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Status of the use of Organic Fertilizers in India: A Review

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ABSTRACT

This research paper aims to identify the emerging trend and prospects of organic farming throughout the world. This paper also gives stress on the usage of organic fertilizer in India. India is a country with huge climate diversity hence different regions of the country have different agricultural climates. The diverse agro-climatic on the country has a direct impact on the natural nutrients of soil which are the key source of soil nutrition for organic cultivation. India covers 1.18 mm hectares of organic agriculture land which led the county on the 9th position globally in 2014-15. In this total organic area, 26% of the land is cultivable and rest 74% is covered under the forest or wild land. In the same year Himachal Pradesh, Madhya Pradesh and Maharashtra have been identified as having most organic agriculture area regions in the country. The country also has a leading position in organic production with consent increment in the organic producers throughout the globe. In the year 2014-15, the county has 0.55 mm producers which led the country on the first position in the world. The country exports more than 135 products including basmati rice, cotton and oil corps. In this review, paper research had tried to analyze the significance of organic farming, export and marketing of organic products in the country. Consumption and production of organic fertilizers in the county also have been discussed in this article.

Key words: Bio-fertilizers, Global scenario, Organic farming, PGS (Participatory Guarantee System).

In recent years, emerging trends of a healthy lifestyle are increasing the uses of agricultural food production which gives immense pressure on the increasing rate of agriculture products and crops. To production maximization, producers or farmers are widely using agrochemicals and agriculture fertilizers and obtaining high yield of crops. The use of chemicals in agriculture is increasing which is effecting adversely to soil and water supplies and leading high soil acidification and groundwater contamination. Moreover, the chemical fertilizers show its ill-effects on friendly micro-organisms and insects, making crops more prone to the attack of diseases, sinking soil fertility and causing irreversible damage to the overall land system. Thus, there is a need to explore substitute of chemical fertilizers for crop yield and food production without any further negative impacts on the global environment to support the growing world population.

Organic farming is one of the best approaches to achieve the goal of sustainable agriculture. Therefore the exploitation, development and application of organic fertilizers or biofertilizers will meet the purpose (Mishra *et al*., 2013), (Agganis, 2013). Organic fertilizers are a cost-effective, eco-friendly and renewable source of soil nutrients that play an important role in maintaining long term soil fertility and sustainability (Agganis, 2013), (Xiang *et al*., 2012). Organic fertilizers are an essential component of organic farming. The method of organic farming is not a newfound technology at all. Organic farming practices have been followed ever since the cultivation of crops in most ancient civilizations. The term organic farming was introduced by Lord Northbourne in 1940. The organic production system is one that maintains the health of the ecosystem, people and soil by depending upon the natural cycles, ecological processes, biodiversity and adapting to the different agro-climatic conditions of the regions rather than using chemical inputs with unfavorable effects. India is bestowed to produce all varieties of organic products due to its various agro-climatic conditions (Rao and Mishra, 2012).

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Global scenario of organic farming

At present 179 countries in all continents of the globe are practicing organic farming. The outlook of consumers towards chemical fertilizers is changing due to ill effects on the environment including soil and aquatic environment of chemical fertilizers. Hence, concerning health priorities, the use of bio or organic fertilizers is increasing. Moreover, leaders and policymakers are developing policies in the favor of organic farming and promoting organic fertilizers and taking initiatives towards the restoration of soil health and uplifting to the rural economy.

The organic agriculture area is consistently increasing and in the year 2014, the total organic agriculture area has been recorded as 50.9 mm hectares with an increment of 6.5 mm hectares land worldwide. Oceania covers the largest part with 22.8 million hectares or 45% of organic agriculture land. With 12.7 mm hectares or 25% of organic

agriculture land Europe is second on the list. Latin America gained the third position with 6.7 mm hectares or 13 percent land followed by Asia, North America and Africa regions with 3.2 million hectares or 9.6%, 3 million hectares or 7.1% and, 1.1 million hectares or 2.8 % respectively. Australia is a country having the most of organic agriculture land with a 22.7 mm hectares area. Whereas Argentina and United States come on second and third rank with having 3.1 million hectares and 2.0 million hectares land. Liechtenstein and Austria have been identifying as regions having the highest share of agricultural land with 30.2% and 21.3% of organic agriculture land. When it comes to organic production, India obtained the first position followed by Ethiopia and Mexico with having 2.4 mm producers in the year 2015. As compared to the previous year 7% increment has been reported in the year 2015. Cereals, citrus fruits, coffee, cocoa, dry pulses, tropical and sub-tropical fruits, grapes, oil seeds, olives, vegetables and cotton are commonly produced commodities worldwide (FiBL-IFOAM Survey 2017).

ASIA: organic farming

Asia is the fourth-largest region with covering 4 mm hectors or 8% of the global organic area in the year of 2015. In recent years the total area of the region has been increased by 400'000 hectares or 11% from the last 10 years. The Asia region comprises around 0.6 mm producers and out of them, around 0.55 million producers are from India. Out of the total organic agriculture land, 2.2 mm hectors or 56% of the land is covered by farmland and use for arable crops. 750'000 hectors area is covered by permanent crops and the rest 25% area is grassland in Asia. Oilseeds, coconuts, cotton, coffee, temperate fruits and tea are the major organic production under arable crops and permanent crops in the Asia region. In the wild collection mushrooms, medicinal plants, wild fruits and, wild oil plants have been reported as major production with 5.5 mm hectares of organic agricultural land during 2015. India gives the largest wild collection production with 4mm hectares by followed Tajikistan and China with 1 million hectares and 0.6 mm hectares of agricultural land. 7.2 billion $ US amount has been reported from organic food sales in Asia, Australia and other regions in the year 2015 while increasing share of Asia in organic food production. South Korea, Taiwan, Japan, Malaysia, Hong Kong and Singapore are the major country having most organic domestic product sales. Whereas, Bangkok, Beijing, Bangalore, Delhi, Jakarta, Kuala Lumpur, Manila, Shanghai and other cities that have been found to have an increased rate of internal consumers of organic products (Joshi, 2012).

Standards and regulations

In the field of organic agriculture, numerous standards and regulations were made in 2009. Firstly, European and Canadian organic standards and regulations came into force. After some time, the Australian domestic organic standard also implemented. Furthermore, Canada and the U.S. have introduced first fully mutual agreement between regulated organic systems and Europe had introduced certification procedures from outside Europe. This development of regulations and standards will ease international trade in organic products and open the future growth of the organic sector. In recent time, many countries are increasing their position in organic regulations now 87 countries have organic regulations besides 17 countries are in the line of drafting legislation. FAO, IFOAM and UNCTAD are major organizations that are working in the Global Organic Market Access (GOMA) project. The Global Organic Market Access aims to bring equivalence and harmonization to ease the process of trade flow of products among the various organic guarantee systems. Hence, it is clear that certification by Participatory Guarantee Systems is increasing in the area of organic production globally. The primary focus of PGS is quality assurance systems and increasing the number of models that are developing in all continents. It is estimated that in 2016 there are more than 250 PGS initiatives in 73 countries worldwide and around 130'000 producers are involved (Yadav, 2010). It is estimated that in 2016 there are more than 250 PGS initiatives in 73 countries worldwide and around 130'000 producers are involved (Yadav, 2010). The highest number of PGS can be found in India with 43'000 producers followed by Pery 22'000, Kenya 12'000. In 2016, IFOAM conducted global studies on policies implemented by various levels of government (local and national governments) to promote organic agriculture (FiBL-IFOAM Survey 2017).

Organic farming in india

In India, there is significant growth in the area of organic agriculture with an increase from 528'171 hectares in 2007-2008 to 1.18 million cultivable lands in 2014-2015. In India, organic farming is being promoted across the country by assisting farmers and entrepreneurs. The use of organic manures (farmyard manure, compost, green manure, *etc*.) is an ancient and most widely methods for nutrient replenishment in the country. Before the year of 1950, organic manures were the only source of soil and plant nutrition. India, with owing a high animal population, farmyard manure is the most common of the organic manures. Unlike fertilizers, the use of organic material has not increased much in the last two to three decades. The estimated annual available nutrient (NPK) contribution through organic sources is about 5 million tonnes, which could increase to 7.75 million tonnes by 2025. Thus, organic manures have a significant role to play in nutrient supply. In addition to improving soil physio-chemical properties, the supplementary and complimentary use of organic manure also improves the effectiveness of mineral fertilizers. The use of biofertilizers is of relatively recent origin. Biofertilizers consist of N fixers (*Rhizobium*, *Azotobacter*, blue-green algae, *Azolla*), phosphate solubilizing bacteria (PSB) and

fungi (Mycorrhizae). Biofertilizers, most growth has occurred with phosphate-solubilizing microorganisms, which account for about 45 per cent of total biofertilizers production and use. Biofertilizers' production and use are concentrated in Maharashtra, Tamil Nadu, Karnataka, Madhya Pradesh and Gujarat (FAO, 2005). The significant growth is attributed to the policies that have lead to an increase in areas under third-party certification and has promoted PGS (Participatory Guarantee Systems).

Policy support and development in India

In 2016 in India both the federal and state governments have taken initiatives to promote organic agriculture. The federal government launched a program "Parsmaragat Krishi Vikas Yojna" with a budget of 40 million Euros. India is in the few countries of the world where PGS is recognized and promoted by the government and the Ministry of Agriculture continues to support PGS and has opened its office in New Delhi, which is a first government-run organic shop selling PGS certified products. The federal government has also extended its support to third party certification with the financial support of 27'000 Euros - 234'000 Euros to the state governments of eight north eastern states for setting Public organic certification bodies and getting accreditation. The government of India has also implemented a National Program on Organic Production that includes the provision of accreditation for certification bodies, lays standards and rules for organic production and provides strategies for the promotion of organic farming, *etc*. These standards have been recognized and provided by the European Commission and Switzerland for unprocessed plant products according to their country standards. Only the organic products which are certified by the accredited certification bodies are accepted by importing countries. The state government of Gujarat announced that it will set up India's first university exclusively dedicated to Organic Farming and Research. In the year 2017, the Organic World Congress and General Assembly of IFOAM – Organics International was held in India (Willer and Arnoud, 2017).

Emergence and growing area

In terms of cultivable land under the organic agricultural area, India ranks 9th worldwide. The certified area includes a 26% cultivable area with 1.49 million hectares and rests 74% (4.22 million hectares) is forest and wild areas. The total organic agriculture land is 1,180,000 hectares with an organic share percentage of 0.7% and 585,200 producers. The state of Sikkim with an area of 700,000 hectares has been declared as the organic state with regulations that prohibit the use of chemical fertilizers and pesticides, Nagaland is also an entirely organic state with an area of 1.6 million hectares. The Indian organic fertilizer market is hard to investigate at a full scale because the majority of agricultural producers use the products that they manufacture themselves (National Project on Organic Farming, 2016). The use of organic fertilizers can be examined by reviewing the organic farming sector. The organic agriculture area has grown from 42,000 hectares under certified organic farming during 2003-04 to 11, 80,000 in 2014-15. The increasing growth of cultivated area under organic management is represented in Table 1 (Ministry of Agriculture, 2016), (FiBL-IFOAM Survey 2017).

In India, Madhya Pradesh covers the largest area under organic certification followed by Uttar Pradesh and Himachal Pradesh. In India, Madhya Pradesh has the highest area under organic farming (6505077.49 ha), Uttar Pradesh is at second (2809593.46 ha) and Himachal Pradesh is at third (2258049.47 ha) while the state of Sikkim and Nagaland are declared as the organic state in 2015 as they prohibit the use of chemical fertilizers and pesticides. The state-wise representation of total land area under organic certification from 2009-14 is shown in Table 2 (Ministry of Agriculture, 2016).

The increasing growth of organic management and increasing demand for wild harvest products introduced to India as the largest country with the highest area of cultivated land under organic management worldwide (Chandrasekhar, 2010).

India is also the largest country in terms of the total area under certified organic wild harvest collection. In 2015-2016, India produced around 1.35 million Metric tonnes of certified organic products including all varieties of food products including edible and non-edible products. India is an organic cotton producer in the world with 112,488 MT production in the year 2015-16. The major main organic agricultural products of the country are shown in Table 3 (Ministry of Agriculture, 2016).

The important commodities produced and exported by using organic fertilizers in India along with their values in crores are shown in Table 4 (Ministry Of Commerce and Industry, 2016). India exported more than 300 organic products under 19 categories for a volume of 263687 Mt realizing the value of USD 298 million (2015-16) (Ministry of Commerce and Industry, 2016).

Table 1: Year-wise growth of organic area.

Years	Area under organic management in (ha)
2003-04	42,000
2004-05	25,71,900
2005-06	28,18,222
2006-07	28,00,000
2007-08	37,99,530
2008-09	45,40,000
2009-10	44,30,000
2010-11	55,61,792
2011-12	5,00,000
2012-13	5,10,000
2013-14	7,20,000
2014-15	11,80,000

Table 2: State-wise area under organic certification including the cultivated and wild harvest for last 5 years.

State Name/ UT	2009-2010	2010-11	2011-12	2012-13	2013-14
Andhra Pradesh	44395.67	14350.72	47456.79	5909.13	12325.03
Arunachal Pradesh	1897.27	243	520.43	231.49	71.49
Assam	6223.12	2047.33	208.27	2299.21	2828.26
Andaman and Nicobar	0.00	334.68	0.00	321.28	321.28
Bihar	1096.3	1303.62	188.6	9531.95	180.60
Chhattisgarh	29084.97	8448.94	299970.60	1887.64	4113.25
Delhi	12734.36	265.82	100238.70	58.40	0.83
Goa	13175.72	13303.7	153684.60	8290.60	12853.94
Gujarat	102488.4	48518.91	41978.94	45257.62	46863.89
Haryana	21951	14763.61	17442.36	7532.62	3835.78
Himachal Pradesh	683697.85	631901.99	933798.20	3965.38	4686.05
JandK	32687.11	776.48	26834.26	5121.14	10035.38
Jharkhand	100	24300	29794.42	254.94	762.30
Karnataka	121507.56	88728.64	118739.70	27191.27	30716.21
Kerala	15372.62	6597.65	15790.49	10568.40	15020.23
Lakshadweep	0.00	12.23	891.93	350.68	895.91
Madhya Pradesh	2829249	2866571.88	432129.50	144239.75	232887.36
Maharashtra	35449.98	177345.48	245339.30	66504.92	85536.66
Manipur	10871.3	2792.03	1296.91	11.25	0.00
Meghalaya	2254.12	2419.67	288.23	1780.49	373.13
Mizoram	38674.62	12544.13	7023.97	1182.00	0.00
Nagaland	29715.28	1603.54	7762.60	2916.96	5168.16
Orissa	2452.47	24417.55	43868.18	18186.40	49813.51
Pondicherry	-	-	0.00	0.00	2.84
Punjab	5264.23	6025.78	927.28	1601.47	1534.39
Rajasthan	260827.88	217712.19	222319.10	38289.04	66020.35
Sikkim	7393.09	1726.34	25716.55	43107.74	60843.51
Tamil Nadu	78442.9	34878.09	38554.33	3066.97	3640.07
Tripura	281.06	348.39	4.05	209.72	203.56
Uttar Pradesh	26567.68	111644.83	2593821	32889.85	44670.10
Uttarakhand	33181.3	105465.98	122880.60	20563.75	24739.46
West Bengal	14861.22	6125.72	19095.55	1279.41	2095.51
Total	4551899	4427519	5550405	504439.47	723039.04

Biofertilizer production and demonstrations in the diffrent states of India

Madhya Pradesh

Soybean rhizobial and PGPR strains-*Bradyrhizobium japonicum* and PGPR-*Bacillus megaterium* were supplied for mass production to JNKVV Biofertilizer production center, Jabalpur. During 2009-11, 6, 06, 676 inoculant packets were prepared with the strains and supplied all over Madhya Pradesh. Detailed observations in five farmer fields in Raisen District showed that soybean seed yield increased with INM option with biofertilizers by 18% over balanced fertilization and 54% over farmers' practice (Rao *et al*., 2012). A demonstration in the fields in 'Havelis' for rabi pulses (lentil, pea, chickpea) showed that indigenous isolates increased the average seed yield of pulses by 33% while standard inoculant from Jawaharlal Nehru Krishi Vishwa Vidyalaya increased it by 44% (without inoculation of *Rhizobium, Azotobacter* and PSB). Field demonstrations carried out in the tribal areas of Seoni district on Soybean, Maize, Kodo and Niger crops in the year 2007-08, it was seen that yield increase due to biofertilizer (*Azotobacter, Azospirillum and* PSB) application was 27%, 52, 23 and 29% respectively for these crops. During 2009-10 integration of biofertilizers with recommended doses of NPK increased the grain yields of soybean, maize, kutki and niger by 25, 32, 40 and 25% respectively as compared to farmer's practice (imbalanced nutrition) (Yadav, 2010).

Maharashtra

Frontline demonstrations were carried out in three types of soils (Vertisol, Inceptisol, Entisol) from five districts of Maharashtra, the increase in soybean yield was noted ranging from 16 to 43% (av. 33%) depending on soil type and management levels (Rao *et al*., 2012).

Table 3: Main organic agricultural products of India[10].

S. No.	Organic products
1	Bajra-mustard-wheat
2	Chilly
3	Cereals-cereals
4	Cereals-pulses
5	Kholar
6	Maize
7	Ginger
8	Soybean
9	Large cardamom
10	Passion fruit
11	Urd
12	Bajra and wheat
13	Wheat and bajra
14	Cotton-grass
15	Pulses-cereals
16	Bajra
17	Mustard
18	Til
19	Wheat
20	Guar-cumin
21	Guar-wheat
22	Moong
23	Mustard
24	Cotton
25	Bajra
26	Pulses and wheat
27	Maize
28	Guar

Tamil Nadu

Experiments conducted on farmers' fields showed a 13-31% yield increase due to rhizobial inoculation in groundnut and 13% increase in rice due to the Azophos application. Awareness about the usage of biofertilizers was conducted for groundnut and pulses (National Centre of Organic Farming, Department of Agriculture and Cooperation, 2016). Research and Demonstrations on Azolla in the North Eastern Hill region were used for the cultivation of *Azolla caroliniana* in the villages around Jorhat. *Azolla* has grown in polythene lined pits round the year; it multiplies in 15-20 days. For the continuous harvest of *Azolla* 10-15 number of pits are required. The maximum cost of each pit is between Rs. 80-90 and can be used for 2 years. After 3-4 weeks of growth and formation of mat, Azolla is incorporated in the soil. Again after 7-8 weeks, the *Azolla* covers the field and requires the second incorporation. 2-3 tonnes of *Azolla* can be supplied in each bigha of rice field with supplementation of 4-8 kg N per crop per season (20-40 kg N/ha) (Rao *et al*., 2012).

Bihar

Evaluation of the package (spent residue or semi decomposed straw + *Pseudomonas spp* along with *Azospirillum SPS*. and cyanobacteria) in the fields in Samastipur, Muzaffarpur and Vaishali districts showed increased yields of rice in resource-rich farmers up to 4-20% and resource-poor farmers by 25-35%. The varietal difference had no impact on deriving benefit from bio nutrient package as 12 different varieties were used by different farmers. Application of *Azospirillum* and PGPR in six farmers fields in rabi maize augmented the yield by 12-15 per cent (Rao *et al*., 2012).

Rajasthan

Rajasthan is the largest state in the country with 3.42 lac sq. km area or 10% of the total area of the country. The state has 342.66 lac hectare of the area reported for land utilization purposes. Out of this, 7.76% (26.60 lac hectare) is under forest cover and 12.43% (42.59 lac hectare) is not available for cultivation. 5.14% (17.60 lac hectare) area is under non-agricultural usage and 7.29% (24.98 lac hectare) of barren and uncultivated land. The estimated net sown area is 50.76% (173.94 lac hectares) and the gross cropped area is 216.64 lac hectares (Ministry of Agriculture Department of Agriculture and Cooperation Krishi Bhavan, 2012). The state has made impressive gains in agriculture and food grain production it stands fourth after UP, Punjab and Andhra Pradesh. The state is the fourth-largest producer of wheat, the second-largest producer of total oilseeds and stands first in seed spices production. In pulses production, the state has the distinction of being among the top two states in the country (Ministry of Agriculture Department of Agriculture and Cooperation Krishi Bhavan, 2012; Chandrasekhar, 2010). Currently, the Rajasthan State has a major share in the production of crops like bajra (40%), moth bean (85%), rapeseed and mustard (51%), coriander (66%) and fenugreek (87%). The total area under the fruit, vegetables, flowers and spices crops in the state is respectively 51600, 143000, 5400 and 598900 ha with a production of 696100, 885000, 9600 and 668000 MT in 2010-11 (Chandrasekhar, 2010).

Orissa

Biofertilizers for vegetables were convincingly demonstrated in tribal areas of Orissa in Kandhamal and Kalahandi districts. On *Rhizobium* inoculation of pulse crops along with paper mill sludge and soil test based nutrient application help in acid soils improvement and a 75, 63 and 74% increase over farmers yield of 37.1q/ha of cowpea pods; 4.5 q/ha of green gram and 4.2 q ha^{-1} of black gram grain respectively were reported. Bioinoculation of potato, ginger and turmeric crops with *Azotobacter*, *Azospirillum and* PSB integrated with soil test fertilizer dose showed 22, 24 and 21% yield increase (Rao *et al*., 2012).

North-East

Impact analysis of biofertilizers as components of integrated nutrient management was studied in different Krishi Vigyan Kendra of Assam. The yield of sali rice was enhanced to

Table 4: Production and export of commodities under organic management (2014-17).

Product	(2014-15)		(2015-16)		(2016-17)	
	Qty	Rs. in Crores	Qty	Rs. in Crores	Qty	Rs. in Crores
Floriculture						
Floriculture	22947.27	460.77	22691.65	483.41	22020.33	546.71
Fruits and Vegetables Seeds	12499.31	427.04	13104.26	529.2	11288.62	522.75
Total	35446.58	887.81	35795.91	1012.61	33308.95	1069.46
Fresh Fruits and Vegetables						
Fresh Onions	1238102.6	2300.54	1382959.54	3097.21	2415739.06	3106.06
Other Fresh Vegetables	835501.2	2402.24	740466.23	2219.13	1016437.72	2832.03
Walnuts	2665.85	136.45	3291.71	117.92	2191.19	55.27
Fresh Mangoes	42998.33	302.54	36779.26	320.64	52761	443.66
Fresh Grapes	107257.81	1086.49	161029.04	1576.69	231116.86	2065.29
Other Fresh Fruits	274436.09	1245.88	377314.78	1771.9	409081.25	1835.93
Total	2500961.88	7474.14	2701840.56	9103.49	4127327.08	10338.24
Processed Fruits and Vegetables						
Cucumber and Gherkins	251183.01	1202.42	202954.44	999.17	179660.96	936.19
Driedand Pres. Veg.	63701.77	847.14	66444.05	915.64	86791.22	1081.71
Mango Pulp	154820.66	841.39	128866.01	796.18	130886.07	846.02
Fruits and Veg.	316059.42	2569.92	321498.98	2906.15	355315.51	3148.81
Pulses	222262.07	1219.08	256051.91	1658.09	136968.03	1278.79
Total	1008026.93	6679.95	975815.39	7275.23	889621.79	7291.52
Animal Products						
Buffalo Meat	1476309.78	29289.16	1314533.59	26688.08	1323576.11	26161.49
Sheep/Goat Meat	22827.77	821.54	21635.69	833.9	22008.58	869.74
Other Meat	261.92	2.67	0	0	12.07	0.21
Processed Meat	406.11	14.2	279.42	6.16	140.9	4.58
Animal Casings	260.15	19.33	206.36	17.02	173.24	13.84
Poultry Products	556698.81	651.19	659304.15	768.72	448724.73	530.44
Dairy Products	66424.37	1205.4	33442.52	755.51	39166.98	905.73
Casein	8168.05	428.53	5897.99	215.94	6129.89	237.66
Natural Honey	29578.56	535.1	38177.04	705.87	45055.45	557.79
Albumin	2125.02	161.19	1934.12	149.83	1703.32	87.82
Total	2163060.54	33128.31	2075410.88	30141.03	1886691.27	29369.3
Other Processed Fruits						
Groundnuts	708386.26	4675.37	542726.41	4075.63	725704.34	5444.33
Guargum	665177.71	9479.94	325250.71	3233.87	419948.19	3106.62
Jaggery and Confectionery	258252.73	1161.81	292841.25	1290.27	297680.57	1467.94
Cocoa Products	20877.7	848.66	32652.56	1267.61	25649.5	1086.77
Cereal Preparations	306328.81	3038.76	316533.44	3358.11	339923.14	3565.55
Milled Products	415984.45	1019.09	431464.5	1102.73	255803.64	813.54
Alcoholic Beverages	264625.53	2231.62	238672.05	2006.39	230827.23	1991.35
Miscellaneous Preparations	372998.36	2437.81	355786.36	2598.69	282577.03	2565.8
Total	3012631.55	24893.06	2535927.28	18933.3	2578113.64	20041.9
Cereals						
Basmati Rice	3702260.07	27597.89	4045822.29	22718.6	3985195.6	21512.91
Non Basmati Rice	8274046.02	20428.54	6464569.77	15483.39	6770804.28	16929.88
Wheat	2924070.18	4991.84	666668.95	1061.77	265606.06	447.85
Maize	2825610.6	4037.51	697947.17	1162.01	566352.23	1030.13
Other Cereals	688199.92	1224.02	269974.46	540.49	168435.54	395.64
Total	18414186.79	58279.8	12144982.64	40966.26	11756393.71	40316.41
Grand Total	**27134314.27**	**131343.07**	**20469772.66**	**107431.92**	**21271456.44**	**108426.83**

4.0-5.0 t/ha by inoculation of Azospirillum and PSB against farmers' practice yield of 2.5-2.8t/ha. Azotobacter and PSB increased Toria yield by 26 % with an average yield of 1.6t/ha against 1.3t/ha under farmers' practice. Azospirillum and PSB as seed treatment enhanced fiber yield of Jute by 20.4% (Rao *et al*., 2012).

Production of Biofertilizers

During the period 2007-11, 2441700, 1607500, 4928100 biofertilizer packets of *Rhizobium, Azotobacter/Azospirillum and* PSB respectively were produced and supplied to farmers amounting to 89.8 lakhs (Ministry of Agriculture Report, 2012). Using the bacterial strains *Azospirillum*, PSB and *Rhizobium*, the Agriculture Research Station, Amaravathi produced and supplied 234.0 tonnes of Biofertilizers (Azospirillum 53.8, PSB 135.0 and Rhizobium 45.8 tonnes) during 2007-11 to the farmers of Andhra Pradesh valued 81.9 lakhs. Biofertilizer production using the strains, *Mesorhizobium ciceri* ca-181, *Bradyrhizobium sp. vigna* S-24, *Pseudomonas sp*. (PSB) N-3, *Azospirillum lipoferum* J-11, amounted to 2,54,232 packest/vials and total sales of Rs. 25.4 lakhs in Hisar Agricultural University 13. The state-wise production of biofertilizers for both Liquid-based and carrier-based for the year 2015-2016 is listed in Table 5 whereas the production of organic fertilizers in the year 2015-2016 is listed in Table 6. According to the annual report survey by National Center for Organic Farming (2015-16) (Ministry of Agriculture, 2016). There is an increase in production of biofertilizers from 20111.05 to 94270.20 tonnes in 2015-16 as compared to the production in the year 2007-2008 which is shown graphically in Fig 1 (National Centre of Organic Farming, Department of Agriculture and Cooperation, 2016).

Several types of research in this area revealed that organic agriculture is continually increasing throughout the world including India. In recent years the Northern state of Sikkim has achieved the goal of 100% organic agriculture. Besides, other states of North East India including Mizoram, Meghalaya and Nagaland are also aiming to shift towards

Table 5: Production of Biofertilizer (Liquid base and Carrier Base) In India 2015-16.

State Name / UT	Carrier Base (MT)	Liquid base (KL)
Andhra Pradesh	3062.6	317.81
Arunachal Pradesh	118	0
Assam	1315	22.5
Andaman and Nicobar	0	0
Bihar	97	0
Chhattisgarh	954.371	9.38
Delhi	106.2	0
Goa	820.52	0
Gujarat	3963.42	2873.317
Haryana	1097.457	58.032
Himachal Pradesh	2.712	190.05
J and K	0	0
Jharkhand	9.172	0
Karnataka	23042.91	488.142
Kerala	4926.045	56.5751
Lakshadweep	0	0
Madhya Pradesh	2741.307	131.033
Maharashtra	7825.142	389.665
Manipur	0	0
Meghalaya	0	0
Mizoram	4.2	0
Nagaland	8.81	0
Orissa	467.634	13.701
Pondicherry	283.641	4.088
Punjab	2197.197	149.581
Rajasthan	680	0
Sikkim	12.91	0
Tamil Nadu	23721.210	861.953
Tripura	1143.07	0
Uttar Pradesh	3053.115	223.34
Uttarakhand	3549.39	428.22
West Bengal	2826.27	23.537
Total	**88029.30415**	**6240.926**

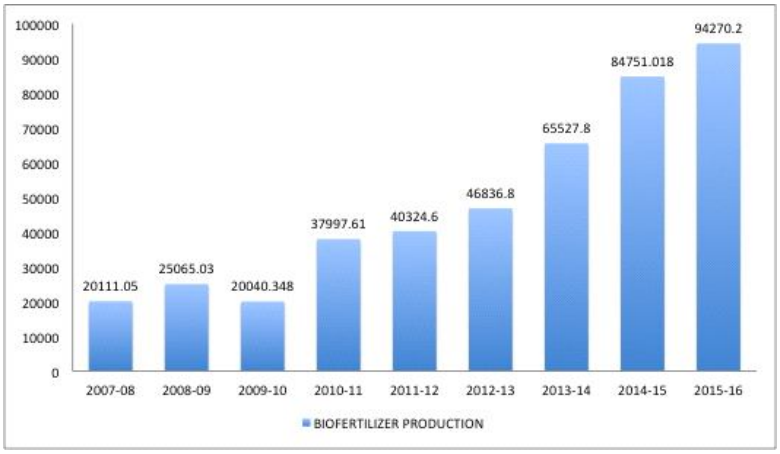


Fig 1: Increase in production of biofertilizers from 2007-08 to 2015-16[14].

Table 6: Production of organic fertilizer in India 2015-2016[10].

State Name / UT	Rural compost	FYM	City Compost	Organic Manure	Vermi Compost	Other Manure	Total Manure	Green Manure
Andhra Pradesh	62	0.35	22.1	0	1.52	0	85.97	29.1
Arunachal Pradesh	0.7	0.21	0	0.01	0.62	0.062	1.602	0.08
Assam	0	841	0	0	93.1	1.56	935.66	3.2
Andaman and Nicobar	0	0	0	0	0	0	0	0
Bihar	10.32	8.5	0.32	5.01	9.12	0	33.27	411500
Chhattisgarh	11.04	42.51	11.23	0	3.02	53.08	97.88	490462
Delhi	0	0	0	0	0	1.1	1.1	0
Goa	0.04	0	0.5	0.04	0.03	0.21	0.82	3.2
Gujarat	0	37	0	0	0.78	4.9	380.68	3.5
Haryana	10.2	8.6	0	2.17	0.2	0.01	2.38	0
Himachal Pradesh	0	0	0	15	25.1	14	29	0.58
J and K	1.9	0	0.23	0	0	0	2.13	1501
Jharkhand	0	0	0	0	396	0	700	0
Karnataka	5.9	6.3	6.55	2.72	19.13	0.15	28.57	0
Kerala	0.72	0	0.68	0	3.25	0.005	4.65	33000
Lakshadweep	0	0	0	0	0	0	0	0
Madhya Pradesh	26.38	15.16	1.02	0.90	10.09	0	0.81	70650
Maharashtra	10.36	6.58	7.5	0	2.5	4	14	6080
Manipur	0	0.72	0	0	0.09	0	0.81	0
Meghalaya	0	19	0	0	9	0	28	0
Mizoram	0	1.12	0	0	1.06	0	2.18	0
Nagaland	0.42	1.3	0	0	1.21	0	2.93	151
Orissa	10.6	0	8.42	0.21	6.16	0	25.040	0
Pondicherry	0	0	3.11	0	0	1.1	1.1	0
Punjab	0	0	0.19	0.83	0.34	7.53	8.70	20100
Rajasthan	21.92	12.2	0	0.012	0	0.0113	34.14	0
Sikkim	0.34	0	0	0	0.05	0	0.39	0
Tamil Nadu	0.05	0	9.28	0	5.78	1.29	18.42	0
Tripura	2.6	0	0	0	0.91	0	0.91	0
Uttar Pradesh	25.3	19.5	0	0	0.23	0	0.23	2490018
Uttarakhand	10.6	14.6	0	0	0.5	0	25.7	0.11
West Bengal	8.5	29.99	8.3	4.2	1.95	4.98	57.92	69
Total	**231.40**	**1409.595**	**79.457**	**31.130**	**591.763**	**95.618**	**2547.86**	**1282553.77**

organic farming (Murry, 2019). Another study presented by (Roy and Dhumal, 2011) says that the green revolution of the 1960s is responsible for this excessive use of chemical fertilizers in the country. Hence this study suggests that formers should go back to organic agriculture to get back the wealth of soil (Roy and Dhumal, 2011). A research study carried out by Namdev and Awasthi focused on the cost analysis of organic and inorganic cultivation practices in the country. This study revealed that organic farming is much cost-effective than inorganic farming. hence, it is also an important reason for the promotion of organic farming in the country (Namdev *et al*., 2013).

CONCLUSION

During the last 10 years, the organic agriculture sector has grown almost by 25-30% per year despite being market controlled and consumer-centric agriculture system. Organic farming in India is being practiced from ancient times but due to the growing demands of consumption and growth of modern science, intensive agricultural practices have removed it out of sight. But with a change in the outlook of consumers and increased awareness about the safety and quality of food, organic farming is gaining importance for being sustainable and equally productive. Thereby, organic farming is emerging as an alternative farming system addressing the quality, sustainability and providing a profitable living option. Appropriate technologies need to be developed, for effective conversion of waste into nutrient-rich organic sources within the shortest possible time at affordable cost and transferred to the farmers. Farmers need to be trained for value addition technology. Massive efforts are needed on the same scale, as were used for chemical farming to harvesting the best benefits in the interest of the nation, environment and sustainability of the system for

future generations. Council of Agriculture (COA) should conduct various seminars as well as workshops on the application of biofertilizers so that farmers would have the opportunity to understand the effects of biofertilizers and are willing to use them.

Thus, Organic fertilizers can contribute to sustainable food security by improving nutrition intake, supporting livelihoods in rural areas and enhancing biodiversity, while simultaneously reducing vulnerability to climate change. On average, organic farms sustain 30 per cent higher biodiversity than conventional farms. Hence, a strong national organic policy formation is required in the country to give importance to organic farming and to overcome current issues and challenges being faced.

Conflicts of interest statement

The authors declare that there are no conflicts of interest.

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