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Cryptocurrency and Sustainable Growth in Developing Economies: Opportunities and Environmental Concerns

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Abstract

Cryptocurrency is becoming very important in global finance, especially in developing countries. It can help more people get financial services and make financial transactions transparent. But it uses a lot of electricity, which can harm the environment. This paper looks at how cryptocurrency can help economic growth while also being friendly to nature. Using simple math models, tables, examples, and studies, it suggests ways to balance technology and the environment.
Keywords: Cryptocurrency, Sustainable Development, Emerging Economies, Financial Inclusion, Blockchain.

Introduction

Cryptocurrency is a new and important innovation in finance. It works without banks and uses blockchain technology. In countries where banks are not easily available, cryptocurrency can help people get financial services, make payments faster, and reduce the need for middlemen.

However, cryptocurrency needs a lot of electricity, especially for mining. This can harm the environment, which is a concern for developing countries. At the same time, blockchain can make transactions more transparent and reduce corruption. The main question is how to use cryptocurrency in a responsible way. For example, in Nigeria, many people use cryptocurrency to send money to family members in rural areas where banks are hard to reach. Similarly, in India, small business owners are starting to accept cryptocurrency for online payments because it is fast and secure. These examples show that cryptocurrency is not just a technology for the future, but it is already affecting daily financial life in emerging economies.

This paper studies how countries can use cryptocurrency for growth while also protecting nature.

Objectives

1. To study how cryptocurrency can help more people get financial services in developing countries.
2. To check how cryptocurrency mining and transactions affect the environment.
3. To suggest ways to balance economic growth with protecting the environment.
4. To give advice for safe and eco-friendly use of cryptocurrency.

Achieving these objectives will help governments make better rules, help people understand cryptocurrency safely, and encourage businesses to adopt technology without harming the environment.

Literature Review

Many studies have looked at how cryptocurrency works in developing countries. El Hajj (2024) says cryptocurrencies can help people who do not have easy access to banks. In countries like India, Nigeria, and Vietnam, people use cryptocurrency for sending money home, protecting money from inflation, and avoiding bank problems.

Globally, countries like the USA, Switzerland, and Singapore are experimenting with cryptocurrencies and blockchain. These studies help us understand what works and what

problems to avoid in emerging economies. Lessons from these countries can guide India, Nigeria, and Brazil to adopt cryptocurrency in a responsible way.

But mining cryptocurrencies like Bitcoin uses a lot of electricity (Chamanara et al., 2023; Cambridge Centre for Alternative Finance, 2022). This can hurt the environment, especially in countries with limited electricity.

Ibañez et al. (2024) explain that if a country bans mining, it can sometimes increase pollution because mining moves to places with dirtier energy. Studies show that using better methods like Proof-of-Stake (PoS) and renewable energy can reduce harm to nature (Hossain & Steigner, 2024).

In short, cryptocurrency can help finance, but it should be used in ways that save energy and follow good rules to keep the environment safe.

Research Hypotheses

1. Using cryptocurrency can help more people get financial services in developing countries.
2. Using eco-friendly cryptocurrency methods can reduce harm to the environment.
3. Good government rules can balance growth and environmental care.

Research Methodology

This study uses both numbers and ideas to understand the topic:

1. Collect data on adoption rates, energy used per transaction, and financial inclusion in India, Nigeria, Vietnam, and Brazil.

2. Use a simple math model called **Sustainable Cryptocurrency Impact (SCI) Score** to measure the balance between growth and energy use:
The SCI score is like a balance scale. On one side, we have benefits like adoption and financial inclusion. On the other side, we have energy consumption. A higher score means a country is getting more benefits while using less energy, which is the ideal balance.

3. Compare SCI Scores between countries to find better ways to use cryptocurrency without harming the environment.
4. Study existing research, rules, and cases to give advice on safe and eco-friendly use.

Data Analysis

Table 1: Adoption, Energy Use, and Financial Inclusion

Country	Adoption Rate (%)	Energy Consumption (kWh/txn)	Financial Inclusion Index
India	7.3	707	0.65
Nigeria	8.5	612	0.52
Vietnam	6.8	680	0.60
Brazil	5.2	750	0.70

From Table 1, we can see that Nigeria has the highest adoption rate and relatively low energy consumption per transaction. This suggests that Nigeria is using cryptocurrency more efficiently compared to the other countries in this study.

Mathematical Model

Sustainable Cryptocurrency Impact (SCI) Score = (Financial Inclusion Index × Adoption Rate) ÷ Energy Consumption

- For India: SCI ≈ (0.65 × 7.3) ÷ 707 ≈ 0.0067
- For Nigeria: SCI ≈ (0.52 × 8.5) ÷ 612 ≈ 0.0072

Interpretation: Nigeria has a slightly higher score, which shows that even countries with fewer resources can use cryptocurrency in an eco-friendly way with proper planning.

Recommendations

1. Use renewable energy for cryptocurrency mining to save electricity and reduce pollution.
2. Make clear rules for crypto exchanges and investors.
3. Teach people about the risks and benefits of cryptocurrency.
4. Use energy-efficient methods like Proof-of-Stake (PoS) instead of heavy mining.
5. Follow UN Sustainable Development Goals (SDGs) in crypto policies.
6. Support research to make blockchain technology safer for the environment.
7. Individuals can use wallets and platforms that are energy efficient.
8. Small businesses can start accepting cryptocurrency for payments to save transaction time and fees.

Future Scope

In future research, we can explore how new cryptocurrencies with low energy consumption can be implemented in schools, hospitals, and local businesses. Studying their impact over 5–10 years will give a clearer picture of sustainability and financial inclusion.

Conclusion

Cryptocurrency can help people get financial services and encourage innovation in developing countries. But it uses a lot of electricity and can harm the environment. By using renewable energy, energy-efficient methods, and good rules, countries can use cryptocurrency safely. Policymakers, companies, and researchers should work together to make cryptocurrency growth eco-friendly.

As a researcher and citizen, I believe that if everyone uses cryptocurrency responsibly and follows simple energy-saving practices, we can enjoy financial innovation while protecting our environment.

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