Land Administration and Blockchain Technology

Subjects: Geology
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Transparency of processes is very crucial across all institutions. In land administration processes, this is particularly important given the multi-stakeholder involvement. This paper argues that transparency of land administration processes involves carrying out and sharing up-to-date information on ownership, value, and the use of land and all of its associated resources among related institutions, right holders and other stakeholders, including third parties, as well as, acting on the information in an open manner. To achieve this in Ghana, blockchain technology has been identified as a complementary tool to the Ghanaian land administration system. Blockchain technology refers to a fully distributed crypto-graphical system that captures and stores a consistent, immutable and linear event log of the transactions between networked actors. The study identifies that given the potentials of blockchain technology which include; decentralization of transaction to all connected stakeholders, the immutability of records, hashing of records that allows for quick access to both historical and current land transactions' data, as well as the blockchain smart contract among others, land administration processes of land tenure, land valuation, land use planning, and land development will benefit from openness, and transparency, and human error elimination. It will also eliminate fraud, and double sales of land among other land challenges identified in the Ghanaian land sector. The study proposes that for real-time land up-date in land information across all the land sector divisions; land valuation division, land title registration, survey and mapping division, and the public and vested land management division, a permisionless public blockchain architecture be adopted for the Ghanaian land system. This is because, in comparison to the other blockchain architecture types, the permisionless public blockchain allows more transparency, decentralization, openness, integration, and also adheres to privacy and data protection laws.

This study and its results are particularly important not only to the Ghanaian land sector and its stakeholders, but to all other land administration systems in the sub-Saharan Africa region given the similarities in land administration across the region. In the Ghanaian context however, the study's findings if implemented will affect the institutional relations and shared authorities between all stakeholders which include government agencies, local chiefs and individual landowners. This is because, land decisions and land data will not become shared responsibility of all stakeholders and not dependent on just some few stakeholders.

A successful implementation of blockchain in Ghana's land administration will however depend on negotiations and consensus amongst the different land stakeholder, education of all stakeholders on the technology, and its impacts, as well as standardization in the land administration processes across the different land divisions. This is because, where there is no such standardization, there is a high possibility of inconsistencies and irregularities in the processes which can affect the efficient working of the blockchain system.

Ghana, Land administration, Blockchain technology

1. Introduction

Land administration involves 'the process of determining, recording and disseminating information about the relationship between people and land' [1] (p. 2), [2]. UNECE defined it as involving the recording and dissemination of information about ownership, value and the use of land, as well as the associated resources, while implementing the land management policies [3]. This relationship between people and land, and the functions performed with regard to ownership, value and the use of land require transparency. The transparency of land administration depicts the situation where land transactions and services are carried out in openness, and with maximum participation by all the concerned stakeholders [4]. Transparency allows for land tenure security [4][5][6][7][8]. Land administration transparency enables landowners and prospective purchasers to know the exact status of their land rights and interests, as well as the relation that they have with other individuals concerning pieces of land. This enhances peoples' confidence to invest in land which improves economic conditions [9]. Transparency is noted as one of the key principles for good land governance [10]. A good governance in land administration is beneficial to societies in diverse ways as it ensures:

'*Pro-poor support: rule of law is equal to all, and citizen has protected rights, Public confidence: greater public confidence, Economic growth: security of the land tenure and regulated transaction cost and taxation, Protection of state assets: legitimate use of state land for social and economic concessions, More effective and efficient public administration of land: formal market and reliable system, more revenue sharing for public services, Conflict prevention and resolution: equity, justice, and social stability'* [9] (p. 13).

Nevertheless, land administration across the world lacks transparency and is corrupt everywhere [10]. Land administration systems are considered to be among the most corrupt institutions in the world [11]. UN-HABITAT in 2007 observed that land offices in most countries are among the most corrupt institutions [12]. Corruption exists where there is lack of transparency [4]. This lack of transparency in land administration begets numerous land challenges which include; land tenure insecurity, high cost of land transactions due to informal payments, reduced private sector investment in land, less revenue for the state, increased land grabbing by officials, increased land conflicts, landlessness, and inequity in land distribution. These challenges promote social instability, exclusion and political instability through land conflicts, land poorness and landlessness. The situation leads to disregard for the ethics and standards of behavior as land titles, building permits and zoning regulations become no longer trusted by citizens [4][7][8]. These outcomes inhibit the overall development of societies. Most countries, particularly in Africa, face stunted development and impoverishment as land dominates the economy, and provides livelihoods to the majority of the continent's population [13]; thus, the focus of this study is from an African country's perspective. The need for the transparency of land administration has not received the needed attention in years past as [9] notes that the attention to the issue of transparency in land administration and land governance is recent.

In recent years, many studies on ways to enhance the transparency of land administration have shifted attention to the potentials of blockchain technology [11][14][15][16][17]. Blockchain is identified to enhance transparency in land administration processes and or functions though the integration of all land stakeholders, in a way that allows each stakeholder to be aware of, and to be involved in land transactions without intermediaries (land administration processes and functions have been used synonymously and interchangeably in this study). Blockchain helps to improve trust in the system and to enhance the confidence of citizens in the land administration system [17]. It is identified that despite the digitization of land records and diverse web applications, the system for land records management is weighed down by various kinds of errors and inconsistencies as well as a lack of transparency [18], the same problems which blockchain technology potentially eliminates [19]. Countries like Georgia, and Sweden, among others, have piloted blockchain technology to land administration and reported the successful outcomes of improved transparency and enhanced citizens' trust in the land institutions [20]. Several studies on the application of blockchain technology for land registration and land titling exist to show the potential of blockchain technology to improve transparency in these land administration processes [17][20][21][22][23][24][25]. These show the surging interest in blockchain technology in land administration. However, despite the rising interest in the potential of blockchain in land administration [19], there is to date no studies that have holistically assessed the transparency of all the processes of land administration, and how blockchain technology can help improve these. The existing studies mainly focus on land registration, and titling [17][20][21][22][25][26][27][28][29]. These, however, only fall under the land tenure processes and or functions [30]. Other land administration processes—including land value, land use planning, and land development—have not been sufficiently explored, if any, in order to see how blockchain technology can enhance the transparency of these processes and in a simultaneous way. This leaves a research gap. To focus only on land tenure processes and to conclude that blockchain technology enhances the transparency of land administration is to miss the vast land administration processes of land value, land use planning, and land development. This leads to missing the broad concept of land administration transparency. This also presents a challenge to aptly conceptualize blockchain technology and the transparency of land administration, and hence, this study aimed to fulfil this research gap. This study argues that understanding the transparency of land administration and the role of blockchain technology in this regard becomes incomplete if the processes of land administration are not holistically considered. To this end, this study was guided by these objectives:

1. To identify the essential elements and relations between blockchain technology and the transparency of land administration in the existing literature;
2. To assess the potential of blockchain technology to improve the transparency of land administration functions—based on the Ghanaian land administration context.

2. Theoretical Basis of Blockchain Technology and Its Operation

Blockchain technology refers to a fully distributed crypto-graphical system that captures and stores a consistent, immutable and linear event log of the transactions between networked actors [31]. Blockchain technology allows for managing the records of transactions without a central server or authority [28]. Through this network, which is made of computers (for stakeholders) that operate on a blockchain system to execute transactions and are termed as

'Nodes', blockchain technology works, based on what is technically referred to as *'Blocks and Hashes'*. In blockchain's operation, transaction data are stored in digital containers called 'blocks'. The first block created is termed as the genesis block [32], and each block after it is created is linked to a parent block (the preceding block) through unique digital fingerprints termed as 'hashes' [14]. This is shown after Figure 1. The hashes are time-stamped in a header at the top of each block of information to give certainty on the order of transactions' creation. After creating a transaction, and before it is accepted onto the blockchain system, the majority of the nodes will have to verify and validate that it is accurate and authentic as exists in reality on the ground. This verification and validation process is done through a system termed as 'consensus mechanism' [1]. Once transactions are validated and accepted onto the blockchain system, the information in the blocks becomes immutable and resilient against tampering or falsification. In this way, not even the one that created it can manipulate the data; and, the transaction with its data can be accessed at any time by all stakeholders, which allows for transparency [16][20][33]. As compared to other land transaction management tools like modeling, database management, and workflow management, there are three main arguments for why the blockchain technology is considered a solution with great benefits and possibly no alternative. First, in blockchain land transaction, records, certificates, and digital IDs, cannot be manipulated. Second, there can be no double spending/sales of land since any purported attempt is automatically known to all stakeholders [34], and thirdly, land transaction rules and requirements can be embedded into the blockchain's 'smart contract' application which makes it difficult for anyone to manipulate the process, and it also reduces human error possibilities [16]. Smart contracts are blockchain applications which allow for a pre-programming of a contract by defining all the conditions and requirements, and when parties have met these conditions and requirements, the contract is executed automatically. The blockchain transaction steps are:

1. A node/stakeholder with an account signs digitally and initiates the transaction;
2. A timestamp is added to prove the time of transaction creation;
3. Transaction is broadcasted by decentralization to all other nodes on the network;
4. The transaction is mined (''which involves validation of a set of transactions (block) in the network by means of showing the computational proof of the work done'') [24] (p. 20), by one of the nodes. After this, it is verified and validated as authentic, or declined if it is found otherwise by the majority of the nodes based on a consensus mechanism;
5. The validated transaction is then recorded in a new block and hashed to the previous block to form the chain of blocks as is shown after Figure 1.

Technically, three processes are identified in how a blockchain works. Digital time-stamping, distributed verification, and cryptographic hashing [35]. Figure 1, below, shows the blockchain transaction process, Figure 2 shows the blockchain structure, and Table 1 shows the inherent elements that make the blockchain beneficial to land administration transparency.

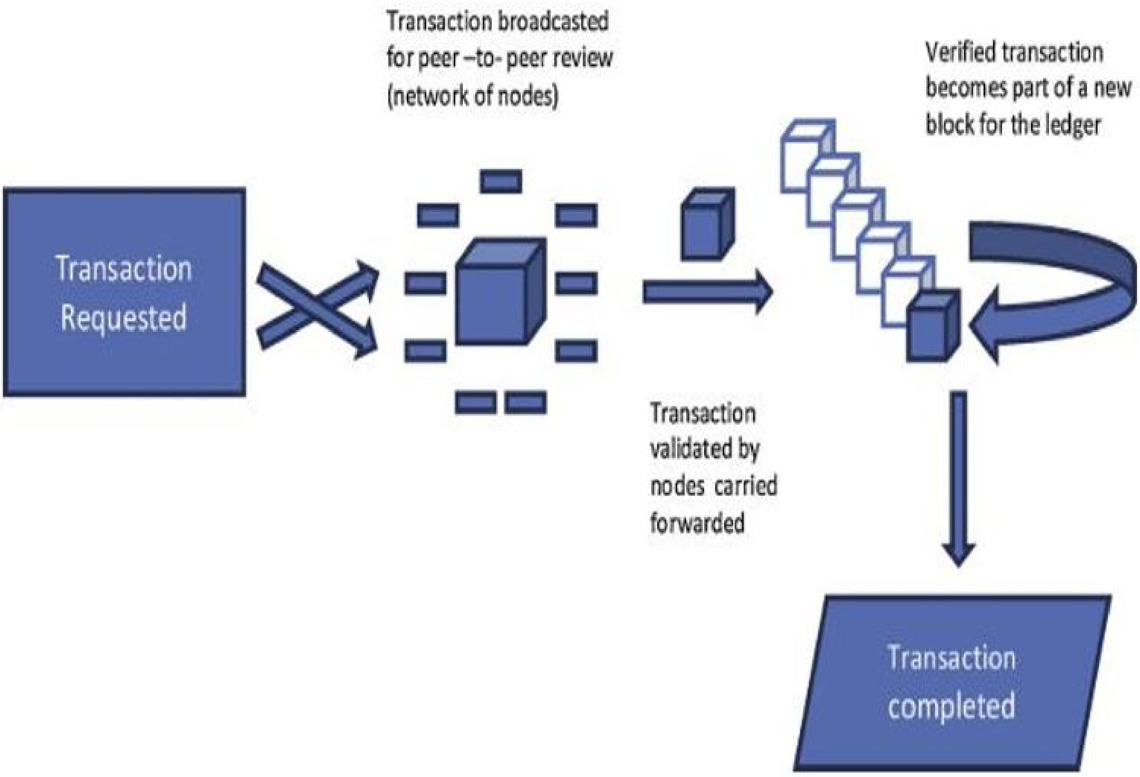

Figure 1. Blockchain transaction process. Source: [23].

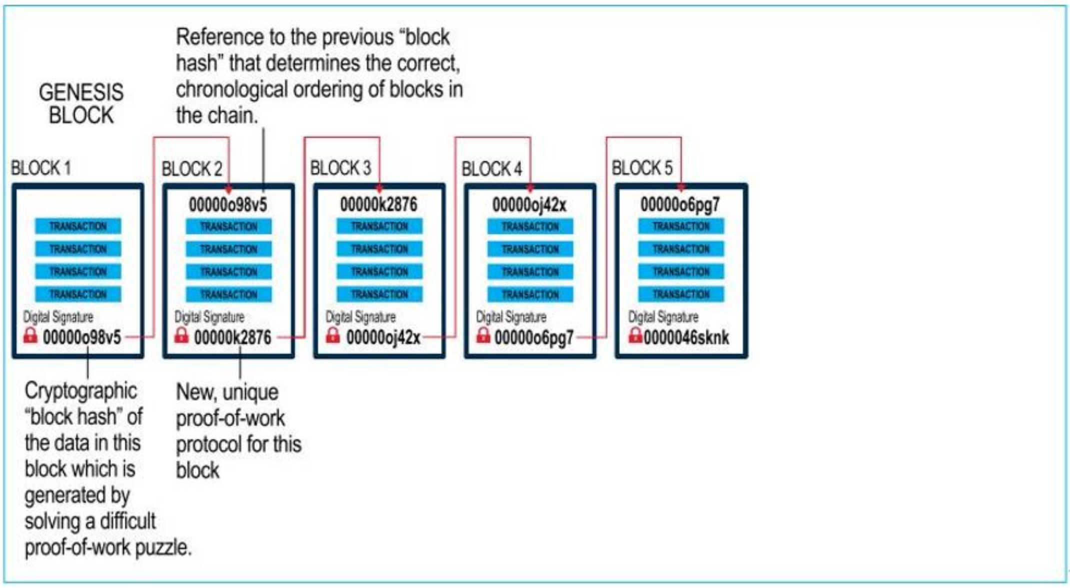

Figure 2. Blockchain structure. Source: [32].

Table 1. Blockchain potentials to land administration Source: authors' construct.

Potential Benefits of Blockchain	Elements that Make It Possible	References

Transparency	**Decentralization** of transactions across all nodes (stakeholders), possibility for evaluating the authenticity of the transaction by all stakeholders, and the access to all transactions and their historical records by all stakeholders.	[10][20][23][28][29]
Eliminating fraud and double sales	**Decentralization**—once a transaction has been completed, all stakeholders have copies and any further action on the transaction is known to the stakeholders. A second attempt to resell the land will be known to all stakeholders and therefore the transaction will not be validated since it has already been sold to another person.	[1][10][11][17]
Enhancing trust	**Immutability and consensus mechanism**—immutability of blockchain coupled with the consensus mechanism by majority stakeholders helps prevent manipulation of land data, as well as misrepresentation of land data in the system.	[1][20][23][26][36]
Establish clear ownership	**Hashing—**the existence and access to the historical facts on the transaction made possible by hashing allows ease in establishing the ownership status as well as all encumbrances.	[17]
Eliminating corruption	**Smart contracts**—land transactions based on and carried out using smart contracts helps to eliminate all forms of corrupt deals since all the procedures involved in the transaction are clear and can be carried out without human intervention thus leaving no room for corruption.	[20]
Eliminates manipulation	**Decentralization and immutability**—due to the distributed copies of transactions available to all nodes; and the difficulty to change blockchain data, any purported unauthorized changes or manipulation will be detected by all the stakeholders and will accordingly be declined or denied.	[10][23]
Easy information access	**Decentralization**—information stored is available to all the nodes at all times. This enhances the ease of access to land transaction information	[20][23][36]

	as there are no intermediaries.	
Data quality, accuracy and integrity	**Consensus mechanism**—the verification and validation process inherent to the system ensures that the information accepted on the blockchain corresponds with reality on the ground. Any inconsistencies, and inaccuracies will lead to the rejection of the transaction.	[23]
Enhances high participation by all stakeholders	**Decentralization**—stakeholders become involved in the transaction at every stage due to the decentralized distribution across all the nodes. This allows all stakeholders to know about the transaction and to partake in it through the consensus mechanism.	[1][23][26][37]
Reduced human error possibilities	**Smart contracts** for land transactions help eliminate human involvement as all required actions necessary for carrying out transactions have been pre-programmed. Once a step is completed, the transaction moves to the next step without human actions until it is completed.	[10]
Security and resilience	**Decentralization and distribution—**due to the decentralized and distributed functionality, data are stored in multiple databases of different stakeholders which are tamper proof, immutable and encrypted. It is thus difficult to hack all the different databases at the same time.	[11][15][24]

The elements of the blockchain identified in Table 1 are reflected in the discussion section on how they help to achieve the transparency of the land administration.

It is important to point out that there are two main architectural categorizations of blockchain technology based on access and use possibilities. These are the public and private blockchain. These are further categorized into permissioned, and permissionless blockchains. The public and private categorizations determine who can access and read from the blockchain ledger, while the permissioned, and permissionless categorization determines who is able to introduce a transaction, and also participate in the consensus mechanism [16][38]. It is therefore important that the right blockchain architecture is selected depending on the purpose of application. Table 2 below shows the accessibility and use possibilities available in the different blockchain architectures.

Table 2. Blockchain architectural categorization Source: adopted from [16].

	Blockchain Architectural Categorizations			
	Public Blockchain		**Private Blockchain**	
	Permissionless	**Permissioned**	**Permissionless**	**Permissioned**
Participants	Anonymous	Identified	Identified	Identified
Data accessibility	Anyone	Anyone	Authorized participants	Authorized participants
Initiating transactions	Anyone	Authorized participants	Authorized participants	Network operator only
Participation in consensus mechanism	Anyone	Authorized participants	Authorized participants	Network operator only
Network types	Decentralized	Partly decentralized	Hybrid	Centralized

Some writers have advocated for the adoption of a private blockchain for land administration, specifically for land registration [36]. However, given the architecture categorizations in Table 2, this study considers a permissionless public blockchain more suitable for a land administration system. This is because, permissioned blockchains invade privacy/data protection policies with or without participants' consent since it allows participants to be automatically identified. Moreover, permissioned blockchains 'lose their decentralized, open nature, and become less transparent and more centralized', [39] (p. 152). These create difficulties in land data accessibility, lead to a lack of trust due to centrality and refute the transparency objective required in land administration. Public permissionless blockchain on the other hand helps to adhere to privacy/data protection policies. The anonymity of participants prevents the breach of privacy policies. In land administration, however, the question of who has what rights and to which land parcel is very critical, and therefore makes it important to be able to know participants' identity. To address this, a public permissionless blockchain has a way to allow participants' identity to be known where required. In [39], the authors noted that, in the public permissionless blockchain, although the users' identity is encrypted and hidden, there exists a possibility that in certain contexts, the identity of the participants can be inferred based on transaction patterns or other markers. This possibility helps to make inferences to participants and their actions whenever the need be, particularly where transactions or actions might appear suspicious. These functional possibilities of the public permissionless blockchain compared with the other architecture types make it more suitable for a public land administration system like the case in Ghana.

Notwithstanding these potentials and possibilities of blockchain enumerated, the technology, like any other technology, has its own flaws and or restrictive factors which must be taken into account before the decision to adopt and implement it. Generally, blockchain is criticized due to its limited storage capacity. Current public blockchains are unable to handle large volumes of land data such as deeds, titles, and maps [40]. This could cause problems in land administration since land transactions and data transactions occur daily. The authors in [17], however, recommend that an external storage for blockchain's smart contracts and documents can be created to support the system—see [17] for further details. Another challenge is scalability. Due to its nascent nature, and storage capacity limitation, there are challenges to scalability of the technology, particularly with increasing volumes of data and workload. This equally affects the speed of the system [39]. Moreover, blockchain technology consumes a huge amount of electricity, and this could be a potential challenge for some developing countries that do not have an equally huge electricity supply. Other adoption considerations of blockchain impede upon technological know-how. Blockchain in land administration is recent and immature [39]. Many land professionals are therefore not conversant with the use of the technology. It is important, therefore, to train professionals prior to blockchain adoption to be able to understand and use the technology. Finally, blockchain operation requires strong computational power and efficiency [41], coupled with strong and stable internet connectivity to be able to perform efficiently. These have to be considered in deciding on blockchain adoption.

3. Summary Overview of Land Administration Processes in Ghana

In assessing the extent to which transparency exists in a land administration system, it is important to know and recognize the differentiations and variations of the land administration processes. It is mainly assumed that the collective degree of transparency of each of the respective processes constitutes the variation of transparency of land administration as a whole. In [42], a land administration system is defined as a formal system that is used to locate and identify a real property, and to keep the records of past and current data regarding the ownership, value and use of that property. This definition is found to be suitable in this study's context as it highlights the different processes of land administration: land tenure, land valuation, land use planning, and land development. Few studies exist on the transparency of land administration in Ghana, and these have somewhat touched upon transparency issues in individual land administration processes of either land tenure, land valuation, land use planning, or land development [43][41][44][45][46]. No single study has concurrently assessed all processes of land administration, and the possibility of achieving a simultaneous transparency in these processes—which leaves a gap where data and research are missing. However, land administration, according to [47], must fulfil land title issuance, land taxation, land transaction registrations, changes in land use, resolving land disputes and handling complaints, and facilitate spatial and land use planning. These processes fall under the four broad land administration processes of land tenure, land value, land use planning, and land development [30]. This study thus argues that achieving a simultaneous transparency in all four main land administration processes has intrinsic and synergistic benefits that outweigh pursuing transparency in the individual processes separately. This is shown in Section 4 which comprehensively discusses the different land administration processes, and blockchain's potential to support and to achieve a simultaneous transparency across these processes.

3.1. Land Tenure Processes

Land tenure processes border on the land registration activities of securing and transferring rights in land and natural resources [48], and also on land information infrastructure. In these processes, [30] notes that land registration by means of land register establishment, creation of accessible land records, land transaction procedures, and the processing of information are the matters of interest. Land registration involves a process of the official recording of rights to land through deeds or titles aimed at supplying legal security to the right holders and potential buyers [49]. The sequence of the land registration process in Ghana is summarized in Figure 3 below. For details, see [50][51][52].

From an actor network theoretical (ANT) view point, Figure 3 below can best be understood not only based on the connection between the different divisions, but also, by the type of communication technology that connects these divisions and their work processes together. ANT helps to analyze the way in which actors (both human and non-human) build and maintain networks [35], for the purpose of achieving a goal. ANT is broadly advocated for in development research works particularly those focusing on technology. This is because, in a practical sense, 'there is ever-greater use of networks of individuals and organizations to deliver development and an ever-greater role for the material (especially technology) in development processes'[35] , p. 38. In the context of this study therefore, ANT theory gives a sound theoretical basis for understanding the different land administration processes, performed by the different land divisions, and stakeholders, and the role of blockchain technology in this relation towards achieving land administration transparency.

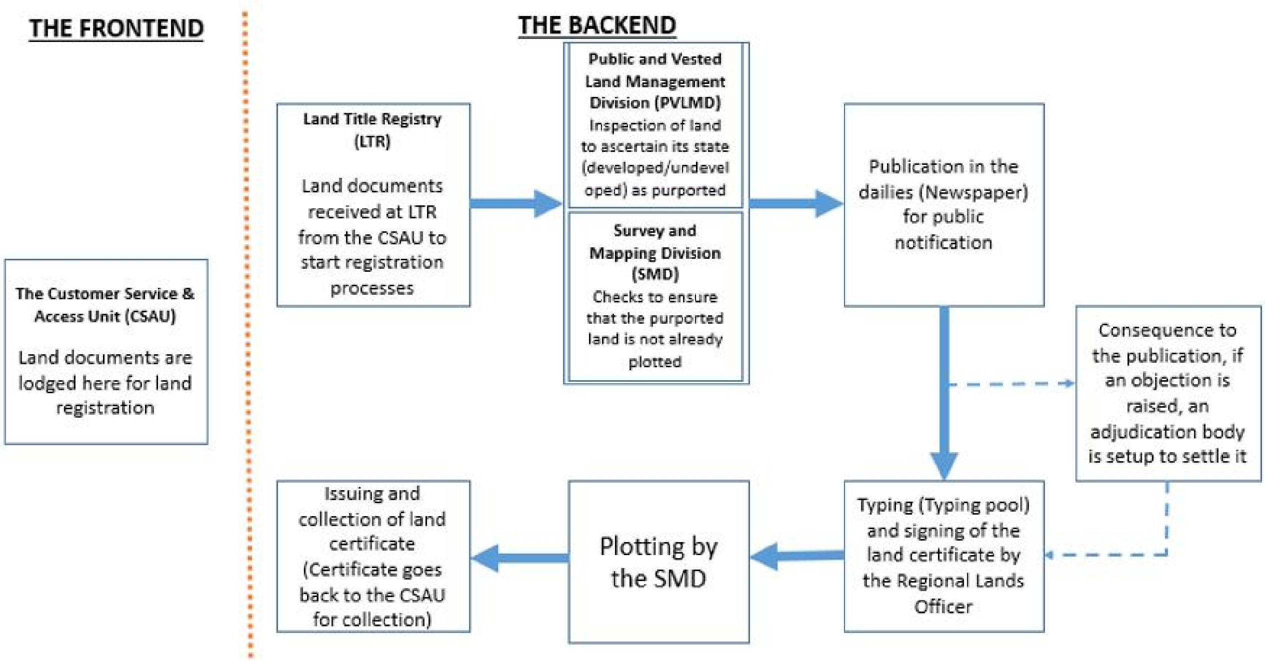

Figure 3. Land registration process. Based on [50][51].

From Figure 3 above, the frontend (Customer Service and Access Unit (CSAU)) serves as the intermediary between clients and the lands commission. Clients visit and submit their land documents, or complaints on any land process to the frontend desk of the CSAU. The CSAU, after certifying the documents, relays these to the right divisions at the backend, be it (LTR, PVLMD, or SMD). For land registration specifically, the CSAU first relays land documents to the LTR, from where it goes through all the formal processes with the different divisions until completed, brought back to the CSAU, and clients invited to pick up their certificates. Although other additional departments, such as the Land Valuation Division (LVD), are involved before land can be successfully registered, figure 3 above is a simplified process which is understandable since the LTR is the first and last department involved in the registration process [51]. Other incidental activities include the submission to and stamping of land documents at the LVD before acceptance for registration, and also the settling of any objections that might be raised upon the publication in the dailies. However, when all documents are found correct and no objections raised, the above process should take on average 3–5 months to complete, but depending on individual cases and circumstances, certain cases could take longer [51].

Land information infrastructure on the other hand is concerned with the cadastral and topographic datasets [48].

3.2. Land Valuation Processes

The main processes considered here are the valuation and taxation of land and properties [48]. Valuation is an estimate or opinion of value based on expertise to meet the supply and demand under certain conditions. These conditions may be subjective or objective depending on the context of the valuation [53]. Valuation must be an unbiased estimate or opinion, a knowledgeable or learned opinion of value, and a supported estimate of a defined value. The value must represent a reasonable market value which according to the 2017 International Valuation Standards Council's (IVSC) definition. is *'the estimated amount for which an asset or liability should exchange on the valuation date between a willing buyer and a willing seller in an arm's length transaction, after proper marketing and where the parties had each acted knowledgeably, prudently and without compulsion'* [40] (p.4), [30] (p. 4). There are five different methods for asset valuation, namely (1) the market approach or comparative method, (2) the income approach or investment method, (3) the residual approach or development method, (4) the profit method, and (5) the cost approach or contractor's method, see details in [40]. The choice of a method relies on three aspects, the nature of the asset, the basis of the valuation, and the purpose of the valuation [53]. The nature of the asset is concerned with the physical properties, characteristics and conditions of the asset. The basis of the valuation may include, market value or the market rent, worth and investment value, and fair or equitable value, while the purpose for the valuation may also include, for sale and purchase, rental, mortgage, insurance, compensation, and lease [40]. Figure 4 below shows the valuation process in Ghana.

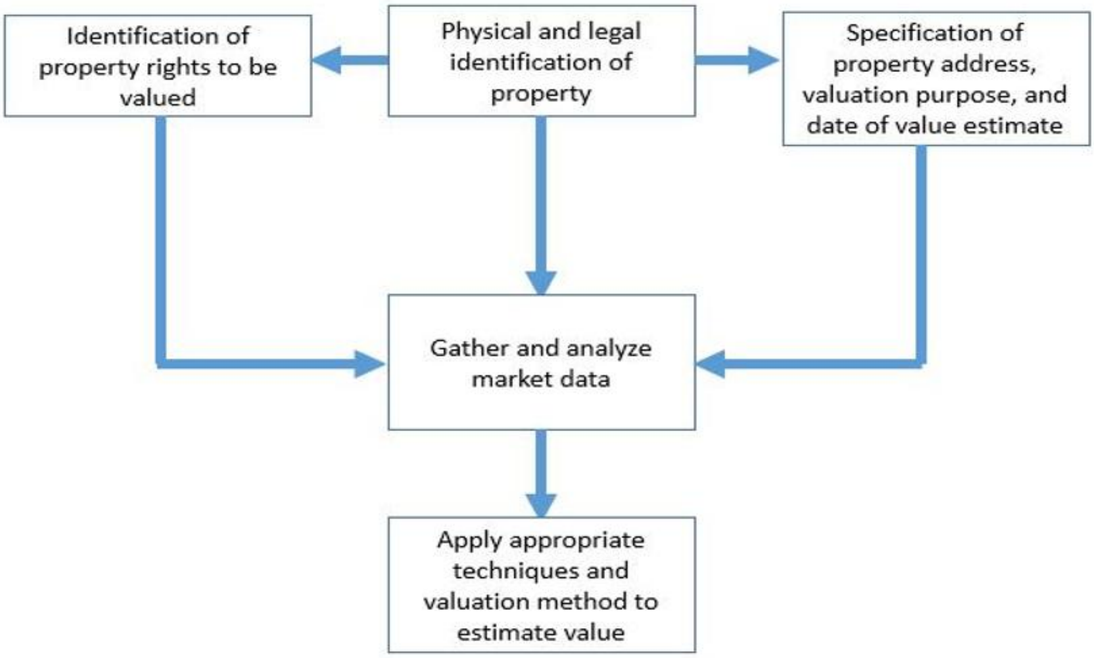

Figure 4. Land valuation process. Authors’ construct.

Land taxation, currently referred to as property taxation or rating in Ghana, is one of the oldest tax forms [54]. In Ghana, this tax is paid with respect to a developed land or an immovable property [55]. Property tax differs amongst countries as it is paid in respect of; the land only in Kenya and Jamaica, buildings and improvements on land in Kosovo, and Tanzania, or to both in Canada, Germany, Japan, some parts of Australia, the United Kingdom, Indonesia, Thailand, Guinea, and Tunisia [55]. In Ghana, District Assemblies are the governmental institutions charged with the responsibility of preparing and levying property tax or rates in their areas of jurisdiction as per Section 144 of Act 936 [56]. Property taxation in Ghana is based on the replacement cost method/contractor’s cost method of valuation. The tax is the replacement cost of the property after depreciation is deducted, and this should not exceed 50% of the replacement cost of an owner occupier’s premises and must not be less than 75% in other cases [56]. The property taxation process in Ghana is illustrated in Figure 5 below.

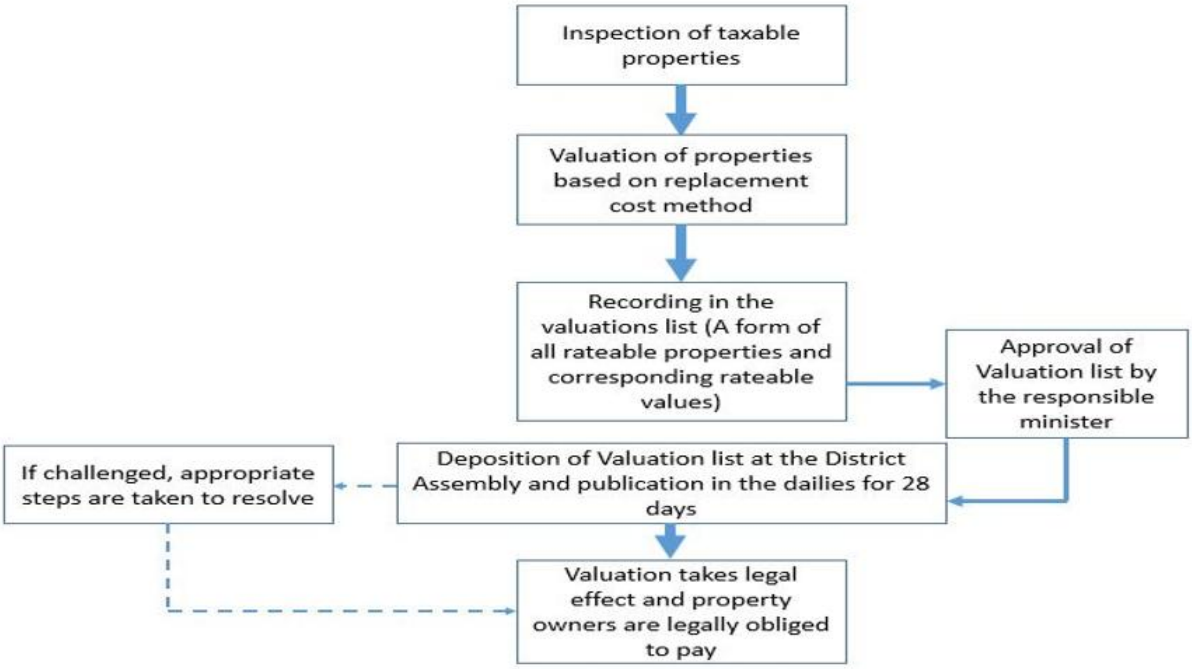

Figure 5. Property taxation process. Based on [55][56].

3.3. Land Use Planning and Land Development Processes

Land use planning and land development are closely linked and as such discussed together [30]. Land use planning is concerned with the planning and control of the use of land and natural resources, while the land development process is concerned with the implementation of development plans. Land development involves the building of new physical infrastructures and the implementation of construction planning and a change of land use through planning permissions and the granting of permits [48]. The designation of different land areas for different use types such as residential, commercial, recreational, and markets, and the actual carrying out of these plans based on the adoption of planning policies and land use regulations for a country, covering the national, regional to the local levels [48]. Land use planning and development in Ghana is concerned with balancing competing land uses for sustainable human settlement development [57]. The main legislation regulating land use planning in Ghana is the Town and Country Planning Ordinance, 1945 (CAP 84) [58]. Other legislations that border on physical planning in general include, National Development Planning System's Act, 1994 (Act 479), the Local Government Act, 2016 (ACT 936) and the National Building Regulations, 1996 (LI 1630) [59][60]. Land use planning in Ghana covers spatial, land use, and human settlement planning [61]. In Ghana, land use planning must ideally be based on decentralization and participatory principles [44][60][62]. Land use and development plans are prepared at the district level, forwarded and harmonized with those prepared at the regional level, and the two forwarded to the national level to the National Development Planning Commission (NDPC), where they are evaluated, and approval can be given for implementation [44][60][62].

The land use planning and development process in Ghana starts with the survey and definition of an area base map. This stage entails the collection, analysis, interpretation, and presentation, in a readily understood form, of all the data that are likely to influence the proposals which will be included in the land use plan. Here, planners with the help of local community people study the area to become conversant with all the characteristics which will help in defining the broad land use categories; residential, commercial among others [61]. Data are gathered through different survey types including a physical survey for data relating to topography, landscape, agricultural lands, and sometimes the geology of the area, a social survey gathers data on the population and its characteristics like the size, composition, structure, and housing, traffic transportation survey data includes the occupation, place of work, or school, origin and destination of work, rail and road networks, and parking facilities. The survey stage is then followed by the planning stage. In planning, the goals and terms of reference are established as the first stage. At this stage, the planning area is defined, and all the involved people contacted. Some basic data of the area are gathered, and followed by a preliminary identification of problems and opportunities, as well as constraints to implementing improvement. The planning period is then set. The second stage is the organization of the work. This involves listing the planning tasks and activities and identifying the people or organizations responsible for these tasks or for contributing to them. Then, the needed resources are set out, and the work plan for the project as a whole is drawn up. Administrative matters and logistics are then arranged and provision is made for transport and other equipment. The third stage is a problem analysis which analyzes the causes of the problem in relation to the data already collected on the existing situation; population, land use, land resources, income, and occupation, among others. Constraints to change are then identified. The fourth stage involves identifying opportunities to change by first identifying and drafting a range of land use types that might help to achieve the goals of the plan. Generate a range of options for solving each problem in terms of opportunities; economic measures, land resources, government actions, the people, improved technology, and in terms of land use strategies; no change, maximum production, maximum conservation, etc. The fifth stage is the land suitability evaluation. At this stage, for each promising land use type, establishing the land requirements and matching these with the properties of the land to establish physical land suitability. The sixth stage comprises the appraisal of alternatives through social and economic analysis. That is, for each physically suitable combination of land use, the environmental, economic and social impacts, of the favorable and unfavorable, and of alternative courses of action, are assessed. Therefore, there should be an environmental impact assessment, financial and economic analysis, social impact assessment, and strategic planning. The seventh stage is the choosing of best options. Firstly, public and executive discussions are held on the viable options and their consequences. The comments from these discussions are then assembled and reviewed, and based on these, the necessary changes are made to the options. A decision is then made on which changes in land use should be made or worked towards. The last stage of planning is the preparation of a land use plan through zoning. This starts with the allocation or recommendation of the selected land uses for the chosen areas of land, followed by preparing the maps, the basic or master land use plan and supporting maps. After this, plans for how the selected improvements should be brought about, and how the plan is to be put into practice are made through an appropriate land management approach. A policy to guide the implementation is then drawn up, the budget is prepared and any necessary legislation drafted. It is important to mention the need for the involvement of decision-makers, sectoral agencies, and land users. The last stage of land use planning and development process is implementation. At this stage, the plan is put into action which is the responsibility of both the implementation agencies (mainly the town and country planning department) and the planning teams. During the implementation, there is the monitoring and revision of the plan in light of the goals defined at the initial stage as well as in light of the experiences that occur.

The land use planning and development process is summarized in Figure 6 below.

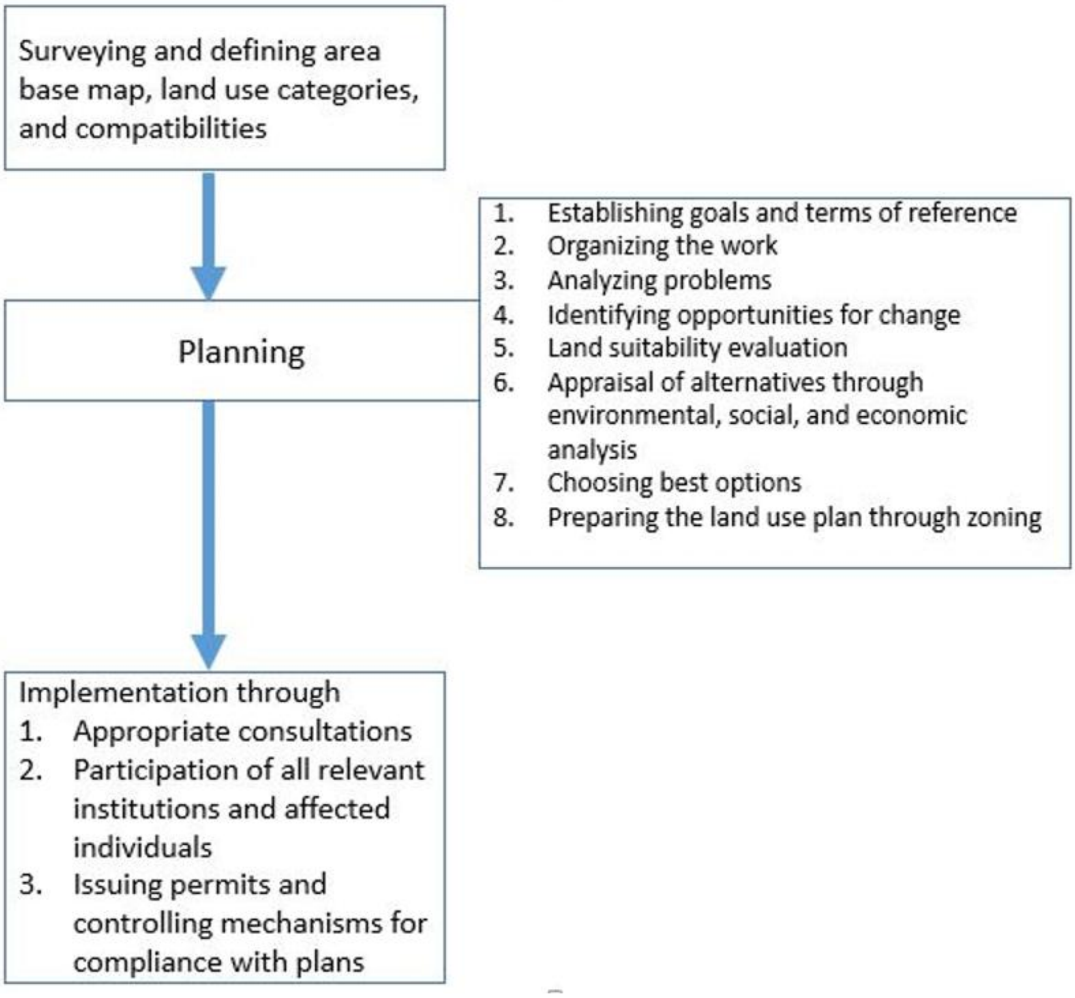

Figure 6. Land use planning and development process. Authors' construct.

The next section discusses the transparency issues inherent to these different land administration processes and the role of blockchain technology to potentially resolve these.

References

1. Vos, ; Lemmen, C.; Beentjes, B. Blockchain-Based Land Administration Feasible, Illusory or a Panacea? In Proceedings of the Responsible Land Governance: Towards an Evidence Based Approach, Washington, DC, USA, 20–24 March 2017; doi:10.1088/0953-8984/19/29/295202.
2. Lemmen, ; Vos, J.; Beentjes, B. Ongoing Development of Land Administration Standards: Blockchain in Transaction Management. Eur. Prop. Law J. 2017, 4, 478–502, doi:10.1515/eplj-2017-0016.

3. Dawidowicz, ; Źróbek, R. Land Administration System for Sustainable Development—Case Study of Poland. Real Estate Manag. Valuat. 2017, 4, 112–122.
4. Bagdai, ; van der Molen, P.; Tuladhar, A. Does uncertainty exist where transparency is missing? Land privatisation in Mongolia. Land Use Policy 2012, 4, 798–804, doi:10.1016/j.landusepol.2011.12.006.
5. Williamson, P.; Grant, D.M. United Nations-FIG Bathurst Declaration on Land Administration for Sustainable Development: Development and Impact. In Proceedings of the XXII FIG International Congress, Washington, DC, USA, 19–26 April 2002.
6. Enemark, Building land information policies. In Proceedings of the Special Forum on Building Land Information Policies in the Americas, Aguascalientes, Mexico, 26 October 2004; Volume 26, p. 2004.
7. Locke, ; Henley, G. The Possible Shape of a Land Transparency Initiative: Lessons from other Transparency Initiatives. 2013. Available online: http://search.ebscohost.com/login.aspx?direct=true&db=lah&AN=20133405582&site=ehost-live%5Cnhttp://www.odi.org.uk/sites/odi.org.uk/files/odi-assets/publications-opinion-files/8599.pdf%5Cnemail:a.locke@odi.org.uk (accessed on 1 February, 2020).
8. UN-Habitat. Tenure Responsive Land Use Planning: A Guide for Country Level 2016. Available online: www.unhabitat.org (accessed on 18 April, 2020).
9. Bell, C.; Bell, K.C. Good Governance in Land Administration; World Bank: Washington, DC, USA, 2007.
10. Phuong, H. Enhancing Transparency in Land Transaction Process by Reference Architecture for Workflow Management System. In Proceedings of the PACIS, Ho Chi Minh City, Vietnam, 11–15 July 2012; p. 69.
11. Anand, ; McKibbin, M.; Pichel, F. Colored Coins: Bitcoin, Blockchain, and Land Administration. In Annual World Bank Conference on Land and Poverty. 2015. Available online: https://www.ubitquity.io/home/resources/worldbank_land_paper_ubitquity_march_2016.pdf (accessed on 8 January, 2020).
12. Bagdai, ; van der Veen, A.; van der Molen, I.P.; Tuladhar, A. Transparency as a Solution for Uncertainty in Land Privatization—A Pilot Study for Mongolia. In Proceedings of the Surveyors Key Role in Accelerated Development, Eilat, Israel, 3–8 May 2009.
13. Jaitner, ; Caldeira, R.; Koynova, S. Transparency International-Land Corruption in Africa-Finding Evidence, Triggering Change. In Proceedings of the Annual World Bank Conference on Land and Poverty, Washington, DC, USA, 20 March 2017.
14. Spielman, Blockchain: Digitally Rebuilding the Real Estate Industry. Ph.D. Thesis, Massachusetts Institute of Technology, Cambridge, MA, USA, 2016.

15. Lemieux, L. Evaluating the Use of Blockchain in Land Transactions: An Archival Science Perspective. Eur. Prop. Law J. 2017, 4, 392–440.
16. Rizal Batubara, ; Ubacht, J.; Janssen, M. Unraveling Transparency and Accountability in Blockchain. In Proceedings of the 20th Annual International Conference on Digital Government Research, Dubai, UAE, 18–20 June 2019; pp. 204–213, doi:10.1145/3325112.3325262.
17. Müller, ; Seifert, M. Blockchain, a Feasible Technology for Land Administration? In Proceedings of the FIG Working Week, Hanoi, Vietnam, 22–24 April 2019.
18. Singh, ; Gupta, H.; Singh, A.; Litoria, P.K. Applications of Blockchain for Land Record Management. In Proceedings of the National Conference on Role of Geospatial Technologies to Bridge the Rural and Uraban Divide, Ludhiana, India, 22–23 February 2018.
19. Eder, Digital Transformation: Blockchain and Land Titles. In Proceedings of the OECD Global Anti-Corruption & Integrity Forum, Paris, France, 20–21 March 2019.
20. Shang, ; Price, A. A Blockchain-Based Land Titling Project in the Republic of Georgia: Rebuilding Public Trust and Lessons for Future Pilot Projects. Innov. Technol. Gov. Glob. 2019, 4, 72–78, doi:10.1162/inov_a_00276.
21. Bal, Securing Property Rights in India Through Distributed Ledger Technology; Observer Research Foundation: New Delhi, India, 2017.
22. Benbunan-Fich, ; Castellanos, A. Digitalization of land records: From paper to blockchain. In Proceedings of the International Conference on Information Systems 2018, ICIS 2018, San Francisco, CA, USA, 13–16 December 2018.
23. Thakur, ; Doja, M.N.; Dwivedi, Y.K.; Ahmad, T.; Khadanga, G. Land records on blockchain for implementation of land titling in India. Int. J. Inf. Manag. 2020, 4, 101940, doi:10.1016/j.ijinfomgt.2019.04.013.
24. Lazuashvili, ; Norta, A.; Draheim, D. Integration of Blockchain Technology into a Land Registration System for Immutable Traceability: A Casestudy of Georgia. In Proceedings of the International Conference on Business Process Management, Vienna, Austria, 1–6 September 2019; Volume 361, pp. 219–233, doi:10.1007/978-3-030-30429-4_15.
25. Krishnapriya, ; Sarath, G. Securing Land Registration using using Blockchain Blockchain. Procedia Comput. Sci. 2020, 4, 1708–1715, doi:10.1016/j.procs.2020.04.183.
26. Vos, Blockchain-based land registry: Panacea illusion or something in between? In Proceedings of the IPRA/CINDER congress, Dubai, UAE, 22–24 February 2016.
27. Kempe, The Land Registry in the Blockchain—Testbed; A development project with Lantmäteriet, Landshypotek Bank, SBAB, Telia Company, ChromaWay and Kairos Future. European Urology Supplements; Kairos Future: Stockholm, Sweden, 2017, doi:10.1016/s1569-9056(18)31707-x.

28. Peiró, N.; García, E.J.M. Blockchain and Land Registration Systems. Eur. Prop. Law J. 2017, 4, 296–320.
29. Yapicioglu, ; Leshinsky, R. Blockchain as a tool for land rights: Ownership of land in Cyprus. J. Prop. Plan. Environ. Law 2020, doi:10.1108/JPPEL-02-2020-0010.
30. Yildiz, ; Zevenbergen, J.; Todorovski, D. Exploring the Relation between Transparency of Land Administration and Land Markets: Case Study of Turkey. In Proceedings of the FIG Working Week 2020 Smart Surveyors for Land and Water Management, Amsterdam, The Netherland, 10–14 May 2020.
31. Karamitsos, I.; Papadaki, M.; Al Barghuthi, N.B. Design of the Blockchain Smart Contract: A Use Case for Real Estate. J. Inf. Secur. 2018, 4, 177–190, doi:10.4236/jis.2018.93013.
32. Natarajan, H.; Krause, S.K.; Gradstein, H.L. Distributed Ledger Technology (DLT) and Blockchain; FinTech note, no. 1; World Bank Group: Washington, DC, USA, 2019.
33. Themistocleous, M. Blockchain Technology and Land Registry. Cyprus Rev. 2018, 4, 195–202.
34. Shuaib, M.; Daud, S.M.; Alam, S.; Khan, W.Z. Blockchain-based framework for secure and reliable land registry system. Telkomnika 2020, 4, 2560–2571, doi:10.12928/TELKOMNIKA.v18i5.15787.
35. Oberdorf, V. Building Blocks for Land Administration: The Potential Impact of Blockchain-Based Land Administration Platforms in Ghana. Master’s Thesis, Utrecht University, the Netherlands, Utrecht, 2017.
36. Kaczorowska, M. Blockchain-based land registration: Possibilities and challenges. Masaryk Univ. J. Law Technol. 2019, 4, 339–360, doi:10.5817/MUJLT2019-2-8.
37. Makala, B.; Anand, A. Blockchain and Land Administration. J. Dev. Stud. 2018, 4, 0–34.
38. Ølnes, S.; Ubacht, J.; Janssen, M. Blockchain in government: Benefits and implications of distributed ledger technology for information sharing. Gov. Inf. Q. 2017, 4, 355–364, doi:10.1016/j.giq.2017.09.007.
39. Petkova, P.; Jekov, B. Blockchain in e-Governance. In Selected and Extended Papers from X-th International Scientific Conference ‘E-Governance and e-Communication’; SSRN: Rochester, NY, USA, 20118; p. 149.
40. Shapiro, E.; Mackmin, D.; Sams, G. Modern Methods of Valuation; Taylor & Francis: Boca Raton, FL, USA, 2012.
41. Agyemang FS, K.; Morrison, N. Recognising the barriers to securing affordable housing through the land use planning system in Sub-Saharan Africa: A perspective from Ghana. Urban Stud. 2017, 4, 2640–2659. https://doi.org/10.1177/0042098017724092.

42. Stefanović, Đ.M.; Pržulj, D.; Ristic, S.; Stefanović, D. Blockchain and Land Administration: Possible applications and limitations. In Proceedings of the International Scientific Conference on Contemporary Issues in Economics Business and Management, Kragujevac, Serbia, 9–10 November 2018.
43. Obeng-odoom, F. Urban property taxation, revenue generation and redistribution in a frontier oil city. Cities 2014, 4, 58–64, doi:10.1016/j.cities.2013.10.003.
44. Fuseini, I.; Kemp, J. A review of spatial planning in Ghana's socio-economic development trajectory: A sustainable development perspective. Land Use Policy 2015, 4, 309–320, doi:10.1016/j.landusepol.2015.04.020.
45. Kuusaana, E.D. Property rating potentials and hurdles: What can be done to boost property rating in Ghana? Commonw. J. Local Gov. 2015, 204–223, doi:10.5130/cjlg.v0i0.4495.
46. Kleemann, J.; Inkoom, J.N.; Thiel, M.; Shankar, S.; Lautenbach, S.; Fürst, C. Peri-urban land use pattern and its relation to land use planning in Ghana, West Africa. Landsc. Urban Plan. 2017, 4, 280–294, doi:10.1016/j.landurbplan.2017.02.004.
47. Stahl, J.; Sikor, T.; Dorondel, S. Transparency in Albanian and Romanian land administration. Paper Forthcoming in the Next Issue of Cahiers Options Méditerranéennes entitled "La question foncière dans les Balkans". 2008. Available online: http://www.landcoalition.org/pdf/07_paper_transparency_land.pdf (accessed on 14 August, 2020).
48. Enemark, S. Understanding the land management paradigm. In Proceedings of the FIG Commission 7, Symposium on Innovative Technologies for Land Administration, Madison, WI, USA 18–25 June 2005; pp. 19–25.
49. Zevenbergen, J. A Systems Approach to Land Registration and Cadastre. Nord. J. Surv. Real Estate Res. 2004, 1. Available online: https://journal.fi/njs/article/view/41503 (accessed on 18 August, 2020).
50. Sittie, R. Land title registration. The Ghanaian experience. In Proceedings of the 23rd FIG Congress, Munich, Germany, Munich, Germany, 8–13 October 2006.
51. Ehwi, R.J.; Asante, L.A. Ex-Post Analysis of Land Title Registration in Ghana since 2008 Merger: Accra Lands Commission in Perspective. Sage Open 2016, 4, 2158244016643351, doi:10.1177/2158244016643351.
52. Mintah, K.; Baako, K.T.; Kavaarpuo, G.; Otchere, G.K. Skin lands in Ghana and application of blockchain technology for acquisition and title registration. J. Prop. Plan. Environ. Law 2020, doi:10.1108/JPPEL-12-2019-0062.
53. Asiama, K.O.; Bennett, R.; Zevenbergen, J.; Asiama, S.O. Land valuation in support of responsible land consolidation on Ghana's rural customary lands. Surv. Rev. 2018, 4, 288–300.

54. Kuusaana, E.D. Property taxation and its revenue utilisation for urban infrastructure and services in Ghana: Evidence from Sekondi-Takoradi metropolis. Prop. Manag. 2016, 4, 297–315., doi:10.1108/PM-07-2015-0033.
55. Petio, M.K. Role of the Land Valuation Division in Property Rating by District Assemblies in Ghana’s Upper East Region. Commonw. J. Local Gov. 2013, 4, 69–89.
56. GOG. Local Government Act; GOG: Warsaw, Poland, 2016.
57. Yeboah, E.; Shaw, D.P. Customary land tenure practices in ghana: Examining the relationship with land-use planning delivery. Int. Dev. Plan. Rev. 2013, 4, 21, doi:10.3828/idpr.2013.3.
58. Torraco, R.J. Writing Integrative Literature Reviews: Using the Past and Present to Explore the Future. Hum. Resour. Dev. Rev. 2016, 15, 404–428, doi:10.1177/1534484316671606.
59. Awuah KG, B.; Hammond, F.N.; Lamond, J.E.; Booth, C. Benefits of urban land use planning in Ghana. Geoforum 2014, 4, 37–46, doi:10.1016/j.geoforum.2013.09.019.
60. Kuusaana, E.D.; Eledi, J.A. Customary land allocation, urbanization and land use planning in Ghana: Implications for food systems in the Wa Municipality. Land Use Policy 2015, 48, 454–466, doi:10.1016/j.landusepol.2015.06.030.
61. GOG. Land Use and Spatial Planning Act; GOG: Warsaw, Poland, 2016.
62. Owusu, G. Small towns and decentralized development in Ghana: Theory and practice. Afr. Spectr. 2004, 4, 165–195.