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Organic farming in India: A brief review

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Abstract

Various food crops are produced in India, including cereals, pulses, and oilseeds. The biggest challenge in India since Independence has been supplying enough food for the growing population. Therefore, high-yielding varieties are cultivated with irrigation water, fertilizers, or pesticides. Government policy continues to encourage the growth of the agribusiness sector through substantial investment in infrastructure and food processing. Technological advancements and agri-infrastructure upgrading is still a concerning matter to achieve excellent status. With the time high use of chemical fertilizers and pesticides for high production soil fertility is losing as well as the food safety is in the challenging condition. At present scenario, organic farming is the backbone of the great Indian civilization. The Organic Farming is safest way of maintaining the soil fertility and public health, too. As a result, organic farming can provide quality food without adversely affecting the soil health, the environment and without compromising the human health as well. Organic products includes all varieties of food products like tea, fruits, rice, pulses, honey, spices, coffee, oilseeds, cereals, herbal products or it may be cotton, cosmetics, functional foods, body care products, and other similar product. The present review focuses on the organic farming importance and status in India.

Keywords: Organic farming, green revolution, high-yielding varieties, soil fertility, human health

Introduction

Due to the growing demand for safe and healthy food and concerns about environmental pollution caused by indiscriminate application of agrochemicals, organic farming has become a major priority area worldwide. In India 68% population and 52% of the total work depends on agriculture and other related activities. It is reported that to reach a double-digit GDP (Gross Domestic Product) and agricultural growth of India around 4% expenses is required^[1]. In Indian economy, Agriculture is the main concern area as well as India is the world's largest producer of wheat, rice, and cotton. India is the second largest producer of sugarcane, fruit, vegetables, and tea^[2, 3].

During 1966-1967 to 1970-1971 food, grain production increased the crop revolution and it is termed as Green Revolution. Green Revolution of India announced during Plan holiday (1966-1969) under the leadership MS Swaminathan^[4]. A steering committee which was led by MS Swaminathan, who appointed by the ministry of agriculture and cooperation task force on organic farming, advocated promoting organic farming in rain fed regions and the north-eastern states, where fertilizers and other agricultural chemicals such as pesticides were limited. Main objective of Green Revolution was production of High Yielding Seed Varieties that was adopted in 1966-1977^[4].

The eleventh plan (2007-2012) of Indian economy is known as Ever Green Revolution. High-yielding production technology has contributed to a food surplus in the country and for soil health, pollution, and pesticide toxicity, and sustainability is need be concern in this part. Agricultural Geography experts use the term to describe a broad transformation of agriculture in developing countries to reduce food shortages^[1-4].

Since January 2016, Indian Government initiated a scheme Pradhan Mantri Fasal Bima Yojana (PMFBY). PMFBY is a dedicated agri-insurance company and aim to save the needs of Indian farmers and to proceed towards a sustainable agricultural growth^[4]. The 42nd Report of the Parliament Standing Committee on Agriculture of the 14th Lok Sabha has well highlighted the progress in organic agriculture development and the need to promote it further.

The committee suggested that, organic farming is one of the best options that will be creating profitable agricultural products in India. Hence, therefore, it must be included as a priority area and impact of organic farming on agriculture and national food security can analyse [4].

First organic crop yielding programs launched from Madhya Pradesh of India. Mango, Pineapple, Bananas, Papaya organic fruits cultivate in Maharashtra and Madhya Pradesh of India. Among the Indian states Haryana, Punjab, Madhya Pradesh, Maharashtra, and Uttar Pradesh cultivate the organic crops like Wheat, Maize, and Sorghum and Oilseeds organic crops produce in only Madhya Pradesh [5].

Concept of organic farming

The word 'organic' denotes 'the plant or animal origin'. Additionally, it refers to an organism's organizational structure. The term organic farming was used by Lord Northbound in 1940. JI Rodale, the founder of the Rodale Research Institute and magazine Organic Farming and Gardening. According to the United States Department of Agriculture study it is defined as 'organic farming is a system which avoids or largely excludes the use of synthetic inputs like feed additives, fertilizer, pesticide, hormone and the maximum extent feasible rely upon crop rotations, crop residues, animal manures, off farm organic waste, mineral grade rock additives and biological system of nutrient mobilization and plant protection' [5]. Another definition according to the Food and Agriculture Organization (FAO) organic farming is a special type of production management that uses on-farm agronomic, biological, and mechanical approaches instead of any artificial off-farm inputs to support and increase the health of agro-ecosystems, including biodiversity, biological cycles, and soil biological activities [5].

Organic Farming during Ancient Time in India

Organic farming initiated several thousand years ago. In farmers of that, time starts crop production in the riversides by using natural resources. Indian scriptures Ramayana, Rig-Veda, Mahabharata briefly narrate the organic agricultural inputs by the farmers at that time [2]. In Mahabharata Kamadhenu cow was found which is related to agricultural practices. Ramayana explains to the cycle of dead things and foul waste stuff that returns to earth in the form of nutrients [3].

The 'Aryans' word comes from the root word, 'Arya' that means to cultivate. The word 'Veda' means knowledge and Agriculture inspired by Vedic knowledge called Vedic Agriculture. Vedic texts describe the principles of organic farming like Krishi Parashar, Brihatsamhita, and Manusmriti etc. In Rigveda describe used of organic manure and important of cow dung for plant Growth [3].

In a study it was discussed that the concepts of agriculture of the times of Kautilya (Prime Minister of Chandragupta Maurya), who wrote the Arthashastra in the 3rd-4th century. Kautilya mentions oil cake and animal excreta in Kautilya's Arthashastra, which was used for agricultural purposes [5].

Various components of organic farming

Most important components of organic farming are biological nitrogen fixation, crop rotation, residues of crops, bio pesticides, and biogas slurry. Vermicomposting is a major element in organic husbandry, which is effective in increasing the soil fertility and growth of crops in a sustainable way [7]. The components of organic farming are as follows:

Crop Residue

India has great eventuality of using remainders of crops and

straw of cereals and beats in recycling of nutrients during organic husbandry. These residues are stalks, stems, leaves, and seedpods. Crop Remainders when invested with fungal species ameliorate physic-chemical parcels of soil and crop yields [6].

Crop Rotation

For rehearsing sustainable husbandry there should be gyration of crops on the same land over a period of two times or further for maintaining soil fertility and control of insects, weed and conditions. For example, use of legumes in rotation improves soil fertility [6, 7].

Organic Manure

The organic manure obtained from biological sources like plant, animal, human residues, and birds. Organic ordure is a well-spoiled material used in organic husbandry it is free from chemicals, dangerous organisms and weed seeds either it is from a beast or factory origin. Organic ordure helps in adding crop growth directly by perfecting the uptake of humic substances and laterally promoting soil productivity by adding vacuity of major and minor factory nutrients through soil microorganisms [6, 8].

Animal manure are used Animal to fertilize like grasslands and Crop. The vacuity of beast wastes projected to rise in unborn decades, specifically in developing countries. The operation of beast coprolites in reducing the toxin of soils defiled with heavy essence, chancing that their operation corresponds to a good volition of phytoremediation [9].

In bird manure, uric acid is the main source of nitrogen. Bird manure is an important, inexpensive fertilizer that is readily available in the market. Sea Bird normally contains 8-21% nitrogen by mass, primarily in the form of uric acid (80%), protein (10%), ammonia (7%), and nitrate (0.5%). Sea Bird stool considerably studied because soils that admit it with high attention of nutrients similar as NO₃ and NH₄ [9].

Wastes

The word waste denotes to a product or a substance that cannot use as intended. Waste from human activities is often highly resilient and takes a long time to decompose, as opposed to waste from natural ecosystems (e.g. oxygen, carbon dioxide, dead organic matter). Wastes are two types i.e. Industrial Waste and Municipal and Sewage waste. Industrial by products similar as spent marshland and coir waste can be used as ordure. Municipal and Sewage waste are most important component of organic waste [6, 10].

Urine

Urine contains the macronutrients like N, P, and K that required for fertilizer production. Mortal urine is a precious toxin, although its value is undervalued, and it is underutilized. The exercise of mortal urine is entering attention as an indispensable toxin because it contains nutrients similar as Nitrogen (N), Phosphorus (P), Potassium (K), and Sulphur (S), Calcium (Ca), and Magnesium (Mg) [11].

Bio fertilizers

The term bio fertilizer or microbial inoculants can be generally defined as a idle cells of effective strains of nitrogen fixing, phosphate solubilising or cellulite microorganisms used for operation of seed, soil or composting areas with the ideal of adding the figures of similar microorganisms and accelerate certain microbial process to compound the extent of the vacuity of nutrients in a form which can assimilated by factory [11].

There are two types of bio-fertilizers, Symbiotic Nitrogen Fixation and Asymbiotic Nitrogen Fixation. Nitrogen is a very essential nutrient for crop growth. In Symbiotic Nitrogen Fixation, *Rhizobium* has symbiotic commerce with legume roots, and Rhizobacteria inhabit on root face or in rhizosphere soil. *Rhizobium* Bacteria fixes atmospheric nitrogen in roots of leguminous shops, form tumours like growth known as root nodes [5, 11]. Symbiotic Nitrogen Fixers and phosphate solubilising microorganisms allow nitrogen and phosphate fertilizers to be used sustainably. In Asymbiotic Nitrogen fixation Blue Green Algae (BGA), *Azolla*, *Azotobacter*, Mycorrhizae and *Azospirillum* grow on decomposing soil organic matter and fixes atmospheric nitrogen in suitable soil medium. *Azolla* Bio-fertilizer used for rice civilization indifferent countries similar as Vietnam, China, Thailand, and Philippines. *Azospirillum* has salutary effect on oats, barley, sludge, and probe crop and plum millet. It fixes nitrogen by colonising root zones [12].

Vermi Compost

Vermicomposting is a process in which earthworms used to convert organic accoutrements into guck like material known as vermicompost [9]. Vermiculture means “worm-husbandry”. Earthworms feed on the organic waste accoutrements and give out excreta in the form of Vertices that are rich in nitrates and

minerals similar as phosphorus, magnesium, calcium and potassium. Vermicompost increased contents of soil total organic carbon, total N, P, K, Ca, Zn and Mn mainly compared with control plots that can be help plant growth [11].

Bio-pesticide

Bio-pesticides are fungicides deduced from natural accoutrements, similar as creatures, shops, bacteria, and certain minerals [13]. The biological activity of these compounds affects the behaviour and physiology of insects, fungi, and nematodes. Bio-pesticides are of factory origin and include products like alkaloids, phenolics, and some secondary chemicals [6].

Plant nutrient from organic sources

Estimation of NPK availability based on total nutrient content from organic sources, efficiency of these sources to meet nutritional needs not sure as mineral fertilizer for crops, while the combined use of chemical fertilizers and organic sources can increase soil quality and crop productivity over the long run. NPK fertilizer treatment significantly decreased soil pH, whereas organic fertilizer treatment significantly increased soil ph. The organic sources provide the plants with NPK, as well as making unavailable sources of nitrogen, bound phosphates, micronutrients, and decomposed plant residues available [14]. Organic farming consists of a variety of elements (Table 1).

Table 1: The Building Blocks of Organic Farming

| Building Elements | Role and Impacts | References |
|--------------------------|---|------------|
| Crop Rotation | (i) Control on weeds and crop diseases (ii) Fertility maintenance for soils (iii) Improve soil stability (iv) Soil environment that promotes biotic-abiotic interactions (v) Water and soil contamination are reduced | [14] |
| Organic Manure | (i) Supply nitrogen to crops (ii) Fertility and structure of the soil can be improved (iii) Higher essential nutrients for plant growth | [15] |
| Bio-fertilizers | (i) Regulate nutrient balance of soil (ii) Conversion of insoluble phosphate in soluble forms | [16] |
| Organic and Crop Residue | (i) Regulation of soil temperature (ii) Helps mineralize insoluble plant minerals (iii) Assist soil microbes in obtaining carbon | [17] |

Organic Farming and Indian Economy

Organic farming has various roles in India rural or rustic economy. Agricultural land has become scarce in rural India due to rapid industrialization. Due to the exponential growth in India's population, food sufficiency has become more essential than ever before. In same time, organic farming produced high amount of antioxidant content, Vitamin E, and omega-3 fatty acids in the soil that help the plants growth like photo protection, blooming. Farmers who lack the financial resources to explore chemical solutions have to rely solely on organic fertilizers and natural pest control [9].

Traditionally the green revolution and the process of modernization have increased the use of chemicals in Indian agriculture. Recent research shows that chemical use and intensive irrigation can be detrimental to agriculture that is why organic farming has become increasingly popular. Interest in organic agriculture has mainly two causes, agricultural yields decline in some areas due to decreased soil fertility and excessive chemical inputs [13].

The Ministries of Industries and Commerce, Government of India has implemented the National Programme for Organic Production (NPOP) during 2001. Agricultural and Processed Food Products Export Development Authority (APEDA) under

the Ministry of Commerce and Industry control national Program for Organic Production (NPOP). NPOP provides for an institutional framework for accreditation and certification of various facets of organic agriculture processes [13]. The main key objective of the National Programme for Organic Production are as it has developed a certification program for organic agriculture, aquaculture, and livestock and it is accomplishing for the development of organic farming and organic processing [13].

In October 2003, the Government of India established the National Institute of Organic Farming (NIOF) and its main aim is to develop rules, regulations, and certification for organic products that adhere to international standard. The major product sold in global markets include cocoa, spices, herbs, oil crops, non-food items include cotton, cut flowers, livestock and potted plants [13].

In 2002, over 200 million tonnes total food production, India produces only 14,000 tonnes of organic food products. Currently India has only 1426 certified organic farms. The largest producer is Madhya Pradesh, followed by Maharashtra, Karnataka, Uttar Pradesh, and Rajasthan. The total volume of organic crops, which export during 2019-20, was 6.389 lakh Metric Tonnes [18].

Promotion of Organic Farming by Indian Government

Over the years, organic promotion activities have led to the development of state-specific organic brands, increased domestic supply, and export of organic products from the Northeast region. Awareness programs, availability of adequate post-harvest infrastructure, marketing facilities, premium price of organic products among others will surely encourage farmers towards organic farming thereby increasing organic coverage in the country. Government has launched many programs to promote for organic farming [4]. These are as follows:

Paramparagat Krishi Vikas Yojana (PKVY)

The Paramparagat Krishi Vikas Yojana (PKVY), launched in 2015. The PKVY is one of the components of the National Mission of Sustainable Agriculture project. The aim of PKVY is to promote the organic farming and provide the latest information on organic farming technologies. The scheme supports cluster formation, training, certification, and marketing [4].

One District-One Product (ODOP)

The Uttar Pradesh Government launched it in 24th January 2018. It aims to create employment at the district level by increasing visibility and sales of indigenous and specialized products/crafts of Uttar Pradesh [4].

Mission Organic Value Chain Development for North Eastern Region (MOVCDNER)

Farmer Producer Organisations (FPOs) are promoted as third party organic farmers of niche crops in the north-east region. An organic input assistance program of Rs. 25,000 per hectare offered for three years to farmers. A maximum of two crores also provided for the formation of FPOs, capacity building, and post-harvest infrastructure. Awareness programs, availability of adequate post-harvest infrastructure, marketing facilities, premium price of organic produce among others will surely encourage farmers towards organic farming thereby increasing organic coverage in the country [4].

National Food Security Mission (NFSM)

National food security mission (NFSM) launched in October 2007. The main aim of this scheme, to encourage chemical-free farming, Bharatiya Prakritik Krishi Padhati (BPKP) of PKVY promotes organic farming inputs. Kerala and Andhra Pradesh have allocated 0.8 lakh and 1 lakh hectares, respectively, for promoting organic farming or natural agriculture [4].

Organic farming and west Bengal

West Bengal has plentiful natural resources and six different agro-climatic zones, fertile soil and a vast array of biodiversity. A major part of the State's economy is agriculture, which employs nearly three out of every four people [19, 8]. During last five times, the area under certified organic husbandry in West Bengal has increased by 18% despite facing several challenges while rehearsing organic husbandry [20].

Modern farming methods came to West Bengal in the late 1970s. While only in West Bengal, 26% of the total agricultural areas are used high yielding varieties (HYV) technology in 1977-78 and this increased to 90% in 1998-99. Now West Bengal is a leading state in agriculture in India and the help of organic farming develops this [21, 22].

Advantages of organic farming

Pests and diseases are naturally resistant to it

Using organic farming methods increases yields by eliminating

synthetic products. Organic farming creates healthier soil those encouraging healthy plants that are naturally resistant to complaint and pests. These shops have stronger natural defence mechanisms through this fashion, which thickens the cell walls of the shops being grown [13]. A specific commodity crop is the focus of traditional farming practices. The most common crops are soybeans, wheat, and corns are grown in the United States [13].

Organic Food for Health

Organic foods frequently have more salutary nutrients, similar as antioxidants, than their conventionally grown counterparts and people with disinclinations to foods, chemicals, or preservatives may find their symptoms lessen or go down when they eat only [22].

Organic fertilizer reduces pollution

The fungicides (Captan, folpet, dithiocarbamates, pentachlorophenol, and mercurial) used in non-organic product run off with water and contaminate our water too. Organic husbandry extensively considered a far more sustainable volition when it comes to food product. Therefore, organic farming reduces pollution [23].

The advantages of organic farming summarized as:

- Organic fertilizers are safe and does not yields harmful chemical substance liken polychlorinated biphenyls (PCBs) and dioxin [24]
- Chemical fertilizer needs huge amounts of water to activate its molecule, but organic fertilizers do not need such conditions [24]
- Approximately 2.4 million hectare of certified forest area for collection of wild herbs [24]
- Poor client service from the Indian dealers is the major problem in import marketing [23]

Disadvantages of organic farming

Crop yield is low

The use of organic sources of nutrients, the yield of the crop is veritably low, especially during original stages, although it may stabilize latterly, yet complete dependence on pure organic husbandry would not be sustainable in the long run [23].

High Cost

The high costs involved with organic farming are one of its major disadvantages. Pests and diseases are frequently attack crops which grown without the use of pesticides. Therefore, the farming can lose. The husbandry can be a lot further labour ferocious and the cost of organic feed is much advanced than non-organic feed [23, 25]. These costs transferred to the consumer making organic food more precious to buy than conventionally produced food. Whilst numerous people are, further than willing to pay further for their food because it is organic, but during hardship time and recession people are less likely to buy organic. On one hand, target groups of organic food products similar as big hospices, caffs, airlines, cafes, etc. that can go to pay decoration prices for high quality organic foods are fully lacking [23].

The lack of Knowledge

In organic farming, the quality of a crop depends heavily on the knowledge, skills, and wisdom of the farmer. There is lack of mindfulness and knowledge about ultramodern styles or ways of composting, vermin composting among the growers from the medication as well as operation point of view and therefore both

quality and efficacy are poor at the end ^[7].

Lack of Supply

Request development, especially domestic requests, continues to be one of the biggest challenges facing organic husbandry. Lack of supply and a very little product diversity is one of the most disadvantages of organic farming in India ^[13].

Costly inputs

Now a day's resource like Neem cakes, Groundnut cakes, Cow dung, Earthworms, etc. are becoming costlier day by day. Because the number of trees and Vermin Compost are decreasing for use of in organic farming. That is why one of the major closes that increasing the price of organic farming. Chemical fertilizers are easier to purchase given the farmer has purchasing power ^[13].

Conclusions

In organic farming, sustainability and environmental sensitivity go hand in hand. A number of rules and standards developed to achieve these two goals. In the organic farming system, food and fibre are produced in an environmentally, economically, and socially sustainable manner. Organic food market is steadily increasing worldwide. Now a day Consumers buy organic food because they believe they are naturally produced, safe, healthy, and of advanced quality. Whereas organic crops have advanced antioxidant exertion and advanced attention of a range of individual antioxidants; increased inputs of polyphenolics and antioxidants has been linked to a reduced threat of certain habitual conditions similar as cardiovascular and neurodegenerative conditions and certain cancers. India with different agro climatic conditions has great eventuality for organic husbandry and numerous products produced organically in India ^[26-32]. High price for organic products and lack of proper marketing functions within domestic requests are the major constraints in organic husbandry in India. Organic fertilizer does not contain the same number of bad replicas and really have bones that advance life span and well-being. Organic foods health benefits are not only good for individualities but society in general.

Conflict Of Interest

The author declares no conflict of interest.

References

- Chandrashekar HM. Changing scenario of organic farming in India: An overview. 2010;5(1):34-39.
- Bhattacharyya P, Chakraborty G. Current status of organic farming in India and other countries. Indian J Fertil. 2005;1(9):111-123.
- Dhiman V. Organic Farming for Sustainable Environment: Review of Existed Policies and Suggestions for Improvement. 2020;7(2):22-31.
- Layaraja M and layaraja C. Organic farming in India: Benefits and Challenges. 2020;7(11):3021-3029
- Kulhade A, Gupta A *et al.* Role of organic farming in indian agriculture. 2016;22(1):41-48.
- Santhoshkumar M, Reddy GC, Sangwan PS. A Review on Organic Farming - Sustainable Agriculture Development. 2017;5(4):1277-1282.
- Akhtar MS and Siddiqui ZA. Effect of phosphate solubilising microorganisms and *Rizobium* sp. on the growth, nodulation, yield and root-rot disease complex of chickpea under field condition. Afr. J. Biotech. 2009;8(15):3489-3496.
- Koner N, Laha A. Economics of alternative models of organic farming: empirical evidences from zero budget natural farming and scientific organic farming in West Bengal, India. 2021;19(3):22-28
- Mariappan K, Zhou DA. Threat of Farmers' Suicide and the Opportunity in Organic Farming for Sustainable Agricultural Development in India. 2019;11:2-17.
- Rai A, Thomas T, David AA, Khatana RS. Assessment of Physical Properties of Soils of Darjeeling District, West Bengal. 2021;13(2):481-487.
- Mohammadi K, Sohrabi Y. Bacterial biofertilizers for sustainable crop production: a review. 2012;7(5):307-316.
- Singh R, Jat N, Ravisankar N, Kumar S, *et al.* Present Status and Future Prospects of Organic Farming in India. 2019;1-25.
- Wani SA, Wani MA, Mehraj S, *et al.* Organic farming: Present status, scope and prospects in northern India. 2017; 9(4):2272-2279.
- Kumar M, Kumar S and Kumar K. Role of bio-pesticide in vegetables pest management: A review. 2019;8(2):1757-1763
- Bullock DG. Crop Rotation. 1992;11(4):309-326.
- Han SH, a JY, Hwang J *et al.* The effects of organic manure and chemical fertilizer on the growth and nutrient concentrations of yellow poplar (*Liriodendron tulipifera* Lin.) in a nursery system. 2016;12(3):137-143.
- Mishra D, Rajvir S, Mishra U, *et al.* Role of bio-fertilizer in organic agriculture: a review. 2013;2(2012):2277-2502.
- Lim SL, Wu TY, Lim PN *et al.* The use of vermicompost in organic farming: overview, effects on soil and economics. 2015;95:1143-1156.
- Rai A, Thomas T, David AA, Khatana RS. Assessment of Physical Properties of Soils of Darjeeling District, West Bengal. 2021;13(2):481-487.
- Patra S, *et al.* Modelling impacts of chemical fertilizer on agricultural production: a case study on Hooghly district, West Bengal, India. 2016;2(180):1-11.
- Biswas RK, Majumder D, Sinha A. Impacts and Constraints Evaluation of Organic Farming in West Bengal; c2011.
- Ram a, BiswasA, Datta J Organic farming - a source of livelihood security of the farmers of Cooch Behar district in West Bengal. 2015;19(2):281-288.
- Muscanescu A. Organic versus conventional: advantages and disadvantages of organic farming. 2013;13(1):252-156.
- Vilvijayan C, Lalitha N. Organic Food in India: Health and Environmental Advantages and Disadvantages. 2021;25(5): 289-297.
- Das S, *et al.* Role of agri-business entrepreneurship, innovation, and value chains/networks in farmer income improvement: models, policies and challenges. 2021;76(3): 515-532.
- Konar A, Mukherjee K, Ghosh P, *et al.* Traditional Medicinal Plants Used in Different Districts of West Bengal by the Tribal Communities. Journal of Pharmacognosy and Phytochemistry. 2022;11(5):104-110.
- Poddar S, Sarkar T, Choudhury S, Chatterjee S, Ghosh P. Indian traditional medicinal plants: A concise review. International Journal of Botany Studies. 2020;5(5):174-190.
- Sarkar T, Ghosh P, Poddar S *et al.* *Oxalis corniculata* Linn. (Oxalidaceae): A Brief Review. Journal of Pharmacognosy and Phytochemistry. 2020;9(4):651-655.
- Ghosh P *et al.* Green synthesis and characterization of silver nano-conjugates using some common medicinal weeds leaf

- aqueous extracts. International Journal of Pharmaceutical Sciences and Nanotechnology. 2020;13(1):4752-4758.
30. Biswas S, Ghosh P, Dutta a *et al.* Analysis of nutritional constituents and evaluation of antioxidant and antimicrobial potentiality of some underutilized parts of vegetables. Current Research in Nutrition and Food Science Journal. 2021;9(1):62-74.
 31. Ghosh P *et al.* Green synthesis and characterization silver nano-conjugates using *Heliotropium indicum* and *Glycosmis pentaphylla* leaf aqueous extracts. Journal of Nanoscience, Nanoengineering & Applications. 2019;9(2):22-30.
 32. Ghosh P *et al.* Some Roadside Medicinal Weeds as Bio-indicator of Air Pollution in Kolkata. Journal of Applied Biology & Biotechnology. 2021;9(2):164-168.