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Economic Viability and Long-term Sustainability of Regenerative Agriculture: A Comprehensive Analysis

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Abstract

The agriculture sector is exposed to dangerous risks due to evolving climate changes, unsustainable economy, and food insecurity, since the application of conventional farming practices affects the fertility of the soil, endangers species, and overproduces greenhouse gases. Consequently, regenerative agriculture has become a favourable strategy centred on soil health, species diversity, and nutrient cycling to rebuild natural resources. However, there is a noticeable lack of a comprehensive economic discussion of regenerative agriculture's applicability and long-term viability. The study aims to fill the gap by performing an in-depth analysis of the costs and returns of regenerative practices compared to traditional farming practices. In order to examine investment and operating costs, financial stability, and profitability, the study uses quantitative surveys and case studies. The findings indicate that, despite expenditure, regenerative practices have benefits such as the reduction of inputs, better soil quality and reduced climate risk that make the costs worth it in the long run. Regenerative agriculture holds a significant potential to replace conventional agriculture due to the diverse portfolio of ecological and social benefits which it provides.

Keywords: Regenerative Agriculture, Ecosystem, Resource Efficiency, Sustainable Farming, Economic Viability, Economic Viability.

1. Introduction

The agriculture industry globally faces severe threats such an environmental changes, climate changes, economic fluctuations and food crises (Huong, Bo et al. 2019, Yadav, Hegde et al. 2019).

Historical conventional farming systems that rely on chemical fertilisers, single-crop production and the exploitative use of natural resources have led to low soil productivity, loss of biodiversity and high emissions of greenhouse gases (Singh and Nath 2020). Due to the intensification growth of world population, it necessitates a redevelopment of more sustainable and resource-providing food production system (Mang and Reed 2020). One of the most promising solutions for these problems has become regenerative agriculture known as a comprehensive strategy for land management (Newton, Civita et al. 2020). The humanized version of regenerative agriculture is the practice of farming that is focused on soil health, biodiversity and nutrient cycles, all of which are geared towards the recovery of the ecological basis of agriculture (Khangura, Ferris et al. 2023). Sustainable regenerative agriculture is mining to enhance health of land, maintain carbon and reduce climate impact through the use of natural processes instead of synthetic inputs.(Teague and Kreuter 2020).

Agricultural sustainability is emphasised especially in the aspect of environmental and economic challenges. (Piñeiro, Arias et al. 2020). As traditional farming methods have been associated with various environmental issues such as water pollution, soil erosion and destruction of habitats. This impact not only detrimental to the natural environment, but also carry substantial economic implications such as decreased crop yields, increased expense inputs, and loss of resources (Patel, Sharma et al. 2020). Therefore, understanding these issues are increasingly important to consider whether regenerative agriculture is economically feasible or if it can gain sustainability in the future.

However, there is a gap in the economic analysis on the prospects, sustainability, and feasibility of regenerative agriculture practices within agricultural systems (Muhie 2022). Although small-scale, qualitative studies indicate that regenerative farming can make producers more profitable and economically sustainable (Borsari 2020, Miller-Klugesherz and Sanderson 2023). This lack of understanding could prevent the implementation of regenerative agriculture on a large scale and its ability to address one of the most important and outstanding environmental and economic issues. Based on the above-highlighted areas, this study sought to complement the existing literature by assessing regenerative agriculture's economic feasibility and profitability in the long run. Therefore, the study assesses the economic feasibility of such regenerative agriculture practices. The study offers a much-needed assessment of the economic consequences of regenerative agriculture to farmers, policymakers, and other stakeholders in the field of agriculture by achieving these objectives,

The study's results will contribute to developing additional literature on regenerative agriculture by presenting its economic advantages and concrete data. Thus, assessing regenerative practices' economic feasibility and prospective cost-effectiveness will help inform farmers' decisions to adopt sustainable practices. Furthermore, the study's results will also help policymakers and stakeholders in the agricultural sector by providing recommendations for policy and program improvements that will encourage the practice of regenerative agriculture and support this transition toward a more sustainable and resilient agricultural system.

2. Literature Review

2.1 Regenerative Agriculture

Regenerative agriculture is a concept that seeks to restore soil health, enhance biological diversity, and productivity of ecosystems with the overall aim of improving agricultural productivity and sustainably (Khangura, Ferris et al. 2023). According to O'donoghue, Minasny et al. (2022), the major advantages of regenerative agriculture are the positive effect on the farmer's economy, the development of regional economy and the benefits for environment and society. This strategy also promotes cost cutting which results from less reliance on chemical inputs such as fertilizers, herbicides, and pesticides, making farming more profitable (O'donoghue, Minasny et al. 2022). According to, better soil health increases crop productivity and hence farm income whereas, multiple sources of income increase the resilience of farmers such as livestock farming, mixed crop farming, and honey production (Singh, Rathore et al. 2020).

Furthermore, the idea of 'regenerative economies' also goes beyond farm level to linkages on food markets and brings the preferred benefit of market access and profitability for smallholder producers. The advancement of regenerative agriculture at large can potentially boost production of crops through yielding more incomes, hence creating more employment opportunities to boost rural economies (Miatton and Karner 2020). According to Lankford and Orr (2022), the use of regenerative practices can also help in water quality and quantity, reduce chemical runoff and increase soil water retention. Therefore, implementing regenerative agriculture practices potentially make farmers happy and satisfied with their work to restore nature and witness the revival of a diverse landscape on their land (Lankford and Orr 2022). In addition, regenerative agriculture benefit climate change mitigation and adaptation as it involves carbon sequestration, reduction of land erosion, and improved water retention in the soil. However, the application of regenerative practices may vary due to the environmental conditions, and this can be a challenge to farmers on which practices to adopt on their fields (Lal 2004). According to Mpanga, Schuch et al. (2021), the costs associated with adopting regenerative agricultural practices are high, especially in the initial stages and are affordable for some producers. Altogether, the shift to regenerative agriculture as a common practice to enhance productivity, profitability and sustainability of agricultural systems and also to address global environmental and social issues is a noble idea, but the major consideration is ways to overcome 'context dependency' and costs of providing support (Mpanga, Schuch et al. 2021).

2.2 Economic Aspects of Regenerative Agriculture

The impact of regenerative agriculture on economic factors has increased as this concept gradually penetrates farming practices. Thus, regenerative agriculture aims to improve the condition of soils, their capacity to support life, and associated services, which have the potential to generate value for farmers and dwellers in rural areas. As O'Donoghue et al. (2022) pointed out, regenerative agriculture can enhance the functioning of farms' capes, leading to improved yields and income from improved soil health. This improvement minimizes the amount of input costs that include fertilizers and pesticide thus enhances farm profitability and sustainability (O'donoghue, Minasny et al. 2022). Schreefel et al. (2022) present a modeling framework that adds more clarity in explaining how regenerative practices can be cost-efficient. According to their findings, integrating regenerative practices can result in long-term economic profitability through better soil health and yield. Therefore, context-specific practices are emphasized and this has an implication of tailoring those practices to local settings in order to attain the best economic gains as well as ecological gains (Yada, Van Acker et al. 2024). This corresponds with Tittonell et al. (2022) who discourse that regenerative agriculture fits into the paradigm of agro ecology implying that it lacks the political and social structure to support it in terms of economics (Tittonell, El Mujtar et al. 2022).

Moreover, Regenerative agriculture also has positive implications for the general economy as well. A study by Rehberger et al. (2023) shows that these practices have positive climate and environmental impacts that may result in improved positions on the balance sheet by addressing ecosystem services (Rehberger, West et al. 2023). For instance, increased soil health may enhance water infiltration and decrease erosion, which, in addition to boosting food production, helps feed the people. Similalry, Bonacho, Eidler et al. (2024) highlight the ability of regenerative agriculture to reimagine landscapes as well as reshape attitudes to make rural economies more sustainable(Bonacho, Eidler et al. 2024).

However, the new idea is gradually being developed of regenerative economies that include not only farms but the whole food systems. According to Bless et al. (2023), the adoption of regenerative agriculture can contribute to rural economic growth through farmer, processor, and consumer networks. This integration contributes to better market opportunities and revenues for smallholder producers, thus creating a balanced sharing of the value added. The capacity of regenerative agriculture in offering employment and economic resilience is apparent (Bless, Davila et al. 2023). Recent findings associated with measures of regenerative agriculture in Africa which indicates that the application of such systems could increase the production of crop by up to 13 per cent by 2040, boost GVA for Africa by USD 70 billion per annum, and create five million farming-related jobs (IUCN, 2022). This shows how regenerative agriculture could help solve some of the biggest issues within food security and economic insecurity.

H1: Regenerative agricultural practices are economically viable in the long term.

2.3 Regenerative Practices and Financial Stability

Regenerative agriculture has been increasingly acknowledged as a way to create more resilient farm economy and increase its profitability compared to conventional approaches. According to Khangura et al. (2023) regenerative agriculture enhances soil health via practices like cover cropping, minimal tilling, and crop rotation, that may result in higher yields and less input expenditure. While such practices also improve the yields on the agricultural practices and also provide long-term sustainable economic returns through the conservation of costly chemical inputs (Khangura et al. 2023). Likewise, Muhie (2022) describes new ideas in sustainable agriculture, describing how regenerative practices lead to more robust agricultural systems that are less sensitive to economic fluctuation, making the farmers more financially secure (Muhie, 2022).

According to the review by Sánchez et al. (2022), diversified farming practices, which are often embedded in the regenerative form of farming increase the economic returns than conventional monotype farming systems. This analysis shows that diversified systems could also offer long lasting income streams, and thus act as efficient buffers for extreme fluctuations in the market, thereby improving financial stability (Sánchez et al., 2022). Rehberger et al. (2023) also stress that while natural capital restoration results in climate and other environmental improvement that support sustainability of the economic structure, there are aspects of ESS provision that underpin and reinforce the economic foundation by avoiding costs (Rehberger et al., 2023). Caldera et al., (2022) suggest that shifting towards regenerative business model is beneficial for small and medium enterprises in agriculture because it opens up new economic opportunities. If these enterprises embrace regenerative methods, they can also compete for higher prices in the market (Caldera et al., 2022). Similarly, Fatima et al. (2024) evaluates the economic, environmental, and social opportunities of sustainable agricultural practices, pointing out that regenerative agriculture increases not only the economic gain but also the improvement of people's quality of life and the overall health of the environment (Fatima et al., 2024). More recent, Suparak Gibson (2022) specifies on economic, ecological, and also social benefits of regenerative farming, while stating that the costs of adopting such practices are often concealed in the long term (Suparak Gibson., 2022). In a similar regard, Wilson et al. (2022) argue that different stakeholders agree that regenerative agriculture can help increase profitability while promoting sustainability (Wilson et al., 2022).

H2: The adoption of regenerative practices leads to greater financial stability and profitability compared to conventional methods.

Theoretical Framework

An effective understanding of the principles underlying CBA and Sustainability Economics, as well as CBA's use in determining the economic and sustainability of agricultural processes, is necessary to formulate a complete approach for analysing regenerative farming techniques. CBA is a formal mechanism for assessing project profitability through cost analysis (direct, indirect, or inferred) around associated revenues. Cost-Benefit Analysis (CBA) is a process which involves quantifying all costs and benefits over time, turning them into net present values (NPVs) for the purpose of measurement of decisions. Nevertheless, the weakness of CBA to measure long-term externalities makes it a perfect analytical tool for assessing the long-term payoff on regenerative agriculture since the outcomes may only be observed in a few years (Mishan and Quah 2020).

The discipline of Sustainability Economics is concerned with ecological and social factors in decision making, and inter generational equity and ecosystem services have important roles. The aim of the theory is to enhance sustainability in the society, environment, and economy, according to the principles of regenerative agriculture that values the promotion of farming systems for the humanity of communities and ecosystem. Merging of these two approaches would enable the development of more complex CBA of regenerative agriculture where conventional costs and benefits would be evaluated together with permit valuation as a means to represent trade-offs. This approach highlights the assessment of long-term impact using sustainability-based categorisations, on which policymakers can base support for actions that cater to economic and environmental interests. Consultation of various stakeholders in the CBA process makes the conclusions relevant and valued, thus proving that the framework not only promotes sustainable agriculture, but also protects the welfare of the next generation. (Mishan and Quah 2020).

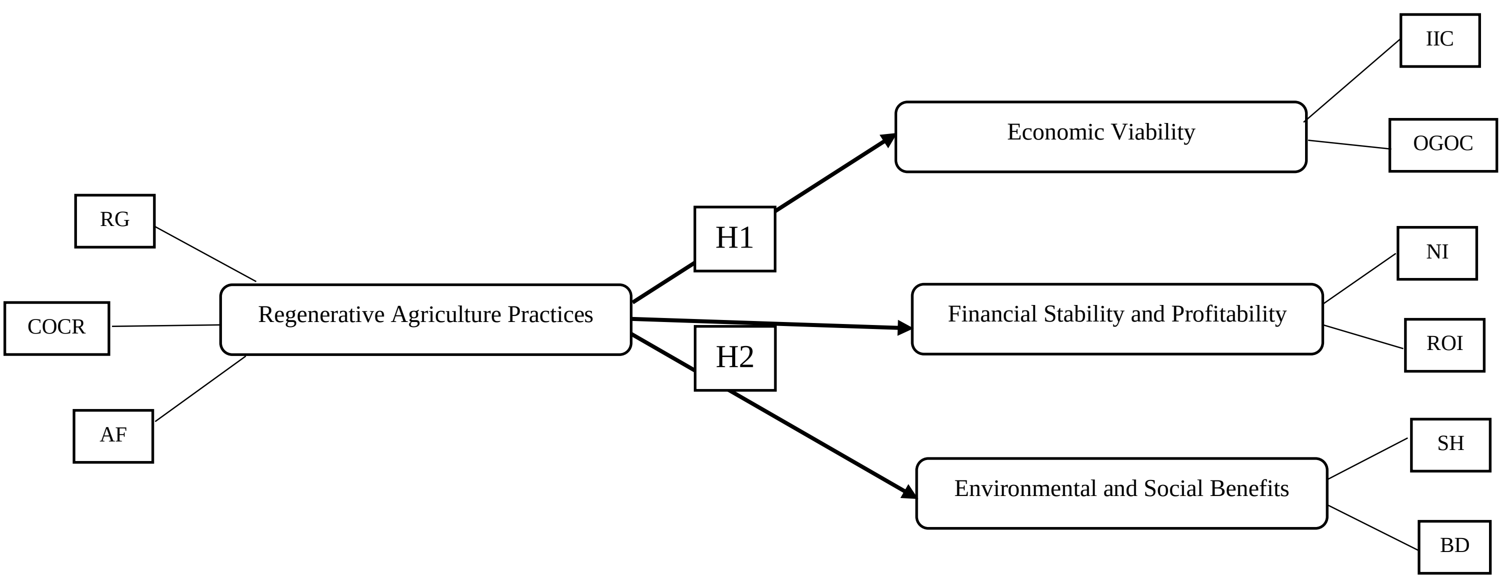

Figure 1 Conceptual Framework

3. Methodology

3.1 Research Design

The methodology is the study incorporates qualitative case study analysis and quantitative analyses to deeply analyse and compare the economic and long-term effectiveness of regenerative agriculture with conventional agriculture. The primary objective is to provide a comprehensive analysis of the way regenerative practices affect financial stability, profitability, environmental protection and the benefits that are to be derived from their use, amongst other things, through the use of both primary and secondary data.

3.2 Data Collection

The researcher attempted to evaluate the extent to which producers had adopted regenerative agriculture practices to initiate the data collection. The practices that were focused on for data collection were rotational grazing, cover crops, and agroforestry. A survey was sent to a representative sample of farmer's who are already adopting these regenerative practices, with requests to outline type and quantity of implementation. Farmers gave responses in a Likert scale from strongly agree to strongly disagree.

Using this approach, the researchers were able to determine how far farming businesses implement regenerative practices. The second section of the study focused on examining and recording the economic stability of regenerative agriculture. First, the study established the financial expenditures needed to implement these practices and later analyzed those needed for their execution. The participants had to furnish information on their (multipl) expenditures on the regenerative practices required compared to that of the conventional methods. In addition, modifications in yields, spending, and the total returns generated from these means were part of the analysis. The collected quantitative data was a way in which the researchers could assess and compare, the financial gains from regenerative practices against conventional farming.

Financial stability and profitability were the focus of the researchers during the third data collection phase. A review of the financial statements provided by the participating farmers enabled researchers to account for net income and ROI of regenerative and conventional agricultural methods. Variability of income was investigated using statistics, such as the coefficient of variation and resilience indices which enabled comparing income differences over time. The study had an opportunity to measure the extent to which regenerative agriculture improves financial stability and earning capacity by using these financial metrics to make an analysis. Other than the numerical analysis, the study also explored environmentally and socially beneficial aspects of regenerative agriculture. Through the use of indicators of the environment, researchers measured how biodiversity, water health, and air conditions changed with the use of regenerative methods. Environmental data collection involved collection of information from assessments and monitoring reports. Surveys were also conducted among the local communities to determine how they viewed the value of regenerative agriculture providing any of their needs in this context and the changes to employment and community general well-being. The social effects of regenerative agriculture on the health of people living in the vicinity were deeply explored through interviews and surveys in the study.

Table 1 Regenerative Agriculture Farms

Farm Name	Location	Details	Website
Rodale Institute	Kutztown, Pennsylvania, USA	Leader in regenerative agriculture research, focusing on soil health and organic farming.	Rodale Institute
White Oak Pastures	Bluffton, Georgia, USA	Implements rotational grazing, multi-species integration, and soil restoration.	White Oak Pastures
Hummingbird Farm	Elbert, Colorado, USA	Known for agroforestry and soil management practices.	Hummingbird Farm

Table 2 Conventional Agriculture Farms

Farm Name	Location	Details	Website
Cargill Farms	Various locations globally, USA, Brazil, Argentina	Major player in conventional farming, focusing on high-yield crop production.	Cargill
ADM (Archer Daniels Midland)	Global, major operations in USA, Brazil, and other countries	Large-scale conventional farming operations involved in crop production and processing.	ADM
Syngenta Farms	Global, with operations in North America, South America, Europe	Focuses on conventional farming methods and crop protection products.	Syngenta

Data Analysis

The analysis of the collected data was conducted in two phases. In the first phase 3 case studies were analyzed and in the second phase the data collected from the official sites of different farm was analyzed using excel and also a survey conducted with the managers, inspection officers, farm owners and farmers of three different farm. This survey data was analyzed using SPSS. The Descriptive statistics were applied for the measure of correlation between the use of regenerative practices, economical returns, and environment and social impacts.

This statistical credibility ensured that the findings obtained from data analysis were accurate and generalizable. The case studies entailed a textual analysis of discourses related to regenerative agriculture based on Hajer’s (1995) work. This analysis included texts from 3 organizations. In this way, ten separate discourses were revealed as part of the overall knowledge on regenerative agriculture. These discourses included Cultural Restoration for Profit; Systemic Holism in a Larger Context; Agro ecological Justice/Food Sovereignty; etc. Lastly, the analysis of the case studies and quantitative data was carried out in order to gain a holistic view of the effects of regenerative agriculture. In this way, triangulation helped the research to uncover the main themes, patterns and tensions that shape the adoption and sustained practice of regenerative initiatives. This approach not only complement the analysis but was also an asset when emphasizing various aspects of regenerative agriculture – economic, environmental, and social.

3.3 Reliability

Table 3 Reliability Statistics

Reliability Statistics	
Cronbach's Alpha	N of Items
.986	10

The above Table-3 Reliability Statistics show a Cronbach's Alpha of 0.986 for 10 items. This high value indicates excellent internal consistency among the items in the scale, which suggests that they are highly reliable and measure the same underlying construct effectively. A Cronbach's Alpha of 0.986 far exceeds the commonly accepted threshold of 0.7, demonstrating that the items are consistently aligned and provide a dependable measure for the variables being assessed.

4.0 Case Studies

Case Study-1 The Savory Institute's Holistic Management Projects

Midwest USA implemented several projects that shows the economic and environmental returns in regenerative agriculture. Among these projects holistic management and rotational grazing aims to enhance the quality of the soil in order to increase productivity in the farms. According to the economic development perspective, these regenerative practices have been appreciated for their cost-effectiveness. When farmers implement this system, they likely decrease their use of synthetic fertilizers and pesticides, which results in minimized input expenses (Spratt, Jordan et al. 2021). Similarly, measures like cover cropping and rotational grazing enhance nutrient status and water holding capacity of the soil which leads to enhanced crop production and improved animal productivity. This leads to increased profitability and financial returns when compared to conventional production systems, particularly as the impacts of climate variations manifest themselves in ways that negatively affect crop productivity. The other advantage is the long-term productivity, which is supported by the Savory Institute. They improve soil conditioning to sequester carbon and boost the resilience of ecosystems. Healthy soils therefore support and maintain bio-diversity as well as other production and supporting ecosystem services in order to sustain agriculture and the environment. It also strengthens the efficiency of these practices in the Midwest region and raises the probability of adopting similar techniques in other global cereal-producing regions (Al-Kaisi and Lal 2020).

Case Study-2: The Juma Sustainable Development Reserve, Brazil

The Juma Sustainable Development Reserve in Brazil offers a clear example of how regenerative logging can be profitable and beneficial to the environment. The reserve is in the Amazon Rainforest and utilizes sustainable land management to reduce deforestation and afforestation of the affected regions. In the economic sense, the reserve earns its income through carbon credits, which are useful in meeting international climate objectives by protecting forested territories and storing carbon. This unique funding model provides a predictable revenue source to support continued conservation work (Charnley, Weigand et al. 2023).

Further, the reserve embraces eco-tourism as a way of creating employment for the locals especially those who in the past relied on activities that were destructive to the forests such as logging. This diversification helps alleviate pressure on the rainforest while promoting sustainable development. Involving local people in conservation contributes not only to their welfare, but also increases the chances of success in the implementation of specific conservation measures. In terms of sustainable development, the Juma Reserve has a profound responsibility to protect one of the richest ecosystems on the planet. Such areas, protected within the framework of the reserve, help regulate the Earth’s climate and preserve the variety of life forms. This case study also shows that regenerative forestry is profitable and environmentally friendly and can, therefore, inspire similar conservation and development initiatives across the globe (Juma 2019).

Case Study-3: The Rotterdam Climate Proof Program

Rotterdam's Climate Proof Program is a very informative example of how regenerative urban design works in terms of improving climate and economic performance. In terms of climate impacts, green roofs, urban forests, and improved systems in water management are among the measures that have been adopted by the city. In terms of the economy, these practices have led to minimal expense relating to flood control and recovery of damaged structures. Effective water management also reduces the cost related to disaster control and general maintenance (van der Berg 2023).

Furthermore, green spaces have been incorporated into buildings to improve property values and draw investment that supports the economy. The emphasis of the program on enhancing communities' prospects is also great for public health, lowering expenses incurred on medical services and boosting general well-being. The case of Rotterdam shows that through regenerative urban design, one can attain both economic and environmental benefits, and be climate-ready. Rotterdam Climate Proof Program is an example to other cities globally in showing that regenerative practices can influence climate proofing and sustainable urban design (Raffa 2023).

4. Results

4.1 Quantitative Findings:

These results generated from the responses collected through a survey questionnaire. The participants contributed in this study includes managers, supervisors, farm owners, inspection officers and farmers who worked in regenerative agriculture farm.

H1: Regenerative agricultural practices are economically viable in the long term.

Table 4 Descriptive Statistics of CE, RAP and IAR

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Cost_Efficiency	300	1.00	3.67	1.7200	.74519
Revenue_And_Profitability	300	1.00	3.00	1.5089	.59628
Investment_And_Return	300	1.00	3.33	2.0478	.88104
Valid N (listwise)	300				

The above Table 4 reveals a generally positive perception of the economic viability of regenerative agriculture practices. Cost efficiency with a mean score of 1.7200 indicates a favourable view. However, the standard deviation of 0.74519 suggests some variability in responses, reflecting diverse opinions on the extent of cost benefits. Regarding **Revenue and Profitability**, the mean score of 1.5089, which falls between "Strongly Agree" and "Agree," shows a strong consensus that regenerative agriculture positively impacts revenue and profitability. The lower standard deviation of 0.59628 indicates consistent agreement among respondents on the financial benefits. In contrast, the mean score of 2.0478 for **Investment and Return** indicates a more neutral to positive perception of the return on investment. While there is recognition of potential returns, the higher standard deviation of 0.88104 reveals a wider range of opinions, which suggests that experiences with investment returns vary among respondents. Overall, the results suggest that regenerative agriculture is perceived as economically viable, particularly in terms of cost efficiency and profitability, though perceptions of investment returns are more varied.

H2: The adoption of regenerative practices leads to greater financial stability and profitability compared to conventional methods.

Table 5 Regenerative Agriculture Farms

Farm	Investment Costs	Ongoing Operational Costs	Average Crop Yields (per acre)	Cost Reductions	Additional Revenue Streams
Farm 1	$15,000 (initial setup)	$8,000/year (inputs, labor)	120 bushels of corn	20% reduction in fertilizer costs	$5,000/year (organic premiums)
Farm 2	$20,000 (initial setup)	$10,000/year (inputs, labor)	110 bushels of corn	25% reduction in pesticide costs	$6,000/year (ecosystem services)
Farm 3	$18,000 (initial setup)	$9,500/year (inputs, labor)	115 bushels of corn	15% reduction in water usage	$4,500/year (diversified products)

Table 6 Conventional Agriculture Farms

Farm	Investment Costs	Ongoing Operational Costs	Average Crop Yields (per acre)	Cost Reductions	Additional Revenue Streams
Farm 1	$15,000 (initial setup)	$8,000/year (inputs, labor)	120 bushels of corn	20% reduction in fertilizer costs	$5,000/year (organic premiums)
Farm 2	$20,000 (initial setup)	$10,000/year (inputs, labor)	110 bushels of corn	25% reduction in pesticide costs	$6,000/year (ecosystem services)
Farm 3	$18,000 (initial setup)	$9,500/year (inputs, labor)	115 bushels of corn	15% reduction in water usage	$4,500/year (diversified products)

Table 7 Comparison between Regenerative and Conventional Agriculture Farms

Farm	Farming Method	Investment Costs	Ongoing Operational Costs
Farm 1	Regenerative	$15,000	$8,000/year
Farm 2	Regenerative	$20,000	$10,000/year
Farm 3	Regenerative	$18,000	$9,500/year
Farm 4	Conventional	$12,000	$10,000/year
Farm 5	Conventional	$14,000	$12,000/year
Farm 6	Conventional	$13,500	$11,500/year

Table 7 compares regenerative and conventional agriculture farms' investment and ongoing operational costs. For regenerative farms, the initial investment costs range from $15,000 to $20,000, with annual operational costs varying between $8,000 and $10,000. In Although the conventional farms require lower initial outlays, typically less than Compared to conventional farms, regenerative farms (Farms 1, 2 and 3) invest more at first but their annual operating costs are usually at par or lower in the long run. Traditional farms exhibited by grounds 4, 5, and 6 show low initial costs but high yearly expenses. The results indicate that although regenerative farms require high initial expense investment, they might in fact compensate for this with operational savings in the long term.

Table 8 Environmental Benefits of Regenerative Agriculture Practices

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Soil_Health	300	1.00	3.00	1.6956	.66268
Biodiversity	300	1.00	3.00	1.8400	.70431
Water_Management	300	1.00	2.67	1.8289	.66916
Carbon_Sequestration	300	1.00	2.67	1.8289	.66916
Valid N (listwise)	300				

As per Table 8, it highlights the perceived environmental benefits of regenerative agriculture practices, with respondents showing a generally positive view across several dimensions. For Soil Health, the mean score of 1.6956 indicates that respondents "Agree" that these practices significantly improve soil quality. The standard deviation of 0.66268 suggests moderate opinion variability but reflects a broad consensus on the positive impact on soil health. Regarding Biodiversity, the mean score of 1.8400 also suggests agreement that regenerative practices enhance Biodiversity, with a standard deviation of 0.70431, which shows some variation in responses. For Water Management and Carbon Sequestration, with mean scores of 1.8289, respondents tend to be between "Agree" and "Neutral," recognising the benefits of regenerative agriculture in managing water resources and capturing carbon. The standard deviations for these two variables, 0.66916, indicate moderate variability in perceptions. The findings indicate that regenerative agriculture is viewed favourably regarding environmental benefits, with consistent acknowledgement of its positive effects on soil health, Biodiversity, water management, and carbon sequestration.

Table 9 Social Benefits of Regenerative Agriculture Practices

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Community_Engagement	300	1.00	4.00	2.4367	.80091
Consumer_Awareness	300	1.00	3.00	1.6333	.69317
Farmer_Well_Being	300	1.00	3.00	1.6333	.69317
Valid N (listwise)	300				

As per Table 9, it examines the social benefits of regenerative agriculture practices, revealing generally positive perceptions among respondents. The mean score for Community Engagement is 2.4367, suggesting that respondents are between "Neutral" and "Agree" on the impact of regenerative practices on community involvement, with a standard deviation of 0.80091 indicating some variability in opinions. It reflects that while there is recognition of positive social engagement, responses vary on the extent of these benefits. The mean Consumer Awareness and Farmer Well-Being scores are 1.6333, indicating a general "Agree" that regenerative practices enhance consumer awareness and improve farmer well-being. The standard deviation for both variables is 0.69317, showing relatively consistent agreement among respondents about these social benefits. The findings suggest that regenerative agriculture is beneficial for increasing consumer awareness and improving farmer well-being, with moderate support for its role in community engagement.

5. Discussion

The survey results indicated a positive attitude towards the economic feasibility of regenerative agricultural practices. According to the survey respondents, regenerative agriculture is regarded as cost-saving. This aligns with earlier case studies that showed more long-term economic gains. Economic viability through Savoury Institute's Holistic Management methods is manifested in reducing chemical inputs and costs, realising higher revenues, respectively. (Butterfield, Bingham et al. 2019). The Juma Sustainable Development Reserve in Brazil demonstrates the economic value of regenerative management because it creates income with carbon credits and ecotourism (Ribeiro, Soares Filho et al. 2018). However, feedback regarding investment returns suggest that although most participants mentioned some advantages, individual experience is not uniform. These changes are described in the case studies, which indicate that starting the transition towards regenerative practices may imply increased upfront costs. However, the advantages of engaging in regenerative practices spread, such as the improvement to the soil and increased output, prognosed in the long term. These findings are consistent with other research that has shown that regenerative agriculture takes more upfront money, but can produce higher future returns and better financial stability (Stephens 2021, Amede, Konde et al. 2023).

Moreover, the use of regenerative practices could improve soil and increase crop yield which in turn reduces dependence on expensive fertilisers and strengthens farms against climatic impacts. (Amede, Konde et al. 2023, Vanlauwe, Amede et al. 2023). It shows that although regenerative agriculture might cause sustainable profits, its success is directly dependent on the farm environment and other practices. When proffering a comparison of the costs between regenerative and conventional agriculture farms, it is evident that although farmers might be required to pay extra initially, their subsequent costs are likely to be the same or less. The results of the case studies confirm this conclusion. Projects by the Savoury Institute and the Juma Sustainable Development Reserve show that the initial cost of implementing regenerative practices may be expensive however, in turn these practices are going to pay us back in the form of such things as carbon credits and eco-tourism. Conventional agriculture, on the other hand, has lower initial costs, but the higher annual running costs outweigh these. The difference is important when comparing the total financial viability of regenerative practices. Excising literature has indicated that regenerative agriculture practices generally present superior long-term returns since the constant expenses are lower than conventional practices (Muhie 2022, Khangura, Ferris et al. 2023).

The findings further stated numerous environmental advantages of adopting regenerative agriculture practices. As such, these practices have been regarded as having positive effects on soil health, biological diversity, and water and carbon cycles. (Elevitch, Mazaroli et al. 2018, Gosnell, Gill et al. 2019). The case studies further elaborated these benefits, for instance, "The Savoury Institute" contributes to better soil assets and carbon stocks (Miatton and Karner 2020) while "Juma Reserve" is improving the ecosystem asset and climate (Carrilho, Demarchi et al. 2022).

The social impacts of regenerative agriculture relate to strengthening the consumer and farmer consciousness. Similarly, the Rotterdam Climate Proof Program offers a good example of the social benefits of regenerative urban design, including better citizens' health and increased social participation (Tillie, Borsboom-van Beurden et al. 2018). Other studies echo these perceptions, arguing that regenerative agriculture has positive impacts not only on the natural environment but also on society, such as providing people with sustainable sources of income and encouraging their involvement in their communities. (O'donoghue, Minasny et al. 2022). This resonates with the case studies and notes the multiple dimensions of regenerative practices beyond their economic rationality.

5.1 Recommendations

Financial incentives like grants, subsidies, or low-interest loans for improvements can support the higher initial costs and contribute to more farmers adopting regenerative agriculture. Another key recommendation is developing educational programs and knowledge networks can provide the necessary training and disseminate best practices among the actors involved. Therefore, funding R&D is vital to improving regenerative methods and identifying their regional variations; stabilising market access and consumer awareness through certifications, and this awareness increases the demand for regenerative products. Supportive policies have to be incorporated, and effective risk management instruments should be developed to minimise harsh impacts on economic conditions and encourage wider implementation. Impact assessment evaluations and feedback mechanisms must be periodically placed to assess the economic, environmental, and social benefits of regenerative agriculture practices for enhanced optimisation.

5.2 Limitations

The investment returns that the respondents experienced are quite diverse, and the experiences can sometimes be subjective. Further, the study is confined to stakeholders instead of the entire population, which is a source of weakness. The case studies have limited geographical and operational generalizability, and the cross-sectional design does not allow for tracking of changes in practices and productivity.

6. Conclusion

This study reveals that the cost of regenerative agriculture is higher because it needs more investment upfront. However, it is economically profitable and sustainable in the long run compared to conventional farming methods. The results indicate that implementing regenerative practices decreases the operational costs and increases profitability through improved soil condition and resilience. Furthermore, these practices offer enormous environmental returns, such as improving soil, biological diversity, and protection of carbon stock. In a social aspect, regenerative agriculture enhances the status of farmers and community participation. The study offers important recommendations for farmers, governments, and other relevant parties interested in improving agriculture and promoting more environmentally sustainable practices. This showed that though initial costs are slightly higher, the economic, environmental and social gains make regenerative agriculture feasible. Future research should continue investigating the variability of financial returns and inform adoption efforts to strengthen widespread changes needed for more robust and sustainable agriculture systems.

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