

Water Crisis in Haryana

Current Status and Management Strategies

Rajbir Singh Khedwal¹ and Ankur Chaudhary²

College of Agriculture, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana 125004

Indiscriminate withdrawal of groundwater leads to a significant alteration in water availability for different water-consuming sectors such as irrigation, industrial and domestic purposes. The groundwater level in Kurukshetra, Kaithal, Bhiwani, Mahendragarh, and isolated patches in Fatehabad and Sirsa districts of Haryana is approaching more than 40 meters below the ground level and has been falling more than one meter every year since 2013 and now water table has reached to 20.67 meters in May, 2020. The annual groundwater consumption is more than the annual groundwater recharge rate in Haryana and adjoining regions viz. Punjab. The water deficit level i.e. difference in net annual groundwater availability to net annual groundwater draft is increased by 311% from 2004 to 2017. The State average decline in the water table is about 10.65 m from 1974 to 2019. Vigorous imbalance of water pumping and amount of natural recharge in several aquifers of Haryana along with over-reliance on groundwater for consumptive uses categories these aquifers as overexploited (55-78), semi-critical (5-21) and critical (3-21). Further, the monsoon rainfall has failed by six times in Haryana during the last ten years. If situation remains the same then potentially it can affect the social balance, food security and economic growth as aquifer depletion is mainly concentrated in a densely populated area and highly agriculture-based productive regions. Different water management techniques like in-situ conservation practices, artificial recharge, crop diversification with remunerative prices and; reclamation and recycling of waste water along with alternative efficient irrigation system (drip and sprinkler) can be employed to arrest the declining rate of groundwater. Further, industries also have a huge water demand that must be addressed to halt groundwater depletion.

Keywords: Groundwater level and depletion, Haryana Overexploited, Water saving crops

Introduction

India is the largest consumer of groundwater as groundwater contributed 60% of the Nation's supply. Groundwater has been recognized as the major water source in India for irrigation, domestic and industrial purposes. It is the most preferred source to meet the requirements of various user sectors due to its near-universal availability and low capital cost. Groundwater has made significant contributions to the growth of Indian economy and has been acknowledged as an important component of sustainable socioeconomic development. But over the years, there have been

overexploitation of groundwater. Water-logging, demand-supply gap, groundwater pollution due to industrial effluent disposal and the adoption of continuous rice-wheat (RW) cropping system and crops like sugarcane are mainly responsible for the drafting of groundwater. Cultivation of additional rice crop and early transplanting of rice in some areas has further aggravated the problem. Inadequate recharge due to erratic rainfall over the years and poorly distributed canal system with the disturbing equilibrium of subsurface hydrological regime is also the important factor contributing depletion of groundwater resources.

Because of high rates of extraction, groundwater availability is likely to be limited in the near future.

Water availability scenario in Haryana

Haryana is a water deficit state in surface and groundwater resources. The State is mainly occupied by the alluvial deposits (older and newer types), which cover around 98% of the state consists mainly of silt, fine to medium sand and clay particles. The State is sub-divided into nine physiographic units and is drained by two major rivers – Ghaggar and Yamuna. Total water requirement in Haryana is 20 million acre-feet (MAF). It receives around 2.3 MAF

water from the Yamuna River and Bhakra system, while, 12 MAF water is extracted using 8.48 lakh tube-wells (out of which 2.98 lakh are diesel and 5.50 lakh are electric operated). Annually, it still faces a shortage of 5.7 MAF water. Average annual rainfall of Haryana is 354.5 mm. Haryana had normal monsoon rainfall in 2018, as it has received 415.2 mm rainfall but during 2017, and has 25% deficit rainfall. In 2019, India had the wettest monsoon in 25 years; the State received 42% rainfall in the June-September period. Haryana witnessed 37 deficient monsoon rainfall during the period of 1901 to 2019. The situation is grimmer if the data of the last 10 years (2010-2019) is taken into account as monsoon failed six times (2012, 2013, 2014, 2015, 2016 and 2017) in Haryana. The shortage of water to meet the water requirements and erratic rainfall has led to the accelerated use of groundwater in Haryana.

Gravity of water depletion in Haryana

Groundwater level, particularly fresh groundwater zone is depleting at a faster rate due to over exploitation of groundwater associated with continuous RW cropping system. According to data, the State average decline in the water table is about 10.65 m from 1974 to 2019. More than three-fourths of the State's total area (about 76%) spread across 20 of the 22 districts has seen a dip in water levels since the last decade.

Estimates of groundwater depth in Haryana showed that the groundwater level is generally high in the southern parts and low in the north and north-east, which is a hilly tract. Broadly, the groundwater problem in Haryana has two dimensions; first is the rising groundwater table southern parts with low quality aquifers, leading to secondary salinization and waterlogging. Due to this, about 10% area of the state is under waterlogging conditions. The over abundance of canal waters and groundwater salinity as the extraction of groundwater is very less, has led to waterlogging in Rohtak, Sonapat and

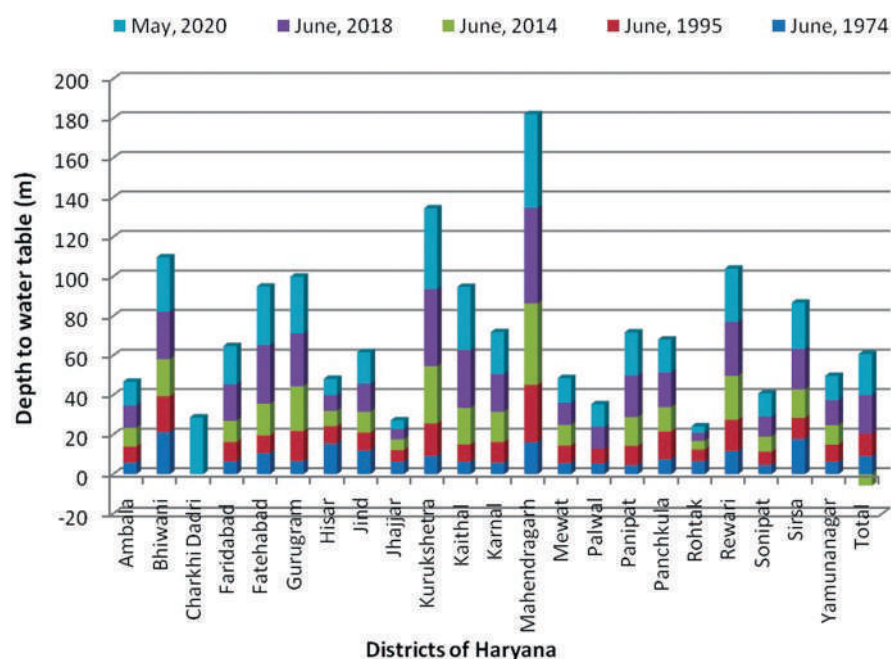


Fig. 1. Haryana's scenario for periodical depth to water table during 1974 to 2020

Jhajjar districts. The second aspect is declining water tables due to the over-pumping of groundwater in freshwater quality aquifer zones. Declining water table is alarming, particularly in paddy and sugarcane growing districts. As many as 20 districts witnessed an overall decline in the water level by more than 3 meters (m). Very deep water levels (more than 40 m) occur in 7% that falls in Kurukshetra, Kaithal, Bhiwani, Mahendragarh and; isolated patches in Fatehabad and Sirsa districts.

The data revealed (Fig. 1) that the average depth of water table among the districts of Haryana is increasing (1974-2014). The depth has nearly

doubled in Gurugram, Kurukshetra, Mahendragarh and Rewari. Concussively, the annual groundwater consumption is more than the annual groundwater recharge in Haryana (Fig. 2).

Annual groundwater draft for irrigation, domestic and industrial purpose has increased by about 31.5% in 2009 as compared to 2004 estimates (Fig 3). Reduction in annual groundwater draft from 2013 to 2017 was recorded due to reduction in the yield of wells. Furthermore, the deficit in water balance (net annual groundwater availability- annual groundwater draft) is increased by 311% from 2004 to 2017.

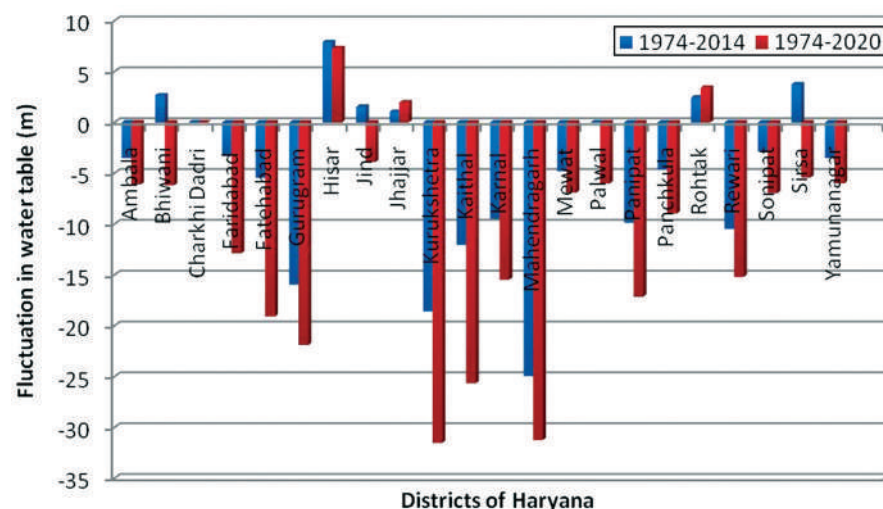


Fig. 2. Haryana's scenario for periodical fluctuation in water table during 1974 to 2020

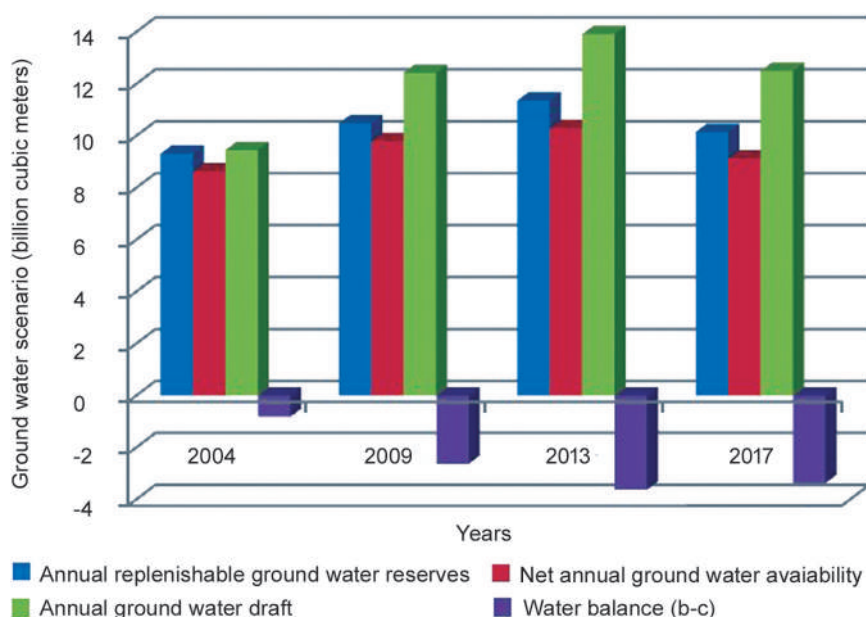


Fig. 3. Periodic groundwater scenario of Haryana from 2004-17 (billion cubic meters)

Zone-based demarcation

To capture the severity of depletion, it is common to categorize areas as being safe, semi-critical, critical and over exploited. A zone is termed to be 'over-exploited' if the pumping out of the underground water exceeds 100% (Table 1). Water table in Haryana is falling at an alarming rate year after year. As per a report (2017-18) of the Ground Water Cell, Agriculture and Farmer Welfare Department, Haryana, it is declining, on average, by 0.5-1 m every year in paddy-growing districts. Based on estimates of the Central Ground Water Board (CGWB), Haryana is staring at a severe water crisis with the groundwater depleting at a rapid rate and completely drying up in some areas (Fig 4). Districts in Southern, Western and North-Eastern regions are the worst-affected.

Deterioration of groundwater quality

The quality of underground water has also deteriorated as fluoride (Ambala, Bhiwani) were recorded in drinking water.

Causes of water crisis/depletion

The RW is an important cropping system under irrigated regions of Haryana.

The increased popularity of these crops due to minimum and assured support price may be attributed due to resilient and ensured market. Initially, at least, providing remunerative prices for rice and wheat was important not only for ensuring food security, but also to drain out excess water inundated due to unlined canals and to tackle inadequate drainage in the state. But intensive cultivation and expansion of area under paddy along with wheat over the years has resulted in a massive decline in the water level and become a primary cause of the

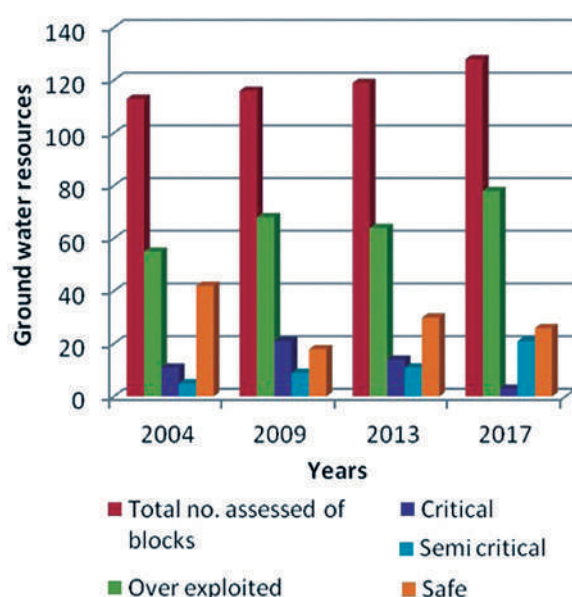


Fig. 4. Comparison between groundwater resource estimation during 2004-2017

Table 1. Basis of categorization of groundwater resources

Category of block	Withdrawal of groundwater against recharge (%)
Over exploited	>100
Critical	90-100
Semi critical	70-90
Safe	<70

Source: Groundwater cell, Government of Haryana

irreversible loss. An acre of paddy is required to be flooded around 26 times and 3,000-5,000 litres of water are required for 1 kg of rice produced. Apart from this water-guzzling cropping pattern, increasing number of submersible tubewells was also equally responsible for that. At the time of Haryana's formation as a separate state in 1966, around 1.96 lakh ha of land was under paddy cultivation, which went up to 14.70 lakh ha last year- a seven-fold hike in 50 years (Fig 5). Further, almost all paddy growing regions in Haryana are based on intensive puddling of the land area followed by transplanting of 25-30 days old seedlings. There is an urgent need for artificial recharge and rain-water harvesting in the state. The subsidies based electricity-driven pumping has also resulted in an unintended increase in groundwater use for irrigated agriculture. Increase in water logging areas in central Haryana due to the salinity and intensive canal-based irrigation. Groundwater is polluted due to industrial effluent disposal without proper treatment. Further, even at village scale disposal of untreated sewerage directly in community-based water body/storage structures (*Joahd*). A study has shown that more than 50% of Panipat district having high fluoride (1.6/ mg/L) concentration in groundwater and is comparatively higher in western parts. The prolonged intake of fluoride concentration could lead to dental or skeletal fluorosis in the locals. Similarly, in the Bhiwani region total dissolved solids (1,692-2,560 mg/l), total alkalinity (442-

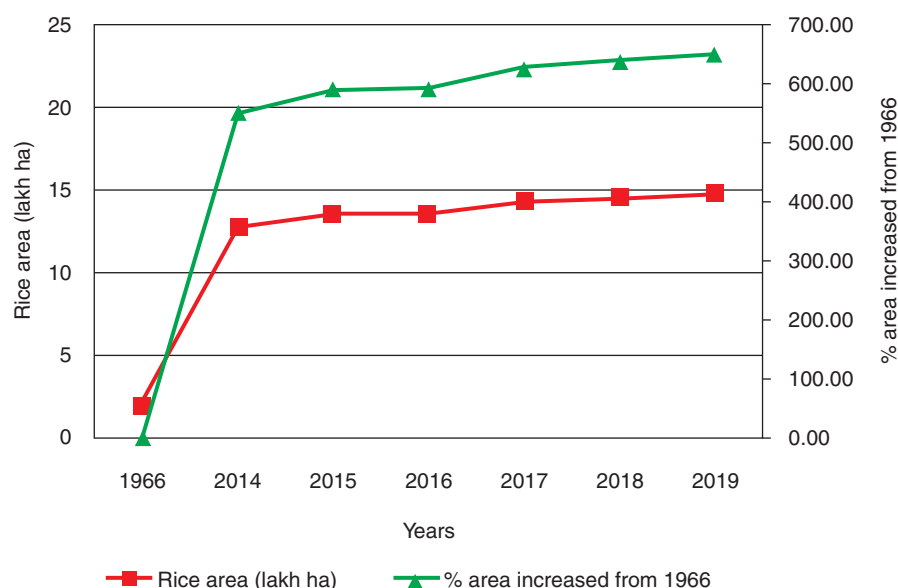


Fig. 5. Scenario of rice cultivated area (lakh ha) in Haryana

1,232 mg/L), bicarbonate (554-672 mg/L) was also higher than the maximum permissible limit. Even maximum fluoride concentration (86.0 mg/L) was recorded from Motipura village from Haryana. High to a very high concentration of geogenic contaminants in groundwater such as fluoride and salinity, unavailability of treated water supply is also the main problem in Jhajjar district. The contaminated water is also causing an economic burden to the villagers/locals in terms of expenditure on health.

Mitigation water crisis challenges in Haryana

Government interventions/policies to mitigate water crisis

Sincere efforts have been made by State Agriculture Department as per available resources to arrest the depletion of groundwater levels across the State. The schemes like underground pipeline system, establishment of sprinkler irrigation system in south-western regions of the State, watershed management schemes in rain-fed as well as flood-prone for need-based soil and water conservation activities, recommendation and subsidized availability laser land leveller for precision land levelling and roof-top rain water harvesting (Table 2). Further, a major initiative was taken with the formation of “The Haryana State Preservation of Sub Soil Water

Act, 2009” that has been enacted and according to which sowing of paddy nursery before 15 May and transplanting of paddy before 15 June is prohibited. This act has been quite successful in checking the exploitation of groundwater especially in paddy growing areas. Recently, the state government announced a programme “Mera Pani Meri Virast” to save water for the future generation. According to it, farmers get ₹ 7,000/acre to change the rice (paddy) with less water

requirement crops like maize (makka), pigeon pea (arhar), black gram (urd), clusterbean (gwar), cotton (kapas), pearl millet (bajra), sesame (til) and green gram (summer moong). However, timely providing of inputs and monetary awards are required to motivate the farmer for adopting such kinds of practices during the initial years.

Adoption of best water conserving agronomic practices

There is an urgent need to increase water productivity by adopting environmentally and resources friendly alternative crops and cropping systems as a substitute for rice. Direct Seeded Rice (DSR) saves about 15-20% of water and save more than ₹ 3,000 (preparatory tillage practices, transplanting) per acre. Direct Seeded Rice was proposed as cost-saving technology to diminish the accelerated groundwater depletion as it eliminates water-guzzling puddling operation, besides reducing intensive pressure on labour availability (Table 3). The losses through evapotranspiration and soil percolation are more in irrigated puddled transplanted rice.

The resource-conserving

Table 2. Important groundwater issues of Haryana and remedies

Issues/Problems	Remedies
Groundwater depletion (in fresh groundwater quality area)	- Establishment of legal measures as “The Haryana State Preservation of Sub Soil Water Act, 2009” has been quite successful in checking the exploitation of groundwater in paddy growing areas. - State government announced a programme “Mera Pani Meri Virast” (May 2020) to save water for future generation. - Under different projects funded by ICAR, CSSRI got installed water recharge systems in farmers’ fields to conserve rainwater. - For improving water table, Atal Bhuajal Yojana (funded by World Bank) - Underground Pipe Line system
Waterlogging (central Haryana due to salinity and intensive canal irrigation)	Rejuvenate the sub-surface drainage and judicious use of irrigation water; grow salt-tolerant crops, proper drainage system
Demand-supply gap (non command area)	Use water-saving devices (underground pipeline system), rain-water harvesting structures on the farm. Irrigation scheduling based on crop-soil climate relationships.
Groundwater pollution (industrial effluent disposal without treatment)	Setting up of sewage treatment plant; reuse of drainage water
Cultivation of water intensive crops (rice and sugarcane) in fresh ground water area	Cultivation of low water consuming crops, promotion of micro-irrigation systems i.e. sprinkler, mini-sprinkler and drip irrigation systems.



Fig. 6. Iron deficiency under DSR



Fig. 7. Field view of DSR (45 DAS)

technologies such as reduced tillage, laser land levelling, no-till with residue retention, brown manuring, nutrient management tools as leaf colour chart, SPAD, Green Seeker, sub-surface drip irrigation in wheat under RW have been validated under irrigated conditions in the Indo-Gangetic Plains can be employed to restrict the rate of groundwater depletion.

Management strategies

Keeping in view the degradation of groundwater resources, it is essential to optimize the utilization of

groundwater resources. The following management strategies should be considered to tackle the problem:

Water conservation practices

The efficient on-farm management of groundwater is very important. It is essential to improve the water use efficiency by strengthening bunds land levelling, cleaning of field channels, adopting proper architect of irrigation plots depending on slope, soil physical conditions and drainage. The depth and time of irrigation of different crops should be

optimized.

Artificial recharge

Artificial recharge by water spreading water injection in the wells, accumulation of water in a stream, drains and pits should be adopted to replenish the receding groundwater resources. However, depth for artificial recharge should be precisely determined as it may lead to contamination of groundwater due to direct contact.

Crop diversification

Continuous adoption of RW cropping system in more than three decades leads to a tremendous decline in the water table of groundwater. Thus there is an urgent need for having remunerative crop diversification options to replace RW cropping system. During the *rabi* wheat can be replaced by oilseed, winter maize and in the *kharif* season rice can be replaced by pulses.

Reclamation and recycling of waste-water

A large amount of industrial effluent sewage water is produced and their disposal is a great problem. However, these can be used for irrigation after suitable treatment such as primary, secondary and tertiary treatment. This treatment considerably decreased the toxicity hazards making it suitable for irrigation and can also be used efficiently for forest plantation.

Table 3. Agronomic practices for Direct Seeded Rice (DSR)

Particulars	Practices
Suitable soils	DSR feasible only in the medium to heavy textured soils. Its' cultivation is not successful in light-textured soils due to severe iron deficiency and higher weed infestation resulted in lower crop yields.
Laser levelling	Laser levelling improves irrigation water use efficiency and ensures better germination. Plough the field twice with disc harrow followed by cultivation with cultivator and planking, then level the field with laser leveller.
Suitable varieties	PUSA Basmati 1121, PUSA Basmati 1, Short (PR 126) and medium duration varieties
Sowing time	1-15 June
Seed rate and method of sowing	Sow the crop with rice seed drill fitted with inclined plate metering system. Lucky seed drill (for simultaneously sowing and spray of pre-emergence herbicide) using 8-10 kg seed/acre in 20 cm spaced rows in a dry field or a moist field after <i>rauni</i> (irrigation given for seed-bed preparation) irrigation. The seed should be placed at 2-3 cm depth.
Weed control	Application of pre-emergence pendimethalin followed by bispyribac sodium (at 15-25 days after sowing)
Spray for Iron deficiency	If iron deficiency appears, start giving copious irrigations as soon as chlorosis appears and give 2 or 3 sprays of 1% ferrous sulphate solution per acre at weekly intervals (Fig 6 and 7).

Alternate/pressurized irrigation system

More efficient irrigation systems like drip and sprinkler irrigation methods can be adopted for saving water and also to utilize the saline/sodic water for cultivating crops.

Future prospects

With this rate of groundwater exhaustion, Haryana is likely to face a water crisis in 15-20 years. Due to climate change, rainfall pattern has become skewed and erratic. Therefore, there is an urgent need to collectively undertake water budgeting to address the concerns of water scarcity. The groundwater extraction associated with subsidized electricity for pumping needs to be

reevaluated for energy-water nexus as day by day, it is reducing the capacity of aquifers to serve as a buffer against current situations or future under heat and drought scenarios. Fine tuning of agronomic practices under DSR is urgently needed as the development of competitive rice cultivars of short duration that can perform better under a low iron environment. Crop diversification options need to be developed with competitive market prices and more economically secure than the prevailing RW system. Practices like zero-tillage with residue retention can also reduce the water footprint by omitting irrigation and unnecessary under RW system. However, it could

cause more infiltration and may aggravate iron deficiency associated with increase the aerobic environment in the rice rhizosphere under DSR. The community-based management of aquifers and sustainable management of surface water bodies are urgently needed to prevent water pollution and infestation of water hyacinth in water bodies. Further, regular assessing of the groundwater is required to minimize public health risks.

¹Technical Assistant, Scientist. Corresponding e-mail: rajbirsinghkhedwal1524@gmail.com
²Assistant



HANDBOOK OF HORTICULTURE

VOLUME 1 & 2



The Indian Council of Agricultural Research has brought out the Second enlarged and revised edition of the Handbook of Horticulture. Horticultural crops are gaining more and more importance as they have been instrumental in improving the economic condition of the farmer and contributing significantly to the national GDP. This new revised edition has been divided into 2 volumes – Volume 1 contains General Horticulture and Production Technologies (Fruit, Vegetable and Tuber crops) and Volume 2 has Production Technologies (Flower, Plantation, Spices crops and Medicinal and aromatic plants), Plant Protection and Post-harvest Management. The earlier chapters have been thoroughly revised and new chapters have been added. It is hoped that the readers will find this Second edition more useful and informative.

Technical Specifications

Pages : i-xxxiv + 1-682 (Vol. 1)
i-xxiii + 683-1218 (Vol. 2)

Price : Rs 2000/- (Vol.1 & 2) • Postage Rs 200/- • ISBN : 978-81-7164-187-1

Copies available from:

Business Unit

Directorate of Knowledge Management in Agriculture (DKMA)

Indian Council of Agricultural Research

Krishi Anusandhan Bhavan, Pusa, New Delhi 110012

Tele: 011-25843657; e-mail: bmicar@icar.org.in, businessuniticar@gmail.com

