



FinTech *for the* Last Mile

Financial Inclusion in the Era of Amrit Kaal

Dr. B. Indira Priyadharshini

Mr. A. Prakalathan

Dr. D. Saranya

Dr. M. Nirmala

**FinTech for the Last Mile :
Financial Inclusion in the Era of
Amrit Kaal**

Editors

Dr. B. Indira Priyadharshini

Mr. A. Prakalathan

Dr. D. Saranya

Dr. M. Nirmala

FinTech for the Last Mile : Financial Inclusion in the Era of Amrit Kaal

Dr. B. Indira Priyadharshini

Assistant Professor

Department of Commerce (CA), NGM College, Pollachi

Mr. A. Prakalathan

Assistant Professor

Department of Commerce (CA), NGM College, Pollachi

Dr. D. Saranya

Assistant Professor

Department of Commerce (CA), NGM College, Pollachi

Dr. M. Nirmala

Assistant Professor

Department of Commerce (CA), NGM College, Pollachi

First Edition : January 2026

ISBN : 978-93-94004-59-7

Price : Rs. 850/-

Copyright All rights reserved. No part of this book may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, mechanical, photocopying, recording or otherwise, without prior written permission of the author.

Printed at

CAUVERITECH Computerised Print Shop

21/2, Rajamill Road, Pollachi – 642 001.

Ph : 04259 – 221734

E-Mail : cauveritech@gmail.com

10.	FINTECH INNOVATIONS IN RURAL INDIA : A CATALYST FOR SOCIAL IMPACT AND FINANCIAL INCLUSION IN THE ERA OF AMRIT KAAL Mr. S.P. Gokulnath, Mr. B. Saran Vishnu & Mr. N. Dinesh Kumar	74
11.	EMPOWERING MARGINALIZED COMMUNITIES THROUGH DIGITAL FINANCIAL INCLUSION : STRENGTHENING ORGANIC FOOD SYSTEMS IN THE AMRIT KAAL ERA Dr. E. Renuga	80
12.	LOW-CODE AND NO-CODE PLATFORMS AS CATALYSTS FOR DIGITAL TRANSFORMATION IN INDIA Dr. S. Sathiyapriya	87
13.	EMPOWERING MARGINALISED COMMUNITIES THROUGH DIGITAL FINANCIAL INITIATIVES Mr. R. Senthilkumar	94
14.	DIGITAL FINANCIAL INCLUSION MEETS CLIMATE INTELLIGENCE : A MACHINE LEARNING - BASED WEATHER PREDICTION FRAMEWORK FOR MARGINALIZED COMMUNITIES Ms. S. Saranya & Dr. M. Rajasenathipathi	101
15.	A STUDY ON THE IMPACT OF PMMY ON FINANCIAL INCLUSION AMONG MARGINALIZED COMMUNITIES (2015–2024) Ms. V. Poornima	108
16.	THE CONNECTIVITY PARADOX : ADDRESSING INTERSECTIONAL BARRIERS AND RURAL-URBAN DISPARITIES FOR DIGITAL REVOLUTION Ms. S. Lavanya	115
17.	SOCIO ECONOMIC DETERMINANTS OF DIGITAL EXCLUSION Dr. E. Renuga, Dr. G. Akilandeswari & Dr. K. Priyatharsini	126
18.	INDIAN DIGITAL PUBLIC INFRASTRUCTURE (DPI) STACK : ENABLING FORMAL AND INFORMAL SECTORS Ms. T. Saranya	133

DIGITAL FINANCIAL INCLUSION MEETS CLIMATE INTELLIGENCE : A MACHINE LEARNING - BASED WEATHER PREDICTION FRAMEWORK FOR MARGINALIZED COMMUNITIES

Ms. S. SARANYA

Research Scholar & Assistant Professor, Department of Computer Science,
NGM College, Pollachi, Tamilnadu, India saranyashana21@gmail.com

Dr. M. RAJASENATHIPATHI

Associate Professor, Department of Computer Science,
NGM College, Pollachi, Tamilnadu, India r.senathipathi@gmail.com

ABSTRACT

Digital financial inclusion is a cornerstone of equitable economic development, particularly for marginalized communities that face limited access to traditional banking services. Concurrently, climate uncertainty and extreme weather events significantly affect livelihoods, especially in agriculture-dependent regions. This paper proposes an integrated framework that combines machine learning-based weather prediction with digital financial services, termed climate intelligence-driven financial inclusion. The framework leverages machine learning algorithms such as Long Short-Term Memory (LSTM), Random Forest, and ensemble models to generate accurate weather forecasts that inform climate-aware financial products, including weather-indexed insurance, adaptive microcredit, and digital savings mechanisms. Aligned with India's Amrit Kaal vision, the proposed system aims to bridge the digital divide, reduce climate-induced financial risks, and promote inclusive and sustainable development.

Keywords: Digital Financial Inclusion, Climate Intelligence, Machine Learning, Weather Prediction, Marginalized Communities

1. INTRODUCTION

The rapid advancement of digital technologies has transformed financial ecosystems worldwide. Digital financial services such as mobile banking, Unified Payments Interface (UPI), digital wallets, and fintech platforms have expanded access to financial resources. However, a significant digital divide persists, particularly among marginalized communities, including smallholder farmers, daily wage workers, women, and rural populations.

At the same time, climate change has increased the frequency and intensity of extreme weather events, affecting income stability and financial security. Weather uncertainty directly impacts agricultural productivity, loan repayment capacity, and insurance claims. Integrating climate intelligence with digital finance offers a promising solution to address both financial exclusion and climate vulnerability. This explores a machine learning-based weather prediction framework that enhances digital financial inclusion by enabling climate-aware financial services, contributing to inclusive and sustainable development during the Amrit Kaal era.

2. RELATED WORK

Obtainable studies on digital financial inclusion focus on accessibility, affordability, and digital literacy. Separately, machine learning approaches for weather prediction such as LSTM, CNN-LSTM, and ensemble models have demonstrated improved forecasting accuracy. However, limited research explores the convergence of weather intelligence and digital finance, particularly for marginalized communities. This paper addresses this gap by proposing an integrated framework.

2. DIGITAL FINANCIAL INCLUSION AND MARGINALIZED COMMUNITIES

Digital financial inclusion refers to the use of digital technologies to provide affordable and accessible financial services to underserved populations. Key components include: Digital payments and remittances, Microcredit and digital lending, Savings and insurance products, Financial literacy through digital platforms. Despite policy initiatives such as Pradhan Mantri Jan Dhan Yojana (PMJDY), Aadhaar-enabled payments, and Direct Benefit Transfer (DBT), marginalized communities face barriers such as limited digital literacy, poor internet connectivity, and lack of risk-aware financial products.

3. CLIMATE INTELLIGENCE AND WEATHER PREDICTION

Climate intelligence involves the use of data analytics and artificial intelligence to understand and predict weather patterns. Accurate weather forecasting is essential for: Agricultural planning, Disaster preparedness, Weather-linked insurance schemes, Credit risk assessment. Traditional numerical weather prediction models are computationally intensive and

struggle with nonlinear atmospheric behavior. Machine learning models offer scalable and data-driven alternatives capable of handling complex climate patterns.

4. MACHINE LEARNING ALGORITHMS FOR WEATHER PREDICTION

This work employs the following machine learning algorithms : Long Short-Term Memory (LSTM): This network is effective for time-series forecasting and capturing temporal dependencies in weather data such as rainfall, temperature, and humidity. Random Forest (RF): In this model handle nonlinear relationships and feature interactions, making them suitable for multi-variable weather prediction. Ensemble Models: Combining multiple models improves robustness and prediction accuracy, reducing uncertainty in climate forecasts. These models utilize historical meteorological data from sources such as national weather agencies and satellite observations.

5. PROPOSED INTEGRATED FRAMEWORK

This framework integrates weather prediction with digital financial services : Data Collection: Historical and real-time weather data, financial transaction data. Machine Learning Layer: Weather prediction using LSTM, RF, and ensemble models. Climate Intelligence Engine: Risk assessment and climate alerts. Digital Financial Services : Weather-indexed crop insurance, Climate-aware microloans, Adaptive savings and repayment schedules, Digital payments and benefit transfers, User Interface: Mobile-based platforms in local languages. This integration enables proactive financial decision-making and enhances resilience against climate shocks.

6. USE CASES FOR MARGINALIZED COMMUNITIES

Farmers, especially smallholders, face significant risks from increasingly volatile weather patterns. Weather-based advisories use data on local forecasts and climate trends to provide actionable information, such as optimal planting times, irrigation schedules, and harvest predictions. By linking these advisories with digital financial services, farmers gain access to : Digital Credit is automated loan approvals based on predicted harvest success and weather conditions. Insurance Payouts is parametric insurance products can issue automatic, rapid payouts when specific adverse weather

events (e.g., drought, excessive rain) are detected, eliminating lengthy claim processes and providing immediate relief for recovery.

Many micro-entrepreneurs operate small, weather-dependent businesses (e.g., street vendors, small-scale processors, local transport). Climate-informed loan products can integrate hyper-local weather data into credit risk assessments. This allows financial institutions to Approve Loans: Offer credit to individuals who might otherwise be considered too risky using conventional metrics. Ensure Flexible Repayment : Automatically adjust repayment schedules during climate-induced disruptions (e.g., closing a market due to a storm), preventing default and allowing businesses to recover without accumulating insurmountable debt.

Women Self-Help Groups (SHGs) are crucial community-based financial systems. By incorporating risk awareness into their financial products, SHGs can better manage collective and individual risks. This can involve : Risk Pooling is to design saving products that function as internal insurance mechanisms for climate shocks. Microfinance Access is utilizing collective data and group guarantees to access larger, external microfinance loans, which can be deployed for climate adaptation measures, such as purchasing drought-resistant seeds or water purification systems.

Rural households often lack access to timely information and the financial buffers needed to prepare for or respond to crises. Early warning systems (EWS) provide critical, timely information via SMS, local radio, or digital platforms about impending climate events (e.g., floods, heat waves) or potential economic instability. Proactive Planning is allow households to take protective measures, secure assets, or temporarily relocate. Linked Financial Support can trigger rapid-response financial aid, such as conditional cash transfers, directly into mobile wallets, ensuring funds reach the most vulnerable populations before or immediately after a disaster strikes.

7. ALIGNMENT WITH AMRIT KAAL VISION

The framework supports India's Amrit Kaal goals by : Promoting Inclusive Digital Growth is Utilize AI for broader access to services (healthcare, education, finance) for informal workers and remote areas, bridging digital divides. India AI Mission, Digital Shram Setu, Sarvam AI for smarter Aadhaar services, and LLMs for language translation of government services. Strengthening Rural & Agricultural Economies integrates

advanced tech (AI, drones, IoT) into farming for precision agriculture, better yields, and climate-smart practices, empowering smallholder farmers. AI for disease detection, weather forecasting, decision-support systems for crop management, and promoting natural farming. Enhancing Climate Resilience through AI uses AI for predictive analytics in weather, resource management, and promoting green energy/infrastructure, reducing climate impact. AI for predicting climate patterns, integrating renewable energy, and developing green infrastructure for sustainable cities.

Supporting Sustainable Development & Financial Empowerment drives overall economic growth with technology, ensures benefits reach all (youth, women), and provides digital tools for financial inclusion. Tech-driven knowledge economy, leveraging 'Nari Shakti' (Women Power), PM Gati Shakti for logistics, and AI for skilling and livelihoods. In essence, this framework translates Amrit Kaal's vision into action by making technology (especially AI) a core engine for achieving holistic, sustainable, and equitable development across India, from cities to villages, Data availability and quality. Digital literacy gaps. Infrastructure constraints in rural areas. Cybersecurity and data privacy concerns. Addressing these challenges requires policy support, capacity building, and public-private partnerships.

8. CONCLUSION

To presents a novel integration of digital financial inclusion and climate intelligence through machine learning based weather prediction. The proposed framework demonstrates how AI-driven weather forecasting can enhance financial services for marginalized communities, reduce climate-induced risks, and bridge the digital divide. As India advances into the Amrit Kaal era, such interdisciplinary approaches are essential for achieving inclusive, resilient, and sustainable development.

9. FUTURE WORK

Future research may explore : Real-time IoT-based weather data integration, Explainable AI models for transparency, Pilot implementations and impact assessment, Expansion to other climate-sensitive sectors.

REFERENCES

1. Luo, J., & Chen, L. (2025). Climate change risk, digital financial inclusion and multidimensional relative poverty among farm
-

- households. *Sustainability*, 17(12), 5404. Shows how digital inclusive finance mitigates climate risk-induced poverty. MDPI
2. Artificial intelligence for financial inclusion and sustainable development: a systematic literature review. *Discover Artificial Intelligence*, 5:390 (2025). Systematically links AI and inclusive finance. Springer Link.
 3. Agyekumhene, A. et al. (2025). How digital inclusive finance improves the climate resilience of food production systems. *Frontiers in Sustainable Food Systems*. Highlights digital finance and climate-smart risk pricing. *Frontiers*.
 4. Zhang, H. (2025). *Machine Learning Methods for Weather Forecasting*. Atmosphere. A survey of AI-based weather prediction techniques. MDPI
 5. Kotsuki, S., Shiraishi, K., & Okazaki, A. (2025). Ensemble data assimilation to diagnose AI-based weather prediction models. *Geosci. Model Dev.*, 18, 7215–7225. Discusses AI–NWP integration. GMD
 6. Saravana, M. K. et al. (2025 ed.; 2023 papers collated). *Next-Generation Weather Forecasting: A survey on ML-based rainfall and climate prediction*. IJSRST. Includes seminal 2023 ML methods. IJSRST
 7. Amnuaylojaroen, T. (2025). Advancements and challenges of artificial intelligence in climate modeling. *Frontiers in AI*. Discusses AI in climate modelling challenges. *Frontiers*.
 8. El Alami, S. E. A. et al. (2025). Machine learning & deep learning in computational finance: systematic review. *arXiv*. Broad ML in finance. *arXiv*
 9. Artificial intelligence and climate risk: A double machine learning approach. *Int. Rev. of Financial Analysis* (2025). AI's impact on climate risk assessment. *ScienceDirect*
 10. I Price et al. (2025). Probabilistic weather forecasting with machine learning. *Nature*. State-of-the-art ML forecasting model GenCast. *Nature*

11. FinTech and economic readiness: climate and digital finance readiness. Sci. Direct (2024) examines FinTech resilience to climate change.
12. Yang, R. (2024). Interpretable machine learning for weather and climate prediction. Environmental Modelling & Software. Reviews interpretability of AI weather models. ScienceDirect
13. Verma, R., & Pandiya, D. K. (2024). The role of AI and ML in U.S. financial market predictions. IJGIS. Reviews AI/ML trends in finance, useful for digital finance section. Home.
14. Deep learning-enabled high-resolution weather forecasting. Ayoub, A. (2024). Shows ML weather forecasting model development. ScienceDirect
15. Chen, S., Long, G., & Shen, J. (2023). Prompt Federated Learning for weather forecasting foundation models. arXiv. Early federated ML for global forecasting. arXiv
16. Bochenek, B., & Ustrnul, Z. (2022). Machine Learning in Weather Prediction & Climate Analysis. Atmosphere. Early survey of ML weather techniques. IJERT
17. Appiah-Badu, N. K. A. et al. (2022). Rainfall prediction using ML for ecological zones. IEEE Access. Application of ML in meteorology. IJRSRT
18. Dos Santos, R. P. et al. (2021). Deep learning in time series forecasting with Transformer models. Highlights advanced models relevant to climate/weather ML. PMC
19. Digital financial inclusion: a gateway to sustainable development (2021 review). PMC. Reviews global digital finance inclusion trends. PMC
