Determinants of NRLAIS in Ethiopia

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Ethiopia has embarked on one of the largest digitalization programs for rural land registration in Africa. The program is called the national rural land administration information system (NRLAIS). NRLAIS utilizes a modular technology stack with web-based approach and Land Administration Domain Model (LADM) for rural land registration. NRLAIS considered the functional and legal requirements at four government organizational structures (federal, regional, zonal, and woreda).

Keywords: land register ; digitalization ; standardization ; tenure security ; governance ; structural equation model

1. Introduction

Traditionally, land administration systems were created to record information about property ownership, rights, and boundaries, and other attributes of real properties [1]. However, depending on the context, the strengthening of land rights can take a variety of forms, from documenting customary uses to formalizing individual rights [2]. In other instances, existing customary land tenure systems may be sufficient to ensure land tenure security [3]. Land registration and information system programs and procedures to implement these programs are among the major reasons for failure or success to achieve stronger tenure security [4]. Thus, land registration and information system organization should be part of studies on land tenure and investment in land and productivity [5].

Land information systems (LIS) are understood as a set of land information technologies (hardware, software, infrastructure, and equipment), personnel, data, rules-based procedures, and organizational structures. The existence of good and well-functioning land information infrastructure is key to answering the fundamental land development and management decision-making questions (i.e., why, who, what, where, when, and how) [6]. The LIS should be complete, reliable, uniform, up to date, and sustainable [7]. Accurate and up-to-date land administration data are also understood as occurring between land information system establishment and maintenance phases [8]. Hence, LIS needs to reflect the reality on the ground and transform itself into a dynamic and sustainable innovation hub and meet service expectations [9][10].

However, it is worth noting that the overall establishment, effectiveness, and maintenance of an integrated geospatial land information system depends on governance, technology, and people factors [11][12]. The governance factor further decomposes to the establishment of appropriate policy, legal framework, and governance structures, while the technological aspects include the data, innovation, and standards. The people dimension is concerned with capacity building, education, partnership, communication, and engagement [13]. Particularly, understanding factors influencing the intention of personnel to accept and use the system is important for the digital transformation and effective land administration service deliveries [14].

In the land registration and land tenure discourse, the 1970s and 1980s marked a move from a paper-based and manual type of data management and process to digital and automated systems in developed economies [15]. Many attempts have been made to set up titling systems in numerous African countries in the same period [16]. However, the efforts have largely failed to achieve the expected transformation, owing to colonial imported rules and systems that disregard local context, among other reasons [17][18]. In most cases, land registries failed to provide authoritative records of titles and transactions and quickly became outdated due to poor planning, lack of capacity, and the flouting and manipulation of law by officials and elites [19].

Despite low coverage of land registration in Africa (only 10%), the surge of land titling programs following the recent reform of land policy and legal framework, such as in Ethiopia and Rwanda, have shown positive trends and outcomes [17][20]. The reform provides a rapid scale-up across the continent that improves access to land and tenure security [17]. These approaches take different forms, ranging from fit-for-purpose to pro-poor land recordation approaches [20][21][22]. Advancements in information technology have also facilitated the speedy acquisition, storage, dissemination, and application of data related to tenure, use, value, as well as the development of land and other natural resource

governance [23]. Demands for a more customer-oriented focus is also one of the drivers for the automation of the land administration systems [15][11]. In this regard, a first step in introducing a new information technology (IT)-enabled land administration system is the determination of the user needs [1]. Hence, if LIS is to be successful, it will be designed to fulfill the requirements of its end-users [10]. Evidence shows that some African countries such as Rwanda and Ethiopia have launched modernization initiatives for their land information systems [9]. These countries accelerate and securely register land titles into a functional land registration information system [24][25].

In Ethiopia, at the heart of the land administration reform is the digitalization of the manual land register. Recognizing the manual land register shortcomings related to the maintenance, security, accessibility, and integration of land information at different administration levels, the Ministry of Agriculture (MoA) has opted for digitalization. Between 2015 and 2017, the MoA has developed and successfully piloted the national rural land administration information system (NRLAIS) in the highland regions [26]. NRLAIS is a web-based system developed on open-source licensed software and based on the land administration domain model (LADM). Hence, NRLAIS is the programmatic approach of the MoA to address the shortcomings of the semi-manual land register, improve the standardization of service delivery, and promote informed policymaking [26].

2. Study Site

The study covers 50 sample woredas of three regional states (Amhara, Oromia, and SNNP) in Ethiopia. These three regional states hold over 80 percent of the total population and close to half of the country's landmass [27]. Geographically, most of the study areas are located in the central highlands of the country and some along the south-central parts of the Rift Valley, characterized by high population density and diverse land uses. The male (50.1%) population is slightly higher than the female (49.9%). Over 70% of the population in the study areas is under age 30, which aligns with the overall national age breakdown [27], showing a high density of younger people in the study areas. Agriculture, forestry, and livestock raising contributed directly or indirectly to the livelihoods of most of the population in the study areas. Climate change is leading to above average temperatures and greater rainfall variability, with a pronounced effect on agricultural productivity and the suitability of major crops in the study areas [28].

According to official figures from the Ethiopian Central Statistics Agency (CSA), the urbanization rate is growing at an average rate of 5.2 percent per year since 2018. If these trends continue, the urban population is projected to reach 50 million by 2034 [29]. Natural increase rather than rural-to-urban migration was the main driver of urban population growth up to 2018, with rural-to-urban migration being the main driver since 2018 [30]. As population density increases, combined with continued land fragmentation, large cohorts of young people will increasingly become functionally landless. This fuels intense land use competitions and conversions of rural land to built environments. This is becoming a serious land governance issue, particularly in the urban–rural frontiers of most Ethiopian cities [31]. Currently, access to land continues to be difficult due to increasing land scarcity and the total area of landholding per household diminishing over time in the study areas [32]. The average number of rural land parcels per study woreda is 83,000. The woreda land administration offices had an average annual subsequent land transactions turnover of 1 percent, mainly through inheritance, donation, and land rentals. The average size of parcels involved in these transactions was about a quarter of a hectare [33].

According to the MoA [33], as of November 2021, over 180 woredas had established NRLAIS and made it operational. Woredas with operational NRLAIS are found in Amhara (61 woredas), Oromia (68 woredas), and SNNP (56 woredas) regional states. The study excluded the inaccessible Tigray regional state due to the ongoing armed conflict and instability. According to the same source, information of about 11 million parcels has been registered in NRLAIS, covering close to 6 million hectares.

3. Sampling Method

To determine the sample size required for a study that uses a structural equation model (SEM), the authors applied the Soper [34] online free statistic calculator, which calculates prior sample sizes for structural equation models. This sampling calculator considers the number of observed and latent variables in the model, the anticipated effect size, and the desired probability and statistical power levels. Accordingly, the model of this study contains 29 observed variables and six construct latent variables. The model considers the anticipated effect size of medium (0.3), the desired probability level of 0.05, and desired statistical power level of variables of 0.8. Hence, the minimum initial sample size to detect effect was determined to be 161, the minimum sample size for the model structure was 100, and the recommended minimum sample size was 161. The random selection process was stratified by regions in proportion to each region's number of woredas covered with operational NRLAIS.

4. Sample Size

As a result of these sample size requirements, 50 woredas were selected randomly (17 from Amhara, 18 from Oromia, and 15 from SNNP). There are four to six land administration experts per woreda on average who operate the NRLAIS, which means about 450 experts in total. In this study, land administration expert is used as a common name for people working on land administration matters in the woreda land administration offices with different titles, including land registration experts, cadastral surveyors, geospatial and land information management experts, land law and compliant management experts, land transaction experts, team leaders, etc.

From the 50 sampled woredas, about 275 land administration experts were targeted and invited to respond to the self-administered quantitative survey questionnaire by email and the Telegram social media platform. The survey data collection was conducted between April and May 2021. This virtual method of data collection was preferred due to restrictions on movement to field sites caused by the COVID-19 pandemic outbreak and the state of emergency in some of the study areas following social instabilities, particularly in the northern parts of the country. Telephone follow-up calls were also employed to clarify question items to respondents and enhance the quality of the survey data. Of the 220 filled and returned questionnaires, 19 were incomplete. The result shows a 73% success rate of properly completed questionnaires. Depending on the study design model selected, the sample and effect size of the survey data were found satisfactory.

5. Current Discussion

Land administration governance in Ethiopia is complex and requires the use and integration of an innovative and robust set of land registration information technologies that meet the social, economic, and environmental goals of tenure security and service delivery. Innovative information technologies and systems can be used to help build a quicker, accessible, affordable, and more reliable LIS. This, in turn, provides landholders, communities, business firms, and the general public with a clearer sense of tenure security, particularly to women, by providing evidence of recognized and enforceable land and resource rights.

Historically, the land administration system in Ethiopia has evolved in the urban–rural cadastral and land registration system divide. This costs the country a great deal in terms of economic, social, and environmental management and governance systems. With the depth of functional and legal requirements compliance, NRLAIS is instrumental in strengthening secure tenure rights in rural jurisdictions. It also demonstrates that standardization would pave the way for the development of a unified land administration information system in Ethiopia that embraces both urban and rural land tenure. Landholders with secure tenure rights will be incentivized to make long-term land-based investment that improve welfare and environmental outcomes.

This study demonstrated that the theoretical application of the research model that integrated selected variables from the IS success and TAM models to explain the acceptance and actual usage of NRLAIS in Ethiopia; acceptance and usage serve as proxy predictors of NRLAIS' operational success. The paper explored the determining factors and their relationships with technical (SYQU), organizational (SRQU and INQU), and the behavioral (PEOU and PRUS) aspects of the woreda land administration experts that influence the acceptance and actual usage of NRLAIS in Ethiopia. These constructs, along with measuring the LRIS' operational success, pave the way to scientifically research land administration system digitalization, particularly in developing economies. The research suggests that the IS success model integrated with TAM with selected variables was applicable for explaining LRIS acceptance and actual usage as a proxy predictor for operational success. This study does not include the organizational net benefit in its latent variable constructs measured by productivity, competitiveness, and management improvements. The discussion of the results is presented in detail as follows.

Firstly, based on the structural model, the study examined the relationship between the system quality and acceptance and actual use of NRLAIS. The results indicate that there is a positive and significant relationship between the system quality and the acceptance and actual use of NRLAIS (H1) on SRQU (1a), on INQU (1b), and on PEOU (1c). Based on that, it can be inferred that the woreda land administration experts relate this system quality with the acceptance and actual use of NRLAIS. The system quality constructs reflect the technical aspects of NRLAIS to its acceptance and actual use. These are that it is easy to learn, easy to use, and useful to do daily business related to land transaction management and service delivery at the woreda land administration offices. Malik et al. [35] and Hamdan and Al-Hajra [36] observed that a system's level of association had a positive influence on the perceived ease of use and the perceived usefulness of the system under investigation [35][37]. Moreover, the system quality would also affect the information quality

and the service quality of the organization under study, and this, in turn, affects the acceptance and actual usage of the system.

As described in the background section, the technical requirement review provides an understanding of the different components of NRLAIS as an automated and streamlined land registration information system for rural land. The functional and legal aspects of the rural land administration are key requirements of NRLAIS. This includes data capturing, data management, visualization, and workflow management and reporting. The NRLAIS system development process has engaged the regional and federal level land administration professionals in terms of the definition, verification, and approval of the functional and legal requirements as part of its quality assurance system. Hence, the multi-tiered application architecture makes NRLAIS possible to use at the different administrative levels with differentiated functionality and user interface. The login function and session time-out are also suited to secure the user's access to the system and the subsystems before any transaction begins. Furthermore, the classified roles of system users (officer, expert, and supervisor) represent read-only, data entry, and approval, and change secure system access as primary actors in the existing administrative roles in the institutions that operate the NRLAIS.

Regarding information quality, the results of this study are consistent with what was found by Nugroho and Chang et al. [38][39]. NRLAIS also manages information regarding land transaction performance at the woreda level, such as the type and patterns of land transactions made. Updating the land record is one of the key functions of the woreda land administration offices. This affects the efficiency and effectiveness of the land administration system and staff job performance related to all land transactions. Relevant and accurate land information affects operational business decisions of transactions to the regional governments, to federal ministries, and to the general public. Since land relationships change frequently, the information in NRLAIS needs to be updated and maintained. Timely and accurate management of information ensured through well-maintained cadastral and land use related information should reflect the reality on the ground. Complete and up-to-date land information will support expedited business decisions made by the woreda land administration offices, thereby enhancing legitimacy and trustworthiness of the woreda land administration offices. Further to this, the availability of such geospatial land information lays a foundation for the national spatial data infrastructure to flourish and be accessible to all concerned in order to inform strategic and policy reform.

Moreover, NRLAIS has a modular design that allows the system to be deployed at several administrative levels. The modular stack and the web-based server design of NRLAIS enable the transfer of data and information from lower to higher administration levels to include zone, region, and federal levels that facilitate easier deployment. However, this data and information flow is yet to happen due to low and weak telecom network infrastructure coverage in the country for access to strong bandwidth Internet services.

With regard to service quality, the result of the current study is consistent with the findings of Al Fraihat [40], Nugroho [38], and Malik et al. [35]. These studies found that the effective role or support service of the technical staff, (i.e., service quality) is positively related to the eventual use of the system [40]. Competency of the support staff, vendor support, and availability of training affected acceptance and use of IS [41]. The current study also revealed that the technical support service is significantly affecting the acceptance and actual usage of NRLAIS. However, an IT-enabled LRIS at this decentralized scale needs a solid IT management approach, which is dependable, available, and has good empathy of support staff. NRLAIS with sufficient quality affects the type and intensity of technical support in the transition operation from manual to digital service delivery. The quality of support service, in turn, affects adherence to standardized methods and procedures for service delivery in the acceptance and actual use of NRLAIS.

The transition and service operation is the highest priority for NRLAIS to function and be operational at the woreda level. In the context of the establishment of NRLAIS, it is essential to have a proper knowledge transfer from the developer to an in-house or outsourced local IT company, which carries out the ongoing system maintenance, upgrading, and operational support services. The woreda land administration experts' knowledge and skill acquired through training, experience gained during data migration, self-practice, and helpdesk support are also critical success factors. Therefore, the support service quality should be strong, regular, dependable, and available when needed at the woreda level.

Fourthly, the analysis revealed that perceived ease of use has a positive but insignificant effect on the acceptance and actual use of NRLAIS. However, perceived ease of use has a positive and significant effect on the perceived usefulness of NRLAIS (H4a). Hence, H4 was not supported, while H4a was supported. Malik et al. [35][37] found that perceived usefulness is influenced by an understanding of the information quality; [42] the current study analysis also revealed similar findings (H2b). Machdar and Malik et al. [35][37][43] found that the quality of information positively affects perceived usefulness and ease of use, and perceived ease of use positively affects perceived usefulness [43]. Several studies have found strong relationships between perceived usefulness and self-reported use [44], extent of use [45], or dependence on

an information system [46]. Empirical studies in various contexts have confirmed that the post-usage perception of usefulness has a strong association with actual use [47]. This holds true in the current study too, since the hypothetical relationships between the perceived ease of use effect on acceptance and actual use was found to be significant. This may be due to the fact that the survey collected post-usage perceptions rather than measuring intention to use prior-actual system use. Therefore, the behavioral antecedences of perceived ease of use and actual use should not be underestimated to meet operational success, though perceived ease of use has shown a weak relationship to actual use in the analysis.

The result of this study revealed that 69.5% of the acceptance and actual use of NRLAIS is explained by the perceived ease of use construct. The quality of information affects the perceived ease of use (27.5%), as well as the perceived usefulness (28.3%) of the woreda land administration experts. This, in turn, affects the acceptance and actual use of NRLAIS to maintain the land records of subsequent land transactions and to make effective and efficient business decisions in daily service delivery.

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