Emerging Water Insecurity in India

"Sustainability of water use at the present level is under great strain particularly in Punjab where ground water is over exploited and is getting increasingly polluted. The overall policy environment mainly with elements like free electricity for water extraction and free/subsidised water for domestic use is totally insensitive to the macro outcomes of the behaviour of water users involving huge wastages and inefficiencies. The wheat rice dominant cropping pattern which greatly contributed to the food self sufficiency of the nation has become unsustainable. This book dwells upon all these issues with insightful analysis of data and facts. The strongest point of the work is a comprehensive field survey of water use behaviour of farmers, industrial units and households. This book by Ranjit Singh Ghuman and Rajeev Sharma is a very valuable contribution to the study of water economy."
—Dr. S. R. Hashim
Ex-Member Secretary, Planning Commission,
Government of India; Director, IEG, New Delhi; and
Ex- Chairman, National Commission for Integrated Water
Resources Development Plan, Government of India.

"The water security in this book has been viewed in the form of sustainable use of water and maintenance of its fair quality. The emergence of water scarcity in an agriculturally advanced region have been analysed in a development process based on private profiteering sans social concerns. Apathy of public policy through free power for agriculture and lack of rain water harvesting has been brought out and lessons from development experience have been made through empirical analysis. The book will be very useful reading for all those concerned with sustainable development and having stake in the water sector."
—Dr. Sucha Singh Gill
Professor of Economics and former Director General
Centre for Research in Rural and Industrial Development
Chandigarh, India

"Punjab represents a classic case of overexploitation of water resources driven by the nexus of technology and policy. The authors demonstrate how a blessed region is heading towards dreadful future not due to any natural factors but due to absence of suitable regulation and measures essential for sustainable use of natural resource. I hope the book will awaken the society to collectively decide future course of action to save Punjab from reckless over-exploitation of water resources."
—Professor Ramesh Chand,
Member, NITI Aayog, Government of India

Emerging Water Insecurity in India:

Lessons from an Agriculturally Advanced State

By

Ranjit Singh Ghuman and Rajeev Sharma

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Scholars
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With lots of love and affection for my grandchildren Annika, Ritwik and Arjit who I hope do not have to face water scarcity

Ranjit Singh Ghuman

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Ranjit Singh Ghuman
Rajeev Sharma

PREFACE

Human demand for water, mainly originating out of its requirement for food, energy, and industry, is continuously rising and resulting in an ever-increasing gap between its demand and supply. The increasing world population and modern-day development paradigm are raising the demand for food, energy and industrial produce which, in turn, is leading to an ever-rising demand for fresh water which is not only limited in supply but also has alternative and competing usages. The major portion of demand for water comes from agriculture and subsoil water is becoming very handy as it is the most reliable source of irrigation. It is essential for stabilising and increasing the incomes and livelihoods of farmers and agricultural labourers. However, in most of the countries, water availability for agriculture is not only limited but also uncertain. It has also been estimated that by 2050, the number of countries with water scarcity will be greater than fifty and India will be on that list. About 2 billion people will be living under conditions of high water stress by 2050. This necessitates efficient management and governance of water. The global community is responding to the emerging scarcity and insecurity of water through various international agencies.

After independence in 1947, ground water emerged as the most preferred source of irrigation and for other uses in India. Irrigation accounts for 92 percent of total ground water use. About 55 percent of irrigation requirements, nearly 85 percent of domestic and other water requirements in rural areas and 50 percent of requirements in urban areas and of industries are met through ground water

The aggregate scenario of net water availability and the net draft seems to be quite comfortable. And there is quite a high scope for ground water development in the case of a large number of states in India. This is also an indicator that in many of the states, groundwater for irrigation and other purpose can be further developed as the ground water development level is substantially below 100 percent. However, the wide geographical and regional variations in the water resources and very high proportion of rain-fed agriculture in the country do not support such a scenario. The rising needs for water coming from the rapidly increasing population and consequent developmental needs would further lead to higher demand for water.

The Indian Punjab is located between North latitudes 29^{o} 32’ and 32^{o} 28’ and East longitudes 73^{o} 50’ and 77^{o} 00’. It is surrounded by Himachal Pradesh in the northeast, Jammu and Kashmir in the North and Haryana and Rajasthan in the south and southwest, respectively. The state also shares an international border with Pakistan and a number of its districts are in the border region. At the time of independence from the British Empire in 1947, the territory was divided into India (Hindustan) and Pakistan and Punjab was the worst victim of partition. A very large proportion of undivided Punjab went to Pakistan and a smaller part of Punjab remained in India. The undivided Punjab was known as the food basket of the undivided country and that was mainly because of the canal-irrigated agriculture in that part of Punjab which went to Pakistan after partition.

The state lies in the Punjab basin of the great Indo-Gangetic Plain and has three perennial rivers (Sutlej, Beas, Ravi and one ephemeral river Ghaggar). It has a vast network of canals. With the advent of the green revolution and emerging predominance of wheat-paddy crop rotation, demand for ground water registered a phenomenal increase as agriculture is the largest consumer of water. It led to over-exploitation of ground water resources, and the water table consequently suffered a serious depletion.

Out of a total population of 27.74 million of Punjab, 17.34 million people live in rural areas and the remaining 10.40 million people are in urban areas. About 76 percent of people are literate. Out of the total 9.90 million workers, 1.94 million are cultivators, 1.59 million agricultural labourers and the remaining 6.37 million are engaged in the non-farm sector. For administrative purposes the entire state is divided into 22 districts and 149 development blocks. The state has three major agro-climatic zones, namely, central, south-west and sub-mountain. *Mjaha*, *Doaba* and *Malwa* are its three cultural zones.

With 1.53 percent of the total geographical area of India, the state has come to be known as the food bowl of India. The total geographical area of the state is 50,362 sq. km. out of which 48,265 sq. km. is rural and 2,097 sq. km. is urban. The state is mainly a flat alluvial plain. The area occupied by the mountains (Himalayan Foothills) in the northeast is about 1,243 sq. km. Approximately 83 percent of the total area is under cultivation. With 100 percent irrigation intensity, nearly all the arable land is under double cropping. The success story of the green revolution of Punjab helped India to become a food sufficient from a food deficient country.

In fact, optimality and rationality are the two fundamental assumptions of economics and use efficiency of resources is closely connected with the happening or non-happening of these two assumptions. Human behaviour, however, is not always governed by rationality and optimality. As such, people do not always make rational choices. It is equally applicable to their behaviour towards the consumption of natural resources despite the fact that such resources are non-renewable. Unfortunately, the greed and market-driven growth model has always been at loggerheads with these fundamental assumptions of economics as far as the use of natural resources is concerned. Nevertheless, it is assumed that every economic agent is rational and uses the resources in an optimum and rational manner. Of course, this is true as far as profit is concerned but it has put a serious question mark over the question of sustainable use of resources, especially natural resources.

Punjab is no exception to this. To provide the much-needed food security to the country, the state of Punjab has used its subsoil water in such a manner that optimality and rationality have been put on the back burner. Since the mid-1970s, Punjab has been virtually exporting its subsoil water to other states of India in the form of rice. It has been contributing between 25 percent and 45 percent of its rice and between 40 percent and 75 percent of its wheat to the central pool of the country for more than four decades. And in the process, its water table has gone down drastically. The excessive use of chemical fertilisers and pesticides has not only contaminated its subsoil water but also damaged the soil health beyond repair. As a result, poisons have entered into the whole food and fodder chain and have started adversely affecting both human and animal health, along with the flora-fauna and the environment. Such a scenario has brought to the fore the issue of sustainability of the present water use pattern.

In order to examine the main objectives of the study and validate and cross-check the secondary data, we undertook a field survey of the pattern of water use in agricultural, industrial and household sectors of Punjab. In the case of agriculture, the primary data pertain to 300 cultivators belonging to 30 villages located in 10 blocks of 10 districts of Punjab. The list of the villages and districts is given in appendix A.P.1. The basic village-level data of all the 30 sampled villages is given in appendix A.P.2.

The blocks were selected out of the list prepared by the Economic and Statistical Organisation of the Punjab according to their level of development in descending order. Out of all the 22 districts, 10 districts were selected in such a manner that they represent the three main agro-climatic zones as well as all three of the cultural zones of Punjab. Besides, these districts represent the main cropping patterns, wheat-paddy and wheat-cotton, prevalent in the state.

From each of the sampled districts, we selected one block from each district in such a manner that they represent various levels of development. The sampling of 30 villages also represents the relative level of development. In the sample, 10 villages are less developed, 10 are moderately developed and 10 are highly developed. For collecting primary data, we have selected seven districts (Gurdaspur, Amritsar, Ferozepur, Jalandhar, Ludhiana, Patiala and Sangrur) from the central plain zone (CPZ); three districts (Bathinda, Mansa and Muktsar) from the south-west zone (CWZ) and one district (Hoshiarpur) from the sub-mountain zone (SMZ). Thus, in all there are 21 villages from CPZ, six villages from SWZ and three villages from SMZ. The CPZ and SMZ are mainly the wheat-paddy zones whereas the SWZ is a cotton-wheat zone as well as a wheat-paddy zone as the area under paddy in the SWZ is quite substantial. The study can thus be claimed to be a representative one.

In the case of the industrial sector, we have randomly selected 50 small-scale industrial units, covering ten major industries, located in six districts of Punjab. In the case of medium and large industries, we have sampled 100 industrial units, covering ten industries, located in eight districts of Punjab. Care has been taken to include all the major water-consuming industries, both in the small-scale sector and in the medium and large-scale sector.

In the household sector, we have studied the water use pattern in 300 rural households and 200 urban households. The rural households belong to 30 villages in 10 districts and include both agricultural and non-agricultural households. The urban households belong to two cities namely, Amritsar and Sangrur. The primary data from all the sectors have been collected with the help of specially designed and pre-tested questionnaires.

It has been found that the prevailing water use pattern is not sustainable in view of the depleting water table and deteriorating quality of available water balance especially in Punjab. The water users (agriculture, industry and households) in Punjab are not observing water use efficiency and, hence, are ignorant about the wastage of water resources mainly because of their low level of awareness. The ever-depleting water table due to continuous over-exploitation of ground water is a threat to the sustainability of the existing cropping pattern in Punjab. There is almost no rain water/surface water harvesting in Punjab. Free electricity in the agricultural sector and the paddy crop have led to an irrational use of ground water. The free supply of water for domestic use to a large number of rural and urban households and/or very low charges from other households is not only a serious drag on the state exchequer but it also results in an injudicious use of water. The public policy response to the water crisis and demand-supply management is too weak and casual. However, the book offers a number of lessons emerging from the experience of Punjab, an agriculturally advanced state of India.

This book is the outcome of our concern about the fast-depleting water table, shrinking water balance and near absence of a public policy response. The main objectives of the study were to examine the water consumption pattern in Punjab across all sectors and among all sections of water users, namely, agriculture, industry and rural and urban domestic consumption. In view of the limited quantity of fresh water and poor quality, water use efficiency has also been studied, though to a limited extent. An effort has also been made to identify more efficient ways and means to use this scarce natural resource in an optimum manner.

Besides Punjab, we have also discussed the global and Indian water scenario in the first and second chapters, respectively. The rest of the chapters dwell on the pattern of water use in Punjab across all sectors and users. Chapters 3 and 4 are based on secondary data and discuss the development of water resources and irrigation patterns in Punjab. Chapters 5 to 7 dwell on primary data pertaining to the pattern of water use in agricultural, industrial and household sectors. Chapter 8 is also based on primary data and discusses the level of awareness and sensitivity about water usage in each sector. Policy response and water management is the subject matter of chapter 9. The last chapter gives the summary and policy recommendations.

CHAPTER ONE

GLOBAL WATER SCENARIO: AN OVERVIEW

'Water is the Driving Force of Our Nature'
—Leonardo da vinci

'Pavan Guru, Pani Pita, Mata Dhart Mahat'
(Air is teacher, water is father and earth is mother)
—Guru Nanak Dev, founder of the Sikh Religion

1.1 Introduction

Though water has been the essential life supporting system ever since the inception of life on the planet Earth, it has become a rather more critical input in modern-day life. The issues of water use efficiency and sustainability of livelihood and life on earth are thus, closely interdependent. However, in the mad pursuit of material wealth, modern man is using this scarce resource in a reckless manner. In the name of growth and development, we are even consuming the water meant for our future generations and are putting the very sustainability of water and development at risk.

Out of the total available water at the global level 97.5 percent is salt water. Thus, global fresh water reserves are only 2.5 percent. The further breakdown of fresh water reserves is: glaciers—68.70 percent, groundwater—30.10 percent and others—1.2 percent. Thus, ground and surface water amount to only 0.76 percent of the total water resources on the planet Earth. Fresh and renewable water is not only limited in supply but has numerous alternative and competing usages. It is in this context that Lionel Robbins' scarcity definition of economics has become all the more relevant in the case of water. In view of the ever-increasing demand for water the global groundwater extraction rate has at least tripled over the past 50 years and continues to increase at an annual rate of 1 to 2 percent (UN, 2012). Despite this, about 92 percent of rain water is lost due to surface run off and evaporation etc. More than one billion people in the world who are living in developing countries are water stressed (UN, 2015).

Human demand for water mainly originates from their requirements for food, energy, and industry. Significantly, all these requirements have been on the rise, especially since the advent of the Industrial Revolution. The continuously increasing world population and modern-day development paradigm are raising the demand for food and other agricultural produce which, in turn, is leading to an ever-increasing demand for water. The world demand for water in agriculture and domestic sectors is expected to increase 1.5 times in 2030 as compared to 2010 and in the industrial sector it is expected to double. This, along with the impact of climate change, has led to serious uncertainties about the amount of water required to meet demand for food, energy and other human uses. It is significant to note that the right to adequate food was recognised by the UN General Assembly as long ago as 1966 in the International Covenant on Economic, Social and Cultural Rights (ICESCR).

Most of the demand for water comes from agriculture. Agricultural water withdrawal accounts for 44 percent of total water withdrawal in OECD countries that rely heavily on irrigated agriculture. In the BRIC countries (Brazil, Russia, India and China), agriculture accounts for 74 percent of water withdrawals, but this ranges from 20 percent in Russia to 87 percent in India. In less developed countries LDCs, the figure is more than 90 percent. However, in most of the countries water availability for agriculture is not only limited but also uncertain.

According to Food and Agricultural Organisation FAO (2009), out of 311 million hectares of land under irrigation in the world, 281 million hectares (about 84%) are actually being irrigated. This corresponds to only 16 percent of all the cultivated land that contributes nearly 44 percent of the total global crop production. This means 84 percent of the arable land is still not under assured irrigation but 56 percent of the global demand for food is being met by this land. This implies that the world has the potential to take care of food and other needs for agricultural produce coming from the increasing population and the industrial sector provided we can bring the additional area under irrigation. Certainly, that would require additional water for irrigation. At the global level irrigation is by far the largest user of water. It used about 252 billion cubic metres (bcm) of surface and ground water withdrawals in 2013 which is equivalent to 6.5 percent of the global renewable fresh water resources flows (HLPE, 2015).

Just imagine, if we were to bring all the arable land under cultivation, what amount of water would we need? Would the world be able to meet the huge demand for water from the agriculture sector? But to feed the ever-increasing population, the world will have to increase food production and, hence, bring a matching area under irrigation. Certainly, that would put an enormous additional burden on the already stressed water resources. At the same time, reliable irrigation is also essential to increase and stabilise incomes and provide livelihoods for a large number of marginal and small farmers and agricultural labourers.

Besides agriculture, approximately 20 percent of the world's freshwater withdrawals are used by industry, although this varies across regions and countries. The domestic water use is about 10 percent (UN, 2012). Significantly, global water demand has been projected to increase by 55 percent by 2050, mainly due to the growing demand for water from manufacturing, energy and domestic usages (UN, 2017).

It has also been estimated that by 2050, the number of countries with water scarcity will be more than 50 and India will be on that list. About 2 billion people will be living under conditions of high water stress by 2050 (UNEP, 2001). Two-thirds of the world's population are currently living in areas that experience water scarcity for at least one month a year (UN, 2017). About 40 percent of the global population living in river basins may experience severe water shortage especially in North and South Africa and South and Central Asia. It is estimated that manufacturing, thermal electricity and domestic demand will rise by 400 percent, 140 percent and 130 percent, respectively, by 2050. In such a scenario, there is little scope for increasing irrigation water use (HLPE, 2015).

In view of the ever-increasing pressure on water and the emerging scarcity, it is often said that a future world war may be fought over water. Let us hope that sanity prevails, and water is used, harnessed, conserved and managed in an efficient, judicious and sustainable manner and the above prophecy does not come true. Besides, there is an urgent need to reduce; recycle and reuse the water in every usage of water across the globe. Sustainable development also depends on the extent and manner in which we use our water and other natural resources, especially those which are non-renewable. The judicious use of fresh water is, thus, a compulsion and not a choice. In this context the nexus between water, land, energy and food is rather a bigger challenge.

The poor people living in slums and illegal settlements have little access to improved sources of water as compared to others who live in planned and formal settlements (WHO, 2017). In fact, access to safe drinking water and improved sanitation continues to be a serious challenge in most of the developing countries (Bain et al., 2014). As a consequence, 80 percent of illnesses are linked to unsafe drinking water and unhygienic sanitation conditions (UN, 2003). Approximately, 50 percent of hospital beds are occupied by patients suffering from water-related diseases.

As a matter of fact, the poor are subject to multi-pronged vulnerability and risk and do not have adequate access to improved drinking water and they often face food insecurity. Their water and food insecurity are not simply because of the shortage of water and food but mainly because of un-affordability. In the absence of adequate access to water, even their livelihood is at risk. Such people are often victims of macro-economic policies and the market-driven development model in which without adequate earnings and purchasing power they cannot afford, even to purchase the basic necessities of life. Significantly, 83 percent of the world population, living in the low-income countries, is below the poverty line (head count ratio) and 48 percent of people in the lower middle-income countries are earning $2.50 PPP daily (World Bank, 2014). In order to manage the macro-economic risks, the world would have to build stronger institutions for better policy outcomes. “The increasing complexity of macro-economic management necessitates continuous strengthening of institutional capacity” (WDR, 2014: 243). The occurrence of natural hazards (droughts, earth quakes, floods and storms) has increased from 2,561 during 1993–2002 to 3,132 during 2003–12 (World Bank, 2014a).

Increasing urbanisation also puts a lot of pressure on water resources. A significant proportion of the population is still without safe drinking water, electricity and improved sanitation facilities. Between 2009 and 2050, the world population is expected to increase by 2.3 billion, from 6.8 to 9.1 billion (UNDESA, 2011). The rising proportion of the urban population would also lead to a higher and higher demand for water. Out of the total world population of 7,346.7 million in 2015, 54 percent were living in urban areas. About 11 percent of urban people did not have access to improved drinking water and 36 percent were without access to improved sanitation (World Bank, 2017). There is a positive and high correlation between size of the population on the one hand and demand for agricultural and industrial produce, energy and water use in other activities. Most of the demand for water is, thus, an indirect demand.