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Economic and social impacts of Web3 and the metaverse in the Global South

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Economic and social impacts of Web3 and the metaverse in the Global South

Abstract

Individuals and organizations in the global south are participating at an increasing rate in Web3 and the metaverse economies. This paper gives an overview of the key benefits to these economies that stem from Web3 and the metaverse. It provides a perspective on the global south's preparedness to benefit from Web3 and the metaverse looking at key indicators related to the adoptions of cryptocurrency, and Web3 browser and investment in Web3 and the metaverse. It provides details of economic and social impacts of the metaverse in key areas. The paper talks about the role of the metaverse economy as a job creator. It also reviews the metaverse's effects on training, education, and knowledge exchange, innovation and entrepreneurship. It will discuss how the metaverse can help the global south internationalize cultural products and artifacts. It analyses how Web3 can provide leapfrogging opportunity in areas such as finance. It also considers the roles of Web3 in dealing with emergencies, crisis and humanitarian intervention. This paper also explains how various trust issues can be addressed by Web3, which is especially important in the context of the global south due to low levels of trust and high costs of intermediation. It highlights some challenges that the global south needs to overcome to realize the full benefits of Web3 and the metaverse.

Keywords: global south; leapfrogging; metaverse; P2E games; Web3

Introduction

Web3 and the metaverse are nascent but are growing rapidly in the global south (GS). These innovations are expected to have substantial economic and social impacts in GS economies. A study of the economic consulting firm Analysis Group indicated that if the metaverse's adoption begins in 2022, the total contribution to Sub-Saharan Africa's GDP in 2031 will be 1.8% or \$40 billion¹. The figures for Asia-Pacific (APAC), Latin America (LATAM) and India are 2.3% (\$1.04 trillion), 5% (\$320 billion) and 4.6% (\$240 billion) respectively.

A number of mechanisms by which Web3 and the metaverse can bring socio-economic transformation in the global south can be suggested. Countries in the global south are characterized by low levels of trust and high costs of intermediation². Since trust reduces the cost of transactions, high trust societies produce more output than low trust societies. Trust is thus tightly linked to economic development. Douglass North (1990, p. 54) has observed that

the inability to “develop effective, low-cost enforcement of contracts” is the most important source of underdevelopment of global south economies³.

Web3 technologies’ trust-producing mechanisms are thus highly important in such contexts. For instance, Web3 solutions can help address a number of trust-related issues that have hindered the development of the insurance industry and market in the global south. These solutions have already helped insure smallholder farmers against agricultural risks in countries such as Cambodia, Kenya, and Sri Lanka⁴.

In Web3, users often just have to trust the code and there is no need to trust the company behind a project⁵. Thus, challenges related to newness and small size do not adversely affect firms based in the global south. For instance, blockchain, the key Web3 technology, has allowed marginalized and vulnerable groups such as small coffee growers and artisanal and small-scale miners (ASMs) in Africa to demonstrate sustainability performance of their products at low costs without relying on third-party certification (TPCs) agencies and sell their products in international markets⁶.

In some countries in the global south, the metaverse economy has helped generate economic benefits such as new employment opportunities. For instance, the crypto metaverse play-to-earn (P2E) game Axie Infinity, which was inspired by video game series Pokemon, has become popular in the global south. This and other metaverse games allow players to make real money. According to SimilarWeb, which provides traffic-monitoring data, four of the top five countries in terms of the number of Axie Infinity players were countries in the global south: the Philippines, Venezuela, Argentina and Brazil (<https://www.similarweb.com/website/axieinfinity.com/#geography>). In addition to the

Philippines, other Southeast Asian countries have also become a major market for blockchain games.

The metaverse is also driving entrepreneurship and innovation in the global south. Some technology companies in the global south have launched their own metaverse platforms. For instance, Axie Infinity, which had 2.5 million daily active users in February 2022, was developed by Vietnamese game maker Sky Mavis⁷. Likewise, the virtual reality (VR) metaverse featuring digital land Africarare, which is the first African metaverse, was launched in 2021. It aims to connect Africa to the global economy⁸.

Some firms in the global south have already established their operations in the metaverse. To take an example, South African mobile telecommunications company MTN purchased land in Africarare. The company plans to provide various forms of content such as gaming and music in order to enhance customers' digital experiences and engagement (<https://www.frontieraficareports.com/article/mtn-purchases-land-in-africa-s-first-metaverse>). In the same vein, Thai bank Siam Commercial Bank's venture arm SCB 10X has bought digital piece of real-estate in the Sandbox's metaverse⁹.

The metaverse has the potential to increase the export of cultural products and entertainment such as live music performances from the global south. For instance, on the Indian Republic Day January 26, 2022, the first Metaverse Concert by Indian bhangra/pop singer Daler Mehndi attracted 20 million viewers from all over the world. The concert was performed on the PartyNite platform created by Hyderabad, India-based company Gamitronics, which focuses on AR and VR¹⁰.

This paper focuses on the global south's preparedness to benefit from Web3 and the metaverse. It also discusses the applications and impacts of Web3 and the metaverse on the

global south. The impacts are classified according to their quality and the resources required for the Web3 and the metaverse application to run.

The global south's preparedness to benefit from Web3 and the metaverse

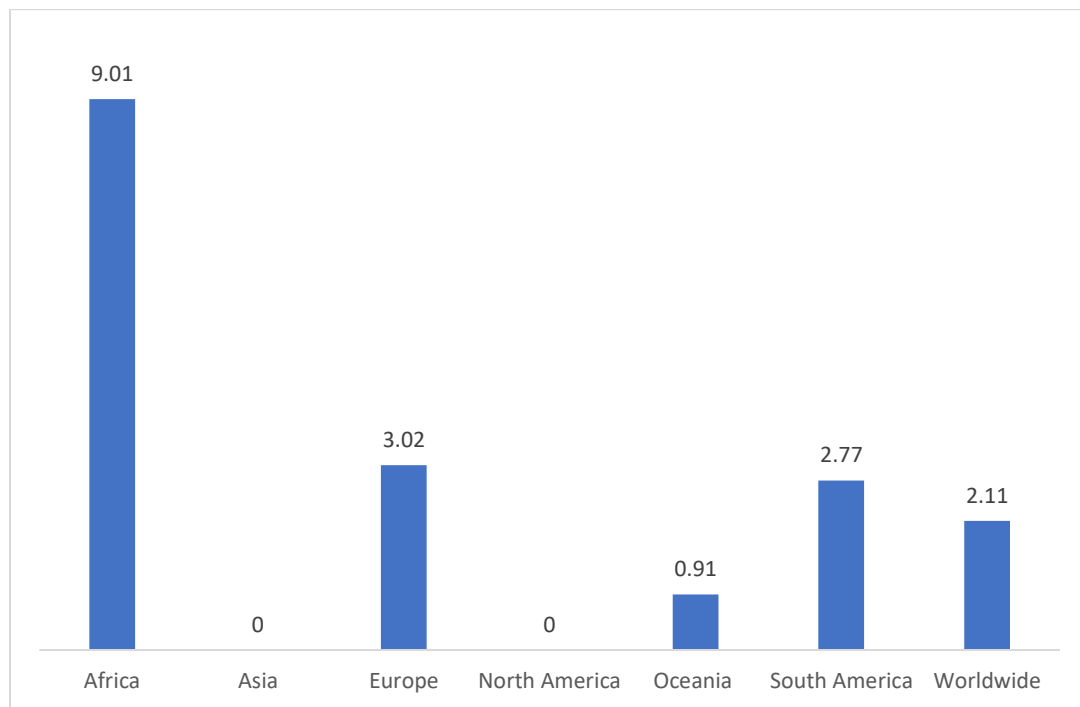
Some of the key prerequisites for Web3 and the metaverse have been fulfilled by several GS economies. For instance, among the top 12 economies in Chainalysis 2021 Global Crypto Adoption Index, which is based on on-chain cryptocurrency value received, on-chain retail value transferred (both weighted by purchasing power parity (PPP) per capita) and peer-to-peer (P2P) exchange trade volume (weighted by PPP per capita and number of internet users), 11 are economies in the Global South¹¹.

It is worth noting that the middle-class populations in the U.S. and other developed countries are taking a long-term approach to digital assets such as bitcoin and other cryptocurrencies in the hope that there will be price gains over a period of years¹². However, people in the global south such as the Philippines and Venezuela do not consider crypto as a store of value. They think it as a means to earn money to satisfy immediate needs such as feeding their families and paying medical bills¹³.

Similarly, the Philippines is the largest market for cryptocurrency wallet MetaMask. MetaMask is used to transfer cryptocurrency and is popular with blockchain gamers. Indonesia, Vietnam Thailand and India also rank among the top 10 countries by users (Table 1).

Likewise, the market share of the native web3 browser Opera is higher in Africa compared to any other regions (Figure 1). Opera has provided an integrated cryptocurrency wallet and basic Web3 support since 2018¹⁴. In March 2022, the company announced that it added support for several major blockchain ecosystems, including Solana, Polygon, StarkEx, Ronin, Celo, Nervos, IXO and Bitcoin¹⁵.

Figure 1: Opera browser's market share (% , May 2022)



Data source: Browser Market Share Worldwide May 2021 - May 2022

(<https://gs.statcounter.com/browser-market-share>).

Table 1: Some key indicators related to crypto-adoption

Rank	Chainalysis 2021 Global Crypto Adoption Index ¹⁶	Percentage of Internet users who own crypto (July 2022) ¹⁷	Top 15 countries using MetaMask (August 2021) ¹⁸
1	Vietnam (1)	India (29%)	The Philippines
2	India (0.37)	Nigeria (27%)	The U.S.
3	Pakistan (0.36)	Vietnam (25%)	Vietnam
4	Ukraine (0.29)	Ghana (21%)	The U.K.
5	Kenya (0.28)	Hong Kong (20%)	China
6	Nigeria (0.26)	Singapore (20%)	India
7	Venezuela (0.25)	Brazil (18%)	Russia
8	The U.S. (0.22)	Venezuela (18%) Russia (19.6%)	Brazil
9	Togo (0.19)	Australia (17%)	Indonesia
10	Argentina (0.19)	The Philippines (16%)	Thailand
11	Colombia (0.19)	Colombia (15%)	Turkey
12	Thailand (0.17)	Indonesia (15%)	Germany

13	China (0.16)	Malaysia (15%)	France
14	Brazil (0.16)	Argentina (14%)	Canada
15	The Philippines (0.16)	Kenya (14%)	Spain

Investments in Web3 and the metaverse

The Web3 and metaverse economies in the global south have provided an attractive investment opportunity for global investors. Especially this has been the case of Southeast Asia, which has some high-profile start-ups in the Web3 and metaverse sector such as Axie Infinity and Yield Guild Games (In Focus 1). As of October 2021, Sky Mavis had raised \$161 million¹⁹. Investors included venture capital fund Andreessen Horowitz, global exchange giant FTX (which went bankrupt in 2022), Accel, Paradigm, Standard Crypto, as well as Fabric Ventures and Samsung²⁰.

In Focus 1: The Philippines' Yield Guild Games (YGG) is emerging as a major player in the P2E gaming industry

The Philippines-based Yield Guild Games (YGG) is a gaming guild that focuses on blockchain P2E games. YGG started in November 2020 to **rent NFTs** out to Axie Infinity game players, who could not buy their own NFTs²¹. In 2021, Sky Mavis rolled out its own blockchain called Ronin, which allowed users to trade NFTs and cryptocurrency without paying high fees for using Ethereum. YGG gained momentum from this change²².

Expanding into other P2E games

Axie Infinity is not the only game YGG has been pursuing in. By the end of 2021, YGG was involved in 48 projects in games, gaming guilds, and other P2E infrastructure²³. To take an example, in 2021, Australian gaming start-up Immutable sold its first batch of NFTs consisting of digital monsters, pets and warriors. They were characters with names such as Chieftain of the Deadlands or the Exiled Necromancer, which were based on an upcoming role-playing game called Guild of Guardians. The biggest buyer was YGG, which bought them to lend out to gamers²⁴.

Rapidly growing network of scholars

YGG's scholarship program started in April 2021. As of December 2021, YGG had 10,000 Axie Infinity scholars across in Southeast Asia, India, Latin America, Brazil and Europe. YGG scholars had generated over US\$13.6 million in SLP. Despite sharp reduction in SLP prices, demand for scholarships with YGG was reported to increase. By the end of 2022Q1, there were 29,548 YGG scholars, who used 90,000 NFTs to play the metaverse game²⁵.

Expanding into foreign markets

In 2021, YGG raised about \$40 million in VC from investors such as U.S. venture capital firm Andreessen Horowitz²⁶. YGG has entered Japan via partnerships with several industry players. The company plans to onboard local players to P2E games and support Japanese companies to launch blockchain games. YGG aims to develop services for gaming communities, and promote awareness of blockchain games among Japanese gamers.²⁷

In Focus 2: Jambo is building Africa's Web3 app

The Democratic Republic of **Congo**-based startup, Jambo, is building Africa's **Web3** app. As of May 2022, the company had a 100-member team and offices in 15 countries including Nigeria, Kenya and South Africa. Jambo has teamed up with thousands of internet cafes and college booths to improve consumers' access to computers and high-speed internet. Its ambassadors also offer 10-week courses on Web 3. By the end of 2022, the firm hopes to have a presence in 15 additional cities and over 200,000 active community members.²⁸

Jambo raised about \$7.5 million in the seed funding round and about \$30 million in the Series A funding round. The Series A round was led by crypto-focused venture firm Paradigm, which was its first investment in Africa²⁹.

Jambo's target market is the under 30 smartphone user market that comprises over two-thirds population of the Sub Saharan African. As of early May 2022, it had more than 30,000 users registered. It is scheduled to be launched in 2022Q3. The app also includes a non-custodial wallet built on the Polygon network, P2E games and a native token of Jambo. P2E games will be selected based on bandwidth requirement and other features³⁰.

As its user acquisition strategies, Jambo was reported to partner with telecom providers to get about 70% on discount airtime and data and sell directly to its users at a low cost. Jambo is also partnering with social media companies to pay users in tokens for watching contents on its app³¹.

Countries in the global south have also received investments in broader areas such as Web3 app development (In Focus 2 and In Focus 3). Substantial investments have also been made in projects involving on/off-ramps that act as bridges between the traditional economy and the Web3 economy³².

In March 2022, US-based company Fonbnk, which aims to enable interoperability between the Web3 internet and traditional fiat-based monetary systems closed a \$3.5 million seed round. Fonbnk plans to develop a ramp that helps convert prepaid mobile SIM card holders' fiat value from the centralized finance (CeFi) to Crypto and DeFi. The company has created a decentralized, market-making dApp which can be used to convert the value on prepaid mobile SIM cards into cryptocurrency. It works with a network of airtime liquidity providers or market makers, which trade their respective mobile carriers' prepaid airtime credits. If a user in Nigeria wants to convert their MTN mobile airtime credit into the cryptocurrency ether (ETH), they can swap the credit for Fonbnk's ERC20 token MIN, which can be used to mint USD Coin (USDC), which is a digital stablecoin pegged to the US\$. The credit in USDC can then be for ETH on crypto exchanges. Fonbnk works with peer-to-peer payments technology company Circle Financial. It has built a bridge to Celo wallets from Fonbnk's dApp, which allows users to convert fiat-based prepaid airtime credits into Celo Dollars (cUSD)³³.

In Focus 3: Afropolitan's Web3-based digital nation for the African Diaspora

Afropolitan was founded in 2016 as a "community as a service for the African Diaspora". It featured events and travel for African Diaspora. In 2022, the group became a decentralized autonomous organization (DAO). Afropolitan's vision is to utilize Web3 to develop a digital nation for the African Diaspora. In June 2022, Afropolitan announced that it had raised \$2.1 million in pre-seed funding. Afropolitan plans to use a collection of Ethereum-based NFTs as a passport to the new digital nation. Members will get access to events and future services.³⁴.

The roles of industry bodies and professional associations

Industry bodies and professional associations are playing major roles in the development of Web3 and the metaverse industries. Web3 education and awareness programs have been launched in many countries in the global south. In Africa, Jambo's ambassadors offer 10-week courses on Web 3³⁵.

Web3 Student Developer Clubs in Kenya offers blockchain development training to develop Web3 talent pool³⁶. The Vietnam Blockchain Association was established in May 2022. It is collaborating with crypto exchange, Binance to develop blockchain applications. The goal is to develop Vietnam as a hub for web3 developers³⁷.

Likewise, Play4Change is educating public and private institutions on the value of Web3 and helping to reverse the negative image of cryptocurrencies created by widespread media coverage in Brazil³⁸. As a guild, it also onboards Brazilians into Web3 through P2E games³⁹.

Other initiatives have aimed at creating awareness for specific sectors such as P2E games and insurance. Guilds such as YGG bring awareness and resources to the gaming industry. Axie Infinity was reported to increase in users after YGG's involvement⁴⁰. According to Axie Archipelago, which tracks data about guild projects in the Philippines, as of June 6, 2022, there were 528 P2E gaming guilds⁴¹ in the country (<https://axiearchipelago.org/>). The country's first few gaming guilds were established in rural provinces. Most of the managers are also from rural

areas, who have built up their player communities. Guilds are important for most to people in rural areas due to the unavailability of jobs⁴².

Web3 as a trust production mechanism: An illustration of the insurance industry

The insurance market in the global south is among the best examples to illustrate the roles of Web3 in producing trust. Traditional crop insurance has failed to work for most of the world.

Current challenges

Trust is a function of social, economic and institutional environments in which economic transactions take place⁴³. These environments in countries in the GS lead to low levels of trust⁴⁴. An upshot is dismally low rates of adoption of agricultural insurance among smallholder farmers. Only 20% of smallholder farmers in the global south are reported to have agricultural insurance (<https://tinyurl.com/eee6tk8u>). Africa has about 300 million smallholder farmers. According to the InsuResilience Solutions Fund (ISF), which promotes sustainable climate risk insurance products in developing and emerging countries, less than 3% of farmers in Sub-Saharan countries have crop insurance⁴⁵. The global market for uninsured crops is about at \$1 trillion⁴⁶. Estimates suggest that by removing farming risks through crop insurance, it is possible to increase smallholder farmers' investments and income by 20-30%⁴⁷.

The main reason behind the low rates of adoption of farm insurance products is that such products are difficult to develop and offer and hence they are too expensive⁴⁸. Key challenges from an insurer's perspective include moral hazard, adverse selection, and high administrative costs. First, farmers that face high risk of loss are more likely to invest in insurance. Such farmers may not provide all the relevant information to the insurer. The insurer lacks the ability to determine if the farmer is lying. This state of information asymmetry, in which farmers may strategically withhold information from the insurer leads to an adverse selection problem.

Second, farmers that are insured might behave in more risky ways. For instance, the farmer may not undertake sufficient efforts to increase farm productivity. This leads to moral hazard since the insurer is not often in a position to determine if the farmer is cheating or acting dishonestly. Third, there are high administrative costs for some types of insurance *plans*. For instance, in a type-specific insurance, the insurer needs to identify various types of farmers and then design individual contracts for each type. Each type of farmer will be offered a contract that reflect the risks facing the farms of that type. A drawback of this type of contract is that it results in high administrative costs since detailed information is required about the farmer and farm operation to design an optimal contract. Thus, due to manual legal work and complexities in claims, weather-risk insurance for is too expensive for smallholder farmers⁴⁹. In some countries, it costs more for insurance companies to service the claim than the claim itself⁵⁰.

Index-based insurance, which utilizes an index (e.g., area-wide yields or a weather index) that is correlated with the farmers' yields can address most of the above challenges. Index-based insurance does not pay the policy holder on the basis of individually assessed loss and can thus resolve the key problems associated with individual insurance. First, since payments to the policy holders are based on a sub-regional measurable index, there is no moral hazard. Second, there is no requirement to make a field-level assessment, which reduces costs. Third, since the insurance is based on a reliable and independently verifiable index, it is possible to reinsure, which allows local insurance companies to efficiently transfer part of the risk to the global market.

Kenya's insurer Agriculture and Climate Risk Enterprise (ACRE) (formerly Kilimo Salama, which was run as a social enterprise) drastically reduced the administrative costs associated with signing people up, verifying claims and paying for the damage by digitising all

the activities. At the end of a season the data are aggregated and combined with satellite data in order to map out rain patterns. ACRE works with agronomists to calculate the index and identifies the locations that experienced too much rain, too little rain, or rain at the wrong time. Farmer pay-outs are calculated based on crops, location and the amount invested in seeds.

There is, however, a lack of transparency regarding what information is used by the insurers to calculate the payouts. Insurers thus have a moral hazard problem as they have the opportunity to cheat their policyholders. Insurance companies lack good quality crop and weather data to model for smallholder farmers⁵¹. The number of Kilimo Salama's insured farmers fell in 2014.

Web3's roles

Web3 technologies such as blockchain and DeFi have the potential to transform the insurance industry and make insurance more affordable by using automation and parametric insurance⁵². Web3 powered index insurance, which uses clean and open data from weather stations and farms on blockchain is gaining popularity in Africa and other global south countries⁵³. Such insurance has been the focus of for-profit as well as non-profit organizations (In Focus 4). Table 2 presents some examples of blockchain-based crop insurance schemes that are in various stages of development in three countries in the global south: Kenya, Cambodia and Sri Lanka.

Kenya

'Agriculture and Climate Risk Enterprise' (ACRE)⁵⁴ uses localized measurements produced by Global Index Insurance Facility (GIIF)-sponsored weather stations, which validate satellite data (also referred to as ground-truthing) (<https://tinyurl.com/3ktwmmak>). The GIIF is a program launched by the World Bank Group to facilitate the adoption of index-based insurance among smallholder farmers and provide other catastrophic risk transfer solutions in the global south. In

November 2020, the collaboration between Etherisc and ACRE Africa received a Chainlink Community Grant to develop a decentralized insurance protocol to deliver sustainable, blockchain-based parametric crop insurance solutions. The goal is to serve up to 250,000 smallholder farmers in Kenya. Farmers can pay premiums in small installments, which could be as low as US\$0.50 (<https://tinyurl.com/cspfjkcp>). The insurance is built on top of Etherisc's Generic Insurance Framework (GIF), which is an Ethereum-based decentralized insurance protocol. It is indexed to local weather parameters. Chainlink connects to different external weather data sources and broadcasts the data within Etherisc's smart contracts (<https://tinyurl.com/55sxr7xk>).

As of July 2021, Etherisc and ACRE Africa had covered more than 17,000 smallholder farmers from 17 regions in Kenya under the collaboration. About 6,000 were expected to be compensated for lost or affected crops before the end of the season in 2021⁵⁵. A payment is made directly to the farmer's mobile phone through an API that connects the Etherisc software solution to mobile phone-based money transfer service, M-Pesa's payment gateway. All payments are notarized on-chain using Etherisc's GIF for increased transparency and auditability⁵⁶.

ACRE is adding more data in order to design a more optimal insurance policy. As of 2020, soil moisture index was being tested to combine with the usual rainfall-based indices. The company plans to install soil moisture sensors in the weather stations to complement remote sensing data (<https://tinyurl.com/3ktwmmak>).

Cambodia

Arbol has teamed up with financial and technical assistance facilitator Agribee Cambodia PLC to offer a blockchain-based crop insurance. Chainlink provides decentralized weather data for Arbol (<https://tinyurl.com/3fc3ebth>). A pilot for a parametric extreme weather solution for the

Cambodian agricultural sector was launched in October 2020.

(<https://emergingrisks.co.uk/parametric-pilot-targets-rice-farmers/>). Based on result of the pilot study, the plan is to scale the program to up to 20,000 farmers in 2021

(<https://tinyurl.com/68h4rwb7>). Arbol covered about \$2 million in risk in 2020, which increased to \$300 million in 2021. The start-up expected to double that coverage in 2022⁵⁷. Specialty provider of parametric solutions for natural hazard and extreme weather risk in emerging economies Global Parametrics and reinsurance group Hannover Re supported the initiative (<https://tinyurl.com/3m2fp4nx>).

Arbol's drought coverage protection charges a premium per hectare of US\$13 with a maximum pay out per hectare of US\$150. The trigger in the insurance contract is 89% of average cumulative rainfall and the exit is 50% of average cumulative rainfall (https://agribee.co/home/category?parent_id=22&id=75&menu_id=0). If the rainfall total during an agreed period exceeds the trigger, no pay out will occur. If the rainfall total is less than the exit, the policyholder receives the maximum pay out.

Arbol's application is built on Ethereum smart contracts. It secures data via the peer-to-peer protocol Interplanetary File System (IPFS) (<https://tinyurl.com/44899t9y>). IPFS allows users to download webpages and content stored across multiple servers. It also provides "historical versioning" showing any manipulation in documents (<https://tinyurl.com/4hy8x9z3>).

Sri Lanka

In 2018, Etherisc teamed up with British financial risk-mitigation products provider Aon and charitable organization Oxfam to develop a blockchain-based crop insurance system in Sri Lanka. Etherisc and Oxfam also reported that they were working with one of the world's largest insurance brokers to expand the market for their services⁵⁸. The initial goal was to automate the

existing policies and reduce operating costs⁵⁹. In July 2019, a blockchain-based micro-insurance platform was launched and about 200 smallholder paddy field farmers were enrolled (<https://tinyurl.com/f967vwxs>) In November 2019, the system made first pay-outs to the policyholders (<https://tinyurl.com/kzm8d7fc>).

Table 2: Some examples of Web3-based crop insurance in the global south

<i>Country</i>	<i>Insurers</i>	<i>Technology solutions providers</i>	<i>Implementation status</i>
Kenya	ACRE Africa	Etherisc and Chainlink	July 2021: covered more than 17,000 smallholder farmers from 17 regions in Kenya, about 6,000 were expected to be compensated in 2021. April 2022: 22,000 farmers in Kenya insured ⁶⁰ .
Sri Lanka	Aon	Etherisc	July 2019: about 200 smallholder paddy field farmers were enrolled. November 2019: the system made first pay-outs to the policyholders
Cambodia	Global Parametrics and Hannover Re	Arbol, Chainlink	October 2020: a pilot was launched. Plan to scale to up based on result of the pilot study.

In Focus 4: The Lemonade Foundation enters into Web3-based crop insurance

In March 2022, the nonprofit organization Lemonade Foundation announced a plan to fund the Lemonade Crypto Climate Coalition, which will use the decentralized aspects of web3, real-time weather data and parametric insurance to provide affordable and instantaneous climate insurance for low-income farmers. Key coalition partners include the world's third largest reinsurance firm Hannover Re, and the Decentralized Insurance Protocol company Etherisc. Etherisc has been involved in similar parametric insurance projects in Kenya and Sri Lanka. Other players involved in developing weather insurance models include oracle network company Chainlink, Ethereum blockchain-based operating system for decentralized coordination DAOstack, Kenyan microfinancing solutions provider Pula, and U.S. weather technology company Tomorrow.io⁶¹. Lemonade's insurance product will run on the open-source Avalanche blockchain, which uses proof of stake (PoS) to validate transactions on the network and has a smart contract functionality⁶². The solution is expected to be launched within a year.

Sensors are used to detect weather events such as a flood or drought and automatically make a payout. Farmer do not need to submit a claim. An ancillary technology, known as oracles, facilitate smart contract execution. Using an oracle, the sensors submit data to the blockchain. Data are also automatically extracted and verified data from the digital world by web scraping. For instance, oracles would continuously monitor data from weather stations and satellites. The data tell which claims it should pay out⁶³.

The decentralized oracle network company Chainlink offers oracle infrastructure for many smart contracts including those related to crop insurance. The infrastructure involves node operators that provide hardware and software to power and secure oracle networks that run on Chainlink (<https://blog.chain.link/what-is-a-chainlink-node-operator/>). As of December 2021, more than 1,000 projects used Chainlink's off-chain data in their hybrid smart contracts⁶⁴. Chainlink has teamed up with several players in the insurance sector such as New York-based parametric insurance startup Arbol, East Africa's agricultural microinsurance provider for smallholder farmers Agriculture and Climate Risk Enterprise Ltd. (ACRE), and smart contract developer Etherisc. Chainlink

provides verifiable data about weather conditions for insurance products targeted at smallholder farmers⁶⁵. Chainlink was launched on Ethereum in 2019. However, it is agnostic and can be used with other blockchains such as bitcoin, Hyperledger, Polkadot, Cosmos, and Ava⁶⁶.

Instead of a traditional insurance company, a decentralized autonomous organization (DAO) is involved, which is viewed as a combination of cooperative, crowdfunding and blockchain. Smart contracts will replace insurance policies, and oracles handle the roles that claims professionals play in a traditional insurance company. Farmers make and receive payments on their cellphones using stablecoins or local currencies⁶⁷.

While the Lemonade Foundation will provide funding initially, the future plan is to allow cryptocurrency investors to invest via a DAO governance token and stake capital in the liquidity pool of the project. The investors can earn a share of the premiums. It will also lower the smallholder premiums by cutting the cost of capital and reinsurance⁶⁸.

There is also the need to educate consumers about the benefits of Web3 in the insurance market. Lemonade Foundation has teamed up with Kenyan microfinancing solutions provider Pula to convince users to sign up⁶⁹.

Applications and impact

The previous section explained Web3's potential to transform crop insurance in the GS. In this section, we describe some other key sample applications of Web3 and the metaverse and the impacts in the GS economies.

P2E games

P2E games are becoming an attractive economic option for the world's 200 million people that are looking for jobs (<https://tinyurl.com/3s6cwzfv>). Crypto Gaming United (CGU), which lends non-fungible tokens (NFTs) to blockchain-based metaverse gamers, hopes to employ 1,000,000 people in the global south using P2P platform by 2024 (<https://tinyurl.com/3s6cwzfv>).

Many people in the GS are earning their living by playing P2E games in the metaverse. For instance, in Axie Infinity, players can buy or rent digital pets called Axies, which fight with other Axies. With enough tokens, a player can breed their Axies and create new ones. Players that fight well can earn Axie's native token Smooth Love Potion (SLP), which is an Ethereum-based ERC-20 token. There is a marketplace within the game (<https://marketplace.axieinfinity.com/>) which allows the trading of Axie NFTs. Since The ERC-20 Ethereum token standard is the most widely used standard for smart contracts, tokens earned from playing the game and the proceeds from selling Axies in the marketplace within the

game can also be taken to open marketplaces outside the game to convert into traditional currency⁷⁰.

In the mid-2021, Axie Infinity had about half a million daily active users (DAU), which increased to 2.5 million in December 2021⁷¹. A YouTube video explained that a player with a basic team of monsters, playing for about three hours can earn about 220 SLP per day (<https://www.youtube.com/watch?v=ISXz5FsYx-U>). Over 25% of Axie players were reported to be unbanked (<https://twitter.com/axieinfinity/status/1445427690605932545?lang=en>) and many are low-income workers in the global south who rely on Axie for a significant portion of their income⁷².

About 60% of Axie Infinity user in mid-2021 were from the Philippines. Axie Infinity served as a lifeline for many Filipinos. During the pandemic 7.3 million people were out of work. Those in rural areas living day-to-day were the hardest hit. Some players went to local internet cafes to play on PCs. Others played on their phones. They could earn a few hundred dollars per month, which was several times the minimum wage in the Philippines.⁷³

On August 26, 2020, news site specializing in bitcoin and digital currencies CoinDesk published a story about an Axie player from the Cabanatuan City of the Philippines, who was earning 10,000 Philippine pesos (PHP) (\$206) per week by playing the game (<https://tinyurl.com/mr3ppes9>). The average player earned 4,500 SLP a month (<https://tinyurl.com/534zw6dk>). The all-time high price of SLP was \$0.399727 in July 2021 (<https://www.coingecko.com/en/coins/smooth-love-potion>). This translated to a monthly income of \$1799 or an annual income of \$21585 ($0.399727 \times 4500 \times 12$). In 2020, the average monthly salary in the Philippines was about 45,000 PHP (\$894) (<https://www.statista.com/statistics/1048636/philippines-monthly-average-salary/>). A 2020

survey conducted among repatriated Filipino overseas workers (OFWs) during the COVID-19 pandemic found that more than half of the respondents had a monthly income in the 20,000-50,000 Philippine pesos (\$397-\$993) range (<https://www.statista.com/statistics/1245088/repatriated-ofw-philippines-income-range/>). This means that an average Filipinos Axie Infinity player earned significantly higher than an average Filipino working in the Philippines as well as an average Filipino overseas worker in July 2021.

In Venezuela, which had the second highest number of Axie players in early 2022, the minimum wage is around \$2.40 a month due to an extremely high inflation. A Venezuelan Axie Infinity player reported that by playing Axie, he earned as much as or sometimes even more than people working in professional jobs such as lawyer, doctor or engineer⁷⁴. Similarly, Axie Infinity gamers in Ghana were reported to earn between 854 and 2,562 Ghanaian cedis (\$140-\$420) per month, which is significantly higher than the country's minimum salary (<https://pvplive.net/axie-infinity-now-a-very-popular-nft-game-in-developing-countries/>).

Capacity-building

The metaverse can also facilitate capacity-building such as training, education, and knowledge exchange. Unavailability of funds and the lack of knowledge and skills among teacher are among the key barriers to implement ICTs in education in the GS.

Some recommendations have been provided to overcome such barriers include the use of FM radios and television in teaching and learning activities⁷⁵. The metaverse can also expand educational opportunities in the global south since VR can provide a low-cost and effective way to access training (<https://tinyurl.com/3rdmvu63>). For instance, many physiotherapy courses are offered online, which typically involve watching video screens. The

metaverse can enrich user experience with technologies such as haptic sensors (which create a combination of force, vibration and motion sensations in order to recreate the sense of touch to the user), 3D representation and gait analysis (study of body movements, body mechanics, and muscle activities). In this way, the metaverse is superior compared to the current internet⁷⁶.

Several studies have confirmed this potential. For instance, by using VR headsets, Walmart was reported to enhance employee training and cut training time for certain activities from 8 hours to 15 minutes. In a study, commissioned by the U.K.'s National Health Service to determine the value of VR in educating hospital frontline staff in infection control measures, 92% of participants were found to have an adequate understanding. The proportion was only 16% in the control group that did not use VR headsets. Likewise, the post-training performance increased by over 230% for the VR group, compared to 16.75% for the control group⁷⁷.

Some GS economies have already taken initiatives to use the metaverse for training, education and knowledge exchange. The University of Nigeria has announced a plan to launch a knowledge metaverse hub to its Lion Science Park health hub. The University has partnered with the U.S.-based VR and augmented reality (AR) software developer EON Reality to develop the metaverse. It will use extended reality to provide solutions to students and faculty. EON Reality was also reported to be working with the Ministry of Education of Ethiopia to create a knowledge metaverse hub. The hub will be targeted for students, teachers and entrepreneurs⁷⁸. The goal is to provide immersive learning experiences and content to users irrespective of location or economic status (<https://eonreality.com/university-nigeria-knowledge-metaverse/>).

The World Bank and the Organization of Eastern Caribbean States (OECS) Commission have teamed up to support national colleges in the Eastern Caribbean to incorporate the metaverse in learning. Some key metaverse activities planned include hosting joint events such

as job fair, holding classes, and accessing student services in the metaverse. These activities are expected to build the capacity of colleges in the region and improve remote collaboration. Students from one island can meet with local employers from other islands⁷⁹. In this way, metaverse can help overcome various challenges such as remote geography that small island developing states face.

The metaverse's potential as an education platform is also being used by some governments in the global south to achieve their political goals. For instance, the Chinese Communist Party's top cadre training school, the Chinese Academy of Governance uses metaverse system to enhance the effectiveness of its party-building experience. Beijing-based VR firm Mengke is a major technology provider of the system. Users can remotely access virtual activities such as party conferences and party history lessons. The system allows participants to move around. They can use their virtual avatars and listen to virtual narrators. Among other benefits, the new system was reported to save time and travel costs⁸⁰.

Innovation and entrepreneurship in the Web3 and metaverse economy

Some high-profile entrepreneurial ventures in the metaverse economy have been initiated in the global south. Some notable examples include Axie Infinity and Decentraland. Seven of the world's top 200 blockchain companies are reported to have Vietnamese founders⁸¹. As mentioned, the crypto metaverse game Axie Infinity was developed in Vietnam. Likewise, Decentraland, which is arguably the first metaverse to be built on the blockchain, was started by an Argentina-based team. The team had raised \$25 million in a 2017 initial coin offering (ICO)⁸².

Some countries in the global south have also been involved in the creation of intellectual property such as trademarks and patents for the metaverse industry. For instance, by February

2022, the number of metaverse-related trademark applications in China reached 16,000, about half of which were filed in the previous two months (<https://en.pingwest.com/a/9858>).

In some GS countries, socio-economic and other factors fostered the early development of some key Web3 and metaverse industries. A notable example is the P2E gaming industry in the Philippines. These have helped gaming companies such as YGG to develop skills, resources, and technology needed to compete in the industry and to internationalize and compete in foreign countries.

Internationalization of cultural products and artifacts

Entertainment such as movies and popular music around the world is currently dominated by the U.S.-made products. The metaverse has the potential to change this dominance by helping the global south internationalize cultural products and artifacts such as music and art.

For entertainment events such as concerts, the metaverse allows viewers to participate virtually and get almost real experience⁸³, which is likely to be a game changer for artists based in the global south. Some success has already been reported in which the metaverse helped attract audiences from all over the world. The example of the first Metaverse Concert by Indian bhangra singer Daler Mehndi we discussed above shows that the metaverse has the potential to help the global south overcome the barriers they face in exporting cultural products. Likewise, Africarare's SingularityU South Africa Summit 2021, which was held on-line from 12 – 15 October 2021, attracted more than 3000 participants⁸⁴. In the same vein, Thailand's first metaverse concert, the Hype Type Metaverse Concert (<https://www.hypetype-concert.com/#>) is targeted for a global audience. It features NFTs, cryptocurrency and virtual shops. Over \$7 million was spent to build the concert's metaverse platform⁸⁵.

Impact on development goals such as financial inclusion

Web3 and the metaverse can also provide leapfrogging opportunity in the financial sector. For instance, Africa's high unbanked population presents an attractive opportunity for fintech, DeFi, and Web3. There is a large credit gap, volatile and currencies are illiquid, and cross-border payments are inefficient and expensive. Africa has embraced crypto due to the decentralized nature. DeFi offers real-time transactions and can be used by anyone with a wallet. It can also help monetize assets and facilitate borderless transactions, and global capital flows⁸⁶. Nigeria's lack of financial services infrastructure has been found to be a key factor that encouraged cryptocurrency ownership. The country's consumers started accepting cryptocurrency as a means of storing and transferring assets⁸⁷.

Development and humanitarian interventions

Arrival of Web3 is set to transform development and humanitarian activities in developing economies. For instance, some fundraising campaigns supporting humanitarian aid efforts in Ukraine such as Soul of Ukraine

(<https://soulofukraine.io/>) have been run through smart contracts. Funds are automatically transferred to the Ukrainian government or associated charities. Donors can thus trust that their funds are likely to be used properly even if the organizers of campaign are anonymous⁸⁸.

The World Food Program's (WFP) "Building Blocks" project started in 2017 is the most spectacular example of the use of Web3 technologies in humanitarian interventions. In the early phase the, the solution was used to provide food and cash assistance to needy families in Pakistan's Sindh province and Syrian refugees in Jordan. In Jordan's refugee camps, for instance, supermarkets have iris scanners to identify the beneficiaries and settle payments. No banks are involved, and beneficiaries receive goods directly from the merchants.

Web3 is expected to facilitate more seamless integration of technology into everyday activities, especially with the further development of blockchain⁸⁹. In the WFP's "Building Blocks", when the applications reach at a more advanced development stage, more benefits are expected to be realized including possible access to entrepreneurial financing for refugees. The WFP expects that refugees will be able to access their funds by controlling their cryptographic keys. This feature can allow them to incorporate personal data from diverse sources such as medical records from the World Health Organization (WHO), academic credentials with the United Nations Children's Fund (UNICEF), and nutritional data with the WFP (Wong, 2017)⁹⁰. In this way, they can build their economic identity and demonstrate creditworthiness to increase the chance to access entrepreneurial financing.

Similar benefits can be achieved in the systems used to distribute donations and aids. For instance, the WFP expects that blockchain-based solutions would reduce its overhead costs from 3.5% to less than 1%⁹¹. What is even more important is that an estimated 30% of development funds do not reach the intended recipients due to problems such as third-party theft and mismanagement (Paynter, 2017)⁹². Blockchain holds a great potential and promise to fight such fraudulent practices.

The metaverse in national marketing strategies in international tourism

The metaverse can be used as a tool to enhance the physical world⁹³. Of special relevance is the role of the metaverse in national marketing strategies in international tourism. Countries such as Maldives, Aruba and Seychelles, which heavily rely on tourism⁹⁴ can use the metaverse as a promotional tool.



Visiting a country is likely to be more realistic supplemented by using the metaverse. In this way, the metaverse can complement traditional travel. Businesses in the travel and tourism

industry such as hotel chains, cruise brands, and travel agencies can use the metaverse to promote and showcase their products. Travellers can visit the metaverses of two different cities and compare key attractions and hotels using 3D images that have accurate colors, lights, dimensions, sounds and other features⁹⁵. For instance, Egypt’s General Authority for Health Care is using the metaverse to promote its medical tourism project. Tourists can visit the metaverses of the health facilities affiliated with the authority such as those in Port Said, Luxor and Ismailia to understand whether these facilities’ capabilities match their needs. Potential health tourists can also get ideas about other facilities such as hotel amenities in the cities⁹⁶.

Classifying Web3 and metaverse activities in terms of impacts and resource requirement

In order to bring positive societal disruption, resources such as computing power or human labor need to be channeled to perform actions that are valuable to societies and reward financially. In this regard, in Table 3, we classify Web3 and metaverse activities in terms of resources requirement and economic and social impacts. A prominent example of Web3 deployment that has high economic impact as illustrated above is blockchain-based crop insurance for small holder farmers (Cell I). Other examples include the use of blockchains to enhance payment security and store documents such as land titles. No advanced technological infrastructures are required for such solutions.

Table 3: Classification of Web3 and the metaverse activities in terms of resources requirement and impacts

Requirements		
Activities		
Activities with high economic and social impacts	Applications that do not require access to advanced technological resources [I] <ul style="list-style-type: none"> • Web3-based crop insurance • Use of blockchains to enhance payment security 	Applications that require access to advanced technological resources [II] <ul style="list-style-type: none"> • Metaverse in healthcare

	and store documents such as land titles	
Activities with questionable or clearly negative economic and social impacts	[III] <ul style="list-style-type: none"> • Web3 games such as MetaCelo 	[IV] <ul style="list-style-type: none"> • Web3/metaverse games such as Gala Games distributed through the Epic Games

The creation of new types of online jobs such as developers for blockchain projects or virtual assistants (VAs) for companies in developed countries can also have positive economic impact and are sustainable⁹⁷. Rapid growth in the metaverse requires diverse skills such as community management, content creation, digital discovery, transactional talents and metaverse office skills (<https://tinyurl.com/3s6cwzfv>). The metaverse can thus make it possible for workers in low-income countries to get jobs in foreign companies without leaving their homes (<https://tinyurl.com/3rdmvu63>).

Web3 and the metaverse are also likely to transform mission-critical fields such as healthcare (Cell II). Traditional healthcare delivery model involves bringing people together in the same room for consultations, medical training, procedures and treatments. People in remote areas face physical and logistical barriers. The metaverse can provide an opportunity to provide healthcare to rural populations that are spread over a large geographic region⁹⁸. There have already been some initiatives on this front. In June 2022, Hyderabad, India-based Yashoda Hospitals Group reported that it acquired space on Decentraland to establish a virtual clinic. The Group expects that the clinic will be ready by 2023, in which patients' avatars can seek expert consultations from doctors. Such applications, however, require resources such as technological infrastructures. For instance, real-time healthcare applications such as remote surgery via the metaverse may require ultra-wide bandwidth technologies such as 5G cellular networks, which provide a low latency, high capacity and speed.

Web3 and metaverse games are often viewed as economically unproductive or low-return activities. Some such games do not require access to advanced technological resources (Cell III). In February 2022, MetaCelo was launched as the first P2E metaverse NFT Game on Celo Network⁹⁹. The game is designed for low-end smartphones with slow connections to deal with the problems of high latency and low bandwidth¹⁰⁰.

Some games require access to advanced technological resources (Cell IV). In June 2022, web3 entertainment company Gala Games announced that its blockchain linked game titles would be distributed through the U.S. video game and software developer and publisher Epic Games Store¹⁰¹. Epic Games does not have its own Web3 games. Epic Games has arguably grown from game to metaverse¹⁰² but it does not host servers in Africa, which puts African gamers at a disadvantage. Since the servers are far away in other continents, African gamers' reachability, also known as "ping", is adversely affected, which compromises the quality of their game. Ping is measured in milliseconds (ms). African gamers playing on European servers are reported to experience 160ms- 200ms ping, compared to European players' less than 20ms ping. A European player can see the African player first and can fight more quickly¹⁰³.

Currently gaming is the dominant activity in the metaverse in which players earn in cryptocurrencies. In this regard, observers argue that, in general, P2E games lack sound economic fundamentals. P2E models require constant user growth. Games like Axie Infinity are zero sum. No money is produced inside the game. The only money anyone can take is money somebody has invested in it. The only players investing more money than they expect to take out of there are new players who buy NFTs to get started¹⁰⁴. For instance, Axie Infinity's economy involves three major resources: the in-game cryptocurrency SLP, the axes that live as in-game items as well as NFTs on Sky Mavis' blockchain; and the "governance token" AXS. Of these

three, the first two categories of resources constantly increase. For instance, player-versus-player battles increase SLP. Players can breed Axies to produce new creatures. In this way, the pool of NFTs increases¹⁰⁵. In a Medium post, M Goes called Axie Infinity “the biggest Ponzi scheme in crypto” and Axie “one of the most price inflated and conceptually over-hyped assets in crypto”. However, when millions of gamers engage in activities that lack real-world value outside the game, these actions’ long-term sustainability becomes questionable¹⁰⁶. Likewise, in Brazil’s International Games Festival held in July 2022, game developer Mark Venturelli accused the P2E gaming industry of turning games into “salt mines and sweatshops” and engaging in predatory practices. Venturelli also criticized the industry for their big carbon footprints¹⁰⁷.

A related concern is the volatility of cryptocurrencies. For instance, the price of SLP declined following the all-time high level of July 2021. On April 3, 2022, 1 SLP was trading for around \$0.02299 (<https://coinmarketcap.com/currencies/smooth-love-potion/>), which was 94.2% lower than in July 2021. At this rate, the earning of an average player, who was making \$21,585 per year in July 2021 would reduce to \$1241.46 per year. A May 2022 article published in Conversation reported that only the best players were earning above the minimum wage¹⁰⁸.

A further challenge is that P2E metaverse games have erected a high capital-investment barrier to low-income populations in the developing world. For instance, in order to play Axie Infinity, a requires three Axies. Players can buy or borrow them. On April 1, 2022, the average price per Axie was \$66.08 (<https://coinmarketcap.com/currencies/axie-infinity/>), which required about \$198 to buy three Axies that are required to play the game. The cost was more than five times higher in September 2021. Players with better Axies that cost more have a better chance of

winning battles and earn more SLPs as well as the game's other crypto token Axie Infinity Shards (AXS)¹⁰⁹.

While players can rent NFTs, the owners take a large share of players' earnings. Axie Infinity has what is referred to as "scholarship", in which players that own AXS tokens but do not have enough time to play the game (known as managers) lend out their tokens to others (known as scholars) who want to play the game but lack adequate financial resources to buy the tokens. According to analytics firm Naavik, a 'scholar' gets only 60% to 70% of the earnings and the rest goes to the manager¹¹⁰. Similarly, the P2E metaverse casino Decentral Games requires players to have an NFT worth \$5,200. Many gamers in Argentina and Brazil were reported to play on behalf of NFT owners from the U.S. and Germany¹¹¹.

Finally, P2E games account for only small proportion of the gaming revenue. According to DappRadar, about \$4.5 billion of gaming NFTs were traded in 2021, which was one-fifth of all NFT sales. It is, however, a small fraction of the \$180 billion in gaming revenue generated across PC, mobile and console-based games¹¹².

Paper summary and conclusion

The impacts of Web3 and the metaverse are being felt across the world--not only in industrialized countries but also in the global south. Web3 tools have also provided marginalized groups' access to risk-management tools, such as crop insurance. Insurance costs are high due to high administrative costs and fraud. Web3-based solutions address both of these issues.

The metaverse can help developing economies to internationalize fashion, art, entertainment and cultural products and artifacts. As discussed above, the metaverse has supported the internationalization of concert and live performance. The metaverse is also expected to provide equitable access to education, training and healthcare.

The metaverse economy has created socioeconomic benefits such as employment opportunities, and income generation. Despite several drawbacks of P2E games, such games have already benefitted needy populations in the developing world. They played a key role in providing livelihood for the marginalized groups that had been particularly affected by the pandemic. For instance, metaverse games such as Axie Infinity made it possible for many people in the Philippines and other countries to make a living during the COVID-19 pandemic. However, there are legitimate arguments about whether such games are sustainable in the long run. Metaverse game players also suffer from the usual challenges such as volatility of cryptocurrencies and cybersecurity.

Entrepreneurship and investment activities indicate that Web3 and the metaverse have a great market interest and potential in the developing world. Prolific venture capital investors in the tech ecosystem such as Andreessen Horowitz and crypto-focused investment firms such as Paradigm have invested in the Web3 and the metaverse ecosystems of the global south. Especially Southeast Asia is home to some prominent companies in the Web3 and metaverse sector.

There are a number of barriers that hamper the global south's ability to reap the benefits offered by Web3 and the metaverse. Expensive high-tech gadgets, such as VR headsets or glasses are not accessible to majority of the population in the developing world. healthcHowever, some positive signs have emerged. Measures need to be taken to encourage people in the developing world to engage in economically productive and socially just and useful work using Web3 technologies.

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