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Economic And Environmental Sustainability Of Vegetable Production

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ABSTRACT

Although farming has gained attention as a model of sustainability in recent years, its economic viability for farmers has been called into question due to lower yields compared to the conventional regime. The findings demonstrated a decrease in impact of 60-100% when cutting-edge was compared to conventional. Although farming has less of an effect on production than conventional farming, it has a far more significant effect on income, which is down 61%. This demand is partially met by the higher price customers are prepared to pay for goods and by subsidies from the Common Agricultural Policy. farming has been proved to be on par with conventional methods due to the use of cutting-edge commodities and ground-breaking strategies for controlling soil. Our approach goes beyond just identifying a suitable synthetic alternative.

Keywords: Economic, Environmental, Sustainability, Vegetable, Growing and Production.

INTRODUCTION

The horticultural sector of India's agricultural industry is developing at a far quicker rate than any other part of the industry. After China, India is now the world's second-largest provider of fresh food. Since 2019-20, its output has surpassed that of food grains, with horticultural output now at 313 million tonnes compared to food grain output at 295.67 million tonnes. People's awareness of the need of maintaining a healthy lifestyle, together with their increased spending power, has increased the demand for a diet higher in fruits and vegetables. Small and marginal farmers in India now have a chance to make a living from horticulture because to advances in technology and supportive government policies. As a result, horticultural crop production and consumption have important effects on national economy and, by extension, on the health and well-being of the people.

Maintaining or improving the natural environment, meeting the food requirements of humans, being economically viable, and contributing to the social good are all essential components of any agricultural system that is intended to be long-term and sustainable (Hansen, 1996). The multifaceted nature of sustainable development necessitates looking at it from three different angles: the bottom line, the distribution of income, and the preservation of natural ecosystems. Definitions of sustainability have expanded to include considerations of social values including fairness, autonomy, tradition preservation, and support for family-run farms. Natural resources are degraded in two ways: via accumulation when too much chemical input is used, and through depletion when not enough is used. On the other hand, sustainability may be seen as a function of the amount of chemical input.

The public at large has come to embrace the idea that organic farming may help solve environmental issues. Sustainable land use is supported by organic farming techniques, which also boost environmental protection, animal well-being, and the quality of agricultural outputs. Generally speaking, this kind of organic farming has to be overseen cautiously and responsibly to ensure the safety of future generations and the planet.

LITERARTURE REVIEW

Nadia Tecco, et.al (2016) Sustainable food items are becoming more important to consumers, and this demand has the potential to propel the food industry forward economically. Sustainability, here seen as more focus on the social and environmental performance of the product and its supply chain, may be viewed as a strategy to mitigate customer unhappiness, particularly in the case of perishable produce. Strategies based on historic values recognized by the segment, as well as a set of supply chain qualities that may distinguish the product by conveying its sustainability, can be useful for marketing fruit and vegetable goods. How to construct a sustainable supply chain, how to effectively reach consumers with a concept as multifaceted and complex as the product's sustainability, and how to make the sustainability attribute a factor to be considered in the final purchasing decisions are all questions that still need answers.

Nidal Shaban, et.al (2017) To have a positive environmental impact on agrarian ecosystems, sustainable horticulture education must incorporate a new system that emphasizes an ethical perspective on production, a combination of time-tested methods, a deep appreciation for the land that has been handed down through the ages, and the breakthroughs of contemporary science. Integrating different systems and methods of production is an important topic that should be discussed in lectures and practices. Some examples include sustainable fertilizing and irrigation management, energy use associated with production, and integrated pest control on farms. A dedicated section named "Sustainable Growing of Vegetables" should be created to convey these fundamentals. With the help of knowledgeable persons, they should be included into the right spots in the appropriate chapters for each vegetable crop.

Baliyan, Som Pal (2014) Botswana's reliance on imported veggies is a result of the country's historically subpar and seasonal vegetable output. Sunburn and bird damage, among other things, have a significant role in low vegetable yields. In order to maximize vegetable output, it was necessary to investigate methods of reducing losses due to sunburn and birds. It was determined that using a shade net to protect crops from the sun and birds was an effective method of increasing yields. In 2012, Livingstone Kolobeng College in Gaborone, Botswana (Southern Africa) devised and conducted a shade net project to increase vegetable output and, by extension, revenue. The initiative has three main goals: to expand the school community's access to fresh, high-quality vegetables; to earn extra money via the sale of those veggies; and to provide pupils access to a working model. Analyses of situations, stakeholders, problems, goals, strategies, log frames, schedules, SWOTs, budgets, and performance evaluations, monitoring and evaluation, and so on have all been presented and discussed as essential components of designing a successful project.

Anacorita Oliquino-Abasolo et.al (2016) The environmental effects of conventional and organic vegetable growing were compared in Tayabas, Quezon, using life cycle assessment (LCA). From clearing land to delivering goods to consumers, all of the material inputs, outputs, and emissions within a certain area were measured and quantified. The operational units used to evaluate the potential for global warming, acidification, eutrophication, and human toxicity were the kilogram and the hectare. When comparing the global warming potential of greenhouse gas emissions from conventional and organic vegetable growing, the former was found to be 42 percent higher. The potential for acidity was 23% higher in conventional vegetable farming than in organic. Organic farming increased vegetable potential eutrophication by 16% compared to conventional farming, which contributed 4.70E-01 kg PO4 eq kg-1.

Xiaoqiang Jiao, et.al (2016) China has made a significant contribution to global food security by expanding grain production four-fold over the past five decades, while using just 9% of the world's arable land to feed 22% of the world's people, from 110 Mt in 1961 to 557 Mt in 2014. More than half of China's increased crop output, but may be associated with a greater use of chemicals, especially fertilizers, than in more developed nations like the USA and EU. Overfertilization in the grain business has led to low nutrient utilization efficiency and high environmental costs. We analyzed the fundamental needs supporting greater sustainability in China's crop production, and found that doing the following—(i) fertilizing the root zone instead of the soil to improve root/rhizosphere efficiency by creative nutrient management in the root zone. —could have the greatest impact on both nutrient use efficiency and nutrient loss; (ii) improving agricultural yields and reducing input costs by combining sound agronomic techniques with cutting-edge research; and (iii) spreading knowledge about root zone nutrient management— Coordinating grain production with environmental protection by improving the sustainability of fertilizer consumption is essential to achieving sustainable crop production in Chinese agriculture.

METHODOLOGY

Innovative Organic Protocol

The research was carried out in an experimental setting, with two identically sized fields (one hectare each) selected. To ensure a fair comparison of the farms under review, all of them were located in the same cultivation area to minimize differences in climate and environment, and all of the farmers were similarly qualified, so their farms shared similar traits in terms of their technical management. Table 1 summarizes the amounts of all inputs for the two growing strategies. How much energy and water are needed for farming, as well as the number of seedlings employed per acre, vary significantly.

To implement Bresov's innovative method for organic farming, 41,000 seedlings must be planted with a closer spacing between rows to reduce weed development and increase harvests. This yields around twice as many plants per hectare as the standard technique. A

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high yield per hectare is necessary for the crop to be economically sustainable, hence increasing the number of smaller inflorescences is desirable. Due to the use of chemicals for weed control, only around 20,833 seedlings are used in traditional production. The Bresov protocol relies on surface tillage using rotary disc harrows and vibrocultivators to preserve a healthy soil structure and an optimal level of organic matter. Effective crop rotations, which are often used to suppress weed growth, also contribute to soil fertility. In contrast, standard farming practices include deep plowing the soil and then doing further tillage operations like milling and harrowing prior to sowing seeds or seedlings.

Table 1. Components of cutting-edge conventional and organic broccoli farms

Input	Unit	Innovative Organic Broccoli	Conventional Broccoli
Plants	n./ha	41,000	20,833
Fertiliser NP (18–46)	kg/ha	-	400
Fertiliser NH_4NO_3	kg/ha	-	100
Organic fertiliser (pallet manure)	kg/ha	3500	-
Herbicides (Oxifluorfen)	kg/ha	-	0.12
Pesticide (Spinosad)	kg/ha	-	0.12
Organic pesticides:			
Copper	kg/ha	1	-
Bacillus Thuringensis	kg/ha	2	-
Organic compounds: mycorrhizal fungi and microorganisms	kg/ha	3.3	-
Diesel	L/ha	10.5	34.5
Water	m^3/ha	2493	9000

What goes into cutting-edge organic and conventional broccoli farming (*) and what comes out. When comparing the revolutionary organic protocol to the traditional approach, Table 1 shows a dramatic decrease in water use.

Impact Assessment

Selecting impact categories, indicators, and characterization models helps estimate possible environmental consequences throughout the impact assessment process. Emissions may be converted into relative environmental effect ratings using life cycle impact assessment (LCIA). Recipe midpoint was used as the software's impact technique for this investigation. This results in a reduced degree of uncertainty and a tighter connection to environmental fluxes. Table 2 displays the chosen method's defining impact categories and associated outcomes.

Table 2. Innovative organic and conventional broccoli cultivation: defining characteristics and environmental effect per hectare

Impact Category	Unit	IOB	CB
Global warming	kg CO_2 eq	2187.77	8304.40
Stratospheric ozone depletion	kg CFC11 eq	0.00	0.13
Ionizing radiation	kBq Co-60 eq	54.03	249.92
Ozone formation, human health	kg NOx eq	2.82	16.85
Fine particulate matter formation	kg $PM_{2.5}$ eq	1.99	13.67
Ozone formation, terrestrial ecosystems	kg NOx eq	2.88	17.12
Terrestrial acidification	kg SO_2 eq	3.89	44.44
Freshwater eutrophication	kg P eq	0.34	2.19
Marine eutrophication	kg N eq	0.03	0.19
Terrestrial ecotoxicity	kg 1,4-DCB	6946.09	40,197.32
Freshwater ecotoxicity	kg 1,4-DCB	179.79	916.96
Marine ecotoxicity	kg 1,4-DCB	226.05	1160.19
Human carcinogenic toxicity	kg 1,4-DCB	37.02	199.92
Human non-carcinogenic toxicity	kg 1,4-DCB	1784.33	10,838.79
Land use	m^2a crop eq	366.22	280.45
Mineral resource scarcity	kg Cu eq	7.02	65.33
Fossil resource scarcity	kg oil eq	637.43	1599.60
Water consumption	m^3	2527.91	9973.59

Economic Assessment Method

The research aims to contrast the cost-effectiveness of traditional farming practices with those of more forward-thinking organic ones. Farmers will get an understanding of their potential market advantage in this manner. The concept of gross revenue was selected in spite of the many approaches used in the literature to calculating agricultural income in order to reach a predetermined goal.

To determine one's gross income (GI), the formula GI = GSPVC (1) is used.

GDP = Total Output Available for Sale

Changeable Expenditures

The total variable costs (VC) consist of all inputs, labor, and a percentage of total wear and tear on all inputs, whereas the gross selling price (GSP) is the product of the yield times the selling price of the crop. Input prices are gathered from direct surveys of raw material providers, and average quotations are provided by horticulturalists in the area of interest for both conventional and organic crops.

Most of the variables may take on one of three qualitative values: "Low" for not sustainable, "Medium" for approaching the sustainability threshold, and "High" for being really sustainable. The medium class is missing from Div-lavor, Motivo, Appro_sist, Ndisp/Nasp, and Obiet_azien, five of the most fundamental variables.

Figure 1. DEXi-BIOrt decision tree model and weighting pattern

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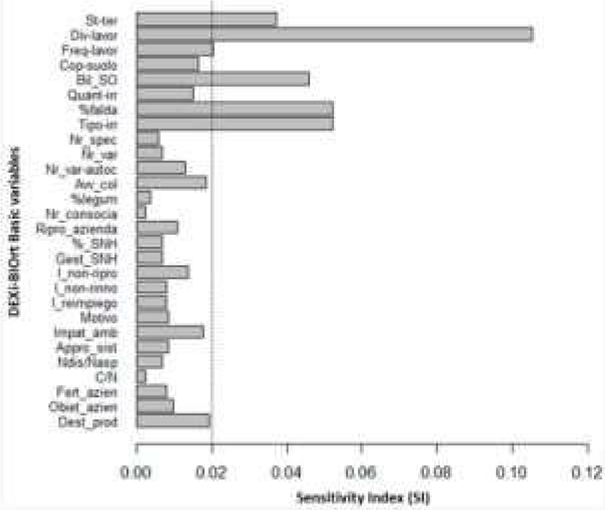

Figure 1 shows how "if-then" decision-rules or utility functions aggregate the basic variables based on their weights, allowing for a qualitative evaluation of both (1) the sub-components and (2) the four main components

DATA ANAYSIS

Table 2 and Table 3 show the impact characterization findings for 1 hectare of conventionally grown broccoli (CO) and 1 kilogram of innovative organic broccoli (IOB), respectively. Alluding to the results of using the Table 1 inputs in the cultivation operations. The effect types are arranged in this table according to the kind of conservation area they endanger. Determining variables for the human health protection zone include, but are not limited to: global warming; stratospheric ozone depletion; ionizing radiation; ozone production; human health; fine particulate matter creation; human carcinogenic toxicity; and human non-carcinogenic toxicity. The other categories all have to do with environmental destruction, but because global warming affects both the environment and human health, it falls into all of those safe zones as well.

Table 3. Environmental effect and defining characteristics of organic and conventional broccoli yields per kilogram

Impact Category	Unit	IOB	CB
Global warming	kg CO_2 eq	0.10672	0.39867
Stratospheric ozone depletion	kg CFC11 eq	0.00000	0.00001
Ionizing radiation	kBq Co-60 eq	0.00264	0.01200
Ozone formation, human health	kg NOx eq	0.00014	0.00081
Fine particulate matter formation	kg $PM_{2.5}$ eq	0.00010	0.00066
Ozone formation, terrestrial ecosystems	kg NOx eq	0.00014	0.00082
Terrestrial acidification	kg SO_2 eq	0.00019	0.00213
Freshwater eutrophication	kg P eq	0.00002	0.00010
Marine eutrophication	kg N eq	0.00000	0.00001
Terrestrial ecotoxicity	kg 1,4-DCB	0.33883	1.92978
Freshwater ecotoxicity	kg 1,4-DCB	0.00877	0.04402
Marine ecotoxicity	kg 1,4-DCB	0.01103	0.05570
Human carcinogenic toxicity	kg 1,4-DCB	0.00181	0.00960
Human non-carcinogenic toxicity	kg 1,4-DCB	0.08704	0.52035
Land use	m^2a crop eq	0.01786	0.01346
Mineral resource scarcity	kg Cu eq	0.00034	0.00314
Fossil resource scarcity	kg oil eq	0.03109	0.07679
Water consumption	m^3	0.12331	0.47881

All of the evaluated farms' operations were included into the calculation of the variable costs associated with both the innovative organic and conventional systems. Table 3 displays the

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output in hours per hectare (h/ha). It reveals a great deal of variation between the two farming techniques, with the new organic approach requiring 218 more hours of work and labor per hectare (ha) than the traditional one.

According to Table 4, the farmer's gross income is EUR 1355.85/ha for the innovative organic technique and EUR 3456.14/ha for the conventional method after subtracting the variable expenditures from the gross production value. The innovative organic regime's earnings fell and its production expenses rose, according to the economic study. Simple solutions to this problem include increasing demand for organic products, giving them a premium above conventional alternatives, and compensating farmers for increased input costs despite no discernible difference in crop yields.

Table 4. Economic values of broccoli growing (*).

Indication	IOB (a)	CB (b)	Variation (a–b)
Yield (t/ha)	20.50	20.83	−0.33
Gross production value (EUR/ha)	10,250.00	10,415.00	−165.00
Variable costs (EUR/ha)	8894.15	6958.86	1935.29
Gross income (EUR/ha)	1355.85	3456.14	−2100.29

Table 5 summarizes the results of the assessment of the major and subcomponents' sustainability for the Adriatic coast scenarios.

Table 5. Main component and sub-component sustainability assessment obtained with DEXi-BIOrt

	Adriatic Coast			Metaponto Plan					
	CO2007	AE2016	SU2016	Scenario A	Scenario B	Scenario C	Scenario D	Scenario E	Scenario F
Soil	M	H	H	M	M	M	M	M	M
Physical quality	M	H	H	M	M	M	M	M	M
Chemical-biological quality	M	M	M	M	M	M	M	M	M
Water	H	H	H	H	H	H	H	H	H
Biodiversity	H	H	M	L	M	M	M	M	H
Genetic	H	H	L	L	L	L	L	L	H
Specific	H	H	M	L	M	M	M	H	H
Habitat	H	H	H	M	M	M	M	M	H
Production	H	H	L	L	H	H	H	H	H
Energy	H	H	M	H	H	H	H	H	H
Phytosanitary management	H	H	L	M	H	H	H	H	H
Fertilizer management	L	L	L	L	L	L	L	L	L
Product value	M	M	L	L	M	M	M	M	M

Soil evaluations gave AE2016 and SU2016 top marks (high), whereas CO2007 was given a middling grade. The "Soil structure St-ter (Soil_str)" feature is to blame for this discrepancy, since it was given a middling rating in AE2016 and SU2016 but a bad rating in CO2007. Whereas "Soil organic carbon balance—Bil_SO (SOC_bal)" was rated as low across all scenarios with a high score for all qualities, all other fundamental soil variables were rated similarly.

The water management in all three situations was identical, hence they all received the same score (high value) on this metric. The superiority was achieved by giving more weight to the parameter "Percentage of groundwater withdrawal%falda (%_withdr)" and less to the attributes "m3 of water consumed Quant-irr (Wat_m3)" and "Type of irrigation system Tipo-irr (Irr_sys)".

CONCLUSIONS

Studies comparing conventional and organic farming practices are necessary for identifying a sustainable agricultural paradigm. Broccoli was grown using the groundbreaking Bresov protocol, an organic technology that has the potential to enhance both environmental quality and human health. Surface tillage has other benefits as well, including lower environmental impact and lower energy use. Organic farming methods are less harmful to the environment because they eliminate the need for synthetic fertilizers, pesticides, and herbicides, and they use less water and diesel fuel during crop production. The Bresov protocol offers farmers a chance to boost production yields, which are often lower in the case of organic farming, in addition to the obvious environmental and health benefits. Taking into consideration CAP subsidies and the premium price offered to the more sustainably produced product may help farmers make up for the increased production costs and lower profitability shown by the economic analysis. Broccoli is one of the most widely grown vegetables in Sicily, providing essential income to the island's farmers. Therefore, the purpose of the research is to encourage the adoption of novel organic farming practices, which would be beneficial for both the environment and the farmers' bottom lines.

REFERENCES

1. Nadia tecco, nicole giuggioli, vincenzo girgenti and cristiana peano (2016) environmental and social sustainability in the fresh fruit and vegetables supply chain: a competitiveness' asset

2. Nidal shaban , sergei bistrichanov , eman kadum and miroslav tityanov (2017) sustainable development in education of horticulture in bulgaria doi: 10.17265/2161-6256/2017.06.006

3. Baliyan, som pal (2014) improving sustainable vegetable production and income through net shading: a case study of botswana issn 2201-4357

4. Anacorita oliquino-abasolo oscar b. Zamora (2016) agro-environmental sustainability of conventional and organic vegetable production systems in tayabas, quezon, philippines issn 0119-1144

5. Xiaoqiang jiao, yang lyu, xiaobin wu, haigang li, lingyun cheng, chaochun zhang, lixing yuan, rongfeng jiang, baiwen jiang, zed rengel (2016) grain production versus resource and environmental costs: towards increasing sustainability of nutrient use in china

6. Ballew, m.t.; leiserowitz, a.; roser-renouf, c.; rosenthal, s.a.; kotcher, j.e.; marlon, j.r.; lyon, e.; goldberg, m.h.; maibach, e.w. Climate change in the american mind: data, tools, and trends. Environment 2019, 61, 4–18. [google scholar] [crossref]

7. Zhao, c.; liu, b.; piao, s.; wang, x.; lobell, d.b.; huang, y.; huang, m.; yao, y.; bassu, s.; ciais, p.; et al. Temperature increase reduces global yields of major crops in four independent estimates. Proc. Natl. Acad. Sci. Usa 2017, 114, 9326–9331. [google scholar] [crossref] [pubmed][green version]

8. Hunter, m.c.; smith, r.g.; schipanski, m.e.; atwood, l.w.; mortensen, d.a. Agriculture in 2050: recalibrating targets for sustainable intensification. Bioscience 2017, 67, 386–391. [google scholar] [crossref][green version]

9. United nations, department of economic and social affairs, population division. World population prospects 2019: highlights. 2019, (st/ esa/ser.a/423). Available online: https://population.un.org/wpp/publications/files/wpp2019_highlights.pdf (accessed on 13 september 2022).

10. Intergovernmental panel on climate change (ipcc). Climate change and land: an ipcc special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems; ipcc: geneva, switzerland, 2019; available online: https://www.ipcc.ch/srccl/ (accessed on 13 september 2022).