ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 11, Issue, 01, pp.117-127, January, 2019

DOI: https://doi.org/10.24941/ijcr.33906.01.2019

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

EVALUATION OF SPATIAL CHANGES IN THE LOCAL DEVELOPMENT PLAN OF DEBRI-DINGUR AREA MEKELLE CITY, TIGRAI, ETHIOPIA

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ARTICLE INFO

Article History:
Received 10th October, 2018
Received in revised form
06th November, 2018
Accepted 08th December, 2018
Published online 30th January, 2019

Key Words:
Debri-Dingur,
Ethiopia, Land use,
Local Development Plan,
Mekelle, Spatial, Tigrai.

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ABSTRACT

Urban spatial expansion is very common and principally increasing in fast economic growing developing countries. Ethiopia is not only least urbanized, but also most urban areas in the country are predominantly unplanned. Currently, Ethiopian cities are experiencing unprecedented growth and Mekelle a regional capital city of Tigrai province is one of the fast growing city which engulfing the nearby suburbanized fringe *kebelles* like Debri-Dingur area. The objective of this paper is to assess and evaluate the spatial changes in the newly developed local development plan (LDP) of Debri-Dingur area in Mekelle city. The main research method applied here is qualitative, quantitative analysis besides spatial analysis was done using aerial photo and GIS computation and field observations, survey, questionnaires and interview was done to collect the primary and secondary data from dwellers and different relevant sources. The results indicate that in Debri-Dingur area urbanization is growing in population, lack regularization, poor infrastructure development and unplanned squatter housing construction as a leap-frog is common, unless the newly developed LDP is implemented in a revised way as fast as possible. The local development plan (LDP) has recommended a fancy spatial neighborhood design with higher land use coverage of mixed residence, excluding pure residence areas, though economically unfeasible to the local administration and the dwellers unless it is implementation in phase based approach with pure residence as an alternative land use and also the proposed and implemented spatial coverage has discrepancy with the main structure plan of Mekelle city.

Citation: Samuel Bekele, J., 2019. "Evaluation of Spatial Changes in the Local Development Plan of Debri-Dingur Area Mekelle City, Tigrai, Ethiopia", *International Journal of Current Research,* 11, (01), 117-127.

INTRODUCTION

Following preparation of structure plan or master plan, Local Development Plan (LDP) is a next step that leads the biggest and brief plan to implement it into practice. Local Development Plan (LDP) is a detailed development plan of a defined locality. It is a statutory instrument that zooms out the general and broader proposals of a Citywide Structure Plan of an urban area. It serves as a transition between a structure plan and projects in the process of implementation of urban planning. The local development plan is a planning instrument that facilitates the implementation of the structure/master plan by focusing on selected strategic intervention areas. This tool is generally approached by various methods, which include urban renewal, urban upgrading, urban redevelopment and new development. The local development plan (LDP) of Dingur-Debri is approached as the urban fringe upgrading LDP approach by regularization and upgrading of tenure security which intended to prescribe the functions, urban design principles and spatial organization of a given locality. It combines urban design with planning proposals and regulations as clearly defined below.

- **Legal component**: Consisting of *hierarchy* plans, *conformity and consistency* of rules and regulations, including land use zoning of the area.
- **Design component**: Consisting of *integration* plan, design proposal, perspective plans, 3D and design strategy (image diagram, map).
- **Implementation components**: This component consisting of a strategic action plan, implementation phasing, the volume of public investment, mechanism for financing and stakeholder involvement. Furthermore, the detail description of the components is stated in the proposal part of this project.

Local Development Plan (LDP) implementation is aiming to enable a given neighborhood to be more suitable for living, working, recreation and entertainment. It is an enabler for local communities' to make and activate small scale business enterprise, healthy social environment and community empowerment outputs (Ministry of Works and Urban Development, 2006).During a planning year 2016/7, many LDP plans were prepared for different settlement areas of Mekelle city, including other parts of Debri-Dingur area.

Some LDPs implemented, but many others outdated, but the sites were remained under control from any development intervention. In 2017/2018, Mekelle city administration has decided to prepare and implement Debri-Dingur LDP to solve the problems raised by the community including land ownership issues/tenure, land regularization, land use changes, infrastructure development and socioeconomic benefits.

Justification of the study: Local Development Plan (LDP) is a lower level urban plan, which is prepared within the framework of a structure/master plan. It is detailed and focuses on the specific locality of an urban center for immediate implementation. It is, therefore, an important tool for implementation of structure/master plan proposals. The preparation of LDPs in Ethiopia has a very brief history. Moreover, it is limited to few urban centers mainly central business districts (CBDs). The methodology has been ad-hoc lacking systematized approaches and prepared with lack of expertise knowledge. The approaches, pursued by the LDPs prepared for various localities in Mekelle city are not similar due to the fact that there are no locally developed standardized guidelines and well organized consulting firms with different expertise from different field of studies. This has significantly affected the quality of the local development plans so far prepared and impeded their effective execution. Evidently, most of the LDPs prepared for the various localities of Mekelle are either left on shelves or wrongly implemented (Ministry of Works and Urban Development, 2006). Another problem is the knowledge gap in the preparation and implementation of LDPs in Ethiopian urban centers has necessitated for this critical evaluation of the recently implemented Local Development Plan of Debri-Dingur area in Mekelle city with special focus on the spatial analysis.

Research Objective

General Objective: The main purpose of the study is to evaluate the recent implemented local development plan (LDP) of Debri-Dingur area focusing on analysis of spatial changes.

Specific Objective

- To assess the spatial features focus on housing, urban morphology, road pattern, built up area and density.
- To identify the existing land uses in its composition and dynamics.
- To compare the spatial changes and draw possible recommendation on the land use proposal.

Scope of the research: The study of the research coverage of Debri-Dingur area LDP, which covering a total area of 1,370,000m^2 (137 hectares). The thematic issues in this study are the existing spatial and land utilization. These issues include housing condition, housing facilities, existing land use, physical and social infrastructures are under study.

MATERIALS AND METHODS

Research study area

Geographical and administration location: Mekelle, the capital city of the Tigrai National Region State, is located in the northern Ethiopia highlands at 783 km drive north of national capital city of Addis Ababa.

Geographically, it is located between $13^0$24'30" to $13^0$36'52" Latitude and $39^0$25'30" to $39^0$38'33" Longitude. It has an average altitude of 2200 meters above sea level with a mean minimum, mean maximum and mean average monthly temperatures of 8.7, 26.8 and 17.6° C, respectively. Amount of rainfall is variable in Mekelle, on average about 600 mm, and more than 70% of it falls between July and August, followed by long dry season (Mekelle Structure Plan report submitted to Mekelle city administration, 2017). Administratively Mekelle city, has divided into seven sub cities; namely *Hadinet, Kedamayweyane, Hawelti, Semen, Ayder, Quiha* and *Adihaki* (http: //www.mekellecity. com/ mekelle.asp).The study area Debri-Dingur, is administratively found in the fringe of the city in south direction and included in the sub city of *Hadinet,* which is recently included in the city administration after the completion of the new LDP. To be more specific on spatial location, the local development plan is in *Hadnet* sub-city near to Debri *tabia* (local administration) in close proximity to Kelamino special high school, *Mizer* low-cost mass housing neighborhood and Meles Zenawi Leadership Academy, which is also the study areas is located in major urban agricultural developments with nearby to major highway Mekelle-Samre and near to the future artificial lake of Mekelle city.

Population: Mekelle has an estimated total population of 310,436 (The Federal Democratic Republic of Ethiopia Central Statistical Agency, 2018). Assessment study indicated (2016) that Debri-Dingur has inhabited with a total number of 458 household heads. In addition a total number of average persons per household were reported to be 5.6 on the average. To this effect, based on average estimation of persons per household, it is possible to say Debri-Dingur settlement area inhabited with 2,565 population size during LDP preparation period/2016/7 (Mekelle Structure Plan report submitted to Mekelle city administration, 2017). Due to the population increase and new under construction low-cost neighborhood develop it is important to undertake into consideration to add some number of population size as a contingency at a level of social service requirement planning and land allocation for that purpose. To this end, 7.1% as lower variant, 8.1% medium variant and 9.1% as a higher variant population growth rates are undertaken into consideration to address backlog massive population pressure towards to Debri-Dingur end for the last five years (Mekelle Structure Plan report submitted to Mekelle city administration, 2017).

Topography and slope analysis: In the administrative boundary of Debri Dingur area which is in the *Hadinet* sub-city of Mekelle city, the slope has classified into five categories that are from 0-2%, 2-5%, 5-7%, 7-10%, and greater than 10%.The slope category from 0-2% is flat area covers 6% of the total LDP site and this creates water inundation which is flood prone with the high cost of construction for drainage lines. The slope category from 2-10% covers 63%, which is a favorable for urban development even though the degree of suitability varies across the slope category. However, the rest 31% is above 10% slope category which is unsuitable for urban development which is almost one third of the total action area which is 137 hectares.

Research Methodology: The detecting spatial or land use change provides a proper background for environmental, planning and urban management analysis. However, examining spatial or land use is not easy due to various factors.

To investigate the local development plan mainly the changes on the spatial/land use in the new and first in its kind local development plan (LDP) developed and implemented in the study area, is evaluated a detail spatial analysis, comparison and categorization was/has done. The main research method applied here is qualitative and quantitative type of data and analysis was done using categorization, comparison and MS-Excel. Besides, spatial analysis was done using ground survey, aerial photo and GIS computation. Comparative analysis using classification operation enables us to detect trends of land use/cover changes in different times. The mainly utilized method was map-to-map comparison and post classification comparison.

Sources and Types of Data: To undertake this study, both primary and secondary data are utilized. The data gained from randomly selected informants, experts and stakeholder in depth discussion (local administrations and city level administration), analysis, non-structured questionnaire, interviews, ground survey and reconnaissance survey through site visit or observation of the study represents the primary data. Secondary data from relevant literature, review of the previous studies and documents, working manuals, reports and notes are made by assessing relevant documents from different sources that elucidate the spatial development and changes. Besides, the research mainly utilizes both qualitative and quantitative type of data.

Situational Spatial Analysis

Introduction: The spatial expansion trend of Mekelle city in the last decade is relatively very fast. It expands towards the four directions of the city by incorporating new rural settlements. In the newly revised structure plan of the city, the Debri–Dingur peri-urban area is proposed as one of the potential growth direction of the city. It was originally restricted around the locality of parts of today's called Debri-Mekayih, where the initial settlement was, and began to expand into the south.

The large swampy open area in front of the settlements offers a grazing land for the animals. This area lies in the major urban agricultural land in the city near to Kelamino River, so the re/development of the area is very important in terms of the future development of the city as well as enhances the living environment of the people. Debri-Dingur area is also located in the future center for the entertainment and modern urban agriculture development. In general the study area is characterized by lack of basic utilities and social services, poor housing condition as well as relatively low income people with small scale agricultural activity, irregular pattern of roads and blocks and rugged topography and swampy areas (Mekelle Structure Plan report submitted to Mekelle city administration, 2017). The study area has been considered as one of the Local Development Plan project areas of the structure plan to improve the basic infrastructure provision and improve the accessibility and enables the area to play its future role as part of the mixed use residence. When the asphalt construction from *Mayweini* is completed the vehicles will prefer to travel via this road and it will become an important commercial development area hence the road will be an important infrastructure to attract new development. The study area also exposed to legal and illegal land occupation by the nearby administration and the residents (Mekelle Structure Plan report submitted to Mekelle city administration, 2017).

Spatial Characteristics of the Local Development Plan (LDP): Debri-Dingur area land use cover is mainly characterized by housing and also important functions like a market place, service sector area and road. The Debri-Dingur area LDP is characterized with a different plot and block layouts. Irregular plot and block arrangements of the old settlement of the area is characterized by inaccessible settlements, poor basic infrastructure facilities (water, power and telephone), poor to fair housing condition, irregular parcel layout with large plot size, irregular block layout arrangement, lack legal land ownerships (land tenure problems),swamps or wetlands and social infrastructure problem. The assessment of the land use shows that the study area lacks basic social services like a Kindergarten (There is only one KG available), health center, farmer's training center, playground and public facilities (toilet, garbage collection). The LDP area is dominantly occupied by residential land uses which are dispersed all over the site without following the standard planning andsome of them are mixed-use with other urban agricultural activities, notably fattening and dairy farms. In the new structure plan the study area has mainly mixed development which includes housing and commercial function and there is a proposed an artificial lake.

Urban Density: As shown in the figure 9 below, the action area of Debri-Dingur area covers 137 hectares of land and there are about 458 inhabitants in the area. The gross population density of the LDP site is 3.34 residents per hectare. When comparing the density of the site with that of other parts of the city it is sparsely scattered.

Existing Morphology and Block Arrangement: The LDP site has an irregular arrangement of blocks, since the area is dominated by old settlements of dwellers. The irregular block arrangements have caused the site not to easily get links well with the rest parts of the city. It has also made the local roads narrower and some of them are even dead ends. Generally the unplanned block arrangement and haphazard development has made/left the area with poor road hierarchy. Based on household non-structured assessment results and ground surveying and field observation made the following possible, concluding strategic actions have been made to address LDP assessment results of Debri-Dingur area.

Plot size and BAR (Built up Area Ratio): The LDP residence acquired large plot areas compared with the main urban areas standard($140m^2$ and above) however, with very small built up areas in proportion to the total area, this implies that the study area is not well developed yet and sparsely scattered development, vacant spaces and underutilized plots are common. Houses within the range of 300-$600m^2$ plot sizes are common thus, plots below the minimum standard and excessive plot areas need planning intervention to be regularized the tenure system.

Land acquisition and tenure: It is only 43.2% the residences acquired their land from local administration/municipality this implies that there is another way of land acquisition means and need to follow legal framework for land administration, hence illegal housing construction and squatter settlements is vivid.

Housing Ownership: In the Debri-Dingur area,88% of the housing units are privately owned and this indicates the housing provision and development is dominated by the private or self-financedland developers.

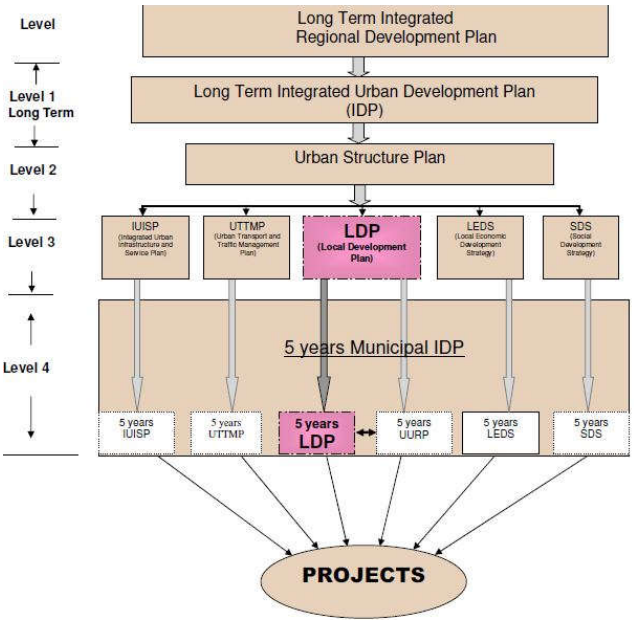
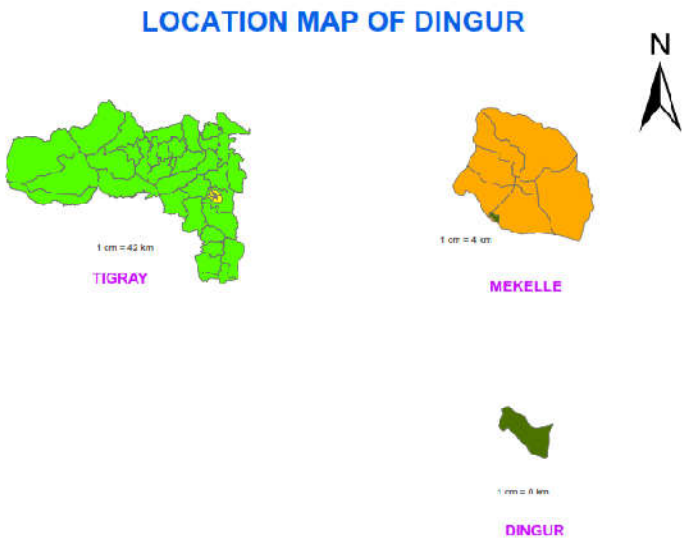
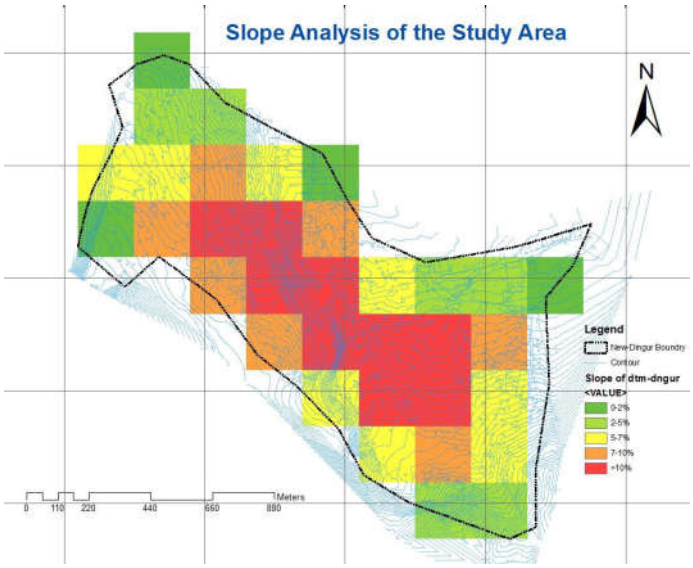


Figure 1. A Framework of the Trend in the Ethiopian Urban Planning System



(Source: GIS computation)

Figure 2. The location map of Debri-Dingur



(Source: Ground Survey, 2016)

Figure 3. Topography/slope of the study area

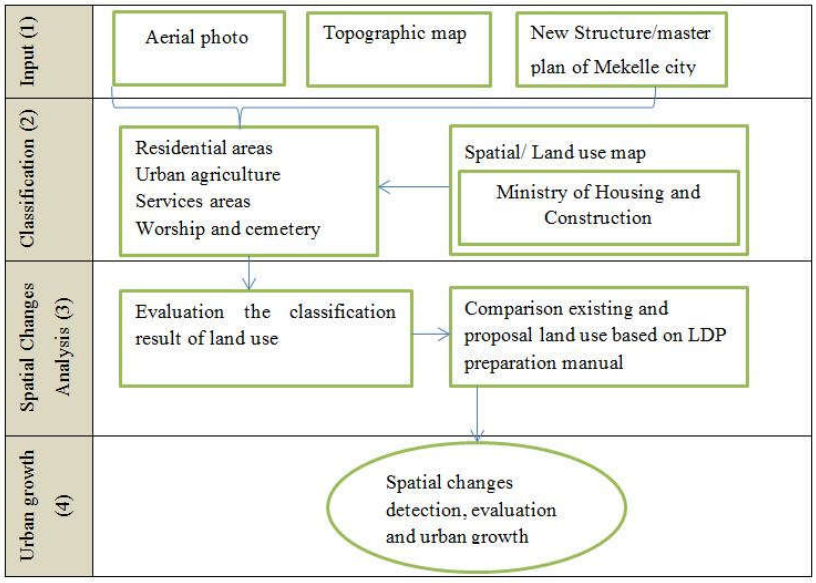
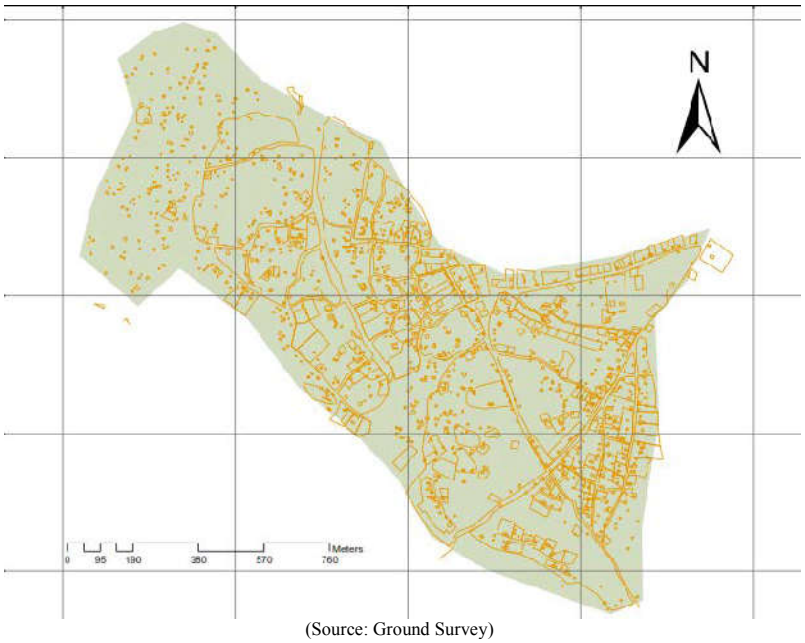


Figure 4. Methodology for evaluation the spatial changes in the LDP of Debri-Dingur area of Mekelle City

(Source: Google map 2017)

Figure 5. Showing settlement of the study area



(Source: Ground Survey)

Figure 6. Map showing the spatial characteristics of the area

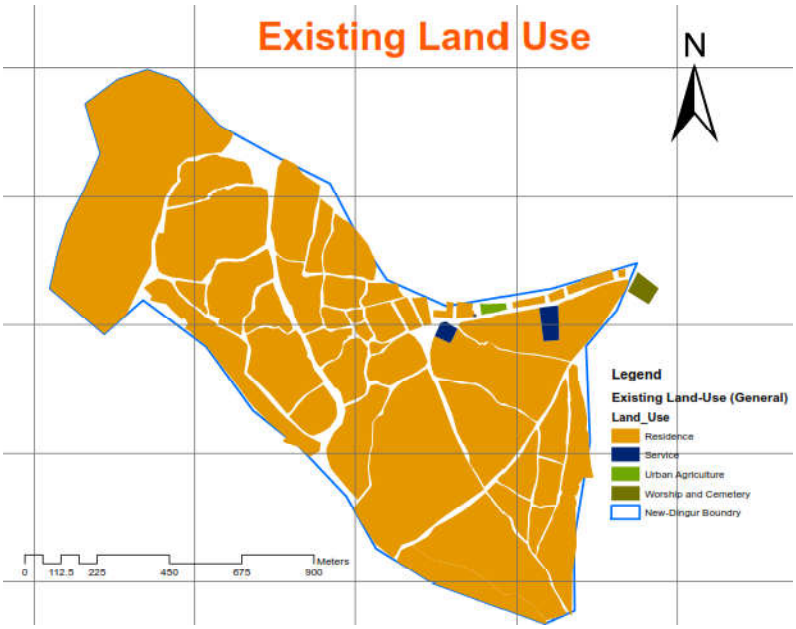
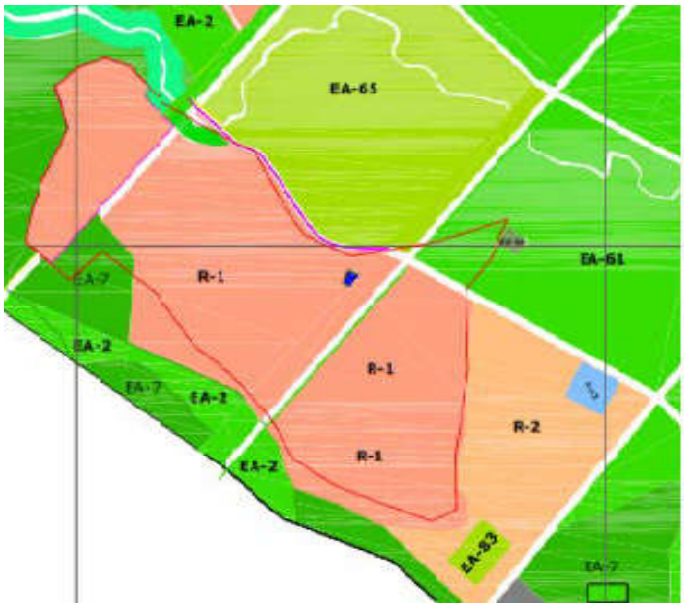


Figure 7. Existing land use (Computed by author)



(Source new structure plan of Mekelle city)

Figure 8. Structure plan land use cover of the study area

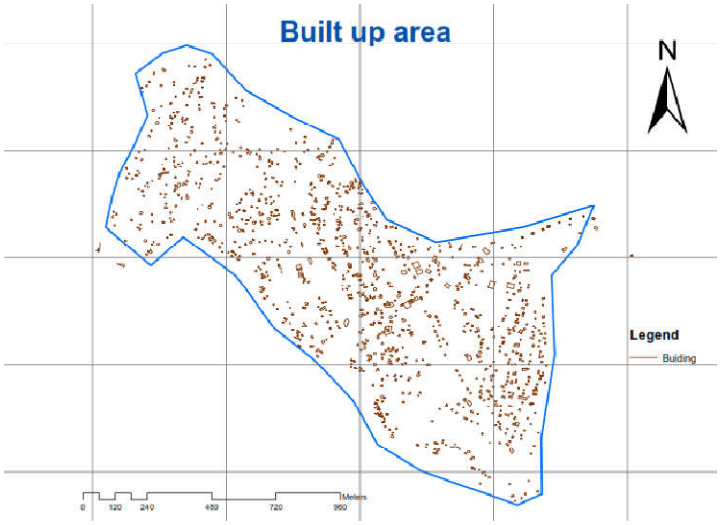


Figure 9. Built up area of the study area

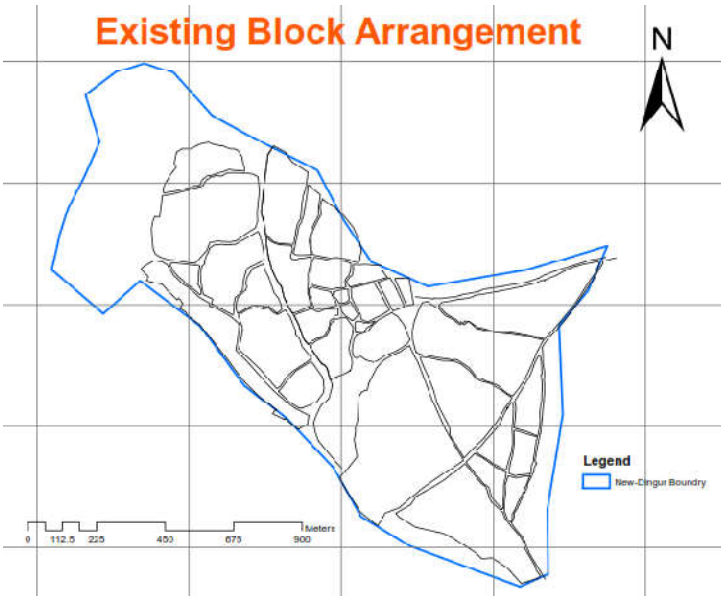


Figure 10. Existing Morphology and Block Arrangement (Computed by author)

(a) (b)

Figure 11. The housing condition of the study area

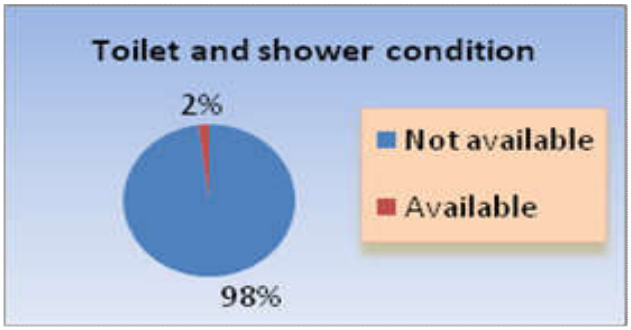


Figure 12. Toilet and shower in the study area

(a) **(b)**

Figure 13. Access road to the study area

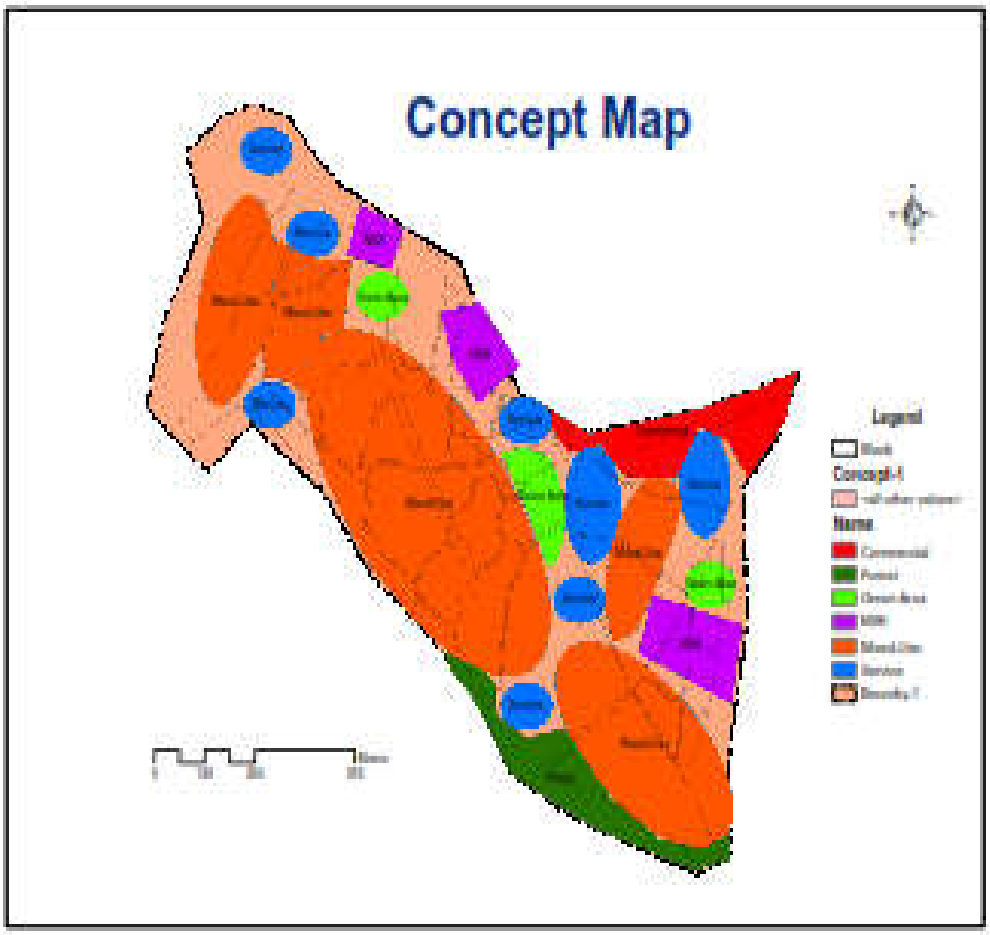


Figure 14. Concept map of land use proposal

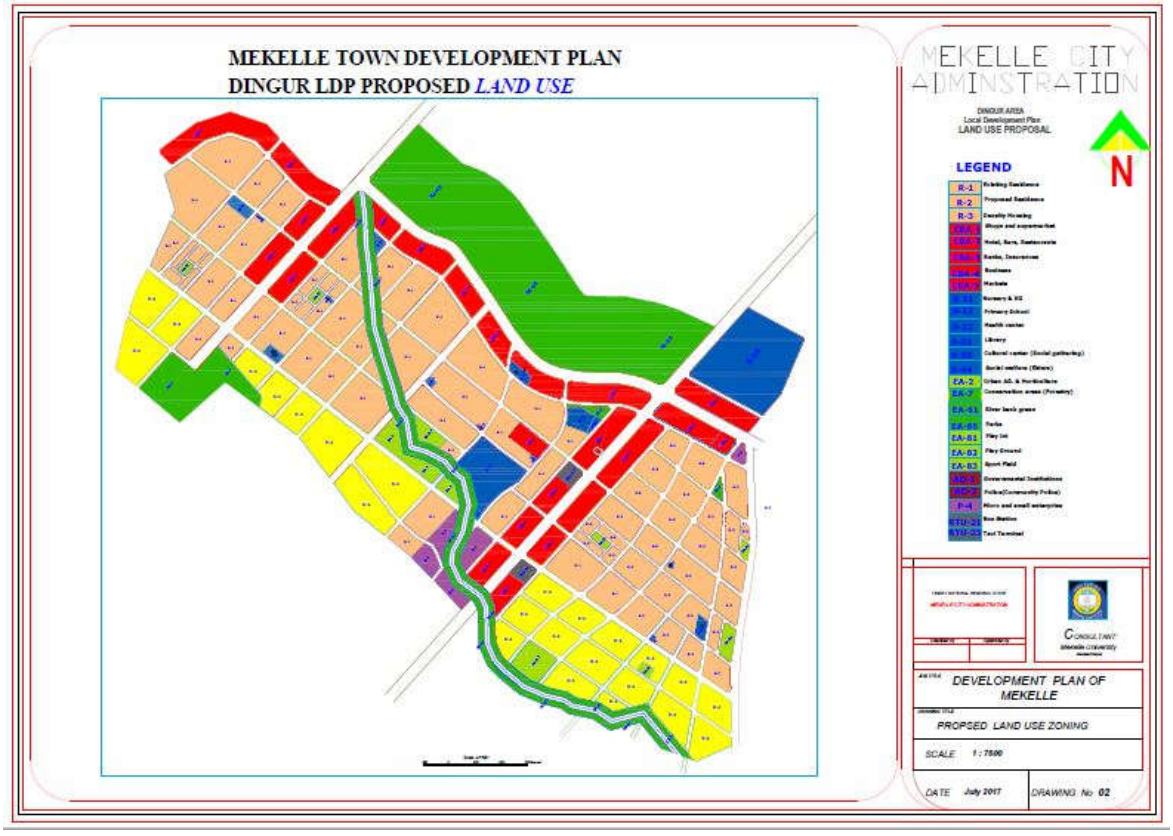


Figure 15. Proposed land use of Dingur-Debri area

Figure 16. LDP land use proposal

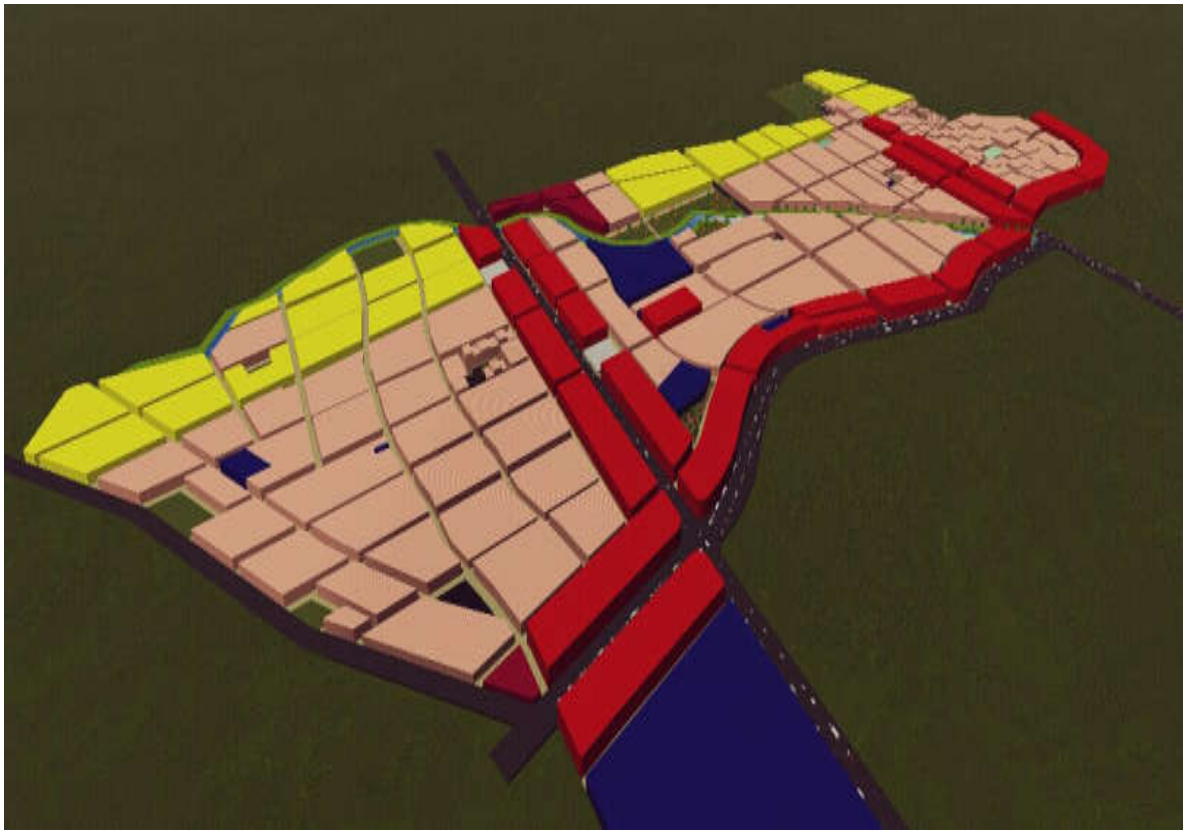


Figure 17. 3D of the land use proposal

Housing function: The houses mainly function as a living area and 95.2% of those are used for as a residence or living, hence, this makes the LDP area is economically inactive.

Housing Typology and condition: The common housing typology is the row house accounts 46.9% of from the total housing typology and the rest is detached and other housing typology.

The physical housing conditions in the Debri-Dingur LDP is 56.1% accounts the medium housing condition since 45.7% of the housing are constructed before 10-20 years ago.

Building materials and housing construction: The majority of the materials of the houses for wall, ceiling, roof and floor are made of local abundant construction materials. Mud and stone are the widely used local materials for floor and wall

Table 1. Existing Land use, Gap Analysis & Proposed LDP

No.	Land use components/elements	Standard	Existing(ha)	Gap in %	Proposed in %
1	Housing (Residence)	40-50%	121ha (88%)	38%	58%
2	Business and commerce	7-20%	-	8%	8%
3	Services (special functions)	10-20%	0.96ha (0.7%)	10%	6%
4	Green, recreation, sports and environmental sensitive area	15-20%	4.1ha (3%)	11%	11%
5	Administration	3-7%	0.023ha(0.02)	1.5%	1.5%
6.	Manufacturing and storage	10-15%	0.5ha (0.37%)	2.5%	2.5 %
7.	Utilities and infrastructures	15-25%	10.4ha (7.6%)	13%	13%
	Total	100%	100%		100%

Table 2. Existing land use, gap Analysis & proposed use allocation

No.	Spatial Services	Proposed No.	Area (msq)	Total area (msq)	Remark	Existing No.
1.	Nursery	3	175	525		0
2.	KG	2	1500	3000		1
3.	Primary school	1	18,000	18,000	Maximum population of 25,000	0
4.	Heal center	1	2000	2054	2054	1
5.	Model Cemetery	1	50000	50,000	Out of the LDP area	0
6.	Elders recreation area	1	500	500		0
7.	Social gathering /festival places	1	25000	25000	18,175.5	0
8.	Market center	1	2500	2500	2550 Small scale	0
9.	Community empowerment center	1	500	500	635	0
10.	Housing	1080 (HU)	140	151,200		
11.	Urban agriculture Poultry and livestock production			10,657		1
12.	Manufacturing			8117	Garage also	0
13.	Carwash		1500		1000	0
14.	Garage & parking			Manufacturing		0
15.	Retail				CBA	0
16.	Play lot	5	1066	2000	1000-2000 standard	0
	Play ground	1	3456	3000	3000-4200	0
17.		1	3021			0
18.	Kebele Level Football field	1	7676	7676	8064	0
19.	Administration					0
20.	Community police	5	175	875		1
21.	Public Water Tap	5	25	125		-
22.	Mobile Toilet with Landscape	1	300			

respectively with 77.3% and 78.2% respectively, and the most common roofing material is CGIS which accounts 85.6% with some flat *hidmo* house (vernacular housing style) are still available.

Housing facilities and utilities: Traditional kitchens accounts 69.2% and most of them are in poor quality. There are also 98.5% of the houses without toilet and shower and these existing toilets and showers are also in poor physical condition. From the existing unplanned road 53.1% are in a poor condition and also there is lack of access and connectivity, no drainage and water supply systems, insufficient of access and supply to electric and telecommunication networks. In the entire existing housing unit there is no septic tank and the solid waste is dumped on various open spaces. Therefore, special emphasis should be given to the design, construction of housing, and provision of infrastructure in accordance with planning rules and regulation during the proposed LDP implementation period.

Conclusion

Before going to the spatial comparison (existing land use, gap analysis and the proposal) it is very important to see the concept plan and the general framework of development which helps to solve problems mentioned in the situational analysis and it includes:

General framework of the concept plan development

- Upgrading the old neighborhood by providing suitable access and efficient road linkage
- Providing basic infrastructures and utilities
- Improve the security of tenure
- Provide sufficient social and municipal services.
- Improve the residential with various dwelling densities and types of housing.
- Ensure efficient use of land for different uses.
- Provide a good quality of public spaces and enhance the quality of the environment

The planning area for the LDP includes proposed potential area for park, river for urban agriculture, connectivity, social services, churches, recently on going and under construction of good quality residential neighborhoods, hence, The action area for the LDP includes health center, some micro and small industries, lack of open space and greenery, poor quality infrastructures and residences and it covers a total area of 137 hectares.

Existing Land use, Gap Analysis & Proposed LDP: The evaluation of the existing spatial cover and the new developed LDP proposed and currently implemented has been compared based on the Federal LDP manual or standard as stated in the Table 2.

Proposed Land Use Allocation: Since the study area is found on the fringe of the peri-urban area and the LDP is newly developed to include the study area in the rapidly urbanizing Mekelle city administration. Hence, based on the population growth and LDP manual prepared by Ministry of Works and Urban Development, Federal Urban Planning Institute, in order to propose the land use zoning for newly developed LDP the following land allocation have done and based on the land requirement, the total action area, population and standard the spatial allocation is stated in the Table 1.

Recommendation

The newly developed LDP, which is a fancy neighborhood spatial proposal includes all the spatial elements and with its building height regulation has tried to follow the standard land use allocation according the Federal LDP preparation manual, but it needs strategic approach how to implement the proposal, including the time framework or phasing based development indicate the community and stakeholder engagement during the actual implementation. The proposed LDP also recommend a higher land use coverage of mixed residence, excluding pure residence areas which makes it uneconomical to the local administration and the dwellers unless its implementation in phase based approach with pure residence as an alternative land use and the LDP's spatial proposed has discrepancy with the main structure plan of Mekelle city. Based on the findings, discussions and drawn conclusions the following recommendations are also forwarded:

- The local administration shall provide and regularize the land according the standards and regulations of the Federal urban planning manual and the newly developed LDP. The existing land ownership issues and illegal land acquisitions should also need legalization and standardization.
- Most of the local residence area supporting the local development plan since they are looking forward to a better urban area with ample infrastructure and facilities, but a continuous awareness creation program me is very important to continue such participatory approach.
- Before desiring to give land for other new dwellers which comes outside of the current action plan area, it is necessary to empower/secure residents' livelihood & wellbeing using urban agriculture, small and medium enterprises, business centers, indigenous recreation center, etc.
- Landfill site and the solid waste collection and disposal of the site should be improved and integrated with the main city of Mekelle.
- Use rehabilitation rather than to use compensation approach during a time of LDP implementation practice to help the original dwellers.
- Provision of infrastructure that enable residents to run business and access social services should do prior to give land for new residence.
- All the development should consider increasing the creation of job opportunities by SME (small and medium enterprises) for youth which are unemployed.

Acknowledgements

The author wishes to express his gratitude to all people who have participated directly and indirectly during the research work and special thanks goes to my spouse Feven Tekeste.

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