A BLOCKCHAIN-BASED SOLUTION TO PROPERTY RIGHTS IN SRI LANKA

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Abstract

This paper explores a possible solution for the property rights crisis in Sri Lanka. I propose a blockchain-based solution, combing public and private blockchains to store all land titles in Sri Lanka. The system will also allow users to buy, sell, and transfer property on a secure platform. Sri Lanka's land registry's department is plagued with corruption - where politicians and businessmen sell and use fake deeds - the blockchain network elimates all corruption through the use of hash keys. The system allows land titles to be accessed instantly, which ensures that people can take a loan against their immobile assests immediately, to help grow their business; thus rejuvenating a crumbling Sri Lankan economy. The system increases reliability, accountability, efficiency, and security. The public will be directly involved in the system as they monitor it, along with designated monitors, white-hat hackers, the government, and banks. The paper proposes that the government allows a private company to build the network to maintain decentralization. The system will run on autopilot, and the government will fund the system. The research implemented in this analysis has been conducted through interviews with employees in the Registrar General's Department, and by using other research papers and peer-reviewed journals online. One can expect an in-depth analysis covering the blockchain network's design, understanding why it is perfect for Sri Lanka (due to the Bim Saviya and e-Land Acts), and the limations of the solution - including how the government and the company which sets up the network can tackle them.

I. Introduction

Mr Gunasena is 51 years old. He lives in northwest Hambantota and owns 41 cows, 60 chickens, and a brick house. He lives a relatively extravagant life compared to his neighbours. However, he has one issue; he disallows his son from travelling to Colombo for university studies, curbs him from purchasing conditioner and shampoo, and prevents him from watching cricket matches on a coloured television (TV). His father gave him a parcel of land; however, he did not have the deeds to this property. Therefore, he does not have property rights and cannot obtain a loan with this property as collateral to grow his business. If he could use his property as capital, he could earn more money each year. Limited access to property rights is a vital preventive of economic growth in developing countries. Economic growth could be exponential if everyone in these countries had access to property rights (Ali et al., 2011).

In Sri Lanka, some issues arise when the government provides its people with a system of storing their property rights (Dunham & Jayasuriya, 2000). The corruption and inefficiency of many officials in Sri Lanka!s public registry have disrupted the system (Ampratwum, 2008). Sometimes, corrupt officers either misplace or destroy some property titles (Aidt et al., 2008). According to the World Bank Group (2022), Sri Lanka ranks 138th out of 189 for ease of registering property. This is extremely disappointing for a country with a gross domestic product (GDP) per capita of approximately $4,000, a lower-middle-income country by World Bank statistics. Sri Lanka could solve these issues using a single solution - a hybrid blockchain-based network for property rights (Hazem & Rosana, 2020).

A blockchain-based network prides itself on increased efficiency, accountability, reliability, and security (Shuyun et al., 2020). Property titles can be stored with multiple defence programs, which are secure and accountable (Vos, 2017). The network is also reliable due to its ease of access for members of the general public. (Wang & Zhang, 2018).

This paper proposes that the Sri Lankan government stores land titles on a blockchain network and will proceed to describe the advantages of this change throughout the rest of the paper.

II. Background: Property Rights in Developing Countries

Peruvian economist Hernando de Soto (1986) has stated that more than half the world does not own the land they inhabit (Fontana, 2016). He calls this dead capital. Capital, according to de Soto, H. (2000), is something that can generate wealth. According to Overstock founder Patrick Byrne, De Soto Inc. plans to put property titles in developing countries on a blockchain network (Dale, 2021). As stated previously, property holders can use their property to take loans against their land. For example, if one owns a property worth $218,000 (the average property price in Sri Lanka), one may secure a loan worth $100,000. The additional $100,000 helps them repay existing loans or invest in their business. Around 3.5 billion people worldwide do not have land titles (World Urbanization Prospects, 2018). If people throughout Sri Lanka had access to the property benefits, one can only imagine the wonders it would do for the economy. As Kshetri, N. & Rogers, R. (n.d.) stated in their article on blockchain-based registries, "The value of those properties, and the lost economic opportunities for owners of assets without formal documentation, has been estimated at United States (US) $20 trillion worldwide.

FIGURE 1: THE PERCENTAGE OF PEOPLE (ILLUSTRATED THROUGH A SPECIFIC SCORE) WHO HAVE ACCESS TO THE BENEFITS OF PROPERTY BY COUNTRY ("PROPERTY RIGHTS INDEX." MAPS OF WORLD, MAPSOFWORLD.COM/ANSWERS/WORLD/PROPERTY-RIGHTS-INDEX/.)

The issue with current property rights in developing countries like Sri Lanka essentially boils down to one word: inefficiency (Estrin & Pelletier, 2018). Developing countries use paper documents to track who owns what property (Gurara et al., 2018). Unfortunately, the paper documents used could be easily misplaced or destroyed. There is no sense of accountability as the government can always claim that they have misplaced it or even deny the existence of such documents. Transparency International's 2021 Corruption Perception Index shows that Sri Lanka is the 102nd most corrupt country out of 180. According to the same report, Sri Lanka achieved a 38/100 score. This score measures the level of corruption in each country (the lower the score, the worse the level of corruption).

Politicians can choose which property gets registered and which does not in many developing countries like Sri Lanka (Mijiyawa, 2009). These politicians and notaries are susceptible to being bribed. In various cases, they can be bribed and give property developers property deeds. According to workers at the Registrar General's Department Office (Interview of an anonymous worker at the Registrar General's Department conducted on September 16th, 2021), stamp duty corruption is prevalent. Another issue faced by the Registrar General Department's Office, besides corrupt politicians abusing the system, is common criminal activity (Aidt et al., 2008). Since they store most Sri Lankan land titles in paper form, they get lost easily. As a result, some citizens take advantage of this; by drafting and selling fake land titles (Chigbu et al., 2017; Benjaminsen & Sjaastad, 2002). After reaching an all-time high in 2019, Sri Lanka's GDP has dropped back down to 2014 levels (Gordon, 2022), making citizens more desperate. As a result, more people now engage in criminal activity due to the economic crisis.

With a blockchain-based solution, these documents would be:

a) Stored securely

b) Resistant to fakes.

White-hat hackers, some chosen monitors, and the public can protect the documents. As any document outside of the server cannot be trusted, no fake copies would be created. At the Registrar General's Office, it can take six months to a year to recover a lost land title using the paper document means, an inefficiency that Blockchain solves because of instant-time data (one can access their titles on the server in seconds) (Bashir, 2017). The Registrar General's Department has acknowledged the above issues. Another property rights issue developing countries face is the reluctance to take economic risks due to fear of debt (Boucher, Carter, & Guirkinger, 2008). Without fundamental property rights, people cannot borrow against it (Besley & Ghatak, 2008). They end up spending conservatively and not taking risks to expand their business. If given access to their property rights, they would be more willing to take risks, as they know that even if those decisions failed, they could still take a loan against their property. (Besley & Ghatak, 2008).

Please refer to Figure 1 for a map that shows the sheer difference in property rights between developed and developing countries. The paper proposes people be given access to their property rights through a blockchain-based system (Mougayar, 2016). Sri Lanka has digitized multiple property rights through numerous government acts (De Bustis et al., 2018), giving the island nation a head start. The way to further this success is through a blockchain-based solution. Many countries have already used blockchain-based solutions to solve the lack of property rights (O'Leary et al., 2017). Georgia added hashes (a specific code used to keep data safe in the network) to 1.5 million land titles and placed them on their blockchain network (Shang & Price, 2019). Georgia's main aim in using a blockchain network was to counter corruption. Blockchain

networks are almost impossible to tamper with and can provide accountability, reliability, and security (Shuyun et al., 2020). Before they introduced the blockchain system, the Georgian public registry had to be used for every transaction, which cost between 150-617 Lari ($50-$200) per transaction. Following the implementation of the blockchain system, the fee was reduced to 0.15-0.31 Lari ($0.05-$0.10) (Shang & Price, 2019). Before they introduced the blockchain system, the Georgian public registry had to be used for every transaction, which cost between 150-617 Lari ($50-$200) per transaction. Following the implementation of the blockchain system, the fee was reduced to 0.15-0.31 Lari ($0.05-$0.10) (Shang & Price, 2019). Initially, there was no transaction fee, but as blockchain has grown in popularity, the transaction fee has increased as miners have charged (A miner is someone who validates a cryptocurrency transaction (Frankenfield, 2022)).

However, this fee is nowhere near the fee of a transaction without Blockchain. It is important to note that public trust in government institutions increased after implementing the blockchain-based solution (Shang & Price, 2019). In addition, Georgia achieved 5th out of 190 nations for the registering property section of the Doing Business report (done by the World Bank). In Ghana, the government plans to create a blockchain server with a Canadian company called Bitland (Adedamola, 2019). They plan to use Blockchain to curb fraud and make mortgage lending more efficient (Bugri, 2013). Addressing these issues could be essential to Ghana's sustained development (Adedamola, 2019). Blockchain can increase confidence in real estate transactions, opening up a significant asset class," David Shrier told the Oxford Business Group. 90% of rural Africa has no access to the documents for their land. So, if they implemented this on a larger scale (a blockchain solution for the continent), it could ignite significant economic growth (Ali, Dercon, & Gautam, 2011). This shows that blockchain-based solutions have the potential to work not just in developed countries but in developing ones, too (Mougayar, 2016).

Sri Lanka suffers from a lack of property rights, limiting the poor's capital sources (Dunham & Jayasuriya, 2000).

III. The Blockchain Solution

Blockchain offers accountability, reliability, efficiency, and security as a decentralized virtual system for storing records and making transactions (Shuyun et al., 2020). It helps people discover who owns what (both presently and in the past) and whether these assets are legally owned (have proper documentation) (Wang & Zhang, 2018). Blockchain helps the public understand what is publicly owned and privately owned. The most useful and impactful feature of a blockchain-based system is its decentralization. It belongs to no government body but solely to the people who use it (Carson et al., 2018). If implemented in Sri Lanka, the government would reserve the right to view documents to ensure that the Blockchain is being used within the constraints of the law (De Bustis et al., 2018).

Blockchain is an effective and efficient way of controlling corruption and identifying illegal assets (Ampratwum, 2008). However, they would have no right to alter or remove information, only to copy it to store in their servers if needed (for a legal case, etc.) (Hazem & Rosana, 2020). If the government were to find the asset stored in the system to be acquired or earned illegally, the government would be obliged to conduct a formal trial of the asset owner. They may use illegal assets stored in the Blockchain as evidence; however, the asset will only be removed from the blockchain network once the judicial body has decided so.

Blockchain ensures that the person who enters their data on the blockchain has a guarantee that their data will neither be corrupted, removed, nor lost.

Blockchain for Immobile Assets Like Land

This paragraph outlines how and why one should store land titles on a blockchain server, especially in developing countries like Sri Lanka. The first important distinction is the difference between immobile and mobile assets (Yale, 2015). Immobile assets are assets that do not move such as land (Proptiger, 2016). One can move a mobile asset: a car, for example, or an iPad (TechDissected, 2016). Storing mobile assets on a blockchain network is not possible at this point (Maes, 2013). This is because it is too complicated for a blockchain system. Since the item is constantly in transit, it is extremely tough to keep a record and track where it is at all times (Maes, 2013). The owner cannot be expected to log everywhere they have taken their car each day. In addition, if one puts too much information on the network, it could crash and risk losing billions of documents (Poon & Dryja, 2016). Therefore, until one makes significant advances that allow networks to cope with mobile assets, this paper proposes a blockchain-based solution for immobile assets, especially concerning property rights.

It is important that before one uploads a land title to the blockchain system; one checks the title to ensure it is untampered (Wang & Zhang, 2018). If tampered documents are digitized, this can confuse users and monitors in the future. After the government reviews all land documents, they will digitize them and send whichever has passed the inspections to the company creating the blockchain network. The government will reissue new property deeds for those whose property deeds have been tampered with or are being contested after the corrupted/ contested ones have been thoroughly attended to or examined. The courts can decide and issue the title. This will be slower and will take several years for all the tampered properties to be analyzed and digitized (Wang & Zhang, 2018). This lengthy process has significant advantages.

Clearing out corrupted records is helpful and will save countless hours in the future for both the government and the people of Sri Lanka (Dunham & Jayasuriya, 2000). It is important to note that all new property bought on the blockchain server will be registered immediately, and owners will be sent their deeds through a secure online network.

Blockchain also provides instant-time data (Bashir, 2017), which increases efficiency. This means that all data is available at the click of a button, as it is constantly updating itself on the blockchain server (Bashir, 2017).

An issue faced by workers at the Registrar General's department is inefficiency (Aidt et al., 2008). It can take six months to a year to recover a lost paper land title. The blockchain network resolves this issue instantly, as documents and their backups are stored on the server, where they can be accessed quickly (Wang & Zhang, 2018). This will save time in the future for the Sri Lankan government and the public.

How to Use the Blockchain System for Recording Land Titles

A Blockchain network (Figure 2) comprises multiple blocks that form links (Jafar et al., 2022). Each block can only have one previous block. A block contains three components: the data, the hash, and the previous hash. Data is stored inside the block (with property rights, it would be the deeds to someone's property) (Jafar et al., 2022; Lemieux, 2017). The hash is a unique and specific code, an online fingerprint. The hash is generated by 'hashing' the private key (using an algorithm like SHA-256) (Vos et al., 2017). The private key is the property owner's key to enter their private blockchain for their specific property (Jafar et al., 2022; Lemieux, 2017). Only the owner has the private key, which, when entered into the private blockchain, decrypts the contents of the private blockchain from documents written in randomly generated hash keys to documents written in actual text so the owner can read the documents. The hashing of document text is for additional security. Documents may be the land title, sale

deed, wills, birth certificates, etc. After the private key is hashed it is placed on the block. Note that the hashing of the private key is separate from the hashing of the documents inside the private blockchain. The private key is to enter the private blockchain, the hashed documents are for an additional layer of security inside the private blockchain. The last, and most crucial component of the block, is the hash from the previous block (the previous owner's hashed private key) which is also placed on the block (Jafar et al., 2022; Lemieux, 2017). This is the component that makes   blockchain corruption-proof. For example, if one changes or removes the data inside any block, the hash immediately changes to a different code. Therefore, the current and the previous block's hash do not match. Immediately, monitors (people who keep track of transactions on the Blockchain network) disable that chain, thus keeping the data safe. Sufficient proofs are also required which further protect the data - such as 'proof of work,' 'proof of process,' 'proof of existence,' and so on. Each blockchain network has multiple backup servers. Therefore, if one block is corrupted and someone loses the deeds to their property, a new block that reads' END' will be added. The block will self-destruct, the private blockchain network (private blockchain networks which will be described later) will be scanned for viruses, and the network will upload the backup private chain from the backup server. After they have uploaded it, the network will create a new backup private chain in case this problem occurs twice. If someone loses access to the system the system will not crash as all networks attached to the blockchain have all the data downloaded on their systems. The system is decentralised so when the user can access the internet again they must re-download all of the data from another account on the network onto their device. This re-downloaded data does not contain any private information such as private keys that makes blockchain corruption-proof.

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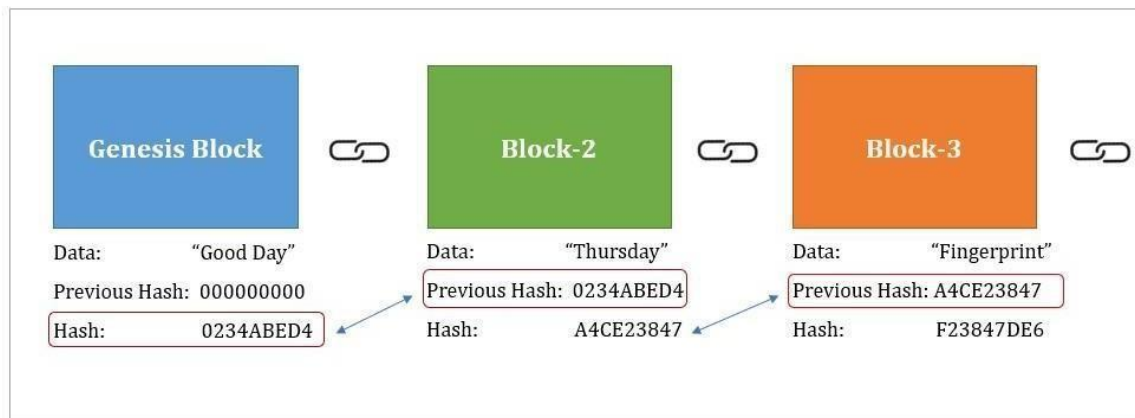
FIGURE 2: A DIAGRAM OF A TRADITIONAL BLOCKCHAIN NETWORK ("WHAT IS HASH FUNCTION – SECURE HASH ALGORITHM - (SHA-256) IN BLOCKCHAIN TECHNOLOGY?" BLOCKCHAIN KNOWLEDGE, 9 FEB. 2021, BLOCKCHAIN KNOWLEDGE.IN/WHAT-IS-HASH-FUNCTION-SHA-256-IN- BLOCKCHAIN TECHNOLOGY/.)

The private company will give everyone who stores their property on the blockchain network access to an app. This app will open to an image drawing of their land and their land's GPS coordinates rather than its address (because road names can change frequently). They will then provide the person with official measurements of their land (Vos et al., 2017). Therefore, this information cannot be disputed and can resolve arguments over who owns the land.

One can use the blockchain network if one wants to purchase land. There are two possible land sellers via blockchain: the government and a private citizen. The person who wants to purchase the land (Mr X) would do so through cryptocurrency or the Sri Lankan rupee via bank transfer (the blockchain system is equipped to process both). The buyer must sign a smart contract with the seller to authorise the transaction. The steps are as follows (Chigbu et al., 2017);

1. Mr X finds the land he wants to purchase.

2. Mr X enters the geographic coordinates of the property he wants on the blockchain system.

3. The system automatically directs him to that property's specific Blockchain.

4. He then purchases the land (the Blockchain network acts as the middleman, along with the monitors - people who approve transactions on the Blockchain network - who approve the transaction).

5. They then transfer the money to either the person who previously owned the land or the government. This is a peer – to – peer (P2P) transaction using a bank transfer, digital rupee (stable-coin) or a specific cryptocurrency - monitors charge a significantly lower percentage for the transaction than banks/governments do.

6. A new block is added to the server, which stores all property deeds and is labelled Mr X's property. It also has a specific hash to protect it. Transferring either money or property on a blockchain network securely; is called a smart contract (Mougayar, 2016). If one forgets to add a block to the Blockchain server, monitors must examine and approve it, and if approved will be added to the part it is supposed to be in on the Blockchain network.

If multiple parties own a property and wish to sell it or multiple parties wish to purchase a property the same steps will occur as specified above. However, to execute the smart contract (the transaction), all parties must approve the contract by signing into the blockchain system (passing firewalls and security checks by white hat hackers and monitors) and using their digital signature to approve the contract. All purchases and sales must be approved by all parties involved in the transaction, using a digital signature on a smart contract.

The Hybrid Blockchain: Combining Public and Private Record Systems

Blockchain networks can be both private and public (Hazem & Rosana, 2020). Private blockchain networks are only accessible to those given the password, and everyone can access public blockchain networks.

A hybrid blockchain system is more effective than a traditional blockchain system (Hazem & Rosana, 2020). A hybrid blockchain solution involves using a private and a public blockchain network. Besides the blockchain system, a public registry - which is decentralized, will always be available (Hazem & Rosana, 2020). Note that this paper is not proposing that the public registry system be abandoned. It should be changed to a decentralized public registry, which will be accessible to those who are unable to access the blockchain network. Essentially, it is the same as a public registry; the only difference is that it is not managed by the Sri Lankan government (Vos, 2017) but by a private company. The private company cannot engage in illegal activities as they have no control over the system. They established the system, but their control over the system ends at that. The people control the system (Shuyun et al., 2020); thus, the system runs on autopilot. However, by using this decentralized public registry system, people must understand that there is no guarantee that their data stays safe; it is decentralized but can be misplaced since they are still paper records. If one does not have access to the internet, this is the system they would use to store their property titles. Blockchain offers a decentralized system that ensures reliability, accountability, efficiency, and security (Shuyun et al., 2020).

The private and public blockchain system works by creating individual blockchain networks for each asset. They will store all data regarding each asset inside an individual blockchain network, including the actual title deed stored as an non – fungible tokens (NFT). This is called a private blockchain network as it ensures that only the owner and people who were given permission can access the data inside it; the public cannot access a private blockchain (O'Leary et al., 2017). If multiple parties own a property, as is the case for many properties in Sri Lanka, all parties are given access to the private blockchain for that property. They may monitor the private blockchain but cannot change data or sell the property without digital signatures and smart contract approval from all other parties.

This ensures that the blockchain system falls within various privacy laws. To ensure that transparency is maintained, everyone on the public blockchain will be able to see certain components of the blocks on the private blockchain (O'Leary et al., 2017). These parts include all three components of a blockchain, the name of the property/blockchain, the hash, and the previous hash; however, the data inside each block will not be available to the public. The public cannot see the selling price of the property unless disclosed by the seller. When a private blockchain gets tampered with, the rest of the monitors, white-hat hackers, and the public can observe it. To ensure that no illegal activity occurs within a private blockchain, the government reserves the exclusive right to investigate any private blockchain that contains assets of people based within their country (O'Leary et al., 2017). A permissioned private blockchain is when the owner (the company which sets the blockchain) chooses who can access the blockchain system. The host (the government) assigns nodes (monitors) to the blockchain. Please note that when a 'public blockchain' is mentioned in this paper, this is essentially a permission less public blockchain. One tweak to this is that not everyone can see all the information because of the need to adhere to privacy laws.
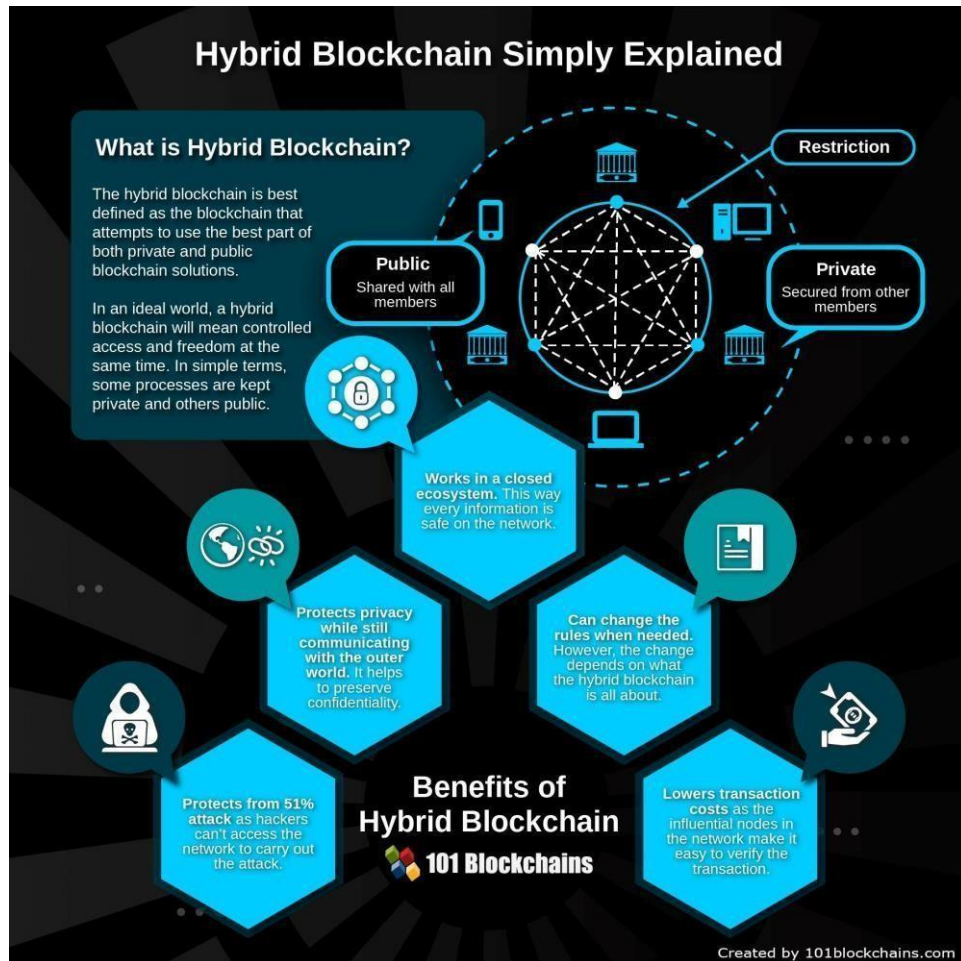
FIGURE 3: A DIAGRAM OF A HYBRID BLOCKCHAIN NETWORK ("HYBRID BLOCKCHAIN." 101
BLOCKCHAINS, 101BLOCKCHAINS.COM/HYBRID-BLOCKCHAIN/.)

Setting it Up

Another important decision to be made is who will set up this blockchain network. This

paper proposes the Sri Lankan government abandon the idea of constructing the blockchain

network themselves. This is not because they have insufficient resources to do so but because if

they are to set up the network, people may be sceptical of it (Ampratwum, 2008). The

attractiveness of a blockchain-based system for property rights revolves around the concept of

decentralization (Ali et al., 2011). The courts can still accept the proof of title, as the government

has approved them before being placed on the server. The government has approved all titles on

the blockchain cloud; thus, the courts and banks can accept them as proof of title (Besley &

Ghatak, 2008). If the government were to set up the blockchain network does not mean that it would be centralized, however, it gives the public the impression that this is inevitable (Ali, Dercon, & Gautam, 2011). If the public is sceptical of how decentralized the new blockchain-based system is (Ampratwum, 2008), they may be less likely to use it. This paper proposes that the government hire a private company to set up a blockchain-based network for property rights. Many companies, such as BitFury, are helping governments set up blockchain based networks.

Local alternatives are also available, companies like Yaala Labs in Colombo. The Central Bank of Sri Lanka hired Yaala Labs to construct a blockchain-based system for a Know-Your Customer Proof of Concept. Yaala Labs is no stranger to implementing blockchain in Sri Lanka. The private company will turn a profit by charging all blockchain system users a percentage of all transaction fees, perhaps 0.01%, for a specified number of years - thus local firms will be incentivised to compete for this large scale and subsequently high revenue government contract.

In the previous section, the paper identified the following problems faced by people who do not have property rights in Sri Lanka: corruption, the inability to obtain a loan against one's property, and inefficiency (Estrin & Pelletier, 2018). As the paper has explained above, blockchain solves the problem of inefficiency (Aidt et al., 2008), because it uses quick transactions that avoid expensive intermediaries. The corruption problem is solved as the data is secure and watched by both monitors and the general public; backups are also kept to ensure data protection. The inability to obtain a loan against one's property is solved as all records uploaded to the blockchain-based system are approved by all parties, secure and untampered. They are easily accessible to the general public and can be sold through secure transactions, using cryptocurrency or the Sri Lankan Rupee.

The proposed layout for the blockchain network, as seen by the user by page order

Welcome Message

Login Details

Full Name

NIC Number + Other necessary security measures

Access my property/
properties

Browse property

When 'Access my property/properties' is clicked

This page can be accessed by only the: property owner, government, monitors, white hat-hackers, and banks (at the holder's request),

Property name

GPS Coordinates

Address

Satellite Image of Property

Open Property

Sell Property

If user clicks 'Open Property' this will open

Link to digitised land title

IN ADDITION TO THE LAND TITLE THESE DOCUMENTS MUST BE UPLOADED
Current Survey plan copy (Within 10 Years old with subdivision approvals) & other Survey plans within 25 years
Certified Extracts for last 25 years from the land registry
Local authority certificates
Street line
Non-vesting
Assessment notice
Tax receipt-last quarter
Ownership certificate

If user clicks 'Sell Property' this will open

To list on Marketplace:

Input Selling Price

If you want to use a specified real estate agent input their Name and NIC number below
Full Name
NIC Number :

Upload property photographs here:

Drag and Drop images here

USE THE SAME FORMAT FOR ALL PROPERTIES. IF SOMEONE HAS MULTIPLE PROPERTIES THEY CAN SCROLL DOWN ON THIS PAGE AND THE SAME PAGE WILL BE DUPLICATED BUT FOR PROPERTY 2
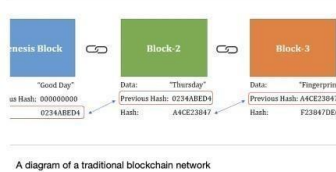
To Browse Property: (Purpose: To monitor property to ensure no criminal activity is taking place)

Type GPS Coordinates of property below:

Hash keys of private blockchain for individual property will be displayed to prove that that specific property's data is not compromised

After entering GPS Coordinates

↓

Users are redirected to a page like this

nesis Block		Block-2		Block-3
"Good Day"		Data: "Thursday"		Data: "Fingerprint
us Hash: 000000000		Previous Hash: 0234ABED4		Previous Hash: A4CE23847
0234ABED4		Hash: A4CE23847		Hash: F23847DE8

A diagram of a traditional blockchain network

To Buy Property:

What type of property are you searching for?

☐ House
☐ Apartment
☐ Other

Location:

eg. Colombo 1

Size:

eg. 10 perches

Price Range: (Below is the outline for a price slider [price range to be determined based on answer choices])

_____

Real estate agent name:

Drop-down list of all real estate agents registered on the blockchain network

SUBMIT

After filling out property criteria users are redirected to this page, designed by the real estate agent they specify

List of properties continue this way ⟶

Property 1 (that fits criteria specified by user)

1. Name/Address
2. GPS Coordinates
3. Photographs of property
   + Other information

Property 2 (that fits criteria specified by user)

1. Name/Address
2. GPS Coordinates
3. Photographs of property
   + Other information

Property 3 (that fits criteria specified by user)

1. Name/Address
2. GPS Coordinates
3. Photographs of property
   + Other information

After user clicks on property

Real Estate Agent can place further information on user-selected property here

Click box to enter secure chat room with realtor for information on property and negotiation on price. Chat room is protected by white-hat hackers/firewalls

Select this box to purchase property

Purchase Property

Property Coordinates

Price in Sri Lankan Rupee decided on by both parties

Seller's Bank Details	Buyer's Bank Details	

Seller's Signature	Buyer's Signature	Notary's Signature
		(Can be automatically generated after title and bank details are scanned + any other duties are completed)

Seller 'Authorise Transaction' Button	Buyer 'Authorise Transaction' Button	Notary 'Authorise Transaction' Button

ONCE ALL 'Authorise Transaction' BUTTONS ARE SELECTED, THE MONEY WILL BE TRANSFERRED (PROGRAMMED BY A SMART CONTRACT) AND THE NEW OWNER WILL GAIN ACCESS TO THE PRIVATE BLOCKCHAIN OF THEIR NEW PROPERTY

IV. Putting it into Practice

The following section addresses how the blockchain-based system will integrate into modern Sri Lankan society. Common questions, problems, and aspects of the blockchain-based system, which will directly impact certain social groups organized in it, are addressed in this section. Sri Lankan society is extremely adaptable to new technology (Dunham & Jayasuriya, 2000). However, Sri Lanka needs to educate and train people who will interact daily with the network and the public (Kshetri & Rogers, n.d.). The system relies on the public's input; if they cannot interact with the system, it will render the blockchain system useless. Another issue that arises, especially in Sri Lanka, is the need to integrate informal tilting. Since few write wills (which have been approved by the government), the blockchain system must have a way to decide who legally owns the asset. Finally, the displacement of workers is addressed in this section.

The Port-City Proposal

Georgia, a country that implemented its blockchain-based solution for property, began by using "Zones for Employment and Economic Development or ZEDEs' (Shang & Price, 2019). These ZEDEs were attractive for the blockchain-based system because they were new. Land titles in these areas had not entered the traditional land records system and could be easily digitized (Shang & Price, 2019). The government did not have to digitize paper documents. This gave the Georgian government an easier start; it was a way to implement the blockchain-based solution quickly before the rest of the country's documents were digitized (Shang & Price, 2019). Sri Lanka has recently (2018) finished building the land for the "Colombo International Financial City," better known as "Port- City" (Pulse, 2018). Port City could serve as the pilot project for the blockchain-based system.

Since the city is not complete and they have constructed negligible infrastructure, the government could hire a private company to create a blockchain-based solution for Port City's property. Port City would be the first area to use the system until the rest of the countries' records were completely digitized and approved (Pulse, 2018).

Building the App and Financing the Network

The same company that has designed the blockchain-based network will design the app. This could be any blockchain company - BitFury has helped governments create blockchains (Chavez-Dreyfuss, 2017); the link to their website is included in section two. LinearSix is another company that excels in creating blockchain-based solutions (Daily News, 2021); it is a Sri Lankan company. One can find their website here- https://www.linearsix.com/.

As for financing, the government or international lenders like the World Bank will pay for the blockchain network. This is likely to be a large sum of money at the beginning. However, after they pay the company to set up the system, it runs on autopilot. The private company will employ the monitors, who were previously employed by the government as notaries (Bashir, 2017). Therefore, the government essentially minimizes all costs after implementing the blockchain-based solution.

It is important to remember that implementing a national blockchain-based system will take years to complete (Bashir, 2017). This is because of the digitalization and clearing of all property titles (Dale, 2021). Since many are non-existent, lost, or corrupted - it will be tough to upload all of them at once. It will be a gradual process. Therefore, we are unsure whether the Sri

Lankan economy would have bounced back or deteriorated further by then (Vos, 2017).

Financing the network may prove to be an issue in the future. There are two ways in which this

can be amended. The first is that once the private company creates this blockchain system, it will

spark exponential economic growth. This should be enough of an incentive for the Sri Lankan

government. In reality, the entire cost of implementing the blockchain system will not be as high

as some say it could be (De Bustis et al., 2018). However, for the sake of argument, let us

assume the cost of a blockchain-based system will be extremely high. The Sri Lankan

government can then rely on foreign aid or support to fund the blockchain-based system - from

international lending organizations such as the International Monetary Fund, The World Bank,

The International Finance Cooperation, or the Asian Development Bank (Vos, 2017).

Training the Users

There are two interfaces with the blockchain system (Shrestha et al., 2020). The first is

the system itself, which will run on a program that can be downloaded off the web. Everyone has

access to this (Wang & Zhang, 2018). One can purchase, sell, or look at a property on this. It

will be made relatively self-explanatory, and the company that sets it up will be required to

create a user manual. The second is the app for purchasing properties on the blockchain network

(Ferrer- Sapena & Sánchez-Pérez, 2019). The app will be available for download on all app

stores. When someone (Mrs Y) purchases land on the blockchain network, a new block will be

added to the private Blockchain, including all of Mrs Y's information and records. It will then

provide Mrs Y with a user ID and a password, which she can enter on the app after they have

downloaded it on her phone, iPad, or other devices. The app will open to an outline sketch of her

land and the GPS coordinates.

Mrs Y cannot access her private Blockchain from the app because it is a security risk if someone steals her phone/iPad. She will access the private Blockchain from the program (the one available for everyone to access). She can use a set of identity document (IDs), face IDs, etc., to enter her private Blockchain from the network, which is well secured (as the private company employed white hat hackers to secure the system).

Integrating Blockchain into Existing Titling Practices

The following people will interact with the blockchain system more than others. A real estate agent's job will be easier than having a designated page for just the properties they are listing (Shang & Price, 2019). If one wants to purchase or sell a house from or through a real estate agent, their contact details would be available on their page on the blockchain network. The realtor can find the best house for their client by looking through the entire blockchain network, or the client can choose a property from the properties that the realtor is already selling (uploaded to the realtor's page on the network). They can use a secure chat room to organize a visit to the house and negotiate a price between the seller and buyer. When the decision is final to sell or purchase, they can make a secure crypto (or currency of that specific country) transaction (Shang & Price, 2019). The realtor will receive a portion of the proceeds of that transaction. This also removes corruption, as realtors cannot take more than promised. In addition, the salesperson cannot pay the realtor less than what they were initially promised, as every promise is recorded in the secure chat. However, it is essential to educate all those who interact with the blockchain system on how to use it, as one cannot expect them to learn independently (Wang & Zhang, 2018).

Either the government or the private company contracted to set up the blockchain-based solution will do this. It is important to remember that one's property's price will be available to whomever they want it to be available to. If someone is not interested in selling their property, their property price will not be visible on the blockchain server. If needed, their property price will only be accessible to people interested in purchasing the property (price on request).

For law enforcers, blockchain makes their jobs easier (Aidt et al., 2008). After one stores his/her/their data inside a blockchain, it is now more or less impossible to steal or lose. If someone tries to tamper with data stored in a blockchain, the hash will change; it will not match the previous hash (Carson et al., 2018). Therefore, that block is isolated, meaning that law enforcers only need to focus on that private Blockchain. This helps to pinpoint where the attempted hack was. This means that law enforcers have an extra clue - using blockchain to reduce criminal activity. In addition, the government reserves the right to look through the private blockchain; law enforcers will have access to all data and not need to waste time searching for misplaced paper documents. (Carson et al., 2018). Note that the government will also hold duplicates of all land titles in paper form which may be stored in their database/ ministry. Blockchain will assist lawyers in their jobs, as all documents will be in one place and easily accessible (Muve Media & Marketing, 2020).

As for notaries, hundreds of thousands of notaries work in the property rights department (Ampratwum, 2018). Multiple departments house these notaries who are constantly approving these property transactions. These notaries will be transferred to the blockchain system. They will act as monitors. Fewer notaries will be needed if all their work is transferred to a virtual platform. However, it is important to remember that many more people will have access to their property rights (Wang & Zhang, 2018). Therefore, many more will need to interact with the blockchain-

based system for property rights. This is because more people would be on the server. This increase means that more notaries will be needed, ensuring few get laid off. The government or private companies will also train notaries on using the blockchain system (Muve Media & Marketing, 2020). Monitors on the system are incentivised to validate transactions as they receive a percentage of the transaction fee on top of their salary.

The point of a blockchain-based system for property rights, especially in developing countries, is to make the process easier (Chigbu et al., 2017). This is because, as stated before, it is extremely inefficient in developing countries like Sri Lanka. The inefficiency of the similar public registry system in India, a neighbouring developing country, is shown in Figure 3.

Integrating Informal Titling

If someone has been given property through oral agreement, they will go through the proper legal means to retrieve it (Benjaminsen & Sjaastad, 2002). This is extremely common in Sri Lanka, as few Sri Lankans write wills. There are two options regarding wills. The first is that the will is written while the person is still alive; if all lawyers have approved it, the will documents will be added to the private Blockchain, and the property proceeds to pass onto the legal inheritor (Dunham & Jayasuriya, 2000). It will be a smooth transaction. If no will has been written, the child must use proper legal methods to retrieve the property (Benjaminsen & Sjaastad, 2002). When the court ruled that the property belongs to the next of kin, a new block will be added to the private Blockchain with this data (De Bustis et al., 2018).

Another issue is that many people's personal property titles are stored with their lawyers. Regarding family property, once the lawyer has died, the person who is to inherit the property must go through a tedious legal process to retrieve their property titles (Benjaminsen & Sjaastad, 2002). This can take almost a year. With a blockchain-based system, the property titles will transfer instantly if the person is deemed the legal inheritor, as the will document would have

been stored in the private blockchain server (Kshetri & Rogers, n.d.). If someone does not have their land title, as in their title never existed, as is the case with a percentage of Sri Lankans, this will highlight the issue for the government. During the process of digitisation, the government will survey all Sri Lankan property and can thus identify people who live on land they do not have rights to. The government can then take legal action against them and if required evict them. The government can also take the more humane method of relocating them to temporary public housing. Identifying squatters and unauthorised occupants (Squatters and Unauthorised Occupants. (n.d.). Retrieved from https://www.nidirect.gov.uk/articles/squatters-and unauthorised-occupants) is necessary for a state, and a blockchain-based solution will highlight this issue for the government to address.

Managing the Displacement of Workers

Some will be moved to other government sectors; some will remain in the decentralized public registries or work on the blockchain-based system (O'Leary et al., 2017). In the blockchain-based system, they will act as monitors and be provided with sufficient training. In the decentralized public registries, their jobs will not change from what they used to be (Vos, 2017). Although they may have a new boss, the government will ensure that they are being paid the same salary as they were being paid before the blockchain-based system (Vos, 2017). The government will pay them their compensation and incentivize them to learn how to monitor the blockchain network because each time a blockchain transaction is made, the seller is charged a monitor fee, which goes directly to the monitors (Ferrer-Sapena & Sánchez-Pérez, 2019). This is a bonus income for the monitor, along with their original salary. The paper previously stated that notaries in the Registrar General's Department are prone to be bribed; thus, one would assume that someone can still bribe them after becoming monitors (Ampratwum,2008)

It is important to note that monitors cannot change data (Bashir, 2017). In addition, the government must conduct background checks on all monitors. The monitors are now being monitored by the public. Thus, they cannot engage in illegal activity.

Blockchain and its interaction with Banks

Blockchain will primarily interact with banks in two ways:

1. Circle Rate: For example, if someone illegally lists their property for 60% of its value and requests the remaining 40% be transferred via cash. This is impossible on the blockchain network because Blockchain provides easier access to circle rates around Sri Lanka (Benjaminsen & Sjaastad, 2002). Since the blockchain system is monitored by white hat hackers, monitors, the government, and the public, they will be aware of general property prices in a certain area (Benjaminsen & Sjaastad, 2002). For example, the Circle Rate in Angoda is approximately $7,000 per perch. If one is to sell their 15 perch property for $50,000 when it should be close to $100,000, this will raise a red flag on the blockchain network, which the government will then attend to, and legal action may be taken. Once again, Blockchain provides this information and raises this red flag for the government - the evidence can be used in court. What the government decides to do with this information is not under the control of the blockchain network (Estrin & Pelletier, 2018). Circle Rate is also extremely important for bankers (Gupta, 2017). It is usually a difficult calculation as there are many variables and little data, especially in the developing countries like Sri Lanka. Blockchain will provide average property prices and values in areas and will, as a result, be able to generate a close to accurate Circle Rate (Gupta, 2017). This can help banks give out loans to people who want to borrow against their land.

2. Mortgages and Loans: Since there will be a significant increase in the number of people who have access to their property titles, more people will request to borrow against their property titles (Gurara et al., 2018). Hence, banks will need to give out more loans due to implementing a blockchain-based system. Giving out a loan is easier for banks, as all the data required is digital and stored on the blockchain server and can be accessed with the click of a button (Carson et al., 2018). They can also verify user identity using the identification documents stored on the system. The person asking for a loan must allow access to this part of their private blockchain (identification documents) for banks to confirm their identity, allowing for a safe and smooth transaction.

The Bim Saviya and e-Land Act

The Bim Saviya Act makes the blockchain-based method easier to implement in Sri Lanka. The Act provides people who own property with an e-certificate (Gunasekera & Dedigama, 2016). This e-certificate means that their property is now digitized. However, this process has not reached the whole island yet. Since many have already digitized their land (Maes, 2013), all left is being cleared of corruption. Since they still digitize it on the government database, this is essential, as just because they digitized it, it does not mean it is not corrupted; the data is still centralized. It is important to note that this gives Sri Lanka an advantage in the

blockchain-based system, as the whole process will now take even less time (De Bustis, Vidhya, & Ganaka, 2018). Blockchain solution criticizers say the main issue with Blockchain is the sheer time to set up. However, this time is reduced in Sri Lanka's case (Maes, 2013). After they have cleared some digitized records of corruption, they can send them to a private company to be implemented on the blockchain-based network (De Bustis et al., 2018).

The process is as follows (Gunasekera & Dedigama, 2016):

1. Digitise the land record (using the Bim Saviya program).

2. Clear it of corruption, tampering, and general mistakes (wrong entry of data) - done by the private company and international organizations (e.g. International Foreign Corporation, World Bank, or Asian Development Bank)

3. The government stores this clean land record in its database.

4. Once the outline for the blockchain-based network is set up by the private company, it will send the data to them and delete the same from government servers.

5. The private company will upload it to the blockchain network.

This is further helped through the e-Land act, which addresses the "utilization of Land as a tool for generating capital." The e-Land act ensures Sri Lankan citizens have easier access to their "property titles, land registers, registration information, and facilitates the development of pedigree information with the safety of documents, and provides a speedy and, more convenient, and economical service to the public and other government organizations (Gunasekera &

Dedigama, 2016)." The government says, "Elevating the position of Sri Lanka in the doing business indicator by improving access to land registration information is also an important aim of this program (World Bank Group, 2022). On average, registering property in Sri Lanka takes approximately 40 days (Dunham & Jayasuriya, 2000). These statistics are for 2020. Georgia, in 2020, achieved a ranking of 5 (on the registering property section of the doing business indicator). On average, it takes one day to register a property in Georgia (Shang & Price, 2019). As discussed earlier in the paper, they have implemented a blockchain-based solution for property rights.

Sri Lanka, using these acts, has the potential to reach this ranking with the assistance of Blockchain. A difference between the E-Land/Bim Saviya Acts and a blockchain-based system is, naturally, the decentralization of the blockchain-based system (Gunasekera & Dedigama, 2016). Still, another difference is the role of the Registrar General's Department. These acts are mainly for storage and uncomplicated access, not to be used to purchase property through. One cannot purchase property through the Bim Saviya or e-Land Act (Gunasekera & Dedigama, 2016). The acts do not make transaction history accessible to the public, nor are they monitored by the people. One must examine the traditional paper system to register property; only then are the records digitized. This means that stamp duty corruption and all other forms of corruption are still possible (Ampratwum, 2008), as the government solely managed it. Inefficiency still exists, as paper records are still used.

Sri Lanka has also created an online system to receive deeds and extracts. People can now access their land records virtually, which is a significant step toward a successful blockchain based solution for property rights in the country.

This period of implementation could be far shorter in Sri Lanka's case because of the Bim Saviya and eLand Acts.

V. Limitations

The Romans defined property as 'the right to use and abuse one's own within the limits of the law.' India, a developing country that could benefit tremendously from a blockchain-based solution for property rights, stated that property rights are a set of rights that the constitution should promise. Governments have traditionally regarded property rights as fundamental rights. As a result, resistance in Sri Lanka to finding a solution to give everyone their property rights is unlikely. However, we must first understand what property is to enforce property rights. The Oxford Dictionary defines property as a thing or things owned by somebody; a possession or possessions.' Indeed, they are right. Property is an asset; it is owned by a person, a few people, the public, or the government.

After defining what property is, the question arises when discussing how to implement a blockchain-based solution. This is because the government may reject it for two reasons. The first is the fear of technology and blockchain, especially after the recent cryptocurrency crash. This can be processed by outlining the positives (economic rejuvenation) and using examples like Georgia (explained in Section 1). Addressing general scepticism, in light of the recent FTX Trading Ltd. scandal and cryptocurrency crash, by implementing educational programs for the public on the difference between blockchain and cryptocurrency is essential in making the adoption process smoother. The second is corruption. Since the blockchain-based system will remove corruption and provide people with a fundamental right, it will likely be supported by the vast majority of the population. Citizens can put public pressure on corrupt officials who refuse to accept the blockchain-based solution. Social media is the voice of the public. Social media is the tool to achieve this.

The recent anti-Rajapaksa protests have shown the power of the people, and this patriotic energy can be channelled to fuel protests demanding blockchain implementation. The digitisation process has exposed fundamental flaws in the land registry as some Sri Lankans have realised that the registry has lost their land title - the public is desperate for land registry modernisation and will likely push for reform.

The following section answers common questions and misconceptions relating to the blockchain-based system. The limitations include understanding blockchains legal status, how the system interacts with organized crime networks and tax evasion, regulation, the fear of debt, validity, the IT and Registrar Generals Department Development, internet penetration in Sri Lanka, and the role of the government.

The section also attempts to answer misconceptions about crime and tax evasion on the blockchain network. Finally, the section addresses the economic aspect of the blockchain-based system, such as a free market with no government intervention. The section also mentions limitations and their solutions, such as the Sri Lankan IT sector.

Blockchain's Legal Status

After the government accepts Blockchain to solve the property rights crisis, the next issue is how Blockchain interacts with the law. A common misconception is that blockchain solutions have many legal obstacles (DLA Piper, 2017). However, this is far from the truth. Although it is decentralized, the government reserves the right to look at any private blockchains (DLA Piper, 2017). Therefore, any illegal activity is detected. Privacy laws are also taken care of as all data is protected. Everyone can see hash keys (to ensure that no illegal activity occurs); however, as stated before, no one can see data inside a private blockchain (other than the government, the asset owner, monitors and white hat hackers).

It is important to remember that a blockchain based solution is to store information efficiently (Bashir, 2017).

For Blockchain to be implemented in Sri Lanka, the government must pass certain laws to give the decentralized platform and decentralized public registry legal standing (De Bustis, Vidhya, & Ganaka, 2018). In addition, they must pass certain laws to make the existing systems inapplicable.

A common misconception made is that certain countries are "against" Blockchain. Countries like China have banned bitcoin (Quiroz-Gutierrez, 2022), not Blockchain. Blockchain will work in China because they can make transactions through two routes: cryptocurrency or the currency of that specific country (Ekman, 2021). As more and more countries create their digital currency, they can use these instead of traditional cryptocurrencies like Ethereum (Hazem & Rosana, 2020). For example, people can use the digital renminbi (e-RMB) currency on the Blockchain in China. An issue brought up by many experts that relate to this is that countries like Venezuela use bitcoin to avoid hyperinflation because of US sanctions (Martin, 2021). The issue that many still cannot understand is that Blockchain and bitcoin are not the same (Frankenfield, 2022). The Sri Lankan government has imposed no restrictions on holding bitcoin in Sri Lanka. The public is now notified that Central Bank of Sri Lanka (CBSL) has not given license or authorization to any entity or company to operate schemes involving virtual currencies, including cryptocurrencies, and has allowed no Initial Coin Offerings (ICOs) (Helms, 2021). Therefore, the Sri Lankan government has two options to run the software: create a digital rupee or use any cryptocurrency (Bitcoin, Ethereum, etc.)

Crime

Many assume that, since blockchain operations are decentralized, they are easier for criminals to operate and infiltrate (Hazem & Rosana, 2020). However, the opposite is true. Firstly, corruption has plagued many developing countries' governments (Aidt et al., 2008). Since the government still has access to all private blockchains, if corrupt government officials attempt to hack the blockchain system, this will be seen by all monitors and the public. The private company that sets up the blockchain server has no control over the system. They set up the system but cannot change anything without government and public approval; thus, they cannot engage in illegal activities (Hazem & Rosana, 2020). In addition, the public, the government, white-hat hackers, and monitors will closely monitor them. People do not log into the blockchain system in incognito mode. White hat hackers who regulate the network can discover who is sitting behind the computer screen (Aidt et al., 2008). They then share that information with law enforcers. This also applies to rules for property rights, such as whether a foreigner can purchase land. Large criminal organizations also have no incentive to use the system, as there is insufficient money. Large criminal organizations cannot transfer hundreds of millions of dollars on the network without notifying white hat hackers, monitors, and, subsequently, law enforcers. The government can monitor private blockchains, which means they can address those concerns. The Registrar General's Department may worry that a user may misuse the blockchain system (hacking, fraud, etc.) They will cease any attempt to misuse the blockchain system by:

1. Multiple firewalls of defence.

2. Multiple monitors.

3. Law enforcers (as the government reserves the right to monitor private blockchains).

Regulation

In addition, another fear is that when an asset is placed on the blockchain network, it becomes a free market with no bounds and restrictions (Benjaminsen & Sjaastad, 2002). People fear that prices can surge and fall immediately. However, the government will have the right to control property prices to a certain extent, as they would in the current market.

Fear of debt

Many Sri Lankans are extremely scared of debt (Boucher et al., 2008). Partially because they have dealt with extreme poverty before or the stigma attached to being 'in debt." This is a major issue, as it means a reluctance to take risks and take a loan. Taking loans was essentially one of the advantages of the proposed blockchain-based solution for property rights (Carson et al., 2018). There is no solution to curing debt fear. The only possible solution is a long-term plan to, over many years, erase the stigma. This will come after more and more people take risks and loans against their property. The majority will be able to repay the loan (Boucher et al., 2008). This will give the impression that there is no issue in taking loans. However, the challenge comes in convincing the first few to start to take loans against their property. One may propose the

Ghanaian solution: to give people rewards every time they correctly enter information into the

blockchain system (Bugri, 2013). This will firstly give people an incentive to use the system

properly and incentivize them to take loans. Another action government can take is to provide

compensation for those whose investments (from the loan) go south. This is a short-term

solution; however, if the government can ensure enough loans and assure enough people that

they will not lose their property, people will start to take loans even without government

assurance - because they will see that even though some people had guaranteed compensation,

they did not go bankrupt and require it. Instead, their loans helped them to expand their

business.

Tax Evasion

Blockchain can also prevent tax evasion and hidden property (Dunham & Jayasuriya,

2000). Firstly, all records uploaded to the blockchain network must be deemed legal by the

government - and therefore will be inspected. Secondly, even if they turn out to be illegal property,

where untaxed money is being stored, the government and monitors still have access to it. They

can still see all transactions and the property's location, making it impossible for people not to pay

property tax. One may claim that one can misuse the blockchain system easily for their gain

through corrupt methods (Dunham & Jayasuriya, 2000). This is solved using Circle Rate,

discussed earlier in the paper under the "Blockchain and its interaction with Banks section under

the 'Putting it into practice section.'"

Validity

The validity of the blockchain system is also questioned, especially concerning property

rights. However, the system is in fact completely valid. Multiple monitors must approve

transactions when purchasing from a person or the government on a blockchain network. If it is approved, the transaction will be registered on the Blockchain server. Additionally, the government will be sent information so they know who lives where and owns what. If the government deems this transaction illegitimate, they reserve the right to intervene.

The IT Sector's development

An issue with implementing a blockchain-based property rights system is the information technology (IT) sector's readiness to handle the technology. The solution to this issue is simple. The first is an investment in the IT sector. As the world's technology advances tremendously, developing countries are bound to be left behind (Ferrer-Sapena & Sánchez-Pérez, 2019). A blockchain system will expose the weaknesses in the IT sector. Once this weakness is exposed, the IT sector in Sri Lanka will receive proper funding (from foreign countries or international lenders), and the new blockchain-based system for property rights will work smoothly. Private individuals in developed countries with IT experience may also be willing to help develop the IT sector in Sri Lanka to adapt to the Blockchain network. This will be especially useful at the beginning of the project until the Sri Lankan IT sector has completely developed. The IT sector is one sector that can be remotely developed since it is virtual. Sri Lanka ranked 85th out of 193 countries on the United Nation (UN) e-Government Development Index. Sri Lanka demonstrates promise in the E-Participation Index, ranking in the top 33% globally, with plans to establish a robust and modern Digital Economy by 2024, as demonstrated in Figure 4. This shows promise for a nation of only twenty-two million people, which shows the Sri Lankan IT sector is ready to upgrade to a sector that will be able to handle a blockchain-based solution.

FIGURE 4: SRI LANKA'S DIGITAL ECONOMY MILESTONES ("INDUSTRY DEVELOPMENT." INFORMATION AND COMMUNICATION TECHNOLOGY AGENCY OF SRI LANKA, ICTA, ICTA.LK/ INDUSTRY-DEVELOPMENT/.)

The Registrar General's Department's Development

After the blockchain-based solution is approved and in action, the Registrar General's Department's role is to authorize all transactions (notaries/monitors) and monitor the platform (Kshetri & Rogers, n.d.). The decentralized public registry will employ a significant proportion, and the rest will be trained to work on the platform as monitors.

According to Registrar General's Department members, many office members cannot use a computer, let alone manage a blockchain-based solution for property rights. The Registrar General's Department is unaware:

a)   That the blockchain system runs on autopilot most of the time.

b)   Any technical difficulties will be managed by the private company, not
the government.

This is to maintain decentralization.

c)   The private company will, along with educating the public on how to use the system, educate those who interact with the blockchain system daily. Therefore, the lack of technological expertise in the Registrar General's Department is addressed. Those who interact with the system (will be trained to do so). This is ensured as there's a clear incentive for government and private companies to protect the data in the network. If people are not trained in using the system, this could cause malfunctions, leading to data being compromised (Mougayar, 2016).

Internet Penetration in Sri Lanka

According to the Data Reportal, Sri Lanka's internet penetration by 2022 was 52.6% (11.34 million users). We can expect this number to double in a decade because, using previous data, we see an upwards trend in internet penetration. From 2016 to 2017, internet penetration in Sri Lanka doubled from 16% to 34%. Using this data, one can only assume this will continue to increase further. It is important to remember that if one does not have access to the internet, they can still use the decentralized public registry (which uses land records) to store their property deeds. Implementing the blockchain-based system will take a few years (De Bustis et al., 2018). By the time it is completely developed, the Sri Lankan IT sector will have improved along with its internet penetration. Sri Lanka will be ready for a blockchain-based solution for property rights.

The Sri Lankan government's willingness to implement Blockchain

On July 7th, 2020, the Central Bank of Sri Lanka decided to implement 'Blockchain Technology-Based Shared Know-Your-Customer (KYC) proofs of concept (POCs).' The Sri Lankan government recently announced the formation of a committee to supervise all Blockchain and cryptocurrency-related activity in Sri Lanka (De Bustis et al., 2018). These events show that the government is not opposed to a blockchain-based solution, nor are they unfamiliar with it, which is a major success in advancing a blockchain-based solution for property rights in Sri Lanka. However, an advantage of the blockchain solution is that it is corruption-proof. As a result, corrupt politicians are likely to oppose this change. In the case of this event, the private company must first reach out to international lenders to fund and support the project. The private company must also reach out to international lenders if the government cannot afford to fund the project. Historically, international lenders like the World Bank have been pro-tech and have funded tech startups, and since this project alleviates poverty, they are bound to support it. With the World Bank's support, implementing the blockchain-based solution is easier. The private company must also educate the public on the advantages of a blockchain based solution for property rights, and why the corrupt government refuses to authorise it. As seen with the recent anti-Rajapaksa protests, the public is ready to come out in large numbers to fight against corruption and thus will protest in support of the blockchain solution. However, the government is likely to approve this project due to one of its advantages - poverty alleviation leading to economic rejuvenation. Due to the economic crisis in the country, this sole advantage is enough incentive for the majority of the government to back the project. The private company

is likely going to need a face for the project in the form of a politician (backed by the World Bank if necessary) to help push the project into parliament for approval and to win the support of the public.

The Trilemma

Blockchain has traditionally faced a trilemma where one of the three must be sacrificed for the system to function effectively - decentralisation, scale, and security. For this project, the private company must prioritise scale and security and then decentralisation. The project must be secure as classified and important documents are stored on the server (a potential 22 million land titles and birth certificates). The project must have the scale to potentially accommodate 22 million users. The project maintains decentralisation in every aspect except one: the government still holds duplicates of all land titles in paper form and has access to all private blockchains for legal reasons (to manage criminal activity).

VI. Conclusion

A blockchain-based solution for property rights in Sri Lanka is a complicated one. It requires government approval, public understanding, and the digitalization of multiple property titles. After the decentralized blockchain system is implemented, there is a decrease in corruption, and an increase in reliability, accountability, efficiency, and security (Shuyun et al., 2020), along with the rejuvenation of a stagnant Sri Lankan economy.

Corruption is minimized due to protected data. Data is protected through multiple programs generated by white hat hackers, who design the blockchain-based system. The second

line of defence is the monitors. Even if the blockchain system is penetrated by corrupt officials, business people, or criminals, it detects changes in its chains. These alert the monitors, who can then report it to law enforcers.

The inefficiency of the public land registry will be avoided, as no paper documents will exist, apart from the land titles stored in the decentralized public registry. The blockchain-based solution will provide an accessible method for Sri Lankans to access the value of their property, the dimensions of their property, the loans they can take against their property, and most importantly, their property titles.

The Sri Lankan economy could benefit from a blockchain-based solution because the ability to use one's property as capital comes through a blockchain-based solution. Hernando De Soto defines capital as anything that can generate wealth. Sri Lankans, using a blockchain-based solution, which gives them access to their property, can take loans against their property, releasing many citizens from a serious issue - which is the lack of an asset to fall back on. If one can consider their immobile asset - their property - as an asset against which they can take a loan, they will be far more likely to take risks. These risks assist the overall Sri Lankan economy.

In this paper, a hybrid block chain-based solution for property rights in Sri Lanka is proposed. A hybrid blockchain-based solution is a blockchain with both private and public blockchains. A public blockchain is accessible to everyone, and a private blockchain is accessible to the owner of that particular asset.

It is important to remember that the Sri Lankan government reserves the right to intervene in blockchain-based solutions to a certain extent. They can view everything on the server, public and private blockchains.

However, they cannot alter information on the server; they can only view information. They cannot change information on the blockchain network either.

This is the solution to the lack of property rights in Sri Lanka, using a hybrid blockchain based solution to solve the crisis.

Abbreviations:
- TV- Television
- GDP- Gross domestic product
- US- United States
- SHA- Secure Hash Algorithm
- GPS- Global Positioning System
- P2P-Peer-to-peer
- NFT- Non-Fungible Tokens
- ZEDE- Zones for Employment and Economic Development
- ID- Identity Document
- e-RMB- Digital renminbi
- CBSL- Central Bank of Sri Lanka
- ICO's- Initial Coin Offerings
- IT-Information technology
- UN- United Nation
- KYC-Know-Your-Customer
- POC's- proofs of concept
- ICTA- Information and Communication Technology Agency
- ICTA.LK-Information and Communication Technology Agency of Sri Lanka

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