



Review

Groundwater Decline and Prolonged Drought Could Reduce Vigour, Enhance Vulnerability to Diseases and Pests and Kill Perennial Horticultural Crops: Needs Urgent Policy Intervention

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ABSTRACT

Perennial horticulture in India has undergone a change from rainfed system to drip fertigation systems and from isolated hedge and bund trees to high intensity orchard systems with enhanced number of trees per unit area. In several parts, particularly in the Deccan plateau, the system has now become completely dependent on water pumped from tube wells. Severe competition for water from tube wells makes farmers to devote more water for cash rich annual crops and even sell water for city dwellers nearby. As a consequence, the groundwater level in the past three decades has fallen from few feet to above thousand feet. At several places it has crossed the “peak water”. Frequent and prolonged exposure of fruit trees and nuts to drought coupled with ground water depletion has led to soil profile drying leading to reduced vigour and enhanced vulnerability to diseases and pests. This has led to withering of fruit and nut trees. Perennial crops are likely to become increasingly maladapted to their environment, particularly in the earlier period of climate change they are more likely to be attacked by diseases and insects. Coconuts, areca nuts and mango trees have died in several places and the government constituted committees have recommended compensation to the farmers. As a country, we have dramatically increased our reliance on groundwater. 175 million Indians are now fed with food produced with the unsustainable use of groundwater. This increase has dried up rivers and lakes, because there is a hydrologic connection between groundwater and surface water. Yet the legal rules governing water use usually ignore the link between law and science. The issue needs thorough examination and needs policy interventions to come out of this vicious circle.

Keywords: Drought, Fruit trees, Groundwater depletion, Peak water, Perennial crops, Policy issue

INTRODUCTION

Perennial horticulture in arid and semi-arid regions of India was a rainfed system since beginning. With time, the area under perennial horticulture has shown enormous increase and with advancement in technology perennial horticulture along with annual horticultural crops and agriculture started receiving irrigation both through surface irrigation and through drip fertigation systems. Also, both number of trees per unit area and the intensity of cultivation have increased. Of late in arid and semiarid regions, particularly in the southern, central and north-western states, very large number of tube wells have been dug

and put to use for irrigation. Such tube wells were sunk in highly unscientific way and are resulting in increase in tube well depth and deteriorating quality of water. The system now has become completely dependent on water pumped from tube wells. In the past two to three decades the groundwater levels are falling steeply. Occurrence of prolonged drought, early withdrawal of monsoon, and reduced number of rainy days spreading over short periods are exposing the trees to severe moisture stress and symptoms of declining tree vigour could be felt. In the past five years, several incidences of trees withering like coconut and areca nuts, mango,



pomegranate etc. are being reported. Government has constituted committees to look into the causes and compensations are being given to the farmers for the loss of trees. There is hence a need to scientifically look and rethink on perennial horticulture in the wake of emergence of these situations.

Impact of prolonged drought on perennial horticultural crops

Distribution of trees in arid and semi-arid lands depends mainly on rainfall, surface water, and groundwater and air moisture. Change in climate of the given region (rainfall, temperatures, wind) further affects the distribution of trees. Soil quality and extent of its deterioration decides the future of existing population and scope for further expansion. Each tree species is adapted to certain conditions and is located in its “niche”. When optimal conditions are widely distributed, forests or shrubs may cover large areas. The natural distribution of vegetation has long been altered by human activities like unsustainable cropping systems. For example, by growing fruit trees, nuts and other perennial crops by exploiting the ground water in such places where its over drawing is unsustainable and can cause havoc. Conversion of forest lands to agricultural use in the past and more recently from agricultural use to unsustainable perennial systems are among the major causes of soil degradation in arid and semi-arid areas. Furthermore, global warming is expected to result in rainfall decrease throughout most of the arid and semi-arid zones, which will lead to more severe water scarcity and increased desertification risks. Some of the semi-arid regions started showing symptoms of desertification like Kolar and Chikkaballapur districts of Karnataka, Anantapur and Madanapalli in Andhra Pradesh etc.

Occasionally, fruit trees decline and often die. Diseases affecting the leaves, fruit, and twigs of fruit trees usually do not cause the trees to die, with exceptions for such diseases which causes death of trees like coconut wilt and bud rot, citrus and guava wilts and recently pomegranate wilt and nodal blight, wilt in many perennial crops. Leaf, fruit, or twig diseases weaken the tree, interrupt normal bearing, and reduce fruit quality, but the trees usually survive. The cause of death for most fruit trees is damage to the root, trunk, or the crown. Drought, flooding, crown and root diseases, and borers, winter cold,

frosts, can cause injury to these parts but not lethal to the trees. Frequently, a combination of two or more of these is the cause of death. The most severity being reported and becoming more common than exceptions is the soil profile drying in arid and semiarid regions caused due to drought coupled with over exploitation of groundwater and drought alone usually will not kill healthy fruit trees, unless the drought is prolonged and severe coupled with decline in water table due to over draft of ground water. But gradual exposure of trees to drought weakens the trees which predisposes trees to insect pests and diseases.

A gradual decline in tree health as a consequence of limiting moisture is a common problem for many trees, more so, underclose spacing mono cropping, intensively managed orchard systems. Symptoms may include stunted growth, premature leaf drop, late spring leaf development, sparse foliage, light green or yellow foliage, twig and branch die-back and many other abnormal symptoms like flowering but not bearing fruits to the expected crop load. As mentioned above, usually there is no single reason for tree decline. Often, a combination of factors, linked to one another, reduces a tree’s vigour. Stress on a tree can make it vulnerable to additional problems. Diseases and insects often capitalize on the tree’s low vigour and accelerate its decline. Trees survive stress temporarily by using stored food and water reserves, but once these reserves are used up, symptoms of decline begin to appear. Because trees are so efficient at storing food and water reserves, it may take 2 or 3 years after a stress episode before decline symptoms appear. One of the most common causes of stress is planting orchards tree species not suited for a particular site. Many species have specific site requirements. Site characteristics that influence tree growth in limited moisture situations include soil moisture holding capacity, soil moisture availability, soil resource base erosion, mainly the organic front and drainage. All these come under land use planning which is surprisingly ignored while planning perennial crops entrepreneurship.

Declining trees as a consequence of prolonged drought and overdraft of groundwater leading to profile dryness make trees weak and susceptible to insect pests and diseases. Certain insects and diseases can cause defoliation leading to further stress. Most healthy trees can survive some defoliation, but

defoliation year after year can cause decline and even death. Mango foliage damage caused by hoppers, loppers, beetles etc. in the very initial stage of leaf emergence is a typical example in southern and western part of India. Apple scab and anthracnose of shade trees are examples of diseases that cause infected leaves to fall prematurely. The stem and root borers take the opportunity of tree weakness and overtake the tree health and intensify the attack. A typical example is the spurge in the stem borers of Arabica coffee in Coorg and mango in South India. Leaf diseases like powdery mildew and anthracnose and other diseases cause severe damage to foliage, inflorescence and fruits. Tree wilts due to *Ceratocystis* are emerging in mango in recent years which normally happen during trees exposed to long period of moisture stress.

Climate change effects on insects and pathogens under horticultural ecosystems

Increase in summer temperature will generally activate insect development rates. Some insects may shift from completing a generation every two years (semivoltinism) to completing one generation per year (univoltinism), a factor that contributes to large-scale outbreaks. Warmer winters could also lead to more successful survival. Outbreaks may also increase in entirely new areas crossing the limits of host species due to warming temperatures relative to their current distribution. The indirect effects of climate change on insects are more complex; therefore, they are more difficult to predict. Because trees are likely to become increasingly maladapted to their environment, particularly in the earlier period of climate change they are more likely to be attacked by insects.

Climate change will affect the developmental sequence of insects and their predators. Natural insect enemies of defoliator and borer species depend on climatic factors to maintain their life processes and synchronicity with their insect host and the habitat in which they live. Key parasitoids and predatory species population may dwindle due to over use of chemicals or even as a consequence of climate change and can further be a primary driver in causing the outbreaks. However, such predictions are difficult due to their complexity and variability. In general, the projected change in climate coupled with poor tree vigour as a consequence of increasing moisture deficit conditions, will promote pest and pathogen

activity due to low moisture availability following prolonged drought, higher temperature and reduced mortality in winters. However, the complex interactions among hosts, pathogens and environmental conditions make scientific prediction difficult. A warmer and dry climate may change some pathogens and pests and decline in others.

Emergence of stem borers as a serious pest is a consequence of progressive exposure of intensively managed orchards to drought. Progressive foliage loss in mango due to complex insect damage may also be a consequence of this. However, short periods of hot, dry weather put severe stress on weak or injured trees and may cause them to die. Death most frequently occurs in the early summer, during or just following the first heat wave. A heat wave puts a severe strain on a weakened tree. Weak trees frequently leaf out in the spring, bloom profusely, and set a heavy crop of fruit but fail to retain the crop load. Although in mango the trees leaf out, the leaves usually are smaller than normal, are pale-green to yellowish green in colour and are severely affected by foliage pests and or diseases even before the leaves turn green from the initial copper colour.

Consequences are seen in recent years of loss of coconut trees, arecanut trees, mango trees and other perennial trees in some of the groundwater over exploited areas like Chitradurga, Tumkur, Chikkaballapur, Bangalore, Hassan, Anantapur, Madanapalli, Solapur, Theni, Virudhunagar and other districts and Arabica coffee in Coorg and Chikmagalur districts of Karnataka. Over mature trees progressively lose their resilience to climatic stress, so that a single climatic event can destroy a whole area of those species. For example, over aged coconuts and areca nuts in Southern Karnataka died few years back.

Water and land resources degradation

The United Nations Conference on Environment and Development (UNCED, 1992) defined desertification as “land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities”. Desertification is not an advance of existing deserts but is rather the effect of localized degradation of the land. It rapidly follows deforestation and soil exhaustion. Exposed to the sun, the wind and the rains, exhausted soils lose their organic matter and

their structure while nutrients are leached away. Fine elements are blown into dust storms and sand grains become mobile. Overexploitation of forest, tree, bush, grazing land and unsustainable cropping systems by overexploitation of soil resources and ground water has been increasing desertification. Recent report of ICRISAT under NICRA project has shown that in the past 50 years there has been a shift from dry sub-humid climate of some region to semiarid climate and trends in semiarid regions becoming arid regions (NICRA, 2014). Fruit trees are occupying larger areas in such locations in dry sub-humid and semi-arid regions under irrigation from tube wells which are over drawn leading to a steep gradient of dry profile down from surface soil. A poor monsoon spread over short period, too low number of rainy days, early withdrawal of monsoon coupled with groundwater over draft predisposes fruit trees to wither.

Natural resources, particularly surface and ground water, are important for sustainable development and achieving higher economic growth. Efficient and scientific utilization of these resources ensures the ecological balance of an ecosystem. The contribution of natural resources to local economy is outside the market framework, which are both its strength as well as weakness. Strength in the sense of social justice, that it supports rural families. Weakness lies in unsustainable exploitation of these resources, which would result in the tragedy of these resources. Further, unsustainable exploitation leads to scarcity of resources that would then be beyond the reach of the poor.

Consequences of groundwater overexploitation

Groundwater depletion is by far the most widely debated issue in the resource economics literature. Groundwater depletion problems are related to the question of resource management and the coalition of powerful property owners protecting their interests, under a capitalist society. Overexploitation of ground water and its social consequences are the result of certain processes of development in irrigated agriculture that occurs at the cost of depletion of aquifers and sustainable farming systems (Raghupathi and Ganeshamurthy, 2013). The state intervened initially through agrarian reforms, and later by providing credit facilities and supporting marginalized

groups to have irrigation facilities by implementing Million Well Schemes, Ganga Kalyan Yojana and politically influenced free power supply etc. All these led to rise in groundwater structures, shifting cropping pattern towards water intensive crops as well as resource abuse by overexploitation of the aquifer. The distinctive impact of irrigation, in general, and groundwater irrigation, in particular, on farming begins to emerge more clearly and recognizably where irrigation permits extension of cultivation to additional seasons (Rao, 1978). This allows farmers to benefit from surplus production which otherwise would not have been possible. As a result, groundwater became a chief source of irrigation primarily in dry sub-humid, semi-arid and arid areas and at the same time several problems like those mentioned above emerge due to heavy pumping.

Counter argument

Trees consume water. The more the aerial system of trees is developed, the more water they transpire. The desirability of tree planting in arid lands is debated because trees may consume more water than they provide to the water cycle. Some countries, such as South Africa, have imposed a tax on the water consumed by forests. In certain circumstances where trees consume all the rainwater, it may be judged better to harvest this water through a bare watershed, store it in a reservoir and use it to irrigate high-value agricultural crops. For example, in Yatir, Israel, where average precipitation is only 270 mm per year, more than 3000 ha of rainfed *Pinus halepensis* were planted in the early 1960s under a large-scale afforestation project. Although the forest provides carbon sequestration benefits and contributes to the livelihoods of nearby communities (particularly through fuel wood and non-wood forest products such as resins, fodder and medicinal and aromatic plants), it uses all the precipitation water. Furthermore, the forest has altered the biodiversity of the region, as new predation dynamics threaten endemic species. Rueff and Schwartz (2007) reported that the water that the watershed would have provided if it had not been afforested would have alleviated poverty better if it had been used for agriculture. They suggested that afforestation on a smaller scale, such as on farmers' plots, may yield similar benefits with fewer drawbacks, as combining tree planting and agriculture is less disturbing to the environment, improves agricultural yields, conserves water and soils and provides fuel wood for farmers.

Peak water and Future threat

Groundwater contributes 42%, 36% and 27% of water used for irrigation, households and manufacturing, respectively. In regions with extensive surface water irrigation, such as Indo-Gangetic plain, net abstractions from groundwater are negative, i.e. groundwater is recharged by irrigation. The opposite is true for areas dominated by ground water irrigation such as southern plateau regions covering Karnataka, Andhra Pradesh and Tamil Nadu where net abstraction of surface water is negative because return flow of withdrawn groundwater recharges the surface water compartments first and then excess flow downwards (Raghupathi and Ganeshamurthy, 2013).

The National Academy of Agricultural Science (NAAS) in its meeting on phosphorus in 2013 discussed about “Peak phosphorus” going to threaten future food security. But the real threat is the “Peak water”. We may produce some food with low phosphorus supply, but we cannot produce food without water. Human beings on an average require four litres of water per day. But the water required for producing each day food per person is around 2,000 liters. This is 500 times as much compared to direct consumption of water by man. We must now understand that getting enough water to drink is relatively easy, but finding enough to produce the ever-growing quantities of food, fruits, vegetables, fodder and other requirements is a matter of serious concern. For example, it is a common scene seeing water tankers carrying water from tube wells from the farm land heading towards cities as a consequence of unplanned city expansions like those seen in Bangalore, Hyderabad, Chennai and Pune. There is concern that the state of peak water is being approached in many areas. Some areas are suffering from peak renewable water, where entire renewable flows are being consumed for human use, peak non-renewable water, where groundwater aquifers are being over pumped (or contaminated) faster than nature recharges them and peak ecological water, where ecological and environmental constraints are overwhelming the economic benefits provided by water use (Gleick and Palaniappan, 2010, 2011) if present trends continue.

In a short span of two to three decades the extraction of water began to exceed the recharge of aquifers from precipitation, and water tables began to fall. And

then wells begin to go dry. For example, in the district of Chikkaballapur in Karnataka, Madanapalli in Andhra Pradesh, the farmers draw water worth 1800-2000 mm rainfall for rowing tomato after tomato, whereas the average precipitation is only 750-800 mm. In effect, over pumping creates a water-based food bubble, one that will burst when the aquifer is depleted and the rate of pumping is necessarily reduced to the rate of recharge. Definitely regions such as this have crossed the peak non-renewable water.

A World Bank study estimates that 15% of India’s food supply is produced by mining groundwater. Stated otherwise, 175 million Indians are now fed with grains produced with the unsustainable use of water. As early as 2004, Fred Pearce reported in *New Scientist* that “half of India’s traditional hand-dug wells and millions of shallower tube wells have already dried up, bringing a spate of suicides among those who rely on them. Electricity blackouts are reaching epidemic proportions in government where half of the electricity is used to pump water from depths of a kilo meter and above.”

The excessive “mining” of our aquifers is causing environmental degradation on a potentially enormous scale (Raghupathi and Ganeshamurthy, 2013). As a country, we have dramatically increased our reliance on groundwater. This increase has dried up rivers and lakes, because there is a hydrologic connection between groundwater and surface water. Yet the legal rules governing water use usually ignore this link. This disconnection between law and science is a major cause of the problem. So too is our refusal to recognize the unsustainability of our water use. Significant reforms are necessary if we are to save our trees, prevent further degradation of our rivers, streams, lakes, wetlands, and estuaries. A final consequence of ground water pumping is its impact on surface water, including lakes, ponds, rivers, creeks, streams, springs, wetlands, and estuaries. These consequences range from minimal to catastrophic. An example of the latter is the Arkavati and Vrishabha vatirivers and a chain of 65 lakes in Bengaluru. Two lakes viz., Hessaraghatta lake and Tippagodanahalli lake provided sufficient good quality drinking water to metropolitan city “Bengaluru”. It is more than two decades these very important water bodies have dried-up. Once a verdant riparian system with a lush canopy provided

by several tree species and big gardens, groundwater pumping has lowered the water table, drained the rivers and lakes of their flow, devastated vegetation and driven away the local birds and wildlife. The rivers and lakes have become an oxymoron—a dry river and lake—a pathetic desiccated sandbox. Other lake cities, Bhopal and Udaipur are in the verge of reaching the state of Bengaluru in near future if corrective measures are not taken.

How do water bodies go dry?

Groundwater and surface water are not separate categories of water. The designations groundwater and surface water merely describe the physical location of the water in the hydrologic cycle. Indeed, groundwater and surface water form a continuum. Virtually all groundwater was once stream flow that seeped into the ground. The converse is also true but not obvious. Groundwater pumping essentially interrupts the water cycle by removing water, directly or indirectly, that would otherwise discharge from aquifers to rivers, streams, and other surface water bodies.

As groundwater pumping lowers the water table, the direction of the flow of rivers streams and lakes changes. Once the water table is below the elevation of the rivers, streams and lakes, water flows from the water bodies toward the aquifer. This is what groundwater pumping did in areas where perennial fruit and nut trees are drying. Groundwater pumping literally sucked water from the rivers, streams and lakes and produced horrible environmental consequences. First, of course, the flow in the rivers and streams gets reduced and lakes dried and water-dependent species like areca nut, coconuts and mangos suffered heavily and areca nut and coconut trees withered and mango trees are in the queue.

In considering other examples of environmental problems caused by groundwater pumping, the first thing to note is that the impact of groundwater pumping on the environment is not confined to any given region. Like Karnataka and other southern states, the central Indian states also have similar problems. But the peak has reached in south and may take little more time for the other regions. In the North and Indo-Gangetic plain, the problem is similar but for the well supplied water from Himalayan river systems.

We use groundwater to grow all kinds of things, even when there is no need to do so. Until rather recently, many of our farms were “dryland” farmed. However, as the demand increased farmers shifted from dryland to irrigation farming. In places where only highly drought resistant crops like ragi and horse grams were grown, farmers shifted to highly water dependent crops like tomato, watermelons etc. with almost three-fold increase in cropping intensities, all through exploitation of ground water. We require 200 to 225 litres of water to produce one kilogram of tomato. We export this tomato to other countries at the rate of approximately Rs. 20/- per kg. Are we not foolish to do this and farmers suffering many a times from tomato glut? Such over pumping of water irrigates the surface layers of soil in annual crops like tomato and other vegetables. But the perennial crops in the region, particularly in areas like Srinivasapura in Kolar district in Karnataka and Nuzvid area in Andhra Pradesh under mango and Tumkur and Hassan districts in coconut and areca nut undergo severe stress due to continued profile drying.

Another pitiable example is our newfound fascination with bottled water. It is a scene even plaguing the rural areas. The domestic bottled water market (including organised and unorganised players) is estimated at Rs 8,000 crore. The bottled water market which has been growing at a CAGR of 19%, is expected to continue its growth momentum and grow over four-folds to Rs 36,000 crore by 2020 (Mukherjee, 2012). The industry is heavily dependent on ground water (onelitre bottled water = 1.8 litre of ground water) has become a competitor with the irrigation system.

The urgent need for reforms

The impact of groundwater pumping on agriculture in general and perennial horticulture in particular, is an example of what biologist Garrett Harden called “the tragedy of the commons.” The legal rules governing groundwater use is not strong and the law makers are yet to understand the ground reality. We have failed to eliminate the gap between law and science. In lieu of legal reform, we have shown limitless ingenuity in devising technological fixes for water supply problems. These so-called solutions have altered the hydrologic cycle in order to sustain existing usage. As our water use spirals upward, we must begin to rethink the economic structure by which we value our water

resources. At the same time, we must act to protect our rivers, springs, lakes, estuaries and wetlands from groundwater pumping. There is considerable urgency. Because groundwater moves so slowly, it may take years or decades of groundwater pumping before the effect on the environment is apparent. The hidden tragedy is that groundwater pumping which has already occurred will cause irremediable environmental damage.

To control the impact of groundwater pumping on the environment, we must combine a command-and-control model of government rules and regulations with the market forces of transferable rights and price incentives. Any meaningful reform must do two things: protect the rights of existing users by creating quantified water rights that are transferable and therefore valuable; and break free of the relentless cycle of increasing use by placing restrictions on individual freedom to pump groundwater. The law makers must take cognizance of the following issues to save the environment, orchards, water bodies and our future generations.

- Government rules and regulations deserve a prominent place in our reform efforts as we attempt to protect the environment. The government should undertake a number of very specific reforms.
- Even though water is a scarce commodity, most of us have not yet faced the condition that economists call scarcity, which occurs when people alter their consumption patterns in response to price increases. Our habits of water use will not change until the cost of water rises sufficiently to force an alteration. Therefore, we must increase water rates so that all users pay the replacement value of the water, which includes environmental impact cost. Economists agree that significant price increases would create incentives for all users to conserve. All farmers, businesses, or industrial and other users could then decide which uses of water to continue and which to curtail. Rate increases would encourage the elimination of marginal economic activities and the movement of water toward more essential and productive uses.
- The government should carefully craft water conservation standards. However, the experience of some western government with conservation standards sends a mixed message. If the government attempt to impose elaborate and detailed conservation standards, the regulated groups will fight tooth and nail over every sentence in the proposed regulation. This process can consume enormous amounts of time, energy, and money. The lesson for government is that it is better to embrace simple conservation standards that are easy to administer and implement. They are likely to have the most practical effect in terms of actually saving water and will avoid prolonged political struggle.
- The government should establish minimum stream flows and protect those flows from pumping of hydrologically connected groundwater. The legislature should authorize the State Departments of Environment and forestry, agriculture and horticulture to establish minimum water levels for streams and lakes to protect water resources. The minimum levels become appropriations within the prior appropriation system and offer protection against subsequent groundwater pumping.
- The government should prohibit the drilling of new wells in areas that are hydrologically connected to surface flows. Generally speaking, the farther a well is from a watercourse, the less significant the impact of groundwater pumping from that well will be. Government has two options to solve this problem: They can make the ban on wells near watercourses turn on a hydrologic analysis of the particular region, or ban on drilling wells within, for example, a mile of the river.
- Both the state governments and Panchayats should commit resources to purchasing and retiring groundwater rights to protect critical catchments, watersheds and habitats. For example, the catchment area of critical water bodies like Badatalab of Bhopal or Hessaraghatta and Tippagodanahalli lakes in Bengaluru, Sukna lake in Chandigarh, Pichola, Fatehsagar, Jaisamand and Rajsamand lakes of Udaipur, Husain and Himayathsagar in Hyderabad.
- Government should foster a market in water rights by allowing the easy transferability of rights from existing users to newcomers. Enormous quantities of groundwater are used for extremely low-value economic activities. State law must facilitate the movement of water from these uses to higher-value ones by establishing a water rights market as the mechanism for accomplishing this shift.

- The government should impose an extraction tax on water pumped from any well within a certain distance of a river, spring, or lake. This tax would have two benefits: It would encourage existing pumpers to conserve water, and it would create an incentive for new pumpers to locate wells farther away from watercourses.
- The government should not allow land developers to drill wells in an aquifer already under stress and land developers should not be allowed to source water from agricultural areas.
- The government, especially through panchayats, should use financial incentives as a significant part of water policy. Quite simply, we are not paying the true cost of water. When homeowners or businesses receive a monthly water bill from the utility, that bill normally includes only the extraction costs of drilling the wells, the energy costs of pumping the water, the infrastructure costs of a distribution and storage system, and the administrative costs of the water department or company. Water rates, with rare exceptions, do not include a commodity charge for the water itself. The water is free.
- Unplanned urbanization has forced cities to depend on rural areas for sourcing water supplies. The flow of water from rural tube wells to urban areas for meeting domestic and industrial water requirements of cities must be stopped
- Several crops which need huge quantity of water are grown for export like sugarcane, gherkins, tomatoes, capsicum, scented rice etc. These crops are exporting water more than the produce. The actual cost of water is not calculated while working out the economics. Growing crops for export purpose using groundwater is not justified when local populations are going to suffer from severe shortage of water. Such activities must be restricted.
- The government certainly has powers to impose location specific regulations on groundwater pumpers, yet there are two good reasons why it should not do so. First, it would provoke a bruising political battle. The political capital expended to win that fight could be better spent elsewhere. Second, the impact of groundwater pumping on the environment is nuanced and site-specific, depending enormously on the particular hydrologic characteristics of an aquifer. Imposing a uniform template on the nation is likely to exclude some pumping that should be regulated and to include some pumping that poses no serious risk of harm.
- The impact of groundwater pumping on the environment is enormous. And it is getting worse. As the drought that frequently grips the country, farmers, cities and individual homeowners are scrambling in search of additional water supplies. They have often focused on groundwater; indeed, well-drilling businesses around the country are booming. The drought has prompted the media to pay remarkable attention to water issues. A massive campaign to save water is the need of the hour.

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