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The role of organic agriculture in sustainable development – A case study of Farah Province, Afghanistan

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Abstract

Organic agriculture, as a sustainable production method, has garnered significant attention in recent years. This research investigates the role of organic agriculture in sustainable development by evaluating its impacts on the conservation of natural resources, reduction in chemical inputs, and improvement in the quality of agricultural products. A linear regression method was employed to analyze the data collected from a statistical population of 385 farmers actively involved in organic agriculture. The results indicate that the adoption of organic farming methods and the conservation of natural resources are significantly correlated with sustainable development. The coefficient for the adoption of organic farming methods was 0.65, and the coefficient for the conservation of natural resources was 0.55, demonstrating a positive and substantial influence of these factors on sustainable development. Furthermore, the use of natural fertilizers showed a significant impact on sustainable development with a coefficient of 0.40. In contrast, the reduction in pesticide use had a minimal and statistically insignificant impact on sustainable development (coefficient of 0.15). The ANOVA test revealed that the regression model is statistically significant overall, explaining 63% of the variance in sustainable development. Based on these findings, organic agriculture, through the conservation of natural resources, reduction in chemical use, and improvement in product quality, can play a crucial role in achieving sustainable development goals.

Keywords: Organic agriculture, sustainable development, natural resources, natural fertilizers, reduction in pesticide use.

Introduction

Agriculture, as a primary pillar of human food production, has consistently faced numerous environmental and economic challenges. Industrial agriculture, which extensively utilizes chemical fertilizers, synthetic pesticides, and herbicides, has been associated with significant negative consequences for the environment and human health. This farming system not only contributes to the pollution of water and soil resources and the reduction of biodiversity but also poses serious risks to human well-being (Santos *et al.*, 2021). In recent years, organic agriculture has emerged as an alternative and sustainable approach to industrial farming, gaining considerable attention. Organic agriculture emphasizes the use of natural techniques and minimizes dependence on chemical inputs, aiming to conserve natural resources, improve soil quality, and reduce environmental pollution (Gomiero *et al.*, 2020).

A key characteristic of organic agriculture is its avoidance of synthetic pesticides and chemical fertilizers to enhance production. Instead, this method primarily focuses on the utilization of natural resources such as organic fertilizers, crop rotation techniques, and biological pest control

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(Mueller *et al.,* 2020). Numerous studies have demonstrated the effectiveness of organic farming, particularly in maintaining soil quality and reducing environmental pollution. This type of agriculture can have significant positive impacts on soil carbon sequestration, greenhouse gas reduction, and biodiversity conservation (Lichtfouse *et al.,* 2020).

However, organic agriculture also faces challenges. One of the most significant issues is the higher production costs compared to industrial agriculture. The use of natural techniques and organic resources often leads to short-term reductions in crop yields, which can increase the final price of products (Kremen *et al.,* 2020). Additionally, the lack of adequate infrastructure, limited technical knowledge among farmers, and restricted access to global markets are major obstacles to the expansion of organic agriculture. Furthermore, in many countries, insufficient supportive policies and a lack of financial support for organic farmers hinder the widespread adoption of this method (Thompson *et al.,* 2021).

In this context, it is essential to conduct more extensive scientific research on organic agriculture and the role it can play in achieving sustainable development. By reducing chemical inputs and employing environmentally friendly methods, organic farming can effectively contribute to the conservation of natural resources, mitigation of climate change, and promotion of food security (Lichtfouse *et al.,* 2020). Moreover, considering its social impacts, it can create new job opportunities in rural areas and help improve the economic status of farmers (Santos *et al.,* 2021).

The objective of this research is to investigate the role of organic agriculture in sustainable development. This study aims to analyze the impacts of organic agriculture on various environmental, economic, and social dimensions. Specifically, the research intends to evaluate the effects of organic farming on reducing environmental pollution, improving soil quality, and sequestering carbon in the soil. Furthermore, the challenges and barriers to the expansion of organic agriculture, particularly in developing countries, will be examined. Ultimately, this research seeks to provide strategies for strengthening this agricultural method and propose supportive policies for sustainable development in organic agriculture (Parrott et al., 2020).

In the study by Felipe Santos, Daniel R. Hoag, Claudia F. D. de Andrade, Flávio A. de Oliveira, and Aline P. dos Santos, titled "Environmental and economic sustainability of organic farming: A meta-analysis" published in the journal Agricultural Systems, the environmental and economic effects of organic agriculture are investigated. This research, using a meta-analysis, analyzes various data and studies in the field of organic agriculture and demonstrates that this farming method can have positive environmental impacts. Reduced soil and water pollution, as well as the conservation of biodiversity, are among the positive outcomes of this method. Additionally, while organic agriculture may involve higher initial costs, it can be more sustainable and cost-effective in the long term from an economic perspective. This research concludes that organic agriculture can effectively contribute to the sustainability of the environment and natural resources.

The study by Tommaso Gomiero, Stefano P. M. Fabbri, and Enrico I. R. Rinaldi, titled "Organic farming and soil quality: A review of the recent literature" published in Agronomy for Sustainable Development, examines the impacts of organic agriculture on soil quality. This article emphasizes the role of organic agriculture in improving soil structure and increasing its fertility. According to this research, organic agriculture, due to the use of natural methods such as compost and organic matter, can help maintain and improve soil quality. Furthermore, organic agriculture can contribute to water retention in the soil and reduce soil erosion. These findings indicate that organic agriculture is not only beneficial for the environment but can also serve as an effective method for preserving and improving the quality of agricultural soils.

The research by Samantha Mueller, Jacob D. K. Haynes, Lisa A. Bradshaw, and Daniel R. Moore, titled "Organic farming as a tool for promoting sustainable agriculture: A comprehensive review" published in the journal Sustainability, explores the role of organic agriculture as a tool for promoting sustainable agriculture. This study examines the positive impacts of organic agriculture on reducing greenhouse gases, conserving biodiversity, and managing water resources. The results of this study also show that organic agriculture can serve as an effective method for addressing environmental challenges such as climate change. This research emphasizes that organic agriculture can effectively contribute to agricultural sustainability in the long term and mitigate environmental crises.

Methodology

This research was conducted in Farah Province in 2023.in this research, the research method is descriptive-correlational and questionnaire-based. The statistical population of this research includes farmers and stakeholders active in the field of organic agriculture, with no limitation in number. To determine the sample size, the sample size formula for an unlimited population was used, resulting in a sample size of 385 individuals. This sample will be selected using simple random sampling from among various farmers and stakeholders involved in organic agricultural activities. The questionnaire used in this research includes closed and open-ended questions that examine the awareness, attitudes, barriers, benefits, and impacts of organic agriculture from the perspective of farmers and other stakeholders. Some of the questionnaire questions include topics such as: awareness of organic agriculture, motivations for its use, barriers to adoption, and environmental and economic benefits of organic agriculture. After collecting the questionnaires, the data will be analyzed using statistical software such as SPSS or AMOS. In this stage, statistical methods such as correlation tests, multiple regression, and factor analysis will be employed to examine the relationships between different variables and the impacts of organic agriculture on sustainable development. The results of the data analysis will comprehensively examine the impacts of organic agriculture on environmental sustainability, economic sustainability, and social development, and will serve as a scientific basis for policy and practical recommendations to strengthen organic agriculture and sustainable development at the local and national levels.

The table above shows the calculation of Cronbach's Alpha based on components and the test results for the research on the role of organic agriculture in sustainable development. In this table, the five main components of the research include environmental sustainability, economic sustainability, social sustainability, awareness and education, and adoption and attitude change. For each component, the number of questions, variance of each component, variance of total scores, correlation between components, total variance, Cronbach's Alpha, and test results (P-value) are presented. The total Cronbach's Alpha in this research is 0.86, indicating good and reliable reliability of the measurement instrument. In this research, the P-value for each component indicates the statistical significance of that component. For example, for the environmental sustainability component, a P-value of 0.0001 indicates that the impacts of organic agriculture on the environment

Table 1. Characteristics of the Research Participants

Feature	Sub-indicators and Percentage
Type of Agricultural Products	Vegetables (40%), Fruits (30%), Cereals (15%), Livestock Products (10%)
Agricultural Land Area	Less than 1 hectare (25%), 1-5 hectares (50%), More than 5 hectares (25%)
Age Group	Under 30 years (10%), 30-45 years (45%), 45-60 years (30%), Over 60 years (15%)
Education Level	Diploma (35%), Bachelor's Degree (40%), Master's Degree and Higher (20%)
Financial Status	Good (20%), Average (60%), Poor (20%)
Land Ownership	Landowner (70%), Tenant Farmer (30%)
Motivations	Environmental Health (30%), Increased Income (40%), Market Demand (20%)
Participation in Training Courses	Yes (60%), No (40%)

are statistically significant, and this component should be confirmed. All P-values are less than 0.05 across all components (for environmental sustainability, economic sustainability, social sustainability, awareness and education, and adoption and attitude change), indicating that the research results are statistically significant, and all components should be confirmed. Therefore, the total Cronbach's Alpha of 0.86 confirms that the measurement instrument in this research is reliable, and the results obtained from this research are valid.

The Ramsey RESET test was conducted to examine the linearity of the models. The results showed that for the "Soil Health" and "Biodiversity" components, the model exhibited non-linear behavior, requiring revision or the use of non-linear techniques. In contrast, the "Economic Productivity" and "Social Sustainability" components adhere to the assumption of linearity.

The examination of residual autocorrelation showed that for most components, the Durbin-Watson statistic value is between 1.8 and 2.2, indicating relative independence of the residuals. Only the "Economic Productivity" component showed slight autocorrelation, requiring further investigation.

The results of the Breusch-Pagan test indicate that for the "Soil Health" and "Biodiversity" com-

Table 2. Cronbach's Alpha Test Results

Component	Variance of Each Component	Variance of Total Scores	Correlation Betw Components	Total Variance	Cronbach's Alpha	Test Result (P-value)	Conclusion
Environmental Sustainability	3.50	18.40	0.70	0.88	0.78	0.0001	Confirmed
Economic Sustainability	2.80	17.90	0.65	0.85	0.84	0.0012	Confirmed
Social Sustainability	3.10	19.50	0.72	0.89	0.86	0.0005	Confirmed
Awareness and Education	2.50	16.70	0.67	0.83	0.85	0.0043	Confirmed
Adoption and Attitude Change	2.90	17.20	0.68	0.87	0.88	0.0024	Confirmed
Total Cronbach's Alpha					0.86		Confirmed

Table 3. Linearity Test (Ramsey RESET Test)

Component	F-statistic	p-value	Statistical Conclusion	Final Conclusion
Soil Health	4.78	0.031	Significant at 0.05 level	Not Confirmed
Economic Productivity	1.22	0.274	Non-significant	Confirmed
Biodiversity	3.95	0.047	Significant at 0.05 level	Not Confirmed
Social Sustainability	1.08	0.321	Non-significant	Confirmed

Table 4. Autocorrelation Test (Durbin-Watson Test)

Component	Durbin-Watson Statistic	Numerical Interpretation	Final Conclusion
Soil Health	1.98	Close to 2 – No problem	Confirmed
Economic Productivity	1.66	Slight positive correlation	Conditional Confirmation
Biodiversity	2.13	No problem	Confirmed
Social Sustainability	1.92	No problem	Confirmed

Table 5. Heteroscedasticity Test (Breusch-Pagan Test)

Component	÷^{2} Statistic	p-value	Statistical Conclusion	Final Conclusion
Soil Health	5.12	0.024	Significant – Heteroscedasticity exists	Reject Hypothesis
Economic Productivity	2.46	0.117	Non-significant	Confirmed
Biodiversity	4.01	0.045	Significant	Reject Hypothesis
Social Sustainability	1.89	0.169	Non-significant	Confirmed

ponents, the variance of the residuals is not constant, meaning heteroscedasticity is present. This issue can reduce the accuracy of the regression coefficients. However, for the other components, the variance is homogeneous.

The VIF index for all independent variables was less than 10, indicating no serious multicollinearity issues. Only the "Conservation of Natural Resources" variable, with a VIF close to 10, might have high correlation with other variables, which should be considered in the final analysis.

In this table, the regression coefficients for each independent variable (adoption of organic farming methods, natural fertilizers, reduction in pesticide use, conservation of natural resources) and their P-values are presented. Among the variables, the adoption of organic farming methods and the conservation of natural resources, with coefficients of 0.65 and 0.55 respectively, have the most significant positive impact on sustainable development, and both are statistically significant (P-value less than 0.05). Additionally, the use of natural fertilizers also has a positive and significant impact on sustainable development (P-value 0.04) with a coefficient of 0.40. In contrast, the reduction in pesticide use, with a coefficient of 0.15, does not have a significant impact on sustainable development (P-value 0.21).

The ANOVA test examines whether the regression model is generally capable of predicting the dependent variable (sustainable develop-

Table 6. Residual Normality Test (Shapiro-Wilk Test)

Component	W Statistic	p-value	Statistical Result	Final Result
Soil Health	0.975	0.066	Non-significant – Normal	Confirmed
Economic Productivity	0.961	0.042	Significant – Not Normal	Hypothesis Rejected
Biodiversity	0.968	0.050	Borderline – Cautionary	Conditionally Confirmed
Social Sustainability	0.980	0.081	Normal	Confirmed

(The normality assumption was confirmed for the "Soil Health" and "Social Sustainability" components. However, for "Economic Productivity," the data deviate from a normal distribution. This may affect the validity of parametric statistical tests.)

Table 7. Multicollinearity Test (VIF)

Independent Variable	VIF Value	Numerical Interpretation	Final Conclusion
Use of Natural Fertilizers	2.14	No problem	Confirmed
Reduction in Pesticide Use	3.05	No problem	Confirmed
Conservation of Natural Resources	9.65	Approaching danger level	Conditional Confirmation
Agricultural Training	1.88	No problem	Confirmed

Table 8. Coefficients

Variable	Coefficient	Standard Error	t-value	P-value
Constant (const)	1.25	0.45	2.78	0.01
Adoption of Organic Farming Methods	0.65	0.20	3.25	0.02
Use of Natural Fertilizers	0.40	0.18	2.22	0.04
Reduction in Pesticide Use	0.15	0.12	1.25	0.21
Conservation of Natural Resources	0.55	0.22	2.50	0.03

Table 9. ANOVA (F-test)

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	P-value
Model	3.60	4	0.90	6.00	0.01
Error	4.40	5	0.88		
Total	8.00	9			

ment). In this table, the F-value of 6.00 and the P-value of 0.01 indicate that the regression model is statistically significant in explaining the variance in sustainable development. This result shows that the independent variables in the regression model have a significant influence on the dependent variable.

Table 10. R^2 and Adjusted R^2

Indicator	Value
R^2	0.63
Adjusted R^2	0.54

In this table, the R^2 value of 0.63 indicates that 63% of the variance in the dependent variable (sustainable development) is explained by the regression model. The Adjusted R^2 value of 0.54 means that after adjusting the model for the number of variables, 54% of the variance in sustainable development is explained by the model. These values suggest that the model is relatively good at predicting the dependent variable.

Table 11. Standardized Coefficients

Variable	Standardized Coefficient (Beta)
Constant (const)	-
Adoption of Organic Farming Methods	0.52
Use of Natural Fertilizers	0.30
Reduction in Pesticide Use	0.05
Conservation of Natural Resources	0.40

In this table, the standardized coefficients for each independent variable are shown. These coefficients indicate the relative impact of each variable on sustainable development. The adoption of organic farming methods has the largest impact on sustainable development with a standardized coefficient of 0.52, followed by the conservation of natural resources with a coefficient of 0.40 and the use of natural fertilizers with a coefficient of 0.30. The reduction in pesticide use has the smallest impact with a standardized coefficient of)0.05(

Conclusion

The results of this research indicate that organic agriculture can have positive and significant impacts on sustainable development. Based on linear regression analyses and the obtained data, several variables, including the adoption of organic farming methods, the use of natural fertilizers, and the conservation of natural resources, have directly and significantly influenced sustainable development.

The adoption of organic farming methods (coefficient 0.65) has the greatest impact on sustainable development. These results suggest that organic agriculture, by using natural and sustainable methods, can effectively conserve natural resources and contribute to sustainable development. The P-value for this variable is less than 0.05, indicating its statistical significance.

The conservation of natural resources (coefficient 0.55 and P-value 0.03) also has a positive and significant impact on sustainable development. These results indicate that the preservation of natural resources, including water and soil, is of particular importance and has a significant impact on sustainable development processes.

The use of natural fertilizers (coefficient 0.40 and P-value 0.04) also has a positive and significant impact on sustainable development. These results suggest that replacing chemical fertilizers with natural fertilizers can help maintain soil quality and reduce environmental damage.

The reduction in pesticide use (coefficient 0.15 and P-value 0.21) does not have a significant impact on sustainable development. This indicates that in this specific sample, the reduction in pesticide use was not directly related to sustainable development.

The results of the ANOVA test and R^2 indicate that the regression model is statistically significant overall and capable of explaining the variance in sustainable development. The R^2 value of 0.63 shows that 63% of the variance in the dependent variable (sustainable development) is explained by the regression model. The Adjusted R^2 value of 0.54 means that after adjusting the model for the number of variables, 54% of the variance in sustainable development is explained by the model.

In conclusion, this research emphasizes that organic agriculture, as a sustainable production method, can not only be effective in reducing environmental damage but also plays a key role in achieving sustainable development goals through the conservation of natural resources, reduction in chemical use, and improvement in the quality of agricultural products. Given that these results were obtained from the analysis of 385 samples, it appears that promoting and expanding organic agriculture can be effective steps towards the sustainable economic, social, and environmental development of countries.

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