

AI -DRIVEN APPROACHES TO FINANCIAL INCLUSION: ENABLING GREEN FINANCE FOR SUSTAINABLE DEVELOPMENT

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Abstract:

This article explores the intersection of artificial intelligence (AI) and financial inclusion. and inexperienced finance To promote sustainable development As AI technology develops rapidly These provide transformative opportunities for the financial sector. Particularly in improving access to financial services for the underserved and underserved population of the bank. Leveraging AI-powered tools combined with credit scoring Threat assessment and mortgage disbursement It enables financial establishments to offer more comprehensive and effective financial offers. Moreover, AI in green finance is becoming more and more important. Because it helps assess climate risks. Invest in inexperienced initiatives and promote sustainability This article examines the interplay between AI-driven financial inclusion and green finance. Each uses AI technology to force financial inclusion and environmental sustainability. A framework is presented. The potential of these technologies to empower communities Guide inexperienced financial initiatives. and contribute to achieving the Sustainable Development Goals (SDGs) are critically analyzed. This reveals a virtuous circle of inexperienced collective resilience.

Keywords: artificial intelligence (AI), financial inclusion green finance sustainable development Climate risk assessment credit scoring credit disbursement green project Financial Technology (FinTech) Environmental Sustainability Sustainable Development Goals (SDGs)

I.INTRODUCTION

1. AI-Driven Transformation in Finance and Sustainability

Integrating artificial intelligence (AI) into the economic fabric will reshape the landscape of financial inclusion. and promote green finance for sustainable improvements. By leveraging generation tools such as machine learning and herbal language processing, AI will enhance the allocation of beneficial resources. Optimize financial offers and support environmentally friendly initiatives. This phase will introduce key features of AI to link economic inclusion with environmental sustainability. and summarize the objectives of the consideration

2. Interplay between financial transformation and AI

Financial inclusion should aim to offer periodic fee-based financial deals to underserved populations. AI-powered technology facilitates this by offering customized financial solutions. Automate your strategy and increase credit for marginalized organizations The power of AI in analyzing large data sets allows for

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Figure: 1, The Virtuous Cycle of Inclusive Green Resilience: AI and Finance Driving Sustainable Development

3. Green Finance: A Pillar of Sustainable Development

Green finance makes a speciality of investment initiatives that sell environmental sustainability, collectively with renewable power, strength overall performance, and smooth technology. AI enhances inexperienced finance by using the usage of using enabling correct assessment and monitoring of Environmental, Social, and Governance (ESG) metrics. This allows allocate capital to environmentally sound responsibilities and music their effect on sustainability dreams.

4. AI's Role in Promoting Green Innovation

Green innovation involves technological advancements that reduce environmental degradation and useful resource intake. AI helps this through accelerating studies, improving method performance, and fostering the development of sustainable era. AI-enabled systems moreover facilitate collaboration for the duration of industries, promoting huge adoption of green improvements.

5. Digital Payment Systems and Environmental Impact

AI-driven virtual charge structures, which encompass online banking and cell wallets, play a pivotal function in reducing carbon footprints. These structures reduce paper use, reduce journey for economic transactions, and offer inexperienced bypass-border price mechanisms. Such improvements make a contribution to a greener monetary tool through fostering digitalization in financial sports activities.

6. Policy Implications and Strategic Recommendations

The adoption of AI-driven techniques necessitates sturdy policies to make sure their topexceptional use for economic inclusion and green finance. Governments and monetary establishments want to invest in AI infrastructure, sell regulatory frameworks for ESG compliance, and incentivize green initiatives. This section explores techniques for aligning AI technology with sustainability objectives.

7. Final Insights and Pathways for Further Exploration

AI has terrific functionality to allow monetary inclusion and increase green finance, thereby driving sustainable improvement. This examine underscores the need for persevered exploration of AI's function in addressing climate exchange, reducing inequality, and fostering green innovation. Future research ought to hobby on improving AI algorithms for sustainability and exploring their programs in numerous socio-financial contexts.

II.LITERATURE REVIEW

Financial Inclusion Through AI

Artificial Intelligence (AI) has converted the monetary panorama through facilitating broader monetary inclusion, especially in underserved and unbanked areas. AI-pushed systems leverage superior records analytics, gadget learning algorithms, and herbal language processing to address barriers to financial offerings together with price, accessibility, and take delivery of as right with. Studies spotlight the placement of AI in lowering operational inefficiencies and enhancing patron-centric financial solutions, together with credit score rating assessments and custom designed financial planning (Dwivedi et al., 2020). Through predictive modeling and threat profiling, AI allows monetary establishments to provide loans and credit rating score to people and companies with restricted credit score histories, thereby fostering monetary boom and reducing inequality (Zhang et al., 2023).

AI and Green Finance

Green finance makes a speciality of funding environmentally sustainable responsibilities, alongside side renewable power, inexperienced infrastructure, and green era. AI plays a pivotal characteristic in advancing inexperienced finance via improving the efficiency and accuracy of Environmental, Social, and Governance (ESG) assessments. AI algorithms can observe large datasets to show the environmental impact of investments, locate greenwashing, and decorate choice-making for stakeholders (Xu et al., 2023). Furthermore, AI-pushed structures like blockchain and IoT facilitate transparency and traceability in inexperienced financing, ensuring that price range are allotted correctly within the course of sustainable development goals (SDGs) (Peng and Zheng, 2020).

Linking AI, Financial Inclusion, and Sustainability

The integration of AI with monetary inclusion and green finance creates synergies that power sustainable improvement. AI-powered monetary services increase get entry to to capital for small and medium organizations (SMEs) engaged in green innovation, thereby bridging the space amongst financial inclusion and environmental sustainability (Awawdeh et al., 2020). Research demonstrates that AI-enabled systems beautify collaboration amongst stakeholders, streamline regulatory compliance, and align investments with global sustainability requirements (Wang et al., 2022).

Challenges and Opportunities

Despite its potential, the adoption of AI in financial inclusion and green finance faces disturbing situations, at the side of statistics privacy concerns, regulatory hurdles, and the virtual divide. These troubles necessitate strong governance frameworks and equitable get admission to to AI technology (Edeh et al., 2022). On the opposite hand, the integration of AI with emerging technologies inclusive of blockchain and big facts offers possibilities to beautify transparency, performance, and scalability in green finance responsibilities.

III. RESEARCH METHODOLOGY

The studies method for this have a look at goals to find out how AI-pushed techniques can be used to enhance monetary inclusion, with a selected awareness on allowing inexperienced finance for sustainable improvement. The methodology will follow a systematic and blended-techniques method to acquire quantitative and qualitative insights.



Figure: 2, Data collection and pre-processing steps.

1. Research Design

• **Mixed-Methods Approach:** An aggregate of both qualitative and quantitative research strategies might be employed to provide a comprehensive evaluation of AI-pushed techniques in economic inclusion and inexperienced finance.

• **Exploratory Research:** Given the evolving nature of AI and green finance, the research will to begin with explore the modern-day panorama and technological advancements in those regions.

2. Data Collection

Primary Data:

• **Interviews:** Semi-structured interviews with monetary establishments, AI specialists, policymakers, and inexperienced finance specialists will offer insights into the practical programs and demanding situations of AI in economic inclusion and inexperienced finance.

• **Surveys:** Surveys can be distributed to a broader target market, inclusive of people from marginalized groups, monetary area professionals, and green marketers to apprehend their notion of AI's function in monetary inclusion and its capability for promoting sustainable development.

• **Case Studies:** Real-international case studies of a success AI programs in inexperienced finance (e.G., AI-enabled lending for renewable power tasks, climate-threat modeling) might be examined to become aware of nice practices.

Secondary Data:

• Literature Review: A thorough evaluate of instructional papers, industry reviews, and government courses could be carried out to apprehend the existing AI-driven economic inclusion models and their effect on inexperienced finance.

• **Industry Data:** Financial sector reviews, inexperienced finance tasks, and AI adoption records might be analyzed to evaluate the traits and overall performance of AI-based totally monetary inclusion efforts.

3 Sampling Strategy

Target Population: The studies will recognition on financial institutions, inexperienced finance establishments, policymakers, AI era vendors, and people from underbanked or unbanked groups.

Sampling Technique:

• **Purposive Sampling:** For interviews, purposive sampling might be used to select individuals with expertise in economic inclusion, AI technologies, or green finance.

• **Stratified Sampling:** For surveys, stratified sampling will make sure that the sample represents exceptional segments, inclusive of individuals from diverse socioeconomic backgrounds, genders, and areas.

3. Data Analysis

Qualitative Data Analysis:

• **Thematic Analysis:** Interviews and case studies may be analyzed the usage of thematic analysis to perceive key themes related to AI-driven approaches in economic inclusion and their role in allowing inexperienced finance.

• **Content Analysis:** Secondary information from reports and literature will undergo content material evaluation to discover developments and emerging practices in AI packages for sustainable improvement.

Quantitative Data Analysis:

• **Descriptive Statistics:** Survey information could be analyzed the use of descriptive statistics to summarize trends and styles associated with AI's role in economic inclusion and inexperienced finance.

• Correlation Analysis: The relationship among AI adoption and the achievement of green finance initiatives may be explored thru correlation evaluation, using variables inclusive of economic access, investment for inexperienced tasks, and sustainability outcomes.

4. Model Development

• **AI Model Simulation:** The studies may additionally involve the development of AI fashions to simulate capability situations where AI can facilitate inexperienced finance. For instance, AI-based totally credit score scoring fashions for lending to renewable electricity projects or the usage of machine getting to know algorithms to assess weather risks and opportunities in economic portfolios.

• **Simulation Tools:** Statistical and device mastering gear including Python, R, or specialized AI systems can be used to increase those models, as a way to be tested towards ancient financial data and sustainability metrics.

5. Ethical Considerations

• **Informed Consent:** All participants in interviews and surveys will offer informed consent concerning the reason of the observe and the use of their data.

• **Data Privacy:** Personal facts will be anonymized to ensure privateers and compliance with facts protection rules consisting of GDPR.

• **Bias Minimization:** The research will take steps to minimize bias by way of using various sampling strategies and making sure that members' perspectives are pretty represented.

6. Limitations

• **Data Availability:** Some areas or financial establishments may additionally have restrained information on AI applications in financial inclusion or green finance, that may have an effect on the comprehensiveness of the findings.

• **Technological Variability:** The stage of AI adoption and technological infrastructure may vary throughout areas, main to differing consequences and demanding situations in AI-pushed financial inclusion and inexperienced finance tasks.

7. Expected Outcomes

• **Identification of Key AI Applications:** The studies will discover the most effective AI technology for using financial inclusion and helping inexperienced finance, along with AI-primarily based credit scoring, chance assessment, and automatic lending.

• **Policy Recommendations:** The take a look at will offer suggestions for policymakers and monetary institutions on how to integrate AI into green finance strategies for sustainable improvement.

• **Impact Assessment:** The studies will verify the effect of AI-driven techniques on monetary accessibility, green finance funding, and long-time period sustainability dreams.

• By following this system, the research will offer a complete view of the position AI plays in advancing monetary inclusion and promoting green finance, contributing precious insights to the sector of sustainable improvement.

IV. DATA ANALYSIS AND RESULTS

1. Data Analysis Overview

The information evaluation for this research is based totally on both quantitative survey information and qualitative insights from interviews and case studies. The primary goal is to explore the effectiveness of AI-driven procedures in selling monetary inclusion and allowing inexperienced finance for sustainable improvement. The analysis objectives to pick out key tendencies, relationships, and high-quality practices.

2. Quantitative Data Analysis

The survey accrued responses from two hundred contributors throughout diverse sectors, including economic establishments, green finance establishments, and individuals from underbanked communities. The records become analyzed using descriptive records and correlation evaluation.

Variable	% of Respondents	AI Adoption Rate
Financial Institutions Using AI for Credit Scoring	50.5%	65%
Green Finance Institutions Using AI for Risk Assessment	70.2%	80%

Table 1: Survey Results on AI Adoption in Financial Inclusion and Green

Financial Institutions Using AI for Loan Disbursement	40.8%	50.3%
Underbanked Individuals with Access to AI-Driven Financial Services	30%	25%
Percentage of Green Projects Funded via AI-enabled Lending	60%	58%
AI Usage in Climate Risk Evaluation (Financial Institutions)	65%	68%
Satisfaction with AI-Driven Financial Inclusion Solutions	80.3%	N/A
Impact of AI on Green Finance Sustainability (Perceived Improvement)	90%	N/A



Figure: 3, AI Adoption and Respondent Percentage in Financial and Green Finance Sector

Interpretation:

- A widespread percentage of financial and green finance establishments (seventy two% and eighty%, respectively) use AI-pushed approaches, in particular for danger evaluation and credit scoring.
- AI adoption remains limited among underbanked individuals (30% of respondents), with 25% gaining access to AI-pushed monetary services.
- The use of AI for green finance appears promising, with 60% of respondents indicating that green tasks are funded via AI-enabled lending systems.
- Most establishments (90%) understand AI to improve sustainability outcomes in inexperienced finance.

AI-Driven Process	Green Finance Funding (Correlation Coefficient)	Sustainability Outcomes (Correlation Coefficient)
AI-Based Credit Scoring	0.82	0.75

AI for Risk Assessment in Green Projects	0.88	0.80
AI for Loan Disbursement (Green Projects)	0.74	0.70
AI for Climate Risk Evaluation	0.85	0.80
AI-Driven Portfolio Management for Green Finance	0.79	0.76



Figure: 4, Correlation of AI-Driven Processes with Green Finance Funding and Sustainability Outcomes

Interpretation:

• There is a robust fine correlation between AI adoption and the overall performance of inexperienced finance initiatives, as seen in credit score scoring, risk assessment, and mortgage disbursement.

• AI-driven procedures like AI for danger assessment and AI-based credit score scoring display the highest correlation with inexperienced finance investment and sustainability results.

• AI for climate risk evaluation also suggests an excessive correlation with sustainability, suggesting that correct danger predictions result in better funding selections in inexperienced finance.

3. Qualitative Data Analysis

In addition to the quantitative survey, qualitative insights were gathered via interviews with key stakeholders in financial establishments, inexperienced finance companies, and AI technology carriers.

Key Themes Identified:

• Al's Role in Expanding Access: AI has shown capability in achieving underserved populations by means of lowering the fees of credit threat evaluation and presenting customized economic products.

• **Challenges in Implementation:** Data privacy worries and a loss of technological infrastructure are primary obstacles inside the adoption of AI, mainly in growing nations.

• Success Stories: AI-driven inexperienced finance tasks, which include those the use of AI for predictive modeling of renewable strength tasks, have established massive high quality environmental impacts and economic returns.

• **Policy Support:** Government and regulatory support are crucial for fostering AIpushed green finance, as clean frameworks are wished for ethical AI use and financial danger management.

4. **Results Summary**

• AI Adoption in Financial Inclusion: AI is extensively used by economic establishments for credit scoring and mortgage disbursement however has lower penetration in underbanked populations.

• **AI-Driven Green Finance:** The integration of AI in inexperienced finance has shown promising effects, especially in phrases of chance evaluation, investment for green tasks, and improving sustainability outcomes.

• **Correlation Between AI and Green Finance Performance:** Strong fine correlations exist among AI adoption and green finance overall performance, suggesting that AI notably improves the achievement and sustainability of green finance projects.

These findings underscore the capacity for AI to beautify financial inclusion and pressure sustainable improvement via allowing higher danger management, focused lending, and stronger transparency in inexperienced finance.

Findings and Discussion

The analysis of AI-pushed methods in financial inclusion and green finance discovered numerous key findings:

Widespread Adoption of AI in Financial Institutions:

A significant variety of economic establishments (sixty five %) have followed AI in credit scoring, and 53% in mortgage disbursement. This suggests that AI is becoming an imperative a part of the economic offerings area, enhancing performance in operations inclusive of risk evaluation, loan approvals, and patron profiling. Green Finance and AI Synergy:

The use of AI in green finance is quite correlated with enhanced sustainability outcomes. Institutions concerned in green finance (e.G., investment for renewable strength tasks, power-efficient homes) are an increasing number of leveraging AI equipment for risk analysis, investment selections, and portfolio control.

Approximately 60% of inexperienced finance establishments use AI for comparing inexperienced initiatives, with a big percentage (eighty one %) of respondents reporting enhancements in sustainability consequences due to AI applications. AI-driven equipment like weather threat evaluation have allowed for greater correct predictions of economic viability within the context of environmental issues, which in turn has expanded investment for green tasks.

Challenges to Full AI Adoption:

• Underbanked Populations: Although AI has been implemented by using financial establishments, get admission to stays limited amongst underbanked populations. Only 30% of respondents indicated that AI-pushed monetary offerings have been to be had to those agencies, and most effective 25% of underbanked people had direct get right of entry to to AI-based offerings. Barriers consisting of loss of digital literacy, restrained net get right of entry to, and information privateness issues save you these groups from benefiting completely from AI-driven financial answers.

• **Infrastructure and Policy Limitations:** Data privateness and protection concerns, as well as the shortage of infrastructure in developing areas, have hindered the broader adoption of AI in these areas. Additionally, the absence of a standardized regulatory framework for AI in monetary offerings, especially regarding green finance, poses demanding situations for massive-scale implementation.

Positive Perception of AI's Impact on Sustainability:

An overwhelming 90% of respondents inside the survey indicated that they trust AI drastically enhances sustainability consequences in inexperienced finance. This sentiment was in particular obvious in AI's role in evaluating the environmental risks of investment possibilities, which permits establishments to make knowledgeable selections which can be useful both financially and environmentally.

Correlation between AI Adoption and Improved Financial Inclusion:

Data confirmed a robust nice correlation between the adoption of AI-based totally credit score scoring and stepped forward economic inclusion. Institutions using AI for credit scoring mentioned better quotes of mortgage popularity of previously underserved people, which contributed to extra monetary inclusion.

The findings from this look at underline the transformative ability of AI in both monetary inclusion and green finance for sustainable improvement. Below, we speak the implications and insights drawn from the findings:

AI as a Catalyst for Financial Inclusion:

The statistics absolutely demonstrates that AI can extensively enhance get admission to to monetary services, especially for historically underserved populations. AI-driven credit score scoring models allow monetary institutions to evaluate risk extra accurately, which lowers the boundaries for people with little to no credit score records. However, the lack of get admission to to AI-driven monetary offerings among underbanked populations stays a main task. To address this, there ought to be elevated funding in digital infrastructure, in addition to tasks to beautify digital literacy and consider in AI technologies, particularly in developing economies.

Green Finance: AI's Role in Sustainable Investment:

AI is showing incredible promise in driving green finance forward. The adoption of AI tools for environmental hazard evaluation, credit scoring for green tasks, and predictive analytics for renewable electricity investments has ended in more accurate opinions of green finance possibilities. AI's capability to research huge datasets speedy and accurately improves decision-making for each financial institutions and traders in sustainable initiatives. Moreover, the integration of AI in green finance supports the UN Sustainable Development Goals (SDGs) with the aid of making sure that investment choices consider environmental and weather dangers, which contributes to the broader desires of mitigating climate trade and selling sustainability.

Challenges to Broader AI Adoption:

While AI is making strides in monetary services and green finance, the barriers to adoption—mainly for underbanked populations—cannot be ignored. To really power economic inclusion, policymakers ought to paintings to create regulatory frameworks that balance innovation with consumer protection, ensuring equitable get entry to to AI-pushed services. Additionally, establishments should invest in constructing the essential infrastructure in areas wherein virtual literacy and era access are confined.

The demanding situations related to information privateness and security are great worries that need to be addressed earlier than AI may be fully embraced, specifically in sensitive sectors like finance. Clear recommendations and moral standards must be advanced to ensure that AI technology are used responsibly and transparently.

Impact on Sustainable Development:

The position of AI in green finance is pivotal for enabling more sustainable improvement within the economic quarter. AI is helping to mitigate risks and drive smarter investment selections, which might be key to funding the transition to a greater sustainable economic system. As AI programs in green finance mature, it is expected that the volume of green investments will boom, riding the boom of eco-friendly projects which could yield both economic returns and environmental advantages.

The tremendous fine perception of AI's effect on sustainability highlights the potential for AI to be a key device in reaching international environmental goals. This should consist of reducing carbon emissions, improving electricity efficiency, and promoting using renewable strength.

The Future Outlook:

Within addition advancements in AI technology and an growing attention on ethical AI utilization, the position of AI in enabling inexperienced finance and monetary inclusion is anticipated to develop. To make certain that the advantages are calmly disbursed, it's miles essential to integrate AI solutions into existing economic and regulatory frameworks even as addressing the technological and social challenges faced by way of underserved populations.

Ongoing studies, collaboration amongst AI developers, monetary institutions, and policymakers, and the lively involvement of environmental stakeholders may be key to scaling the impact of AI-pushed inexperienced finance projects. Additionally, making sure that AI technology are used responsibly and ethically may be critical for fostering agree with and accomplishing lengthy-term, sustainable effects in financial inclusion and inexperienced finance.

Conclusion

AI-driven strategies to economic inclusion and inexperienced finance hold giant capability for permitting sustainable development. However, demanding situations associated with infrastructure, access, and law should be addressed to maximize their impact. As the generation matures and more establishments include AI, it is anticipated that AI-driven green finance turns into a huge force in international efforts to cope with weather exchange and promote social equity.

V. CONCLUSION

In end, AI-driven techniques have the capacity to revolutionize economic inclusion and green finance, driving sustainable improvement by using enhancing get right of entry to to monetary offerings and facilitating investments in environmentally sustainable projects. While AI applications, together with credit scoring, danger evaluation, and inexperienced venture evaluation, have shown promising effects in increasing performance and improving choice-making, demanding situations consisting of constrained infrastructure, data privateness worries, and unequal get entry to for underbanked populations should be addressed. By fostering collaboration amongst monetary institutions, policymakers, and

generation builders, AI can play a vital role in permitting a more inclusive and sustainable financial environment that helps each monetary increase and environmental sustainability.

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