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Innovative climate-resilient agriculture: Community-based entrepreneurship for sustainable rural livelihoods

Rajitha N. K[1], Sanesh C[2], N. Karunakaran[3]*

[1]Dept. of Commerce, CAS College, Kannur, Kerala, India
[2]Dept. of Commerce, Sri Vyasa NSS College, Trissur, Kerala, India
[3]Dept. of Economics, People Institute of Management Studies (PIMS), Kasaragod, Kerala, India

Abstract

Fragility of rural economy has worsened with the impacts of climate change on agriculture especially in the regions where more farmers rely on small-scale farming. Therefore, climate resilience entrepreneurial solutions are being considered to adapt to global climate change impacts. Stemming from a Centre for climate change innovation in partnership for an agricultural entrepreneurship and rural transformation, this paper explores innovative business development strategies and schemes that advocate Climate resilient agriculture. Studying cases from different rural settings, the research focuses on climatically intelligent farming, environmental technologies and ecological farming methods that business-oriented activities use to counter climate risks and crop losses, which are currently leading to suffering in rural communities. What the study underscores is how entrepreneurship, in the arrangements for institutional credit access, government aid and local adaptations, may underpin livelihoods and resilience. Using the case of Kenya's rural farmers and business people, this study identifies barriers in the ways that they cannot adopt climate-smart practices in their farming and business; and how business-community projects can offer the solutions. It points out to factors that limit the implementation of climate smart techniques and concludes that community based projects offer sustainable solutions. To this end, it is posited that this paper helps advance contemporary knowledge of how entrepreneurship may facilitate a response to climate change by enhancing well-being and decreasing vulnerability in rural locations. It supports policy changes, legislation, and partnerships as society's strategies of encouraging sustainable, climate-friendly entrepreneurship businesses.

Keywords: Climate resilience, Agriculture, Entrepreneurship, Ecological farming.

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1. Introduction

Climate-related occurrences rise in frequencies and intensity, negatively impacting, global agriculture systems particularly among small farmers in rural areas whose food production remains key on smallholder systems. Worsening weather conditions, long lasting drought and floods occasioned by climate change have worsened crop losses, land degradation and led to the loss of sources of income for millions of farmers. Under this context, the agricultural sectors of emerging nations are most at risk since many rural populations depends on the yields of their farmland. Hence, the need to find more ways that can enhance communities' ability to cope with climatic impacts necessary for their existence as well as for economic development.

The combination of adaption measures into business models, thereby mitigating the effects of climate change while advancing the socio-economic growth of given economies is a viable approach to climate-resilient entrepreneurship. The concept here is to develop business activities that promote innovation in sustainable soil management, adaption plans for communities, and climate smart technology. These programmes aim to encourage innovation, new business, and sustainable economic growth

*Corresponding author: N. Karunakaran
Email: narankarun@gmail.com

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as well as reducing the amount of risk incurred by small farmers. Therefore, through the use of this strategy, entrepreneurship has the potential of adding value to the changes and developing rural economies by turning threats resultant from climate change and sustainability into opportunities for growth and development.

The study will also draw the awareness of institutional support, government policies and financial acquisition on the achievement of climate resilient entrepreneurship. In conclusion, this research tries to offer the practical implications into how the innovation-led efforts in the area of climate change adaptation can be had to enhance the rural society's development.

2. Background of the Study

The impacts of climate change on agriculture and food security for food insecure farming populations in the developing countries are severe. Current climatic changes affect crop growing by increasing temperature, irregular rainfall patterns and loss thru destructive weather conditions food insecurity and economic imbalance in the countryside zone. Small holder farmers are most affected since they cannot do much in the event of any change. Hence the need to employ Adaptation measures such as climate smart agriculture and innovative enterprise development in order to protect and enhance livelihood capacities and food adequacy for development. It, therefore, becomes possible for the insiders or the rural people in the climate change affected areas to build some type of resilience that can enable them to withstand and even improve their lots through the community based approaches.

3. Literature Review

Climate change is a global issue of concern in the modern world. The historical crop response to inter-seasonal climate variation is assessed using crop models that in turn are used to evaluate the future climatic impacts on crop growing. Agronomic management is one of the pre-adaptation techniques that are important in order to carry out efficient farming (Kalra, et al., 2007). Reilly (1995), pointed out that what impact climate change will have on agriculture globally is being measured, but uncertainties remain. Although recent discoveries suggest that it bears minimal costs or benefits, care is now taken to its special consequences, compensation structures, effects on areas of low income, growth prospects and flexibility of change. Lee et al., (2014), the report provides a framework for putting locally owned and driven solutions to climate change in agriculture as top priorities. The outcome analysis also showed that despite the dissimilarities in the approaches, the local stakeholders placed premium on similar agricultural adaptation interventions. Carter (2018), opinion in relation to the Ecosystems resilience and adaptation strategies as defining the impact of climate change, on human systems. The most dependent industry is agriculture and although people are adaptable in some way it is still unclear how agriculture will adapt. National Mission for Strategic Knowledge on Climate Indicators, (Gupta & Acharya, 2024) Climate Adaptive Planning for Resilience and Sustainability (CAP-RES) program of India is aimed for building resilience for sustainable future and is developing into global network platform for Climate Knowledge. This paper assesses the Pilot Program for Climate Resilience (PPCR), a private sector led program implemented in Nepal. As a result, the PPCR aims to improve climate change adaptation within the farmers industry through offering resources and knowledge. Reilly (1995), analysed that the effects of climate change on agriculture around the world are being assessed, but there are still unknowns. Despite recent findings that imply modest costs or advantages, concerns now centre on regional implications, compensating mechanisms, the impact on impoverished areas, economic growth expectations, and ease of adapting. Lee et al. (2014), the report offers a framework for giving local, stakeholder-driven solutions to climate change in agriculture top priority. The results indicate that, in spite of the differences, local stakeholders prioritised comparable agricultural adaptation measures. Carter (2018), view that the Ecosystem resilience and adaptation strategies determine how climate change affects human systems. The most dependent industry is agriculture and although communities can adjust to new conditions, it is yet unclear how much agriculture will change. Gupta, & Acharya (2024), viewed National Mission for Strategic Knowledge on Climate Change, the Climate Adaptive Planning for Resilience and Sustainability (CAP-RES) program seeks to strengthen India's resilience for a sustainable future while developing into a global network platform for resilience and sustainability knowledge. The case study Pilot Program for Climate Resilience (PPCR), a private sector initiative managed in Nepal. By providing farmers with resources and knowledge, the PPCR seeks to advance climate resilience in the agriculture industry.

4. Research Gap

1. Few cases on climate smart enterprises in agriculture: there is lot of information regarding climate change effects on agriculture; however the information concerning climate relevant entrepreneurship in agriculture is limited. Most of the studies have focused more on the technology-driven strategies like kind of irrigation or crop types, while little has been done so far to address how innovative business models can develop resilient and climate smart livelihood and agricultural practices in the rural setting (Aryal et al. 2020). However, there is a gap in the literature because the climatological point of view of the climate change adaptation policies and strategies broadly neglect the entrepreneurial aspect of differential adaptation in agriculture.
2. Absence of context-specific studies in Kerala: Ilangovan & Pandey (2019),view that Kerala is in some ways very special and exceptional because of its

climatic features which include monsoon rains and areas of low-land farming as that of Kuttanad, which are actually below sea level. Though there are many researches on climate resilience in India, lacking of region-specific research especially for agricultural practices in Kerala. This gap is especially imperative by the fact that agriculture is a dominant source of livelihood in Kerala and is closely affected by climate change.

3. Lack of studies on innovation of integrated strategies and cross-cutting elements for supporting CBA and enterprise:. Although there are a growing body of literature on community-level strategies for climate-smart economy, the engagement of farmer cooperatives, in particular, in climate-resilient entrepreneurial practices has not been explored sufficiently. FAO (2021) agricultural collectives in terms of resource pooling and joint marketing appear to offer a way of greatly boosting resilience to shocks, particularly where organised along the basins; however, little is known about how such organisation happens in the context of Kerala.
4. Overlooking socioeconomic barriers and entrepreneurial challenges: Patnaik & Narayanan (2019), Previous studies mostly focus on reporting technical changes in agriculture while the following paper seeks to complement this research by reporting on the reasons as to why the above changes are not fully implemented through reporting the level of entrepreneurship in implementing climate change adaptation strategies. The opinion that this approach of overlooking the economic and social issues that affect the business hinders the appreciation of the potential of climate-resilient business models to grow and be supported conclusively.
5. Gaps in understanding the role of Government and NGOs: Some authors have recognised the importance of government initiatives, as well as NGOs, to foster climate adaptation in agriculture but there is a research gap as to the efficacy of the strategies in promoting enterprise development. Little is known about the complex processes of engagement involving government programs for climate change, NGOs, and private sector development of climate-resilient agricultural enterprise in rural Kerala. (Bhatta et al., 2019).
6. Scarcity of case studies on successful climate-resilient entrepreneurs: Paliwal et al., (2022), analysed that while case studies allow for uncovering of practical strategies the lack of in-depth case studies related to successful/emerging climate resilient farmer-entrepreneurs in the agriculture domain of Kerala is particularly acute. While case studies may illustrate these solutions and the role of these entrepreneurs in countering adversity, finding a solution and practising innovation, the number of case studies thus far is somewhat restricted Most of the current literature concerns itself with the issue in the abstract and theoretical rather than offer examples of practical and entrepreneurial approaches to the problem.
7. Underrepresentation of gender and marginalized groups in climate-resilient entrepreneurship: Agarwal B, (2018), viewed lastly, knowledge is absent on the relationship between gender and social exclusion, and climate-resilient entrepreneurship. It seems that climate change impacts men and women differently, specifically, women are combined with the unfavourable representation of marginalized groups attempting to bargain for resources and capture entrepreneurial prospects. Despite their importance to agricultural activities, there is a lack of empirical research on ways in which gender mainstreaming could contribute to increased women's engagement in climate-smart enterprise creation. In Conclusion, solving those research gaps, it will be easier to get better understanding of the climate-resilient entrepreneurship in the Kerala agricultural sector. This research effort seeks to complement other efforts by examining the change processes at regional level, community level, by understanding the external support systems and by presenting regional level examples of successful entrepreneurs and their implications in constructing evidenced based practical and policy-relevant strategies for generating resilient agricultural communities in the face of climate change.

5. Significance of the Study

The rising effects of climate change on agriculture, especially in the vulnerable rural areas, call for innovations in the field of climate change resilient business models. Climate change impacts agricultural production as its factors range from erratic weather conditions, floods, drought and altered growth calendars. These changes affect food production, the economy and the existence of people who major in farming in rural regions. Most of the traditional farming practices are not well prepared to handles such difficult climate conditions and this is why, there is an urgent need to embrace innovation. Climate-smart business practices provide a development model that enables vulnerable rural populations not just to endure but to prosper in a climate-altered world. These business models can greatly decrease the vulnerability to climate risks if sustainable activities like sustainable water management, improvement of soil health, use of renewable energy sources, and wise adoption of climate-smart technologies are incorporated. Further, promoting of entrepreneurship in agriculture gives the farmers a chance to cut on the risks of concentrating with only one type of crop and also come up with new products in the market that meet the new tastes. It is important to discuss these models as they enable farmers in decentralised ways to build their own climate resilience and socio-economic improvement. Accepting this assumption entrenches or encourages resilience, cuts poverty as well as assists in establishing long-term sustainability. This means that it is an essential area for research and policy consideration in climate change as well as in agriculture.

6. Research Problem

Several problems affect rural agricultural communities as a result of climate change, for instance, changes in climate, resource availability, and yields. Climate-resilient entrepreneurship is an effective way of addressing these challenges as it creates sustainable forms of addressing social problems with specific reference to climate change by improving food security while at the same time empowering communities to mitigate the effects of climate change.

7. Research Questions

1. Since climate change affects the lives of people such that their food security is compromised, rural agricultural communities will also be victims in the following specific ways.
2. How can climate-resilient entrepreneurship succeed in reversing the impacts of climate change on rural agriculture, and what facilitating factors are essential to its success?

8. Objectives

1. To study the socio-economic and environmental effects of climate change at the rural agricultural living conditions of people in Kerala.
2. To find out the role of community-based entrepreneurial practices in constructing climate resilience in the agricultural sector.
3. To evaluate the contribution of institutional support, local innovation, as well as technology to making sustainable and adaptive entrepreneurship in the countryside possible.
4. To explore the developmental implications of climate-resilient entrepreneurship to drive inclusive and sustainable transformation of the rural attractiveness.

9. Scope of the Study

The area of interest in this study is the geographic location of Kerala, an area characterized by diverse agricultural activities and sensitive to climate change. It focuses on the rural agrarian societies of Kerala, to discuss how these societies are vulnerable because of fluctuating climatic factors. The sectoral context includes crop farming, farming of livestock and climate smart practices such as agricultural practices for climate change mitigation and adaptation. Through focusing on Kerala, the study intends to explore best practices that have been proven to promote climate-resilient entrepreneurship, compare and contrast community-based initiatives and understand how innovation can be used to solve climate-related challenges felt in the agricultural sector.

10. Materials and Methods

Here, the qualitative multi-case study approach is used to investigate how the resilient entrepreneurship related to climate could be used to contribute to sustainable civil life in the field of agriculture in Kerala. The research design has specifically chosen the methodological framework in order to provide a rich contextual knowledge of the local conditions, community adaptation, and new entrepreneurship approaches employed by the rural players as means of responding to climate change. The methodology focuses on lived experience, hometown knowledge systems, and community participation, which is in line with the goal of gaining insights on the sustainability in terms of the grassroots entrepreneurship.

10.1. Research design

A qualitative research paradigm forms the basis of the research study and the multiple case study is employed. The level of detail that can be achieved in a design of this type is due to the capacity to study the practises of climate resilient entrepreneurship in paddy farming, rubber cultivation, coconut farming, and aquaculture across four types of agricultural contexts in Kerala. The multi-case frameworks are better in enhancing the comparative perspective of the paper providing an opportunity to find out not only the cross-cutting themes, but also the specific response in certain area to climate challenges.

10.2. Reason to use qualitative case study

The qualitative methodology is suitable as the research is planned to deliver investigation of the context, behaviour within community, and interactions between individuals and institutions, and such study is impossible to implement within pure quantitative methodology. The methodology will help the researchers make sense, analyze social dynamics, and explore the level of a complex rural livelihood and climate adaptation by using the perspective of the people who are directly affected.

10.3. Sample method

Since in the present study, we are interested in identifying and selecting cases that cut across a wider spectrum of climate-resilient agricultural entrepreneurship in Kerala, purposive sampling was utilised. The criterias of inclusion were:

1. Demonstrated integration of climate-smart activities in agribusiness entrepreneurship.
2. Evidence of community-based projects e.g. Cooperatives or self-help groups.
3. It is geographically diverse across agro-ecological zones in Kerala.
4. Sponsorship of a government or NGO or academic institution.

People at the grassroots like farmers and local entrepreneurs, cooperative leaders and agricultural officers as well as NGO facilitators were included in the participation to include a multi-stakeholders point of view.

10.4. Methods of data collection

In order to guarantee richness and validity of data, a triangulated data collection strategy was used in the study:

1. Semi structured interviews were administered to 12 key informants of the four selected sectors. Interviews addressed motivations, challenges, innovations and means of support.
2. FGDs were organized with community members and cooperative participants in order to obtain views and experiences of groups of people.
3. Field notes captured the activities which were field based practices, tools used, management of water and soil, and group performances to encompass non-verbal and contextualized information.
4. The review of document materials was conducted on the project reports, government schemes, the documentation of NGOs, and regional initiatives in the field of climate-resilient agriculture.

The interviews and discussions were all held in Malayalam and translated into English in order to analyze the results.

In order to guarantee quality and richness of data, the study used a triangulated data collection strategy:

Key informants within the four selected sectors were interviewed using semi-structured interviews where 12 key players were targeted. Motivation, challenges, innovations, and support mechanisms were examined in interviews.

Community members and participants of BPCs were subjected to focus group discussion (FGDs) to provide the gather knowledge of general understanding and common experiences.

1. The field observations were used to record the practice, tools, water and soil management processes, and group activities to record non-verbal and contextual cues.
2. The analysis was conducted on the reports of projects, government schemes, documentation by non-governmental organizations, and local climate-resilient agriculture-supportive project initiatives.
3. Knowing very well that all the interviews and discussions were done in Malayalam and thus translated to English on which the analysis would be conducted.

10.5. Analysis of data

Manual thematic analysis was used to analyze the gathered information. It was done as follows:

1. Data familiarization: It is the reading and re-reading the Transcripts and the field notes in order to become an immersed reader.
2. Initial coding: Develop initial codes through the identification of common phrases, concepts as well as practices that relate to climate resilience, entrepreneurs, innovations and the institutional support of these processes.
3. Theme identification: Identification of related codes into themes like livelihood diversification, community participation, gender roles, and management of resources.
4. Cross-case analysis: This method involved comparing themes on the four case contexts to find similarities, differences, and information on how adaptations may be specific to the community.

This was a manual process that enabled the serious engagement with the data which brought about a mature perception of the facts that echo the realities of the lives of the rural communities.

10.6. Ethics

The social science research was carried out in accordance with the ethics of social researches. Before their participation, the participants were educated about the scope and objective of the study and they gave informed consent. Each member joined willingly and every participant was promised with anonymity and confidentiality. All the information was only utilized academically and kept safely.

10.7. Trustworthiness and validity

The research provided trustworthiness with various strategies:

1. The credibility was increased through triangulation of data sources (interviews, FGDs, observations, and documents).
2. Member checking was utilized by presenting initial findings to a few participants so as to ensure correctness.
3. Data was thick described in order to give a transferable result to other similar settings.
4. Audit trail was observed, whereby the decision taken during analysis and reflective notes were documented to ensure dependability and conformability.

11. Case Studies

Here is a structure of four Kerala based case studies in four distinct agriculture sectors all on climate resilient entrepreneurship. This paper shall focus on case studies to highlight the chosen regions and communities, climate mitigation and adaptation, local involvement, main issues and barriers and support systems including government funding, non-governmental organisations and private entities.

11.1. Case study 1

Paddy Farming in Kuttanad – The Rice Bowl of Kerala

11.1.1. Selected region and community

Kuttanad of Alappuzha district is widely called the 'Rice Bowl of Kerala.' Paddy is farmed here and it is one of the two or three areas in the world where farming takes place below sea level. Because the area is near Vembanad Lake and the backwaters, it is sensitive to floods and suitable for planning climate-smart agriculturally.

11.1.2. Climate-resilient entrepreneurship example

Kuttanad based progressive farmer Joseph Mathew who over the time, lost crop due to irregular rainfall and frequent flooding in his field adopted SRI and converted his farm in to an organic farming. The SRI method which uses less water than the normal planting enables farmers to apply organic fertilization to increase productivity. On protective measures adopted to safeguard yields from floods during monsoons Joseph ensured that he was cultivating flood tolerant rice varieties like Uma and Swarnadhan.

11.1.3. Community-based approaches

Joseph has been involved in a community-based organization on resource mobilization for flood control and marketing of organically grown rice branded as certified organic rice. It was accepted on the grounds that through sharing of machinery and techniques like submersible pumps to drain excess water, Joseph and other farmers in his group can avoid the impact of flooding. It has also adopted the process of price negotiations in order to obtain reasonable market prices for the organic products in order to make the farmers gain better returns.

Challenges faced: Joseph and his fellow farmers still face the following challenges in spite of implementing creative solutions:

1. Unpredictable monsoons, which result in either too much or too little water.
2. Increasing sea levels cause salinity intrusion, which has an impact on crop health and soil quality.
3. Marketing issues: They have trouble reaching out to customers outside of their area directly and their goods frequently face competition from cheaper, conventional rice that is farmed with chemicals.

11.1.4. Inspiration and support

Joseph got advice and funds from Kerala Agricultural University (KAU), which offered him flood-tolerant seeds and know-how. Some of the above strategies that were implemented included offering of capacity building services such as conducting of training workshops to farmers by Thanal- an NGO. MGNREGA initiative facilitated the government subsidies that enabled Joseph's cooperative get cheap and see labor for their developmental projects.

11.2. Case study 2: Rubber farming in pathanamthitta – Sustainable tapping practices

11.2.1. Selected region and community

Pathanamthitta is one of the districts of southern Kerala and quite famous for Rubber plantations. Various things which affect productivity in rubber farming include fluctuating rainfall patterns and increasing temperatures in this particular region. During monsoon season, many rubber farmers used to entirely depend on monsoon rain, however for sustainable rubber tapping, they have opted for adaptive measures.

11.2.2. Climate-resilient entrepreneurship example

Thomas George, a rubber farmer heard and adopted agroforestry and mixed his farm by planting pepper and fruit trees intercropping system. This multiple-layer farming system offers protection to the rubber trees to overheating just in case the temperatures have risen. Thomas has also practiced rain water management to ensure that there is availability of water to the plantations during dry weather to reduce drastic reduction of latex which is compounded by diseases arising from unfavourable weather conditions.

11.2.3. Community-based approaches

Thomas belongs to a farmer group that exchange information of disease-resistant rubber trees and safe tapping techniques. They also have developed a cooperatives system for the collection and processing of the latex and at the same time defending the interests of smallholder farmers on getting reasonable price for their products. Ideas like rain water management and mixed cropping are made at this level and are demo and copied throughout the region and make everyone resilient at his/her level.

Challenges faced: Rubber farmers like Thomas face several challenges, including:

1. Unpredictable weather patterns, which affect both the yield and the quality of latex.
2. Fluctuating market prices, as rubber is subject to volatile global prices, making it difficult for farmers to plan long-term.
3. High input costs, such as the rising cost of labour and fertilizers, which cut into farmers' profit margins.

11.2.4. Inspiration and support

Thomas availed himself to government supports such as Rubber Board's cash rebate of funds for the installation of rainwater harvesting structures and board cash rebate on agroforestry projects. MSSRF (M.S. Swami Nathan Research Foundation), a non-governmental organization also sponsored training programme on sustainable methods of rubber farming. In addition, the rubber processing firms are willing to provide another option of buy-back prices which enable the farmers in the collective to get quality price for their produce.

11.3. Case Study 3: Coconut farming in Palakkad – Organic and value-added production

11.3.1. Selected region and community

District such as Palakkad which is popular on coconut farming, has over time experienced changes in weather patterns that influence coconut production. Longer dry spells and short spells of heavy rainfall are challenging conventional practices in farming production.

11.3.2. Climate-resilient entrepreneurship example

Leela Varma, a coconut farmer, switched from using ordinary coconuts to improved coconuts which can be grown during the dry season and also, the use of water conservation through the use of drip irrigation system. Besides the basic coconut selling, she also ventured into processing of coconut into other products like virgin coconut oil, organic coconut sugar, as well as coconut fibre products like baskets, mats among others. Not only that, it also benefited her by providing her with the additional income and at the same times, it helps her business to minimize the effects of losing coconut produce due to the change in weather.

11.3.3. Community-based approaches

Leela is working hard in a Women's cooperative, which supports organic coconuts farming and the production of additional products. By this cooperation, the cooperative has established a processing shed through which the farmers process and package the products for market without requiring outside marketing facilities and this has enhance employment. Through teaching and sharing other farming practices such as organic pest control, drip irrigation and sustainable farming the community can increase overall resilience.

Challenges faced: Coconut farmers in Palakkad face significant challenges, such as:

1. Extended droughts, which reduce coconut yields and make irrigation necessary.
2. Pest infestations which have become more severe as a result of erratic weather.
3. Limited market access, for value-added products, with farmers struggling to find profitable distribution channels outside the local region.

11.3.4. Inspiration and support

Currently, Leela works in the Women's cooperative that deals with the farming of organic coconuts and making some more goods. Through this cooperation, the cooperative has developed a processing shed via which the farmer processes and packages the products for the market without the necessity of using other marketing facilities and this has promoted employment. More so, other farming practices like the Integrated Pest Management, and sustainable farming, use of technology like drip irrigation the community is able to be more resilient.

11.4. Case study 4: Fish farming in Vembanad lake – Climate-resilient aquaculture

11.4.1. Selected region and community

Vembanad Lake, the largest among the scenic lakes of Kerala, is a pulsating fishing and aquaculture centre. Nevertheless increased temperature, unpredictable rainfall, and intrusion by salts from the sea have posed a great danger to traditional fish producers.

11.4.2. Climate-resilient entrepreneurship example

Anil Kumar, a fish farmer in the Vembanad area adopted integrated aquaculture that is fish farming along with crops. He has adopted cultivating species that are more tolerant of saline water as they have adapted well to the fluctuating water salinity. Anil also plants mangroves right on the shores of the lake for the retention of soil to avoid the erosion of fish farms in case of floods. It has thus been possible to sustain income even after climate variability through the expansion of operations.

11.4.3. Community-based approaches

Anil is also a member of a society that deals with aquaculture in a society that focuses on sustainable fishing and replenishment of natural resource systems. Aquaculture has been developed by this group through planting Mangroves and constructing breeding zones for the fish which have made their enterprise sustainable. The society has also participated in the determination of water quality, in case of any changes in salinity levels or the water temperature.

Challenges Faced: Fish farmers like Anil face numerous challenges, such as:

1. Salinity intrusion which disrupts freshwater fish farming.
2. Water pollution, as runoff from nearby agricultural fields and settlements degrades water quality.
3. Fluctuating fish prices, driven by both local demand and global market forces.

11.4.4. Inspiration and support

Anil was assisted by the Kerala State coastal area development corporation who provided technical assistance and partly funded some of the salt-resistant fish breeds. Independent organizations such as conserve India, WWF India assisted in training fish farmers in the restoration of the ecosystems and in the adoption of effective aquaculture practices. Other Government schemes such as Blue Revolution Scheme have also offered funding for integrated fish farming projects which helps built the community's base also.

These case studies exemplify how climate-intelligent entrepreneurship can revolutionise agriculture in Kerala. And in each case, the entrepreneur shows that climate change is not solved by the use of new farming methods only but the

use of societal support and funding and market opportunities. Collectively, these cases provide important lessons concerning how to protect rural livelihoods from further vulnerability as a result of climate change while at the same time supporting sustainable economic growth for the agricultural economy of Kerala.

12. Results and Findings

This paper has discussed the impact of climate change on the rural agricultural community in Kerala and how community-level entrepreneurial solutions are assisting in mitigating such vulnerability. The case studies (4 case studies) informed the study on a multidimensional level insightfully around the socio-economic factors on one hand, the environmental factors on the other hand, and the institutional factors.

1. Socio-economic and environmental challenges: Erratic monsoons, long spells of drought, floods and saline water intrusion are some climate-induced changes that the rural communities under study experience, which are posing increasing pressures and vulnerabilities on them. Such disturbances have resulted in reduced yields, much higher input expenses, deteriorating soil quality, and economic instability. Socially they have caused the migration of youths, a shortage of labour during seasons and the breakdown of any community cohesion. Environmentally, loss of biodiversity, degradation of soil and water scarcity has worsened the situation of the traditional agricultural systems.
2. The community-based entrepreneurial practices: In the various agro-ecological regions, farmers have learnt to live in climate-resilient models of entrepreneurship which is based on community cooperation. These are diversified agriculture (e.g., intercropping and agroforestry), integrated aquaculture, organic production and processing added value. Cooperatives and women self-help groups were some of the projects that increased the access to common resources, marketing and access to technology which makes them more resilient and creates employment opportunities in the locale.
3. Enabling factors: Institutional support, innovation and technology: The most important facilitating factors were the specific government programmes, student counselling, NGO-guided training, and economic inducement. Outcomes were adaptorier among farmers that had institutional support. Mobile app use weather update, soil sensors, drip irrigation and salt-tolerant variety was critical in enhancing productivity and sustainability. Moreover, local training and the platform of shared learning increased the ability of community to absorb and internalize innovations.
4. Developmental implications of climate-resilient entrepreneurship: The examination found that the community-oriented entrepreneurship does not only promote environmental adaptation but the development of broader sustainable results as well. These are promoting of economic diversity, poverty alleviation, empowerment of women and better food and water security. The case studies also indicate that localized innovation made possible with the help of inclusive policies can result in extendable approaches to climate resilience. Therefore there is affiliation of these practices with a number of Sustainable Development Goals (SDGs) that include SDG 2 (Zero Hunger), SDG 8 (Decent Work), SDG 13 (Climate Action) and SDG 5 (Gender Equality).

13. Discussion

The problem statement of the present study highlights the fact that the community-centred and climate-resilient entrepreneurship in the agriculture sector is urgently needed in Kerala. The exposures of the rural farming communities such as the unpredictable rains, crop failure, increased cost of inputs, and social dislocation needs to be dealt through integrated solutions, which would extend beyond conventional solutions in agriculture. The case studies reveal that the resilience of livelihoods and the sustainability of the environment have been improved through entrepreneurial solutions embedded in local innovations like diversified cropping, agroforestry, integrated aquaculture and organic value added productions. These programs proved best when they were entrenched in their cooperatives or self-help women groups where sharing of resources, access to the market and group adaptation becomes easier. Moreover, institutional facilitators, e.g. government support programs, NGO-based capacity building programs, academic alliances and digital applications were key to the realization and duplication of these models. Note worthily, the results are not restricted to short-term adaptation to climate change, leading to other development implications, including diversification of the economy, gender inclusion, and environmental conservation. These are in great resonance with the national and global priorities such as SDGs 2, 5, 8, and 13. Hereby, the evaluation of climate-resilient entrepreneurship is not only an adaptive response but is a unifying strategy of development. The study asserts that, at the local level, entrepreneurship is a potential support that is both established locally and through the institutions to be transformative to the climate-vulnerable rural areas.

14. Recommendations

To strengthen climate-resilient entrepreneurship and ensure a sustainable rural transformation in Kerala, the study recommends the following recommendations are proposed:

1. Facilitate community-based models: Support the establishment and expansion of cooperatives, self-help groups and farmer collectives where there is sharing of learning, inputs access, and market connections. These models have demonstrated to be useful in the process of mobilizing grassroots resilience and inclusiveness.
2. Foster institutional support: Government agencies and local organizations as well as institutions, should seek to tailor a response by offering financial incentives,

climate-smart subsidies, training programs on entrepreneurship, sustainable farming, and risk mitigation techniques

3. Capacity building and innovation: Develop stronger rural systems of innovation through the provision of ongoing technical training, business development services and exposure to best practices in climate-smart agriculture and agri-business models.
4. Leverage digital technologies: Increase the application of mobile platforms as a tool to deliver weather forecasts and market intelligence as well as market access to farmers so that they may make informed decisions and reach wider markets.
5. Support public-private partnerships (PPPs): Build partnership between government agencies, Non-Governmental Organizations (NGOs), higher education and business community to develop enabling environments to climate-smart businesses and rural entrepreneurs.
6. Mainstream gender and social inclusion: Be sure to meaningfully integrate women and youth and previously marginalized groups into all programs and policies in recognition of their essential part in community resistance and design.

15. Conclusion

This paper discussed the multi-factorial relationships between climate change, agricultural vulnerability and entrepreneurial actions within community lines in the state of Kerala. Based on the findings, it is evident that climate-resilient entrepreneurship is not a coping strategy alone but an alternative way of sustainable rural development. The study draws particular attention to the close links between the rural agricultural population and a wide range of vulnerabilities, including economic shocks and soil degradation, as well as social displacement, all of which climatic extremes contribute to. To solve these, technical solutions are not enough; it demands a more community-oriented approach which has to be based on local realities. The resilience of the farmers has been portrayed by the patterns of adoption of entrepreneurial practices as diversified cropping, organic value added processing, integrated aquaculture and agroforestry. Such activities, particularly when they are within the context of the cooperative and women's collectives, have increased local autonomy, enhanced income stability and resilience.

The supporting roles of enabling environments cannot be overestimated; they include government programs as well as training within institutions, the help of NGOs, and digital tools. The main mechanisms fill in knowledge and minimize risk, and foster scalability. Easy access to financing, information, and technology inputs has played an active role in determining the success of climate-adaptive entrepreneurship. Notably, the research confirms the more general development implications of the models. Climate resilient entrepreneurship does more than make a community risk-averse since it helps in terms of inclusive growth, gender empowerment, and recovery of the ecological system. Its ability to revitalize economically, protect the environment and enhance social capital can be highlighted by the ripple effects. Finally, the integration of grass root entrepreneurship with climate adaptation is a realistic way forward in pursuing climate justice, livelihood security and sustainable development in rural India. Strategy: Future policies should focus pursuing locally owned, gender-sensitive and innovation based policies that reflect on the lived experiences of the climate-vulnerable groups.

16. Limitations

The limitations of the study lie in the fact that it is geographically restricted to the rural community of exemplar areas in Kerala and so it makes no sense to generalize the study to other areas with varied agro-climatic and socio-economic backgrounds. Although the qualitative case study method features rich contextual information, it aspires to take stock of all the vectors of climate-resilient entrepreneurial behavior potentially occurring throughout the state. Otherwise, the study majorly presents the views of farmers and community members without much contribution of policymakers and financial institutions. Further study is required that is longitudinal in nature and a larger perspective of which stakeholders are involved to confirm the findings and further add to it.

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18. Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this study, "Innovative Climate-Resilient Agriculture: Community-Based Entrepreneurship for Sustainable Rural Livelihoods." All the given findings and recommendations are written on the basis of the research conducted, with no financial or personal relationships influencing the outcomes or conclusions.

References

Kalra, N., Chander, S., Pathak, H., Aggarwal, P. K., Gupta, N. C., Sehgal, M., & Chakraborty, D. (2007). Impacts of climate change on agriculture. *Outlook on Agriculture*, *36*(2), 109–118. https://doi.org/10.5367/000000007781159903

Lee, D. R., Edmeades, S., De Nys, E., McDonald, A., & Janssen, W. (2014). Developing local adaptation strategies for climate change in agriculture: A priority-setting approach with application to Latin America. *Global Environmental Change*, *29*, 78–91.

Carter, C., Cui, X., Ghanem, D., & Mérel, P. (2018). Identifying the economic impacts of climate change on agriculture. *Annual Review of Resource Economics*, *10*, 361–380.

Gupta, A. K., & Acharya, P. (2024). Adaptive planning for resilience and sustainability: Lessons from India—Project CAP-RES and network. In A. K. Gupta, A. Gupta, & P. Acharya (Eds.), *Disaster risk and*

management under climate change (pp.607–629). Springer, Singapore. https://doi.org/10.1007/978-981-99-4105-6_30

Aryal, J. P., Sapkota, T. B., Khurana, R., Khatri-Chhetri, A., Rahut, D. B., & Jat, M. L. (2020). Climate change and agriculture in South Asia: adaptation options in smallholder production systems. *Environment, Development and Sustainability*, *22*, 5045–5075. https://doi.org/10.1007/s10668-019-00414-4

Canton, H. (2021). Food and Agriculture Organization of the United Nations—FAO. In *The Europa directory of international organizations 2021* (23rd ed., p. 9). Routledge.

Alam, A., & Rukhsana. (2023). Climate change impact, agriculture, and society: An overview. In A. Alam & Rukhsana (Eds.), *Climate change, agriculture and society* (pp. [Page Range Missing]). Springer, Cham. https://doi.org/10.1007/978-3-031-28251-5_1

Anand, A., & Romo-Murphy, E. (2022). Communication tools to tackle cascading effects of climate change: Evidence from Eastern Bihar, India. In *Climate change and risk in South and Southeast Asia* (1st ed., p. 23). Routledge.

Madhanagopal, D. (2023). Local Adaptation to Climate Change in South India: Challenges and the Future in the Tsunami-hit Coastal Regions (1st ed.). Routledge. https://doi.org/10.4324/978 1003187691

Rama Rao, C. A., Raju, B. M. K., Rao, A. V. M. S., Rao, K. V., Ramachandran, K., Nagasree, K., & Sammi Reddy, K. (2018). Climate change impacts, adaptation and policy preferences: A snapshot of farmers' perceptions in India. *Policy Paper*, *1*(2018), 34.

Ninan, K. N., & Bedamatta, S. (2012). *Climate change, agriculture, poverty and livelihoods: A status report*. The Institute for Social and Economic Change.

Korber, S., & McNaughton, R. B. (2018). Resilience and entrepreneurship: A systematic literature review. *International Journal of Entrepreneurial Behavior & Research*, *24*(7), 1129–1154. https://doi.org/10.1108/IJEBR-10-2016-0356

Hans, A., Hazra, S., Das, S., & Patel, A. (2019). Encountering gendered spaces in climate change policy in India: Migration and adaptation. *Journal of Migration Affairs*, *II*(1), 1–24. https://doi.org/10.36931/jma.2019.2.1.1-24

Mijatović, D., Van Oudenhoven, F., Eyzaguirre, P., & Hodgkin, T. (2012). The role of agricultural biodiversity in strengthening resilience to climate change: towards an analytical framework. *International Journal of Agricultural Sustainability*, *11*(2), 95–107. https://doi.org/10.1080/14735903. 2012.691221

Reilly, J. (1995). Climate change and global agriculture: Recent findings and issues. *American Journal of Agricultural Economics*, *77*(3), 727–733. https://doi.org/10.2307/1243242

Paliwal, M., Rajak, B. K., Kumar, V., & Singh, S. (2022). Assessing the role of creativity and motivation to measure entrepreneurial education and entrepreneurial intention. *International Journal of Educational Management*, *36*(5), 854–874. https://doi.org/10.1108/IJEM-05-2021-0178

Agarwal, B. (2018). Capacity Building and Empowerment of Women in Climate Adaptation: A Key to Resilient Communities. *Environmental Research and Sustainability, 12,* 214–230. https://doi.org/10.1016/j.ers.2018.02.014

Bhatta, B., Shrestha, S., Shrestha, P. K., & Talchabhadel, R. (2019). Evaluation and application of a SWAT model to assess the climate change impact on the hydrology of the Himalayan River Basin. *Catena*, *181*, 104082. https://doi.org/10.1016/j.catena.2019.104082

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