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Determining the potential role of VGI in improving land administration systems in Iraq

Mustafa Hameed¹, David Fairbairn¹, and Suzanne Speak²

¹ School of Civil Engineering and Geosciences, Newcastle University, Newcastle upon Tyne
NE1 7RU, UK

² School of Architecture, Planning and Landscape, Newcastle University, Newcastle upon Tyne
NE1 7RU, UK

Abstract. Land is undoubtedly the most important natural resource and asset in any nation, contributing half to three quarters of the national wealth in most countries. Hence there is a need to manage it in a sustainable manner. The management of a land system is affected by a number of factors, including the political situation, the socio-cultural environment, and economic aspects e.g. financial crises. In Iraq all these problems are present and further, the country has endured decades of internal and external conflict. The results of such factors include different waves of human population displacement, land ownership document forgery, seizure of public land by unauthorised groups, manipulation of urban planning by changing the use of the land, and subdivision of single parcels into multiple landholdings. By examining volunteered geographic information (VGI), we hypothesise that it has a role in enhancing the Iraqi land administration system. The paper presents the aims and objectives for conducting such VGI application in Iraq, and concludes with a framework for conducting challenging fieldwork in local communities which seek improvements in land administration..

Keywords: VGI, Land administration system, Fit-for-purpose.

1 Introduction

This paper examines current issues and concerns related to land administration, volunteered geographic information (VGI) and the current state of socio-economic activity within the nation of Iraq. It begins by presenting a picture of current trends in land registration and cadastre development around the world, to justify the need for the development of varying methods. It then explores how different countries have tried to develop cadastres and the difficulties they have encountered. Finally, it focuses on the use of VGI and an understanding of how this can be conceptualized, and used, for land administration and cadastral purposes. With an international view in mind it identifies relevant issues for Iraq and aspects which might inform practical methodologies in data collection and management. The paper concludes with a definitive framework of research questions, tasks and applications in which the issues raised can be explored.

2 General definition and components of Land Administration system(LAS)

Land administration is considered as the collective operations of determining, registering and propagating information about the value, tenure and use of land within a policy framework for implementing land management. It encompasses land registration, cadastral surveying and mapping, fiscal, maintaining legal and multi-purpose cadastres, and managing land information systems (Williamson, 1985). As one important aspect of the land administration system, land registration is the procedure of recording all interests in land with regards to ownership, parcel size, location, land use, and value, and the preparation and structuring of such information in the public register (Ituen, 2014). Cadastral surveying is a specific term to describe the process of gathering the data, particularly measured survey data, about the land parcel and recording it. These data comprise the geometrical data, including the size, shape and location of the land parcel (Steudler et al., 2004). A further step of cadastral surveying is the production of cadastral maps. The main use for such a cadastral map is to produce a title registration system, the title being fundamental to simplify the process of land transaction. A cadastre is defined as the up-to-date information on the land parcel which contains records of the interests in land, such as rights, restrictions and responsibilities (Bennett, 2010). A fiscal cadastre is the cadastre that is organized mainly for valuation and fair taxation; a legal cadastre is established mainly for legal conveyancing, assisting in using and managing the land, facilitating environmental protection and sustainable development, and supporting the land market; a multipurpose cadastre meets multipurpose requirements and supports social, economic and environmental sustainability. The land information system is the digital data handling capability which contains information that is essential for decision making and managing of the land. Our study examines cadastral and registration systems which are responsible for demarcating plot boundaries and recording information of the land.

2.1 Current state of land registration and cadastres

Recent technological developments in data handling and application of higher land surveying and data collection techniques in formal land administration system in developed countries can ensure high security, easy access, and efficient services for citizens and their interaction with land. The majority of countries in the world, however, still do not have a functional land administration system and many people live under threat of the appropriation of their land and insecure tenure.

Only 25% (35-50 countries) have a complete land registration system, mostly in the industrial countries (McLaren, 2013). The majority of the land occupiers in the remaining countries include the most vulnerable and poorest groups in society. The increasing proportion and numbers of urban population is likely to lead to serious problems in organising and recording land tenure in new densely populated areas. The abilities of

the formal land administration system to cover the excluded 75% of the world population are limited, so there is an urgent need for considering an alternative approach for land administration that is fast, cheap and supports community needs and services.

2.2 General issues with land administration systems in developing countries

The difficulties with formal land administration systems in developing countries which make them insufficient, ineffective, and unable to serve the need of the majority of the communities include the major reason of lack of funding (Adlington, 2010). World Bank progress evaluation reports studied a large number of land reform projects (about 30 countries), which had started directly after political change and economic transition from central to free market: 48% of these suffer from budget deficits and 17 projects are stalled due to resource issues. In Bulgaria, for example, the official cadastral system covers only 18% of the land parcels, and has been stopped due to the lack of funding (Basiouka and Potsiou, 2012). A further factor leading to inefficiency is lack of trained staff: despite new technologies the number of land professionals is insufficient (McLaren, 2013). Enemark et al. (2014) exemplify this in Rwanda where there are very few qualified surveyors. Lemmen (2010) argued that an official tenure system may only consider the legal rights of ownership, while neglecting the millions of people whose tenures are predominantly social rather than legal. In sub-Saharan Africa, the minority of the land (one-third of the total land) is considered under official systems, and knowledge from social tenure is ignored, particularly neglect, during official cadastral field work, of opinions of land owners about the nature of their parcels and location of their boundaries. An official cadastral project in Tsoukalades, Greece ('Hellenic cadastre') was repeated four times and did not succeed due to fundamental errors in the shape, location, and boundaries of parcels, along with mis-registration (e.g. unknown owners being recorded) (Basiouka and Potsiou, 2012). Alemie et al. (2015) considered that no official system could efficiently cope with a change of regime or following a war: but even when a new country emerges following independence, or if formal regime change results from a war it is unwise to build a new official system from scratch, due to the time and cost needed. In such cases, it is appropriate to consider an interim land administration system that can serve the need of the community, in an established 'Fit-For-Purpose' manner until the official system develops.

Policy issues may promote land re-distribution: an example is in Zimbabwe, wherein 1980 75% of the total land area was owned by 3% of the population, and re-allocation was promoted up to 1996 (Chitsike, 2003). Inaccessibility is a situation which often appears in developing countries where the owners are unable to register their ownership or do formal transaction, due to the high taxes levied on such activities: in many circumstances people may not register their ownership or they may buy or sell their land without using the formal system. Fairbairn and Al-Bakri (2013) noted that there are shortcomings in official systems even where they do exist: these often relate to completeness of data, and lack of currency of information about numbers of plots, changes of use etc. Engagement with such agencies may be very slow and may not be appropriate for some communities (e.g. rural areas where land ownership has differing connotations to central governmental views).

3 Experiences with the Iraqi land administration system

An example of an incomplete and inefficient land registration system can be seen in Iraq. Several problems are evident here, some internal to the system (notably forgery of title deed documents, and corruption within the agencies), and many external societal aspects (including extensive short and long range displacement of populations; unchallenged building expansion onto under-utilised public lands; expropriation of land by political regimes, including seizure of public property; military operations; sectarian violence; internal terrorism; economic crisis; and a general climate of fear throughout society. Two periods, the Baath regime (before 2003), and after the US-Led Occupation in 2003, are considered here.

3.1 Land-Registration Problems Before 2003

During the former regime, many people were forced out of Iraq completely or out of their original city as internally displaced people, and their land was taken by or given to other citizens illegally. For example, thousands of Tabaiya, people of Persian origin who had lived in Iraq for generations and speak Arabic, but accused as supporters of Iran during the Iran-Iraq war in 1980s, were evicted, their property sold cheaply mainly to the Ba'athists, who later resold it at a profit. These ethnic Persians were found mostly in the south near Karbala, An Najaf, Hillah, and, to some extent, in what is now known as the Sadr City District in Baghdad. Since the occupation in 2003, many of those expelled have returned to reclaim their homes and land (USAID, 2005).

Internal displacement was also the result of "Arabization" which forced out non-Arab inhabitants (mainly Assyrians, Kurds, Turkmen) from cities such as Kirkuk, and replaced them with Arabic people from different Iraqi cities. This policy aimed to reinforce the control of the Baathist regime over the oilfields and large tracts of fertile land in those areas (Isser and Van der Auweraert, 2009).

The previous regime also distributed much land on an individual basis to enrich Baath Party loyalists. These actions were hurried and caused stress in the land administration offices, preparing ownership documents on government land, to satisfy the need of party supporters, often without a proper survey of the land, which then caused many problems after the fall of the regime. It should be noted, however, that the land administration system was supported politically and working legally with little evidence of personal illegal behaviour.

3.2 Land-Registration Problems After 2003

After the fall of the Baathist regime, inherited problems became evident, and the weakness of the new government quickly became clear. *Post war forced displacements of people* continued, but now caused by the victims of the previous regime, such as Kurds who expelled tens of thousands of long-standing Arab settlers, e.g. in Khanaqin, where 54,000 Arab settlers were expelled from 2003. The same happened in Kirkuk which caused such problems between old and new victims, that the city continues to be so-

cially and economically unstable till now. *Rigging of title deeds and changing the ownership of the land in the official records* happens due to the weakness of post-war regime: it is especially evident on lands that belonged to Baathist party members who migrated after the fall of the regime, or those who fled after displacement. The national governmental land administration system has tried to establish a new mitigating policy to clamp down on such practices. *Seizing public buildings* is prevalent among those without property and displaced families, who occupy public buildings and change them into living spaces. For example, a notable area in central Baghdad (Salhiya) which used to house senior army officers from Saddam's Republican Guard, is currently occupied by homeless families and individuals (Isser and Van der Auweraert, 2009). Some people have occupied public land and built their own house on it, violating any effective formal land registration system (USAID, 2005). *Infringement on orchards and building on agricultural land within cities* is a phenomenon which increased rapidly after 2003 due to the weakness of municipal authorities and a clear advantage in the financial benefits derived from the exploitation of these areas for residential purposes rather than agricultural purposes. This fragmentation has led to unplanned development of cities, decrease of the green zone, and inability of the government to provide services such as sanitation (Istabraq, 2016). *Subdivision of single plots into several sub-plots* is common as a result of the long-standing housing crisis in Iraq with United Nations and World Bank estimates of 3 million housing units shortfall (Shaikley, 2013). Such sub-division results in very small plots with complex ownership. After the February 2006 bombing of the Shia Al-Askari mosque (Saladin Governorate), *displacement from sectarian violence* accelerated significantly mostly in mixed Shia-Sunni areas close to Baghdad, affecting one and a half million Iraqis (Isser and Van der Auweraert, 2009). More recently, *displacement resulting from the activities of Daesh (Isis)* has affected cities in the north and west of Iraq (Mosul, Ramadi, Tikrit and Fallujah). Continuing today, high waves of displacement both internal, to different Iraqi cities, and external, to different countries, causes further pressure on the land administration system, unable to monitor any occupancy in Isis-occupied cities, nor to prepare temporary places for migrant people to live.

The context is clearly, therefore, of a land administration system beset by problems of external societal issues, and internal resourcing and procedural issues affecting effectiveness, working methods, and results. It is proposed that engagement by the community and their participation in the land administration system can address these and other problems. Formal land tenure for the world's poorest people, including millions in Iraq where the recent wars have left the formal system broken and unable to secure land rights for the citizens, is a critical driver. Secondly, because cost and time are barriers to registering land there is need for exploratory projects which seek to establish whether VGI can offer a low cost, inclusive approach to updating existing records, making the formal land administration system more efficient and meeting the needs of the community by creating more fit-for-purpose systems. A further impetus is the need to constantly maintain completeness of attribute data as well as spatial data.

4 Fit-For-Purpose land administration

Systems which serve the need of the communities in countries where the official cadastral system is weak or does not exist at all, and where the cadastre is not multi-purpose (e.g. where it considers only legal ownership, neglecting other aspects can be described as ‘fit-for-purpose’: these are not necessarily high geometric accuracy systems, but rather they can identify, rather than monument, land parcels, record ownership and provide security of tenure for underprivileged communities (Enemark et al., 2014).

These systems adopt principles such as ‘general boundaries’ rather than fixed boundaries, meaning the accuracy of the delineation process is not necessarily precisely determined, especially in the rural and semi-urban area, but rather concentrates on the information needed for day-to-day land administration purposes. A successful example that has adopted this approach is Land Tenure Regularisation in Rwanda in 2009 (Enemark et al., 2014). Secondly, it is common to use satellite or aerial imagery rather than traditional surveys (with total station), which can be three to five times cheaper overall yet yield data suitable for most land administration purposes. The Tsoukalades, Greece project, already mentioned, is a good example of the use of printed 1:25,000 scale satellite images by non-professionals to allow for annotation of land ownership details by pencil. In ‘fit-for-purpose’ systems, the required accuracy of the information collected and maintained is aligned to its potential use, rather than some imposed high-order specification; and further, the system is designed to optimise update and embed flexibility to allow for improvements with the time.

The ‘fit-for-purpose’ approach builds on several important elements (Enemark, 2013): the *participatory nature of the system*, meaning the geospatial data is collected and handled with the aid of the community; *inclusivity*, ensuring that all tenure types are considered without any exceptions, crucial to ensure coverage of non-traditional (and unrecorded in the majority of the official land administration systems) tenure patterns; *attainability* ensuring realistic system building depending on available resources and within a short timeframe and *upgradability* meaning that the data can be readily updated and the system improved in response to developments in society and practical experiences.

The idea of ‘fit-for-purpose’ suggests that there is a role for less technically accurate data, but much research still needs to be done to assess its value for the many purposes of land administration, and to draw up the specifications of such systems. In order to focus on such developments, a spectrum of variables needs to be considered.

4.1 Spectrum of variables

The variables which drive fit-for-purpose land administration systems are themselves disparate and multi-faceted. Firstly, tenure may involve aspects such as occupancy, usufruct (official usage rights without ownership), informal rights, customary rights, indigenous and nomadic rights, with varying levels of security depending on their level and application. These levels differ from informal land rights to the formal ones, but land tenure can migrate from one category to another, upgrading with time and changing towards better levels of security. For example, the informal settler may upgrade to

an improved level of tenure if government begins to formally recognize certain group rights (Quan and Payne, 2008). Secondly, the legal rights used in land administration may reflect a number of acceptable and practical systems such as tribal rights, religious rights embedded in the Islamic system, for example, and customary rights. A third variable is accuracy, which reflects different methods and techniques for collecting cadastral data by officials. This recognition of variability could be extended to public participation in collecting VGI, for example by field sketches, satellite imagery, or GPS observation. The volunteers may themselves exhibit useful variability - young amateurs may have technical experience whilst elders possess useful historical information; young people may prefer to use digital technologies (e.g. iPad or GPS) but older people may prefer to use sketch map for presenting their land information to the public participation system.

4.2 Different terms emerged for the public participatory work for collecting geographic data

The nature of public participation in the collection of geographic data has been addressed by many researchers, and although the main perception for all is nearly the same, terminology can vary. Turner (2006) referred to 'neo-geography', meaning the use of geographical techniques and tools for personal and community activities, or by a non-expert group of users. Goodchild (2007) proposed the term 'citizen as sensors' for those numerous people who participate in collecting information on the weather and predicting catastrophe. The further term 'citizen science' describes the engagement of amateurs in any experimental and scientific observation (Bonney et al., 2009). In geographic terms, the use of the word 'crowdsourcing' can suggest the process of collecting information by the local citizen by means of mobile devices and the geoweb (Niederer and Van Dijck, 2010), although it can also be used to refer to the validation of such data by multiple volunteers who can give a 'best estimate' on its trustworthiness and accuracy. For LAS, a relevant recent term is 'neo-cadastrés' - citizen-built and legitimized land data handling systems maintained by volunteers rather than the government (de Vries et al., 2015). The work described in this project demonstrates the convergence of VGI with neo-cadastrés: the focus will be mainly on the definition of VGI, its uses, issues related to quality and the methods for verifying VGI. A hypothesis and research questions relating to the role of VGI in LAS will be presented also.

5 Volunteer Geographic information (VGI)

For centuries, the collection and use of spatial data has been reserved to official agencies (Goodchild, 2008). However, VGI offers the public the opportunity to be involved in data collection and use: this can be perceived as challenging to authorities and they may raise concerns about the data or the process. Many who write about VGI attempt to overcome such concerns, through considering the motivation for adopting VGI in land administration projects, the quality of the data, and the ways of verifying the participatory data (Seeger, 2008).

5.1 The motivation for VGI

The motivation for using VGI technologies in LAS The ineffective nature of many LAS suggests that there is a need to build fast and inexpensive land administration systems that can activate stagnant land markets; and it may be that such initiatives are much more valuable than building highly accurate systems which may need time and money (Adlington, 2010). Associated with this approach, it seems obvious that VGI can form a major part of such initiatives, and that contributions from people who live near to spatial phenomenon can release best knowledge on its characteristics (Bishr and Mantelas, 2008). In terms of specific application, therefore, there is motivation to consider that official cadastral data provided by official expert structures can be completed and up-dated when combined with data that is provided by volunteer geographic information. From a technological perspective, the expansion of internet coverage and its availability around the world together with the developing of the smart phones technology allow for easy and quick techniques for collecting, picking, uploading, correcting and mapping of geospatial data by ordinary citizens without depending on GIS experts (Tulloch, 2007).

Citizens' motivation for collecting and editing geospatial data for LAS The most motivation is that of the volunteers without whom no VGI project can succeed. The urge of citizens to participate as volunteers for collecting geospatial data, over lengthy periods, not directly linked to financial gain has been examined by Tulloch (2007) who identified "achieving a higher level of empowerment" as the main factor that motivates citizens to participate in the OpenStreetMap project (the highest profile VGI initiative). Goodchild (2007) has suggested that "self-promotion and personal satisfaction" are major factors also. Coleman (2010) suggests that positive factors might include altruism, professional and personal interest, intellectual stimulation, protection of personal investment, social reward, personal reputation, self-expression opportunity and (especially in the case of geographic information) pride of place. Negative factors include mischief, social, economic or political agenda and malice intent. Haklay and Budhathoki's study (2010) presents concepts such as fun, recognition, money, unique, ethos, reciprocity, instrumentality to characterise volunteer experience. Coffas and Diosteanu (2010) considered volunteer participation as a recreational activity, such that the public does not need to be particularly aware or motivated for their participation. However, Laarakker (2011) has suggested that the focussed recognition of a need for better public services and improved systems for land administration, might be a more positive driver for participation than such altruistic reasons. Basiouka and Potsiou (2012) who conducted the first practical cadastral mapping exercise using crowdsourcing techniques, have emphasised that the main reason for the motivation of their participants was the perceived need to overcome bureaucracy and to open the land market, which had blocked for more than twelve years. The key opportunity for contribution might therefore be Market-Driven (professional or personal interest at an economic level); the enhancement to a personal job or project; being part of a large social network and being rewarded for having a strong personal presence online; the 'fun-factor' in

working within a ‘trendy’ environment; humanitarian and altruistic drivers etc. (Coleman et al., 2009; Winterbottom and North, 2007; Genovese and Roche, 2010).

The authorities’ motivations Although the project of VGI is created and maintain by the ordinary citizens, the role of authority in supporting and guiding the VGI mapping project is particularly important to acknowledge in LAS. It is highly unlikely that a VGI-based cadastre can be successfully envisaged as a replacement for the official, formal system. McLaren (2013) has suggested that completion of unmapped areas or updating the existing system are the obvious incremental benefits of VGI in LAS, benefits which can be recognised by governmental authorities.

Another scenario which might be considered is to apply VGI in a highly populated urban slum area with very small plots, where low land values might suggest that high accuracy for obtaining land boundaries is not so important for the authority. Such data can exemplify the ongoing flowline of land rights and boundary delineation information, which can be used for planning and updating social services and infrastructure (McLaren, 2013). According to Enemark et al. (2014) crowdsourcing actually motivates land professionals by expanding their potential role and making them able to serve the whole population rather than focussing only on a small elite. They also pointed out that the role of the professional will be more managerial in relation to managing and using land related data, expanding their responsibility beyond just capturing it. It has also been suggested that VGI, as a new source of fresh data, will enhance the quality and quantity of the information in the hand of professional and decision makers (Seeger, 2008).

Such considerations of motivation will directly help in the development of test data collection tools, and in the engagement during the fieldwork with both the authorities and communities. Once the test fieldwork data in this study project has been collected and analysed, it will be possible to liaise with the relevant authorities and explain the value of the VGI data, and approach, to their work.

5.2 Evaluating the use of VGI in the land administration system

In recent years, the evaluation of the utility and quality of data that has been collected by participatory methods has been important. Its application has been considered as an opportunity for official land administration systems: de Vries et al. (2015) argue that the use of volunteer spatial data in cadastral systems is an opportunity for creating and maintaining geospatial data, because it changes the role of the ownership from being passive to active, which can guarantee faster, cheaper and more fit-for-purpose techniques than the traditional method of registration. Bennett (2010) also considered the importance of using VGI for cadastral purposes, notably as an interim cadastral solution that can serve the needs of the community by securing land rights, and/or transferring such rights to a different level of tenure security. Seeger (2008) refers to the opportunity of government cadastral authorities to obtain a new source of fresh data that may help them for planning and decision making. On the other hand, de Vries et al. (2015) also

suggest that using VGI in cadastral systems may cause threats to official systems, because it may conflict with the rules and mechanism of official organization and the experts.

Goodchild and Li (2012) also point out some issues with VGI the quality of even crowdsourced data is difficult to control because of the fact that only a small number of people can verify the correctness of the information: in the case of a cadastre, those directly in touch with the land parcel can provide the right boundary information. Experience also counts: the majority of the VGI producers are amateur who have little or no experience with the mapping process (Mummidi and Krumm, 2008).

The usage of VGI for specific tasks in land administration has also been examined by Navratil and Frank (2013) who argued that although it is difficult to depend on VGI totally as an alternative option for an official cadastral system, as an important part of the LAS is land ownership which can only be verified by a limited number of people, it still has an important role to play in observing parameters which could easily be obtained by authorities but only with considerable time and effort.

To conclude, de Vries et al. (2015) regard VGI as an opportunity and ‘fit-for-purpose’ as a reliable concept, ensuring serving the need of the community in case of under-development or absence of an official cadastral system. However, it clearly needs good methods for checking the quality of the VGI data.

5.3 VGI quality considerations

It is clear that land administration systems are only as good as the quality of the spatial, and other, data held therein. Because VGI is provided, in most cases, by people with little or no knowledge of the mapping process (Ciepluch et al., 2010), it is necessary to verify the quality of their data and balance the potential benefits. Data quality can be examined from a number of different perspectives.

- Positional accuracy, is the nearness coordinate values of a VGI feature (e.g. a point) to its corresponding authoritative equivalent feature based on Euclidian distance (Mullen et al., 2015).
- Thematic accuracy /Attribute accuracy, refer to the reliable and reasonable correctness for the attribute attached to the points, lines and polygons features of the spatial database.
- Completeness, refers to the comparison between two different sources of data sets for same area of interest to find which features are included or excluded from a dataset.
- Temporal accuracy, refers to the agreement between encoded and ‘actual’ temporal coordinates (Veregin, 1999).
- Logical consistency, refer to the existence of logical contradictions within a dataset (Hashemi and Abbaspour, 2015).

Goodchild and Hunter (1997) evaluated the accuracy of VGI by using traditional statistical methods (Root Mean Square Error (RMSE) and the standard error) to describe the spatial error of point features. Much more recently, Al-Bakri and Fairbairn (2012)

agreed with Goodchild and hunter's earlier work when they reviewed the spatial accuracy between VGI and government data. They found that the RMSE is quite high for VGI. They attributed the errors to the low-precision devices, for example personal GPS units and commercial imagery services which are commonly used in VGI collection.

Quality appears to change depending on the location. For example, Zielstra and Zipf (2010) found that the quality of the VGI became worse the further it was collected from the urban core, when they examined the differences between VGI and commercial data sources in Germany.

Completeness is used to discuss the difference between what is recorded (for example, number of houses or length of roads) and what is actually found in the real-world (Brassel et al., 1995). Haklay (2010) suggested that it is possible to rely on a numerical assessment, by simply counting the total length of streets in OpenStreetMap (OSM) compared to Ordnance Survey (OS) datasets data sets for London and England. However, Jackson et al. (2013) undertook a study based on schools, first by simply counting them, which showed similarity across four data sets. However, when they repeated the study basing it on names (and in two cases on addresses) they noted that, although the numbers were similar, the schools themselves were not the same. Thus, they conclude that simply basing the data collection on numbers was insufficient to assess completeness. Using the same datasets of schools Mullen et al. (2015) included demographic features in their specification (general population; economic status; educational attainment; and race/ethnicity). However, they failed to identify a clear association (or statistically significant correlation) between either positional accuracy or completeness with any of the demographic properties.

It is clear that there is need for a better study of potential accuracy and quality of VGI in relation to land administration systems. It is interesting that there is agreement that completeness and currency are also measures of quality. Focussing on that, rather than simply on spatial accuracy, would be an innovation for this research. This will be discussed in the methodology. This literature has also helped my focus my research question and position my work in the discussions about empowerment of citizens. I can now understand that current formal land systems might actually be used to maintain the status quo only work for the rich and the government.

Methods to assess and validate VGI when no other data sets are available It is important to also validate the process of data collection, especially where there may be no formal or alternative data sets to assess the data against. In this situation, we must have confidence that the collection and collectors are reliable. Since the quality of VGI data depends on the reliability of the information that can be obtained from volunteer people, it is crucial to find some ways for verifying these participatory information that aim to serve the need of the community from others that aim to fraud or malicious the system (Coleman et al., 2009). These methods of verification depend on some criteria such as producer reputation, which means to evaluate the volunteer information that someone has provided by some other users (Maué, 2007). Another method has been suggested by Bishr and Mantelas (2008) that depends on the experience and expertise of the producer, which mean that a person who has good presence in checking and

editing other's volunteer work as well as actively participate with his own volunteer data. Furthermore, Haklay et al. (2010) had proved that eliminating the error in the participatory mapping can be achieved by a reasonable number of volunteer per area. Other approaches has emerged recently such as social approach (which based on the principle of senior trusted users) that act as a get keeper who check and correct others data contribution, crowdsourcing approach (which base on the Principle of agreement) on the data between large group of people, geographic approach based on the principle of comparing the data with existing geographic knowledge, and lastly, comparing the VGI data with other source of data such as public registry data (Goodchild and Li, 2012). Addressing concern about the validity of data and conflicts with existing formal systems are a focus of this research. The study will draw on these suggestions to analyze and validate VGI from field work. In particular, the case study areas will include formally registered so that data can be validated against existing formal data. However, if an area does not have a formal record, I will draw on agreement within the community to verify the data, in line with (Maué, 2007) and others above.

5.4 Experiences of using VGI for many purposes around the world

Volunteer geographic information (VGI) techniques have been used for many successful tasks around the world (World Bank). Sometimes VGI is used for things not directly related to cadastral systems. These uses are relevant because they tell us something about the difficulties or the methods of VGI. These will be discussed in a later section on methods. Here the focus is on VGI in land administration and cadastral.

Examples and Lessons from governmental organizations Volunteer geographic information (VGI) techniques have been successfully used for many tasks around the world (World Bank). Although some of these uses are not directly related to cadastral system, however it provides this project with the experience about the difficulties that may face the use of VGI technique. From these uses is for creating new dataset, for example, South Sudan is a new emerging country that got independence a few years ago and the country is poorly maps. They have successfully created a new cadastral maps with the aid of the local community in a few cities such as Nairobi and Juba (Haklay et al., 2014). Another example is mapping Kibera which aim to create a basic map for the Nairobi's biggest informal settlement. Further example, is the mapping of the slum places in urban area in India which aimed to provide up-to-date information about the informal settlements (Haklay et al., 2014). Another use of VGI is for updating official data sets. In this situation the official datasets available but it is out of date. Good examples can be seen in Corine Land cover in France, where the aim of the project is to engage the community in the process of updating official cadastral data with land use and land cover information, especially in the rural area where the contribution is limited (Gallego and Bamps, 2008). Another example, is the Canadian government project for correcting and updating topographic map using VGI technique (Bégin, 2012). Further example, is the updating cadastral data in New York City, US with the aid of volunteer people (Barth, 2013). Next use of VGI is for risk management. In this

situation the use of community mapping is essential for supporting better governmental disaster plan. For example, the participatory mapping project in Philippines which was used to support local government for predicting the effect of the catastrophe and the preparing quick action in case it happens (Meyer, 2013). Finally, the use of VGI for the public services, for examples a US project for mapping Street Bump in Boston by using the volunteer geographic participation.

Examples and Lessons from non-governmental organizations (NGOs) Other successful examples for adopting VGI without the intervention of the government authority and these situations happens when there were no existence for an operational cadastral systems or the existing system do not reflect the community understanding of their land boundaries and rights. Three examples have mentioned by de Vries et al. (2015) which shows a bottom-up approach of mapping communities. These examples are firstly, the participatory mapping practices and associated tenure allocation in communal areas in southern Ghana. As reported by Olowu (2003) and Arko (2011) described a few cases in Ghana such as Ashanti Region and Jisonayilli where the residential created and demarcated their own tenure system depending on their own roles and regulation that base on their knowledge rather than following the government land administration system. Secondly, the bottom-up boundary mapping process for the indigenous land in Canada. The roles of the community mapping may not follow the government roles for cadastral system, however it reflects the community social, cultural and religious relation with the land (de Vries et al., 2015). The third example is Larasita the bottom up land tenure right in Indonesia which depends on the community recording and allocation process.

Here VGI is considered as threaten for the authoritative LAS because it depends on the bottom up approach with the community roles and mechanism of surveying and registration which is different from the government one.

The main value to this research of the review of other studies has been in identifying gaps. It appears that previous uses of VGI have evaluated the spatial data but not the completeness or currency of data. This study will do both.

Other projects and studies have not offered citizens a range of data collection methods so we do not know if some methods and tools can provide greater motivation or accuracy than others or if some are more easily sued by people of different ages or education. This study will analyse data collected using a range of different methods to assess spatial accuracy and usability. This is important for a 'fit for purpose' system because it may be that very low tech approaches, while not as precise or accurate as higher tech (e.g. GPS) are valid in some situations where cost is a problem. It also helped us in creating hypothesis and the main and sub research questions. The result of our methodology was already published in GISRUK conference.

6 The main hypothesis and research questions:

The main hypotheses being tested in this work are that:

- VGI can provide adequate, current and complete data to inform ‘fit-for-purpose’ land registration systems to secure land rights
- Different individuals and geographic contexts require adoption of different methods of collecting and supplying VGI
- Land professionals can be motivated to use VGI if they have more understanding of its use and potential

Thus, the overarching research question is:

‘What existing and potential roles do the professional and volunteer stakeholders have in collecting and handling geospatial data for land administration systems?’

This main research question can be understood and explored through a series of associated research sub questions, as follows:

Sub research question	Purpose	How answered
1. What is the range and scope of current land administration systems in the developing countries?	To set the context and assess the potential need for VGI to support a fit-for-purpose system	Through a literature review
2. Do the official systems efficiently support customary and social tenure?	To identify if some issues might be better covered by VGI based systems than current official LAS	Through a literature review
3. What difficulties do land administration professionals currently experience in the case study area?	To identify areas and tasks where VGI might be particularly valuable to professionals	From fieldwork – notably interviews with professionals
4. What is the current knowledge and perception of VGI and ‘fit-for-purpose’ land systems amongst land professionals in the case study area?	To identify barriers to professional acceptance	From fieldwork – interviews with professionals
5. What is the current knowledge of the local citizens about the importance of registering their land?	To assess motivation for engaging in VGI	From fieldwork – interviews with volunteers
6. What are the current technical and non-technical mechanisms being used by people participating in VGI?	To inform the methods to be used in the field work and develop data collection tools	From literature
7. Which methods and data collection tools work best in different contexts and for different individuals?	To analyze the usability and validity of different approaches	From fieldwork VGI collection

8. Which type of data can be provided by citizens for the system, and which types are not possible?	To acknowledge the limitations of VGI	From fieldwork VGI collection
9. How complete, current and accurate is VGI compared to more formally collected land data	To acknowledge the limitations and strengths of VGI	From analysis of field work VGI collection
10. How can VGI to be incorporated into, or supplement, an official LAS?	To identify what changes formal systems might need to accommodate VGI	From final workshop with land professionals in the case study location

7 Conclusion

This research has reviewed the issues of land administration systems in developing countries, focussing on an Iraqi case study. The country is suffering from different waves of population displacement, uncontrolled illegal expansion, seizure of public land and building, fragmentation and parcel subdivision, forging of ownership deeds, and other LAS issues. The motivation for, previous lessons from, and quality of VGI generally was considered, specifically its role in addressing such land administration issues. Finally, a detailed examination of the role of VGI in enhancing official systems was proposed.

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