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EVALUATING THE SCOPE OF NATURAL FARMING FOR THE SUSTAINABLE ECONOMIC DEVELOPMENT OF FARMERS – A CASE STUDY OF THE TURMERIC PLANT HARVESTED AT BHUINJ, DISTRICT -SATARA, MAHARASHTRA

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ABSTRACT

*A vision of sustainable agriculture came into the spotlight to accomplish the United Nations Sustainable Development Goals and achieve the agenda of sustainable development by the year 2030. Agriculture can facilitate sustainable development with three main pillars, offsetting economic, environmental, and social requirements. Sustainable Agriculture aims to increase profitability, promote environmental conservation, improve quality of life, and increase resource production. Turmeric is one of the essential ingredients of Indian spices. It has been used in food preparation since ancient times for health benefits. This research paper focuses on natural farming practices carried out for the cultivation of turmeric in remote areas of Maharashtra. This paper will highlight the sustainable agricultural practices carried out by using biofertilizers, compost, and traditional agricultural practices. the observations are made based on **a** comparative analysis of turmeric (rhizome) production by chemical and natural farming. The results indicate that natural farming processes are not only environmentally suitable but are economically sustainable for the farmers.*

Keywords: *Sustainable agriculture, Natural Farming, Turmeric*

Agriculture can facilitate sustainable development with three main pillars, offsetting economic, environmental, and social requirements which are influenced by their exchanges. The agricultural industry must decrease its impacts on the environment and acclimate the production of food by contemplating recent issues of climate change and nutrient capacity. India includes an incredible variety of agro-climatic zones with as many as 127 zones underneath five agroecosystems such as rainfed, arid zone, irrigated, marine, mountains, and hilly regions. However, data regarding various parameters that are used for sustainability are mentioned by many researchers. (Kalakada et. al, 2017). Agriculture exerts a conceivable influence on natural resources and the environment. Sustainable agricultural approaches are used for the protection of the environment and to enhance Earth's natural capacity to provide long-term benefits. Sustainable Agriculture aims to increase profitability, promote environmental conservation, improve quality of life, and increase resource production.

Sustainable agriculture often confines a wide range of practices, including traditional and advanced farming techniques. Sustainable Agricultural Practices include the processes found to be environmentally feasible, economically viable, and socially acceptable. The farming technique that sustains, enhances, and, maintains the quality of the ecosystem is known as organic or chemical-free farming. These farming techniques are natural and do not have any deteriorating effects on human health as well as the environment.

Today fertilizer has evolved effectively for current agriculture to feed the growing population. The use of chemical fertilizers has brought modifications to mankind, which helped control issues like hunger and death in other corners of the world. (Lin, W et, al. 2019). Though chemical fertilizers augment crop

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production; their overuse has hardened the soil, reduced fertility, and polluted air, and water in many ways, producing ecological deterioration. With the excessive application of chemical fertilizers, there is a major loss of soil fertility and natural microflora, The restoration of the environment can be achieved by using Sustainable Agricultural Practices.

Turmeric is one of the essential ingredients of Indian spices. It has been used in food preparation since ancient times for health benefits. Turmeric evolved as a beneficial plant to humans when it was found that the powder form of rhizome helps to maintain the freshness and nutrition capacity of the food. Turmeric was initially used in cooking and other food storage due to its preservation properties. The turmeric market was shot up due to its medicinal properties. It possesses Curcumin - a yellow pigment present in turmeric that has anti-inflammatory properties and the capacity to boost the release of antioxidants in the body. (Phukan M. et, al.2022) Turmeric has been used in Ayurvedic medicine for many centuries in the 5,000-year-old natural healing system of India. As per Ayurveda, turmeric is known to offset the three doshas i.e Vata, Kapha, and Pitta. It is consumed as medicine in various forms such as juice, boiled water, tinctures, or ground powder. Turmeric was also applied directly on the skin for the treatment of many diseases in the form of thick pastes along with other medicinal plants. It also possesses properties to be utilized as an antibacterial, analgesic, anti-inflammatory, anti-oxidant, anti-allergic,anti-tumor, antiseptic, astringent, and digestive. Contemporary science has started recognizing and valuing the unique healing qualities of turmeric. Extensive research is presently being carried out on turmeric to extrapolate the maximum benefits of the plant. Turmeric has a high domestic and international market due to its extraordinary benefits in the medicine and food industry. In 2020, with exports worth more than 225 million U.S. dollars. India is the leading exporter of turmeric worldwide. Turmeric added a value of about 43 billion rupees to the Indian economy.

The rate of turmeric, just like any other agricultural commodity relies extensively on seasonal practices and market availability. Since turmeric is a Kharif crop, its peak arrival season lies between March and April. In the financial year 2021, the price of turmeric in the southern city of Chennai was over 118 rupees per kilogram. Over the past few years, slight fluctuations in the price were seen. According to the article - Hero Herb, from Down to Earth published in November 2021 - the pandemic time has noticed a bang in the production and export of turmeric. The topmost five turmeric-producing states in India in the year 2020-21 are Telangana, Maharashtra, Karnataka, Tamil Nadu, and Andhra Pradesh, as per indiaspices.com, a website which is maintained by the Spices Board of India. India is the largest producer, consumer, and exporter of Turmeric. Telangana state possessed the first rank in turmeric production in 2018-19. But the state of Maharashtra has shown a tremendous rise in total turmeric production from 38310 tones to 226714 tones occupying 56669 hectares of land under cultivation. After the COVID pandemic, turmeric is one of the fastest-growing nutrient supplements. As per *reportlinker.com* 'Global Turmeric Industry', a market report by *reportlinker.com* curcumin market at the global level is $58.4 million in the year 2019, which is expected to catch a shift of 12.7 percent by the year 2027. India being the prominent producer of turmeric, contributes 80% to international production. for the year 2018-19, with net production of 389 thousand tonnes. India earned 201,152 Thousand US Dollars in 2020. The United state of America is the largest consumer of Indian turmeric, 22 percent of the total exported turmeric goes to the USA. followed by Bangladesh (18%), then Iran (6%), and UAE around (5%) in the year 2021.

The commercial applications of turmeric are very much known. The rate of production is increased to satisfy the higher demand in the market. Along with food preparation and medicine, turmeric is found to be utilized in many other products such as cosmetics, as a coloring agent in the manufacturing of biscuits, cheese, ice cream, cakes, yogurt, juices, sauces, sweets, etc. Food Adulterant is substances that are used to mix with the natural product before it is sold in the market. It lowers the quality of the product and can

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damage the health of human beings in several ways. Turmeric is commonly sold in the form of powder so chemical powders of cheaper substances with similar colors are utilized as Adulterants. Usually lead oxide or metanil yellow 6which is a toxic azo dye is added to imitate the impression of curcumin pigment in turmeric powder.

According to the Ministry of Food Processing Industry- Government of India farmers can cultivate turmeric under "One District One Product" by Centrally Sponsored Scheme PM - Formalization of Micro food processing Enterprises Scheme. Small landowners can be motivated to embrace a cluster approach for production and producer cooperatives. This can help to obtain benefits for both farmers and microenterprises.

STUDY AREA

The area selected for study is small agricultural land from Bhuinj, Wai situated in the Satara district of the state of Maharashtra. The total geographical area of the village is 1721 hectares with a total population of 7,414 people. The Bhuinj climate is suitable for turmeric cultivation. Approximately 11 to 39 degree C temperature for the entire year. Turmeric cultivation is carried out by both chemical and natural farming techniques. The samples were collected from two different lands from nearby locations one with natural farming practices and another one with chemical farming.

The area selected is a farm using natural farming practices and chemical farming practices is 1011.07 sq. meters (10 Gunthe) producing Indigenous species of turmeric.

Sustainable agriculture practices carried out in the farmland

1. Jeevamrita preparation:

1. Take 200 Liter water in a barrel
2. Take 10 Kg of Local Cow dung and 5 to 10 liters of cow urine and mix it in the water, then add 2 Kg of pulses flour and a handful of soil from the bund.
3. Stir the solution well and keep it fermenting for 48 Hrs in shadow. Now Jiwamrita is ready for application.
4. Application of jeevamrita to the crops with each irrigation water or directly to the crops.
5. Spray 10% filtered Jiwamrita on the crops.

Role of Jeevamrita:

Soil is saturated with all the nutrients but these nutrients are in the non-available form of the roots of the plants. Beneficial microorganisms in Jeevamrut convert the nutrients in non-available form into dissolved form when it is inoculated into the soil.

Jeevamrut is either sprayed/sprinkled on the crop field or added to the irrigation tank at a regular interval of 15 days until the soil is enriched.

2. Beejamrita preparation:

1. 5 kg Cow dung + 5L cow urine + 20L water
2. Soaked for 12 hrs Squeeze in a water tub Ready to be added to the seeds. Stir well
3. Add 50gm lime water and cow urine.

Role of Beejamrita:

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Naturally occurring beneficial microorganisms are found in cow dung. These microorganisms are cultured in the form of Beejamrita and applied to the seeds as inoculum. It is reported that seed treatment with Beejamrita protects the crop from harmful soil-borne

pathogens and also helpful in producing IAA and GA3.

3. Different Astras for pest management:

1. Agniastra This primarily is the mixture of Chilli, Garlic, Neem, and cow and is used to control the insects (leaf roller, stem borer, fruit borer, pod borer).

2. Brahmastra-mixture of several locally available plants like Neem, Guava, Custard Apple, Pomegranate, etc. with cow urine and is used to spray over the leaves of the plant.

3. Neemastra-mixture of cow dung, urine, neem, etc. And used against leaf-sucking insects and mealybugs.

Therefore, natural farming reduces the cost of seeds, fertilizers, and plant protection chemicals.

Because of continuous incorporation of organic residues and replenishment of soil fertility. Helps to maintain soil health. The new system of farming has freed the farmers from the debt trap and it has instilled in them a renewed sense of confidence to make farming an economically viable venture.

MATERIAL AND METHODOLOGY

Selection of sampling sites

Sample selection is done based on farming practices followed for the cultivation of Turmeric species Shelam- (Scientific name ***-Curcuma longa***)in Bhuinj village. Two different farms were selected for a sampling of soil for comparative analysis of two distinct agricultural lands from the same region

Sample 1 - Turmeric plant is cultivated by using chemical fertilizer and pesticides

Sample 2 - Turmeric plant is cultivated by using natural and conventional farming practices.

Collection of samples:

Soil samples were collected from both sampling locations 1 and 2 by using random sampling methods with sterile sampling equipment. The soil surface was dug up to 15 cm depth from three different locations inside the farm. Approximately 500 gm of soil was collected and blended thoroughly to form a composite sample of the soil. The collected soil is packed in a zip-locked plastic bag and carried to the laboratory for further physicochemical analysis.

Processing of soil samples:

Soil Samples were brought to the laboratory and kept for air drying for 48 hrs in a dry atmosphere. After drying, the desired amount of sample was sieved by using a 50 mm sieve, and the remaining soil samples were preserved in a refrigerator in airtight plastic bags

Analysis of Soil Samples

The physical and chemical analysis of soil samples was performed using the standard operating procedure. All chemicals were standardized and instruments were calibrated before the analysis.

RESULTS AND DISCUSSION

Table No 1 Results of chemical parameter of soil

Sr, No.	Name of Parameter	Sample 1	Sample 2

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		Chemical Farming	Natural Farming
1	Water Holding Capacity	29.42%	34.18%
2	Organic Matter	15.21%	16.90%
3	Available Phosphorus	1.6128 kg/h	2.0608 kg/h
4	Available Nitrogen	0.224 mg/g	0.604 mg/g

A chemical analysis of the soil was carried out to determine nutrient value of the soil. The analysis was performed by using a standard operating procedure in the laboratory using standard calibrated instruments. The nutrient quality of the soil from agricultural land is found to be high for all chemical parameters performed. The amount of water-holding capacity and organic matter is slightly high in natural farming in comparison to chemical farming. Whereas available nitrogen and available phosphate values are found to be considerably high.

A comparative analysis of turmeric (rhizome) production by chemical and natural farming

	Chemical Farming	Natural Farming
Name of Turmeric species	**Common name shelam- Scientific name *(Curcuma longa*)**	
Area	1011.07 sq. meters	1011.07 sq. meters
Farming practices	Chemical farming	Natural farming
Total production	5 quintals	8 quintals
Rate for 1 Quintal	Rs. 9000/-	Rs. 8500/-
Total Income	45000/-	68000/-
Total Expenditure	10000/-	6000/-
Net profit	35000/-	62000/-

A comparative analysis is performed for the chemical and natural farming process for the turmeric (rhizome) plant production. The total area taken for the study is 1011.07 sq. meters for each chemical and, natural farming in a nearby region. The Shelam *(Curcuma longa*) species of turmeric is used for production at both of the sampling sites. The production of the turmeric (rhizome) is found to be high from the natural farming process i.e. 8 quintals in comparison to 5 quintals for chemical farming. The rate at which the turmeric (rhizome) is sold is found to be higher for the turmeric cultivated by chemical farming i.e. Rs. 9000/quintal in comparison to Rs. 8500/quintal for natural farming-based turmeric. The higher price of the turmeric (rhizome)produced by chemical farming was due to the bigger size of the turmeric in comparison to natural farming-based turmeric as reported by the owner and a farmer of this agricultural land. Total expenses for chemical farming are comparatively high than the expenses incurred for natural farming. The net profit from the production of turmeric grown by using chemical farming is found to be Rs. 35000/-, whereas in the case of natural farming it is very much higher i.e. Rs. 62000/-.

Comparative analysis of prices of powder turmeric produced by Chemical farming, Natural Farming, and Organic Farming.

A maximum amount of turmeric is sold as the turmeric (rhizome) from small farmers in the nearby region. Though some amount of turmeric is processed and converted into turmeric powder and sold in the local market. There are several organic brands available in the market selling turmeric as an important product in the international market. The turmeric powder with the maximum amount of Curcumin pigment possesses a higher value in the market i.e. Lokadang with Rs. 1200/- per kg. other brands like organic indica and conscious food show prices of Rs. 400/- and Rs. 500/- per kg respectively. In comparison the price of naturally grown turmeric is found to be very less in powdered form. Most

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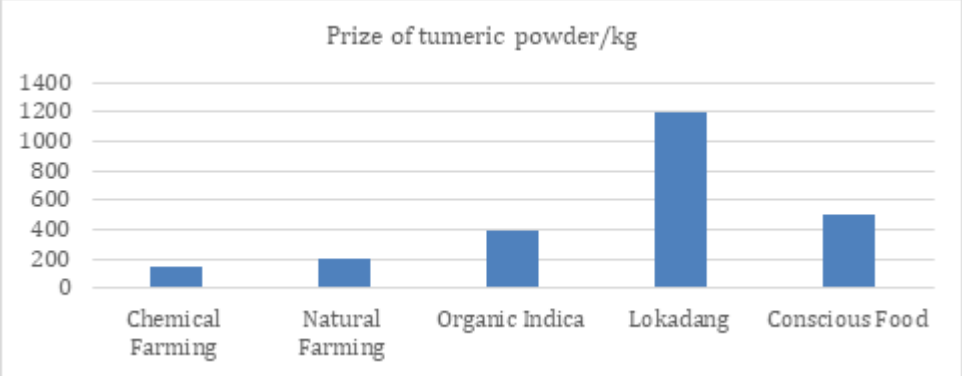
branded organic turmeric products are sold at higher prices and as due to certification under the requirements of organic food in the country. It would be very difficult for



Graph 1: Showing comparison of prices for turmeric

the farmers carrying farming practices at the small-scale level to undergo organic product certification process. The farmers carry out farming by using a natural process and can stand with the requirements of the certification process with few additional changes in the techniques. This will lead to improvement in economic benefits of the farmers.

Organic products are produced in agriculture without the use of chemical fertilizers and pesticides through an eco-friendly process. This is a form of farming that operates to preserve the nutrient capacity of the soil, high quality of soil growing healthy food rich which is benefitted for the entire human race. India contributed with a lot of prospects to deliver all sorts of organic products with diverse climatic conditions. The organic product certification process in India is governed by The National Program for Organic Production (NPOP) under the Ministry of Commerce & Industry. The certification process is been prepared in accordance to fulfillment of International Standards for export of material. Farms can also acquire Organic Farming Certification and stick to the standards established by the authority and generate maximum financial profit

CONCLUSION

The sustainable agricultural practices used in the study area show a substantial positive impact on the environment. The nutrient value of the soil is found to be higher in the case of natural farming processes in comparison to chemical farming. This indicates natural farming methods not only take care of the environment but also create a positive impact on the health of society by providing healthy food resources. One of the crucial agendas for sustainability is economic profit and environmental conservation. The total amount of earnings gained from natural farming practices is higher than from chemical farming methods. Effective implementation of sustainable policy for the financial aspect of the local economy is a prerequisite for the current situation. The highest portion of the turmeric is sold to the turmeric rhizome from small farmers in the nearby region immediately to avoid damage. Most farmers do not carry out the processing of turmeric due to a lack of funds, land, or advanced techniques for the same. The demand for natural or organic-grown turmeric is very high as an impact of several adulteration cases Though some amount of turmeric is processed and converted into turmeric powder and sold in the local market. For extending economic opportunities for farmers, different schemes launched the Indian Government. As per the Ministry of Food Processing Industry having PM formalization of micro food processing enterprises schemes. The CSIR-CFTRI method produces a unique strategy for turmeric processing. The procedure for getting turmeric powder refined from fresh turmeric rhizome can be completed in less time, reducing excessive labor work and in batch-wise long thermal treatment and

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drying. The total number of days can be reduced to 7 days from 60 days for production with 100 turmeric yields. In this way, a sustainable approach to natural farming is found to be very effective to achieve the goals of sustainable development. It gives one point solution to many issues in terms of environment, society, and economy.

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