated by Govt. of India.

APPRAISAL BY THE PLANNING COMMISSION

Observations of the Planning Commission

The National Development Council (NDC) in its 51st meeting held on 27th and 28th June, 2005, while considering the Mid-Term Appraisal (MTA) of the Tenth Five Year Plan carried out by the Planning Commission, Govt. of India, broadly agreeing with the goals and objectives of the MTA, observed as under:

"In the water sector, the MTA has expressed concern about the rapid decline of groundwater levels in some parts of the country. It has been noted that groundwater legislation, where enacted, has not been found effective and has suggested setting up of an Expert Group comprising officials, NGOs, academicians and experts to review the whole issue of groundwater management and ownership and suggest line of action for implementation in the Eleventh Plan".

Constitution of an Expert Group

The Planning Commission vide its orders dated 21.10.2005 constituted an Expert Group under the Chairmanship of Dr. Kirit S. Parikh, Member, Planning Commission to address the following issues:

- (i) to take stock of the groundwater situation in the country in regard to availability, present use and projected demand;
- (ii) to identify reasons for fall in groundwater levels in certain parts of the country;
- (iii) to review the efficacy of groundwater recharge schemes implemented so far;
- (iv) to study the effectiveness of legislation where enacted;
- (v) to review the present legal position regarding groundwater ownership; and suggest modifications keeping in view international practices;
- (vi) to suggest other measures to tackle the groundwater management problems; and
- (vii) any other issue which the Group may consider relevant.

Report and Recommendations of Expert Group

A Draft Report (Feb. 2006) of the Expert Group after few meetings was issued by Govt. of India, Planning Commission, in March, 2006. The detailed comments of Punjab Government on the Report were sent, which were further considered by the Expert Group, in its meeting held on 21.4.2006 and thereafter a Revised Draft Report was circulated. The comments of Punjab have been duly recorded as Para 4.3 of Chapter 4: "Experiences of States in Ground Water Management" at page 24 of said Revised Report. It has been mentioned that, "Punjab is not in favour of groundwater legislation as it apprehends such a step will cause hardship to farmers." Some of the suggestions of Punjab to tackle groundwater over-exploitations, such as, crop diversification, artificial recharge, controlled and regulated electric supply, promotion of micro irrigation, encouraging late sowing of paddy etc. have been enumerated in the para. It has been further mentioned that, "That State is also contemplating complete ban on new tubewells and restricting horse power to 10 HP so that the deeper aquifers are not tapped. The pumps need to be replaced with energy efficient pumps. Conjunctive use of saline and fresh water will also help in bringing down the demand for fresh water".

Further, a perusal of Chapter 5 (International Experiences in Ground Water Management) of the Report of Expert Group reveals that the institutional and regulatory actions to improve groundwater governance have not been successful to solve the problem to desired extent in U.S.A. and implementation of groundwater legislation has proved to be very difficult in Spain. Although Spain and Mexico reformed their water laws to make groundwater a national property, their success in getting water rights of agricultural users registered has been insignificant. The Mexican experience has shown that 'passing of laws and executing administrative barriers is not likely to work unless social and economic realities are taken into consideration'.

The experiences of states in India in the matter of groundwater management by legislation are contained in Chapter 4 of the Report of the Expert Group. While the measures taken by the southern States are still in their infancy and need proper appraisal, the Maharashtra experience of enacting 'Maharashtra Ground Water (Regulation for drinking water purposes) Act, 1993', has not been successful. No state has reported actual number of violations detected and penalty meted out but the Study has shown that the legislation has badly affected small and poor farmers and its implementation is most difficult due to weak institutions, lack of clarity of ownership rights of ground water and

invisible resource characteristics of ground water. On paper, it is expected of the legislation to introduce some discipline in the system by way of registration of wells/issue of permits but its enforcement is highly problematic.

Expert Group in its Revised Draft Report has summed up in Chapter 7 "Way Forward" that the institutional and regulatory action to improve groundwater governance has not solved the problem to the desired extent. It has been further stressed in the following words:

"The Group is of the view that the Model Ground Water bill is deeply problematic. While some legislation is necessary, the present Model Bill would need drastic changes. Compliance to existing legislation where enacted has been peripheral, there is no incentive structure in the current legislation. It only says what should not be done but not what the government will do to promote a certain line and approach. Instead of banning further exploitation in semi-critical and critical blocks, government should offer incentives for community management of new wells, for construction of recharge structures, for energy saving devices like installation of capacitors and frictionless foot valves and for adoption of micro irrigation. Thus the state is not required to entirely take over the sector but is required to in-build measures in the legislation that stops short of actual take over but incentives to the community for a better groundwater management in critical areas". Government should offer incentives for community management of new wells, for construction of recharge structures, for energy saving devices and for adoption of micro irrigation and tapping of deep aquifers/flood plain aquifers.

As such, the views of Punjab State on enactment of legislation for governance of groundwater resources have been fully agreed to and endorsed in the Report.

LEGAL POSITION REGARDING GROUND WATER

The Indian Easements Act, 1882 links groundwater ownership to land ownership and illustrates the exclusive right under Clause 7 as follows:

"The right of every owner of land to collect and dispose within his own limits of all water under the land which does not pass in a defined channel and all water of its surface which does not pass in a defined channel."

Under the Govt. of India Act, 1935 (Entry 19, List II, Seventh Schedule), irrigation was a provincial subject. 'Water' is a State subject under the Constitution by virtue of Entry 17, List II (State List) in the Seventh Schedule subject to Entry 56 in List I (Union List) of the same Schedule. The State government's power to legislate under Entry 17 in List II, though subject to Entry 56 in List I, is unfettered. It is, thus, clear that in the matter of utilization of water resources within a state, the Constitution casts an obligation on the states and assigns it an important role to play in the agricultural and industrial sectors. Entry 17, List II (State List) of the Seventh Schedule states as under:

"Water, that is to say, water supplies, irrigation and canals, drainage and embankment, water storage and water power, subject to provision of Entry 56 of List I"

The water supplies as referred in Entry 17, List II covers both surface and ground water.

However, Entry 56 in List I of same schedule confers power on the Central government in the matter of regulation and development of inter-state rivers and river valleys which states *"Regulation and development of inter-state rivers and river valleys to the extent to which such regulation and development under the control of the Union is declared by Parliament by law to be expedient in public interest"*.

What emerges from the above constitutional provisions is that as per Entry 17, List II of the Constitution 'Water' both surface and underground, is a State Subject and Entry 56, List I restricts and empowers the Central government to make enactment in the matter of regulation and development of inter-state rivers and river valleys by a specific declaration. Thus, the subject of ground waters remains in the exclusive domain of states.

Further, section 2 of the Indian Easements Act, 1882 also makes it clear that nothing contained therein could derogate from any right of the government to regulate the collection, retention and distribution of water, river and streams flowing in natural channels etc.

It is worth mentioning here that while circulating Model Bill, Ministry of Water Resources, Govt. of India, has also stressed that as water is state subject, necessary legislation in the matter has to be enacted by the concerned Govts./U.T. Administrations. The Indian Easements Act, 1882 vests groundwater ownership in owners of land.

GROUNDWATER MANAGEMENT

Since the 1970s, a significant increase in groundwater development has occurred in the agrarian state of Punjab. An unprecedented expansion in the number of irrigation tubewells has occurred in these regions based on improved drilling and pumping technology. In Punjab farmers now apply irrigation water more via private wells and pumps (73%) as the government's canal irrigation systems which provides 23% water only, is unable to meet the increased demand due to limited allocation of surface water resources from its rivers and increased cropping intensity. With ground water generally being a reliable resource, its use has had tremendous implications for agricultural production and productivity as well as the livelihoods of millions of poor farmers after the advent of Green Revolution introduction in the state. With groundwater resources being increasingly put to strain due to intensive use, signs of over-exploitation of ground water became evident. The situation was further aggravated due to decrease in natural recharge because of less rainfall, run-off in rivers, increase in urbanization etc. As a result there has been continuous decline in groundwater level, competitive deepening of wells, increased pumpage expenditures, ecological imbalance and soil depletion etc. But the increase in cost of heavy inputs and decrease in returns is affecting the small and marginal farmers. Groundwater management per se is complex due to the invisible character of the resource and its common property nature and the associated difficulty in delimiting and quantifying the extent of the resource. Traditionally, institutional groundwater involvement has focused on the development side of the resource to overcome the severe famines/droughts in the state, whereas there has been lack of interest in groundwater research and management. Thus, there is need to strengthen existing institutions involved in groundwater research and management to undertake more integrated, multi-disciplinary and sustainable approaches to groundwater governance.

However, the wheat-paddy cropping rotation which thrives on exploitation of underground water has contributed in raising the socio-economic conditions of farmers.

The Union Government is pressing to implement the Model Bill by enacting groundwater legislation to control and regulate the development of ground water in the name of good governance. The various states of India and some developed countries, internationally, have tried the groundwater legislation. Based on their experiences and report of the Expert Group constituted by Planning Commission, it would be seen that the disadvantages far outweigh the advantages of legislation as summed up below.

Advantages of Model Bill

- (i) Whereas by registration of structures it may be possible to collect and maintain basic data of all existing wells/tubewells viz. location, depth, design, discharge, command area, canal irrigation at village level.
- (ii) Similarly sufficient data of various aquifer characteristics under different hydrogeological conditions, density and quality of ground water may also become available.
- (iii) The legislation may be successful in urban areas to protect drinking water source and water supply to industrial units as its enforcement is easier in urban areas.
- (iv) However, it would have only a limited value in arresting exploitation of ground water.

Disadvantages of Model Bill

- (i) First Registration of tubewells for agriculture use (which consumed maximum quantum of water) has been a challenge and then monitoring their actual withdrawals has proved more intractable.
- (ii) Issuing permits failed as farmers wanted unrestrained access to ground water.
- (iii) Institutional and regulatory action to improve groundwater governance by legislation through Model Bill have not helped in solving the problems to the desired extent.
- (iv) For registration, concessions/subsidies were provided by various countries to get the job partially done.
- (v) Small and poor farmers are affected by controls on groundwater exploitation and only marginal benefits flow from various subsidies whereas these subsidies have little impact on wealthy farmers, thus creating social injustice.
- (vi) Regulation by control will not work because ownership of ground water traditionally vests in the owners of land and because of its intrinsic nature of being an invisible source.
- (vii) There is hardly any useful or gainful purpose served by way of registration of wells and adopting procedures for seeking permission for new structures which would rather create hurdles and cumbersome procedures for the semi-literate farmers.
- (viii) The institutional and regulatory action to improve groundwater governance through Model Bill by resorting to coercive means may create feelings of unrest.

Other Issues of Model Bill

- (i) The overlapping of functions of SGWA with CGWA in the Model Bill are required to be sorted out so as to avoid conflict.
- (ii) Water, both surface and underground, being a State Subject under Entry 17 List II of the Constitution and groundwater ownership having been linked to the land ownership under the Easements Act, the implementation of the provisions in the Model Bill should be the responsibility of the State Governments. In case the State Authorities under the Model Bill are required to act as per directions of CGWA, the enactment at state level will hardly serve any purpose. The implementation of Model Bill for governance and as per regulatory directions of CGWA will require necessary Constitutional amendment and repealment of relevant clause in the Easements Act.

- (iii) The provisions of the Environment (Protection) Act, 1986 which empowers the CGWA to issue directions, to take such measures or pass any order for the purpose of regulation and control of groundwater management and development alongwith power to resort to the penal provisions, should be vested in the State Authorities under the Model Bill so that there is no conflict in the matter of exercise of powers between the States and the Centre in the field assigned to each under the Constitution.
- (iv) The severity of the restrictions which are to be imposed upon groundwater withdrawals will vary according to the existing groundwater resources in the block areas. This necessitates the strengthening of legal provisions for proper implementation.
- (v) Incentive structure needs to be provided in the Model Bill to promote community management of new wells and other schemes for conservation of water resources.
- (vi) Lack of proper institutional structure and capacity to manage ground water alongwith insufficient human resources and small holdings of farmers hamper the implementing process.

MODEL BILL IMPLEMENTATION IN PUNJAB

Punjab is an agrarian state, depending on heavy requirement of water, its only natural resource. The continuous hard work of its farmers for over a century and a half turned the unlevelled/forest land into highly cultivated and productive land. This, coupled with other inputs by State/Central governments helped the nation to be self sufficient in food grains. **The water of Punjab is thereby being indirectly carried to other states through the food grain productivity being achieved by hard and dedicated work of Punjab farmers**, who inspite of facing the vagaries of the nature, high input costs, high operation and maintenance costs of machinery/equipment and high cost of pesticides/fertilizers, are getting low returns. **Thus, the interests of farming community of the state needs to be kept in view while deciding upon the steps for controlling over-exploitation of groundwater resources in the Notified Areas.**

The possible impact of the implementation of legislation in line with various provisions in the Model Bill vis-a-vis, agriculture scenario, groundwater scenario and govt. policies of Punjab state and experiences of states/countries are described below:

1. The Punjab farmers have small/medium holdings and are dependent on groundwater resources to the extent of 73% of total water available for irrigation for various uses. In addition to the deteriorating groundwater scenario and high inputs to increase the productivity of the crops and its sown area, the introduction of registration/regulation of tubewells and permit system would cause considerable unease/hardship and misgivings in the minds of farming community and will not be conducive to social harmony.
2. The Model Bill seems to be harsh on users as they are already under financial strain and facing diminishing returns in terms of commercial value. Therefore, a system of incentives/disincentives needs to be devised.
3. Bureaucratic control will create another Inspector Raj which may cause unrest in the farming community. The farmers of Punjab die for water and the implementation of Bill may not be conducive to social harmony. While the effect on the rich farmers may be marginal, the poor and small users of groundwater resource will be most affected as it may lead to unequal distribution/withdrawal of water.
4. Registration of tubewells will not solve any purpose in controlling declining groundwater resources. Further, there is no need for such registration in Punjab as regular census of minor irrigation is

carried out in Punjab state and the position regarding number of wells/tubewells is well known. This data is being used in carrying out Dynamic Ground Water Estimation of State periodically. Further, the Govt. loan in installing tubewells in "Dark Areas" or in "Over-Exploited/Critical Areas" is not available to the farmers. Thus, the registration will only cause hardship and discontent towards the government.

5. Spain with 0.5 million wells and Mexico with 0.09 million wells have found it difficult to enforce the new water law for registration and monitoring of scattered wells. Compared to this, the task of Punjab having 1.17 million wells seems to be an uphill task.
6. Seven states, which enacted the legislation as on 28.6.2005, have low stage of development from 27% to 64%, except Pondicherry 105%, and have not reported its successful implementation. The success of it in the agrarian states like Punjab having highest stage of development as 145% in the country appears hardly possible.
7. After registration of tubewells, regulatory measures will be issued to control the groundwater abstraction from each structure in "Notified Area" in which concerned DCs will be directed to enforce prohibition of construction of new tubewells and resort to penal action in case of violation of directions of CGWA. This step is not conducive to law and order in Indian states and even in developed countries. As the dependency on ground water is very high, instead of coercive steps, the necessity is to improve the health of groundwater resources by taking corrective measures on priority. The implementation of Model Bill in the present form may lead to complications.
8. Fast increase in cost of production and resultant fall in income calls for creation of a congenial environment for providing material support and encouragement to the farmers rather than going for strict regulatory orders which would further dampen their spirits. Suicides by farmers all over the country has already assumed alarming proportions.
9. The directions have been issued by MoWR to educate the farmers about judicious regulation of ground water in area of grave concern before attempting such enactment. The farmers of Punjab are intelligent and already practising conjunctive use of surface and ground water.

NEW APPROACH

For sustainable groundwater management and development, the successful strategy is to deftly combine on the demand side, measures to control, protect and conserve water resources with measures to augment the resources on the supply side. The groundwater depletion can be reduced by reducing withdrawals by irrigating reduced area with groundwater, improving irrigation techniques, public awareness campaigns for water conservation, leakage controls etc. and then balancing abstraction with recharge by construction of dams, re-using waste water, desalinated public supply etc.

It is suggested that first demand of water needs to be controlled and steps for conservation and augmentation of groundwater resources need to be taken. In Punjab the increase in demand for water is mainly due to sowing of high yielding varieties and high water intensive crop, specially paddy, multiple cropping, increase in population, urbanisation and industry.

Punjab needs special consideration for conservation and augmentation of its water resources due to the following reasons:

1. The economy of Punjab of late has shown a sluggish growth because of its proximity to the international border with Pakistan and no big industrial project coming up in the state during last two decades. Punjab needs to be given special consideration on this fact alone.

2. Punjab's economy is an agrarian economy depending on food grain production. Surplus food grains are transported to food deficit states through national agencies. The system of MSP designated by Union government is hardly sufficient to sustain cost of agricultural inputs.
3. While other states earn royalty, sales tax etc. on its natural resource, Punjab does not receive anything for its only natural resource 'water' which is used for production of food grains and forms major part of its GDP which goes to the national pool.

The various measures suggested for conservation of water resources are listed below and for sustainable groundwater governance, different departments need to implement various schemes in co-ordinated manner and in an integrated way to achieve the desired results.

To Control Demand of Water

There is a need to put more attention to control the demand especially in the agriculture and industrial sectors. In the agriculture sector, the demand for more water must be curtailed by adopting following measures:

- (i) To discourage paddy, alternative crops be covered under MSP which will help in crop diversification scheme implementation.
- (ii) Electric transmission system needs to be modified to restrict supply of power to tubewells before 16th June so that late sowing of paddy is encouraged to decrease evapo-transpiration.
- (iii) Modern pressurized irrigation practices, such as, sprinkler and drip irrigation along with pipe conveyance system instead of water courses and horticulture needs be encouraged.
- (iv) Industry with heavy demand for water be discouraged and recycling of water be made mandatory.
- (v) 10% area of cultivable land of farmers having large land holdings (720 acre) be covered under forestry or horticulture to improve environment.
- (vi) Depth of tubewells be restricted or horse power of tubewells be limited to 10 HP so that deeper aquifers are not tapped (beyond first two aquifers).
- (vii) Modern techniques of paddy cultivation be encouraged as these do not require flooding of the fields.
- (viii) High investment in R&D is required to ensure introduction of new technology for introducing new viable crops putting minimum strain on water and soil and having high level of productivity.

For Conservation of Water

Following conservation techniques should be promoted. These techniques, if followed strictly, can save a huge quantity of ground water and significantly check its depletion.

- (i) Practicing recommended irrigation scheduling.
- (ii) Mass awareness programme to acquaint people with need for sustainable irrigation management and problems relating to water resources be launched through PIM and WUAs.
- (iii) Zero tillage practice, precision land levelling and straw mulching needs to be encouraged with farmers.
- (iv) Install energy efficient pumps and ensure regular supply of power to tubewells to decrease wastage.

- (v) Depth of tubewells be restricted or horse power of tubewells be limited to 10 HP so that deeper aquifers are not trapped (beyond first two aquifers). Only government should tap deeper aquifers and provide controlled water supply.
- (vi) Increase forest cover.
- (vii) Protection of wetlands and village ponds.
- (viii) Conjunctive use of saline water with fresh water.
- (ix) Recycling of water and proper treatment of waste water to reduce pollution be made mandatory for industries with heavy demand and groundwater abstractions needs to be limited with metered supplies in order to promote multi use of water.
- (x) Modernisation of irrigation system and performance improvement to increase water allowance in the irrigated areas.
- (xi) Install sensors at all public utility places.
- (xii) Development of proper infrastructure for information and data collection system for water resources for proper monitoring and planning.

For Augmentation of Water Resources

The natural recharge has been reduced considerably during the past more than a decade due to deficient rainfall and increased built-up area. The different measures, as described below, must be undertaken at suitable sites in the state to augment groundwater resources.

- (i) Make roof top rain water harvesting mandatory in all new buildings/greater than 500 sq.yards area.
- (ii) Suitable drainage Policy should be evolved for cleaning of drains in order to increase natural recharge.
- (iii) Artificial recharge schemes be taken on greater scale in order to conserve every drop of water going waste during monsoon season.
- (iv) Construction of check dams/low dams.
- (v) Ground water development in flood plains to create cushion for natural recharge.
- (vi) Exploration of deeper aquifers to identify new resources.
- (vii) Bio-drainage needs to be implemented in water logged and saline areas.

CONCLUSIONS AND RECOMMENDATIONS

Although the state of Punjab has country's most developed, well organized and reliable canal irrigation system, yet, the groundwater resources of the state are under enormous strain to supplement its canal supplies due to limited allocation of surfacewater resources of its rivers which are unable to meet the increased demand of water for diverse purposes, especially agriculture, the maximum consumer of water and backbone of state's economy. Over the last more than three decades, extensive use of ground water primarily for irrigation has contributed significantly to agricultural and overall economic development in the Punjab state. Use of ground water for irrigation enhanced irrigated area and increased food grains production besides bringing changes in cropping pattern. Besides, the initiative and hard work of farmers who adopted the new technology through introduction of Green Revolution turned desolate, unlevelled land and jungles into most productive regions and turning Punjab state into India's "Bread Basket". There has been multifold increase in area under rice which is water intensive

crop. On the other hand, area under less water consuming crops such as maize declined substantially. Heavy dependence on ground water for irrigation has been responsible for its over-exploitation in large parts of the state with the result that water table is declining in 79% of the area in the state. Consequently, deeper aquifers are also being exploited for irrigation through tubewells. The cost of inputs have tremendously increased and the financial return by sowing major cash crops (rice and wheat) is fast dwindling. This has already affected the farmers with small land holdings. Any harsh/penal measures for controlling ground water would add to the woes and miseries of farmers.

Water is a state subject as per Constitution of India. It includes both surface and ground water. Further, groundwater ownership is linked to land ownership under Indian Easements Act, 1882. The legislation enacted by some of the states in India for control and regulation of ground water has been found to be ineffective. It has been neither acceptable nor successful. The same is also true for other agrarian states, including Punjab, where notifying areas for control and regulation of groundwater development, grant of permits to extract and use ground water are considered to be retrograde steps for agrarian development. Even Revised Draft Report (Feb. 2006) of the expert group constituted by the Planning Commission has also mentioned the Model Ground Water Bill to be deeply problematic and suggested drastic changes to provide incentive structure, for good water governance, endorsing the Punjab State's views. The registration of tubewells/issue of permits will only cause unease, hardship and discontent towards the Govt. and regulatory measures will sow doubts into the minds of community, which will not be conducive to social harmony as farmers want free access to water. Instead of coercive steps, corrective measures needs to be adopted to check over-exploitation of ground water as suggested in this paper. The incentives may be provided by Union Govt. alongwith giving due consideration of Research & Development in groundwater sector to undertake more integrated, multi-disciplinary and sustainable approaches to groundwater governance and also in the agriculture sector for introduction of new technology for high productivity and low water intensive crops to replace wheat and paddy in the state to sustain agricultural production in the state.

REFERENCES

- Central Ground Water Board (2005). *Dynamic Ground Water Resources of India*, CGWB, New Delhi.
- Economic Advisor to Government, Punjab (2005). *Statistical Abstract of Punjab, 2005 and various other publications*.
- Government of India, Ministry of Water Resources (2005). *Agenda Notes for Conference of Principal Secretaries/ Secretaries (Irrigation and Water Resources) and Command Area Authorities of States on 4th & 5th October, 2005*.
- Government of India, Ministry of Water Resources (2005). *Agenda Notes for 13th National Conference of Water Resources & Irrigation Ministers of State Governments & Union Territories (30.11.2005)*.
- Government of India, Planning Commission (Water Resources Division) (2006). *Report of the Expert Group to Review the Issue of Ground Water Ownership in the Country (Revised)*.
- Government of Punjab (2004). *Expert Group Report*.
- Government of Punjab (2004). *Human Development Report, Punjab*.
- Mavi, Harpal Singh and Tiwana, D.S. (2004). *Geography of Punjab, Second Revised Edition*.
- Punjab State Council for Science and Technology (2005). *State of Environment Report*.
- The Eradi Tribunal (1987). Report of the Ravi and Beas Waters Tribunal.
- Water Resources & Environment Directorate (2005), *Report on Dynamic Ground Water Resources of Punjab State (As on March 2004)* Irrigation Department, Punjab, Chandigarh.