Chronicle of Bioresource Management 2024, 8(2): 067-073

Chronicle of Bioresource Management
An International E-magazine

June, 2024 | Popular Article

Open Access

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Citation: Shahane and Shivay, 2024. Topical Issues and Concerns of Agriculture in India - An Overview. Chronicle of Bioresource Management 8(2), 067-073.

Data Availability Statement: Legal restrictions are imposed on the public sharing of raw data. However, authors have full right to transfer or share the data in raw form upon request subject to either meeting the conditions of the original consents and the original research study. Further, access of data needs to meet whether the user complies with the ethical and legal obligations as data controllers to allow for secondary use of the data outside of the original study.

Conflict of interests: The authors have declared that no conflict of interest exists.

Keywords:

Conservation, diversification, food security, nutritional security

Article History

Article ID: CBM5209a
Received on 10th February 2024
Received in revised form on 25th April 2024
Accepted in final form on 07th May 2024

Topical Issues and Concerns of Agriculture in India - An Overview

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Abstract

Indian agriculture is under the triple burden of degrading natural resource base and increase in the process of purchased inputs, increase in demand for food and feed at affordable cost, and nutritional security of humans and animals in a climate-changing scenario. Hence, despite several innovations and interventions that have taken place, agriculture continuously has several issues and concerns to be addressed to fulfil the demand and expectations. The major concerns in Indian agriculture are defined in terms of food, nutritional and economic security, conservation of plant genetic resources, reducing soil erosion, regulation of seed, input and credit supply system and implementation of a holistic approach to resource management of the agriculture. Besides, agriculture has prospects which include organic, natural and self-resilient farming, changes in the input supply system and marketing system due to interventions such as farmer producer organization, diversification and ecological quantification of agro-ecosystem, energy farming and achieving net zero emission by 2070.

1. Introduction

Indian agriculture is moulding third time starting from the commodity-based revolution including the green (wheat) revolution in the 60s and 70s followed by agricultural development in the area and commodities neglected during the green revolution (such as pulses and oilseed crops and other commodities such as milk, eggs, fruits, etc.) along with the concept of evergreen revolution in 80s and 90s. At present, Indian agriculture is in another moulding with a large diversity of aspects and sectors for improvement. These aspects/sectors are secondary agriculture (Yadava et al., 2020), diversification and value addition, resource use efficiency, food safety, nutritional security and conservation and efficient utilization of genetic resources and most importantly being considered increasing the farmers' income (Anonymous, 2017). At the same time, agriculture become more vulnerable in years to come due to climate change and this is more intense for rainfed agriculture. The income enhancement through improvement in productivity per unit area is now achieving the cap and for this purpose, the alternative

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Journal Home: *https://ojs.pphouse.org/index.php/CBM*

strategy/avenues need to be stressed. This includes reducing the investment on purchased inputs, resource conservation technology, value addition, and product diversification and utilization of waste or by-produce more economically for productive activity. As agriculture is growing on finite resources very rapidly, several changes were observed in these natural resources over time making them either less supportive of agricultural production or in certain cases completely degrading these resources. The resource degradation of land is more emphasized followed by degradation of water sources, genetic resources, and degradation of artificial resources through their less use efficiency. During all these improvements in agriculture, several issues are raised and few of them are highly serious making them concerns. This article discusses different challenges, issues and concerns of present-day Indian agriculture along with future prospects.

2. Issues and Concerns of Indian Agriculture

2.1. Challenge to meet the fast-growing needs of provisional services and goods of India

The current population of India is 1.405 billion (17.7% of the world population) with a cattle population of 535.8 million (nos.) (7.28% of cattle, 21.23% of buffalo, 26.40% of goats and 12.17% of sheep out of total world population) for which different goods and services is catered by Indian agriculture. This is met by finite and degrading resource bases such as 2.4% of the world's arable land, 4.2% of the world's freshwater resource and an increasing negative balance of nutrients in the soil with 9–10 million tonnes at present (NAAS, 2018). The population pressure of both human beings and animals is expected to grow in the future and hence increasing the production from a limited land area to meet the growing need for an increasing population of human beings and animals is at biggest challenge.

2.2. Nutritional security through nutritious food/fodder supply

India has achieved a significant increase in production and moving towards self-reliance with net export of several agricultural commodities including food-grain crops such as rice. With the majority of are under cereals crops in India and the dominance of cereal – pulse – vegetarian diet (Nair and Augustein, 2018), there are several issues of nutrition among the Indian population. Besides that, the lower purchasing power of the population below the poverty line (21.9% out of the total population as per the 2011 census) and the increasing population in peri-urban and slum areas with lower levels of nutritional food and income again aggravate the situation. Therefore, the release of bio-fortified varieties (Yadava et al., 2017 and 2020) are one such attempt to initiate the process (Table 1).

2.3. Development of effective marketing infrastructure and perfect market

Market perfection is another aspect which needs to be addressed especially for small and marginal farmers considering the small quantity of their produce. The regulations in markets help in getting better returns to the farmer besides the assured and timely sale of crop produce. The market perfection is the most essential and urgent in the case of perishable commodities. In infrastructure development, facilities of cold storage as well as facilities for normal cost-effective storage to the farmers will help in getting higher returns and avoiding distressed sales of farmer produce.

2.4. Diversification of monotonous cereal-based cropping system

The cereal crop occupied 50.55% of the total gross cropped area in 2016–17. These cereal crops are heavy feeders of nutrients due to their higher yield and their residue also has a large number of uses (Shahane and Shivay, 2016), thereby reducing crop residue availability as a source of nutrient inputs. The promotion of the cultivation of cereals during the 60s and '70s to meet the national food demand, continuing the same area under cereal cultivation leads to adverse effects on the ecosystem. Cereal crop cultivation causes an adverse impact on the soil resources as well as the sustainability of the crop/cropping system (Timsina and Connor, 2001). The diversification of the cereal-based cropping system (rice-wheat cropping system) was taken at the policy level under Rashtriya Krishi Vikas Yojana in the sub-scheme "Crop Diversification Programme". In this scheme, it is expected to diversify 5% rice cultivation area to other crops.

2.5. Regulation of the distribution of quality seeds of suitable varieties and enhancing the seed replacement ratio

The seed is the basic input of agriculture and ensuring the timely availability of quality seed of improved varieties is considered as the first requirement for higher productivity of agriculture. The seed production in India at present is 383.72 lakh tonnes. The seed replacement

Table 1: Bio-fortified varieties released in India

Sl. No.	Crop	Variety
1.	Rice (concentration in polished rice)	DRR Dhan-45 (22.6 ppm Zn), DRR Dhan-48 (24 ppm Zn), DRR-Dhan-49 (25.2 ppm Zn), Zinco Rice MS (27.4 ppm Zn), CR Dhan-311 (20.1 ppm Zn), CR Dhan-315 (24.9 ppm Zn)
2.	Rice (Brown rice)	High iron rice and improved Chittimuthyalu (30.1–35.0 mg Zn/kg brown rice)
3.	Wheat	WB-02 (42.0 ppm Zn and 40.0 ppm Fe), HPBW-01 (40.6 ppm Zn and 40.0 ppm Fe), Pusa Tejas (HI 8759 Durum wheat) (42.8 ppm Zn and 41.1 ppm Fe), Pusa Ujala (HI 1605) (43.0 ppm Fe), HD-3171 (Zn 41.7 ppm), HI-8777 (48.7 ppm Fe and 43.6 ppm Fe), MACS-4028 (durum) (46.1 ppm Fe, 40.3 ppm Zn), PBW-757 (42.3 ppm Zn), DWR-187 (Karan Vandana (43.1 ppm Fe), DWR-173 (40.7 ppm Fe), DDW-47 (40.1 ppm Fe), PBW-771 (41.4 ppm Zn), HI 8805 (durum) (40.4 ppm Fe), HD-3249 (42.5 ppm Zn), MACS-4058 (durum) (39.5 ppm Fe and 37.8 ppm Zn), HD-3298 (43.1 ppm Fe), HI 1633 (41.6 ppm Fe and 41.1 ppm Zn)
4.	Wheat (Study of 180 Indian landraces from NBPGR, New Delhi	Six landraces with higher amounts of Fe and Zn out of 180 Indian landraces of wheat from NBPGR, New Delhi: IC-532310 (54.5 ppm Fe and 48.2 ppm Zn), IC-82377 (53.8 ppm Fe and 50.0 ppm Zn). IC-79062 (51.3 ppm Fe and 56.0 ppm Zn), IC-82198 (38.7 ppm Fe and 46.8 pm Zn), IC-532790 (51.4 ppm Fe and 44.2 ppm Zn) and IC-534884 (39.8 ppm Fe and 42.7 ppm Zn)
5.	Maize (studied the Fe and Zn concentration in 60 different genotypes for three years)	CM-140 (43.79 mg Fe/kg), HP-3 (54.29 mg Fe/kg) and CM-212 (49.24 mg Fe/kg) BAJIM-06-6 (29.88 mg Zn/kg), V336 (22.01 mg/kg) and BAJIM-06-10 (26.45 mg/kg)
6.	Pearl millet	HHB-299 (73.0 ppm Fe, 41.0 ppm Zn), AHB-1200 (77 ppm Fe and 39 ppm Zn), AHB-1269 (91.0 ppm Fe and 43.0 ppm Zn), ABV-04 (70.0 ppm Fe and 63.0 ppm Zn), Phule Mahashakti (87 ppm Fe and 41 ppm Zn), RHB-233 (83 ppm Fe and 46 ppm Zn), RHB-234 (84 ppm Fe and 46 ppm Zn), HHB-311 (83 ppm Fe and 39 ppm Zn)
7.	Sorghum	Zn concentration in grain for the mean of parent (IS2248 x IS 20843) is 55.46 mg/kg. Fe concentration in grain for mean of parent (ICSB 52 x SPV 1359) is 50.17 mg/kg.
8.	Finger millet	VR-929 (Vegavathi) (131.8 ppm Fe), CFMV-1 (Indravati) (58 ppm Fe, 44 ppm Zn), CFMV-2 (25 ppm Zn and 39 ppm Fe),
9.	Little millet	CLMV-1 (59 ppm Fe and 35 ppm Zn)
10.	Lentil	Pusa Ageti Masoor (65 ppm Fe), IPL-220 (73 ppm Fe and 51 ppm Zn)
11.	Chickpea	Heera, H82-2 and H214: Zn content > 4 mg/100 g and L550, KGD1168, PG114, JG74 and ICCV6: Fe content > 6 mg/100 g
12.	Pigeonpea	Hiasr HO2-60 (46.6 kg Zn/kg), Hisar Manak (44.2 mg Zn/kg) (among 20 genotypes evaluated)
13.	Black gram	Shekhar 2 (100.2 ppm Fe and 60.58 ppm Zn), Yakubpur Early (98.99 ppm Fe), PDU-1 (57.94 ppm Zn) (among 26 genotypes studied)
14.	Cowpea	KBC-6 (41.8 ppm Zn and 150.2 ppm Fe) and PGCP-6 (48.6 ppm Zn and 137.2 ppm Fe) (among 200 genotypes evaluated)
15.	Green gram	Ganga-8 (106.15 mg Fe/kg and 23.41 mg Zn/kg), ML-776 (85.10 mg Fe/kg and 40.46 mg Zn/kg) (among 16 genotypes screened)
16.	Lentil	L-4704 (136.9 mg Fe/kg and 71.69 mg Zn/kg), VL-141 (101.8 mg Fe/kg and 81.54 mg Zn/kg) (among 41 elite lines screened)
17.	Groundnut	ICGV 06099 (57 mg Fe/kg and 81 mg Zn/kg) and ICGV 06040 (56 mg Fe/kg and 80 mg Zn/kg) (among 64 genotypes screened)

ratio of rice, wheat, and maize is higher; while in the case of other crops, it is still low. Besides supply, the seed needs to be available at an affordable cost and on time. The awareness about faulty practices by private firms, awareness about seed purchasing and filing complaints if any defaults are found and is needed among the farmers and other stakeholders. At the same time, seed supply and development of new varieties is also a dynamic and regular programme. Considering all these issues, seed industries need prime attention.

2.6. Conservation of local landraces of crops

The local landraces as well as traditionally grown varieties are adapted to environmental conditions. The diversity of local varieties is an important asset for breeding suitable varieties to address present and future problems. In this context, it is a must to ensure the conservation of these varieties. Along with their conservation, the right to these varieties by local people needs to be protected and their use by any firm for making profiles needs to be regulated. The act such as the Protection of Plant Variety and Farmer Rights Act (2000) gave strength to farming and local residents to keep their hold on such plant resources. These natural resources need to be conserved and prevention of their erosion needs to be avoided.

2.7. Implementing the holistic approach in management practices and input addition such as integrated pest/ disease/ nutrient/ weed management

The fate of a single method of management is clearly seen from excessive dependence on agrochemical-based methodologies for biotic stress management as well as dependence on chemical fertilizers for crop nutrition. As both agrochemicals and fertilizers are purchased inputs, they also increase the cost of cultivation. As suitability and efficacy of these purchased inputs change with the soil, water, plants and socio-economic condition of farmers. Therefore, the combination of different methodologies which economically viable, ecologically sustainable, technically sound and socially acceptable will be the best option for agricultural development. The major concerns in acceptance of IPM are its dynamic nature in time and space dimensions and awareness about the suitable IMP strategy as well as sometimes being less efficient than the single most efficient methods (mostly chemical methods).

2.8. Increasing the availability of credit facilities on time and making a target-oriented decision-making policy for subsidizing the crop produce

Although the credit facilities are available even though, the indebtedness of marginal farmers is a matter of concern. This can be seen from loan waiver schemes and the increasing importance of crop insurance schemes for farmers. Besides that, uniformly subsidizing the inputs was not a good strategy as this will reduce the share of marginal needy farmers in subsidy. The malpractices were also expected in delivering the subsidy to farmers. This concern can be addressed by subsidizing the agro-inputs for farmers having marginal farmers through direct benefit transfer (DBT) schemes.

2.9. Increasing the number of enterprises in farms and also increasing the diversity of enterprises

The income from growing arable crops is significantly affected by weather calamities and market conditions besides production practices. The increasing cost of purchased inputs also reduces the net returns from arable crops. In this context increasing the number of enterprises heals increasing the net returns besides the efficient use of natural resources in agriculture. The concept of an integrated farming system (IFS) is the need of the hour and it is more realistic in hilly areas (NEH region) due to several problems for arable crop cultivation.

2.10. Effective utilization of marginal and degraded land through energy plantation and agro-forestry

In India, marginal land is not suitable for the cultivation of arable crops and is less productive. As most of this land lacks land ownership and the area is extended over a large area, the developmental scheme for these areas remains unimplemented. At the same time, uncontrolled cutting of natural vegetation leads to exposure of soil to different types of land degradation and makes the area again non-productive and these are considered major concerns of marginal land.

2.11. Degradation of natural resources and their conservation

The degradation of natural resources mainly soil is at an alarming rate. The degradation of all physical, chemical (present 6.32 million ha area is salt affected; while the area affected due to acidity is 17.9 million ha) and biological properties leads to reducing the productive potential of agricultural land and raises the concern of sustainability of the agro-ecosystem. Besides soil, the losses of rainwater are another concern; while construction of medium and large dams and other water reservoirs helps in reducing the losses to a great extent. In the case of plant resources, the degradation is seen by reducing the number of

crops grown as well as the narrow genetic base of the varieties grown. This increases the risk of crop failure and the entire area will fall susceptible to a single pest or disease. As these resources are finite, their degradation endangers the entire agro-ecosystem in India and the world as a whole. The conservation of these resources is constrained by the fact that, there is no short-term increase in monetary returns to the farmer as well as the higher cost required for implementing conservation programmes. Another concern in conservation is the requirement of group action and attempts by individual farmers or stakeholders will not serve the purpose.

2.12. Losses of crop produce

The losses are very high in the case of vegetables and fruits with an ever-growing population and lack of access to nutritious food for the section of people, India can't afford such losses. The seasonal nature of crop produce, higher production, and time and monetary requirements for the distribution of perishable commodities again increase the extent of losses of agricultural produce making it an important concern in agriculture.

2.13. Need to emphasize the processing and value addition

The production of vegetables and fruits in India is 189.46 and 100.45 million tonnes, respectively, and being perishable in nature, they need to be utilized within a very short period. This creates scope for processing and value addition. The value-added products also had large demand in the international market thereby increasing the export potential. This processing and value addition is explained by the term 'secondary agriculture'. Secondary agriculture is defined as a productive activity at the enterprise level that, 1) Utilises as raw material the primary product and by-products of agriculture and other biological resources available locally in its rural agrarian neighbourhood; and/or 2) Deploys locally available skills or high-level of rural manpower, to operate/manage/maintain the production of goods and services and 3) Can be categorized appropriately under the micro, small or medium enterprises development (MSMED) Act 2006 (Anonymous, 2018). It has scope in India considering its present level of production from agriculture and allied sectors, workforce involved in agriculture, and domestic market for raw and processed products.

2.14. Entrepreneurship development in input production

Agriculture is viewed as a business model for input production for organic farming and natural farming. As the area under organic farming and natural farming increases rapidly, the requirements of inputs such as manures, bio-fertilizers, bio-pesticides, etc. are increasing rapidly. At the same time, such a business model helps in increasing the income of farmers. The major concerns for the development of such entrepreneurship are a lack of trained human resources and a lack of awareness about the potential of such new enterprises among the farmers.

2.15. Research and development as well as policy initiative of efficient use of genetically modified crops in agriculture

The utilization of genetically modified (GM) crops is constrained by a lack of socio-economical acceptance and concerns about environmental hazards. The non-availability of seeds through public distribution, increased dependence on multinational companies (MNCs), and the possibility of excluding the traditional varieties are the other concerns for the adoption of GM crops in India. The area under GM crops in India is 11.75 mha; while in the world it is 190.4 mha.

2.16. Development of different agricultural practices, management options and input addition which has the potential for mitigating and adapting to changing climate

Climate change is significantly affecting agriculture and evidence of decreasing crop yield and increasing events of natural abnormalities are proof for the same. In such a situation, adaptation strategies such as the development of climate-ready crops and their other measures such as shifting of crop cultivation zones are major concerns for future agriculture. The identification of the potential of different agricultural measures for mitigation and adaptation to climate change of also a concern to shape the future of agriculture.

2.17. Enhancing the nutrient and water use efficiency in agriculture

The nutrient use efficiency for nitrogen, phosphorus and potassium is ≈ 40%, 15–20% and 45–50%, respectively; while in the case of micronutrients, efficiency hardly exceeds 2%. For water, the overall project efficiency of irrigation projects in India is still below 35–40%. This shows the amount of nutrients and water that get wasted. Besides waste, the nutrients and water lost through the system also create secondary problems of pollution of water and air, degradation of soil physical health as well as global warming. Hence, attempts to increase the use efficiency of nutrients and water is a win-win situation for India.

2.18. Need for increasing attention on the new concept such as precision agriculture and their effective implementation

At present day precision agriculture is strongly dependent

on geo-informatics tools such as global positioning systems, geological information systems, remote sensing, as well as sensor-based technologies, their adaption is constrained by lack of expertise. As precision agriculture has a significant impact on resource use efficiency, its adoption is needed today or tomorrow and hence concerns of expertise and methodologies for implementing these new technologies in farmer-friendly mode are need of the hour.

2.19. Use of artificial intelligence in agriculture for automation of different agricultural operations

The increasing productivity of research in agriculture through client-oriented research and promotion of on-farm research is another concern in Indian agriculture that needs to be addressed to increase the adoption of agricultural research.

3. Future Prospects of Agriculture in India

3.1. Way for genetically modified (GM) mustard

In India, cotton is the only crop-approved GM variety; testing of GM mustard has been going on since 2013–14 and different scientists from India are actively involved in the development of GM mustard. India is having a shortage of edible oil and this can be addressed to such improvement in the mustard breeding programme soon.

3.2. Energy farming

Energy farming is possible in two major ways. The use of solar panels to capture sun energy and use it to run the different electric machines is the first way and this can be possible in most of India due to clear sunshine round the year. The second way deals with the production of biomass through the planting of multipurpose tree species (MPT) and fast-growing trees (energy plantation). Both energy harvesting will play a significant role in future agriculture due to energy scarcity.

3.3. Net zero emission by 2070

India is committed to reducing the emissions to zero by 2070 and in this process, agriculture will play a significant role considering its capacity to capture the carbon. The varieties of avenues are available and new avenues will be created in days to come.

3.4. Natural resource conservation

At present natural resources are degrading very rapidly and there is a need to take action to reduce their degradation. This will be going on as long as a restoration of natural resources and needs consistent efforts.

3.5. Ecological quantification

The evaluation of the crop production process in economic terms in the early days and in terms of energy at present will not be sufficient considering the degradation of the natural resource base. The concept of ecological quantification which involves the quantification of provisional and ecosystem services produced as well as the footprint of crop production expected to be evaluated.

3.6. Significant change in marketing due to farmers' producer organization

The Indian Government is giving strength to farmer's producer organizations (FPOs) to provide effective capacity building to FPOs to develop agriculture entrepreneurship skills to become economically viable and self-sustaining beyond the period of support from the government.

3.7. Self-resilient farming

The self-resilient farming signifies farming in which the farmers are self-sufficient in the production of inputs for their farm. In this context, farming is done for both the production of input required from crop cultivation/ animal rearing and the generation of output in terms of crop or animal produce. The significance of self-reliant farmers was significant importance during the COVID-19 pandemic in 2020. The attempts to make farms self-reliant help in reducing the role of external forces in agricultural activities.

3.8. Diversified form of farming

The demand for goods and services from the agriculture sector is getting more diverse and in this regard, there is an emerging trend of getting more diverse farm activities. These diverse forms of agriculture include organic farming, conservation agriculture, integrated farming systems, energy farming, biodynamic farming, urban farming, and natural farming.

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