Application of Nano Organic Materials in Agriculture farming and yield analysis for Groundnut crop with comparison to conventional inorganic farming

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Abstract. Agriculture is the primary source of income for the majority of India's people. Big farmers in India use inorganic fertilisers and pesticides on their plantations. However, it would reduce soil fertility. So, in order to address this problem, this paper encourages farmers to return to organic farming, while still increasing crop yield and decreasing crop water requirements. Nano materials and different bio fertilizers were used to cultivate the groundnut crop. For this, we applied these fertilisers to one acre of land for crop production, whereas on the other hand, we applied simple organic fertilisers and water to another one acre of land for comparison. The key goal is to increase yield with high-quality groundnuts. The use of these Nano organic products results in a 17-20% increase in overall production, and the cost-benefit ratio is 1.98, which is very good as compared to conventional inorganic farming.

Keywords: Agriculture, Irrigation, Groundnut, Organic Farming, Nano Material, Crop

1. Introduction

Agriculture is the backbone of the Indian economy. According to 2018 estimates, Indian agriculture accounts for 17 percent to 18 percent of total GDP and employs 50 percent of the total population [1]. India is the world's leading supplier of peas, corn, wheat, vegetables, and spice oils. India has surpassed China to become the world's second-largest producer of fruits and vegetables. According to the branch of economics and statistics, the production of food grains for the year 2013-2014 was 264 million tonnes, an increase from the previous year's yield of 257 million tonnes [2, 3]. This is a fantastic symptom for the Indian economy from the agricultural sector. India is also one of the top three producers of diverse agricultural products such as paddy, wheat, pulses, groundnuts, rapeseeds, natural merchandise, greens, sugarcane, tea, jute, cotton, tobacco leaves, and so on [4]. Irrigation is described as "the artificial presentation and systematic division of water for agriculture and horticulture in order to achieve better or higher quality manufacturing" [5]. Water is essential for plant growth and has been for millennia. Farmers who have been effective have used one-of-a-kind approaches to water their plants [6]. Irrigation is the artificial application of water to compensate for rainfall deficits in developing plants [7]. Irrigation is a basic determinant of agriculture since its deficiencies are the most important restrictions on agricultural output growth [8]. However, the adoption of high-yielding crops, chemical fertilization, and the usage of multiple cropping systems has greatly increased the use of controlled irrigation for the production [9, 10]. Water is typically supplied to all irrigation farms, with the majority of water available within the soil where plant roots expand in volume. Water is usually supplied to the most important part of the vegetation [11]. Water is usually supplied to the plants by downpours. Regardless, absolute precipitation in a given area can be either absent or badly limited [12].
The majority of studies are focused on improving physical, chemical, and biological measures of soil health and water quality, the protection of biodiversity and the atmosphere, the effects of seed production, profitability, pathogenic vulnerability, and the effects of agriculture on climate tolerance or global warming potentials in organic crop systems. The continued and expanded usage of chemical fertilisers has a number of negative impacts on soil and water quality, as well as a decrease of soil fertility [13]. Long-term field studies revealed a decreasing pattern in production and soil resource depletion as a result of increased cropping with continuous fertiliser inputs but no manure addition.

Organic farming, on the other side, has the possible benefits of encouraging soil structure forming, enhancing soil sustainability, preserving the environment, optimising soil quality, food quality and protection, and maintaining premium price. Crop yield increases recorded within the first few years of organic farming have been attributable to incremental changes in soil resources, such as the soil microbial community's ability to mineralize [14]. As a result, sustainable farming schemes have the capacity to reach farm system sustainability. Organic farms have the advantage of further protecting the environment and being able to withstand changes in the external environment, as well as lowering agricultural input costs, increasing farmers' income, continuously maintaining agricultural productivity, and improving soil quality and agricultural products [14]. As a result, organic farms are regarded as a sustainable farming mode. While the above land, water, and nutrients are more environmentally friendly in organic farming, there are other variations in ecological benefits between organic farms and traditional farms. For example, while organic farms have more aphid enemies than traditional farms, the attack rate of parasitic aphid enemies does not increase significantly. India is the world's largest producer of ground nuts, and they play an important role in the Indian economy. In India, ground nut is regarded as the "King of the Oil Seeds." Ground nut is a cash crop in India since it can be cultivated anywhere in the tropics with a minimum rainfall of 550 mm and a maximum rainfall of 1255 mm. Farmers are also utilizing inorganic fertilizers and pesticides in their farms to increase production and product consistency. However, these pesticides can have an effect on land productivity and, as a result, will have an indirect impact on farm yield and commodity consistency [15].

Nanotechnology is an interdisciplinary branch of science concerned with the production and application of nanoparticles (NPs) from 1 to 100 nm in size. Nanotechnology is seen as a modern method for addressing different issues in agriculture and other related industries [16]. The agricultural system is confronted with issues such as the development of resistance among microbes as a result of excessive pesticide use and deterioration of soil quality as a result of excessive fertiliser use, all of which have a negative impact on the ecosystem. A considerable amount of distributed fertilisers and nutrients are dissolved in the environment and are not used by plants, limiting the usage of traditional approaches. Since bioactive compounds are encapsulated here and released at a regulated pace, Nano science may be a possible answer to these limitations [17]. Diseases may be quickly identified at an early stage by using Nano sensors, and thereby monitored at an early stage for improved efficiency. Various disease-controlling chemicals, such as Nano-pesticides, Nano-fungicides, and Nano-bactericides, are used to shield crops from various biological pressures induced by various microorganisms. The fact that NPs have a low surface area to volume ratio leads to their superior absorption efficiency [18]. Post-harvest methods based on Nano sensors aid in food quality control by improved processing and transportation, resulting in lower post-harvest losses. The agriculture sector also
produces a significant amount of agricultural waste, which is being converted and placed to productive use using Nano materials. The usage of Nano carriers to move the DNA (deoxyribonucleic acid) fragment at the correct site and bring the desired effect has increased agricultural productivity utilising Nano biotechnology [19]. As a result, Nano materials help to increase nutrient utilisation performance. This paper discusses how Nano materials can be used to improve soil quality, plant production, disease identification, control, and care, genetic engineering, post-harvest value addition, and agriculture waste reduction. Even with these advantages, Nano materials can be harmful to the ecosystem, so adequate risk management and policies should be implemented for the best usage of nanotechnology [20]. The use of Nano materials will result in sustainable agriculture, which should be encouraged with careful control.

Over the last decade, the area of nanotechnology has experienced exponential development and has had a measurable effect on all aspects of our environment, from computing to medicine. Nonetheless, nanotechnology uses in agriculture are only in their early stages. People in India are becoming more mindful of the benefits of using organic agricultural goods in their daily lives. As a result, with the demand for organic products, supply will fall short of meeting demand in the Indian market in the coming years. Organic farming is needed by Indian farmers in order to accelerate the development of agri farming using organic fertilizer products. This paper examines the yield of a ground nut crop grown on one acre of land with inorganic and nano-organic fertilisers.

2. Study Area

Mehsana, with a population of about 2,30,000 inhabitants, is a significant city and a small agricultural hub in the state of Gujarat. Mehsana is a significant city in Gujarat, located in the state's northern region. It extends its outskirts to five separate regions of the province. Though Banaskantha boundaries are to the north, Ahmedabad and Gandhinagar are to the south. Patan and Surendranagar are on the western outskirts of Mehsana, though Sabarkantha is on the eastern outskirts. Mehsana stands at a height of 265 feet above sea level.

This area is divided into 9 talukas, which are further subdivided into 604 cities. Mehsana's total topographical area is 4.4 lakh hectares, of which 80 percent is under construction in nearly all of its talukas. Mehsana's latitude is 23.586761° and longitude is 72.369949. The major rivers are the Sabarmati, Rupen, Sarasvati, Khari, and Pushpawati, with an annual rainfall of 600 mm. The research site is in Pamol village, Vijapur taluka, Mehsana district. The groundnut crop, which is a Kharif crop, is grown for research purposes, and the soil is Ghoradu Soil.
3. Methodology and Materials

The main goal is to compare farming, one with traditional farming and another with farming using nano organic content, and determine the production, crop output, and budget price differential of both farming. We begin by identifying the farming region, which is located in Pamol-village, Vijapur-taluka, Mehsana district. Then the task of planting, levelling, and manuring the field began. Following that, seed was sawed in each of the various farming systems, and both procedures were completed under the supervision of expert growers, during which we analysed and compared the results of organic and inorganic farming.

We will grow crops utilising sprinkler irrigation methods and different Nano Organic materials in this research. We used organic items such as Agri Humic and its granular form, Agri-82, and Agri Protek, and we want to use conventional fertilisers such as DAP and cow dung.

3.1 Experimental work

These are some of the pre-processes we've done for crop development. First and foremost, we cultivated the whole land, resulting in soft soil for better crop development. Following that, we applied manure and fertilisers to the soil and levelled it in order to increase crop productivity. We coated the seeds with different protectors to protect them from fug and termites. Then we saw the seeds on the ground and watered them, as well as using a different approach for better crop development.
3.2 Crop Growth

As seen in Figure 4, which depicts the stages of the groundnut crop that we prepared on the farm using Nano organic farming and organic materials. The seed emergence stage begins after 5-10 days of seed sawing. After 10 days, the stage of leaf growth has begun. The flowering stage will begin at the end of the 30-day period. After 45 days, the pegging stage will begin, and at the end of the process, the maturity stage will arrive. We used organic products (including Nano materials) for groundnut crops at the correct dosage, as seen in table 1 below for a 1 acre farm.

Table 1. Product Dosage and details for 1 Acre land area

| Steps | Product          | Quantity | Time                      | Details                          |
|-------|------------------|----------|---------------------------|----------------------------------|
| 1     | Agri-Humic Granules | 5 kg     | While seeds sawing        | Mix with fertilizers             |
|       | AgriNanotek          | 250 gm   |                           |                                  |
|       | Agri 82             | 150 ml   |                           |                                  |
| 2     | AgriHumic          | 300 ml   | Before 7-8 hr of seed sawing | Coating on the seeds            |
|       | AgriProtek          | 250 ml   | Before 7-8 hr of seed sawing | Coating on the seeds            |
| 3     | AgriHumic          | 100 ml   | After 15-20 days of seed sawing | Spray on the crop by mixing with water |
|       | Agri Gold           | 50 gm    |                           |                                  |

Figure 4. Crop growth in time series in farm
| Product       | Quantity | Application Details                                      |
|--------------|----------|----------------------------------------------------------|
| Agri 82      | 150ml    | After 30 days of seed sowing, spray on the crop by mixing with water |
| AgriProtek   | 250gm    | After 30 days of seed sowing, spray on the crop by mixing with water |
| Agri Moss    | 100 ml   | After 30 days of seed sowing, spray on the crop by mixing with water |
| Agri 82      | 150ml    | After 60 days of seed sowing, spray on the crop by mixing with water |
| Agri Nanotek | 250gm    | After 60 days of seed sowing, spray on the crop by mixing with water |
| Agri Gold    | 100 gm   | After 60 days of seed sowing, spray on the crop by mixing with water |

i. Agri Nanotek: It is a highly inventive object made possible by nanotechnology. It aids in soil ripeness by supplying set supplements and minerals to the soil. It improves soil productivity, plant growth, supplement use, and photosynthesis measurement. Nanotechnology has the potential to turn rural frameworks, biomedicine, ecological construction, health and conservation, water assets, vitality transformation, and numerous other areas [21]. Agri-Nanotek is a remarkable product produced by using nanotechnology. Agri-Nanotek is a chelated Nano fertilizer made possible by Nano-chelating technology. Its mechanisms are adaptable, making it clean and robust in both basic and acidic soils. It demonstrates unmistakable Nano scale characteristics on harvests, such as simulative effect on photosynthesis ability and chlorophyll growth rate. It also aids in the growth of the leaf surface [22]. When Agri-Nanotek is added to plant surfaces or soil, it colonises the rhizosphere or the inside of the plant and promotes growth by increasing the gracefulness or accessibility of vital nutrients to the host plant. It lengthens the fertilization period and promotes blooming. It aids in the arrival of inorganic supplements in the soil as well as their preservation via the root. It aids in organizing the retention of minerals from the soil over a large area and delivering the equivalent to the root. This allows the plant to use 2-3 times as much nitrogen, phosphorus, potassium, and calcium [23]. Agri-Nanotek is free of contaminants. When it is said and finished, it strengthens the physical properties of land and soil health. It increases the ripeness and viability of the land. It increases the crop production. It has a significant amount of strength in semi-arid environments. It generates nutrients and aids in the production of hormones.

ii. Agri 82: Agri 82 is a non-ionic splash adjuvant of 82 percent dynamic fixings that is strongly condensed. By developing pesticide inclusion, Agri 82, a great Spreader, Activator, and Wetter, improves seed production. This causes the shower liquid to saturate the plant surface, allowing for uniform splash store distribution. It's a valuable instrument in the water method that boosts soil water intake. It makes it easier and more efficient to blend powders, pesticides, and the rest of liquid manures consistently [24]. It is non-phytotoxic, non-polluting, and environmentally safe. It would benefit fungicides, herbicides, pesticides, foliar manures, plant supplements, and defoliators.

iii. Agri Humic Granules: Agri-Humic Granules is a plant bio energizer that contains 1.5 percent Humic Substances extracted from natural problems. It accelerates plant metabolic processes and aids in supplement absorption. It aids in overcoming dampness tension and establishes yield limits, resulting in higher yields and the nature of harvests.
iv. Agri Protek: It protects crops from termites and other worms such as white worms and other creepy crawlies. Agri Protek is a novel concept of a basic and touch natural fungicide. It multiplies rapidly on root exudates, producing anti-toxins and chemicals that kill microbes in the rhizosphere and protects the host plant. It is made up of conidial spores, mycelia fragments, and vegetative cells. It is effective against the majority of parasitic illnesses found in different harvests. Agri Protek functions as an organic control expert, the aggressive properties of which are dependent on the activation of various instruments. Agri Protek is an organic fungicide that attacks disease-causing microbes until they reach the root framework. It grows quickly and circles across the microbe, entering into it and absorbing nutrients from it [25]. The microbe eventually dies and is discarded from the field. It provides long-term control against the microorganism by releasing optional metabolites that have an anti-microbial effect on the microorganism. It also promotes plant growth by releasing various acids that aid in the solubilization of insoluble phosphorus, thus making phosphorus more available to crops [26]. It serves as both a preventative and a correction measure. It also aids in the improvement of the plant's defence mechanism against disease.

v. Agri Humic: Agri-Humic is a humic material focus. It is a plant bio energizer that contains 6% humic substances derived from freshly treated sustainable Agri Biomass. This item encourages harvests to keep an eye on osmotic strain. These complex humic compounds, for example, humic acid, fulvic acid, and activated phytohormones (plant growth substances), promote cell division or cytokinesis in plant roots and shoots [27]. This item accelerates plant metabolic cycles and improves supplement take-up, allowing the supplement to be used more effectively, resulting in higher growth, production, and enhancement of plants. This thing increases the soil's capacity to retain supplements and water. It also promotes the growth of beneficial microorganisms in the soil. Agri-Humic also helps plants to survive extreme weather conditions [28]. The production of humic compounds is completed through the use of natural crude oil. It is a more effective way of producing Humic compounds. The technique used to strip AgriHumic material is more well-thought-out than other products available on the market. As a result, the item's capability and usability period are increased. It has a higher bio-viability than the object.

vi. Agri Moss: Agri-Moss is a natural birthplace for the complete nourishment of plants. It is a water solvent that is safe for plants, animals, and humans. It improves crop production, resources, yield, and quality. It is highly useful in terms of plant fruitfulness and proliferation. AGRI-MOSS improves crop execution, life, yield, and efficiency [29]. It is extremely beneficial in terms of plant fruitfulness and multiplication. It enhances the hostile to stretch effect. Agri greenery improves plant metabolic activities. It easily reaches the plant body and promotes the flow of cytoplasm. It stimulates cell division. It increases plant hormone transport and changes plant responses to these hormones. It promotes the enthusiastic development of buds, encourages more conspicuous blossoming, advances fertilisation, and the establishment of organic goods. It increases the quantity and quality of the gather. Agri-greenery fundamentally increases seed production and yield. It reduces blossom and natural product falling. It increases supplement take-up and advances the standardised shape and colour of natural goods. It promotes better supplement absorption by increasing root hair output. It promotes lateral stretching and provides a better plant outline.
vii. Agri Gold: Agri Gold is a plant growth controller that can easily reach the plant and provide enchanted results. It aids in the advancement of cytoplasm dissemination inside the plant cell. It is a unique blend of bio-fixings that induces the harvest to increase its metabolic activities and improves its development. This improves both the consistency and quantity of harvests. Agri gold directly and indirectly affects the composition and productivity of common plant networks. It regulates cell measurement in targeted cells. It aids in the placement of roots, branches, and blossoms. It also aids in determining the course of events and the ageing of organic materials. It aids in the regulation of metabolic reaction rate. It also serves as a catalyst, hastening reactions. It performs a role in the photosynthesis and respiration cycles [30]. AGRI GOLD works by stimulating plant cell differentiation, producing more chlorophyll and proteins, which promotes the fiery growth of helper buds, blossom arrangement, and fertilisation, thus increasing organic product weight.

Figure 5. Stepwise process of application of various organic products on crop

The above measures are extra steps in traditional cultivation, and the materials we use in all of them are pure organic products. So, the first stage is fertilisation to promote crop development, and the second step is seed coating to shield the seeds from fungi and termites. The third stage involves maintaining nutrients and water in the soil and assisting crops to withstand harsh weather conditions. The fourth stage is more about getting rid of mosquitoes and treating against fungus and termites once more. The final move is all about healthy and improved crop development, high productivity, and larger product size.

4. Results

Nanotechnology has the ability to solve basic agriculture issues created by traditional fertiliser management. We hope to illustrate opportunities for nanotechnology involvement in fertilisers and plant nutrition in this segment, as
well as provide a glimpse of the current state of nanotechnology in this region. Fertilizers are substances that provide nutrients that are essential for plants. Nano fertilizer is a nutrient of the next decade. It provides nutrients more than traditional fertilisers when applied to soils or plant tissues. Nanotechnology is used in the manufacture of Nano fertilizer. This technique is strongly interdisciplinary in nature, and it is directly related to other biological innovations such as biotechnology, Nano-biotechnology, bio-nanotechnology, and agri-nanotechnology. As a result, for successful quality, the plant's leaves must be in good condition. As a result, the first condition for it is sufficient sunshine and water. However, this product helps the plant to consume only the right amount of water. Excessive watering turns the leaves purple, and too much sunshine turns them dark. So, for a healthy harvest, both water and sunlight should be present in sufficient quantities. This Nano organic product solves the water dilemma. The first explanation we get is that when we use this commodity, most of the seeds develop effectively, while on the other hand, the amount of grown crops is decreased. As seen in Figure 6, this is a view of two separate groundnut crops, one with traditional farming and the other with Nano-organic content.

![Figure 6. After 20 days (a) Where no nano materials are used (b) Where nano materials are used](image)

We can see that the section with Nano organic content appears to be stronger, while the section with traditional farming appears to be worse. The most significant advantage is that the influence of these organic ingredients continues for a long time. This photo was taken after 20 days of seed sowing, demonstrating how much difference can be seen in just a brief period of time. Figure 7 indicates that the leaves of one are whole while the leaves of the other are consumed, indicating that there is a significant contrast between them. As a result, Nano materials were used in those that had entire leaves and were not used in those where the leaves had been consumed. In one of the two frames, the leaves are dark green or black, while in the other, the leaves are light green. This is the primary distinction between organic and inorganic farming. Table 2 shows a quality and quantity comparison of the groundnut harvest, as well as the cost-benefit ratio.
Figure 7. (a) Where no nano materials are used (b) Where nano materials are used

Table 2. Quantity and quality analysis of groundnut crop

| Sr. No. | Farm Type              | Area in ha | Yield in kg | Weight of 100 Nos groundnut in gm | Total Cost in Rs. | Total Benefits in Rs. | Cost-Benefit Ratio |
|---------|------------------------|------------|-------------|-----------------------------------|-------------------|------------------------|-------------------|
| 1       | Organic                | 1 ha       | 1100        | 350                               | 73,000/-          | 1,45,000/-             | 1.98              |
| 2       | Inorganic              | 1 ha       | 800         | 310                               | 70,000/-          | 1,20,000/-             | 1.71              |
| 3       | Normal farm (District) | 1 ha       | 700         | 300                               | 64,000/-          | 1,00,000/-             | 1.56              |

Conclusion

Since Nano fertilisers are more effective, they increase plant growth while saving resources. Plant safety Nano pesticides include Ag, Cu, SiO2, and Zn. Since Nano pesticides are more effective, they also save money. Nano sensors are valuable in precision agriculture since they can identify pests and weeds remotely and in real time, allowing pesticides to be applied quickly and locally. We discovered towards the end of the project that organic farming has a higher overall cost than traditional farming, but the impact is greater and lasts longer, and the outcome is positive and gives us a nutritious harvest. It provides us with increased production, larger package sizes, and a completely organic product that can benefit us for a long time. We will encourage farmers to switch to organic farming as a result of this effort. It also maintains human wellbeing and prevents land degradation caused by poisonous chemicals. Artificial fertiliser usage depletes some of the natural elements in the soil that aid plant growth. However, when utilising these materials, the plant not only receives an adequate amount of natural elements, but also receives extra natural elements that are not present in some forms of soil. According to the results of the trial, organic farming produces a higher yield. Our best outcome was a 17 to 20% increase in yield over conventional cultivation. When it comes to consistency, organically grown peanuts outperform inorginally grown peanuts and the rest of the district. Traditional farming has a cost-benefit ratio of 1.98, whereas inorganic and the majority of the districts have cost-benefit ratios of 1.71 and 1.56, respectively, which are somewhat smaller than organic farming.
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