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Review

Natural Farming: Opportunities and Prospects in Eastern Plateau and Hill Region of India

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The Eastern Plateau and Hill Region of India cover much of Jharkhand state and adjacent parts of Bihar, Odisha, West Bengal and Chhattisgarh. Natural farming is one of the best opportunities to be explored in these potential areas. The demand for food quality, safety and health consciousness, environmental quality, and ecosystem services are on the rise and that's where the producers, investors, and manufacturers need to ensure food they produce is safe and healthy. It has the potential to address issues related to land degradation, soil health, hydro-physical properties of soils, water, and air pollution, improve ecosystem services, and reduce the cost of cultivation and farmers' risks associated with chemical input based high-cost farming. The principles of natural farming are based on minimal soil disturbances, mulching/soil cover, application of ghanajeevamrit, jivamrit, beejamrit, crop rotation, intercropping, use of brahmastra, neemastra, agniastra, etc. for nutrient, water and pest management. These basic principles and practices are by nature and have the ability to can reduce pressure on synthetic chemicals and residues in the environment and farm produce. Conventional farming however increased the food grain production by use of improved varieties of seeds, chemical fertilizers, pesticides, and farm machinery as an outcome of the green revolution, but gave rise to various problems like loss of fertility of soils, environmental issues and health hazards. So, natural farming is one of the best alternatives and advocates the use of organic waste available in farmlands for meeting the nutritional requirements and plant protection measures of plants. These systems produce more nutrient-dense food that is in greater demand both domestically and abroad. Many farmers in India are transitioning to natural farming since it is simple to implement. To address the various researchable challenges and to meet the goal of food security in the region, study goals must be reoriented in light of the Eastern region's generally diverse and risky agriculture.

Key words: Natural farming**,** ghanajeevamrit, jivamrit, beejamrit, brahmastra, neemastra, agniastra, mulching, crop rotation.

INTRODUCTION

A large portion of Jharkhand state, along with nearby areas of Bihar, Odisha, West Bengal, and Chhattisgarh, are part of India's Eastern Plateau and Hill Region. With an average land holding of 1.58 ha, the total geographical area is 79.71 m ha, of which 47.67% is under cultivation and 29.20% is covered by forest. About 130 cm of rain falls there on average each year, which is about twice as much as India receives. The main crops grown in this area include paddy, oilseeds, pulses, wheat, maize, and coarse grains. There are plenty of mangoes, bananas, guavas, papayas, tomatoes, cauliflower, chilies, beans, and other spices. The state has contributed to the growth of agricultural and related industries by roughly 13% throughout the years, and it is also rich in minor forest products. The Jharkhand government has allocated about Rs 17 crore to promote organic agriculture on

26,310 hectares of land, but other states are spending hundreds of crores of dollars to convert their land to organic. This represents just 0.08% of the state's whole agricultural land area. Despite the abundance of natural resources in this area, its promise for raising agricultural output, reducing poverty, and enhancing livelihoods has not been fully realized. About 69% of marginal and small farmers in the area have fragmented land holding boundaries, and most of them are not using the most recent farming techniques. Furthermore, the productivity of key crops is severely limited by the acidity and salinity of the soil, which affects an area of roughly 11.3 million hectares.

In general, soil salinity/acidity, lowest per capita income, ever-increasing human population and highest population density per sq km, poor infrastructure facilities for storage, processing, marketing, etc., are some of the other factors responsible for poor agricultural growth in Eastern Hill and Plateau Region of India.

Under this scenario, natural farming is one of the best opportunities to explore in these potential areas. The demand for food quality, safety and health consciousness, environmental quality, and ecosystem services are on the rise and that's where the producers, investors, and manufacturers need to ensure that the food they produce is safe and healthy. Natural farming has the potential to address issues related to land degradation, soil health, hydro-physical properties of soils, water, and air pollution, improve ecosystem services, and reduce the cost of cultivation and farmers' risks associated with chemical input based high-cost farming.

Minimal soil disturbance, mulching or soil cover, the use of ghanajeevamrit, jivamrit, and beejamrit, crop rotation, intercropping, and the application of brahmastra, neemastra, agniastra, and other techniques for managing nutrients, water, and pests are the foundations of natural farming. These fundamental ideas and methods are in line with nature and can lessen the strain on artificial chemicals and their residues in the environment and agricultural products. Additionally, using natural farming methods will increase the quality of the water and the health of the soil, particularly its biological qualities. In India, the goal is to convert around 10% of the farmed land to natural or organic farming. Approximately 5 m ha of the wild harvest and 5.4 m ha of the cultivated area are currently undergoing the organic farming certification procedure.

The natural farming is a set of farming methods that involve zero credit for agriculture, as the name implies, is a method of farming in synchronization with nature and not through chemicals where the cost of growing and harvesting crops is minimized as no use of chemical fertilizers, insecticides, pesticides, and weedicides to ensure the healthy growth of crops having more nutritional values for human consumption. It is a sustainable and environmentally friendly way of farming with no use of chemicals is drawing the attention of the world since the past few years. It is the adoption of two eco-friendly and sustainable farming practices by the use of organic amendments which can not only reverse the declining trend in global productivity but also help in environmental protection (Naikwade *et al*., 2012). It restricts the use of chemicals and protects plants from infection also in natural way. The application of organic manures like compost, vermi compost, green manures, and crop residues such as dried leaf, straw, etc. showed better results in terms of seed germination, crop growth, and yield potential (Ghadge *et al*.,2013, Naikwade, 2014). In natural farming, the nutrients, soil improvers, growth enhancers, pest controllers, etc., are all made by the farmers using natural materials generally available at the farmland. Nothing needs to be bought from the market. The requirement of nutrients and elements like nitrogen, phosphorous, potassium, calcium, etc. are derived from the decomposition of organic waste. Earthworms and other microorganisms play a vital role in this process. Natural farming works in harmony with nature and only a catalytic culture derived from cow dung and cow urine is used to increase the microbial population in the soil. It does not require any external input in monetary terms. Hence, also called 'Zero Budget Natural Farming' in India as coined by Padam Shree Subhash Palekar.

Natural farming, nowadays is a grassroots peasant movement, which has spread to various States in India. It promises to cut down farming expenditures *i.e.,* production costs curtailed drastically and dependence on purchased inputs as it encourages the use of own indigenous or desi seeds and locally available natural fertilizers, therefore ending the debt cycle for desperate farmers to end a reliance on loans. It is basically a natural farming technique that uses biological pesticides instead of chemical-based fertilizers. Farmers use earthworms, cow dung, urine, plants, human excreta and biological fertilizers for crop protection. It reduces farmers' investment and also protects the soil from degradation.

Organic formulations like Panchagvya, Bijamrita and Jivamrita are used in organic farming. The organic formulations play a major contribution to for their germicidal and growth properties. These are prepared by fermentation process locally and available ingredients at the farm with having no major expenditure. These are the rich sources of beneficial micro flora that which support and stimulate plant growth and help in getting better vegetative growth and quality yield (Devakumar *et al*., 2014). It aims to sustain agricultural production with eco-friendly processes to produce agricultural produce free of synthetic chemicals and promote good agronomic practices (Koner and Laha, 2020).

The cow dung from local cows has proven to be miraculous for the fertility and nutrient value of soil. The Bijamrita prepared from locally available cow dung and cow urine is used for seed treatment before sowing

(Swamy, 2009). The cow dung and urine of indigenous cows (*Bos indicus*) are used for making jivamrita as it has a superior micro culture compared to that of introduced European exotic breeds (Palekar, 2009). Bijamrita is a homemade microbial seed treatment made of similar ingredients as Jivamrita used for treatment of seeds, seedlings, or any planting materials. It protects seedlings from seed or soil-borne diseases and young roots from fungi (Khadse *et al*., 2017).

As both a social and environmental impact, it aims to ensure farming – particularly smallholder farming is economically viable by enhancing farm biodiversity and ecosystem services. It reduces farmers' costs through eliminating external inputs and using in-situ resources to rejuvenate soils, whilst simultaneously increasing incomes and restoring ecosystem health through diverse, multi-layered cropping systems. The four wheels of Zero Budget Natural Farming (ZBNF) to be evaluated practically are 'Ghan Jiwamrita', 'Jiwamrita', 'Bijamrita', 'Mulching' and 'Waaphasa'. The Jiwamrita is a fermented mixture of cow dung and urine of desi breeds, jaggery, pulses flour, water and soil from the farm bund. This isn't a fertilizer, but just a source of 500 crore micro-organisms that can convert all the necessary "non-available" nutrients into "available" form**.** Bijamrita is a mixture of desi cow dung and urine, water, bund soil and lime that is used as a seed treatment solution before sowing. Mulching**,** or covering the plants with a layer of dried straw or fallen leaves, is meant to conserve soil moisture, suppress weeds, and keep the temperature around the roots at 25-32 degrees Celsius, which allows the microorganisms to do their job. Waaphasa, or providing water to maintain the required moisture-air balance, and achieves the same objective.

Conventional farming however increased the food grain production by use of improved varieties of seeds, chemical fertilizers, pesticides and farm machinery as an outcome of the green revolution, but it gave rise to various problems like loss of fertility of soils, environmental issues and health hazards. It requires high input costs and ecologically and economically not sustainable. So, the natural farming is one of the best alternatives. It advocates the use of organic waste available in farm lands for meeting the nutritional requirements and also the plant protection measures of plants. The food and fruits derived from such systems are more nutritious and having more demand in the national and international market. It is easy to adopt and a large numbers of farmers in India are switching over in natural farming. The continuous and indiscriminate use of chemical fertilizers and pesticides has led to loss of fertility of soil (Rodriguez et al., 2004). It impaired the power of 'biological resistance' in crops making them more susceptible to pests and diseases (Sinha and Herat, 2012). High input cost of seeds, chemical fertilizers and pesticides has made this kind of agriculture unsustainable and economically unfeasible (Singh *et al*., (2011). The pests became immune requiring stronger and more pesticides (Pandey & Singh, 2011). It also contaminates the water sources and overall resulted decrease in the agriculture production. The farmers in India recently experienced increased input cost for production and low productivity resulting in overburden of loan in their life. So, the farmers in India are committing suicides due to this high input cost in such agricultural practices (IGIDR, Srijit 2006)**.**

In developing nations like India, natural farming is an affordable technique that works well for small and marginal farmers. Therefore, the Indian government launched a national initiative on organic farming after discovering the negative effects of traditional agricultural methods. India's farmers are gradually returning to natural farming, or sustainable farming. Since 2015–16, the Indian government has been encouraging organic farming in the nation through the Rashtriya Krishi Vikas Yojana (RKVY) and the Paramparagat Krishi Vikas Yojana (PKVY). Numerous organic farming models, including Natural Farming, Rishi Farming, Vedic Farming, Cow Farming, Homa Farming, Zero Budget Natural Farming (ZBNF), and others, have been included. States are allowed to choose any organic farming model, including ZBNF, based on the preferences of the farmers.

In natural farming, Bijamrita a traditional biofertilizer, especially used for seed treatment enhances germination, protects from phytopathogenic infections and increases plant vigour (Palekar, 2009). Bijamrita is a technique of seed treatment from locally available ingredients. It protects the crop from harmful soil borne and seed borne pathogens during the initial stages of germination and establishment. Devakumar *et al*., (2008) and Sreenivasa *et al*., (2010) have also reported the presence of many beneficial microorganisms *viz*., nitrogen fixers, phosphorus solubilizers, actinomycetes and fungi in Jivamrita and Bijamrita. The use of bijamrita a very traditional knowledge in India, documented also by researchers that organic manures contain essential required nutrients which result in increased crop growth and yield (Naikwade, 2017).

It is also evident when any poisonous fungicide is applied to the seed useful effective microorganisms are also destroyed in the soil. As soon as seeds treated with poisonous chemicals germinate and grow, chemicals are also absorbed by the roots along with soil water solution and then transferred and trans located in various parts of the plant.

Jivamrita and panchagavya have enhanced the growth of nitrogen fixers in locally available substrates such as press mud, compost and digested biogas slurry (Devakumar *et al*., 2011) and a greater number of beneficial microorganisms were recorded in panchagavya under higher acidity. These microorganisms secrete proteins, organic acids and antioxidants in the presence of organic matter and convert them into energy thereby the soil micro flora and fauna change a disease inducing

soil to a disease suppressive soil (Somasundaram *et al*., 2003). The reason behind the better performance of Bijamrita treatment may be due to the micro organisms associated with it. Swaminathan (2005) showed that naturally occurring beneficial microorganisms mainly bacteria, yeasts, actinomycetes, photosynthetic bacteria and certain fungi were detected in cow dung which is one of component of Bijamrita. Bijamrita contain macro as well as micro nutrients, many vitamins, essential amino acids, growth promoting factors like indole acetic acid (IAA), gibberellic acid (GA) and beneficial microorganisms (Natrajan, 2007).

The presence of beneficial microorganisms in organic liquid formulation might be mainly due to their constituents such as cow dung, cow urine, legume flour and jaggery and associated microorganisms and their products (Palekar, 2009; Sreenivasa *et al*., 2010). Many environmental groups and governments have demanded decrease of inorganic fertilizer use in agriculture to diminish nutrient leaching into ground water or water pollution (Naikwade, 2014).

Bijamrita are easy to prepare and made from locally available ingredients are useful to increase seed germination percentage, seedling growth and seed vigour index (Jha *et al.,* 2020; Jha *et al.,* 2021). The expenditure incurred on production of Bijamrita is very less as it is made up from locally available ingredients. Its regular use for seed treatment will reduce the use of chemicals and subsequently reduces the pollution caused by chemicals. So, instead of applying chemical to seeds, Bijamrita must be popularized on larger scale.

The Natural Farming, which is like "Going back to Basics" and whether the emphasis on zero budget natural farming can really help to double the farming income in days to come. Therefore, it is the need of hour to evaluate the NF Modules in Eastern Plateau and Hill Region for its economic viability, system productivity and nutritional quality in comparison to the conventional farming.

Pesticide preparation under Natural Farming

Neem and cow urine are crucial ingredients in the manufacturing of natural insecticides. About 200 insects, pests, and nematodes can be effectively managed using neem. Aphids, moths, caterpillars, beetles, leafhoppers, plant hoppers, and grasshoppers are all effectively repelled by it. According to Yadav (2010), cow urine is a highly effective way to control insects and diseases while simultaneously promoting crop growth. Two kilograms of cow dung are combined with 200 liters of water, and then 10 liters of cow urine are added to create the natural insecticide known as Neemastra. To this combination, 10 kg of Neem tree leaf paste is added, and it is aggressively mixed with a stick. It is well covered with a gunny bag and left in the shade for 48 hours to ferment. Every morning and evening, it is thoroughly agitated in a clockwise direction for one minute. A fresh cloth is used to filter the solution, which is then placed in a container for storage. Neemastra is in this way prepared (Palekar, 2009). Keeping this in earthen pots is beneficial. Plants must be sprayed with this straight, without diluting it. To make a natural pesticide, also leaves added from other trees that the cows don't consume, in addition to Neem leaves. Compared to chemical farming, these bio pesticides are said to be far more effective for controlling pests (Ranga Rao, 2007).

Mulching in Natural Farming

A crucial component of natural farming is mulching. Growing suitable intercrops in between the main crop rows is one way to accomplish mulching. Another option is to use dry leaves and twigs as mulch between the crops. When Jivamrita is applied, the twigs and leaves break down, enhancing the soil's fertility. When the whole surface of the soil is covered with mulch and intercrops, sunlight is best absorbed by the canopy and little to no sunshine reaches the soil itself. This lowers the need for external water by preserving a microclimate with high humidity and moisture retention in the soil (Sathyanand, 2010).

Mulching also inhibits the growth of weeds. It enhances soil structure and water infiltration, minimizes water runoff, reduces soil surface temperature and consequently reduces water evaporation. Mulching increases the soil's ability to retain water, encourages the creation of humus, and decreases tillage. The crop will be better able to withstand drought conditions if there is adequate mulching to keep the surface and subsoil moist and to minimize water loss through evaporation (Babu, 2008).

Additionally, the crop residue is used as mulch to retain moisture, increase soil ventilation, produce organic fertilizer, enrich microorganisms after decomposition, and inhibits weed growth. Natural farming acknowledges the importance of native fungus and bacteria to the ecosystem. Since they have a significant role to play, they are valued and safeguarded rather than eradicated.

Yields and Quality of Produce under Natural Farming

In ecologically managed farms, the characteristics of plant and animal products are substantially superior in terms of nutrition, taste and shelf life (Sundaravadivel *et al*., 2011). According to Aher *et al.*, (2012), who evaluated the research done by different scientists, the yields from this type of farming are higher than those from conventional farming. According to Susan (2011), natural farming produces twice as much as conventional farming. In comparison to conventional farming, Sharma (2009) claimed increased yields from his property. In Tamil Nadu, India, Vijayakumari (2012) studied several farming practices and discovered that natural farming

produced higher yields.

In-depth research on vegetable crop yields utilizing natural farming was conducted by Mohan (2008), who found that this approach produces higher yields than conventional farming. Additionally, according to Pretty (2006), the yields from this type of farming are 79% higher than those from conventional farming. Hindu (2009) highlighted an example of farmer in Karnataka who received the higher output of paddy in an acre of land as compared to his surrounding farmers who utilized conventional farming.

Additionally, it has been shown that natural farming produces considerably higher-quality crops than conventional farming. Compared to their chemically grown equivalents, these fruits and vegetables are said to be more nutrient-dense, high in "antioxidants," and potentially very healthy for people (Sinha *et al.,* 2012). Cho (2012) noted that the nutritious content of produce grown naturally is significantly higher. It has been found that natural farming can produce up to 300% more proteins, amino acids, crude fats, and other vital nutrients than conventional farming.

Organic farming makes use of organic formulations such as Panchagvya, Bijamrita, and Jivamrita. Farmers make them at the farm using a fermentation process using readily available, locally sourced materials without incurring significant costs. These are the abundant sources of beneficial micro flora which promote, stimulate the plant growth and help in attaining improved vegetative growth and quality production (Devakumar *et al.*, 2014). In order to produce agricultural products free of artificial chemicals and to encourage sound agronomic practices, it seeks to maintain agricultural production using environmentally friendly methods (Koner and Laha, 2020). This farming technique eliminates the need for the farmer to spend money on buying seeds, fertilizer, and crop protection chemicals from the market. The farmer can develop his own seed or he may use seeds that are available with other farmers (Anand and Kumar, 2020). Natural farming is promoted as a remedy for India's growing farmer suicide rate and agrarian problem (Palekar, 2009). According to Campesina (2010a), each farmer must modify the principles to fit their own ecological and cultural setting. By reducing reliance on outside inputs and financing for farming, natural farming seeks to significantly reduce production costs (Khadse *et al.,* 2017). By improving soil and water quality, it decouples agricultural productivity, reduces ecosystem degradation, and conserves biodiversity, giving farmers and other value chain participants a stable means of subsistence (Naresh *et al*., 2018). The soil quality is the capacity of a soil to work within the limitations of ecosystem, land use to sustain productivity, environmental quality and promote plant and animal health (Doran and Parkin, 1994). Due to the overuse of chemical fertilizers and the under application of organic manure, soil health has declined (Chand and Pandey, 2008).

Since the cow is the foundation of Indian culture and the rural economy, it provides for our needs and is a symbol of biodiversity and cattle richness. It is referred to as "Kamdhenu" and "Gaumata" due to its maternal nourishment, provision for humanity, and medicinal reserves. Since ancient times, cow dung and urine have been employed in India for a variety of organic formulations and medications that are well-known for their therapeutic and germicidal qualities. The fertility and nutrient value of soil have been miraculously improved by using cow manure from nearby cows. It is estimated that there are 300–500 crore helpful microorganisms per gram of cow dung. Ancient Indian treaties such as the Charak Samhita, Sushrut, Vagbhaat and Nighantu, Ratnakar, etc., have all made reference to their application in sustainable agriculture. Before seeds are sown, they are treated with Bijamrita, which is made from locally accessible cow dung and urine (Swamy, 2009). Bijamrita is a homemade microbial seed treatment made of similar ingredients as for Jivamrita used for the treatment of seeds, seedlings, or any planting materials; it is effective in protecting young roots from fungus and seedlings from seed or soil borne diseases (Khadse *et al.,* 2017). The Ayurvedic system of Indian medicine has detailed references for the importance of cow's milk, curd, ghee, urine, etc. in the treatments; each commodity has unique qualities and uses in health, farming, and other sectors (Joshi, 2002; Achliya *et al*., 2004; Chauhan, 2005). Other than chemically treating the main crops of cucurbits, leguminous crops, and poaceae, the use of environmentally friendly organic treatments must be assessed before being suggested in agriculture. As can be seen, beneficial microorganisms in the soil are also eliminated when any toxic fungicide is sprayed on the seed. When toxic chemical-treated seeds sprout and develop, the chemicals are also taken up by the roots along with the soil water solution, which is subsequently moved and deposited throughout the plant. Numerous diseases can affect seedlings of various plants. According to Devakumar *et al.,* (2008) and Sreenivasa *et al.,* (2010), Jivamrita and Bijamrita are home to a variety of helpful microorganisms, including fungi, actinomycetes, phosphorus solubilizers, and nitrogen fixers. According to academics, bijamrita is a very old Indian knowledge that organic manures contain vital nutrients that boost crop growth and output (Naikwade, 2017). The microorganisms found in organic formulations transform raw nutrients into a form that is easy for plants to absorb and utilize effectively, resulting in improved crop growth. In locally accessible substrates like press mud, compost, and digested biogas slurry, Jivamrita and panchagavya have promoted the growth of nitrogen fixers (Devakumar *et al.,* 2011). Additionally, under higher acidity, a higher number of beneficial microorganisms were observed in panchagavya. When organic matter is present, these microbes release proteins, organic

acids, and antioxidants, which they then transform into energy. As a result, the soil's microflora and fauna transform disease-causing soil into disease-suppressive soil (Somasundaram *et al.,* 2003). It suggested that using jivamritha could produce better results in rice than chemical farming (Amareswari and Sujathamma, 2012).

The Jeevamrutha and Panchagavya have enhanced the growth of nitrogen fixers in locally accessible substrates including FYM, compost, and digested biogas slurry, among others, claim Devakumar *et al.,* (2011). Organic manure treatments had shown a long-term benefit on *Vigna unguiculata* and boosted productivity (Mogle *et al.,* 2013). Organic treatments provide micro and macro nutrients to crops, resulting in improved growth and yield (Ghadge *et al*., 2013; Naikwade *et al*., 2011). According to microbiological tests, a higher number of bacteria were seen, followed by phosphorus solubilizers, nitrogen fixers, fungi, and actinomycetes. In order to reduce nutrient leaching into ground water or water pollution, many governments and environmental groups have called for a reduction in the use of inorganic fertilizers in agriculture (Naikwade, 2014). Similarly, organic liquid treatments should be promoted instead of chemical ones for seeds. These higher beneficial microorganisms may help mobilize more plant nutrients and required plant growth promoting substances and other micro nutrients are made available to the plants (Devakumar *et al*., 2014).

Expected Outcome

An approach to sustainability, productivity, profitability, economic viability, improving the nutritional quality of farm produce, cost-free farming in harmony with nature, farming with minimal water and electricity consumption, producing high-quality, poison-free food, agriculture without external inputs, multicrop cultivation technologies for increased net income, lowering the need for external labor, and farming in harmony with nature are the results of the evaluation of natural farming.

CONCLUSION

However, as a result of the green revolution, conventional farming increased the production of food grains by using improved seed varieties, chemical fertilizers, pesticides, and farm equipment. However, this led to a number of problems, including soil fertility loss, environmental problems, and health risks. Therefore, one of the greatest options is natural farming, which promotes using the organic waste that is present on farmlands to meet nutritional needs and protect plants. These systems produce more nutrient-dense food that is in greater demand both domestically and abroad. Many farmers in India are converting to natural farming because it is simple to implement. In light of these facts, it is fundamentally necessary to integrate technology, scale up and frame demand-driven productivity enhancing research agendas, and use both conventional and frontier technologies in a network mode to ensure scientific management of natural resources and production sustainability. In order to solve the various researchable challenges and to meet the goal of food security in the region, research goals must be reoriented in light of the eastern region's generally diverse and risky agriculture.

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