**Online at:** https://researchtrendsjournal.com
**Indexed Journal**
**ISSN No:** 2584-282X
**Peer Reviewed Journal**


**INTERNATIONAL JOURNAL OF TRENDS IN EMERGING RESEARCH AND DEVELOPMENT**

**Volume 3; Issue 1; 2025; Page No. 257-262**

**Received: 02-10-2024**
**Accepted: 07-12-2024**

# To Integrated Impact of Organic and Chemical Fertilizers on Crop Growth, Yield, Environmental Sustainability, And Human Health

**[1]Shivraj Singh and [2]Dr. Sachin Singh**

[1]Research Scholar, Shri Krishna University, Chhatarpur, Madhya Pradesh, India
[2]Professor, Shri Krishna University, Chhatarpur, Madhya Pradesh, India

**DOI:** https://doi.org/10.5281/zenodo.19473099

**Corresponding Author:** Shivraj Singh

**Abstract**

The extensive use of inorganic fertilizers in agricultural causes significant harm to human health and irreversible damage to the environment. The green revolution and industrial revolution increased agricultural productivity per unit area, but they also increased the use of synthetic fertilizers. Ammonium nitrate, potassium chloride, urea, NPK, and other inorganic fertilizers may accumulate in the environment and pose health risks to people if they leak from plants and enter the food chain. Since increasing the consumption of fruits and vegetables is widely believed to be an important factor in the general population's health, the World Health Organization and the Food and Agriculture Organization have issued dietary recommendations that urge individuals to do just that. The diversity of soil microorganisms is a sensitive measure of soil quality that reveals details about the soil biome, long-term viability, and crop yields. The diversity of soil microorganisms is a sensitive measure of soil quality that reveals details about the soil biome, long-term viability, and crop yields. Chemical fertilizers are a typical and extensively used way to provide plants with nutrients. While inorganic fertilizers have several positive uses, they also come with a number of drawbacks.

**Keywords:** Organic, Chemical, Fertilizers, Environmental and Human Health

## Introduction

Agricultural waste materials such as cow manure and wasted mushroom compost or municipal solid waste compost (MSWC) may serve as good sources of suitable local organic fertilizers. There is a lot of organic matter in them and a lot of nutrients to them like nitrogen and phosphorus. Such studies indicate that MSWC can be an ideal alternative to the use of chemical fertilizers. Yet the yield of crops in fields where organic fertilizer is used is less than that in fields where chemical fertilizer is used since there appears to be inorganic fertilizer not to be sufficiently available as plant nitrogen, perhaps because mineralization is sluggish. To obtain the desired yield and quality, it is important to utilize organic fertilizers in the recommended proportions.

The dietary guidelines given by the World Health Organization and the Food and Agriculture Organization have encouraged people to consume more fruits and vegetables due to the general perception that it is a crucial issue in the health of the general population. Increasingly, the positive impacts of consuming fruits and vegetables on people are being learned about. There are three arguments that help to prove the nutritional value of the produce. Firstly, they contribute a lot to the dietary intake. Secondly, they decrease the risk of developing serious long-term illnesses like cancer, cardiovascular disease, neurodegenerative disease, and metabolic syndrome. Lastly, they are low in calories, which is an increasingly important factor in light of the epidemic of overweight and obesity that is sweeping the modern world.

In addition, the UN predicts that by 2030, the world's population, which is now estimated at about 6.3 billion, would have grown to over 8 billion. Consequently, agricultural production will confront a trifecta of challenges: satisfying the increasing demands of the global population while simultaneously protecting the environment and its

natural resources and maintaining the food's nutritious quality. This triple problem may mostly be addressed by varietal development and related cultivation practices, such as fertilization, as agricultural land has become scarce in many countries. In the developing world, achieving food security through sustainable systems is a big task, yet it is vital for poverty alleviation. To get around this problem, farmers have resorted to overusing specific inputs like chemical fertilizers and pesticides, which have already begun to harm the ecosystem. In most countries of agrarian background, manufacturing and service of chemical fertilizers have been practiced as a prime agenda in securing nations food and nutritional security. India, a populous agrarian country, is the world's second- largest producer (48.7M tonnes of production) (Anonymous, 2022a world population review) and Consumer of chemical fertilizers with 29.84 million metric tonnes. As per recent reports, the Indian fertilizer market reached a value of Rs. 887 billion and is expected to grow at a compound annual growth rate of 5.5%. Food production must increase significantly while agricultures environmental impact must decrease greatly to fulfill the worlds future food security and sustainability needs.

The primary challenge is to enhance agricultural productivity while preserving soil fertility to achieve higher crop yields and meet the growing population's food demand in the coming decades in a cost effective and environmentally sustainable manner. Integrated Nutrient Management, which combines the use of inorganic and organic fertilizers, is becoming a viable way to maintain soil fertility. INM combines the long-term advantages of organic additions for soil health with the rapid nutrient release of inorganic fertilizers. Crop rotation, cover crops, and limited tillage are examples of soil conservation techniques that enhance soil fertility by lowering erosion, enhancing nutrient retention, and preserving soil organic matter levels. These actions are especially crucial in areas where agricultural productivity is severely hampered by nutrient depletion and soil degradation. Farmers can maximize yields while maintaining the long-term sustainability of soil ecosystems by implementing this technique. Managing soil fertility is important for protecting the environment for next generations as well as increasing productivity.

**Literature Review**

Rithika *et al*. (2024) [1] Optimal development and nutritional quality of vegetable crops may be achieved via polyhouse agriculture, which offers regulated environmental conditions. This study examines the effects of controlled climatic conditions and targeted fertilizer treatments on the nutritional composition of several vegetable crops cultivated in a polyhouse environment. To ensure crops are cultivated in a safe environment, it is vital for sustainable agriculture to reduce the utilization of artificial fertilizers. That is why our research will combine the results of chemical and biological fertilizers. We examine four distinct fertilizer combinations: one that employs zero fertilizer, one that utilizes one hundred grams of bio fertilizer (coco peat, mushroom compost, cow dung, bone waste, and bone marrow waste), one that utilizes seventy-five grams of bio fertilizer and twenty-five percent chemical fertilizer (DAP di-ammonium phosphate granules), and a third that employs fifty grams of bio and fifty grams of chemical. Preliminary field preparation included precise spacing calculations, which resulted in the development of 16 well-prepared seed beds spread over 75 square meters. The typical dimensions of a seed bed are 0.3 m in height, 2.4 m in base length, and 1.2 m in breadth with an upper face size of 2.29 m.

Vikash *et al*. (2024) [2] Soil biological traits and chickpea yield were studied in relation to organic ameliorants and solid biofertilizers. The experiment was place in the Rabi season of 2020–2021, at ANDUA&T Ayodhya, India's Instructional Farm. Eleven treatments were included in the experiment: control ($T_1$), chemical fertilizers 100% RDF ($T_2$), In the following sequences: ($T_6$), ($T_7$), ($T_8$), ($T_3$ + FYM + Jeevamrit $T_9$), ($T_3$ + $T_5$), ($T_{10}$ + FYM + Jeevamrit), ($T_3$ + FYM + Jeevamrit) ($T_{11}$), and ($T_3$ + $T_4$ + $T_6$) three times in RBD. As a test crop, the chickpea variety KPG-59 was selected. When combined with chemical fertilizer, the findings demonstrated that solid biofertilizers and organic ameliorants greatly enhanced a number of soil biological characteristics. Results showed that treatments combining FYM with Rhizobium + PSB significantly increased soil health and chickpea yield. The results showed that EC, OC, and OM were relevant soil qualities, while physical properties were not.

Kai *et al*. (2020) [3] Pollution, some of the biggest adverse effects of using chemical fertilizers too often are the emergence of insect resistance and a decline in food safety. There has been a recent uptick in studies investigating the potential of plant-beneficial microbes as a partial substitute for chemical fertilizers, motivated by the need for sustainable agricultural expansion. In order to assess the efficacy of a plant-beneficial Trichoderma strain and its bio-organic fertilizer product in reducing the usage of chemical fertilizers and improving crop quality, a field trial and continuous pot experiments were carried out using tomato. Organic fertilizer (OF), Trichoderma spore suspension (SS), or a combination of a reduced application of chemical fertilizer (75% of the conventional application) and Trichoderma-enriched bio-organic fertilizer (BF) were given to two groups, while a control group used the full rate of conventional chemical fertilizer. Tomatoes treated with BF had an accumulation of total soluble sugar of up to 24%, vitamin C of up to 57%, and nitrate of down to 62% when compared to tomatoes treated with CF, according to the data. When using lesser amounts of chemical fertilizer in combination with bio-organic fertilizer, tomato yields were equivalent to treatments using 100% chemical fertilizer, according to results from both laboratory and field tests. However, as compared to the control, yields would be reduced by 6-38% and 9-35%, respectively, whether the inoculant was applied alone (SS) or in conjunction with organic fertilizer (OF).

Almdari *et al*. (2019) [4] Both chemical and organic fertilizers were tested to see how they affected the quality and quantity of peppermint essence in this study. The 2013 experiment was carried out utilizing a Randomized Complete Design at the Agricultural Farm Center in Sari, Iran. From N60 to K60; N60 to P80; N90 to P50; and N90 to K80, the four replicated treatments (control, vermicompost, compounded sheep manure, and basic chemical fertilizers) were given at various times and in varied places. All the measured parameters were

significantly affected by both organic and chemical fertilizers at both harvest dates ($p$<0.05), according to the data. The first harvest had greater wet and dry yield values, essence content, and essence yield than the second crop. In the first crop, the most optimal mixture of sheep manure and chemical fertilizers at N90, P80, and K80 rates produced the best dry and wet yield values, essence value, and overall yield. Vermicompost outperformed other methods with a dry output of 96 kg $ha^{-1}$ and a wet yield of 207 kg $ha^{-1}$. The productivity was 0.46 lit $ha^{-1}$, and the concentration of essence was 0.48 g/100 g. There was little to no difference in the benefits provided by vermicompost and sheep dung. The use of vermicompost and sheep manure as organic fertilizer was proposed for peppermint cultivation. The first-harvest essence content and yield were significantly higher compared to the control group and other treatments.

Many countries in the tropics and subtropics of Asia rely on brinjal as a staple crop, including China, the Philippines, Bangladesh, Pakistan, and India. The US, France, Italy, and Egypt are also big fans. Future mechanical intervention, exercise, and preservation of organic matter and soil biological diversity will be crucial in maintaining soil fertility. The major objective of this study was to examine the impact of six different fertilizers on brinjal, including five organic and one synthetic. We used vermicompost, chicken manure, mustard cake, neem cake, bonemeal, and N:P:K as fertilizers. The most effective organic fertilizer, in terms of total growth and development, was N:P:K @ 1.5%(19:19:19). Vermicompost@5 ton/ha, on the other hand, excelled when evaluated just in relation to organic fertilizer. Nearby, mustard cake at 1.5 tons per hectare has shown its inherited ability to provide nutrients. Poultry dung, like other organic fertilizers, may quickly and effectively provide a large quantity of nitrogen. Temperatures between 21 and 14 degrees Celsius were shown to be optimal for flower and fruit development, whereas temperatures over 25 degrees Celsius caused growth to slow down.

**The Impact of Chemical and Organic Fertilizers on Toma tomato Growth and Yield**

In 2008, researchers Hala and Nadia analyzed vegetative development at the National Research Centre's Research and production station in F.l-Nobaria. tomato production and quality in relation to various organic fertilizers and the addition of sulfur. The multiplicative effect of the application of chicken and farmyard manures was observed on the weight of tomato shoots and roots (fresh and dried) as compared to the control group (mineral NPK) yield quantity and quality, and mineral composition of tomatoes.

Researchers Ayeni *et al.* (2009) [5] applied a randomized complete block design to test the effects of varying levels of poultry manure (0, 10, 20, 30, 40 t/ha), and 300 kg/ha of NPK 15:15:15 fertilizer on nutrient uptake and yield of tomatoes in two sites in Owo, southwest Nigeria, in its early and late crop seasons in 2007. It was found that there was a significant growth ($p$<0.05) in the plant leaf area, number of leaves, branches, fruits, and fruit production with poultry manure 20, 30, 40 t/ha and the NPK 15:15:15 fertilizer.

Adekiya and Agbede (2009) [6] investigated the impact of four field experiments conducted in 2006 and 2007 in Owo, located in the forest-savarma transition zone in southwest Nigeria, on tomato growth and yield. The treatments included poultry manure (PM), NPK 15-15-15 fertilizer, and NPK 15-15-I5 fertilizer mixed with PM. All degrees of poultry manure. Whether applied alone or in conjunction with chicken manure, NPK 15-15-15 increased plant height, leaf area, fruit quantity, and weight. When applied at a concentration of 30 t/ha, chicken manure produced the most fruit. The NPK 15-15-15 fertiliser mixed with chicken dung produced the best results of the seven treatments.

Research on the impact of several biofertilizers on tomato var. $CO_3$ growth, yield characteristics, yield, and quality was carried out by Premsekhar and Rajashree (2009) [7] in the field. Applying Azospirillum + 75% N + 100% PK resulted in noticeably taller plants, better yield characteristics, and greater yield, next, Azospirillum, and finally, 100% NPK. *Azospirillum ochraceum* was shown to have total soluble solids of 4.450 Brix + 75% N + 100% PK was used.

Yoldas *et al.* (2009) [8] set out to determine how different concentrations of organic and inorganic fertilizers affected the final product's quality and yield in processed tomatoes. Organic and inorganic fertilizers significantly outperformed the control group in terms of overall yield, fruit length and diameter, and average tomato weight. For optimal results, use six metric tons of organic manure per acre in conjunction with half the recommended dosage of inorganic fertilizer fruit diameter and length, and average tomato weight value.

**The Effects of Organic and Inorganic Fertilizers on Sugar Candy Masses**

Crop production and animal husbandry are the two main activities that make up agriculture (Khan *et al*., 2021) [9]. In addition to playing the most significant part in people's lives, agriculture is the most important sector since it supplies humans with energy, starch, and dietary components Adnan (2020) [10], Kalsoom *et al.* (2020) [11], all state that it provides humans with fiber, fuel, and food. The production of malnutrition-prevalent foods is strained to keep up with the needs of a growing population in many developing countries (Adnan *et al*., 2020; & Saeed *et al*., 2020) [10]. A more populous planet means more people needing to eat (Kalsoom *et al*., 2020) [11]. Reducing or eliminating food inequities might help with food waste and insecurity (Sen, 1981) [12]. By 2050, the world's food demand could have doubled. Given the scope of the species extinction crisis, the question naturally arises: how did we come across this? One of the greatest threats to the world's biodiversity is the clearing of land for farming (Sala *et al*., 2000) [13].

With the majority of the world's population living in urban areas and rapid economic development taking place in industrialized countries, there is a great deal of pressure to adapt natural habitats and boost agriculture (Tilman *et al*., 2001) [14]. The availability of sufficient, high-quality food for all people depends on agricultural emissions, which will increase by over 60% over the next four decades. There is an immediate and critical need to improve agricultural output and soil fertility in light of the world's rapidly expanding population and accompanying food scarcity. Adding fertilizers and beneficial bacteria to soil is only one of several ways to boost fertility and production. Soil

bacteria are the most important component of the soil ecosystem and are involved in a great many biochemical processes (Rehman *et al*., 2021; & Toor & Adnan, 2020) [11, 10]. Soil contains both organic and inorganic chemical compounds, in addition to various microorganisms such as fungus, bacteria, and viruses (Ilahi *et al*., 2020) [15].

A delicate indicator of soil quality, the population of soil microbes provides information about the soil biome, sustainability, and agricultural productivity. Thusile organic carbon, total nitrogen content, microbial biomass, functional diversity of soil microorganisms, and productivity are all enhanced by organic manure and other continuous fertilization methods (Chinnadurai *et al*., 2014) [16]. Ilahi *et al*. (2020) [15] found that fertilizer had a similar effect on soil fertility, leading to increased output. One of the greatest difficulties of the twenty-first century is managing agricultural nutrients in a way that ensures a sustainable food supply while also protecting the environment (Zhang *et al*., 2012) [17] According to Ju and Christie (2011) [18], the best fertilization methods are based on key variables such crop nutrient absorption and crop yields. Therefore, it is crucial to apply fertilizers efficiently in order to decrease loss and maximize nutrient usage.

The industrial revolution was the driving force behind the dramatic rise in agricultural yields. Following this, As a result of the green revolution, synthetic fertilizers were more widely used in farming, which contributed to the fulfillment of the increasing demand for food. One of the biggest problems with growing agricultural production is the decrease in soil fertility (Ayoub, 1999) [19]. In order to ensure that everyone has access to nutritious meals, agriculture relies heavily on inorganic fertilizer, which causes many health issues and irreparable environmental pollutions. Many industrialized nations have changed their agricultural policies and banned various dangerous pesticides that caused health problems for both humans and animals. In response, a new farming practice known as organic or sustainable agriculture has emerged, in an effort to mitigate or eradicate the detrimental effects of synthetic fertilizers on both.

Compared to chemical fertilizers, organic fertilizers are more accessible and often less expensive. Solomon *et al*. (2012) [20] states that organic matter is the source of soil fertility. For crops to thrive and stay healthy, bio-fertilizers are a must inexpensive, and are very eco-friendly. In contrast, inorganic fertilizers are expensive and, if not handled properly, may cause a plethora of negative environmental impacts (Gupta, 2008) [21]. Reduced agricultural yields due to soil degradation and nitrogen imbalance are caused by all of these factors. Soil, crop yields, human health, and environmental impacts of inorganic and organic fertilizers are covered extensively in this article.

**The Effects of Fertilizers on People and The Planet**

Chemical fertilizers have been a godsend for farmers everywhere by increasing crop yields. Pesticides and fertilizers containing about 300 million tons of different chemical poisons are mass-produced nowadays under a variety of brand names (Tomkins & Bird, 2002) [22]. According to Abhilash and Singh (2008) [23], India has a major issue with pesticide residues, even though the country's average pesticide use is far lower than that of many other wealthy countries. Pesticide overuse and improper management have been major health concerns for people in several developing nations over the last 30 years (Dasgupta *et al*. 2007) [24]. Fertilizer use in farming has been profoundly affected by globalization and the new market economy.

The use of fertilizers enhances soil productivity, leading to agricultural output of superior quality. In recent years, fertilizer consumption has skyrocketed, posing a serious threat to the environment. India and other developing nations saw a dramatic boost in their food production after the Green Revolution. which in turn reduced persistent food shortages. This was achieved by switching to higher-yielding seed varieties, modifying farming machinery, and using substantially more fertilizer. Fertilizers may be composed of both synthetic and natural ingredients. Fertilizers that are organic in nature are preferred over those that are synthetic or chemical. Organic fertilizers include things like manure and other naturally occurring elements, while inorganic fertilizers include things like manufactured components.

In general, they include more nutrients. Fertilizers may either boost the soil's natural fertility or replenish the chemical ingredients that were washed away by earlier crops. Chemically combining and using different compounds as a binding agent allows for the creation of mixed fertilizers. Another option is to mechanically mix plain fertilizers. The fertilizer industry consists of manufacturing facilities for a variety of goods. In order to feed a burgeoning global population, farmers are increasingly turning to chemical fertilizers and pesticides to maximize agricultural output. Overconsumption of these fertilizers, however, is harmful to human and environmental health. Too much fertilizer, too much salt, too much heavy metal, and too much nitrate all contribute to soil infertility. Plants take up chemical fertilizers via the soil and its connections with other creatures in the food web. Groundwater and maybe surface water from rivers and lakes might be contaminated by the overuse of chemical fertilizers on the land.

In order to produce an abundance of food, commercial farmers use synthetic pesticides and fertilizers extensively. To promote plant growth and increased yield, both organic and inorganic fertilizers include chemical components. Inorganic fertilizers are mostly composed of potassium, ammonium, phosphate, and nitrate salts. Naturally occurring radionuclides (238U and 232Th) and heavy metals (Hg, Cd, As, Pb, Cu, Ni, and Cu) are potential pollutants in fertilizer. Both people and the environment suffer greatly as a result of farmers using these chemical components as pesticides and fertilizers. To lessen or eliminate the negative effects of these synthetic chemicals on human health and the environment, new agricultural technological practices are necessary. These practices include shifting away from chemical intensive agriculture and towards organic inputs such as manure, biofertilizers, biopesticides, slow-release fertilizer, nano fertilizers, etc.

**Chemical Fertilizers and Their Impact on The Environment**

Pollutants include any material that has the potential to

cause damage to humans or other forms of life. Chemicals, either naturally occurring or produced artificially, known as fertilizers, are used to enrich soil with nutrients necessary for plant development. The agricultural industry routinely employs chemical pesticides and fertilizers, the majority of which are heavy metals such as mercury, cadmium, arsenate, lead, copper, nickel, and copper from the soil. The incorrect use of these pesticides and fertilizers causes a wide range of environmental problems, including contamination of soil, water, and air. Because of these chemicals, water contamination is becoming worse which are harmful to ecosystems even at low concentrations. The most common causes of water poisoning are chemicals, particularly nitrates, which are present in chemical fertilizers. Soil nitrate levels have been rising due to the growing use of irrigation in India's semi-arid and dry areas. Nitrate, the active ingredient in fertilizer, is one of the most indicative markers of water pollution. Nitrate makes up the bulk of the nitrogen in groundwater. Nitrate, an element found in water and absorbed by the stomach, affects the excretory system.

Chemical fertilizers are a known water polluter since they include nitrates and other contaminants including phosphates, arsenic, and chloride. The growth of aquatic plants and algae raises the concentration of nitrogen and phosphorus compounds in the water, which in turn causes water pollution and a decline in water quality. The acid rain that Sulphur dioxide and nitrogen oxide pollutants produce is a result of their interactions with the water in the atmosphere. Chemical fertilizers pose a significant hazard to ecosystems and non-target organisms because to the pollution they create.

**Growth and Productivity Assessment Using Organic Fertilizers**

To provide plants with nutrients, chemical fertilizers are a common and widely used method. Inorganic fertilizers have many benefits, but they also have many negative aspects. The use of chemical fertilizers is one such example; they cause a 50% nitrogen loss and 90% of phosphorus to water and the atmosphere. This leads to problems like water eutrophication and greenhouse gas emissions. Consequently, an increasing number of farmers are turning to organic fertilizers to provide their crops with the nutrients they need. Fertilizers made on organic materials improve both yield and quality, but they release nutrients at a slower pace than chemical fertilizers.

When applied to soil, organic fertilizers boost seedling development by enhancing microbial activity, nutrient absorption, nutrient availability, physiological functioning, and antioxidant activities, all of which are crucial during the leaf-forming seedling stage. Further research by Adekoya *et al*. indicated that okra plants benefited greatly from the addition of rabbit, cow, and pig manure. Research conducted by Khaitov, *et al*. 2009 [25] found that animal manures (265.4 kg $ha^{-1}$) had a good effect on the growth parameters and nutrient absorption of pepper plants. The use of organic fertilizers has a notable impact on the content of chlorophyll, carbohydrates, and NPK in dill cultivars, according to research by Elsayed *et al*. 2014 [26].

The scientists discovered that plants grown with just organic fertilizers had the highest concentrations of NPs, antioxidant activity, carbohydrates, and leaves. These plants also grew to be taller. Soil modified using sludge-based digestate increased maize yields that were similar to those of plants cultivated in urea, according. The plant growth, tillers, chlorophyll content, and grain output were all much improved by applying a mixture of 75% NPK and farmyard manure (FYM), while the growth and yield qualities were greatly improved by the residual effects of organic fertilizers. found that organic fertilizers greatly improved rice panicles, green leaf area, seed set, and final grain yield.

**Conclusion**

Organic manure was essential for increasing harvest yields and bettering soil and plant samples in every way (physical, chemical, and biological). Soil tests revealed that the addition of organic manure improved a number of physical and chemical properties, including pH, organic matter, and water holding capacity. Many individuals nowadays use synthetic fertilizers to cultivate an abundance of plants. However, they reduce the plant's nutritional value. Ammonium nitrate, potassium chloride, urea, NPK, and other inorganic fertilizers may accumulate in the environment and pose health risks to people if they leak from plants and enter the food chain. Since increasing the consumption of fruits and vegetables is widely believed to be an important factor in the general population's health, the World Health Organization and the Food and Agriculture Organization have issued dietary recommendations that urge individuals to do just that. Organic fertilizers, when added to soil, improve seedling growth in a number of ways, including by increasing antioxidant activities, microbial activity, nutrient absorption, nutrient availability, physiological functioning, and the formation of seedling leaves.

**References**

1. Mohammed S, Renuka J, Surya M, Archana S, Rithika S. Comparison of nutritive values due to impact of controlled environment and fertilizer application on vegetable crops. Educational Administration: Theory and Practice. 2024;30. doi:10.53555/kuey.v30i9.9658.
2. Vikash F, Kumar V, Agrawal SP, Singh A. S1622 Impact of Bariatric Surgery on Inpatient Outcomes in MASLD Patients: Trends and Analysis from a Nationwide Study (2016-2021). Official journal of the American College of Gastroenterology| ACG. 2024;119(10S):S1181.
3. Kai H, Kai M. Interactions of coronaviruses with ACE2, angiotensin II, and RAS inhibitors-lessons from available evidence and insights into COVID-19. Hypertension Research. 2020;43(7):648-654.
4. Sheykholeslami Z, Almdari M. Comparison of the effect of organic and chemical fertilizers on yield and essence of peppermint (*Mentha piperita* L.). Current Journal of Applied Science and Technology. 2019:1–7. doi:10.9734/cjast/2019/v34i530146.
5. Ayeni FA, Adeniyi BA, Ogunbanwo ST, Tabasco R, Paarup T, Peláez C, *et al*. Inhibition of uropathogens by lactic acid bacteria isolated from dairy foods and cow's intestine in western Nigeria. Archives of microbiology. 2009;191(8):639-648.
6. Adekiya AO, Agbede TM. Growth and yield of tomato (*Lycopersicon esculentum* Mill) as influenced by

poultry manure and NPK fertilizer. Emir. J. Food Agric. 2009;21(1):10-20.
7. Premsekhar M, Rajashree V. Influence of organic manures on growth, yield and quality of okra. American-Eurasian Journal of Sustainable Agriculture. 2009;3(1):6-8.
8. Krühler T, Greiner J, McBreen S, Klose S, Rossi A, Afonso P, *et al*. Correlated optical and X-ray flares in the afterglow of XRF 071031. The Astrophysical Journal. 2009;697(1):758-768.
9. Khan SA, Zia-ul-haq HM, Umar M, Yu Z. Digital technology and circular economy practices: An strategy to improve organizational performance. Business Strategy & Development. 2021;4(4):482-490.
10. Adnan M, Anwar K. Online learning amid the COVID-19 pandemic: Students' perspectives. Online Submission. 2020;2(1):45-51.
11. Kalsoom M, Rehman FU, Shafique TA, Junaid SA, Khalid N, Adnan M, *et al*. Biological importance of microbes in agriculture, food and pharmaceutical industry: A review. Innovare Journal of Life Sciences. 2020;8(6):1-4.
12. Sen A. Ingredients of famine analysis: availability and entitlements. The quarterly journal of economics. 1981;96(3):433-464.
13. Sala OE, Stuart Chapin FI, Armesto JJ, Berlow E, Bloomfield J, Dirzo R, *et al*. Global biodiversity scenarios for the year 2100. science. 2000;287(5459):1770-1774.
14. Tilman D, Fargione J, Wolff B, D'antonio C, Dobson A, Howarth R, Schindler D, *et al*. Forecasting agriculturally driven global environmental change. science. 2001;292(5515):281-284.
15. Ilahi H, Hidayat K, Adnan M, Rehman FU, Tahir R, Saeed MS, *et al*. Accentuating the impact of inorganic and organic fertilizers on agriculture crop production: A review. Ind. J Pure App. Biosci. 2020;9(1):36-45.
16. Chinnadurai C, Gopalaswamy G, Balachandar D. Long term effects of nutrient management regimes on abundance of bacterial genes and soil biochemical processes for fertility sustainability in a semi-arid tropical Alfisol. Geoderma. 2014;232:563-572.
17. Zhang ZJ, Wang XM, McAlonan GM. Neural acupuncture unit: a new concept for interpreting effects and mechanisms of acupuncture. Evidence-Based Complementary and Alternative Medicine. 2012;2012(1):429412.
18. Ju X, Christie P. Calculation of theoretical nitrogen rate for simple nitrogen recommendations in intensive cropping systems: A case study on the North China Plain. Field Crops Research. 2011;124(3):450-458.
19. Ayoub IA, Lee EJ, Ogilvy CS, Beal MF, Maynard KI. Nicotinamide reduces infarction up to two hours after the onset of permanent focal cerebral ischemia in Wistar rats. Neuroscience letters. 1999;259(1):21-24.
20. Solomon M, Russell-Bennett R, Previte J. Consumer behaviour. Pearson Higher Education AU; c2012.
21. Gupta B, Dasgupta S, Gupta A. Adoption of ICT in a government organization in a developing country: An empirical study. The journal of strategic information systems. 2008;17(2):140-154.
22. Tomkins J. Learning to see what they can't: Decolonizing perspectives on Indigenous education in the racial context of rural Nova Scotia. McGill Journal of Education/Revue des sciences de l'éducation de McGill. 2002;37(003).
23. Abhilash PC, Singh N. Influence of the application of sugarcane bagasse on lindane (γ-HCH) mobility through soil column: implication for biotreatment. Bioresource technology. 2008;99(18):8961-8966.
24. Dasgupta R, Hirschmann MM, Smith ND. Partial melting experiments of peridotite+ $CO_2$ at 3 GPa and genesis of alkalic ocean island basalts. Journal of Petrology. 2007;48(11):2093-124.
25. Khaitov M, Laza-Stanca V, Edwards MR, Walton RP, Rohde G, Contoli M, *et al*. Respiratory virus induction of alpha-, beta-and lambda-interferons in bronchial epithelial cells and peripheral blood mononuclear cells. Allergy. 2009;64(3):375-386.
26. Elsayed EA, El Enshasy H, Wadaan MA, Aziz R. Mushrooms: A potential natural source of anti-inflammatory compounds for medical applications. Mediators of inflammation. 2014;2014(1):805841.