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Integration of local knowledge systems and decision on land use allocation among rural households in South Africa

Muhammad Mubbin[1,2*], Lobina G Palamuleni[1], Tabukeli Musigi Ruhiiga[3], Syed Atif Bokhar[4]

[1] North-West University, School of Geo and Spatial Sciences, Private Bag X2046, Mmabatho, South Africa;
[2] University of the Witwatersrand, School of Geography, Archaeology and Environmental Studies, Private Bag3, Wits, 2050, Johannesburg, South Africa;
[3] Kabale University, Faculty of Education, Department of Humanities Education, Kabale, Uganda;
[4] Government Graduate College, Department of Geography, Asghar Mall, Rawalpindi, Pakistan.

***Correspondence**: mubbin@hotmail.com

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Abstract: The systematic information based on concepts, interpretations, ideas, observations, and judgments is known as knowledge. The present study portrayed that the focus of scientific investigations is growing towards assessments based upon environmental knowledge system. The study aimed to understand the interactions between local knowledge systems and decision on land use allocation among rural households in South Africa. Decisions about land-use, resource access, determinants of land-use allocation and environmental knowledge were analysed using descriptive statistics. SPSS was employed to calculate a two-tailed Pearson correlation, multiple regression and ANOVA two-way of variance. Landform condition has a strong impact on the distribution of ecosystems through variation of the climate and controlled land-use. The allocations of land-use as related to landforms reveal both effortless and multifaceted results. A more multifaceted model of land-use allocation occurs on stripping slopes, hills, and foot slopes, which are difficult to access and are covered by forests and scrubland. The study detected a strong linkage between land-use patterns and environmental knowledge. The environmental knowledge acquired either from a formal or an informal resource has significant bearings on land-use patterns, thus being useful for sustainable land-use planning and management. Besides that, how the community allocates land for different purposes is dependent on a multitude of socio-economic factors like land ownership (public or private), economic gains, education, access to credits and other resources.

1. Introduction

The systematic information based on concepts, interpretations, ideas, observations, and judgments is known as knowledge (Alavi and Leidner, 2001). Knowledge systems, developed through experimentation, adaptation, and co-evolution, provide valid and useful information/interpretations for sustainable development (Tengo et al., 2014). Since time immemorial, various forms of knowledge systems have been relied upon for many different purposes to cope with the needs of society (Chikaire et al., 2012). Knowledge systems reflect the rules and principles taken by local communities. They define distinctive cultural practices, cultural systems and infer about the history of local people. Local knowledge systems are helpful to cope with discrete issues based on contextual diagnostics (Hens, 2017). They also symbolize a source of cultural pride and, therefore, are very important for decision-making at a local level. Indigenous knowledge is passed on from one generation to another (Owusu-Ansah and Mji, 2013). Since this knowledge is not always in black and white, it is in danger of being unnoticed by different communities (Owusu-Ansah and Mji, 2013) and is susceptible to being used for monetary gains only (Masango, 2010).

The present study investigates the different modes of knowledge used for land-use allocation. Related studies fall in the domain of land-use policy, land resource management, ecological resources, ecosystem services and climate change policy for assessments. Hodgson et al., 2019 opined that such inclinations in the scientific studies are imperative for postulating attainable measures to harmonize the relationship between man and the natural environment.

The present study portrayed that the focus of scientific investigations is growing toward the assessments based upon environmental knowledge system (EKS). The term EKS entails 'the knowledge' and understandings of the people about their contextual setting (Smith, 2011). ŠakićTrogrlić et al., 2019 conclusively elaborated the nature of that knowledge and opined that this vital source of understanding is a product of evolution. Several terms for EKS are commonly found and interchangeably used in the contemporary literature such as 'indigenous knowledge', 'traditional knowledge', 'traditional ecological knowledge', 'informal knowledge, 'indigenous technical knowledge', 'traditional environmental knowledge', 'folk knowledge', 'people's science', and 'folk science' (ŠakićTrogrlićet al., 2019). The reliance to depict the expression is dependent on the academic discipline, context and language skills (ŠakićTrogrlićet al., 2019).

Local communities across the globe are continuously facing a myriad of environmental challenges of varying magnitudes and try to improvise their responses in the light of available resources. The motivations for adaptation and coping with the ensuing environmental challenges from local to global scale, produce valuable understandings. Part of this knowledge is locally or regionally maintained, adapted, and transmitted. The insights based on such experiences productively contribute to the efforts towards environmental sustainability (Nakashima et al., 2012).

Therefore, the EKS system is based on a dynamic and interconnected mix of know-how, practices and skills. It reflects the spatiotemporal connotations of environmental and socio-economic realities for conclusive appreciations. Therefore, the reliance on EKS ensures an intimate understanding of the local cultural and environmental potentials for informed decision making (Sumane et al., 2018). As the environmental knowledge systems are based on the holistic appraisals and time-tested longitudinal assessments, therefore, they provide useful insights (ICSU, 2002). Thus, the perceptions based on this source of knowledge are regarded a vital link in scientific research for articulating choices for the resilience of social and ecological systems (Reyes et al., 2016).

The UN Conference on Environment and Development in 1992 catalysed the interest in indigenous knowledge. It stimulated and argued for enhanced interest in the local knowledge systems for ensuring the sustainable utilization and conservation of the earth's biological diversity (UNCED, 1992). Agenda 21 of the United Nation Conference on Environment and Development (UNCED, 1992) stressed the need for incorporating indigenous knowledge in decision making to accomplish the targets required for sustainable development. Recently, world organisations such as the United Nations Educational (UNE), International Federation of Library Association (IFLA), World Council of Indigenous Knowledge (WCIK) and the World Bank (WB) are also promoting the preservation of indigenous knowledge (Hens, 2017). UNESCO (2003) charters on the preservation of heritage digitally so as to ensure that it remains accessible to the public and accordingly, access to digital heritage materials, especially those in the public, should be free of unreasonable restrictions (Balogun and Kalusopa, 2021). Preserving indigenous knowledge means that it could be managed and communicated without dispossessing it from its owners and carriers (Balogun and Kalusopa, 2021). The study thus looked into techniques or strategies and technologies used in preserving the indigenous knowledge in rural communities in South Africa.

Although the African Indigenous Knowledge System (AIKS) has been around for thousands of years, its concept and function in science only emerged three decades ago. New political, economic and cultural realities and the evolution of postmodern methods have created new foundations and new paths for the adoption and acceptance of AIKS (ŠakićTrogrlić et al., 2019). The political identity of the local population, the failure of development plans to achieve the desired results and the growing frustration of Africans with the promises of modern "Western" science, all at the same time, leads to increased public awareness of cultural value. In other words, heritage and "science" must find their place in the social and cultural contexts (El- Amouri and Neill, 2011), some of which are new realities and developments.

In South Africa, the Indigenous Knowledge Systems (IKS) Policy was adopted by Cabinet in November 2004, thus laying in place the first important milestone in efforts to recognize, affirm, develop, promote and protect IKS. Whilst unearthing the complexities and challenges associated with IKS, the policy provided those involved with extraordinary experiences, a united admiration of the breadth and scale of South Africa's valuable indigenous knowledge resources. It also strengthened the spirit of collaboration between all stakeholders involved in its design, from representatives of government departments and science councils, to tertiary institutions, NGOs and, of course, individual knowledge holders.

2. Land-use allocation

Land-use allocation is the process of allocating land for specified usages in a defined geographical region (Cao and Ye, 2012). The apportionment of land resources is determined by various factors (socio-economic) and their mutual interactions (Cao and Ye, 2012; Pilehforooshha et al., 2014). Thus, the process focuses on how to reconcile multiple, often, conflicting interests, as rationally and transparently as possible (Gong et al., 2012; Li et al., 2014; Pilehforooshha et al., 2014).

Marull et al., 2010 tried to decipher the recent trends in land-use allocation. The same authors concluded that contemporary strides are meant for ensuring equitable distribution of land resources. Besides this, there is a growing realization that the land-use allocation models are more effective to comprehend land-use dynamics. The majority of such initiatives, based upon modelling techniques, are carried out to support land-use policy-making (Sieber et al., 2010). Liu et al., 2012 extensively discussed the methods and techniques of land allocation. They classified these measures into three major categories; multi-criteria decision-based models, simulation-based models, and optimization-based models. Multi-criteria decision-based models help to identify the optimal use of land resources for each actor according to the land-use priority (Carsjens and Wim, 2002). Simulation-based models (cellular automata and multi-agent systems) are employed in the studies designed to decipher the LUC changes (Yu et al. 2011). Land-use optimization is a complex and complicated process (Gong et al. 2012). Therefore, the optimization-based modelling techniques focus on conceptualising the best spatial arrangement for the resilience of the land resources (Zhang et al., 2014). Scholars such as Karimi et al., 2012 proposed that the land-use allocation process falls into three main stages: (i) land suitability evaluation, (ii) demand assessment, and (iii) spatial allocation of land use types.

However, there is a consensus that the global-scale land-use modelling is more challenging when compared to smaller-scale initiatives. These conclusions are embedded in the following causations. Firstly, the set of driving factors for LUC changes and the spatial characteristics of such change are diverse across the globe (Asselen and Verburg, 2012). Secondly, the requisite data is not readily available at a global scale (Meiyappan et al., 2014) or the required spatial resolution (Schaldach et al., 2011; Verburget al., 2013). This study was, therefore, carried out using two rural local municipalities in South

Africa with the objective to examine the relationship between land-use allocation decisions and knowledge systems.

3. Research methods and data collection

3.1. The study area

The study area for the study is located in South Africa, focusing on two local municipalities (LM) chosen from two district municipalities on the basis of having distinct and different ecological belts in the Free State and Limpopo provinces of South Africa (Figure 1). These are Maluti-a-Phofung LM in Thabo Mofutsanyana district municipality (Free State province) situated between latitude 28°33′04′S and longitude 29°4′48′E and Thulamela LM in Vhembe District municipality (Limpopo province) is situated between latitude 22°57′ S and longitude 30° 29′ E. Maluti-a-Phofung LM is a category B municipality established in 2001. Almost 27% of the population lives in traditional residences. Thulamela local municipality is also category B municipality established in 1998. More than 85% of the people in this municipality live in tribal areas.

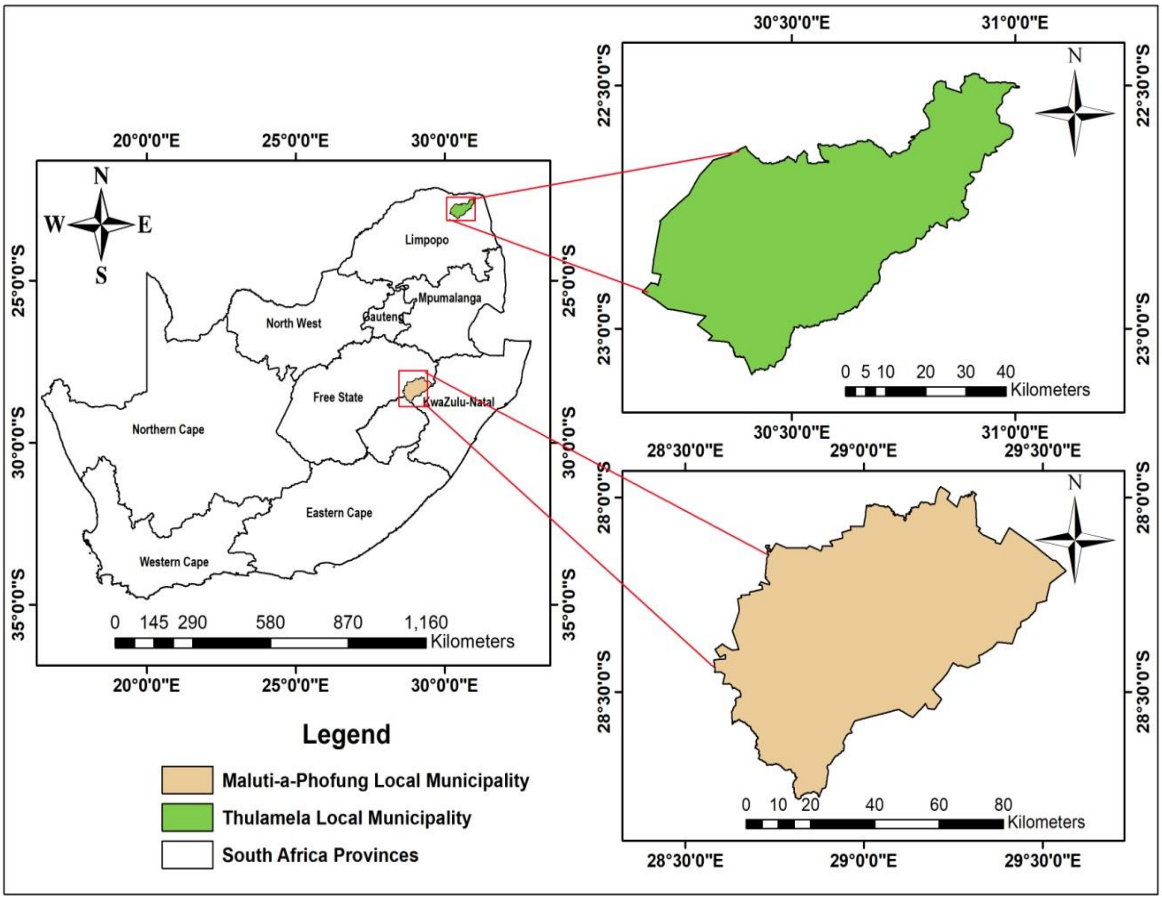

Figure 1: South African provinces and the two study sites

Figures 2 and 3 shows the land uses in Maluti-a-Phofung and Thulamela LM respectively. The land uses in the two study areas range from agriculture, forestry, mining, open spaces, residential to areas designated for wildlife and tourism attraction.

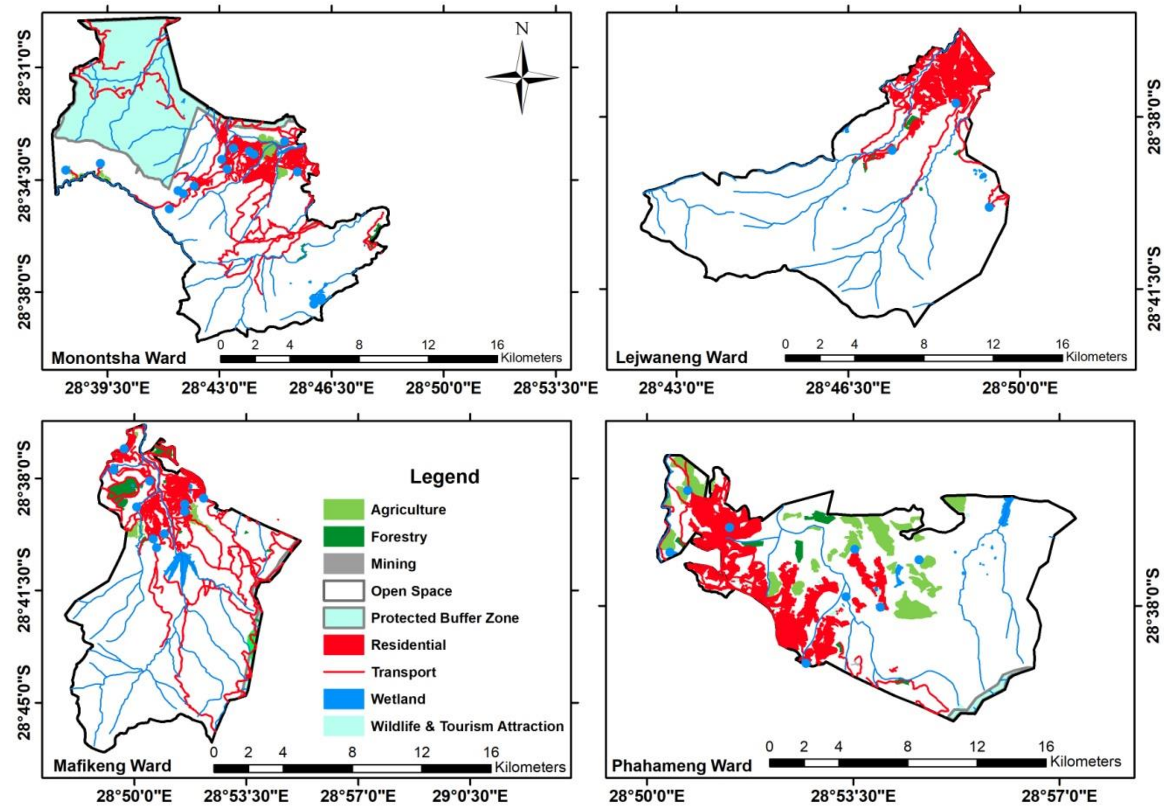

Figure 2: Conventional land-use in Maluti-a-Phofung LM wards.

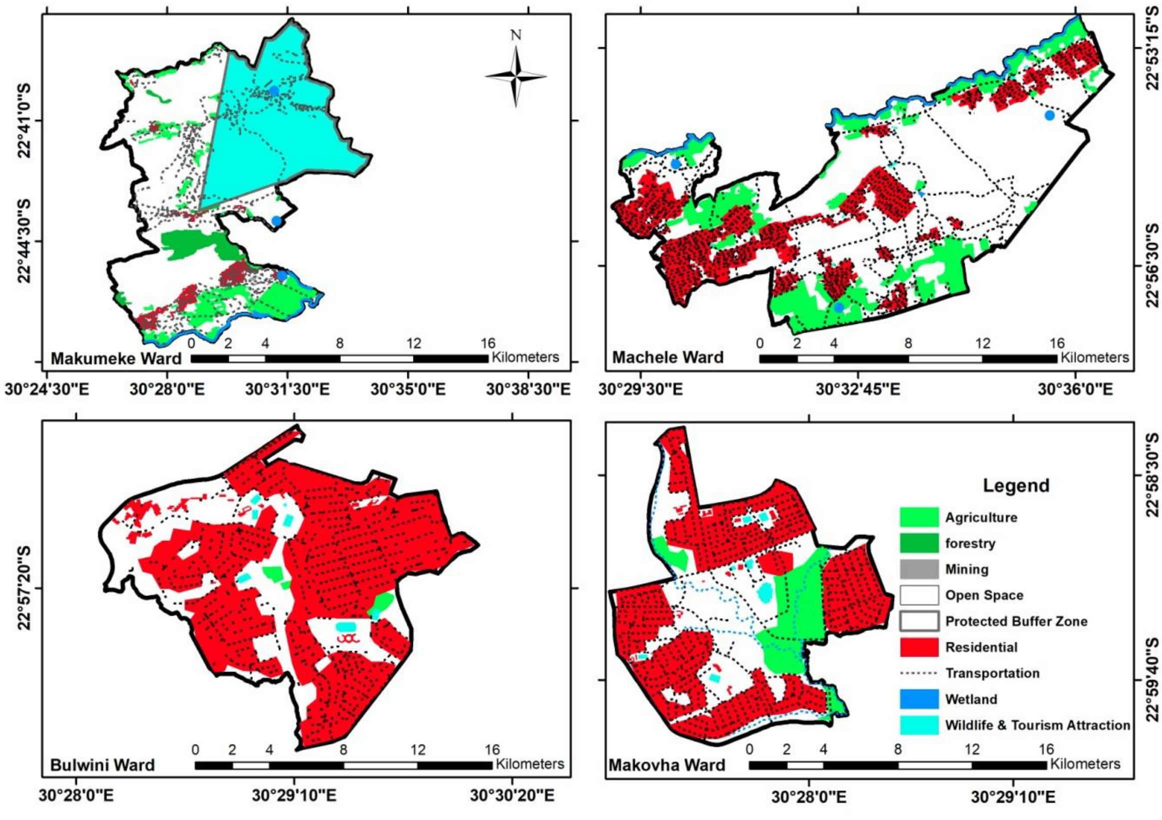

Figure 3: Conventional land-use in Thulamela LM wards.

3.2. Sampling and data sources

The number of households per ward as at the end of 2020 was established from records of the Statistics South Africa (StatSA, 2020) and Municipal Demarcation Board with the stratified random sampling technique. The potential respondents for the study were identified and approached with the help of selection criteria. The selection procedure consisted of over four inter-related phases as follows: Phase 1: population estimates for December 2020 were accessed from (StatsSA) as per local municipality. Phase 2: the number of households from StatsSA, 2020 was established for the LM, and for each ward in the specific LM of interest. Phase 3: ecological zones (EZ) were determined based on climatic, soil, vegetation, landforms and drainage conditions. The boundaries of the EZ were superimposed on the ward map of each LM. This generated an EZ map of each of the two study areas. Phase 4: wards falling within each EZ were noted first and the selection of wards was based on the following criteria: (i) only sites falling within the rural countryside, (ii) have at least 4 clear land-use zones, (iii) easily accessible by road, by public transport and on foot. Using these criteria, 4 wards were selected in each of the two municipalities (Figure 1).

3.3 Instruments and data collection

Permission was sought from the municipal manager of each of the two LMs to conduct the research. Where certain wards (4 wards from Maluti-a-Phofung LM and 4 wards from Thulamela LM) fell under the jurisdiction of tribal chiefs, the chiefs were approached and authorisation sought for the conduct of the study. The chiefs were also involved in the dissemination of information to ward councillors and residents in the selected areas; getting buy-in from community members; explaining how the data collection exercise would be carried out; setting up procedures for contacts and administration and, explaining the long-term value of the study to the community.

Three types of data were collected: (i) primary data on environmental parameters collected through field surveys (ii) primary data on land-use was accessed through field observations (iii) household data on environmental knowledge and land allocation was collected through the selection of a sample as per LM area and administration of a structured interview guide (Appendix 1). Questionnaires were administered to187 households in Maluti-a-Phofung and 198 in Thulamela LM to collect data on household environmental knowledge.

3.4 Data analysis

Decisions about land-use, resource access, determinants of land-use allocation and environmental knowledge were analysed using descriptive statistics. SPSS was employed to calculate a two-tailed Pearson correlation, multiple regression and ANOVA two-way of variance. The findings were condensed in the form of tables, graphs, equations and models. The findings helped to determine the prevailing ideas regarding land-use allocation and knowledge system in Maluti-a-Phofung and Thulamela LM. The findings were based on the premise that the household environmental knowledge was characteristically determined by the socio-economic factors such as, resource access, determinants of land-use allocation (i.e. length of residence, occupational status) and household decision about land use allocation.

4. Results

4.1 Residency

Respondents were asked to provide information regarding the duration of their stay in a particular locality. The results are shown in Table 1.

The findings in Table 1 infer that the majority of the respondents (56%) in Maluti-a-Phofung LM have been residing in the area for between 41 and 60 years. A substantial proportion of 20% of them have lived in Maluti-a-Phofung for the last 30 years; 8% have spent duration of 21-30 years; followed by the 13% and 2%, who have been residing in the area for an approximate time of 61-80 and 81-90 years, respectively. However, a smaller proportion (1%) of the respondents are those who started to live there 11-20 years ago. When compared to Maluti-a-Phofung, the majority of respondents (70%) from Thulamela LM have been residents in the area for 31 to 50 years. A substantial proportion (17%) of them have lived there for 51-60 years; 10% have been there for a duration of 61-80 years and only 1% have lived there for an approximate time of 81-90 years while only a smaller proportion (2%) of the respondents had arrived in this locality between 21-30 years ago. The findings show that the majority of respondents in both study areas started to live there between 31 to 60 years ago. These findings suggest that the inhabitants are acquainted and satisfied with the environmental settings of their contextual surroundings.

Table 1. Residence in Maluti-a-Phofung LM and Thulamela LM.

Residence	Maluti-a-Phofung LM	Thulamela LM
11-20 Years	1%	0%
21-30 Years	8%	2%
31-40 Years	20%	43%
41-50 Years	29%	27%
51-60 Years	27%	17%
61-70 Years	7%	5%
71-80 Years	6%	5%
81-90 Years	2%	1%

4.2 Occupational status

The findings shown in Table 2 indicate that the majority of residents in both of these localities are directly or indirectly dependent on primary economic activities such as agriculture, forestry and mining etc. A substantial proportion of respondents in Maluti-a-Phofung LM (30%) and 25% in Thulamela LM stated that they are engaged in the farming sector. Farming represents a significant job in economic growth and can add substantially to household food security (DAFF, 2020). However, a sizeable share of respondents from Maluti-a-Phofung LM (17%) and Thulamela LM (22%) are involved in the livestock sector. In South Africa, 80% of the cultivable area is suitable for cattle production and makes up about 40% of the farming revenue (Oduniyi et al., 2020). A dual system based upon the principles of commercialized and subsistence form of productions operate in this part of the globe. Farm animals make up the main livestock business in the country in both commercial and smallholder farms (Oduniyi et al., 2020).

Table 2. Occupational status in Maluti-a-Phofung LM and Thulamela LM

Occupational status	Maluti-a-Phofung LM	Thulamela LM
Agriculture crop farming	25%	30%
Agriculture livestock raring	17%	22%
Forestry and craft industry	12%	6%
Mining	8%	4%
Industrial	6%	3%
Open spaces	21%	20%
Transport	6%	5%
Construction	5%	10%

The findings show that a proportion of respondents from Maluti-a-Phofung (12%) are engaged in the forestry and craft industries as compared to only 6% from Thulamela LM. Land and forests are closely related to how people spend their lives, how people live, particularly in remote and rural areas and how they are utilizing forests for the craft industry, cultivation, residence, medicine, timber, commercial and domestic purposes etc (DAFF, 2020). The other occupational groups such as mining, industrial activities and transportation constitute smaller percentages. However, 10% of the respondents from Maluti-a-Phofung LM and 5% from Thulamela LM were linked with construction activity.

4.3 Descriptive statistics

The data was obtained through interviews to perform a comparative analysis of household environmental knowledge. Decision about land-use, resource access and determent of land-use allocation were analysed by calculating descriptive statistics. Table 3 shows the descriptive characteristics of the respondents from the two study sites.

Table 3. Descriptive statistics for variables in the study.

Decision about land-use	Maluti-a-Phofung LM	Thulamela LM
Internal within household	19%	26%
Collective by household and external from outside household	38%	30%
Individual by the family head	35%	33%
Collective by the immediate community	8%	11%
Resource access		
Private land parcel with title deed	15%	23%
Communal land parcel on municipal commonage	18%	24%
Communal land parcel under tribal land	46%	25%
Private land parcel under tribal land	8%	17%
Land parcel under PTO (permission to occupy) status	13%	11%
Determinants of land use allocation		
Climatic condition	12%	17%
Landform condition	9%	12%
Soil condition	20%	18%
Vegetation condition	17%	13%
Drainage condition	10%	11%
General environmental condition	6%	7%
Household circumstances	11%	11%
Land access status	7%	8%
External factor	8%	3%

4.4 Decision about land-use

The household decisions and adaptation behaviours are entrenched in the local and larger socio-ecological background (Singh et al., 2016). Therefore, the respondents were asked to provide information about who decides about the land-use in the family. As shown in Table 3, about 19% of the respondents from Maluti-a-Phofung LM indicated that land use allocation decisions are made internally within the household compared to 26% from Thulamela LM. These results affirm the observation made by Hettiget al. (2016), who noted that the household's decision-making processes usually include more than one person, especially for products and services which are to be used by numerous users.

However, in some cases, decisions are made by the internal and external household members. The results in Table 3 show that 38% and 30% of the respondents in the Maluti-a-Phofung and Thulamela LMs respectively, mentioned that land-use decisions are made by both internal and external household members. In this case, collective decisions are made by the extended family, which includes father and mother-in-law, brother and sister-in-law. In this process, it is repeatedly understood that all house members are urged by similar stimuli and ambitions, thus acting as an identical unit. A family unit as a group of people must consult members' decisions based on their role and position within the household (Singh et al., 2016). Household decisions frequently involve trade-offs, where personal concerns are surrendered for joint benefits and permanent goals (Singh et al., 2016). Land distribution decisions are often made according to the consent, the aspiration and the capabilities of the most powerful household members, possibly having a bearing on all other family members (Michalscheck et al., 2018).

In some cases, decisions are made by individuals, who are deemed to be the head of the family. In Maluti-a-Phofung, 35% of the respondents mentioned that decisions are made by the family head alone compared to 33% of the respondents in Thulamela LM. The decision-making processes depend on the interchanging dominant interests and power positions (Michalscheck et al., 2018), therefore, knowledge on concerns and power positions is founded on personal or mutual reports by husband and wife (Mwungu et al., 2017). Household heads make decisions, either alone or by a discussion with the family (Singh et al., 2016).

In Maluti-a-Phofung LM, respondents who make decisions collectively by the immediate community (village) were 8% and 11% from Thulamela LM. According to the analysis, results revealed that individual decisions by the family head, collective decisions by household and external from the outside household were dominant in Maluti-a-Phofung LM whereas in Thulamela LM, most decisions are internal i.e., within a household and in some cases, collective with immediate community.

4.5 Resources access

Respondents, who have private land parcels with title deeds, made up 15% of those from Maluti-a-Phofung LM and 23% from Thulamela LM. Private landholders are main decision makers for the land they own, in keeping with existing land-use laws and other concerns on the land (Rissmanet al., 2017). Government organizations and non-profit land trusts perform major roles in preserving privately owned land through management facilitation, expenditure-sharing, short-term contracts, leases, tax motivations, deed limitations, regulations, and educational access to change the behaviour of private landlords (Rissmanet al., 2017). On the other hand, communal land parcel on municipal commonage were 18% from Maluti-a-Phofung LM and 24% from Thulamela LM. No less than 17 million South Africans live on ‘communal’ landholdings that are under the authority and possession of more or less 800 conventional leaders (Rissmanet al., 2017). As residents of ‘communal’ landholdings reside in and use land under a system of rights that follows oral traditions, this land is neither documented nor catalogued under the official register of ownership (Rissmanet al., 2017). Communal land parcel under tribal land was 46% from Maluti-a-Phofung LM and 25% from Thulamela LM. Private land parcel under lease agreement was 8% from Maluti-a-Phofung LM and 17% from Thulamela LM. Private proprietors and other players can be of great benefit in the maintenance of local knowledge and expertise (Stolton et al., 2014). Founded on different sources of data, Krug (2001) argued that about 10-20% of private land in Southern Africa was under wildlife protection or wildlife management at the commencement of the century.

Land parcel under permission to occupy (PTO) status showed that 13% of the respondents were from Maluti-a-Phofung LM and 11% from Thulamela LM. It is suggested that quitrent (land tax) term be altered to a permanent or long-term provisional state lease system and the permission to occupy (PTO) system to be changed to legal rights, which should both be supported by various levels of the local-level land management system (Rissmanet al., 2017). According to the study results, a private land parcel with title deed, communal land parcel on municipal commonage, communal land parcel under tribal land, and land parcel held under permission to occupy is dominant in Thulamela LM. However, only private land parcel under a lease agreement is prevalent in Maluti-a-Phofung LM (Table 3).

4.6 Determinants of land-use allocation

Respondents were asked to provide information on the factors, which they consider most relevant and influencing their decisions regarding land-use. Results are shown in Table 3. In this regard, 12% of the respondents from Maluti-a-Phofung LM and 17% from Thulamela LM consider climatic conditions as an important component of decision-making process regarding land-use. The assessment indicates that 20% of respondents in Maluti-a-Phofung LM and 18% in Thulamela LM consider that soil conditions are an important component while deciding on land resources.

The other variables that influence land-use allocation are vegetation condition. The results from the study revealed that 17% of the respondents in Maluti-a-Phofung LM and 13% of the respondents in Thulamela LM base their land-use allocation on the vegetation condition. The vegetation condition plays a key function in preserving the earth exterior from raindrop splatter, earth cumulative constancy, holding and dipping water overflow. Most of the respondents perceive that once the plant layer is destroyed, rainfall effect kicks off an assortment of soil element and results in the creation of coating, which closes the surface and restricts permeation (EEA, 2002).

Land-use allocation decisions are also driven by landform conditions. Only 9% of the respondents in Maluti-a-Phofung LM and 12% in Thulamela LM consider landform conditions important in land-use decisions. The study areas have a landscape that alters from regions of lofty mountains with the Soutpansberg mountain range in the Vhembe district and the Drakensburg Mountains in the Mopani district to lowdown regions (Semenya et al., 2013). These mountain ranges also exert an overwhelming influence on the weather conditions and atmosphere of the districts of study (Kabanda&Munyati, 2010). The low lying areas are usually fertile areas and agriculture is the major land-use allocated to them. The mountain areas form part of the conservation area and are associated with tourism. The homesteads are located on the gentle slopes, whereas the steep areas are not occupied as the terrain is difficult to build and navigate.

The natural drainage patterns reflect the climatic and physiographic characteristic of a contextual setting. The natural flow of water characteristically determines the flora and the orientations of agricultural practices. The study areas have their peculiar drainage conditions. The perennial and non-perennial streams, which are flowing in these contextual settings are an important component of the local drainage basins. Landforms have a strong influence on hydrology and drainage, including the distribution of rivers and wetlands. However, the volume of flow depends upon the atmospheric conditions; with increased flows during heavy rainfall and lower flows during dry spells and the dry season. The findings in Table 3 infer that a significant proportion of respondents from Maluti-a-Phofung LM (11%) and Thulamela LM (10%) give weight to natural drainage conditions. The drainage conditions in these localities symptomatically influence the decision making regarding land-use and transformations in land cover. The areas located in suitable drainage conditions are considered better for agriculture than the poorly drained locations.

The household circumstances are the cumulative result of the socio-economic conditions, family size and decision-making mechanisms deployed by the family. As shown in Table 3, the assessments based upon household circumstances revealed that this determinant significantly shapes the orientations on land-use in both localities. The statistical measurements formulate that household circumstances have a major influence as 11% of the respondents from both of the local municipalities are agreeing with the reported notions.

The other variables were negligible as far as land-use allocation is concerned (Table 3). From these results, climatic condition, landform condition, drainage condition, general environmental condition and land access status were dominant in Thulamela LM as the land-use allocation driving forces. On the contrary, soil condition, vegetation condition and external factors were the dominant variables in Maluti-a-Phofung LM.

4.7 Drivers of local environmental knowledge

The statistical findings helped to decipher the variations between decision making about land-use allocation, resources access and determinants of land-use allocation. The significant findings regarding Maluti-a-Phofung LM and Thulamela LM are shown in Table 4. The statistical findings based upon (two-tailed) assessments infer the very strong linkage between decision making about land-use and environmental knowledge (Table 4). Besides, the findings also indicate that both of these have noticeable inter relationships with resource access and determinants of land-use allocation of the respondents.

Table 4. Pearson correlation results

Maluti-a-Phofung LM		**A.***	**B.***	**C.***	**D.***
Decision about land-use	Pearson correlation	1	-.006	-.002	.625**
	Sig. (2-tailed)		.937	.975	**.000**
	N	187	187	187	187
Resources access	Pearson correlation	-.006	1	.108	-.147*
	Sig. (2-tailed)	.937		.140	**.045**
	N	187	187	187	187
Determinants of land- use allocation	Pearson correlation	-.002	.108	1	.030
	Sig. (2-tailed)	.975	.140		.680
	N	187	187	187	187
Environmental knowledge	Pearson correlation	.625**	-.147*	.030	1
	Sig. (2-tailed)	**.000**	**.045**	.680	
	N	187	187	187	187
Thulamela LM		**A.**	**B.**	**C.**	**D.**
Decision about land-use	Pearson correlation	1	-.021	.075	.351**
	Sig. (2-tailed)		.769	.292	**.000**
	N	198	198	198	198
Resources access	Pearson correlation	-.021	1	.096	-.173*
	Sig. (2-tailed)	.769		.178	**.015**
	N	198	198	198	198
Determinants of land- use allocation	Pearson correlation	.075	.096	1	.122
	Sig. (2-tailed)	.292	.178		.086
	N	198	198	198	198
Environmental knowledge	Pearson correlation	.351**	-.173*	.122	1
	Sig. (2-tailed)	**.000**	**.015**	.086	
	N	198	198	198	198

*** A.** Decision about land-use; **B.** Resource access; **C.** Determinants of land- use allocation; **D.** Environmental knowledge

Multiple regressions modelling is commonly deployed for predictions and it requires two or more predictor variables for assessments. The findings of the study were also assessed by adopting the standard procedures of multiple regression techniques for interpretations, whereby predictions regarding environmental knowledge were modelled against a decision about land-use; determinants of land-use allocation and resource access (Table 4). The regression equation model (F ((df1 (3), df2 (183) = 42.910), $p < 0.000$) was significant in predicting environmental knowledge (Table 4).

The multiple correlation coefficient value of $r = 0.643$ depicts a strong positive relationship, indicating that the proposed model is a normal interpreter of the outcome (s). However, R2 for the overall model is 41.3% with an adjusted R2 of 40.3%, which depicts a model of variation in the environmental knowledge accounted by the linear combination of the predictor variables i.e. decision about land-use, determinants of land-use allocation and resource access. Results for the regression model revealed that decisions about land-use (t = 11.016, p <0.000, β = 0.624), resource access (t = -2.601, p <0.010, β = -0.148), were statistically significant and determinants of land-use allocation (t = 0.839, p >0.403, β = 0.048) were insignificant variables to environmental knowledge.

From the coefficients output,

Environmental knowledge = 26.123 + 5.500 (D) - 2.746 (R) + 0.917 (Dt) (1)

where (D) = decision about land-use; (R) = resource access; (Dt) = determinants of land-use allocation.

The positive slope for a decision about land-use (5.5), as a predictor of environmental knowledge, indicated that there was about a 5.5% increase in environmental knowledge for each 1-point increase in the decision about land-use allocation. In other words, environmental knowledge tends to increase as decisions about land-use increase. The square semi partial coefficient (sr2) that estimated how much variance in environmental knowledge was uniquely predictable from decisions about land-use, was 0.631, indicating that 63.1% of the variance in the environmental knowledge is accounted for in the decisions about land-use. However, resource access results were reported as insignificant.

A similar procedure was adopted for assessments in the case of Thulamela LM. As shown in Table 4, the regression equation model as a whole was insignificant in predicting environmental knowledge (F ((df1, 3, df2, 194), p < 0.000).

The multiple Pearson correlation coefficient value (r = 0.404) is indicative of a moderate positive relationship. However, R2 for the overall model is 16.4% with an adjusted R2 of 15.1%, which depicts that a model of variation of the environmental knowledge is accounted for by the linear combination of the predictor variables i.e. decision about land-use, determinants of land-use allocation and resource access. In the final regression model, the decision about land-use (t = 5.142, p < 0.000, β = 0.339), resource access (t = -2.686, p <0.008, β = -0.177), were statistically significant and determinants of land-use allocation (t = 1.719, p >0.087, β = 0.144) were insignificant variables to environmental knowledge.

From the coefficients output, the applicable regression model becomes:

environmental knowledge (Y) = 33.672 + 2.808 (decision about land-use) - 2.854 (resource access) + 1.997 (determinants of land-use allocation) (2)

The positive slope for determinants of land-use allocation (2.808), as a predictor of environmental knowledge indicated that there was about a 2.808% increase in environmental knowledge for each point increase in a decision about land-use. In other words, environmental knowledge tends to increase as decisions about land-use increase. The square semi partial coefficient (sr2) that estimated how much variance in environmental knowledge was uniquely predictable from decisions about land-use was 0.346, indicating that 34.6% of the variance in the environmental knowledge is uniquely accounted for decisions about land-use control.

5. Discussion

The land is a basic resource needed for human survival. Different uses of land contribute to meet human requirements, relating to the way how land is transformed, dealt with, preserved and its proposed use (Yao et al., 2018). Land-use measures are essential to the functions of the biosphere because various uses i.e. agriculture, forest, industrial land, and residence, as well as their connections, have a considerable bearing on the living environment and quality of life (van Vliet et al., 2016). Land-use is the express upshot of human decisions, which are under the influence of a range of perspective-oriented socioeconomic and biophysical forces and phenomena. Therefore, the significance of perceiving the decision-making processes underlying human land-use has been extensively recognized (van Vliet et al., 2016).

The study noted that the majority of the respondents in both study areas have lived in their respective areas for decades. It follows that the inhabitants are acquainted with the environmental settings of their contextual surroundings. Based on the results described here, one observes that the sample of Maluti-a-Phofung LM was dominated by people, who have been living in this area for well over thirty years. As far as Thulamela LM is concerned, no sample could have been obtained in the range between (11-20) years. In both LMs, most of the inhabitants have stayed in their areas in the range from 31-60 years. However, the majority of respondents from these localities are dependent on primary economic activities, whereby the natural environmental resource base significantly determines their social-economic activities (Table 1). The findings of this study could be applicable to similar environments in South Africa and most rural communities in Africa where environmental resources are vulnerable due to looming threats from global warming and climate change (Sergio et al., 2020). The consequent degradation in the natural environment, could ultimately, translate to some form of human sufferings. Therefore, it is incumbent upon the residents of these localities to sustainably utilize the natural resources because they derive livelihoods from the same. In other words, governmental or national pragmatic decisions of land use planning should utilise the advantages of household environmental knowledge concerning the decisions about land-use allocation among rural households. Any rural community holds a wealth of indigenous knowledge, which should be promoted for sustainable use and consumption of natural resources.

Additionally, the situation demands innovative measures to ensure the resilience of the agricultural sector, which forms a greater proportion of occupational activity among the residents of Thulamela LM and Maluti-a-Phofung LM (Table 2). It plays a cardinal role in the process of economic development in the agro-based contextual setting and offers household food security (DAFF, 2020). The study carried out by Mosissa et al. (2017) reported the advantages of indigenous knowledge of the local environment for the farming communities. The study by Guerrero-Gatica et al. (2020) indicate that environmental knowledge system-based assessments are obligatory for the holistic appraisals and informed decision-making about environmental resources. The feedback from the locals helps to resolve diverse problems of the agricultural sector ranging from soil/land degradation to livestock production. These are required to explain the decision and the action taken by the respondents in a given contextual setting.

According to the analysis in decision making on land-use, an individual family head, collective decisions by members of the household and decisions from outside the household were dominant in Maluti-a-Phofung LM (Table 3). According to the analysis, the dominant variables in Thulamela LM included decision making within household and the decisions made collectively by immediate community (Table 3). Land-use decision-making, therefore, differs in different contexts as well as in different development stages. Frequently, the change from survival-oriented land-use towards a more entrepreneurial-based land-use decision making is linked to a course of development (Lambinet al., 2003). The statistical findings of Maluti-a-Phofung LM (Table 4) and Thulamela LM (Table 4) helped to reveal the strong linkages between the decisions about land-use and environmental knowledge. While there is a rich body of conceptual studies (Groeneveld et al., 2017) as well as local case studies in different environments, documenting how in local contexts land-use decisions are made, there is no global overview of how these characteristics and attitudes influence land-use decisions around the globe (Malek et al., 2019). The findings in this study show that a wide range of variables have noticeable imprints on how land is allocated for different uses. Thus, land-use decisions directly and indirectly shape and tailor the socio-economic conditions of communities and inclinations about environmental resources. This diversity may be accounted for by features and manners of the concerned decision-makers, who openly change land uses (Hettiget al., 2016).

On the other hand, resource access, where private land parcel with title deed, communal land parcel on municipal land, communal land parcel under tribal land and land parcel held under permission to occupy, are dominant determining variables in Thulamela LM (Table 3). Agricultural land is, for the most part, owned by either private landowners or communal owners (Parker et al., 2018). Private land parcel under a lease agreement is dominant in Maluti-a-Phofung LM (Table 3). Communal land is the property of the government but administered through the tribal authority. This system of land ownership is a rule typified by a "permission to occupy" deed, which at this stage, does not have any statutory position although it is widespread in the former homeland areas (GRAIN SA, 2015). Farmland that is owned by a local municipality is known as communal land. It is land that should be available to the local community for farming purposes. South Africa showcases two different types of shared land, namely that which was possessed by the municipality before 1994, which can be rented to anyone, and that which was acquired after 1994, which should be leased to previously disadvantaged individuals to give more land rights for use to town residents (GRAIN SA, 2015). Private land is held by the individual or legal body (Sole Proprietor, Partnership, Property Trust, CC, Cooperative, Pty Ltd Company to mention a few examples). The proprietor of the land in this case has a title legal document to the property (GRAIN SA, 2015).

The land distribution in the context of South Africa is governed by the customary tenure system. Though the government initiates projects for developments (Malek et al., 2019), the local authorities play a leading role in the planning process. However, these authorities prepare land-use plans without authorization from state agencies (Yeboah and Davis, 2013). The findings demonstrate that the stakeholders responsible for land allocation in both of these municipalities are indiscriminately converting large tracts of rural land. Weak institutional ties have compounded the negative impact that land use policies, planning and management gaps have on rural land resources. Statutorily prepared land-use plans and their subsequent enforcement give more focus to residential and commercial land usages as compared to agricultural lands. The prevailing planning system is more reactive rather than proactive in addressing challenges. Thus, there is a need to adopt participatory land-use planning through education to promote awareness. The measures are obligatory for ensuring sustainable agricultural food production.

The climatic conditions, directly and indirectly, influence the biotic and abiotic environments. Thus, the climatic conditions impact ecosystems through soil moistures and thermal variations and, consequently, control the land-use patterns. These conditions alter the floral structure and species composition; and they determine the natural resource availability (Newbold et al., 2019). For example, temperature and moisture conditions significantly determine the qualitative and quantitative characteristics of soil components such as organic matter and pH values (Miller et al., 2020). Chemical and physical characteristics of soil features, directly and indirectly, impact the biomass production, species diversity and species composition (Miller et al., 2020). A lack of soil moisture demands irrigational facilities in arid and semi-arid zones.

Drainage is indispensable for humid as well as dry regions and it is one of the main inputs to acquire better production per unit of the farming area. An efficient drainage system, not only supplements agricultural productions but is also required to convert barren lands into new cultivable areas. However, the absence of such facilities causes a decline in crop growth and production. The study findings indicate that the areas closer to perennial water flow produce better agricultural yields as compared to land that is devoid of such facilities. The farmers in such localities are more prone to invest in agricultural activities. The provision of water encourages farming communities to invest in on-farm and off-farm measures. Resultantly, the socio-economic conditions of such families were observed to be better when compared to those who are doing agrarian practices in dry conditions. The farmers in less moist areas are more susceptible to climatic oscillations and, thus, hesitant to participate in such initiatives. Besides, the presence of permanent streams provides opportunities for dry season cultivation, which is both for the sustenance of livelihoods and maximum utilization of natural resources. In the case of the two municipalities, decisions of land-use allocation for agricultural purposes ensure food and economic security (Table 3).

Landform condition has a strong impact on the distribution of ecosystems through variation of the climate and controlled land-use. The allocations of land-use as related to landforms reveal both effortless and multifaceted results. A more multifaceted model of land-use allocation occurs on stripping slopes, hills, and foot slopes, which are difficult to access and are covered by forest and scrubland. Despite accessibility problems, land-use allocations on steep lands are highly diverse and cover rain-fed agriculture and grazing. In this case, adaptive, traditional, cultural and historical strategies rather than only land qualities, look to better explain land-use allocation. Agricultural activities are being and have been developed over the area in both steep and gentle landforms for Maluti-a-Phofung LM and Thulamela LMs.

Climate affects landforms through the same elements of heat and wetness that manage differences in soil and vegetation. Natural vegetation cover has given way not only to cropland but also to native or planted pasture (Lambin et al., 2003). The findings conclusively corroborate that contextual settings, directly and indirectly, determine the primary activities of the people, plant growth and diversity. Also, the cumulative impacts are observable in the form of floral diversity in these localities (Table 3). Croplands, rangelands and pastures occupy approximately 55% of the Earth's land surface (Foley et al., 2011; FAO, 2015) and provide humanity with food, feed, fibre, fuel and other products. These provisioning services often come, however, at the expense of biodiversity and many other ecosystem services (Foley et al., 2011; Newbold et al., 2019). The floral diversity contributes towards natural ecosystems and their production is a substitute for many agricultural inputs, such as fertilizers, pesticides, imported pollinators and irrigation. The strategies for enhancing diversity such as crop genetic diversity, mixed plantings, rotating crops, and agro-forestry are commonly deployed through land allocation strategies. However, the land-use land cover assessments based on contextual potentials of floral diversity are less focused and, thus, poorly understood. Therefore, further studies are required for assessing the potential of land cover in the context of these localities.

6. Conclusions

Land provides essential resources for human survival. In the past, humans have transformed land for agricultural, residential, industrial or tourism purposes following their knowledge of the basic biophysical functions. These transformations have imprints on land-use decision-making at different levels i.e. by individuals, household and community as a whole community. For this purpose, the knowledge system was assessed in terms of decision making at local municipality levels i.e. Maluti-a-Phofung and Thulamela. The study showed that general environmental conditions and local factors such as economic drivers, social dynamics and environmental conditions have significant ecological, economic and social impacts at local, regional and even worldwide scales (Gomes et al., 2020). The study detected a strong linkage between land-use patterns and environmental knowledge. The environmental knowledge acquired either from formal or an informal resource has significant bearings on land-use patterns, thus being useful for sustainable land-use planning and management. Besides that, how the community allocates land for different purposes is dependent on a multitude of socio-economic factors like land ownership (public or private), economic gains, education, access to credits and other resources. The study also reveals the shortcomings in regulatory mechanisms, lack of institutional coordination, gaps in planning and administrative procedures, adversely affect land allocation by converting land into small parcels. Land-use plans are developed by statutory bodies and enforced without public participation; consequently, such plans give more focus to short term economic gains accrued through residential and commercial land utilization. Incorporating indigenous knowledge in land allocation decision making is essential for the future sustainability of this area. Resilience of land resources could be compromised if the national government in South Africa and similar rural environments beyond ignore local environmental knowledge and potential productivity of a particular local context. The local household knowledge significantly contributes towards the land-use allocation at local, regional and global levels. It specifies the abilities to respond to the vibrant states of the environment and the resources of the system.

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