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Analysis of Educational Services Distribution and Accessibility as Education Quality Indicators: Evidence from Geospatial Analysis and Administrative Time Series Data

(Case Study: Gambela City, Gambella Regional State, Ethiopia, East Africa)

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ABSTRACT: It is universally agreed concept that education is a corner stone for socio economic transformation. Education has been recognized as weapon to fight backwardness, poverty and illiteracy for ages. Experience have shown that all the good benefit of education has been assured only when there is quality education. However, there are visible indicators that education quality has not been still achieved in the entire world. Particularly, education quality in developing countries is perceived as discouraging. Hence, the sharp decline of education quality is becoming major concern for developing countries like Ethiopia. This is also more serious concern in emerging regions like Gambella regional state where most people share pastoralism way of life. It is also understandable fact that there are locally known spatial and non-spatial factors that affect education quality. Therefore, the main objective of this study was to identify spatial and non-spatial factors that influence educational quality of primary schools in emerging regions. As methodological approach, the study was used descriptive design approach with mix of qualitative and quantitative method. The main data sources were both primary and secondary data. Primary data were collected from spatial and non-spatial data sources. The spatial information was mainly collected from GPS reading, aerial photo and land use plan. Non spatial primary data were collected using interviews and discussions. The perceptions and reflections of key informants (teachers, students, principals and parents) were entertained by using focus group discussion, key informant interview and public hearings. The secondary data sources were collected by means of desk review. As result, the study was found that education quality in the city is weakening. The underlying causes are, low teachers motivation level, high students- teacher ratio, high students- section ratio, lack of instructional materials, lack of infrastructure and facilities. From the spatial perspective, the education institutions are an unevenly distributed that students from the central part of the city are more advantageous.

Keywords: *Distribution; Emerging Region; Elementary; Gambela; Quality; School; Service Area.*

INTRODUCTION

Education is the main driving factor for economic, social, and political transformation since human civilization. Advancement in technology, economy and socio cultural change has been achieved by expanding quality education system. Furthermore, it is acknowledged fact that education is one of the most vital factor for human capital development and it has been used as main tool to yank out citizens from ignorance, backwardness and poverty (Jidamva, 2012). Education is a basic human right and plays indispensable role in bringing broader social, economic, political and cultural benefits. Developed countries have been exerting massive efforts to assure education quality via institutional, policy and legal reforms in their educational development (Biggart et al., 2015). However, development of educational system in developing country is not as good

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as that of developed countries (Pradhan et al., 2011). In developing countries at the beginning, greater emphasis was given to expand more educational institution. However, with the accelerated enrolment growth the issue of quality has been put aside (UNESCO 2009).

The same is true for Ethiopian education system. It has been characterized by quantity led education expansion system. Local governments have been investing their resources to increase number of schools which envisages to promote access for education. However, this days concerns have been raised about the decline of education quality for being it is becoming worsen. The substantial achievements in terms of increasing enrolment is shaded by poor education quality (FMoE, 2017). In Ethiopia, due to the dramatic increase of enrolment the desire to ensure education quality is becoming challenging task to all stakeholders. The challenges are manifested on the ground by high student-teacher ratios, insufficient classrooms, inadequate learning materials and unevenly distribution of schools (UNICEF, 2018).

Similarly, though the education sector in emerging regions has shown a considerable progress in terms of access to primary education, there have been huge worry on the rapid decline of education quality (Master plan report, 2018) Hence, as result the sharp decline in quality of education has been a major concern for the region as general and particularly for the city. Here, the important concern that need to address is identifying the major factors that affect education quality in the local context. Because understanding the nature and scale of the factors is prerequisite to solve the problems. Gökçe et al., (2016) and Chapman & Adams (2002) argue that factors that affect education quality are several and context dependent. In deferent countries analyzing factors that influence education quality has been center of researches. However, such researches were mainly focused on the developed world. Studies in developing world were few. In Ethiopia, although, national wide research initiatives has been undertaken to evaluate the situation of education quality, little evidence is available. Particularly in case of emerging region is more acute. Therefore, this study was aimed to analyze spatial and non-spatial factors that influence educational quality in primary schools of emerging regions. Specifically, the non-spatial factors were identified and analyzed from social, cultural and economical, technological perspective. Meanwhile, spatial factors were focused on analyzing distance to school, spatial distribution, accessibility and service area coverage of education institutions using Geographic Information System (GIS) and administrative time series data.

MATERIALS AND METHODS

By their nature factors that influence education quality emanate from spatial and non-spatial dimensions. The non-spatial factors are more associated to the existing economic, social, cultural, and historical, religions, political and environmental contexts. Whereas, the spatial factors are more associated with geographical location. Because education system can be positively or negatively influenced by geographic location of the education institution. In spatial term distance to school, spatial distribution and accessibility of education institutions are some of the factors that influence education quality. Accordingly, to collect such data, this study was employed mixed research approach (qualitative and quantitative). The qualitative data were used to assess perception of teachers, students, principals, parents and school administrators towards education quality. Whereas the quantitative data were used to measure distance, accessibility, distribution and service area coverage of the schools and their impacts on education quality.

Data

The data sources of this study were obtained from primary and secondary data sources. Primary data were collected from spatial and non-spatial data sources. The spatial factors were mainly collected from GPS reading, aerial photo and land use plan of the city which was used to extract location of the existing educational institutions. Spatial information of education institutions have been converted to spatial data layers and stored in the Geographic Information System data database. Non-spatial primary data were collected using key informants interview, focus group discussion and field observations. The perceptions and reflections of key informants (teachers, students, principals and parents) were entertained by using focus group discussion, key informant interview and public hearing approaches. On the top of this, the researcher reviewed thoroughly a number of documents that were directly or indirectly related to the education sector in developing countries. Those were national education policy and strategies. In addition to this the researcher also analyzed relevant education related reports, correspondences, minutes and archives of the local government of the study area (Table 1)

Method to Identify Factors Affecting Education Quality

Non Spatial Factors

As is clearly stated in the background, quality of education is influenced by multi factors. Gökçe et al., (2016) and Chapman & Adams (2002) argue that factors that affect education quality are several and context dependent. As general conception education quality can be influenced by non-spatial factors which emanate from social, political, administrative, environmental and technological domain. By their nature, non-spatial data are expressed in terms of qualitative way which are mainly expressed by reflections and perceptions of participants. Hence, during the course of this study, the perceptions and reflections of students, teachers, principals and parents were collected by using key informant interview, focus group discussion and public hearing meeting approaches. Field observations were also conducted in order to grasp experience on quality, functionality and overall performance of the education service delivery in the study area. Under this evidences were gathered by using photograph and eye witnesses.

Spatial Factors

Under this method spatial factors that have direct and indirect impact on education quality were analyzed by using

Table 1: Data sources

Type of data	Data description	Data type (formats)
Spatial	Satellite imagery(world view)	Digital
	City land use plan (2017)	In CAD and GIS (shape file)
	City land use inventory (2017)	In CAD and GIS (shape file)
	City boundary	GIS (shape file)
Non spatial	Norms and standards	Literature review from federal urban planning manual
	National education annual report	Report
	National education policy and strategy document	Report
	Statistics report from central statistics agency	Report
	Master plan report	Report

geospatial tools. Here, spatial distribution, accessibility and service area coverage of the existing primary education institution were analyzed by using ArcGIS Network Analyst extension to identify which area of the city is well serviced and none serviced. In this regard, concentric service areas were generated to show how accessibility varies with in given distance. Once service areas were created, it was possible to identify how much service area are well served, moderately served and underserved. ESRI also acknowledged that service areas created by network analyst helps to evaluate accessibility of given social services.

Analysis Approach

This study was conducted on the spatial and non-spatial factors affecting the provision of quality education in primary schools of emerging regions. The study used descriptive design with qualitative and quantitative method. The analysis was mainly rooted in analyzing the existing school service against national standards. The existing service delivery was analyzed in terms of education quality indicators such as pupil-teacher ratio, class- student ratio, served population, availability of school infrastructures (toilet, bath, water supply, electric city, IT room, and library and compatibility location of the schools). In addition to this, the quantitative data that deal about geographical location (distribution, accessibility, service coverage and distance from the center of the school) were analyzed using geospatial tools and administrative time series data.

Software Used

A set of analytical softwares were used to assist analysis of quantitative data. In this study popular geospatial tools like arc GIS version 10.5 and CAD (computer aided design) were used to analyze the spatial data. In the other hand, the qualitative data or the non-spatial data were analyzed using Microsoft Excel and SPSS. In such cases, calculation of percentages, proportions, ratios, averages, and comparison of figures with national standards were used as means to interpret the research findings.

RESULT AND DISCUSSION

Non Spatial Factors Affecting Educational Quality

Reflections from Key Informants and Focus Group Discussants

During the discussion with key informants and focus group participants it was underlined that there are potential factors that negatively influence education quality in emerging regions. As per the participants' opinion currently education quality is at its lower position. Detailed survey specially made by the Ministry of Education of Federal Government of Ethiopia (2015) also confirmed that the quality of education offered at the primary school is discouraging. According to same source, in the previous decades encouraging results have been registered in promoting access to primary educations. However, this process was not successful in attaining education quality.

Qualitative interviews confirmed that there are different factors that affect education quality in the city. As per the perception of the participants, those factors are emanated from the cultural, economic, political and technological backgrounds. Qualitative findings asserted that traditional attitudes that support early child marriage creates an additional obstacle to ensure education quality in primer schools. Economic issues are also playing significant role in education quality. In the first place, teachers' salary is not attractive and most teachers are dissatisfied. Secondly, students from poor family are the most disadvantageous that they cannot get additional reference material and teaching aid. Lack of technological inputs like

Table 2: Comparison number of population served in each institution against standard (Source: MWUD, 2017)

Educational level	Existing schools	Standard per institution	Average	Required schools for the existing popula-tion (74,102)	Gap
Pre-primary school (k1-kg3)	05	2,500 1,000-	1750	42	37= 42-05
First cycle (1-4) and secondary (cycle (5-8	12	18,000 12000-	15000	05	This is within the standard
Secondary first (cycle (9-10	03	15,000 10,000-	12500	06	03 =06-03

radio, tape recorder and internet access are also raised as factor to lower education quality. Empirical study also witnessed that primary schools in Ethiopia lack technological inputs. As evidence, as national wide 33 % of primary schools have not radios, 67% have not tape recorders and 89 % have not video recorders (FMoE, 2017)

In general, the perceived hurdles to education quality and reasons to decline education quality remain numerous. Interviews with parents, students and principals asserted that there are common factors that are affecting educational quality. This includes shortages of instructional material, lack of qualified teachers, limited instructional inputs, shortage of classrooms, lack of school facilities and equipment, lack of textbooks and lack of technological inputs are some of the major factors that affect educational quality in the study area. On the top of this, the low level standards in terms of teaching learning material, student desks and black boards are some the indicators that show challenges of the education system in the local area. Ngigi et al., (2012) also acknowledged that educational sector in developing country has numerous challenges. Such as, lack of infrastructural and human resources, poor accessibility, imbalance between demand and supply school facilities are factors that affect education quality. The other factor that influence quality of education in the study area is turn over and less motivation of teachers. A number of studies also have witnessed that teachers motivation is vanguard factor to assure education quality (Ololube, 2006)

Factors Affecting Educational Quality from Empirical Evidences

Number of Educational Institutions and Served Population

Experience has shown that capital cities of developing countries are recognized as primate cities. This is happened due to the fact that people perceived those capital cities are full of opportunities. As matter of fact, today capital cities of developing countries are suffering with over crowdedness, high rate of unemployment, severe housing problem and lack of adequate services which mainly include health and education services. Gambela city which is the capital city of Gambella reginal state also shares the same characteristics. Theoretically, it is understood that when population size increases at alarming rate, local governments are always under pressure to supply adequate service to its residents. In the same line of thinking, it was noted that due to ever increasing of population there is visible gap in demand and supply of educational services (Table 2)

As shown in Table 2, based on the national urban planning manual, 37 additional kindergarten need to be constructed to serve the existing population size. Besides, the city also need 03 secondary first cycle (9-10) schools to be built in the city so as to fill the gaps. This fact indicates that in addition to issue of education quality, there is also an issue of education accessibility problem in the study area.

Analysis of Pupil-Teacher Ratio (PTR) as Quality Indicator

Educational planning is always guided by allowable standard. Among those standards pupil-teacher ratio (PTR) is the most important. UNESCO (2009) stated that standards pupil-teacher ratio (PTR) in most developing countries is in a discouraging situation. Pupil-teacher ratio (PTR) in developing countries estimated that over 84 per cent of classrooms had over 40 pupils per teacher and this is more acute in Sub-Saharan Africa and Asia(Waita et al ., 2016) In Ethiopia, the standard set for pupil-teacher ratio (PTR) is 50 at primary and 40 at secondary level (FMoE,2017). However, in actual condition it is beyond those limits. For example, Addis Ababa has the lowest PTR at 24 students for every teacher in primary school. Emerging regions like Ethio –Somali has the highest PTR at 63 students for every teacher (FMoE, 2017).

Based on the secondary data source pupil-teacher ratio (PTR) in Gambella city ranges from 50:1 to 60:1. This is happening due to the fact that enrolments have grown without supply of adequate teachers. Accordingly, this high ratio of PTR is becoming one major factor that affects education quality

in the study area. According to Gökçe et al., (2016), highest pupil-teacher ratio (PTR) affects student's self-confidence, co-operation, and sense of belonging and behavioral changes. While small pupil-teacher ratio (PTR) promotes participation and confidence of the students.

Analysis of Pupil Section Ratio as Quality Indicator

Having pleasant education environment and class room is prerequisite for achieving efficient and effective educational system. Figueroa et al., (2016) and Blatchford et al., (2011) also argue that the number of students in a class is a primary factor affecting the quality of education. In Ethiopia, pupil section ratio (PSR) has disparities among all regional states. For example, Gambella regional state has the biggest variation between cycles, with 114 in the first cycle compared to 77 in the second cycle. Pupil section ratio (PSR) is lowest in Addis Ababa indicating that students in this region have better access to class room and so are for quality education. Nationally, the average pupil section ratio (PSR) is 43 for primary school (FMoE, 2017). However, as it can be seen in Table 3, the student-class room ratio ranges from 1: 50 to 1:153. This implies that there is limited number of class room in each schools. In this regard, during the field visit it was noticed that class rooms were overcrowded and there is competition for the resources (book, chair and facilities). Blatchford et al., (2011) clarifies smaller classes led to pupils to get attention, support and can create active interaction among pupils and teachers. In the contrary, higher students in class negatively affects the participation of students which in turn affects education quality.

Analysis of Gender Parity Index as Quality Indicator

In this contemporary era, having balanced gender parity index is considered as indicator for good education access and education quality (White et al, 2016). With regard to Ethiopia, still the gender parity index (GPI) issue has visible disparities among regions and schools. For example, currently Gambella reginal state has gender parity index of 0.92, Ethio somali 0.78 and Oromiya 0.87 (FMoE, 2017) While currently, the national gender parity index (GPI) is 0.90 this implies that there is still more work to be done nationally, regionally and locally. In same way, Gambela city also show gender parity index (GPI) disparities. As it is indicated in Table 4, it is witnessed that girls and boys are not offered the same chances to go to school.

Analysis of Facilities and the Physical Condition of Schools

School facility is vanguard tool to motivate and inspire students' wish to stay in education circle. Those school facilities may include in any school system range from the school plant that is the school buildings, classroom, library, laboratories, toilet facilities, learning materials and play fields that would likely motivate students towards learning (Martorel, et al, 2016). In developing countries it is stated that school facility are not available sufficiently (Ndirangu et al, 2016). In Ethiopia, national reports witnessed that education institutions lack adequate infrastructures and this is more acute in emerging regions. For example, only about 33% of all primary schools have electric supply, 67% of primary schools have radios, 33% have tape recorders and 11% have video recorders (FMoE, 2017). Key informants stated that the school environment is not attractive for being schools not equipped with necessary facilities like toilet, bath, library, lounge, recreational space and office facilities (Table 5). As it can be seen in Table 5, out of the ten schools only 60% have electric city, 50% have water supply, 100% have not launch, 80% have not library, 90% have not play field and 100% have not workshops. This implies that lack of those facilities has great direct impact on the education quality

Table 3: Comparison number of students-class room in government schools

S.N	School Name	Grade Level	Number of Students			Rooms	PTR	National Standard
			M	F	Total			
1	Eley praymery	1-8	1003	1046	2049	20	1:103	1:50
2	Wibure	1-8	914	932	1846	17	1:109	1:50
3	Ras gobna Pra	5-8	777	657	1434	16	1:90	1:50
4	Dalekoch	1-8	1438	1158	2596	17	1:153	1:50
5	Chnkware	1-5	877	788	1665	15	1:111	1:50
6	Jejbe	1-5	123	132	255	5	1:51	1:50
7	Terkidi	1-4	196	211	407	6	1:68	1:50
8	Elay	9-10	380	462	842	10	1:84	1:40
9	Newland Seco	9-10	410	210	620	8	1:78	1:40
10	Preparatory	9-12	1323	833	2156	26	1:83	1:40

Table 4: Number of pupils and gender equity by school level

S.N	School Name	Grade Level	Number of Students			Ratio m/f	
			M	F	Total	Male by %	Female by %
1	Eley	1-8	1003	1046	2049	48.5	51.5
2	Wibure	1-8	914	932	1846	49.5	50.5
3	Ras gobna	5-8	777	657	1434	54.2	55.8
4	Dalekoch	1-8	1438	1158	2596	55.0	45.0
5	Chnkware	1-5	877	788	1665	53.0	47.0
6	Jejbe	1-5	123	132	255	48.0	52.0
7	Terkidi	1-4	196	211	407	48.2	51.8
8	Elay	9-10	380	462	842	45.0	55.0
9	Newland	9-10	410	210	620	66.0	44.0
10	Preparatory	9-12	1323	833	2156	62.0	48.0

Table 5: Availabilities of school facilities in Gambela city

No.	School Name	Electricity	Water Supply	Lounge	Library	Play Field	Work Thop
1	Eley praymery	yes	yes	no	no	no	no
2	Wibure	yes	no	no	no	no	no
3	Ras gobna Pra	yes	yes	no	no	yes	no
4	Dalekoch	yes	yes	no	no	no	no
5	Chnkware	no	no	no	no	no	no
6	Jejbe	no	no	no	no	no	no

Spatial Analysis of Education Institutions (Accessibility and Spatial Distribution)

Spatial Distribution Pattern of Primary Schools

In the contemporary social development system elementary schools are expected to be located at neighborhood level (Mustapha et al., 2016) However, spatial distribution of primary school has been generally uneven in most developing countries and thus limits the level education accessibility and education quality (Fabiyi & Ogunyemi, 2015). Likewise, in Ethiopia, most of schools are located in central part of the urban centers and students from the periphery of are disadvantageous being they are traveled more distance to access school. It is also true for Gambela city that primary schools are unevenly distributed (Figure 1). As it is witnessed in Figure, 2.1 about 70% of the primary schools are located in the central part of the city. The north, south, east and west extreme of the city lack education institutions. The qualitative findings support that there are significant number of students that travels more time to access the nearest school. For this reason many students develop habit of late coming. When students travel significant distance there is chance to miss first period which in turn affects education quality. Bramasta (2005) witnessed that uneven distribution of educational institutions greatly affects education quality.

Adequacy of Space for Primary Schools

Ministry of Works and Urban Development (MWUD) (2017) in its urban planning implementation manual issued that 1.5 – 2.5 ha land is required for placing primary school. This space is required not only for the hard landscape (building and road) but it is also for facilities like play field, green area and other outdoor services. In this perspective, most of the existing schools in Gambela city have met the national standard except one schools (Table 6) Key informants stated that though there is enough space in the compound of the school, due to lack of funding schools are not in position to construct additional class rooms, infrastructures like play fields, library, IT room, lounges and show rooms. In other hand, some schools also want to upgrade themselves to secondary school. However, due to lack of resources mainly funding the space available in the school compound is remain still ideal and vacant. Key informants also states that there is also conditions that the school compound can be subjected to informal encroachment by the neighbors. As example, Newland primary school can be point out as

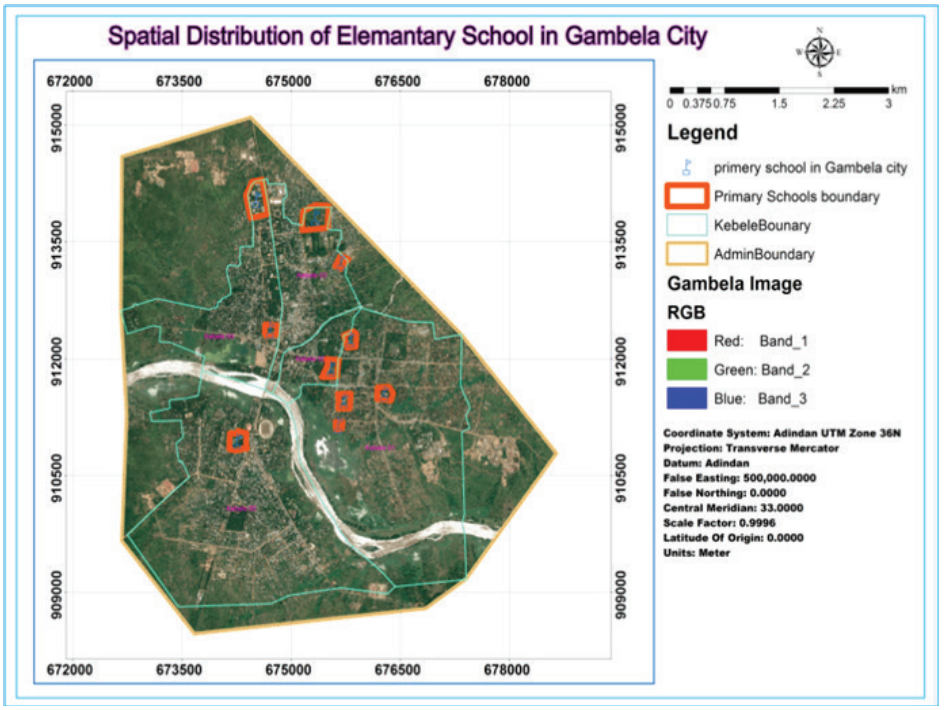

Fig. 1: Spatial distribution of primary

Table 6: Adequacy of space for primary schools in Gambela City

No.	School Name	ExistingArea	National Standard	Implications
1	Eley	5.0	1.5 – 2.5 ha	It has space for future expansion
2	Wibure Pra	2.2	1.5 – 2.5 ha	within limit
3	Ras gobna Pra	3.8	1.5 – 2.5 ha	It has space for future expansion
4	Dalekoch	3.2	1.5 – 2.5 ha	It has space for future expansion
5	Chnkware	3.1	1.5 – 2.5 ha	It has space for future expansion
6	Jejbe	2.5	1.5 – 2.5 ha	within limit
7	Terkidi	1.4	1.5 – 2.5 ha	It needs space for future expansion
8	Elay	2.5	1.5 – 2.5 ha	within limit
9	Newland	8.5	1.5 – 2.5 ha	It has space for future expansion
10	Preparatory	3.7	1.5 – 2.5 ha	It has space for future expansion

one of the schools that was subjected to informal settlement. Eley primary school is also one of the primary school that is subjected to informal settlement.

Analysis of Primary School Service Area Catchment

In urban planning catchment area is the area from which service providing institution attracts service demanders. For example, a school catchment area is the geographic radius from which students are eligible to join schools. Urban planning institutions and firms often used catchment area as criteria for planning purposes. In Ethiopian urban planning practice, distance to school is measured by catchment area. For example, primary school is accessible when student travels less than 3 kilometers (MWUD, 2017). In the local government

Table 7: School service area catchment of the existing primary schools in Gambela city

Total city boundary	Accessibility Level	Distance Coverage in Meter	Area in Ha / Catch-ment area	Accessibility within 4 km radius	Accessibility with respect to the city boundary
2716 ha	1749 ha or 64% is only accessible in the radius of 4km	0-1000	880	50%	32%
		1000-2000	545	31%	20%
		2000-3000	132	% 8	5%
		3000-4000	192	11%	7%
		Sub total	1749	100%	64%
	967 ha (34%) of the city boundary is beyond 4km or not totally accessible.				34%
		Total			100%

practice, school service area catchment is considered as one of the criteria for school admission. As per the key informants, each school has priority service areas in which students can get admission. However, in real practice schools suffer to accept students out of the predetermined service area catchment. This is happening due to different factors. The first factor is there is rural- urban and urban –urban migration to the city and the students' enrolment increases from time to time. The second factor is the awareness to send children to school has shown tremendous increase. The last, but not the least, reason is the number of schools do not grow parallel with the population growth of the city. This all conditions have direct impact on the education quality. If student cannot get education access in her or his neighboring, it is always has economic, social and cultural impact on the student learning process which in turn has also significant impact on education quality. In the same context, in Gambela city there are considerable students that get education access out of their service area. This is mostly demonstrated in students coming from periphery of the city (Table 7 and Fig. 3)

As it can be seen in Figure 2 and Table 8, 64% of the total city boundary is accessible up to four (4) km, whereas 34% of the city boundary is beyond the maximum service area. According to urban planning manual (2017), the maximum service area for primary school is 3 kilometer radius. When school service area stretches beyond 3 km it will not accessible to students.

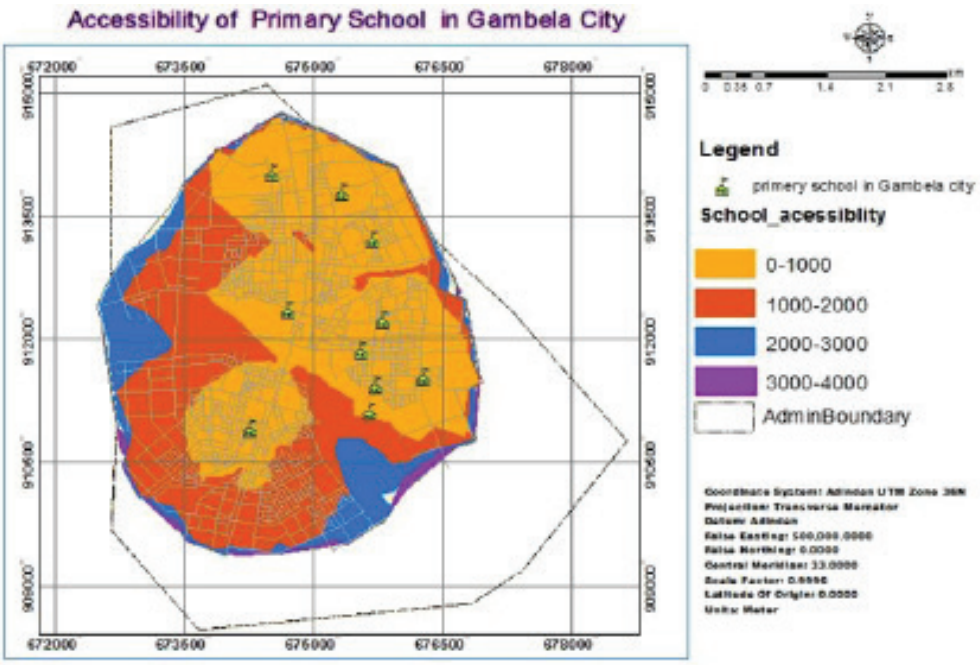

Fig. 2: School service area catchment of the existing primary schools in Gambela City

In this regard in Gambela city 32% is well served, 20% is moderately served and 12 % are fairly serviced. The rest 34% is not accessible at all.

CONCLUSION

In previous decades, keeping its disparities internationally it was witnessed that access to education has greatly improved. In this line of thinking, the notion of achievement of universal education was not fundamentally supported by provision of quality education. It is also recognized fact that the quantitative aspects of education was the main mission of policy makers. However, ground reality and empirical studies have asserted that expanding access alone could not be bring the anticipated socio economic development. It is also true that many developing countries like Ethiopia, significantly expanded access to primary education during the previous decades without adequate attention to quality education. Governments' commitments were silent about the quality of education to be provided. In previous years Ethiopia has registered encouraging result in expanding number of schools. However, the sharp decline in quality of education has been a major concern particularly in emerging regions. The findings of this research also confirmed that education quality in emerging regions is deteriorating. Hence, major educational transformations are required in the emerging regions. The underlying cause for the low education quality includes, low teachers qualification, poor school environment, high pupil teacher ratio, lack of instructional materials, shortage of textbooks and lack of adequate school facilities are some of the grand causes for lowering education quality. To improve the ongoing education quality problems institutional and system planning is critical for the restoration of education quality. On the top of this, planning, supervision and monitoring mechanisms for the entire education system should be in place and should consider as one of the tools for education quality assurance.

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