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Evaluating the Quality of Land Information for Peri-Urban Land-Related Decision-Making: An Empirical Analysis from Bahir Dar, Ethiopia

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Abstract: Proper functioning land information (LI) plays an indispensable role in supporting land-related decision-making processes. In recognition to this, substantial efforts have been made in Ethiopia to develop and modernize land information both in urban and rural land administration sectors. However, in Ethiopia, the quality of the current land information (completeness, appropriateness, time, cost, development, governance, sharing, and so on) needed for making decision is scantly evidenced, whilst the particular aspects of how the current urban and rural land information systems are functioning in view of the needs of peri-urban land governance are rarely studied. Thus, the main objective of this paper is to evaluate the quality of the current land information sources for supporting peri-urban land-related decision-making. The research relied on both quantitative and qualitative data. Primary data were collected using questionnaires, focus group discussions (FGD), and interviews. The data collected using a closed-ended questionnaire was analyzed using descriptive statistics. The validity and consistency of the data were tested using Cronbach's alpha reliability coefficient. The result signals that the quality of land information in the study area lacks responsiveness to support land-related decisions such as land use intervention and spatial management of peri-urban areas. The inefficiencies in the governance of land information and weak institutional efficiency prevailing in the different tiers of land administration institutions are the main causes. Furthermore, the variations in the governance of land information between urban and rural tiers of land administration institutions hamper data sharing, and it derives information redundancies and contradictions, which combined lead to ambiguous information use and reliance. The results further imply that the recordation of LI alone does not mean that it always supports decision making. When reasoning from the perspectives of the 8R framework of responsible land management, we conclude that the existing LI does not support many of the 8Rs. The researchers thus advocate responsive governance of land information and an alternative framework to embed effective land information for any peri-urban land decision making process.

Keywords: land information; quality; governance; decision support; responsiveness; peri-urban; Bahir Dar

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1. Introduction

Land information (LI) is a national asset [1] for supporting spatial decision-making [2–4], land use management [5,6], and overall sustainable development of a nation [5,7]. A good functioning land information infrastructure also helps to address the sustainable development goals in the global development agenda [8]; to answer the six fundamental planning and decision-making questions—why, who, what, where, when, how [9–11]; to understand land use patterns [12,13], and to evaluate the performance of land administration institutions [14,15]. Land information contains both spatial and non-spatial data, which are generated from the land administration functions—land use, value, tenure, and land

development functions [1,16]. Thus, land information that is complete, reliable, transparent, up-to-date, and readily accessible to end-users is pivotal in developing multiple aspects of sustainable development [17,18] and making effective decisions in all kinds of governmental and non-governmental activities [19].

The generation of accurate and good functioning land information depends on the quality of data acquisition processes (in terms of data accuracy, metadata, standard, and workflows), information dissemination platform, and its management framework in line with how and why decision-making processes occur. One school of thought to make this functional is by designing some sort of harmonized governance of land information [20]. In practice, this is however, difficult to easily achieve [21]. One of the challenges is to find suitable means to integrate horizontal and vertical integration of legal requirements [22]. The challenge of reconciling diverse interests and needs of different actors in a single system is another problem [23]. According to Crompvoets et al. [21], governance of land information can be realized 'through the assignment of related tasks to one single organization or through the division of tasks among different organizations'. Additionally, spatial data infrastructures (SDI) provide an important platform to share and disseminate the existing data [19]. However, developing a proper SDI is also a challenge because of the dynamicity and complexity of SDI related data providers and users, differences in versions and applications of spatial technology among providers, and variability of user demands [19]. In addition, the lack of means for adopting a fit-for-purpose kind of spatial technology hinders the development of effective land information use which could support just-in-time decision-making.

Ethiopia invested heavily on finance and resources to modernize urban and rural land information systems separately [24]. To make this clear, the country has two fragmented and distinct land information systems- one for urban and the other for rural land sectors [25]. However, the institutional relation set up and information for peri-urban decision making in Ethiopia is still weak. This is because the fragmentation of information repositories makes data sharing and dissemination complex and ineffective. Additionally, the institutional representation of the peri-urban areas across public sectors in Ethiopia is weak [24,26]. All these factors combined have negative implications on the magnitude to which land information can support decision-making in peri-urban areas effectively. However, an effective and workable land information system that is coined to support the decision-making in dealing with the multidimensional aspects of the peri-urban area is a matter of urgency especially in areas where there is booming urbanization, informality, and attributed land governance challenges [27–31]. In Ethiopia, new informal settlement patterns are developing continuously along with disputes over land in the peri-urban areas [25,32–35]. This means that peri-urban areas in the country are still difficult to manage and this requires sufficient provision of information to make an effective decision on typical peri-urban land-related decisions (such as land use allocation, rights, and restrictions, suitability analysis, relocation problems, and so on). However, the quality of the current land information sources (completeness, appropriateness, time, cost, development, governance, sharing, dissemination, and so on) used for making the land-related decision in Ethiopia is scantly evidenced, whilst the particular aspects of how the current urban and rural land information systems are functioning in view of the needs of peri-urban land governance are rarely studied.

As discussed above, different researchers, for instance, Hallett et al. [2], Abbas et al. [36], Youngho [37], Enemark [3], Chiemelu and Onwumere [38] and the United Nations Global Geospatial Information Management (UN-GGIM) working group [8] have studied the importance and functions of land information. The primary focus of these studies was to identify and describe the significance of land information for decision-making. However, what sorts of information existed with what quality, how the governance of land information is effective, and who provided information for peri-urban land-related decision-making (such as land allocation, rights, and restrictions, suitability analysis, relocation problems, etc.) are rarely/poorly studied. From the methodological perspective, this study is different from

the previous studies as it adopted the new holistic and emerging concept of responsible land management framework [39] to assess the quality of land information for land-related decision-making, which could be applied in further studies regardless of any geographic settings. Hence, this study will contribute to the existing theories especially on how the overall land information is governed and its quality is maintained through explaining the existing frameworks in terms of the 8R land management principles. Arguably, this has not been dealt with in any existing theories. From a practical perspective, such an addition to the existing theory supports decision making at least from two aspects. First, the 8R principles can bring a multidimensional evaluation of LI; secondly, because the evaluation parameters are already identified, decision-makers are expected to directly utilize these parameters to evaluate the LI in any land-related decision-making process. In sum, as it is argued earlier, this research is unique from existing literature at least from three aspects. Theoretically, LI governance and quality is further explained in terms of the land management theory (8R). In this sense, somewhat a harmonized theory between LI and land management framework is created. Methodologically, the adopted framework is a new holistic and emerging approach, and conceptually, this paper tries to bring the issue of peri-urban land governance on board, which is a hot issue in Ethiopia and needs further scrutiny of its governance together with the quality of LI. Therefore, the main objective of this paper is to evaluate the quality of the current land information sources for supporting peri-urban land-related decision-making in Ethiopia, with the intention to suggest an alternative land information management and decision support framework that can better derive relevant and usable policy options for peri-urban land-related decision-making. It evaluates to what extent the existing land information sources and governance frameworks are effective for peri-urban land related decision-making.

In this research, we take into account the general land information quality and governance indicators in the evaluation of the current information sources for making a specific purpose (i.e., peri-urban land-related decision making). According to the contemporary school of thought, land information governance framework is one of the main indicators. This could be seen from the perspectives of a division of tasks for different institutions or through the assignment of related tasks to a single institution [21]. This means that the governance of land information requires clear institutional representation with clear task division and responsibilities. The second indicator is the availability and workability of standards/legal frameworks for acquisition, updating, and governance of land information [24]. Here it is important to note that land information is dynamic in terms of space and time; hence, there should be a clear framework for updating the existing data sources in line with the dynamics of information, purpose, and the needs of the users. Completeness of detecting land information- covering the land administration functions [1] is also another indicator of effective land information. This helps to provide the required information in a given geographical context – local, regional, or national in scope [2]. In other words, the land information should be designed to fit the purposes. For this, a shared view of different actors is necessary [23]. Additionally, availability and accessibility of land information, consistency and usability of the data [40], data sharing and dissemination platform/integration of land information, availability and workability of the decision-making framework, and level of institutional integration for providing the required land information in the decision-making process are also the main indicators for effective land information.

Concerning the scope and limitation of the study, this study is limited to evaluate to which extent the current land information sources and governance frameworks are effective for supporting peri-urban land-related decision-making, with the intention to suggest an alternative land information management and decision support framework. Within this scope, the options and requirements for the improvement of land information and the proposed information management and decision-making frameworks here are based on the empirical evidence, literature, actual context of the peri-urban areas, and the land information management framework of Ethiopia. These contexts might not fit to other

countries with different land policies and legal frameworks, thereby, further empirical work will be necessary to refine the framework for a particular country context.

The paper is structured as follows. We started by discussing the contribution and indicators of effective land information. We then explain how these indicators can be used to evaluate the quality of land information for a specific purpose. Then, we applied this methodology to evaluate the quality of the current Ethiopian land information sources for supporting peri-urban land-related decision-making, from which we derive conclusions and scopes for improvement.

2. Materials and Methods

2.1. Study Area

Bahir Dar, a capital city of Amhara National Regional State (ANRS) was selected as a study area. The reasons to choose this study area are (1) high rate of urbanization and prevalence of peri-urban areas; (2) continuous development of new informal settlement patterns and frequent disputes over land; (3) representative area for many other regional cities in Ethiopia; (4) easy access to data both from the government (at different levels) and households and (5) one of the pilots and exemplary area in developing modern land information [41]. Bahir Dar is expanding horizontally with an unpredicted rate of urban expansion [28,42,43]. This increasingly leads to the existence of land use disputes, informality, and land governance challenges [44,45]. As response to these challenges, there is an urgent need of effective land information that can support the planning and decision-making related to land uses. However, the quality of the current urban and rural land information sources for making a decision, particularly for peri-urban land-related decision-making is rarely studied. Taking these into account, the study was primarily focusing to evaluate the quality of the current land information sources for supporting peri-urban land-related decision-making by taking empirical evidence from Bahir Dar city peri-urban areas. Geographically, Bahir Dar is located at the southern tip of Lake Tana—the source of Blue Nile River, approximately 560 km northwest of Addis Ababa. The geographical map of the study area is indicated in Figure 1.

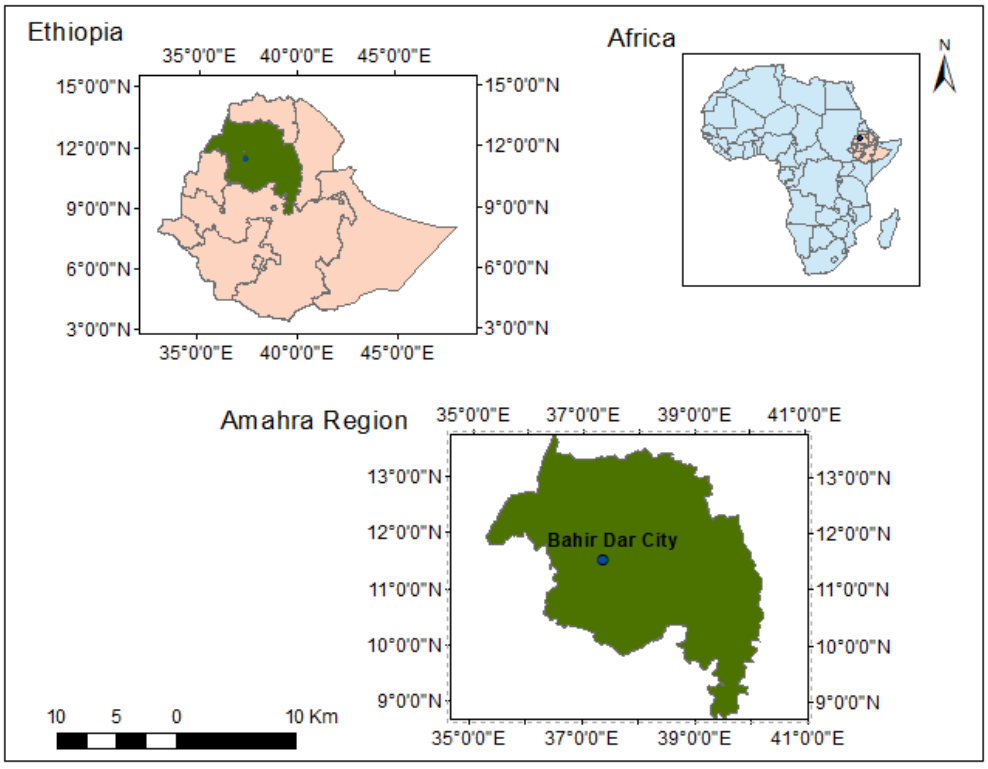

Figure 1. Location of the case study city.

2.2. Research method

The premise of this paper is that there is a need to evaluate the quality of the existing land information sources for supporting the peri-urban land-related decision-making. Such evaluation requires both qualitative and quantitative data. Thus, the approach of the research relies on convergent mixed-method (i.e., using both quantitative and qualitative data). A convergent mixed-method research approach is a form of research approach in which the researcher collects and merges both quantitative and qualitative data to provide a comprehensive analysis of the research problem [46]. In this instance, both quantitative and qualitative data related to the availability and workability of data acquisition, updating and management standards (observable from government documents and collectable through interviews and surveys), completeness of detecting land information (collectable and analyzable from FGD, interviews and survey), availability and accessibility of land information (collectable and analyzable from a survey), availability and workability of land information management and decision-making systems (observable from government documents and collectable through interviews and surveys), and integration of land information and the level of institutional integration for providing quality land information for decision-making (observable from government documents and collectable through FGD, interviews and survey) and so on were surveyed and collected at a time.

2.3. Sample Size and Sampling Technique

The sample size was determined using a proportional sample size determination formula to get representative opinions (considering high population, high population dynamicity, and high variability in the acceptance of specific LI management framework). We used a formula recommended by Cochran [47], Yamane [48] and Israel [49] which calculated as $n = (Z^2\ pq)/e^2 = (Z^2\ p(1-p))/e^2$ where n is the sample size, Z standard score at a specified confidence interval, e is the desired level of precision (the margin of error), p is the estimated proportion population, and q is $1 - p$. Thus, the sample size of the study was calculated with the assumptions of 95% confidence level (Z value with 95% confidence level is 1.96 from Z table), 5% margin of error, and p is 0.5 (maximum variability). Therefore, the total number of sample size using the formula $(n) = (\mathbb{[}1.96\mathbb{]}^2 \times 0.5(1-0.5))/\mathbb{[}0.05\mathbb{]}^2$ is 384 sample households. Sample household respondents were selected using a simple random sampling technique. Additionally, a total of 20 sample land information (LI) experts working at the land administration institutions (LAI) were selected using a purposive sampling technique.

2.4. Methods of Data Collection

Primary data related to the availability and workability of data acquisition, updating and management standards; availability, completeness, appropriateness, and accessibility of land information; availability and workability of land information management and decision-making systems; and alignment/integration/ of land information and the level of institutional integration for providing the required land information for decision-making were collected using questionnaires, FGD and interviews. Differences in the response were validated by the data triangulation technique. The aim and the procedures for each data collection method are discussed as follows:

FGD—Held with selected local communities and land information experts/land administration authorities to complement the results from the questionnaire survey data analysis. The FGD was held following the formal protocol by two moderators—the main moderator and assistant moderator [50,51]. The discussion responses were recorded using an Audio recorder. The audio was translated to texts and summarized by cross-checking the note taken by the moderators. The response was validated by sending the summary of the discussion to the participants.

Interviews—The purpose of the interview was to view the perceptions, experiences, and recommendations of LI experts and authorities towards the quality of the current land information sources for supporting the peri-urban land-related decision-making. Semi-

structured interview questions were prepared and interviews were conducted in various categories with selected LI experts and land administration authorities. Interview responses were recorded using an Audio recorder and translated to texts. The key-informant from each actor was interviewed until the data were saturated.

Questionnaire—Different questionnaires (for households, and land information experts/operational staff/authorities) were developed, and firsthand information related to the quality of the current land information sources (completeness, appropriateness, time, development, governance, sharing, dissemination, and so on) for making a land-related decision were collected from the sample LI experts/authorities, and household respondents. While, supportive secondary data—largely descriptive data were collected from federal and regional land administration institutions.

2.5. Data analysis

The data collected through a closed-ended questionnaire was analyzed quantitatively using descriptive statistics to measure, describe, and summarize the behavior of the sample data. The validity and consistency of the data were tested using Cronbach's alpha reliability coefficient. Cronbach's alpha measures the internal consistency of items based on a set of inter-item relations of an instrument, and the alpha coefficient greater than or equal to 0.7 is accepted as high reliability [52]. Closed-ended responses were analyzed using a statistical package for the social science (SPSS) software; whereas, responses from interviews and FGD were analyzed and interpreted qualitatively in a content-wise. The discussions and interpretations were presented using the 8R "responsible" land management framework, which is equally applied/adapted to land information management [39] (see the description of 8R aspect and indicators in Table 1).

Table 1. 8Rs "responsible" land information management (LIM) aspect and indicators.

8 Rs	Questions/ Issues	The 3 Main Aspects		
		Structures (Functionality and Appropriateness of Institutional and Technical Structures)	**Processes (Appropriateness of Individual Steps/ Processes)**	**Outcomes/Impacts (Appropriateness, Visibility of Results, Changes)**
• Responsive	Addressing the needs, requests, long-term views of peri-urban communities/ citizens/stakeholders	Are the institutional structures related to the LIM and decision making 'responsive' to the needs of peri-urban communities/ citizens (e.g., disseminating information)? Is there a place where citizens can express their voices and check whether there has been a response?	Do processes related to the LIM and decisions include a formal step to seek needs, feedback, or to check opinions	Is the decision responding to the needs of peri-urban communities? Is there a monitoring system to check whether needs and requests have been responded to?
• Resilient	Avoiding major disruptions/ensuring the sustenance of peri-urban communities	Are institutional and organizational structures sufficiently and appropriately providing LI for handling major problems which may arise from the decision?	Does decision making follow appropriate steps to check whether certain risks are dealt with and/or whether different decisions need to be taken at a given time?	To which extent can the socio-spatial structures 'survive' after the decision after the decision with the existing LI
• Robust	Solid mechanisms /not leading to fundamental change or disruptions	To which extent can institutional and technical structures withstand and remain intact after pressure from outside?	Are the execution processes set up in such a way that they can always be followed and not change?	Are the decisions fundamentally changing for the better or create a whole different set of dynamics?

Table 1. *Cont.*

8 Rs	Questions/ Issues	The 3 Main Aspects		
		Structures (Functionality and Appropriateness of Institutional and Technical Structures)	**Processes (Appropriateness of Individual Steps/ Processes)**	**Outcomes/Impacts (Appropriateness, Visibility of Results, Changes)**
• Reliable	Decisions are trusted or are based on trust or creating trust	Do institutional structures sufficiently and/or appropriately provide LI for supporting decisions? Are the facts on which decisions are based sufficiently bias-free?	Are decisions regularly checked and based on facts and/or proper evaluation of facts?	Are monitoring and evaluation systems in place to check whether the decision indeed resulted in what it promised?
• Respected	Decisions are valued positively	Are the formal structures and data sources (for decision making) sufficiently trusted?	Do the actors sufficiently take care of the acceptance and recognition of the decision?	Do communities, stakeholders/firms accept the decisions and processes? ,
• Retraceable	All steps are documented, so history can be reconstructed, and it is possible to see which steps have been taken by whom	Do laws and regulations clearly and unambiguously state where and how LI is accessed and decisions are taken and who or which organization or person ultimately takes a decision?	Are subsequent decisions carefully documented and are these open for all stakeholders?	Can accountabilities for disputed decisions be traced back?
• Recognizable	People can identify with the decisions	Are institutional and technical structures in place where stakeholders can be represented, and where communities can co-decide or express their views?	Do the processes systematically involve stakeholders in the decisions making? Can communities accept the final decision?	Can people identify themselves with the achievements, goals, and aims of the decision?
• Reflexive	At the regular time, there are moments at which the rightfulness or appropriateness of LI is re-evaluated or re-assessed	Are there formal procedures present to change or convert previous LI and decisions if there are new insights?	Do processes systematically build for which the executors and managers re-think whether they are doing the right thing before, during, and after the decision?	Are there measures to monitor the progress of achievements, and to reflect on whether achievements have been met or not?

Source: Adopted from de Vries and Chigbu [39].

3. Result Synthesis

The result presents a range of responses, views, and perceptions related to the quality of the current land information for supporting peri-urban land-related decision-making. It also presents options and requirements for the improvement of land information management, and decision support systems. Out of the total of 384 sample household respondents, 348 sample household respondents correctly completed and returned the questionnaire. Additionally, 20 sample LI experts/operational staff, specialized in land information related fields completed and returned the survey questionnaire. The Cronbach's alpha reliability test was 0.858 which is accepted as high reliable for interrelated items [52]. Thus, the following section presents the views of selected households, LI experts, and land administration authorities on the quality of land information for supporting peri-urban land-related decision making.

3.1. Acquisition and Updating Processes of Land Information

Empirical data were obtained from the sample respondents to assess whether there are clear standards, regulations, and metadata enacted for acquiring and updating land information or not. As presented in Table 2, 70% of the sample LI experts perceived that the land administration institutions have clear standards, regulations, and metadata for acquiring/detecting land information. Whereas, 25% of the sample respondents highlighted that the existing standards and regulations are unclear. The remaining 5% of the respondents were undecided to argue whether there are clear legal frameworks or not. Similarly, 65% of the respondents indicated the existence of clear standards and regulations for updating land information while 30% of the respondents highlighted the presence of unclear standards. This means that nearly three-fourth of the LI experts/operational staff indicated the presence of clear legal frameworks enacted for the development of land information. This is connected with the presence of the national urban cadastre and land registration proclamation, regulation, and standards [53–56]. However, one-third of the LI experts/operational staff perceived that the existing legal frameworks are unclear and fragmented. This implies that there are still different perceptions on the existence of a clear legal framework enacted for the development of effective land information.

Table 2. Responses of LI experts on the availability of clear standards for detecting and updating LI.

How Do Land Administration (LA) Institutions Detect Land Information (LI)? (Valid *n* = 20)		**How Do Land Administration (LA) Institutions Update Land Information (LI)? (Valid *n* = 20)**	
Response	**Percent**	**Response**	**Percent**
There are clear metadata, standards, and regulations for acquiring LI	70.0	There are clear metadata, standards, and regulations for updating LI	65.0
There are unclear and fragmented standards and regulations for acquiring LI	25.0	There are unclear and fragmented standards and regulations for updating LI	30.0
Not known/undecided	5.0	Not known/undecided	5.0
Total	100.0	Total	100.0

Concerning the effectiveness of detecting and updating processes of LI, 55% of the sample LI experts perceived that the current processes of detecting land information are moderately effective. Likewise, 40% of the sample operational staff respondents reported that the process of updating land information is moderately effective. Conversely, 30% and 45% of the sample LI experts respectively, claimed that the acquisition and updating processes of land information are technically ineffective, (see Figure 2). Regarding the completeness of information, 40% of the sample LI experts perceived that the existing process of acquiring land information is moderately complete. Similarly, 50% of the sample LI experts reported that the process of detecting land information is moderately appropriate (see Table 3).

The empirical data synthesis further indicates the existence of weak integration and provision of land information for decision-making. As presented in Table 4, about 59% of the sample household (HH) respondents claimed that the level of integration of land information among the different land administration institutions (e.g., urban and rural sectors from federal to local level land administration units) is ineffective. Likewise, 61% of the sample household respondents argued that the existing organizational setups are ineffective for providing land information for decision-making processes. Conversely, only a few (4%) of the sample household respondents reported that the existing institutional setups are effective to provide land information for decision-making (see Table 4). In this regard, the majority of land administration authority key informants also explained that the "collaboration of land administration institutions for developing, handling, sharing

and providing the existing land information (e.g., at Federal, regional and local/municipal authority level) is very weak". Of note, there is a vertical administrative structural hierarchy from federal to local/municipal level both in urban and rural land institutions. According to the majority of key informants, the urban land administration institution has strong vertical integration/ linkages. This is because of the existence of the same national land information standard and regulations across all national regional states. However, most of the discussants outlined the existence of weak horizontal integration between urban and rural land administration institutions related to the development and sharing of land information. Here, peri-urban areas are loosely considered. Even, one of the land administration authority key informants reported that "the two institutes attempt to evade responsibilities and confront each other in some activities (pushing the task to the other body instead of taking action so that they could avoid accountability)". This is particularly the case in peri-urban areas. This could create problems to develop effective and up-to-date land information that can support decision-making processes.

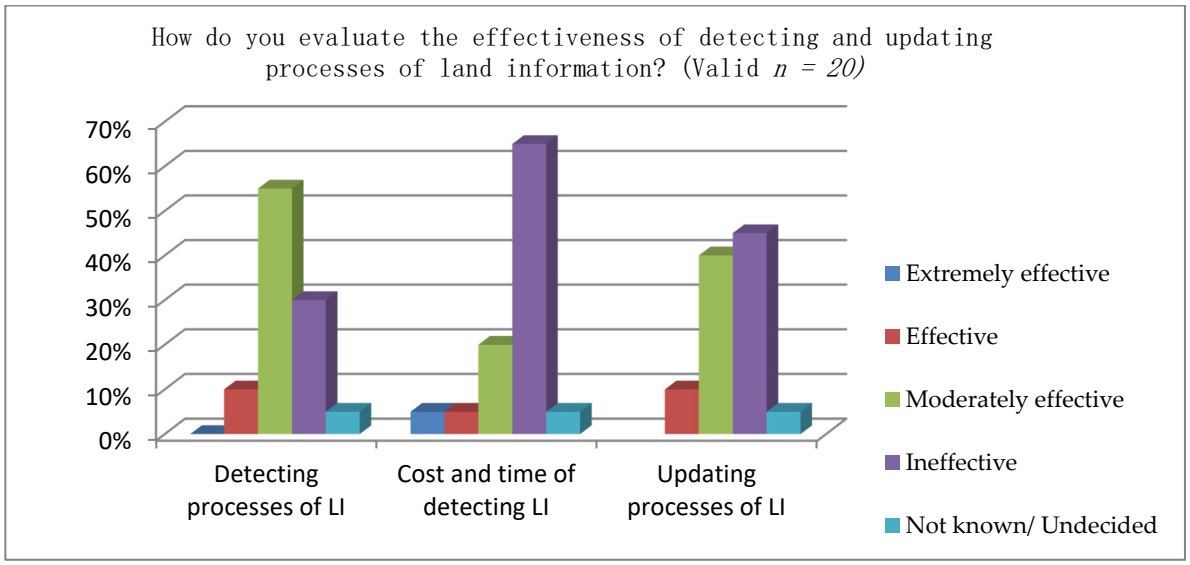

Figure 2. Responses of LI experts about the effectiveness of detecting and updating processes of LI.

Table 3. Responses of LI experts about the completeness and appropriateness of detecting LI.

How Do You Evaluate the Completeness of Detecting/Acquiring Land Information? (Valid *n* = 20)			How Do You Evaluate the Appropriateness of Detecting/Acquiring Land Information? (Valid *n* = 20)		
Response	**Frequency**	**Percent**	**Response**	**Frequency**	**Percent**
Not known	1	5.0	Not known	1	5.0
incomplete	8	40.0	Inappropriate	7	35.0
Moderately complete	8	40.0	Moderately appropriate	10	50.0
Complete	2	10.0	Appropriate	2	10.0
Extremely complete	1	5.0	Total	20	100.0
Total	20	100.0			

Table 4. Responses of HH's on the integration levels and provision of LI for decision making.

Response	How Do You Evaluate the Integration of LI among the Different Levels of LAI? (Valid *n* = 348)		How Do You Evaluate the Effectiveness of Providing LI for Decision Making? (Valid *n* = 348)	
	Frequency	Percent	Frequency	Percent
Highly effective	1	.3	6	1.7
Effective	12	3.4	15	4.3
Moderately effective	102	29.3	92	26.4
Ineffective	204	58.7	212	61
Undecided/Not known	29	8.3	23	6.6
Total	348	100.0	348	100.0

The data sharing process is also a challenge. In this regard, the majority of key-informants reported the existence of only uni-directional/one-way kind of data-sharing framework traditionally with the premises that only urban land administration institution requires land information from rural land sectors during the expansion of the city. This assumption has been included in the urban land information/cadastre/standard which clearly outlines a direction to take data from rural land administration institutions, but nothing is said about the prerequisites and procedures on how to share data between institutions. According to some FGD discussants, "the rural land administration institution does not require land information from urban land administration institution". This is because of the existence of a one-way taking of land (i.e., it is only the urban land administration institutes that require rural land for city development, not the other way round). In addition to the conception of a one-way data-sharing framework, interoperability/compatibility of the data is also another challenge. According to the majority of the key informants, both urban and rural land administration institutions have their own land information systems with different standards (without a national metadata standard). This becomes an acute problem especially when the issue of data integration and compatibility is needed after the data-sharing. Overall, the results here imply that data sharing and dissemination for supporting the peri-urban land-related decision making is challenged by the differences in the existing standards and the misconception that the rural land-related decision making does not require LI from urban institutes. The main differences between urban and rural land information are summarized in Table 5. As presented in Table 5, urban LI bases on a national-oriented standard and platform while rural LI bases more on regional-oriented standards and platforms. This means that urban land administration institutions follow the same LI quality assurance strategy all over the regions while rural LI quality assurance strategy differs across regions. Additionally, differences in the spatial accuracy and registration systems negatively affect data sharing and dissemination processes among the different land administration institutions. This means that the peri-urban area is hardly supported by effective land information due to the existence of fragmented and poorly integrated information sources.

Concerning the sources and governance of LI, key informants forwarded two different views. Some informants perceived that there is land information at different levels of land administration institutions (i.e., at experts/operational, management, and decision-making levels). According to the key informants the problem is how to chain or link this information for supporting decision-making. In other words, those data which are found at the expert/operational level are not well synchronized and shared with the management level. The management level also fails to coach experts and to arrange and present the data to decision-makers. Additionally, most of the land information is archived and managed by an individual instead of institutional-based archiving. This creates problems to know whether the existing land information is trustable or not and how to access it. This means that there is a problem of data sharing among operational, management, and decision-

making levels. According to the informants, this is because of two main factors. One of the main challenges is 'the political sensitivity of land information'. The second main reason is considering land information as a source of illegal income by corrupted experts/authorities and land speculators (e.g., during the land lease or illegal land use changing).

Table 5. The main differences between rural and urban LI (in terms of development and governance of LI).

Rural Land Information	Urban Land Information
• No clear responsible organ for regulating standards, mostly the regions regulate the standards	• There is a responsible organ that can regulate similar standards across all regions
• Standard/manual differences among regions	• The same standard across all regions
• Regional oriented platform	• National oriented platform
• Spatially less accurate (though it is not expected)	• Spatially more accurate
• Deeds like system	• Title system
• Quality assurance strategy differs across regions	• Similar quality assurance strategies all over the regions

Source: Own survey.

Some other informants argued the opposite: they emphasized that the existing land information is not sufficient for making an effective decision. Especially, peri-urban areas are uncovered or left unregistered both in the rural and urban sectors. The urban sector is focusing on the urban land while the rural sector left peri-urban land registration—assuming that the urban land administration will take over the land shortly. This will have a clear consequence on the decision-making process on peri-urban lands. According to the key informants, "the land administration institutions are hardly able to win court cases and this is because land speculators can drive and present false and systematically fabricated land information". This means that land speculators have more power to misuse the land. These speculators are found in different levels of land administration institutions as operational staff or administrative units. This is also another challenge for sharing land information in the formal peri-urban land intervention processes.

However, few key informants reported the growing interest to share data among the different land administration institutions. For example, the urban land administration institution/urban plan institute is consulting rural land administration institutions during orthophoto preparation. Additionally, the city administration is trying to use rural orthophoto and other raw information for peri-urban land use planning/interventions. Rural land administration institution is also trying to provide detailed ownership information to the city administration for the payment of compensation to landholders. The overall discussions emphasized that the land information especially attribute data (e.g., for whom the land belongs) is somehow sharing with urban land administration institutions, but the spatial data is always re-collected by the city administration experts—thinking that urban patterns need detail spatial accuracy.

Overall, the FGD discussant and key-informants reported that the conventional data, first-level rural land certificate/green book/containing only the legal/ownership information with no spatial details, remote sensing data, land survey data, personal witness, neighborhood witness, and witness from local community representatives are the main data sources for decision making related to the peri-urban land intervention. This implies that land administration institutions try to answer the questions of communities and other developmental needs using both conventional and partly digital information (e.g., first-level land certificate-ownership) and other supportive spatial data. However, the spatial data (e.g., remote sensing data, structural plan) are not sufficient and accurate to provide an effective decision regarding where, when, how, why, and who own in what perspectives. According to the FGD discussants, frequent complaints, increasing land disputes and the day-to-day court cases are good indicators for the ineffectiveness of decision-related to land. Most of the day-to-day court cases are related to land disputes. All this implies that the existing land information is not sufficient to drive a feasible decision option related to

peri-urban land use management. The empirical data obtained from the sample household respondents also indicate the ineffectiveness of the existing land information for managing peri-urban land (see Figure 3).

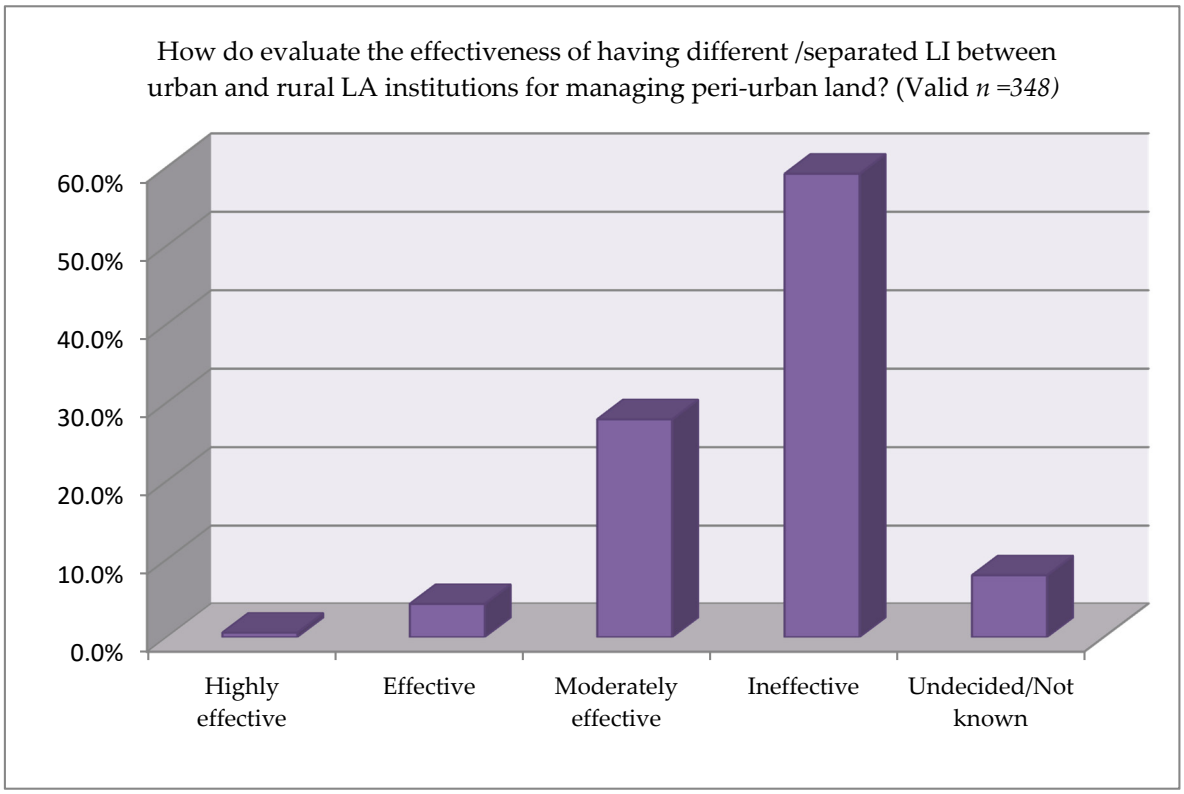

Figure 3. The responses of HH's on the effectiveness of the existing LI for managing peri-urban land.

The empirical data obtained from the sample household respondents also magnifies the problems related to registration and updating of land information. As indicated in Figure 4, only 18% of the sample household respondents reported that the land administration institutions have updated land information related to land use rights, responsibilities, and restrictions. In this regard, one of the communities FGD discussants reported that "the government may register the land; however, whether newly registered or existing information is not transparent to the community, sometimes it is hidden for the sake of political interests/speculation of the land". Three out of six FGD discussants shared this idea. Conversely, two out of six FGD participants highlighted that land administration institutions are recording land information (such as land use rights, responsibilities, and restrictions) whilst first level landholding certificates are provided to the community. From this, one could infer that there are efforts to record land information, however, most of the communities are not yet finding full information related to use rights, responsibilities, and restrictions when they are required during the processes of peri-urban land interventions or other land use transaction purposes. This is because of either technical inefficiencies or lack of transparency in the existing system. Additionally, the communities are experiencing the effects of uncertainties where to go with their requests for services as the institutions are fragmented to urban and rural land administration institutions.

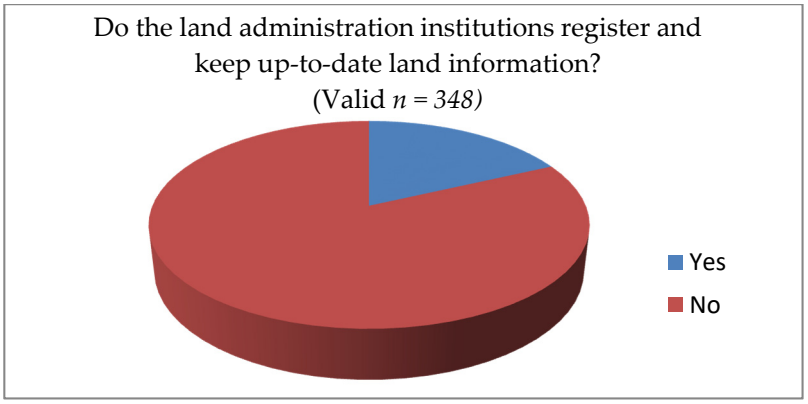

Figure 4. Responses of HH's on the registration and updating of land information.

3.2. Currently Operational Land Information Management Systems (LIMS)

Land information management systems are indispensable for land administration institutions to manage, provide, or effect the required information for decision-making. In this regard, 45% of the sample LI experts responded that the land administration institutions currently have standardized land information management systems. In contrast, 50% of the respondents indicated that land information is currently managed with fragmented and unstandardized land information management systems (Table 6).

Table 6. Responses of LI experts on the availability of LIMS.

Response (*n* = 20)	**How Land Information Managed so far for Providing/Effecting the Required LI for Decision Making? Valid *n* = 20)**	
	Frequency	**Percent**
There are standardized/sustainable LIMS	9	45.0
There are fragmented /different type and unstandardized LIMS	10	50.0
Not known/undecided	1	5.0
Total	20	100.0

Information obtained from FGD participants also indicates the existence of different types of LIMS both in rural and urban land administration institutions. However, the efforts for developing sustainable LIMS are still considered ineffective. A good indicator for this is that the land administration institutions are still in the process of developing two separate LIMS for urban and rural land administration institutions independently. The rural land administration is building a system called the "**Mobile back office**" at the *woreda*- which is a broader administrative unit next to region and zone level, and connected to the front office at the *kebele* level- which a local level administrative unit. This new system aims to provide services for landholders/farmers at one central locality (i.e., "one-center-kebele" will provide land information for the neighboring kebeles). Similarly, urban land administration institutions are building an urban land registration and cadastre system. However, all of these systems are still not yet operational to support decision making. This implies that the land information management systems in both the urban and rural land administration institutions are weak and there are no efforts to develop effective land information management systems. Both the urban and rural land administration institutions foster a land information infrastructure containing heterogeneous standards and systems. This implies that decision-making with the support of reliable information remains a challenge; particularly in peri-urban areas.

3.3. Options and Requirements for the Improvement of Land Information

As discussed above, the existing land information, legal frameworks, and efforts towards the development and management of land information are fragmented and infective. Hence, decision-makers are unable to make effective decisions and actions related to land disputes. This is particularly the case in peri-urban areas where new types of informal/illegal settlements and urban expansion frequently exist. This circumstance needs a clear institutional and legal representation and an improved land information framework that can integrate the land administration institutions both vertically and horizontally. In this regard, the respondents find a central responsible institution more preferable than the existing fragmented land administration institutions. According to the majority of FGD discussants and key-informants, establishing a responsible land administration entity that is mandated to oversee the overall land administration issues related to rural, peri-urban, and urban areas is deemed necessary. This institution can be an umbrella institute like "the Ministry of Land" that is mandated to manage all institutions which are working on the land sectors. Doing so on the institutional setup is crucial in order to encourage collaborative works on the development and governance of land information. However, different options are forwarded regarding the levels of integration of land administration authorities and operational staff. Three out of ten FGD discussants claimed that the land administration authorities and operational staff can continue operating separately in urban and rural sectors as it exists in the present structure, provided that a top-level institute that manages all institutes working on the land matter is put in place. Likewise, three discussants shared the need of a responsible institution, but they also argued that the existing institutional setups should be rearranged in a way that only operational staffs shall be separated for doing specific tasks at local level administrative units and all other top management and decision-making organs shall be aligned. The remaining four discussants argued that all the decision-making, management, and operational levels should be integrated at all levels of administrative units. Additionally, most of the key informants reported the need for organizing a top-level responsible institution that is mandated to manage all land-related institutions. The majority of the local community FGD discussants also preferred to get the land information in one place either in a rural administrative unit or in the urban administrative unit. This implies that the different groups of respondents wish to see a responsible land administration to reduce the effects of uncertainties where to go for service requests and to define service provisions. Of note, the perception of respondents on the degree of institutional alignment is found diverse.

According to the majority of discussants, the above options help to reduce uncoordinated works and double work to secure data for a single plot of land (especially in peri-urban areas- urbanization is a continuous process in the context of the case study area). It also helps to reduce specific thinking (e.g., in the existing system, the urban sector needs a specific plot of land for settlement while rural land administration needs the same land for agriculture purposes). From the analysis, it is possible to note that at least the legal framework and the top-level institution shall be harmonized for easy access and disseminate land information for making effective decisions related to the peri-urban land use interventions. Here, the majority of key-informants wish and recommend the adoption of "One Platform-One Policy" framework that can integrate the fragmented land information found both in urban and rural land administration institutions. According to them, this is because the purpose and significances of land information are almost the same both for urban and rural land administration institutions—i.e., for decision support. Additionally, such a framework helps to reduce costs related to system development and human resource; to have a shared understanding of the development of land information; to get consistent information for decision making/reducing fabricated information/ and to make a real-time and web-based decision.

Besides the fragmentation of land information, the existing data both in urban and rural settings do not have metadata. This becomes the reason that the differences that do exist in the current land information/cadastre system (e.g., codding, spatial detail, attribute

details, and so on) are potential challenges for migrating data from one system to the other. In this case, the land information would need to be developed in such a way that it suits the needs of peri-urban decision-makers. Hence, the captured and stored information should be in line with the kinds of land-related decisions that are necessary for peri-urban land use development, i.e., land right allocations, spatial zoning, suitability assessments, land value assessment, and restrictions on land use. This means that the land information management system shall be designed in a way that supports the peri-urban land-related decision-making processes. Additionally, the system shall incorporate the different source of land information such as conventional and digital data—developed either by urban or rural land administration institutions. This helps to build relevant and trusted information by cross-checking the quality and accurateness of the data from different sources.

3.4. Alternative Decision Support Framework: Requirements and Indicators

The results so far indicated that the quality of land information and decision-making processes are perceived to be ineffective. This is particularly the case for peri-urban areas. Taking these problems into account, an alternative/a new kind of comprehensive and transparent/decision support framework is proposed with the premise that any decision made in one of the land administrations sectors to be transparent and recognized by other land administration institutions. The proposed decision support framework allows the involvement and participation of different land-related sectors including the urban land sector, rural land sector, industry and investment sector, tourism and culture sector, environmental management sector, the community, and land-related advocators to reduce the land speculators working both inside the land administration institution units and outside of the governmental organization.

The interface of the proposed decision-making framework shall have four privileges. The first privilege is the "view only interface". This interface allows different sectors or individuals to access and view the decision made by one of the land administration institutions. This privilege shall be given to all interested sectors or individuals. The second privilege is the "view access and compliance directing interface"—different sectors or individuals who have privilege can access and present their complaints to get improvement on the decision made. The third privilege is a "decision-request privilege"—this privilege gives options to the land administration institutions for requesting opinions and information from the different sectors or communities before a decision is made. This privilege could be a two-way communication privilege. The last interface is "decision-making privilege". This privilege shall be allowed only to the decision-makers. In sum, such a decision-making framework needs effective land information, institutional setup, and political commitments (see the summarized requirements, indicators, and the possible challenges towards the proposed framework in Table 7.

Table 7. Requirements, indicators and possible challenges towards the proposed framework.

Requirements	Indicators	Possible Challenges
• Clear institutional and legal representation • Effective, accurate and updated land information • Data integration/linkage • Central data warehouse • Web-services • Transparency • Data security • Sustainable LIMS • Political commitment • Affordable technology	• Data sharing, dissemination and provision level of land and land-related information • Level of data consistency • System integration • Real-time decision making	• Data integration • Data accuracy and consistency • Information linkage • Political commitment • Budget

Source: Own survey.

4. Discussions

In this section, the results presented in Section 3 are discussed in line with the 8R responsible land management principles (see Table 1). The 8R principles that have so far been applied in the responsive land management framework can still be applied in the context of land information management discussions [39]. When comparing the results in Section 3.1, Table 2 and Section 3.2, Table 6, there are lots of evidence that show the current system of land information governance does not qualify the sense of responsiveness to the actual peri-urban needs of citizens and the associated peri-urban land use interventions. This means that as the results in Section 3.1, Table 2 portrays the existing system of land information acquisition and management lacks completeness and appropriateness. Apart from this, the current system of land information acquisition and management is also not very reflexive on the rightfulness of peri-urban decision-making or peri-urban land intervention. This is because the functionality of the institutional and technical structure for acquiring and updating land information is fragmented and the data are heterogeneous in terms of type and quality. For this, 30% and 45% of the sample LI experts respectively as indicated in Figure 2, claimed that the current context and processes of acquiring and updating land information are technically ineffective. Conversely, only 10% of land information experts reported that the processes of acquiring land information are effective (see the descriptive statistics result in Section 3.1, Figure 2). The data sources for making a peri-urban land related-decision are not also very reliable due to different aspects. First, the institutional and organizational structures within a sector itself are not sufficiently organized to provide appropriate and complete land information that can support the decision-making processes (see Section 3.1, Tables 3 and 4 and Figure 3); second, there is isolated land information for urban and rural land administration as the land information from the respective sectors are managed by urban and rural land administration institutions separately with different standards, and information management systems (see the result Section 3.2); and finally, perhaps the most fundamental one, due to the fact that the peri-urban areas remain unrepresented in the existing system. This context supports the arguments of Wubie et al. [24], who argued that managing the properties of peri-urban land in Ethiopia is still difficult and vague due to the fragmentation of institutional and legal frameworks. These combined could imply that the peri-urban land-related decision is far from being respected and trusted by the citizens. It also fails to create harmony between urban and rural land information management and integration.

Currently, there is an ongoing effort in the land administration institutions in the study area to modernize the land administration system (i.e., creation of digital information such as legalizing ownership rights through first level land certificate and other supportive spatial data) so as to answer the questions of communities and other developmental needs. In other words, once the information is readily available and accessible for decision making and other related purposes, then the outcomes of the decision-making process somewhat recognizable by the end-users, and hence the outcomes of the decision can equally benefit all groups of the society. Despite this effort, and also as the results presented in Figure 4 and Table 3, there is a lack of sufficient and complete recordation of land information in the study area. This challenges the reliability of spatial information i.e., scrutinizing the where, when, how, why, and who own in what perspectives type of information is difficult. As it is presented in Table 5, respondents claim that the existing land information system is challenged by the issue of sustainability due to the different pitfalls presented in the results and discussions made above. When aligning this concept to the notion of the 8R principles, both the land information and its support to the existing decision-making processes are not very resilient to handle and support the resolution of the major peri-urban land-related problems in a sustainable way. The synthesis supports the recent studies conducted in Ethiopia. For instance, the study conducted by Burns et al. [57], Alemie et al. [58], and the United Nations [7] reported that urban land governances in Ethiopia are poorly supported by LI because of the challenge of affording reliable LI. Another study conducted by Wubie et al. [44] also indicated that the extent and levels of peri-urban land use manage-

ment problems and conflicts over land are increasing through time because of the existence of ineffective land intervention and decision-making processes.

Contrastingly, the decision does well on retraceability (as steps of decisions are somewhat documented by existing land information systems) and perhaps also on robustness (as the framework, especially the urban land information framework is relatively stable). Also, perhaps the current system does well in terms of the processes but not in terms of the institutional and technical structures and economic, societal and environmental outcomes.

When reasoning from the 8R framework of responsible land management, we could argue that many of the 8R's are not achieved. This implies that the quality of the current information sources in the case study area is not yet in a way that fits the purpose (i.e., for supporting peri-urban land-related decision-making). And affording workable and good functioning land information that can support the peri-urban area land-related decision-making remains a challenge. This argument supports a recent study conducted in three major cities in Ethiopia by Alemie et al. [59], who reported that urban land governances are poorly supported by existing LI because of the challenge of affording appropriate land information in the three cities. Another study by Burns et al. [57] also reported that decision-makers are not able to obtain sufficient information to make informed decisions due to the technical gaps such as acquisition and management of land information, and the lack of clarity on institutional roles and land registration processes. The United Nations [7] report has also clearly emphasized that affording reliable and up-to-date land information is appeared to be an ongoing challenge in most developing countries. This is mostly because of the limitation in the governance process of the existing land information and fragmentation of land information among the different land administration institutions. This needs an effective institutional platform that is mandated to regulate the land and land-related data collection, management, sharing, and dissemination framework to build uniform, complete, and reliable land information.

From the discussions, one can note that the fragmentation of information repositories makes data sharing and dissemination more complex and ineffective for making decisions. This problem is more magnified in peri-urban areas where there are different land information developed by both urban and rural land administration institutions independently [24]. In this context, effective governance of land information is necessary [21]. According to Crompvoets et al. [21], governance of information can be "realized through the assignment of related tasks to one single organization or through the division of tasks among different organizations". This argument further emphasized that the establishment of a coordinating institute with a respective decentralized shared structure is crucial; however, reconciling the diverse needs and interests of different actors is a challenge. On the other hand, the existing fragmented and duplication of information sources can be a potential source of information for building relevant and trusted information by cross-checking the quality and accurateness of the data from different sources. This supports the arguments of de-Vries and Nyemera [60] and de-Vries and Lance [61] who revealed the importance of redundancies of land information. In this regard, de-Vries and Nyemera [60] argued that the redundancy of information could be necessary to "maintain a minimum store of information, to increase data quality and access, back-up and compare and check data". However, according to Sjoukema et al. [19], there is a need to reduce the data providers effort by connecting the existing data. To do so, knowledge and awareness regarding the scale and spatial accuracy of the existing data are necessary. In sum, reduction of legal and institutional complexities [62], shared view of public and private sectors [23], data acquisition and updating standards, metadata and data sharing frameworks are necessary to build effective land information that can support the peri-urban land related-decision making processes.

Taking the above argument into account, an alternative/a new kind of comprehensive and transparent/decision support framework is proposed with the premise that any decision made in one of the land administration sectors shall be transparent and recognized by other land administration institutions. The establishment of an appropriate decision-

making structure helps to involve different actors and stockholders in decision-making processes [21]. The decision-making framework proposed in this study has four privileges/interface (i.e., view-only interface, view access and compliance directing interface, decision-request interface/privilege, and decision-making interface/privilege, see the result Section 3.4). This framework requires quality land information and data sharing platforms across different land administration institutions. This can be easily managed by the uses of the available geospatial technologies [10,11,20] and ICT [63]. This can be more effective when it is participatory (bottom-up), accessible by everyone through mobile technologies and other location-enabled devices and interactive web-enabled services [63–65]. And this could also be a possible way to easily integrate spatial and non-spatial components of land information in the process of data sharing and dissemination for the required decision-making. In sum, the discussion suggests the adoption of the proposed framework to address the challenges of peri-urban land related decision with the support of effective land information.

5. Conclusions

The main objective of this paper was to evaluate the quality of the land information for supporting peri-urban land-related decision-making in Ethiopia, with the intention to suggest an alternative land information management and decision support framework that can better derive relevant and usable policy options for peri-urban land-related decision-making. The result signals that the quality of land information in the study area lacks responsiveness to support land related decisions such as land use intervention and spatial management of peri-urban areas due to inefficiencies in the governance of land information and weak institutional efficiency prevailing in the different tiers of land administration institutions. The users, the scales at which information is collected and shared, the level of detail employed for information collection and distribution, the use of standards, and applied technologies are improperly regulated and connected. The standards and regulations related to land information acquisition and its governance frameworks are also applied differently in urban and rural land administration institutions respectively. This set-up can be considered as ineffective because it derives information redundancies and contradictions, which leads to ambiguous information use and reliance. Somehow, the decision does well on retraceability (as steps of decisions are somewhat documented by existing land information systems) and perhaps on robustness (as the framework, especially the urban land information framework is relatively stable). In addition, the current system does well in terms of the processes but not in terms of the institutional and technical structures and economic, societal and environmental outcomes. When reasoning from the 8R framework of responsible land management, we conclude that many of the 8Rs are not achieved. This implies that the quality of the current information sources in the case study area is not yet in a way that fits the purpose (i.e., for supporting peri-urban land-related decision-making). The study also revealed that affording workable and good functioning land information that can support the peri-urban area land-related decision-making remains a challenge. Most of the problems are highly connected with the limitations in the land administration institutional setups, legal frameworks, land information management, and decision-making frameworks. Taking into account these problems, the researchers identified the options and requirements for the improvement and governance of land information and proposed an alternative land information management and decision-making framework which could be used as an alternative outlook for effective land-related decision-making. The framework could encourage and allow the involvement of different land administration institutions, stakeholders, and concerned actors in land-related decision-making processes. In conclusion, the methodological framework applied in this study appeared to be an emerging and effective approach to assess both the quality and governance of land information. It could be applied in further studies with similar or related context regardless of any geographic settings. Monitoring the qualities of land information with respect to the 8Rs land management framework helps policy and decision-makers to make effective decisions.

A contemporary decision-making conception gives high priorities for the quality of LI to be used in the decision-making processes. Maintaining the quality of LI is a function of how the data capturing, processing, and system management is governed. This paper has clearly explained these and thus will benefit decision-makers. However, further studies could be necessary to refine and increase the reputability of the framework for similar or related studies. Additionally, further socio-economic based study is essential to complement and fully understand the socio-economic, environmental, and political implications of ineffective land information in the peri-urban areas.

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