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Regenerative Agriculture and Role of Indigenous Technical Knowledge (ITKs) in Climate Resilience: Evidence from Karnataka, India

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Abstract

Climate change has intensified challenges in agriculture, particularly in semi-arid and tropical regions such as Karnataka, India. Regenerative agriculture has emerged as a transformative approach focusing on restoring soil health, biodiversity, and ecological balance. Indigenous Technical Knowledge (ITKs), rooted in traditional farming wisdom, offers sustainable and low-cost solutions that align closely with regenerative principles.

The present study examines the role of ITKs in enhancing climate resilience among farmers across five agro-climatic zones of Karnataka. A total of 100 farmers were surveyed using structured interview schedules. Five key ITKs neem-based seed treatment, Panchagavya application, mixed cropping, traditional water harvesting, and ash-based storage were identified and analyzed.

The findings indicate that ITK adoption significantly contributes to improved soil fertility (mean score 4.3), pest resistance (4.4), and cost reduction (4.6). A strong positive correlation (r = 0.72) was observed between ITK adoption and climate resilience. The study concludes that integrating ITKs with regenerative agriculture enhances sustainability, reduces climate vulnerability, and promotes farmer adaptability.

Keywords: *Regenerative Agriculture; Indigenous Technical Knowledge (ITKs); Climate Resilience; Sustainable Agriculture; Agroecology; Soil Health*

1. INTRODUCTION

Agriculture is highly sensitive to climate variability, with increasing incidences of drought, erratic rainfall, and soil degradation affecting productivity. Conventional agricultural practices relying heavily on chemical inputs have further aggravated environmental degradation and reduced soil fertility.

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Regenerative agriculture has emerged as a holistic approach that focuses on restoring ecological balance through practices such as crop diversification, organic inputs, and soil conservation. It emphasizes rebuilding soil organic matter, enhancing biodiversity, and improving water cycles. Indigenous Technical Knowledge (ITKs) represents a body of traditional knowledge developed by farmers over generations through experience and interaction with the environment. These practices are locally adapted, resource-efficient, and environmentally sustainable. Karnataka, characterized by diverse agro-climatic zones, possesses a rich repository of ITKs that contribute to sustainable agricultural practices. However, modernization has led to the gradual erosion of this knowledge. Therefore, documenting and integrating ITKs into regenerative agriculture is essential for achieving climate resilience.

2. LITERATURE REVIEW

2.1 Global Perspectives on ITKs and Regenerative Agriculture

Miguel Altieri (2018), Emphasized that traditional agricultural systems are inherently resilient due to their biodiversity-rich practices. The study highlighted that agroecological systems based on indigenous knowledge enhance ecosystem stability, reduce pest outbreaks, and improve long-term productivity.

Jules Pretty (2008), Reported that sustainable agricultural practices rooted in traditional knowledge significantly improve soil health, water retention, and farmer livelihoods. The study concluded that ecological farming systems outperform conventional systems under climate stress conditions.

Food and Agriculture Organization (2013; 2021), Recognized Indigenous Technical Knowledge as a critical component of climate-smart agriculture. FAO reports indicate that traditional practices such as crop diversification and organic inputs enhance adaptive capacity and reduce vulnerability to climate change.

Vandana Shiva (2016), Highlighted that indigenous farming systems conserve biodiversity and ensure food sovereignty. The study argued that traditional practices are more sustainable and resilient compared to industrial agriculture.

2.2 Indian Context of ITKs

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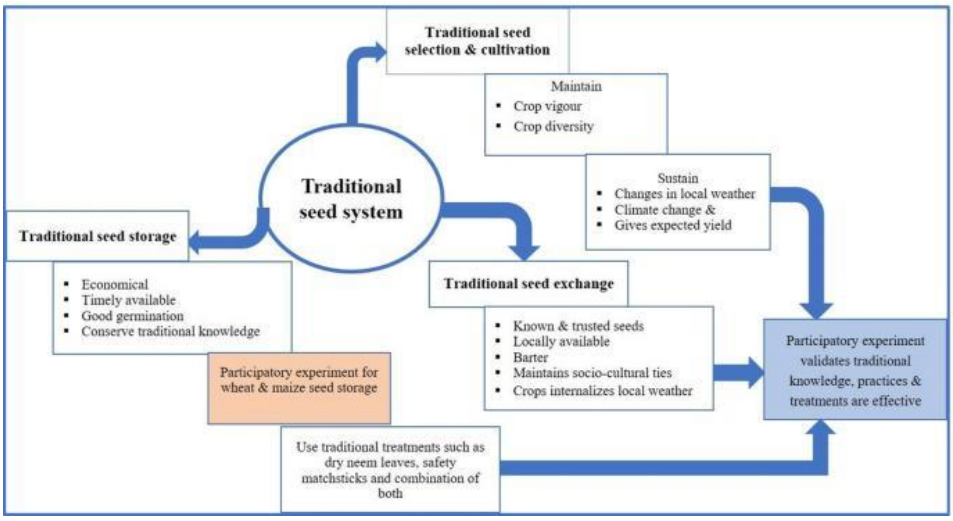

Fig. 1: **Transfer of ITKs in India**

Indian Council of Agricultural Research (2022), Documented a wide range of ITKs across India and emphasized their scientific relevance in pest control, soil fertility management, and water conservation. The report highlighted that ITKs are cost-effective and environmentally sustainable.

Sinha et al. (2017), Observed that indigenous agricultural practices contribute significantly to climate adaptation in rainfed regions. The study found that farmers using ITKs experienced lower crop failure rates during drought conditions.

Gupta (2014), Stressed the importance of documenting grassroots innovations and traditional knowledge systems. The study highlighted that ITKs have strong potential for scaling up through institutional support.

2.3 Studies in Karnataka

Fig. 2. Preparation method of Panchagvya

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Hiremath et al. (2021), Studied indigenous seed treatment practices in Karnataka and found that neem-based treatments effectively reduce pest incidence and improve germination rates. The study validated the scientific basis of traditional seed preservation methods.

Jadhav et al. (2020), Analyzed ITKs in plantation crops and reported that traditional organic formulations enhance soil microbial activity and crop productivity. The study emphasized their role in sustainable farming systems.

Karnataka Biodiversity Board (2020), Documented various ITKs practiced across the state, including mixed cropping, water conservation techniques, and organic inputs. The report highlighted their importance in maintaining ecological balance and resilience.

Rajashekar et al. (2019), Found that farmers practicing mixed cropping and traditional water management techniques showed higher resilience to climate variability and better yield stability.

3. RESEARCH METHODOLOGY

3.1 Study Area

The study was conducted across five districts representing different agro-climatic zones:

- Raichur (dry zone)
- Chikkamagaluru (hilly zone)
- Dharwad (transition zone)
- Mandya (irrigated zone)
- Tumkur (semi-arid zone)

3.2 Sampling Design

A total of **100 farmers** were selected using random sampling:

District	**Respondents**
Raichur	20
Chikkamagaluru	20
Dharwad	20
Mandya	20
Tumkur	20

3.3 Data Collection Methods

- Primary data: Structured interviews
- Secondary data: Journals, reports, government publications

3.4 Analytical Tools

- Descriptive statistics (frequency, percentage)

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- Mean score analysis
- Correlation analysis
- Climate Resilience Index (constructed variable)

4. Results and Analysis

4.1. Socio-Economic Characteristics

The majority of respondents (46%) belonged to the middle-age category, indicating active farming engagement. Small farmers constituted 52%, reflecting resource constraints and higher dependency on low-cost ITKs.

4.2 Identification of ITKs

Table 1: Key ITKs Identified

ITK	Description	Functional Role
Neem-based seed treatment	Use of neem leaves/oil	Pest & disease control
Panchagavya	Cow-based bio-formulation	Soil fertility enhancer
Mixed cropping	Multiple crops grown together	Risk diversification
Water harvesting	Farm ponds, bunding	Moisture conservation
Ash storage	Ash used in seed storage	Pest prevention

Adoption Levels

ITK	Adoption (%)
Mixed cropping	82
Neem treatment	78
Ash storage	70
Panchagavya	65
Water harvesting	60

Mixed cropping shows highest adoption due to its immediate benefits in yield stability and climate risk mitigation.

Climate Resilience Analysis

Table 2: Impact of ITKs on Climate Resilience

Indicator	Mean Score

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Soil fertility	4.3
Moisture retention	4.1
Pest resistance	4.4
Yield stability	4.0
Cost reduction	4.6

Discussion:

- High score for cost reduction indicates economic sustainability
- Pest resistance highlights ecological benefits
- Soil fertility improvement reflects regenerative potential

Correlation Analysis

Variable	**r-value**
ITK adoption	0.72
Education	0.45
Farm size	0.31

A strong positive correlation (0.72) confirms that ITKs significantly enhance climate resilience.

District-wise Variation

District	**ITK Adoption (%)**	**Resilience Score**
Raichur	75	4.2
Chikkamagaluru	80	4.4
Dharwad	78	4.3
Mandya	72	4.1
Tumkur	76	4.2

Discussion

The findings indicate that ITKs are inherently aligned with regenerative agriculture principles:

- **Ecological sustainability:** Reduced chemical usage
- **Economic viability:** Low-cost inputs
- **Social acceptance:** Locally adapted practices

Mixed cropping enhances biodiversity, while Panchagavya improves soil microbial activity. Water harvesting ensures resilience against drought conditions.

The integration of ITKs with regenerative agriculture can create a **synergistic model for climate adaptation**.

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Mapping ITKs with Regenerative Agriculture

ITK	Regenerative Principle	Outcome
Neem treatment	Biological pest control	Reduced chemicals
Panchagavya	Soil regeneration	Increased fertility
Mixed cropping	Biodiversity	Stability
Water harvesting	Water conservation	Drought resilience
Ash storage	Sustainability	Reduced losses

Constraints

- Lack of documentation
- Limited scientific validation
- Youth disinterest
- Weak policy support

Policy Implications

- Promotion of ITKs in extension programs
- Integration into climate-smart agriculture
- Digital documentation of traditional knowledge
- Incentives for regenerative farming

Conclusion

The study establishes that ITKs play a critical role in enhancing climate resilience and supporting regenerative agriculture. Their integration into modern agricultural systems offers a sustainable pathway to address climate challenges, improve soil health, and ensure food security.

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