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THE PROBLEM OF URBAN UTILITY INFRASTRUCTURE PROVISION IN ETHIOPIA: THE CASE OF BAHIR DAR CITY.

MSC THESIS IN URBAN DESIGN AND DEVELOPMENT

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Abstract

Integrated urban utility infrastructure provision is very essential for the modernity, social and economical development of urban localities. The efficiency these infrastructure provision is determined by the responsive act of policy makers, utility authorities, municipalities as well as stakeholders.

Consequently, this study attempted to investigate the issue of municipalities and urban utility authorities. It accounted the storm water drainage, electric power, telecommunication and water supply utility infrastructure provision problem in Ethiopian urban localities.

The problem principally expressed in terms of the planning and institutional dimensions. The planning dimension is characterized by an organic (unplanned) nature of urban land and utility infrastructure development basis while the institutional dimension of the problem is well expressed by uncoordinated system of urban utility infrastructure provision. Due to these facts the problem resulted in inefficient use of public finance and urban land, mixing up placement/conflict of utilities, improperly location/arrangement of utilities, damage of properties and related problems.

The process, dimensions and the cause-effect relationships of urban utility infrastructure provision problem and the role of the partners are the major intended areas of the study. In order to investigate this problem, primary and secondary cases were collected from the departments of Bahir Dar city Administration and the city's utility infrastructure providing authorities and service offices.

In general the lack of integrated urban utility infrastructure policy and common standards, lack of strong link between the land use development and utility infrastructure provision, shortage of institutional coordination and less use of digital mapping technologies are resulted in sub-standardization of the city utility infrastructure. Thus the issue is branded as economical, social and environmental effects. All these resulted in Ethiopian urban localities to have as much comparable utility infrastructure provision problem as Bahir Dar city.

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Acronyms:

ANRS	Amhara National Regional State
B.Sc.	Bachelor of Science
B/Dar	Bahir Dar
BLIS	Bangkok Land Information System
BMA	Bangkok Metropolitan Administration
CSA	Central Statistical Authority
^{o}c	Degree Celsius
DoL	Department of Land
DC	District of Columbia
$	Dollar Sign
ESS	Eastern Sociological Society
Et al	Et alia Which mean “and others”
Eth	Ethiopian
E.C	Ethiopian Calendar
ECSC	Ethiopian Civil Service Collage
EEPCO	Ethiopian Electric Power Corporation
EiABC	Ethiopian Institute of Architecture, Building construction and City development
FUPI	Federal Urban Planning Institute
GIS	Geographic Information System
GPS	Global Position System
ibid	Ibidem, meaning in the same place

ISO	International Organization for Standardization
ISOCARP	International Society of City and Regional Planners
kms	Kilometres
KV	Kilovolt
M.Sc.	Master of Science
Mw	Megawatt
MEA	Metropolitan Electricity Authority
MLIS	Metropolitan Land Information system
MWA	Metropolitan Water works Authority
MUDH	Ministry of Urban Development and Housing
NJUG	National Joint utilities Group
NMP	National Mapping Agency
NUPI	National Urban Planning Institute
No.	Number
OECD	Office of Economic Cooperation and Development
RIUDB	Regional Industry and Urban Development Bureau
SPSS	Stastical Package for the Social Sciences
$\sum$	Summation
SWECO	Sweden's leading consulting Engineering Company
TOT	Telephone Organization of Thailand
USAID	United States Agency for International Development
USA	United States of America
UDC	Utility Data Center

CHAPTER ONE

1. INTRODUCTION

1.1.Background of the Study

The presence, absence as well as the quality of urban infrastructure greatly affects the welfare of citizens and an efficient functioning of urban economy. In broad, urban infrastructure is classified as 'hard' and 'soft' infrastructures (Knaap and Talen, 2003). The former refers to the street network and utility infrastructures while, the latter denotes the communication along with educational services and environmental infrastructures.

Among these broad infrastructure divisions, this study deserves to hub on 'hard' urban infrastructure. The reliability and efficiency of this infrastructure provision is very important to modernize urban localities through the responsive act of utility authorities, municipalities, planners, policy makers as well as stakeholders.

The type of technology employed to provide utility infrastructure as well as these utilities regulation mechanism all are factors which have an influence on the development and restructuring of cities.

Most utility infrastructures could be realized through underground, surface and/or overhead networking systems. Electricity and telecommunication customers are supplied via overhead wires or underground cables through an installation to the ground or in a network of ducts.

In case of Ethiopian urban localities 'hard' urban utility infrastructure accounts electric power, water supply, storm water drainage, and telecommunication systems are the major components of this study.

As other most technologies pipe water supply, electric power and telecommunication utilities initially brought to the country during the period of emperor Menelik II. As though the city of Addis Ababa firstly got pipe water supply in 1894 while the electric power and telephone begun in the year of 1897(Addis Ababa millennium secretariat, 2007). Later the use of these technologies gradually

expanded to different regions in the country. For example the use of diesel generator in Bahir Dar city begun during Italian occupation period.

While in 1953 due to the establishment of the Tis Abay hydro electric power the city offered an opportunity of hydroelectric. Latter in 1995 E.C an extra power from Fincha power station added and then the capacity of Bahir Dar city electric power was upgraded from 12 Mw to 72 Mw (FUPI, 2006).

The city's telephone service had begun in 1970; afterwards this manual telephone service in 1991 is replaced by an automatic system. Currently the city's pipe water supply sourced from the two springs at the basin of Infraz river at a distance of around 5 kilometres to the west of Bahir Dar air port (Oy, 1999; FUPI, 2006).

1.2.Problem Statement

The contemporary urban society needs an efficient system of electric power, water supply, storm water drainage and telecommunication services and facilities. However; the provision of such infrastructures is highly constrained by: planning, institutional, technological and policy factors.

As though, most Ethiopian urban localities are highly exposed to the problem of urban utility infrastructure provision. The magnitude of the issue is well uttered via the planning and institutional dimensions of the problem. The planning dimension illustrates an organic[1] form of urban development process. The institutional dimension also articulated by uncoordinated way of utility infrastructure planning, installation, management and maintenance processes.

The current approach of Ethiopian urban centres utility infrastructure provision goes as similar as the traditional utility infrastructures provision processes. The problem is characterized in terms of poor localization of very heavy and costly electric wire carrying reinforced concrete poles, placement of electric power substations and national power cable carrying towers within urbanized or expansion areas of the city/town. This has an adverse effect on the day-to-day activity of the dwellers as well as on an efficient use of urban land; digging of paved streets for the purpose of water pipes and other utility infrastructure installations, improperly and mixing up placement of utilities and lack of appropriate utility and land use data recording

[1] An organic urban settlement is one of the categories of urban settlement which is developed from the natural urbanization process without having well studied and designed plans.

system. At the same time lack of workable common standards and enforcing policy measures are among the principal problems.

Though, the city of Bahir Dar has much comparable utility infrastructure provision problem as other Ethiopian urban localities. The reality of this problem is quite clear particularly in unplanned old residential areas (*Keble* 03, 04, 05, 06, 11, 10/textile area and 13) and around newly squatting neighbourhood areas (*Keble* 11, 13 &16).

Subsequently the problem demands an extra fold of financial expenditures for utilities compensation, adding financial costs on individual users and other parties through unnecessary property damage, risk on public health during water contamination and power contact, resulted in service fluctuation, physical and visual obstruction effect on human activities. Hence, the issue is categorized as economic, social, and environmental features.

1.3.Objectives of the Study

1.3.1. General Objective

* To assess the extent of urban utility infrastructure provision problem in Bahir Dar City and to recommend alternative solutions to it.

1.3.2. Specific Objectives

1) To investigate the process of urban utility infrastructure provision in the city
2) To identify the real dimensions of urban utility infrastructure provision problem
3) To verify the role of municipalities and utility infrastructure providers in the process of sustainable urban utility infrastructure provision.
4) To show the importance of the problem for municipalities, utility infrastructure providers, policy makers and other stakeholders.
5) To recommend alternative solutions to the problem of urban utility infrastructure provision in Ethiopian.

1.4.Research Questions

1) How is the process of urban utility infrastructure provision enacted in Bahir Dar city?
2) What are the major dimensions of urban utility infrastructure provision problem?
3) What are the cause-effect relationships of utility infrastructure provision problem in Bahir Dar city?
4) How do policy makers, utility infrastructure providers and professionals will resolve urban utility infrastructure provision problem?

1.5.Significance of the Study

This study provides an important study results for policy makers, municipalities & utility infrastructure providing authorities as well as professionals within the area of the study.

Thus, the result will have the following significances for policy makers: first and foremost it will initiate for policy making in the area of the subject matter, second it will serve as an input in the policy making process by easily identifing the core and sub-problematic areas, third it will provide practical policy making experiences of other countries within the same area of study and at the end policy makers could gain a lot from the recommended result of the study.

At the same time the study will have the following significances for municipalities and utility infrastructure providers: first it identified the common issues, second it will promote institutional coordination for the provision of an integrated and sustained urban utility infrastructure, third it will reduce continuous relocation of utility infrastructures, fourth this study will have an advantage for efficient utilization of financial resources of municipalities' and utility authorities' by avoiding unnecessary financial expenditures for compensation and relocation of utility facilities.

Moreover; municipalities, urban utility infrastructure providing authorities, policy makers and professionals could use the document as an input for farther discussion, application and investigation.

At the end, when the study is valued it will have the following out comes: it will provide more quality of utility infrastructures for urban dwellers by decreasing service fluctuation/interruption, water contamination, property damage; it will reduce physical and visual obstruction of utilities; and it will have an indirect benefites for citizens by reducing unnecessary and unplanned public money expenses for utilities relocation compensation.

1.6.Scope of the Study

The scope of the study principally stressed on surface, underground and overhead urban utility infrastructures. Principally for storm water drainage lines, electric power supply, telecommunication and water supply distributions. Besides to this, the study needs to investigate the planning and institutional dimensions of the problem in Ethipoian urban localities with an emphasis of Bahir Dar ciy.

However; the study did not account gas and TV cable facilities, landscape elements (street fixtures, landscape trees, etc.), parking areas and some other detailed urban land use effects on the utility infrastructure provision.

1.7.Limitations of the Study

The most constraints of this study are: insufficiency of referencing materials to review previously conducted studies, lack of superimpose-able utilities bas maps and yearly registered compensation costs to the local utility authorities.

The deficiency of superimpose-able utilities bas maps particularly the city power distribution authority fails to use any base map which is only depend on simple field sketching techniques. While the preparation of the base map of the city's telecommunication and water supply authorities mainly depend on manually overlap tracing techniques using bold lined markers which lacks the accurate location of utilities, all these made unviable for the preparation of an overlay map of these

utilities in to a single geo-referenced map system so as to see the exact conflict of utilities plan.

The lack of yearly registered compensation cost of utility partners on certain extent limited the assertive quantitative information to the study. However; using some systematic cross-sectoral data collection technique - some of the charged amount of compensation were obtained from the city administration and others from the respective utility authorities.

1.8.Organization of the Document

The preliminary pages of the thesis document consisted of the title page, approval sheet; acknowledgment, abstract, table of content; list of figures, tables and acronyms.

The body of the text accounted five chapters, within each chapter there is different but interrelated subtopics.

The first chapter contains the introduction part which comprised the background information, problem statement, objectives, Research questions, significance, scope, limitation, organization and description of the study area.

The second chapter consisted of the literature review part. The third chapter is the research material and methods which covers the research methodology, research design, data source, data type, data gathering tools, data analysis and data presentation.

The fourth chapter is the results and discussion part of the study which concerned about data presentation and discussions. This documented the analysis of the primary and secondary facts of the case study. The last chapter provided the conclusion and recommendation of the study.

1.9.Description of the Study area

1.9.1. Location and Climatic Conditions of Bahir Dar City

1. Location of the City

Bahir Dar city generally lies on flat area at the southern shore of Lake Tana. The centre of the city geographically coordinated at $11^0$35'30" North and $37^0$23'30" East and it is located at 563 kms away on the North West of Addis Ababa along the main highway road (Oy, 1999).

The location favours the advantage of the city as an opportunity of Lake Tana, river Abay, suitable topography, favourable climate to live and to produce, different tourism sites (FUPI, 2009).

2. Climatic conditions of the City

Bahir Dar belonged to the *woina dega* zone from 1961-2000 meters above sea level. The recorded temperature showed that the mean maximum temperature ranges from 23.3 ^{0}c to 29.7 ^{0}c while the mean minimum temperature ranges from 14.2 ^{0}c to 7.1 ^{0}c on the other hand the mean annual rainfall is 1224 mm (FUPI, 2006).

According to the FUPI's (2006) report the maximum and average wind speed in the city is registered as 1.8 and 1.4 meter per seconds correspondingly. The prevailing wind direction in dry seasons is towards south east and in rainy seasons towards North West directions.

1.9.2. Historical Basis of Bahir Dar City

Historically beginning of the City was 'associated' with the establishment of Kidane Miheret Church at the present site of St. George's Church around the 14th century. Firstly the settlement in the area was started around Saint George Church near to Lake Tana(FUPI, 2006). Starting from that time as a rural village on wards it has developed into one of the current largest cities in the country. Its fast development and transformation was made during the Italian occupation period (1928-1933) as it was served as a major military bases for their missions in the area (ibid.).

The naming of the city called as Bahir Dar has a connection with its direct proximity to Lake Tana and River Abay. As far as the reasons for its foundation are concerned, the availability of these two water bodies and the foundation of Kidane Mehiret Church in the area were the major reasons among others.

According to FUPI (2006) report in the 14th century foundation of Mary Savoir Church and in the 17th century Bahir Dar Saint George Church reflects the priesthood followed the Christian settlers as an act of rejoining. After an independency of *fascist* Italy's army in 1934 emperor Haile Selasse approved the continuation of the site as urban centre. Latter for the first time the Bahir Dar city municipality was established in 1936.

Previously for administrative purpose the city has been classified in to 17 *kebles* and six additional rural *kebles*. These 17 *kebles* farther grouped in to nine township *keble'* Administrations and rural *kebles*. The city as the centre includes different satellite cities and rural *kebles* around it. Know the city is divided in to nine major *kebles*.

1.9.3. The Roles of Bahir Dar City

After the Italian occupation the city has played important roles: in 1948 Bahir Dar was served as *woreda* captital, in 1950's its status was raised to an *awraraja* level. While, in 1987 the city was made the capital of Eastern Gojam Administrative Region, from 1991 its role has continued as the capital city of the Amhara National Regional state (ANRS).

In addition to these administrative functions, the city has an access of international air transportation, higher institutions and services, tourist attraction sites, recreation and entertainment areas and it is used as the heart of contemporary western urbanization and civilization. Furthermore, the city located very close to some Ethiopian historical sites including Gonder, historical islands of Lake Tana, and Tis Isat falls.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Introduction

This section accounts the theoretical and practical issue of urban utility infrastructure provision. The concept of the review made from the general to the specific area of the study.

The major and sub contents of the review are: the general concept of urban infrastructure, utility infrastructure policy strategies, utility mapping and experiences and concepts of utility infrastructure provision in international and local contexts.

In the case of local context urban utility infrastructure provision historical basis, the standards, the practice of provision in Addis Ababa and Amhara region are the area of the review.

2.2. Urban Infrastructure

The location and the condition of utility infrastructure services and facilities information are very important for municipalities within the area of their boundary. This information will enable them to set changes in different parts of the city, as level of services they want to identify in the deprived areas of the city/town. Consequently, planners may wish to refine their options to meet the need of the area (Pickering, et al., 1993).

Here, utilities are the 'conduits' or 'technological systems' (Hughes, 1983, Preston, 1991 cited in Graham and Marvin, 1994) which support the rapid movement of waste, water, energy and information up on which their integration together into economic and social structure depends. That's why, any attempt to improve, or even maintain, the standard of living in rapidly developing urban areas cannot go forward without adequate and well administered municipal infrastructures (Pickering, et al., 1993).

Urban utilities infrastructure accounts the water supply, sewerage facilities, drainage systems, power distribution networks, communication transmissions and other related underground, surface and overhead services and facilities. As Pickering and his associates (1993) the economic and efficient delivery of infrastructure service depends on effective planning and management systems. The recorded utilities map information will not only contribute for efficient service provision but also for operation and maintenance of assets, 'sensible' planning extensions and new works.

Consequently, in some countries there is the development of some sort of a legal framework for making infrastructure records more compatible across municipal and utility boundaries however; due to somehow the variation in the scale of maps lead to an overlapping of utility and other land use boundaries. The reason for lack of uniformity is that each utility has developed within the legislative framework of its own function with little or nothing consideration its compatibility with other functions (ibid.).

Hence 'multiplicity of agencies' involved in urban utility infrastructure provision requirements vary in terms of map scale, graphic elements, data accuracy and data currency. This resulted in the adoption of a common standard very difficult in 'any' country. In general, "utility agencies require large scale maps than planning agencies". Therefore, it is so worth full to have the general planning agreement during spatial infrastructure mapping and scaling between the partners'.

A partnership first and foremost is about relationships between different parties to come in to an agreement. This is quite different from the more traditional approach to manage urban infrastructure projects**.** At least authorities should consider introducing 'common' map scale, referencing and standard symbols. Commonly accepted data standardization will reduce the 'duplicity' and redundancy of data. Thus a full of information have to be gathered from all utility infrastructure providing partners (Pickering, et al., 1993).

This type of partnership is 'ubiquitous' in both developed and in developing countries for telecommunications, power generation and transmission, railway, ports, water supply and sewage treatment. Consequently many countries have

begun to reform these entities to achieve greater efficiency and accountability, through commercialization[2]; and corporatization[3] (Kessides, 1993: 23).

In general, information about the location of underground utilities and facilities is (Bishop, et al., 2000) often worse than the maps shown above ground features. In most cases, the "actual location" of these service lines is different from the location appearing on plans. On the other hand depth of underground utility lines is "seldom or correctly" shown on maps and often these utility lines sometimes "run on top" of another utility line at a different depth (ibid.).

Hence, utility authorities required to have update information to manage its assets, plan extension, design new works, and carry out systematic operations and maintenance. Utility base maps must have some spatial referencing system so as to identify in non graphic form, and at the same time be located on other maps at perhaps other scales (Pickering, et al., 1993). The base map will have to be derived from at least an 'aerial' survey and probably a certain amount of ground survey (ibid.).

It is "increasingly recognized" that linkages between the various spatial information development areas leads to greater applications and benefits. In future, utility infrastructure data from "all platforms" will be conveniently exchanged and interpolated for testing decision scenarios. Such integrated systems will provide "seamless" decision support while such alternative option is expected to provide a range of information for different disciplines persuaded in urban planning and design fields (Pickering, et al., 1993).

On the other hand the use of computers, digital mapping and GIS software technology advances the utility infrastructure provision to the higher standards however; the practice of using this spatial information system in most developing countries has not been good (Bishop, et al., 2000). As such "care" should be taken by developing countries in adopting the latest technologies which are only now being adopted in the developed world (ibid.).

[2] Commercialization is where by agencies are given separate budgets and financial autonomy based on tariff revenue, and the managerial autonomy to operate as a business.

[3] corporatization is where by agencies are transformed in to a legal entity subject to company law, with formal separation of ownership and management responsibilities, e.g. thought a board of directors or other body.

2.3. Urbanization and Utility Infrastructure Planning

In most countries land remains the "single" most important source of material, wealth and social prestige. In Ethiopia rural land holding is the primary source of economic welfare where people in the rural area can afford to obtain food, fertilizers, cloths, housing, education, taxation, health and social expenses.

In terms of planning dimension African urban areas characterised by irregular and "spontaneous" pattern of settlement. The problem of spontaneous settlement is aggravated by general "chaotic" layout of buildings and an almost complete absence of "rudimentary" urban service (Dwyer, 1975).

Such unplanned/spontaneous urban settlement is resulted from the continuous unplanned urban growth without having modern urban planning and design concepts. Consequently, it is resulted in inefficient and uncoordinated urban utility infrastructure provision which is resulted in land speculation for financial gain, system of market-induced developments rather than having well designed strategic plans (Bishop, et al., 2000).

As the present circumstances vacant land is used for speculative and squatting purpose, inner city lots are frequently at risk for tactical purposes. State or Church land is usually preferred to private property by spontaneous settlers, vacant sites close to factories or construction projects are especially valued because of the possibilities of casual labour there (Dwyer, 1975: 31).

Utility infrastructure planning in most developing countries seems there is little or nothing in the design or engineering of such networks is substantially modified further to suit third World countries, but "envisages" the extension of pipe networks as the ultimate solution to the problem(ibid.). In broad the understanding of the link between utilities and urban development remains extremely underdeveloped (Graham and Marvin, 1994).

However; according to Korte[4](1994) in these countries there is a range of GIS implementation strategies that have been adopted from developed countries: the planning, analysis and implementation strategies are so important for GIS implementation. Thus, GIS can be used to store, display, and plan utility networks

[4] Cited in Bishop, et al., 2000, pp. 20-28.

and attributes. Combined with remotely-sensed data, GIS (Pickering, et al., 1993) can be an effective tool for sitting new infrastructure, conducting site inventories, updating network information and, preparing base maps.

The adoption of new spatial information technologies in developing countries should also be considered in the context of these main steps and approaches. Still the approach need to be modified by accounting the need for awareness and management support, data standards, data availability, shortage of trained professional, availability of resources, procedures for approval and procurement of technology, vendor support who provides software and after sales support, great deal of commitment from all involved and linkages between the various spatial information development areas (Bishop, et al., 2000, pp. 20-28).

On the other hand GIS "requires" investment in hardware, software, data collection, data integration, data maintenance and education and training, and 'it is very important' to get support for such projects from senior management through technological potential awareness creation. On the contrary; the "bureaucratic procedures" for approval and procurement of technology in developing countries require a great deal of patience and energy (ibid.).

It is increasingly recognized that linkages between the various spatial information development areas lead to greater applications and benefits....In future; data from all platforms will be conveniently exchanged and interpolated for testing decision scenarios. Integrated systems will provide seamless decision support based on shared data using various forms of predictive modelling. The result presentation options will be suitable for the wide range of disciplines involved in urban planning and design (Bishop, et al. 2000:27).

For instance in recent years the city of Cairo in developing countries established a comprehensive kind of Utility Data Center (UDC) with the target (Mustafa, 2005) of: to establish scientific utilities data base, protect the investment of utilities, to provide accurate utilities data for city planners and decision makers, to create coordination among agencies and utilities, to avoid repeating digging and protecting public fund, protecting the environment from pollution resulting from cracking or explosion of water and sewage pipes. Consequently, as Mustafa (2005) the Greater Cairo UDC

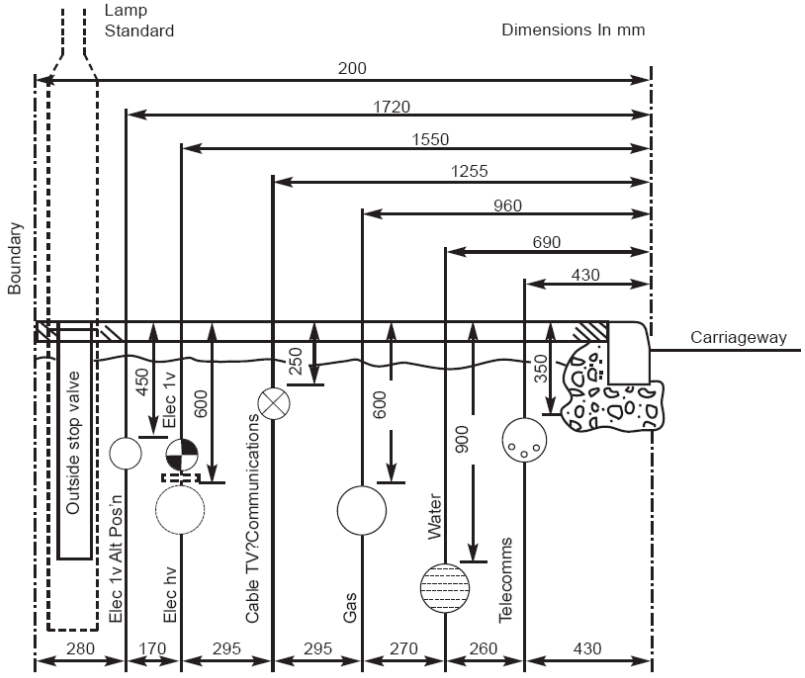
has obtained the international quality certificate ISO 9002-year 1999 and ISO 9001-year 2003.

A fundamental rule for urban planning (Pickering, et al., 1993) ... is that strategic decision can only be as good as the maps and information on which they are bases. Consequently, it is better to have “too” much detailed and well laid out urban street network and utility infrastructure planning. When producing base maps, the specifications should allow for the variety of users. If created by a single utility the specifications should coincide with these of the other utilities assuming that they all expect to make use of the maps (ibid.).

For the design of street side utility infrastructures within two meter wide foot way, there is an exemplary NJUG[5](1995) recommended arrangement of utilities mains and plans. The mains which are shown from the following figure running parallel to the footway, there will also be side branches to individual properties. The relative depths of lay “required” for the various mains argue powerfully in favour of the lateral dispositions illustrated, and these are usually the standard locations. The lateral clearances between adjacent utility mains are the recommended minimum, and represent the “best use” of the limited spaces available (NJUG, 1995:5).

[5] NJUG: National Joint Utilties Group, which formed in 1977 to explore wayse in which mutual co-operation could overcome difficulaties encountered durient streetworks. It is jointly funded by its members, the five utilities: water, gas, electricity and the two tlecommunications companies in London England .

Figure 2.1: Shows recommended arrangement of utility mains in a 2-meter footway



Source: Adopted from NJUG (1995, Fig. 2)

However, according to NJUG(1995) recommendation some local planning authorities have their own design guides and local agreements which is different from this recommendation. For this reason, in any situation the exact location of these utility mains “may vary” depending on local circumstances and the availability of spaces for underground and over ground services and facilities , but especially less than 600 mm deep may be affected by root activity (ibid.).

The “verge” (street sides) should be of sufficient width to allow space for all relevant services, landscaping, indented parking, future carriageway widening, cycle paths and swale drains. In addition to this, designers need to accommodate “all” these facilities within the verge space. This should be arranged early in the planning and design process of the city/town plan. According to NJUG(1995) report, this as well allows for the efficient integration of all these utility mains and required street light equipments into the verge space.

In broad, careful planning for the need of drainage, electricity, telecommunication, water supply and other street side utility operators at an early stage will result in increased savings in costs as well as avoiding for the disruptions associated with footpath and road operating. Underground and over ground utility facilities planning will meet the needs for future advanced services in an efficient, safe, harmonised and cost effective way and need to avoid further repetitive shifting of utilities.

Such works are costly and can give rise to “nuisance and disruption” to the public and damage to roads, foot ways and other facilities. However, the planning and design components of the solution alone will not offer full guarantee for its sustainability unless it is complemented by institutional coordination and policy tools.

2.4. Urban Utility Infrastructure Provision Policy Strategies

In developing countries (Bishop, et al., 2000) the laws and guidelines for land registration, planning and land management is diverse and often uncoordinated. On the same way to this, in most of these countries each utility providing authorities/agencies has developed its own legislative frameworks without consideration (or with a little consideration) of its compatibility to others utility infrastructure rules and regulations.

However, the successful development of spatial infrastructure information in developed countries has partly been due to much of the data being available in digital form or there being a political will and financial backing to build the required data sets (Bishop, et al., 2000).

In developing countries, in order to have such efficient GIS operational information first it is very essential to collect basic infrastructure data. But, in these countries technology ‘alone’ will not guarantee a better information system unless there is a sound urban utility infrastructure policy (Pickering, et al., 1993). Such a policy would deal with institutional and organizational aspects such as institutional mandates and linkages, legal framework, technological strategies, human skills development, and financial management.

The overall responsibility of utility mapping and recording usually (Pickering, et al., 1993) goes to one central department. Among the responsibilities of the assigned

utility infrastructure department the first and the most important one it should “look at the system as a whole”. While, the choice of department will depend on local circumstances and preferences, but it may be the planning department, the new works design department, one of the operations departments, or an entirely separate department (ibid.).

For example, in England and Wales the utilities operate under statutory rights and obligations conferred by the... Parliament acts (NJUG, 1995). As it is described from the same source the New Roads and Street Works Act (1991) controls and co-ordinates work carried out in the street by statutory undertakers, including all the utilities when exercising their various legislative functions. As such, before carrying out any work involving the installation, maintenance or alteration of underground services utilities are required to give notice to the street authority (ibid.).

This Code of Practice on Co-ordination of Street Works places a duty on highway authorities to organise co-ordination meetings at least quarterly. As it is described in the same source as above, the meetings are intended to represent all major interests and should be used to discuss planning and other local policies affecting street works including tree issues.

In order to promote the exchange of information before excavation start, governments might consider introduction of “a single information system” based permitting legislation for all the municipal services and utilities providing authorities within the city. Another option for municipalities might be to set up a “common clearing-house for inquires and to issue digging licenses”. Such licenses might also be an effective way of “controlling digging activities” (Pickering, et al., 1993).

In developing countries as it is recommended[6] it often appears to be a political urgency which negates long term utility infrastructure planning. For instance, during the period (1980-1986) of underground metro planning and executive for Cairo city, the authorities greatly suffered by unavailability of suitable scaled and accurately surveyed above and underground utilities base maps(Mustafa, 2005). According to the writer, this leads to the consumption of time and cost, and damage of utilities.

Due to an increase of the problem, the 1986 assessed result showed that the damaged utility infrastructure of city was estimated to 22 million; this leads the Cairo

[6] (Bishop, et al. 200)

Governorate to take decision to established “Cairo Utility Data Centre” (Mustafa, 2005) so as to “stop” damage of the infrastructures. In Egypt since 1975(Pritchard, 2004) USAID has invested $5.8 billion in utility infrastructure projects. As the result, these projects “predominately” focused in the power, telecommunication and water and waste water sectors with an establishment of utility data centers (Pritchard, 2004 and Mustafa, 2005).

2.5. Utility Mapping

The topographic and cadastral maps are the commonly used base maps for urban planning; on the other hand the cadastral maps are the “most useful” for urban land information and registration purpose. In addition to this, large scale[7] topographic maps are the more essential maps for utilities, because of its containment of detailed roads, buildings and other geographic features. “Certainly”, utilities that lay in pipes and cables along streets and make connections to buildings rely on such maps (Pickering, et al., 1993).

However, the choice of the map scales “partly” depends on the resolution of detail requirements and the ability to put a usable amount of information on each record map. For example, a 1:2500 scale means: a 1 millimetre-width on the map represents 2.5 meters distance on the ground. According to Pickering[8] this may be accurate enough for the location of a water pipe, but unacceptable for, say power or telephone system duct work. The use of different scales for different utilities may be due to the availability of the base map within a given scale or because of particular scale “seems” appropriate but much depends on the density of the urban area under consideration (ibid.).

For such and other reasons, Utilities tend to use a “variety” of map scales but the main set of records is “generally” held at scales of 1:500 to 1:2500. This means, the information of one utility may only need the appropriate width of a street, where as others may need to show the presence of foot paths on either side and be able to “ascertain” their width. For utility mapping, the role of data gathering, records maintaining and information dissemination must be assigned high priority (Pickering, et al., 1993).

[7] In general, large scale maps are commonly used to provide more detail utilities information.
[8] (Pickering, et al., 1993).

Greater Cairo is an urban agglomeration with more than 12 million inhabitants, extremely high population density ... the network of underground utilities in Cairo consists of almost 70, 000 kilometres of different kinds of pipes and cables (water, sewerage, electricity, gas and telephone).... The underground Utilities Data Centre of Greater Cairo (UDC) was officially established in October 1988 as an independent service organization with in the frame work of the Governorate of Cairo. The role of UDC is to collect, process, and store data for the urban management of Cairo. UDC is to create and maintain a geographic information system containing accurate, relevant and basic information on underground utilities. The data bases can also be extended to cover land use, cadastral, soil and other environmental data ...The director general of UDC reports directly to the governor and the operational costs are covered through different utility agencies that is; the water authority, the sewerage authority, the electricity company, the gas company, and the telephone company (Pickering, et al., 1993: 65-67).

As Mustafa's (2005) report, the Cairo UDC started to survey main land marks above the ground to produce base maps scale of 1:500 to allocate the utilities net and to make it easy to determine the exact location of utility. In the city the detection of underground utilities by using detection equipment's, without digging, and determining the location of pipes and cables whatever they are water, sewage, electricity as well as its depths.

Finally, producing maps for the client including printing by geographic science in order to achieve the required level of accuracy in maps: a) printing each utility with a unique color for example electricity with red, tel with green, sewage with brown b) base map must illustrate all main data and land marks c) recording triangulation point on the map and the map must include all base data(northing, map scale, project title, reference map, utility data, etc. information) d) map printing with scale of 1:500-1:250 or sometimes 1:100. e) Delivering to the client a collective map with the exact location of utilities so as to executing without damaging on other utilities (Mustafa, 2005).

Hence, it is very important to have a full recording system for the locations of pipes, cables, telephones, streetlights and other utilities. In the process of utility recording and mapping readily available maps and coordinated reference systems are "vital" for both municipal and utility information systems. On the other hand, adequate

utility recording will resulted in the reduction of accidental utility damage and raises the safety of the general public and the utility operation (Pickering, et al., 1993).

A sound utility infrastructure mapping and recording system (Pickering, et al.,1993) will have financial, service quality and planning related benefits. Moreover, it helps to lower expenditure, saves utility infrastructure reinstatement cost, reduction in likelihood of incorrect compensation payment to the parties, reduces time spent on field work, saving underground utility infrastructure location searching time, easy to search necessary information, improve management and control system, reduces the design preparation time.

2.6. Urban Infrastructure Provision in Developed Countries

The successful development of (Bishop, et al., 2000) spatial information infrastructures in developed countries has partly been due to much of the data being available in digital form or there being a political will and financial backing to build the required data sets.

In addition to this, the National Mapping Agency (NMP) of these countries “has a common practice” in data standards, fixed scales and definition of digital map based national data accuracy. Their digital mapping systems were built from well established manual map systems which have often evolved over decades and sometimes centuries (ibid.).

2.7. Urban Infrastructure Provision in Developing Countries

2.7.1. Urban Utility Infrastructure Provision

Developing world cities (Bishop, et al., 2000) are expanding at a much greater rate than in developed countries, these cities are usually the engines of economic development in the respective countries, their infrastructure and quality of life is “often deteriorating”. Addressing these issues in cities of the developing world is one of the great challenges facing “all” societies in the next millennium.

The authoritative power of these infrastructure provisions might mandate to a range of authorities or partially to a single but comprehensive. The patterned and long lasting provision of such utilities is very much affected by the nature of the city/town, the built environment and the landscape elements. The nature of a city/town is

highly influenced by the nature of the landscape, the street networking and the settlement patterns which influences the scheme of the utilities provision.

On the other hand availability of spatial information for cities in these countries is "poor or nonexistent". Still in these countries, most of the land ownership and utility infrastructure information are experienced in separate department only in the hands of some key personnel. While, the design and implementation of a workable spatial infrastructure data is often "a dream for the future" (ibid.).

For the general adoption and use of GIS and other technologies from the developed world cities, countries first need to know the wide-ranging contribution of this technology in the process of urgent utility infrastructure issues resolution in the developing world. On the other hand, as in developed world the successful implementation and use of urban spatial utility infrastructure information in developing countries is "highly depend on" political, institutional and managerial support of the system. Moreover, municipalities and utility agencies of developing world (Pickering, et al., 1993) cities need to work together to promote awareness by nominating one of their members to coordinate and encourage activities in this direction.

As the case of Cairo city utility infrastructure provision, the UDC of the city(Pritchard, 2004) accounts a set of complementary activities that focus on sustainability, in support of the strategy are 'currently' being implemented activities primarily focus on: 1) improving the management of utilities through training in management/leadership, administration and operations and establishment of management and financial systems. 2) Improving the commercial orientation of utilities through support for restructuring of utilities. 3) Supporting regulatory agencies to carry out functions. 4) Encouraging private sector participation thought support for out sourcing of key functions to private contractors. The point of interest of these activities is to improve the management and operational capability of utilities.

In general, the process of urban utility infrastructure planning and management in developing countries cities is "so workable" because of their low city size, minimal urban land market price and low pace of life style. In these conditions, co-ordination between staff is possible and there is time (Bishop et al, 2000: 9) to negate long

term based planning, political urgency and to share spatial information so as to overcome anomalies. Consequently as Cairo's UDC the Bangkok Land Information System (BLIS) will be a good exemplary strategy to develop appropriate utility infrastructure provision standards in cities and towns of developing countries (Pritchard, 2004 and Bishop et al, 2000).

2.7.2. Urban Utility Infrastructure Provision Experience: in Case of Bangkok City

The city of Bangkok is the capital city and port on the Chao Phraya river just north of Gulf of Northern Thailand, in 2003 the city has an estimated population of 6, 486, 000(Microsoft Encarta, 2009). At first the Bangkok Metropolitan Administration (BMA) decided to initiate a pilot GIS project nearly fifteen years ago (Suwarnarat, 1991)[9]. The Bangkok Land Information System (BLIS) was undertaken from 1989 to 1991 (Wiliamson and Mathieson, 1994)[10]. The primary objectives (Bishop et al., 2000) of the project were: to educate, train and provide experience in GIS, to "evaluate" the need for appropriate common base map for the city of Bangkok to be used by "all" partners of the BLIS program, and to determine an achievable long term BLIS development strategy.

At first, the BLIS team comprising: the Metropolitan Electricity Authority (MEA), the Metropolitan Water works Authority (MWA), the Telephone Organization of Thailand (TOT), the Department of Lands (DOL)[11] and Bangkok Metropolitan Administration (BMA) was put together to undertake the MLIS project with the assistance of Australian technical aid (Williamson and Matheieson, 1992 and 1994)[12].

The BLIS project initially sought to establish the requirements for a common digital base map for Bangkok city. The essential data items considered necessary by each BLIS partner organization for its own purpose were identified (Suwarnarat, 1992)[13]. Although a common interest existed, there were also different points of view. The planners were "satisfied" with maps of scale 1: 10 000 and 1: 400, whereas most of the participant from the utility agencies required a scale of 1: 1000 (Bishop, et al., 2000).

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[9] cited in Bishop et al, 2000
[10] citied in Bishop et al 2000
[11] since DOL provide the base map, DOL was invited as a partner for BLIS
[12] Cited in Bishop, et al., 2000
[13] Cited in Bishop, et al, 2000

But, after some discussions at different levels they determined as 1: 1000 scale was a suitable base mapping scale to “satisfy” most needs, while the BLIS team was also determined the specific graphic elements and associated attributes to be included in the common BLIS data base (ibid.).

The BLIS was “conceived” as GIS designed primarily to serve the MEA, MWA and TOT utility agencies to share the same buildings, the name of the owners of land parcel and some other land information; in addition to this the land parcel frame work is “very useful” for the installation, operation and maintenance of utility infrastructures (ibid.).

Latter the conversion of all BLIS analogue maps in to digital vector maps within a single team was so difficult, expensive and more time consuming operation. Hence, instead of establishing a common digital database at a single team, the utility agencies “agree” to use the same DOL base maps[14] to create their individual digital base map. On the bases of this agreement, MEA took the leading role (Bishop, et al., 2000) to digitize its base maps, at the end of this MEA created its base maps at a scale of 1:1000. Hence the BMA, the BLIS experience “suggests” such a strategic application oriented approach is more relevant than a system-wide comprehensive strategy.

At the end, the databases were linked to numerous attributes by the most common information shared the BLIS partners being the owners’ name, area, location and types of buildings. However, other specialized items[15]: cable sizes, water pipe dimensions and location of meters items were input and managed by participating BLIS organizations(ibid.).

After more than a decade of experimenting with GIS, the BMA “now” realizes that GIS is an effective tool for planning and managing urban infrastructure and utility systems. On the other hand, the MEA also “believed that” an investment in GIS would be returned almost immediately through the collection of additional tariffs (ibid.).

The Bangkok experience in the development of spatial information infrastructures provides a generic framework for cities in developing countries facing a similar

[14] DOL base maps: which were from the same source as those used for BLIS
[15] Specialized items: which were not the direct concerns to the BLIS project team as a whole

challenge. Although urban administration and institutional arrangements differ among countries, the issues discussed here provide an insight into the technological, Managerial and institutional issues involved in the adoption of spatial information systems for cities in developing countries (Bishop, et al., 2000).

2.8. Urban Utility Infrastructure Provision in the Local context

2.8.1. Historical Basis of Utility in Ethiopia

In Ethiopia for the first time an innovation of pipe water supply was introduced in Addis Ababa city 15 years later after the establishment of the City by emperor Menelik II (Addis Ababa millennium secretariat, 2007).

During this period masonry ducts were constructed and laid along the sources of Kebena River at the top of *Entoto* where water was carried down to the desired destinations in the city through the advisory of the Swiss engineer Alfred Ilg to the emperor. Latter important pump was fitted to drive water uphill trough connected pipes to the palace.

Gradually, construction of small dams on rivers was expanded and tap water was being supplied to quite a number of the residents in different areas of the city. The Gafresa dam as the main source of the city water supply was built during the Italian occupation and then it was rehabilitated in 2009(Garretson, 2000).

On the other hand, initially an electric power supply in the city as well as in the country was started in Menelik's II grand palace in 1897 using a small diesel generator which was given to the emperor by the Germany government. Latter other generators were brought to the country for different purposes: in 1903 for money printing, in 1911 for the establishment of bullet factory, 1926 for the establishment of *abujedea* textile factory. According to EEPCO(1999 E.C) report, during the period of Italian occupation some towns in the country start to use generators as means of electric power generation.

However; the use of hydroelectric power is started in 1911 on Akaki River, in 1959 on koka dam, in 1963 on Tis Abay (EEPCO, 1999 E.C). On the other hand different hydroelectric power stations were established and being in establishment in different

areas of the country. Historical establishment of electric power authority proclamation, the first was the Ethiopian electric light and power authority was enacted in 1955, latter this proclamation was renamed as Ethiopian electric power corporation in 1996.

Tthe history of telecommunication in the country “goes back” more than one hundred years with the establishment of the first long distance telecommunication link was made between Addis Ababa and Harar in 1894(Dawit Bekele**,** 1996), but the first telephone service was started as the electric power in 1897(Addis Ababa millennium secretariat, 2007). After the result of Adwa war in Ethiopian victory, from Addis Ababa to Asmara 880 km telephone line project was started in 1902 and completed in 1905 through an agreement of the Ethiopian government and Italian counterpart and this line was connected most towns along corridor(Dawit Bekele**,** 1996).

Between 1905 and 1913 telephone connections were farther expanded from Addis to Gondar, southern and western Ethiopia, Dire Dawa and Djibouti (ibid.). Today the “modern telecommunication technologies” such as satellite, microwave and fibber optic connection are in uses.

2.8.2. Urban Utility Infrastructure ProvisionStrategies and Standards

The Ministry of Works and Urban Development (August 1998 E.C.) policy document clearly put the vision of Ethiopian urban centres. The need of planned and internationally competent urban development is the basic concept for the vision statement. However; in the case of plan realization the vision seems as not yet started in most of Amhara Region urban localities and this could be also true in other Ethiopian regions.

The water supply, street networking, telecommunication and electric light infrastructures are the prioritized policy directions under urban infrastructure provision. But, the mandate of integrated urban infrastructure provision is given for the city/town administrations besides to this; the importance of an integrated urban utility infrastructure provision is not addressed by the document.

However; the Ministry of Construction and Urban Development (January 2004 E.C.) integrated urban infrastructure strategic document stated some of the important urban infrastructure provision problems. The document also indicated the need of integrated infrastructure development strategy, the policy gaps, the direct relationship between some utility infrastructures with the street network and infrastructure provision experiences of South African and Indonesian urban centres.

While the Ministry of Construction and Urban Development (2004: 73) has specified the general consecutive arrangements and minimum horizontal distances between utility lines. The arrangement is required to begin from the sides of streets and then need to end on the side of individual property lines as in the order of: drainage line - electric power distribution line- telecommunication transmission lines and then at the end the water supply distribution system with the minimum required distances of 0.50-1.0 meters between two consecutive utility lines.

However; as the primary data obtained from respective authorities', the Bahir Dar city utility infrastructures providing authorities as well as the city administration were not familiarized about this standard for utility infrastructures arrangement and minimum horizontal distances between utilities.

But after an enlightenment of the general requirements of the standard for each authorities respondent, they individually criticised the standard as follows: where the electric distribution systems may affected by an overflow of the drainage systems (unless it is far enough from the drainage lines), the standard is seen as so workable for the city's telecommunication authority, the water supply pipes need to be far enough from individual property lines so as to prevent water pollution. On the other hand the minimum standardized distance between the telecommunication and water supply lines is criticized as so minimal particularly when both of them installed in underground systems. The other criticism is the difficulty to incorporate all of these utilities in both sides of narrow streets (especially in 10 meter & less width).

Besides to this, most of the city's utility infrastructure providing authorities pursued to use only a few standards which are very much skewed towards individual authorities' specific objectives with a very minimal emphasis for its impact on other utilities and activities.

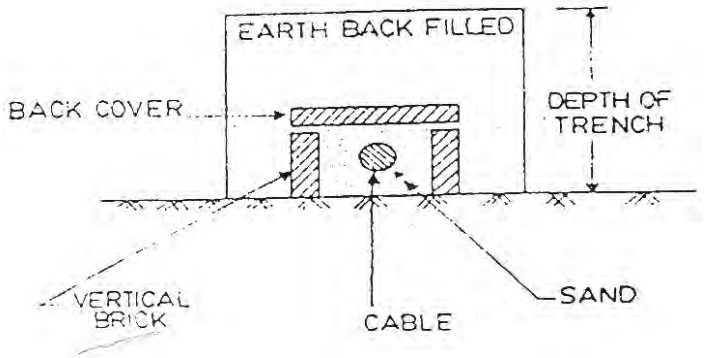
The Bahir Dar city telecommunication authority uses average depths for the primary and secondary underground communication cables are 1.20 and 0.80 meters. On the other hand it is explained that the city communication system applied using both the overhead and underground communication lines depending on the width of streets, soil type and other factors.

While, the city water service office follows to use an average depths for major and housing pipe water connection varies from 1-1.20 and 0.60-0.70 meters respectively. But the distances between the surface water drainage line and other utility lines is expected to be 0.60 -1.50 meters as it was replied by one of utility departments.

The minimum recommended buffer distances from different kilovolt power lines is defined as 50-60 meters for 15 000-30 000 KV power lines and 30-35 meters for less than 15 000 KV lines. On the other hand the power authority planned to use underground power cable systems within the area of the city.

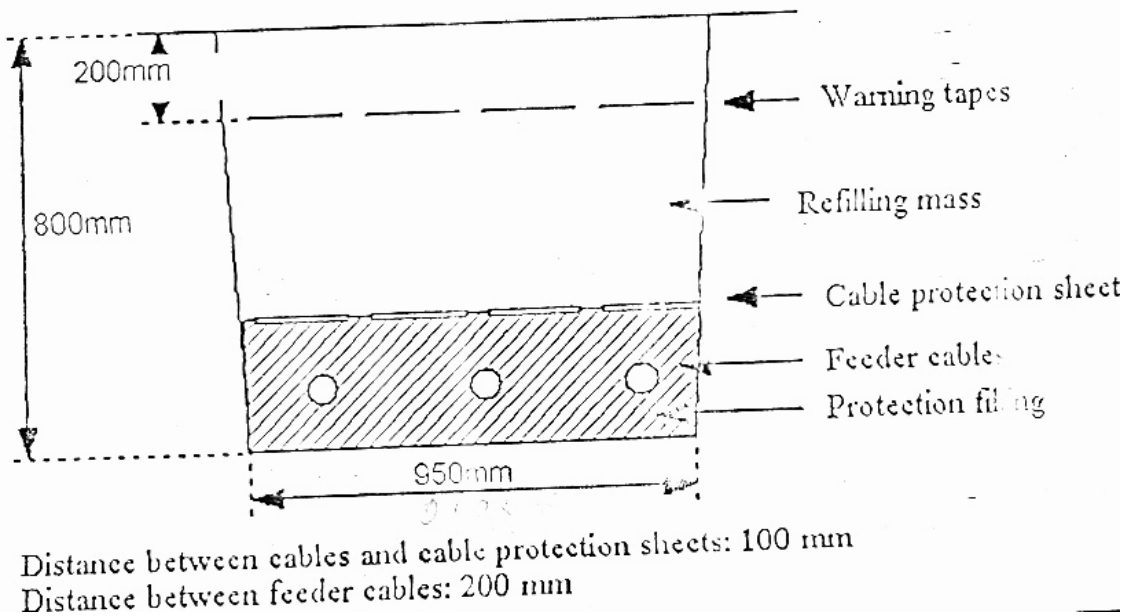
As EEPCO (2008) standard, the widths and depths of underground power cable varies as follow (as their respective orders): on the feeder power cables with street light need to install 0.95 by 0.80 meters; the feeder power cable in walkways, local streets and green areas need to be 0.55 by 1.20 meters; but in limited width walkways, local streets and green areas the feeder underground power cable will have variable widths (1.5 x $\sum$ the diameters of pipes/ducts in the trench + 0.2 meters) by 0.90 meter depths. The detail standard of the underground feeder power cables is shown from the following figures.

Figure 2.2: Shows the system of direct underground laid power cable



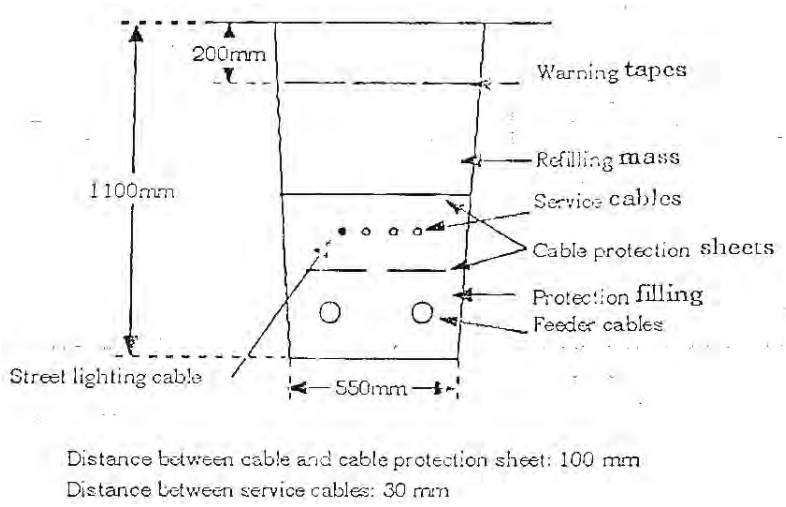
Source: EEPCO (2008) urban distribution rehabilitation and expansion project

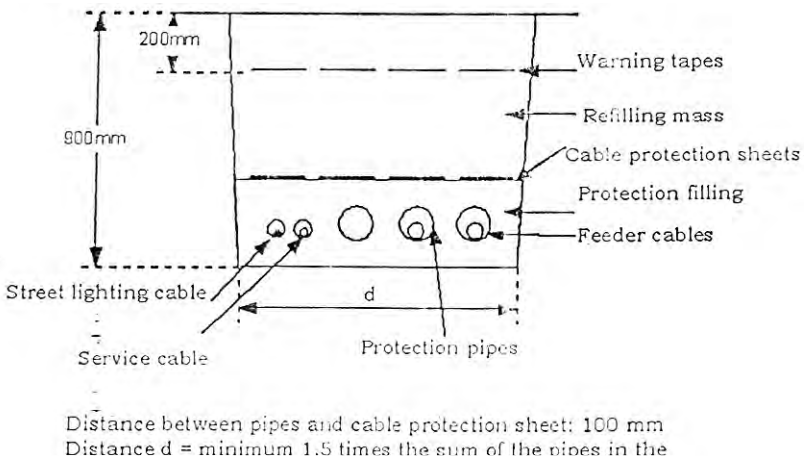
Figure 2.3: Shows underground power cable trench-cross section normal lay



Source: EEPCO (2008) urban distribution rehabilitation and expansion project

Figure 2.4: Shows underground power cable trench-cross section





Inside walkways, local streets and green areas

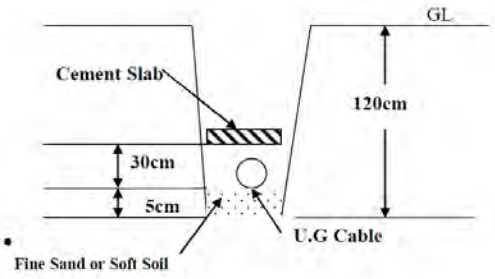
In limited width streets

Source: EEPCO (2008) urban distribution rehabilitation and expansion project

According to the underground power cable standard of EEPCO's, a number of pipes or ducts will be laid in the trench side by sides. Then one or more cables depending upon their sizes are expected to drawn through each pipes/ducts. After the pipes are laid the cables will be pulled into position from manholes by means of a strong rope or flexible steel wire.

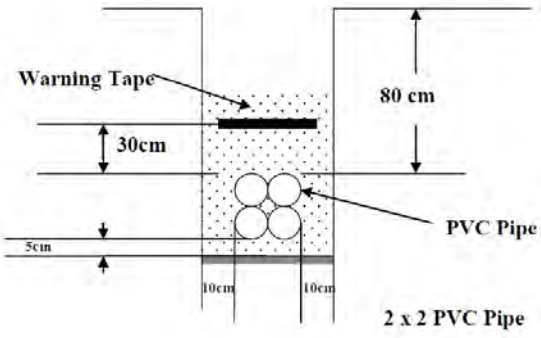
Among the other requirements of the underground power cable networking (EEPCO, 2005) is the minimum clearance-crossing distance between power and water supply pipes should be 0.40 meters whereas the minimum vertical and horizontal distances between power and communication cables ought to be 0.60 meters and need to cross at right angle so as to avoid the disturbances of the communication system by the power of electric.

Figure 2.5: Shows underground communication cable cross section



Source: Ethiopian Telecomm (2011) Bahir Dar branch

Figure 2.6: Shows an alternative underground communication cable cross section



Source: Ethiopian telecommunication (2011) Bahir Dar branch

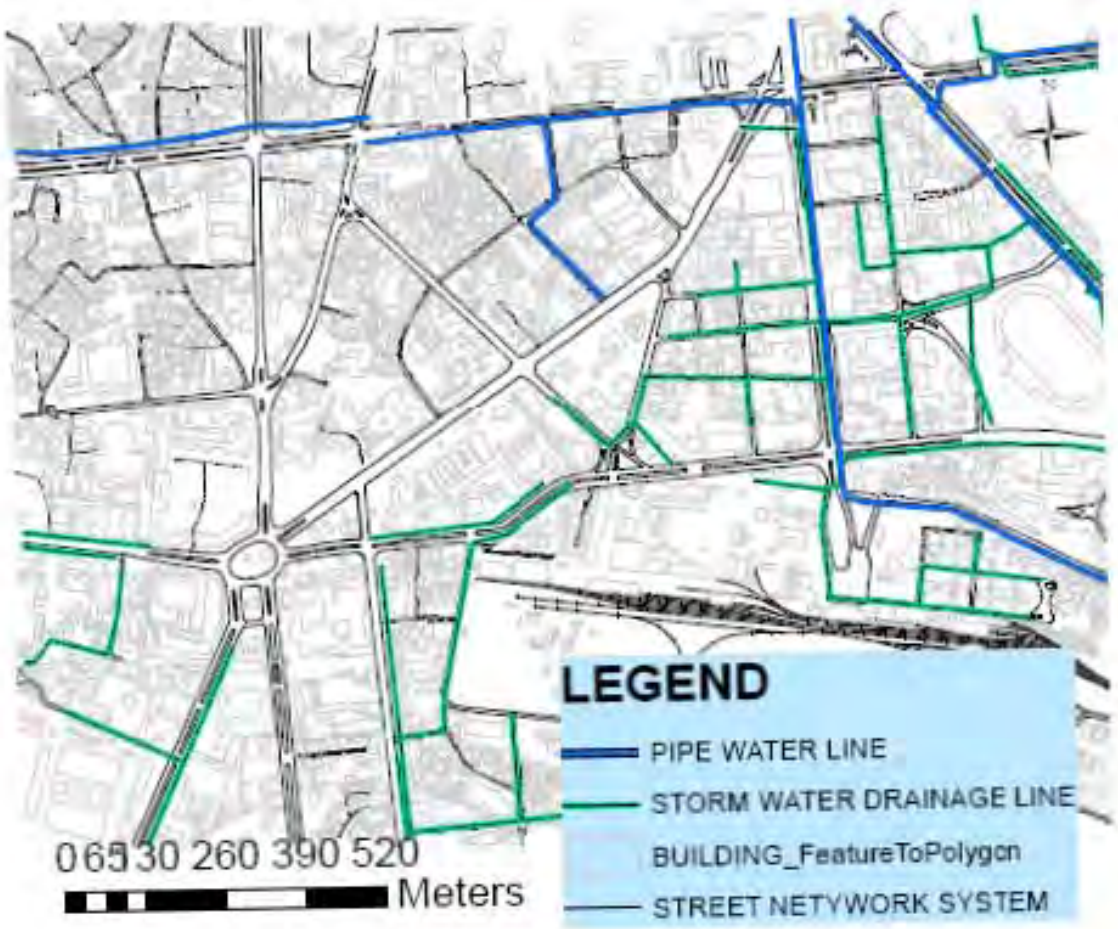
Table 2.1: Summary of the practice of utility Infrastructure provision standards

No:	Type of utilities	Categories		Standard		
				Required width in meters	Required depth in meters	Remarks
1	The drainage system	1	Along arterial streets(at an average)	1.20 - 2.00	1.40	
		2	Along collector streets (at an average)	0.74 - 1.54	0.50	
		3	Along local streets(at an average)	0.50 - 1.30	0.40	
2	Underground power cables	1	Feeder power cables with street light	0.95	0.80	➢ According to EEPCO (2005) report: 1. Minimum vertical and horizontal distances between power and communication cables ought to be 0.60 meters 2. Minimum clearance-crossing distance between the power and the water supply mains should be 0.40 meters
		2	Feeder power cable in walkways, local streets and green areas	0.55	1.20	
		3	In limited width walkways, local streets and green areas the feeder underground power cable	(1.5 x ∑ the diameters of pipes in the trench + 0.2 meters) i.e. variable	0.90	
3	Underground communication cables	1	The primary ducts(at an average)	0.30	1.20	
		2	The secondary ducts (at an average)	0.25	0.80	
4	Water supply pipes	1	Along arterial streets/major connections (at an average)	0.4, 0.3 and 0.2(commonly used pipe diameters)	1-1.20	
			Along collector streets (at an average)	0.2, 0.15 and 0.1(commonly used pipe diameters)		
		2	Along local streets (at an average)	0.08, 0.06 and 0.05 diameters	0.60-0.70	

Source: Self summary (on 2012) Based on Respective utility infrastructure providing authorities interviewed and documented results

2.8.3. Urban Utility infrastructure provision in Addis Ababa City

Figure 2.7: Shows the way of some urban utility infrastructure provision in Addis Ababa City (in Mixico area)



Source: From the department of Addis Ababa city administration

Figure 2.8: Shows the practice of an overhead electric system and poles installation in Addis Ababa City

Source: Field survey (on December, 2011), located at the side of Ethiopian road authority in Addis Ababa 'Ledeta' sub-city

In case of both pictures the electric power installation system illustrates the existing condition of utility infrastructure provision in the city. The left picture shows side by side installation of reinforced concrete and wooden poles while the right picture shows in a narrow Street on both sides an installed wooden electric poles and multi functionality of the poles for both the electric and communication lines. In different location of the city there are variety types of utility infrastructures provision problems, this may reveal the lack of workable rules, regulation and standard of utility infrastructures provision system.

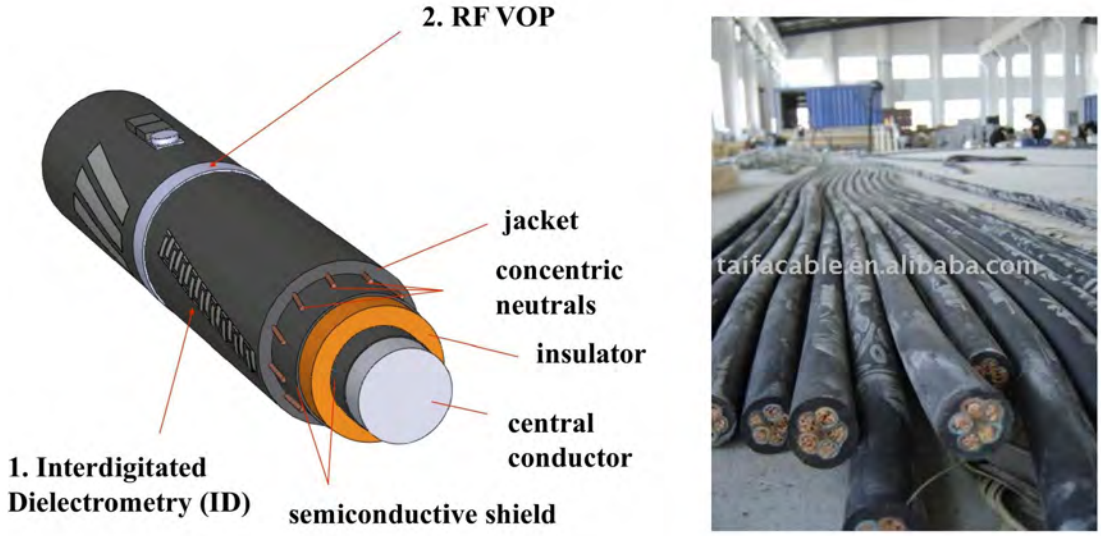
Figure 2.9: Shows crowded electric poles and damaged paved street respectively

Source: Field survey (on December, 2011), located in front side of 'Ledeta' Church and Awash beverage factory respectively in Addis Ababa city

As similar to the above case, this picture confirms the lack of utiltiy infrastructue privision standards. The left picture shows the number of parallelly placed electric poles and lines passes along the side of the street. Such crowded poles instalation affects the day to day activites and movement of people.

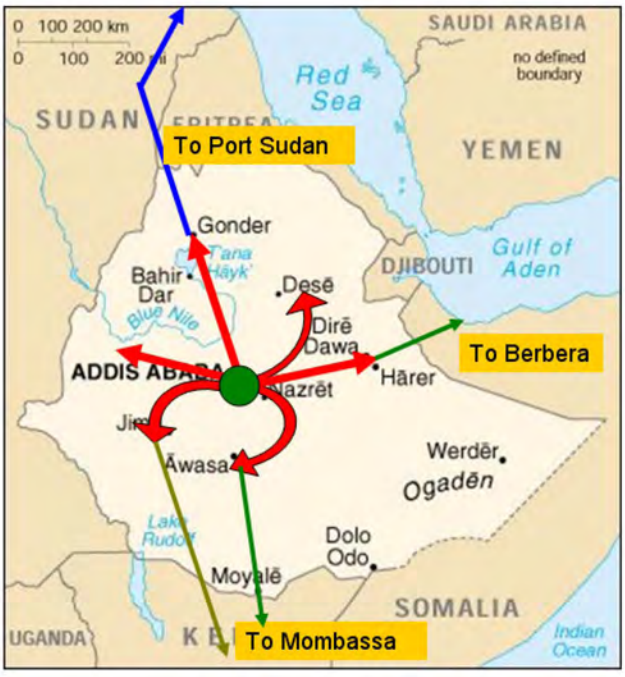
On the other hand the left picture illustrates the damaged paved street for the purpose of unplanned water supply line installation. The digging of such streets is one of the most commonly observed problems in the city of Addis Ababa. This produces an adverse effect on traffic movement, national economy, and the visual quality of the area, standardized location and installation depth of pipes and on natural and manmade environmental effects.

Figure 2.10: Shows the scheme of underground duct steel armoured/resistant power cables



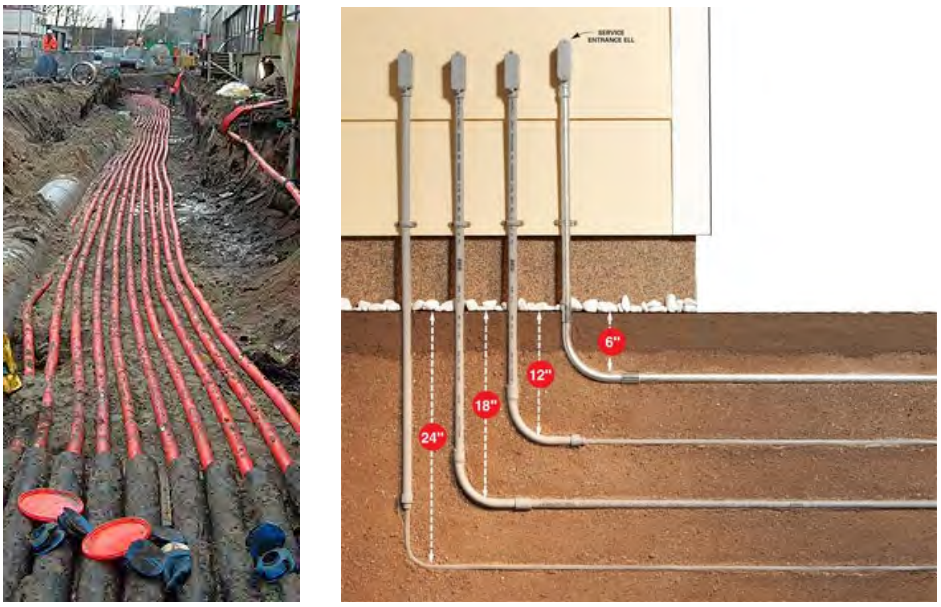
Source: Retrieved from EEPCO website

Figure 2.11: Shows the general Ethiopian optical fibre network layout



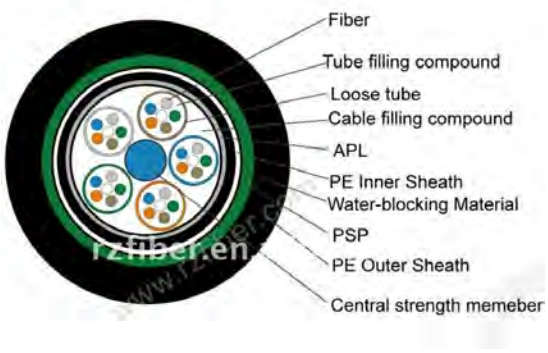
Source: Retrieved from Ethiopian telecomm website

Figure 2.12: The practice of underground power cable work in Addis Ababa city



Source: Retrieved from EEPCO website

Figure 2.13: Underground telecomm cable and its work



Source: Retrieved from Ethiopian telecomm website.

2.8.4. Urban Utility Infrastructure Provision in Amhara Region

Figure 2.14: The practice of electric line provision in Gasay town

1. The way of electric line installation in unplanned town(in existing land use)

Source: Amhara Regional Urban Planning Institute, December 2012

The above figure shows the sample problem of an overhead electric line installation in small towns. The red line illustrates the line of very heavy and costly electric wire carrying reinforced concrete poles in the central area of Gasay town before the town has land use plan. As it is revealed from the figure the poles and electric cables

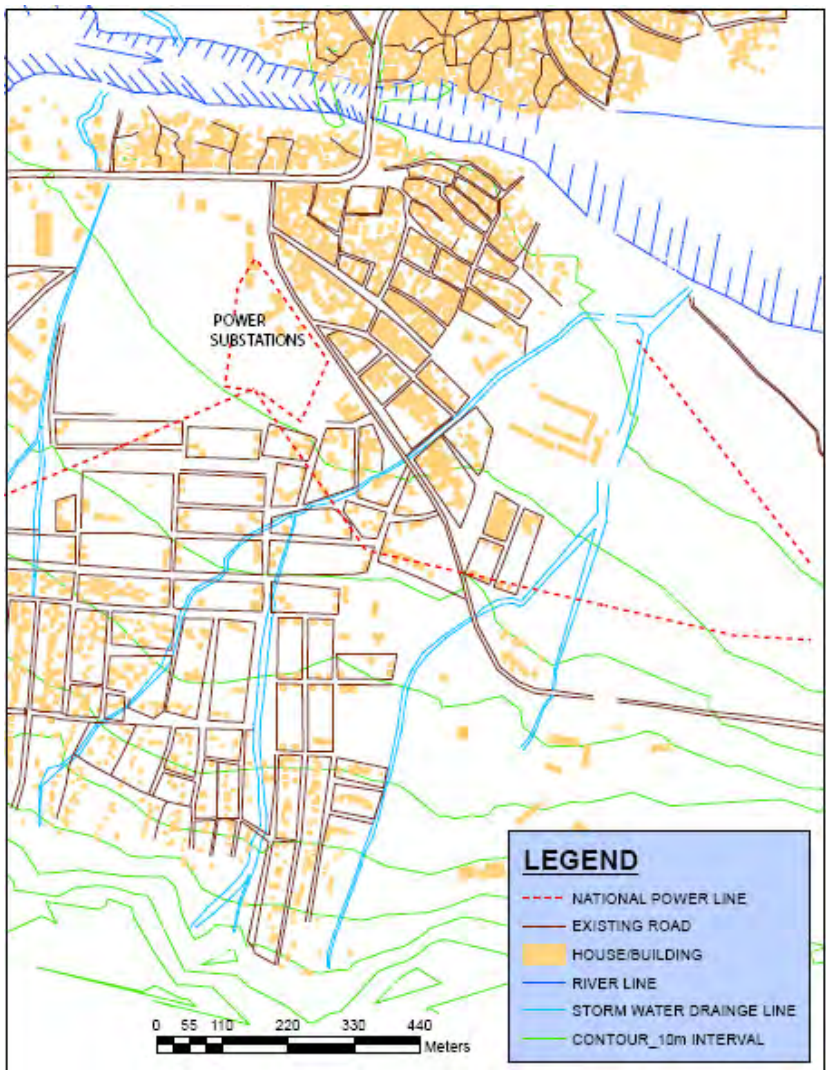
haphazardly placed either inside/over the existing street network or in the built up area of the town. While the next figure indicates the contradiction of these electric lines with the new proposed land use plan.

2. The effect of unplanned electric line provision in proposed land use plan and its future implementation

Source: Amhara Regional Urban Planning Institute, December 2012

Figure 2.15: Shows the practice of utility infrastructure provision in Shoa Robi town

1. The way of utility infrastructure provision in the town (in existing land use)

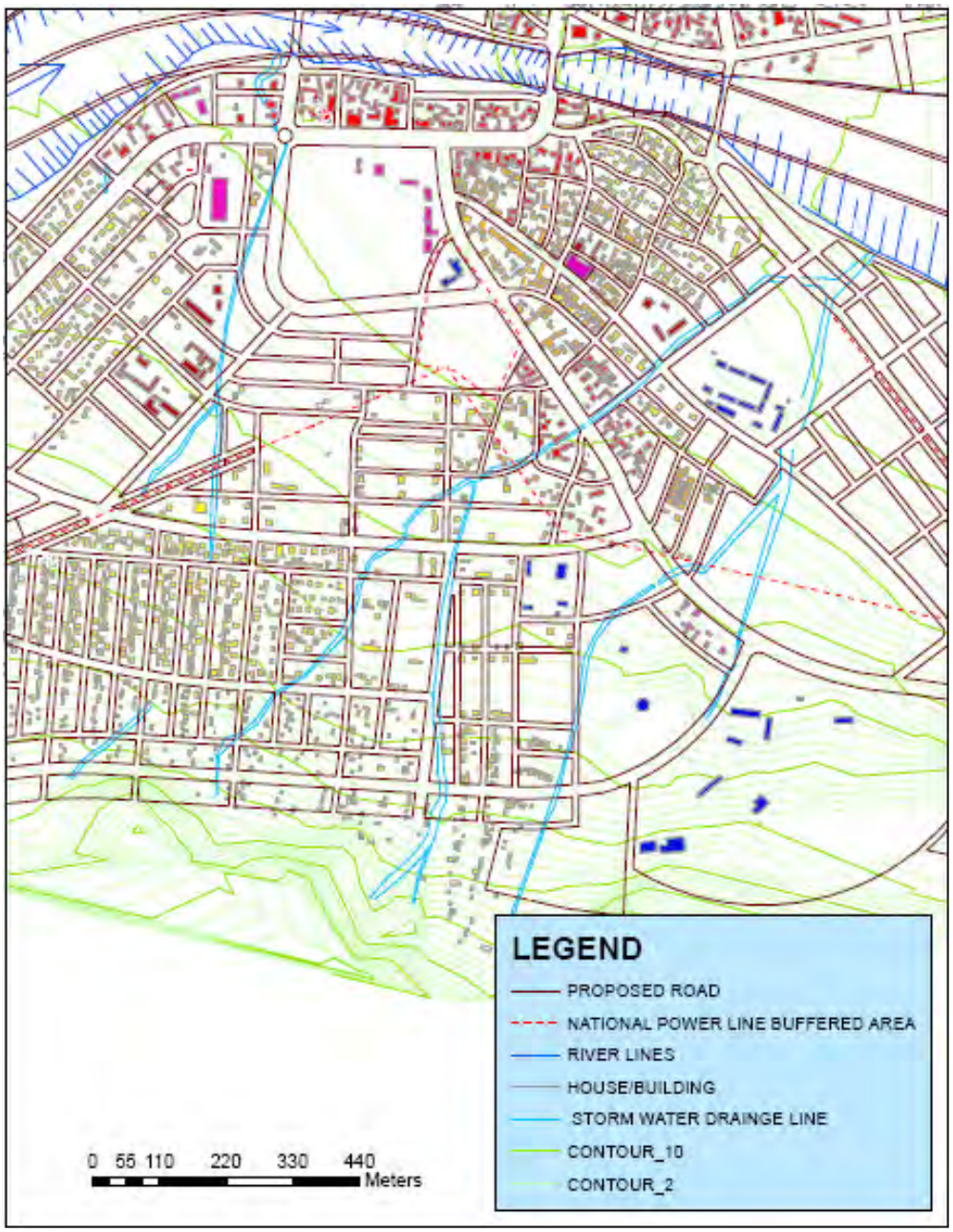


Source: Amhara Regional Urban Planning Institute, December 2012

The above figure illustrates the problem of electric power substation and national power cable carrying towers installation within urbanized area of the town and the problem of storm water drainage system. The red dotted line shows the power substation and the lines of the power cable carrying towers while the blue line represents the storm water drainage system in central area of Shoa Robit town before the revision of the plan of the town. As it is characterized from the figure,

these utility lines are improperly placed within the built up areas of the town. This has an adverse effect on the day-to-day activities of the dwellers as well as on the efficiency of urban land use. Hence the following figure reveals the inconsistency relationship of these utilities and the proposed land use plan.

2. The effect of unplanned utility infrastructure provision on the proposed urban land use plan and its future implementation



Source: Amhara Regional Urban Planning Institute, December 2012

2.9. Definition of terms

Utility: is the conduit or 'technological system' which support the rapid movement of energy, water, waste and information upon which their integration together into economic and social structures (Hughes, 1983; Preston, 199, sited in Graham & Marvin, 1994).

Utility refers the set of 'hard' infrastructure services which is provided by utility organizations consumed by the public hence it is commonly named as public utility. However this study accounts only the most common Ethiopian urban localities utility components: electric power, water supply, drainage and telecommunication utilities.

Infrastructure: is defined to denote the hard components that comprise all systems of urban physical structure that are mainly laid underground, surface and overhead to provide public services. Infrastructure in the context of this study includes the street network and utilities (electric, water, drainage and telephone).

Hence integrated infrastructure denotes a state of affairs whereby different infrastructures are planned, implemented and maintained in a balanced way.

Provision: Refers to the act or process of providing something to somebody. Provision in the context this study denotes an overall process of planning, installation, management and maintenance of urban utilities.

Cooperation: signifies the willingness to work together in order to meet common objectives, which is achieved through the good will of authorities in the development of utility infrastructures without any guiding procedures, rules and regulations.

Coordination: is to harmonize a common action or to create a harmonious interaction among the authorities that are involved in infrastructure and services development. It is achieved based on the adoption of certain procedures and guidelines. Coordination seeks to improve the effectiveness of humanitarian response by ensuring greater predictability, accountability and partnership.

The concept of institutional coordination in utility infrastructure provision is used to express an official enter-relationship or mutual partnership among the municipality

and utility infrastructure providing authorities in the course of actions for urban' utility infrastructures provision.

Integration: it is a combination and coordination of separate and diverse elements or units into a more complete or harmonious whole on the other hand integration is unified control of a number successor of similar economic processes formerly carried on independently. It requires both cooperation and coordination in order to work together, it also calls for the existence of a single formalized decision making system and the procedures that facilitates activities.

Integration potentially allows for more effective and efficient use of resources in order to achieve a common set of objectives. In the framework of this study integration may well stated in three forms: 1) integration among utility infrastructure authorities (intra-sectoral integration) 2) integration between utility infrastructures (inter-sectoral utilities integration) and 3) integration of utility infrastructures with other urban development sectors such urban land use components (also inter-sectoral integration).

Authorities/institutions: is used to refer the four urban utility infrastructure (telecommunication, power, water supply and storm water drainage) providing Ethiopian government organizations. Particularly the Ethiopian electric and telecommunication authorities' Bahir Dar branch offices, Bahir Dar city water supply and storm water drainage service along with the city administration itself.

CHAPTER THREE

3. RESEARCH MATERIAL AND METHODS

3.1. Research Method and Methodology

The study employed case study research through qualitative research type. More of interrelated semi structure interview questionnaires were asked for each of utility infrastructure providing authorities and the Bahir Dar city administration. The interview in most cased is provided for the process owners and in rare cases for the very nearby persons in each of the city's utility infrastructure providing authorities and the city administration land use department. Hence the interviewed persons were given indispensable answers to the questions.

On the other hand documents were collected from different authorities. In addition to this checklist based field survey and technical observation were undertaken so as to aware of the reality on the ground.

Methodologically, the data analysis process is seen in terms of the dimensions and the cause-effect relationships of the city's utility infrastructure provision problem. Based on existing/analyzed facts and theoretical concepts the study provided essential recommendations to the problem.

While the qualitative and quantitative physical, interviewed and documented data is presented in tables, charts, figures and textual techniques. The detail explanation of the data and the way of data presentation were provided in section 3.6 and 3.7 as below.

3.2. Research Design

The research is designed in such way to investigate the crosscutting issue of municipalities and urban utility (drainage, water supply, electricity and telecommunication) authorities. Basically the primary and secondary facts were collected from Bahir Dar city administration and respective utility infrastructure providing institutions.

During the primary data collection for the purpose of data reliability and information crosschecking, only the process owner's or the person who had better exposure in area of the study was interviewed so as to control the quality of the information.

In literature review, the cases were taken from developed and developing countries so as to assess the inconsistencies and similarities of urban utility infrastructure provision. Besides to this, the analysis is supported by maps, pictures and qualitative and quantitative assertive facts.

3.3. Data Source

For the case study there are two types of data sources: primary and secondary data sources. The Bahir Dar city administration, Bahir Dar city utility infrastructure providing authorities and on site observation were taken in to account as the primary source of information.

While secondary data were collected from the city administration, respective utility infrastructure providing authorities, some *Kebele* administrations of the city, Amhara Regional Urban Planning Institute, Federal EEPCO agency, Ministry of Construction and Urban Development and from other published and unpublished materials.

3.4. Data Type

The study employed the primary and the secondary data types. The primary data type accounts the interview, questionnaires, field observation and pictorial data collection.

On the other hand the secondary data types were published and unpublished documents, maps, plans, standard documents, statically information and other related material collected from different sources.

3.5. Data Gathering Tools

Interview and field observation are employed as the major means of data gathering tools. An interview of focal person[16], questionnaires, and physical observation are used as relevant tools to data gathering. In addition to this, the study used some additional helpful quantitative questionnaires.

Firstly, comprehensive open ended qualitative interview questionnaires were provided for each utility provider institutions. Secondly, some close ended quantitative questionnaires also presented to each of these authorities. Finally field survey to assess the condition of the existing utility infrastructure within the boundary of the city was undertaken by the researcher using checklists and physical maps.

3.6. Data Analysis Tools

For the purpose of data analysis the study employed SPSS, Excel, Arc GIS, Auto CAD and some related tools. SPSS is used to analyze some of the qualitative and quantitative data types. Latter all of the basic data were converted into graphs, charts, tables and descriptions. While, Arc GIS and Auto cad tools is used to analyze the spatial land use and utilities information so as to investigate the realities and issues of the city utility infrastructure provision.

3.7. Data Presentation

All the questionnaires, field survey results, graphical information and documented results were systematically presented under the results and discussion section of the study. The data presentation was made in line with the basic objectives of the study.

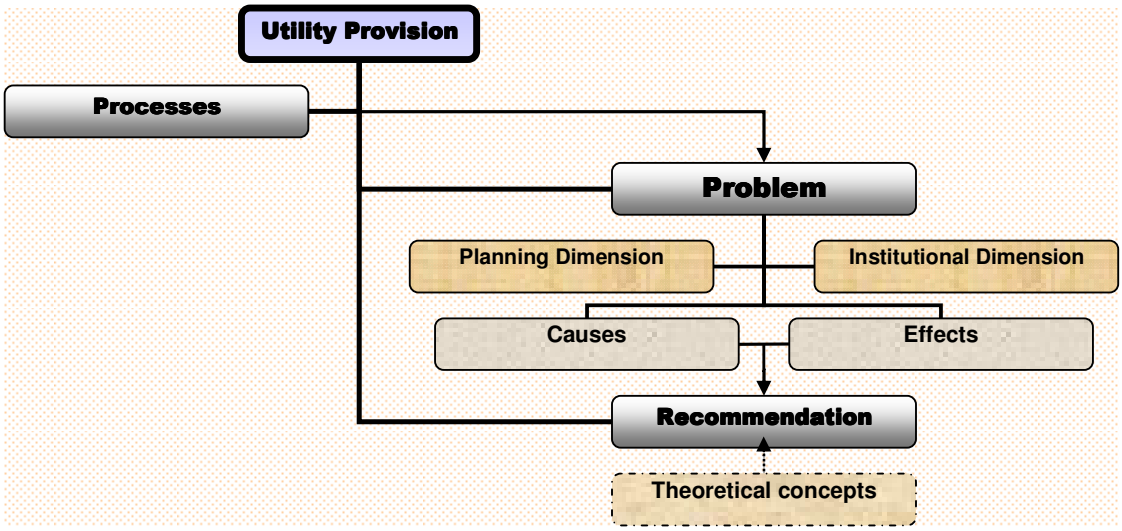
The interviewed results, field survey data, pictures, operational maps and related documents were presented in logical sequences in the form of tables, figures and analysis as predefined objectives of the research.

[16] Focal persons: a Person who is expected to have the better knowledge with in the area of the study, in most cases the process owners.

Farther more such systematic way of result presentation and discussion is used to crosscheck the gap of the city's utility infrastructure provision. On the other hand the individual operation maps were evaluated in line to the reality on the ground.

At the end on the support of data analysis, field observation, graphical information and theoretical facts the study is summarized by conclusion and recommendation.

Figure 3.1: Shows the focus areas of the data presentation process



CHAPTER FOUR

4. RESULTS AND DISCUSSION

4.1. Introduction

The results and discussion section is the most important part of the study. The section principally categorized based on the predefined research objectives and questions. The important finding results were directly linked to the problem of urban utility infrastructure provision in Bahir Dar city.

Hence, the results and discussion is provided based on four major sections and some other supportive subsections. These sections are: the process of urban utility infrastructure provision, the real dimensions and cause-effect relationships of the problem, the roles of municipality and utility authorities for sustainable utility infrastructure provision and the importance of the problem.

Importantly the real dimensions and cause-effect relationships of the problem is discussed based on three subsection i.e. 1) the planning dimension of the problem which accounts the physical land use planning of the city and utility infrastructure planning dimensions, 2) the institutional dimension of the problem which consideres the inter and intra -sectoral institutional relationships in the city utility infrastructure provision process and 3) the cause-effect relationships of the problem which provides the detailed cause-effect relationships of urban utility infrastructure provision problem.

4.2. The Process of Urban Utility Infrastructure Provision

Knowing the process of the city utility infrastructure provision will be an indicator to the solution. Hence, the process[17] of urban utility infrastructure provision from table 4.1 is reviewed in terms of level of administration, type of utilities, authorities, accountability, and roles and responsibilities of the institutions'.

Furthermore, it will portray the link between the land use and utility infrastructure planning, plan implementation and management processes across institutions.

This is the most common factor which affects the compatibility of utilities and urban land use functions. The incompatibility of activities will resulted in an overlap of utilities and land use boundaries. In general the understanding of such factors and incompatibilities of utilities will be the part of the solution to the problem. Hence the reality is presented in table 4.1.

[17] The process is used to indicate the planning, implementation and management aspects of urban utility infrastructure provision.

Table 4.1: Shows the process of urban utility infrastructure provision in Ethiopian urban localities particularly in Bahir Dar city.

		urban utility infrastructure providing authorities/institutions and their level of administration				
		Regionally administrated urban utility infrastructure providing authorities			Federally administrated/mandated but nationally utility infrastructure providing authorities	
		Urban land use, water supply and storm water drainage authorities			Power and communication authorities	
No:	**Evaluation criteria**	**Urban land administration (department)**	**Water supply (service office)**	**Storm water drainage (department)**	**Electric Power (authority)**	**Telecommunication (authority)**
1	The name of concerned authorities	B/Dar City land administration department	B/Dar City water supply service office	B/Dar City storm water drainage service department	EEPCO authority B/Dar branch	Ethiopian telecommunication authority B/Dar branch
2	Accountability	Directly to the city administration and indirectly to the RIUDB[18]	Directly to the city administration and indirectly to the regional water works bureau	Directly to the city administration	Directly to Ethiopian electricity agency (at the federal level)	Directly to Ethiopian telecommunication agency (at the federal level)
3	Among major roles and responsibilities	To develop, monitor and control the development of the urban land and infrastructure	To provide an efficient and well accessed water supply	To provide well planned/designed drainage service	To provide an efficient and well planned electric power	To provide an efficient and well planned communication system

[18] RIUDB: Regional Industry and Urban Development Bureau (the Amhara region RIUDB)

The Bahir Dar city's utility infrastructure planning, implementation and management processes			Urban land administration (department)	Water supply (service office)	Storm water drainage (department)	Electric Power (authority)	Telecommunication (authority)
4	1	Strategic planning period	5-10 years (city plan)	20 years (water supply)	5-10 years (drainage service)	20 years (power supply)	5-10 years (communication plan)
	2	Source of base map	The city administration (land use plan)	The city administration (street network plan)	The city administration (street network plan)	failed to use any base map	The city administration (street network plan)
	3	Practice to use digital mapping	Already in uses	None, but the hard copy of the city's street network map	to some extent soft copy of the city's street network map	Didn't use either of them	None, but the hard copy of the city's street network map
	4	The usual work of land use planning & utility mapping	Prepared in digital form & realized with a better precision. But failed to add utilities scheme, hence highly affected by the work of utility authorities.	Prepared by an overlay tracing system over the city street network map and implemented with very less accuracy	Designed in digital system but it is implemented with very less accuracy	Field sketch system and it is implemented incorrectly	Prepared by an overlay tracing system by an overlay tracing system over the city street network map and implemented with very less accuracy
	5	The accuracy of land use & utility infrastructure designing	The land use & the street network plans were prepared with a better accuracy	Not accurate	Moderate	Not accurate at all	Not accurate
	6	Employed mapping technologies	For land use & street networks: Auto cad and rarely GIS tools	Manually but for the detailed in auto cad tools	Manually but for the detailed in Auto cad tools	Manually (for the over power line)	Manually but for the detailed in auto cad tools
	7	Familiarized utility arrangement	Less controlled by the city administration	Mostly based on the interest of the office	Base on the city administration interest	All in all based on authority's interest	Mostly based on authority's interest

		‘’	Urban land administration (department)	Water supply (service office)	Storm water drainage (department)	Electric Power (authority)	Telecommunication (authority)
	8	The scale of operational maps	Land use mostly in 1:2000 & 1:2500	The same as the land use, but the detail mostly in 1:500	Mostly in 1:100 and 1:1000	None scaled (based on field sketch)	The same as the land use map, but the detail mostly in 1:1000
	9	Planners/Designers (by profession)	Urban/town planners or architect planers	Water engineers	Civil engineers	Electrical engineers	Communication planners (an electrical engineers by profession)
	10	Actual location of utilities in relation to its location on maps	With very little control over the location of utilities	Very less accurate	Very less accurate	Completely different from the location on sketches	Very less accurate
	11	Institutional coordination	Undertaken group discussion with three authorities only two times but now it is stopped	Sometimes (particularly in field work with professionals)	Only for two times	None	Sometimes (particularly in field work with professionals)
	12	Land use and utilities data linkage	None(lacks single information system)	None	None	None	None
5	Authorities prospected Intent		Establishment of an independent authorized organization to direct the overall activities at the federal and local levels	Use comprehensive planning and institutional coordination	Use comprehensive planning and institutional coordination	Jointly working, and realization of the city’s underground power cable system	Jointly working, and alternatively use of the city’s underground and overhead communication cable

Source: Self summarized (on 2012) Based on the city utility infrastructure provision process as per respective institutions information

I. The land use of the city and Utility Infrastructures Planning Period: The result of the primary data reveals that the strategic planning periods for the city's communication system, water supply and the electric power provision depend on the customers demand, rate of urbanization and the city upgrading projects while the storm water drainage service is directly related to the land use planning of the city.

In general the strategic planning periods for the city's land use plan, drainage and telecommunication system varies from 5-10 years. On the other hand the city's water supply and electric power provision planning periods has been stated as 20 years.

Table 4.2: Summary of the land use and utility infrastructure planning periods

No	**The planning periods for land use and utility infrastructures**		
	The land use and utilities	**planning period (in years)**	**Affected by**
1	The land use plan of the city	5-10 for each of them	customers demand, rate of urbanization and city's upgrading projects
2	The drainage system		
3	Telecommunication		
4	Electric power	20 for two of them	
5	Water supply		

Source: Interview results for four utility infrastructure providing authorities and B/Dar city administration, December 2012.

The summary of the land use and utility infrastructure planning period is used to recognize the land use and utility infrastructure linkage, the level of institutional coordination and the periodically compatibly among utilities and other land uses. Such periodical disparity of the utility infrastructure as well as land use planning will have an impact on the overall development of the city. Consequently, the effort of one authority might be negatively affected by other authorities as similarly as the problem between the city water supply and street construction sectors.

However; when there were systems of integrated planning or different means of data and institutional integration between the city administration and utility providers, the result will reduce the effect among the authorities.

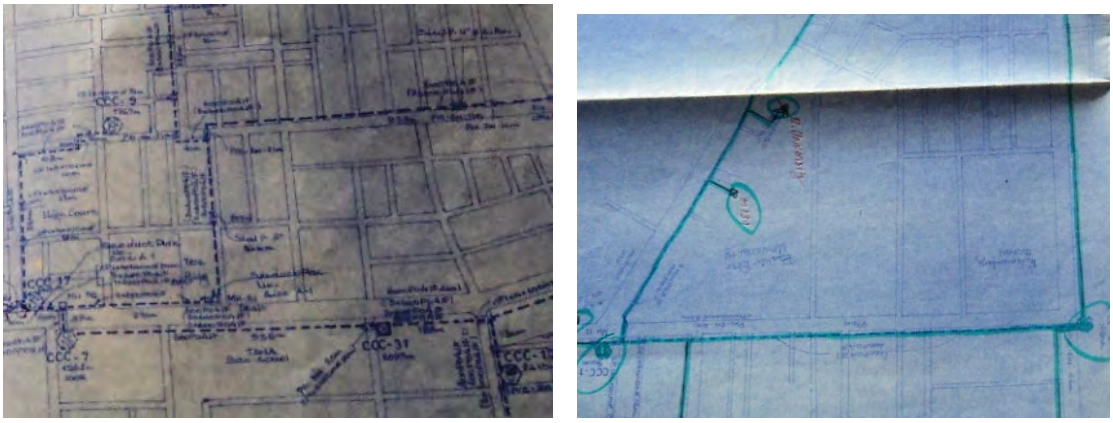
II. Land Use Planning and Utility mapping: The fundamental rule for land use and utility infrastructure planning is that strategic decisions can only be good when the maps and the information on it are complete and useful for different activities. Consequently it is better to have 'too' much detailed and well laid out information and need to coincide with other utilities map information.

As it is explained before, the recent proposed land use plan of Bahir Dar city was prepared in 2006 by FUPI. This plan prepared in digital mapping techniques by urban/town planners using Auto CAD and GIS programs.

The source of the city's utility base map for telecommunication, water supply and drainage systems with an exception of the electric power is the city street network plan. The power distribution authority offers to use a simple kind of field sketched. As the information from the concerned regional utility authority, the overhead system of the city electric power provision is made using the above methods. But for the prospected underground power system of Bahir Dar city the authority has started to prepare the design with the consideration of the city plan. The map of other utilities is prepared by the following techniques.

The telecommunication authority uses the city plan as the base map for the preparation of the city communication plan. The plan is made by an overlay tracing system over the blueprinted street network map. In rare cases there is the possibility of designing in digital forms in Auto CAD programming by scanning the image of the street networking. Electrical engineers who had taken additional training in the area of telecommunication infrastructure planning are supposed to prepare the design of this plan. More over designers are likely to fix the scale of these maps usually in a scale of 1:1000 and 1:2500. The scales are recommended for the purpose of ease data accounting and over-viewing of the basic components of the communication systems on the other hand the scale is influenced by the scale of the base map.

Figure 4.1: The bold coloured line shows the Bahir Dar city's communication plan which had been drawn over the blue print of the city's street network map.



Source: Ethiopian telecomm authority Bahir Dar branch, December 2011

The water supply service office also uses the city street network map for the preparation of the water supply scheme. The office made the main water supply design through a direct tracing system over a copy of the street network map. While the detail water distribution plans were prepared by digitizing the image of the street network in Auto CAD programming. However; the design of the main and the detailed water distribution system were made by professional water engineers.

Consequently the main distribution map is illustrated to prepare as the same scale as the city's street network map while the details is recommended to prepare in 1:500 scales.

Figure 4.2: The bold line shows the Bahir Dar city main water supply distribution plans parallelly traced over the city's street network map/plan.

Source: Bahir Dar city water distribution service office, December 2011

As the communication and water supply authorities, the city's storm water drainage department employed the street network map. Thus the street network served as the base map for the preparation of the storm water drainage lines. As it was explained by the department sometimes the detailed design of the storm water drainage system is made by directly using the digital street network map (when it is available) or through an alteration of the hard copy into digital forms. The design is commonly made by civil engineers in Auto Cad programming in a recommended scale of 1:100 and 1:1000.

On the contrary to these three authorities; the city's electric power authority failed to use the street network as base map for power system mapping. The interviewed result revealed that the technique of the city's electric power distribution made with a simple onsite/field sketching techniques instead of the use of the base map of the city. But; for the prospected undergrounding power system the authority pursued to use the recent street network plan of the city for the detailed design of underground power systems.

The sketch of overhead electric system is made by electrical engineers with none defined scale of maps and none digital system. But; for the future underground power distribution system the design is recognised as it will prepare in computerized digital system.

In general, the system of sound urban land use planning and utility mapping need to maximize the planning, institutional, financial and quality of services related benefits. Moreover it lowers the expense of utility authorities' and municipalities' through the reduction of utility authorities and municipalities cost of reinstatement and compensation.

III. The Location of Utilities: As it is discussed under the land use planning and utility mapping section; most utilities map is prepared in manually techniques without the use of proper digital mapping technologies. As though, currently in the country most urban localities has got the chance digital system city/town planning with a better precision than manually mapping techniques but most utility authorities still depend on the tradition approach utility infrastructure planning system, that is an field sketching and an overlap tracing system. Hence it is obvious that field sketching and overlap tracing techniques are not as precise as digital mapping techniques.

Consequently; the work of our urban centres utility infrastructure provision has various defects as what we do. These defects well illustrated in terms of planning and institutional dimensions, cause-effect relationships, policy and technological related factors. The application usually executed as the interest of individual authorities without having a common regulatory and control measures. The return of all such defective acts resulted in an adverse effect on the work of the municipalities, utility authorities, public property, the quality and sustainability of the services.

Furthermore; the location of utilities on maps is completely different from location on the ground. These could happened due to lack of common regulatory measures, less aware of the issue, less use of digital mapping techniques, absence of geo referencing and XYZ coordinating mapping systems.

4.3. The Dimensions of Urban Utility Infrastructures Provision problem

4.3.1. The Planning Dimension of the Problem

As the first plan of Bahir Dar city is made during the period of Italian occupation. After the Italian departure the plan has been revised in different periods: in 1948, in 1950s, in 1965 a new comprehensive Master plan was prepared by a team of German planning experts while in 1970s the Ministry of urban Development and Housing (MUDH) had prepared the detailed land use parcel plans, in 1996 NUPI prepared another master plan. Recently in 2006 the previous NUPI's master planning was revised by FUPI in the name of integrated development plan (IDP) (Oy, 1999 and FUPI, 2006). The previous plans were brought some meaningful changes only in some corridors in the city. On the other hand the attribute of the lately prepared plans particularly seen in some areas of the city (particularly around Keble 14 and 13).

As though the city has got around seven chances in plan revision most of these plans were failed to realize in to the ground. Consequently most old and lately squatting neighbourhood areas have been perpetuated spontaneously without an intervention by these plans. That's why the effect greater impacted on the sustainable and compatible provision of the city's utility infrastructure and the city land development. Hence the following figures discussed the planning dimension of the city utility infrastructure provision problem.

Figure 4.3: The images show the impacts of physical planning on urban utility infrastructure provision.

As it was discussed above the city of Bahir Dar plan was revised around seven times however the plans did not bring as such reasonable changes in the development of the city. For instance this image shows some old and the newly squatting areas of the city.

The settlement around Bahir Dar textile factory is so old but still continued spontaneously while settlements around *Keble* 11 is one of newly squatting areas of the city and such areas also continuing as patched kind of development.

Hence the image confirms the old and recent spontaneous development areas within the boundary of the city which were developed without the intervention of the earlier plans. This is not the result of lack of city planning but the problem of implementing plans.

Such problem imposed an adverse effect in the development of the city as well as the sustainable of utility infrastructure provision.

Source: Google earth image website, December 2011

Figure 4.3 shows the difference between planed versus unplanned development. No. 1 indicates the recently developed area around *Keble* 14, which has been well planed than the right side (No. 2). The right side demonstrates a kind of spontaneous settlement which was developed without proper planning intervention.

In the case of No. 2 the land seen as inefficiently utilized and settlements were perpetuated as patch kind of development. Therefore the physical plan of Bahir Dar city seems as well implemented around *Keble* 14 than *Keble* 17. Consequently utility infrastructures provision around *Keble* 14 will be so easier than *Keble* 17.

In general unplanned urban development makes it difficult to provide utilities, while providing utilities at a later stage is very costly and cumbersome. As such, the lack of proper land and utilities information greatly affects the efficiency of urban land development and utilities provision.

The other important planning dimension for urban utility infrastructure provision problem are expressed as follow: an overlapping/conflict of utilities, ignorance of utility infrastructure scheme during city planning, damage of paved streets through further utilities installation, improperly and incompatibly placement of utilities, overlapping of underground telecommunication and water supply lines, improper placement of water pipes (within walkway, storm water drainage system and individual property lines), installation of electric and communication utility poles within the drainage line and private compounds. The other planning dimension of the problem is revealed by pictorial representations as followings.

Figure 4.4: Shows the practice of power substation and power tower lines planning & installation

Source: Field survey (on December 2011), located inside Bahir Dar textile factory

The above pictures show the power substation and national power cable towers within the central area of the city. The spread out of power towers from this substation highly affects the development of the city, efficient use of urban land and day-to-day human activities.

For instance the power tower at the right side of the above picture radiated from the main substation. Subsequently it passes through the centre of the city (located very near to papyrus hotel). As though the strip of land underneath it (power line) is so valuable but it is restricted from any development so as to free from the power risk. Moreover it is not so easy to relocate and made the site suitable for different kind of development and high rising building construction.

Figure 4.5: The map shows the impact of power substation and power tower lines (on the side of seven red lines) in the development of Bahir Dar city.

Source: FUPI(2006) proposed land use plan of Bahir Dar city.

Figure 4.5 shows the site of the power substation and power tower lines within the area of the city. The power substation is represented by the red coloured star line while the corridors of power towers were denoted by the seven bold red lines.

The power substation is located in the centre of the city and then it spread out into three directions. Consequently this highly affects the development of the city, the efficient use of the land and day to day activities of the dwells. The other two power tower lines which are originated from 'Tana Beles' hydroelectric power source crosses through the southern expansion area of the city.

Hence, in future it is very important to take great consideration before the incident of such problems. The problem could be sourced by an existing as well as newly established power stations and tower lines from different areas of the country and this could affect the emerging as well as existing urban localities.

Figure 4.6: Shows damaged principal paved streets via water pipe installation.

Source: Field survey (on December 2011), located in front of main post office in Bahir Dar city.

The digging of such important streets is the most common problem in the city of Bahir Dar as well as in other most Ethiopian urban localities. As it is shown from figure 4.6 the double line asphalted street has been perpendicularly sectioned in to different parts, this made a great trouble on safe traffic movement, efficient use of the national economy, standardized pipe location furthermore it harmfully made change on the quality of manmade environment.

Figure 4.7: It portrays the water pipe overlaid on open ditch storm water drainage system.

Source: Field survey (on December 2011), located in front of Mulualem hall in Bahir Dar city

From figure 4.7 it is shown that the water pipe placed over the storm water drainage system. The pipe incompatibly overlaid on the drainage system this reveals the other planning dimension of urban utility infrastructure provision problem. Mixing up placement of such underground and surface utilities could effect on an overall water pollution and effected on the health of users.

Figure 4.8: Shows improperly located water pipes

Source: Field survey (on December 2011), located at the back of Kedanmhirt clinic in Bahir Dar City

In the case of figure 4.8 the pipe instead of being buried into the ground; it is placed over the surface of the ground. Furthermore the pipes were overlaid on the edge of storm water drainage system. This showed that the inconsistence characteristics of pipe water installation within different area of city. In broad, the current approach of urban utility infrastructure provision looks as if it were continued in a similar tendency as the traditional mode of utility infrastructure provision system.

Figure 4.9: Both figure shows improperly located electric poles

Source: Field survey (on December 2011), located at the front of Admass Collage and Shumaboo recreation centre as respective order

On the other hand figure 4.9 demonstrates the general mode of the city's electric power lines and poles placement system. As it is clearly shown from the figure, the mass of electric poles were haphazardly placed in the sides of the street and sidewalks. The outcome result of this problem is below standard of services, impact on the development of the city, vulnerable to high cost of compensation and visual obstruction on human activities and walking.

As it was discussed from the process of urban utility infrastructures provision (in section 4.2), the usual work of over head electric power provision made using a simple kind of field sketching techniques. Furthermore utility poles usually installed in haphazard locations without the consent of the city administration.

According to the result of the primary data, here the most distressing issue is that when the city administration need to develop the area (need to mad redevelop in the area) it faces so complicated and bureaucratic problems. Such problems might happen due to most of utility authorities may not easily able to relocate utility lines and poles.

On the other hand most of these authorities required a full of prepaid compensation for these lines. Hence the city administration first obliged to compensate an average of around 12, 000 Ethiopian Birr for each of wooded poles. However; such problem may not the only fault of utility authorities but it may also be the fault of the city administration and the general setup of urban utility infrastructure providing institutions at the national and regional levels.

4.3.2. The Institutional Dimension of the Problem

As the planning dimension, the institutional dimension used to assess the partners' coordination as the main point of interest. The concept of institutional coordination is used to express official inter and intra-sectoral relationships among the city administration and utility infrastructure providing institutions in the course of the city's utility infrastructures provision.

The institutional dimension is the second and most central factor for urban utility infrastructure provision problem. As the results of the primary data the problem of the institutional dimension is characterized in terms of: inefficient use of resources(financial, material, land, labour and time resources), an expenditure of large amount of money for the relocation utilities compensation, problem in access of the revised city plan, lack of institutional coordination when one institution builds the other destroys, inconsistency in compensation payment, cumbersome procedures during the process of utility infrastructure relocation and during the work of the city redevelopment projects.

For instance the study asserted that the city administration has no any criteria to limit how, when and what amount of money will compensate for each of the city utility authorities. Consequently the cost of compensation solely is determined by the interest of individual utility infrastructure providing institutions/authorities. After this the requested amount money need to be paid for the authorities, but the city administration could pay the money when there is enough capacity to pay the money.

Otherwise the implement-ability chance of the city administration project could be cancelled or transferred into other period, or else the scope/the quality of the projects may get reduced. This is other critical problem under the institutional dimension of urban utility infrastructure provision problem.

Some real evidences for the cost of compensation paid by Bahir Dar city administration to the city utility infrastructure providing institutions is revealed as follow:

- In 2001 and 2002 E.C the city administration compensated more than 110, 500 and 635, 593.85 Ethiopian Birr for the relocation of communication utility lines,
- In 2001 and 2003 E.C the city administration also compensated an amount of 2, 700, 777.81 and 79, 187.51 Birr for the relocation of power lines,
- In 2002 E.C the city administration also paid around 2, 412, 728 Birr for the transfer of water pipes.

However; these figure only represented the result of some recorded compensation data rather than the summary of total yearly cost of compensation. However; the amount of actual yearly compensation cost is expected as very much higher than what is stated in the above. In broad the figure portrays the extent of the problem and the relation among utility authorities and the city administration.

As some informants, the intra-sectoral linkage among individual utility authorities as well as the city administration completely dependent on the interest of individual authorities because of the lack of common enforcing measures. As a negative factor this critically affects the efficiency of the authority, the quality of the services, the environment of the city and the general public property.

To recognize whether international urban utility infrastructure provision cases have been taken into account or not, a simple kind of discussions were made with five respondents' one-one from each institutions. Out of the five only one respondent knows little about Asmara in Eretria and Cairo in Egypt cities utility infrastructure provision experiences, subsequently he was appreciated the cities' institutional coordination and developmentally prioritized utility infrastructure provision. Furthermore, he underlined the importance of understanding other countries utility infrastructure provision experiences so as to validate the qualities into our localities.

According to the review of primary data, the Bahir Dar city administration attempted to establish a simple kind of institutional commitment among the city utility infrastructure providers. But, only two out of four sectors were take part in the discussion with the city administration for only two times. As the result of the

review, the main objectives of the commitment was planned to make institutional dedication and negotiation for the Bahir Dar city utility infrastructure provision.

Table 4.3: Summarizes the levels of the institutional participation during the city's utility infrastructure provision process.

The practice of institutional participation (among five institutions)	
Participant institutions	**Non participant institutions**
Three (assemble only twice)	Two

Source: Interview result of utility infrastructure providing institutions and the city administration.

The primary information asserts that the discussions were undertaken among two utility infrastructure providing institutions with the city administration. The participants were only from the two utility infrastructure providing institutions' and from the city administration. The information revealed that other two institutions were not take part in the discussions.

According to the information from these institutions, participants raised the following points as the major problems:

- Lack of institutional integration,
- Very low level of communication,
- Improper positioning of utilities,
- Failure to remember the location of underground utilities and
- Damage of utilities is illustrated as major problems of the sector.

Figure 4.10: the two pictures also show the practice of urban utility infrastructure provision in Bahir Dar city

Source: Field survey (on December 2011), located at Institute of Bahir Dar University (technology faculty) and Keble 03 administration office respectively

The above as well as the following pictures as before shows the general practice of utility

On the other hand, figure 4.10 shows the other problem in the practice of urban utility infrastructure provision in the city. Such issue might happen due to the lack of institutional coordination, integrated planning system and less responsiveness of other institutions property.

The process continued as the desire of individual authority without having the system of institutional coordination. Thus these institutions could fix their utility either by damaging previously installed other utilities or may directly overlaid on the existing utility as it is shown form figure-4.10 & 4.11. As similar as the planning dimension the institutional dimension is the most common but the less concerned issue for urban utility infrastructure provision.

Figure 4.11: Shows the practice of electric poles installation in Bahir Dar city

☞ The three pictures show an overlay installation of electric poles inside the storm water drainage lines/open ditches/. This will accumulate wastes and will result in an overflowing of the flood (lead to drainage collapse).

Source: Field survey (on December 2011), the pictures were taken in the central area of Bahir Dar city

4.3.3. The Cause-Effect Relationship of the Problem

Table 4.4 confirms the most important causes and associate effects for urban utility infrastructure provision problem.

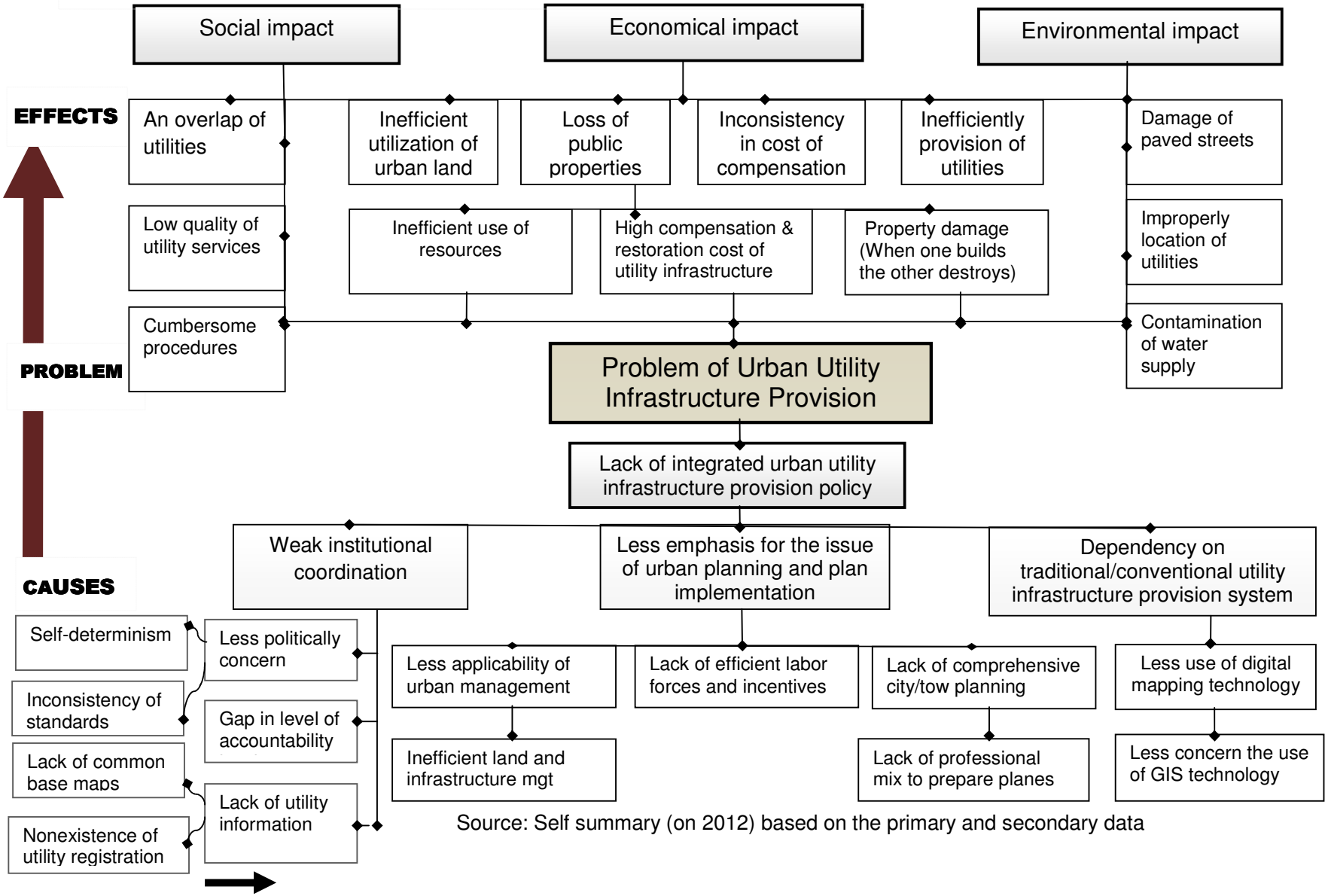
The table shows the cause-effect relationships for our urban localities utility infrastructure provision problem. The major and sub-causes are articulated under the focal problem while the effects are shown above the problem.

On the other hand the major causes are documented on the two rows under the main problem while the broad effects (results) of urban utility infrastructure provision are placed at the top of the table as social, economical and environmental problems.

As the result effects were originated from problems whereas problems were originated from causes. This is commonly explained by a tree diagram, a tree diagram is used to show the causes (as the roots of a tree), the focal problem (as a stem of a tree) and the effects (as the branches of a tree).

The detail cause-effect relationships of the city utility infrastructure provision problem are well displayed in table 4.4. In general the utility infrastructure provision cause-effect relationship table provides a valuable study results for service providers, policy makers and professionals.

Table 4.4: Demonstrates the Cause-Effect Relationship of the Problem Tree



Source: Self summary (on 2012) based on the primary and secondary data

4.3.3.1. The Causes of Urban Utility Infrastructure Provision Problem

Under the problem tree, the causes were outlined as major and root factors. Lack of integrated urban utility infrastructure provision policy resulted in the existence of weak institutional coordination, less emphasis for the issue of urban planning and plan implementation and dependency on traditional/conventional utility infrastructure provision approaches.

The first major feature for the lack of integrated urban utility infrastructure provision policy is the lack of institutional coordination which happened due to: 1) less political concern for sustainable urban utility infrastructure provision. Such political reservation resulted in self determinism of individual utility authorities and inconsistency of standards among utility authorities; 2) gap in level of accountability, as it is described from table 4.1 the land administration and storm water drainage departments as well as the water supply service office are accountable to the region however; the city's electric power and telecommunication authorities are accountable to the federal electric power and telecommunication agencies, and 3) lack of utility information is caused due to the lack of utilities registration and common base maps among the city administration and utility infrastructure providing institutions. In general all these resulted in the existence of weak institutional coordination.

The second major feature for lack of integrated urban utility infrastructure provision policy is less emphasis for the issue of urban planning and plan implementation which is described in terms of: 1) less applicability of urban management which leads an inefficient urban land and infrastructure administration. 2) Lack of efficient labor forces and means of incentives. The labor forces in the area of urban development sector are expected to play very vital roles for the meaningful development of urban centers. But; the inefficiency of the sector occurred due to two important reasons one is the low performance of the labor forces which is resulted by either lack of appropriate training or lack of motive to perform well. The second but the most important reason is due to the lack of different means of incentives. 3) Lack of comprehensive city/town planning. Here comprehensive urban planning is used to define the city/town planning which accounts all the land use and utility infrastructure information. The lack of comprehensive city/town planning also might characterize by shortage in professional mix during the process of plan preparation.

The third major cause under integrated urban utility infrastructure provision policy is dependency on traditional/conventional utility infrastructure provision systems. As it is detailed in section 4.2, the current urban utility infrastructure provision process in the country highly depend on the traditional systems. For instance most of the Bahir Dar city's utility infrastructure providing authorities uses the manual utility infrastructure planning techniques, which is employed an overlap tracing or field sketching techniques. The importance of digital mapping and GIS technologies has very less awareness by these authorities.

4.3.3.2. The Effects of Urban Utility Infrastructure Provision Problem

In general the major effects of urban utility infrastructures provision are categorized in to three broad groups. Each of them also subcategorized into secondary and then tertiary level effects. The three broad effects of urban utility infrastructure provision problem are presented as follow.

The first is the social impact, which is characterized by: low quality of utility services, overlap of utilities and cumbersome procedures. The quality of the services could articulate in terms of service fluctuation, physical and visual obstruction effect on day-to-day human activities.

The second and the most important effect is the economical impact which is defined by the secondary and then tertiary level effects. As it was shown from table 4.4 the economic impact of urban utility infrastructure provision is characterized by the secondary effects: loss of public property, inefficient use of urban land, inconsistency in cost of compensation, damage of paved streets and an overlap placement of utilities. The loss of public properties also subdivide in to tertiary effects that accounts inefficient use of resources (financial, land, material, time, and labor resources), high cost of compensation and restoration and property damage.

The third broad effect is the environmental impact. The environmental impact as it is indicated from the summary of cause-effect relationship table categorized in to secondary effects. The environment impacts also characterized by other detailed effects: damage of paved streets, improper location of utilities and contamination of

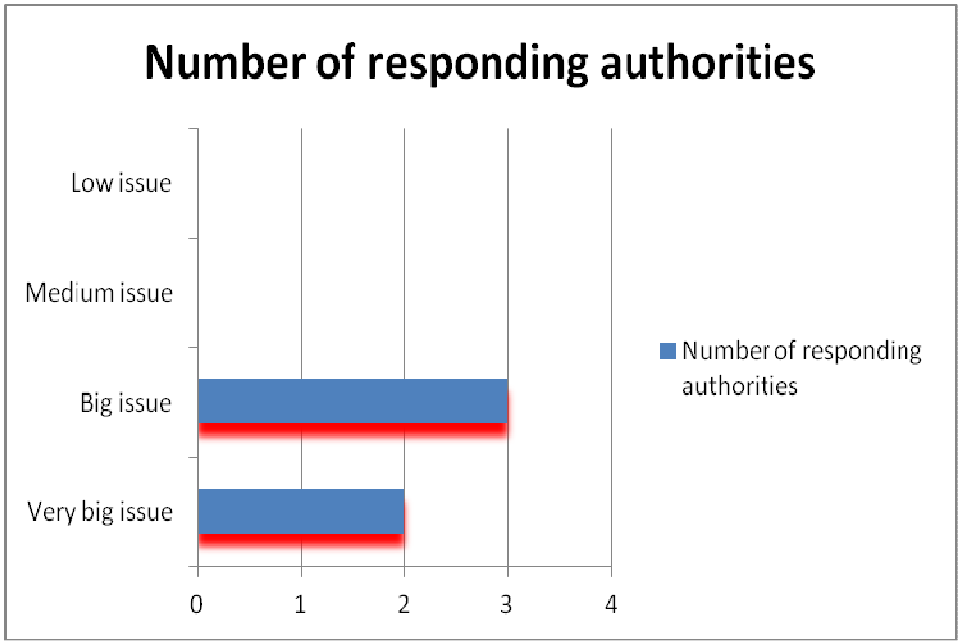
water supply. At the beginning all of these effects are originated from the focal problem on the other hand, the focal problem is sourced by a variety of causes.

Table 4.5: Summary of planning and institutional related effects of the city utility infrastructure provision problem

No:	Among the major utility infrastructure provision problems	
	Common problem	**Number of respondent sectors**
1	Overlapping/mixing up of utilities	5
2	Inefficient utilization of financial resources	5
3	High cost of compensation and restoration	4
4	Ignorance of utilities scheme during city planning	2
5	Variation/change in street width, installation of utilities inside private property lines, problem of compensation	1
6	Inconsistency of compensation, cumbersome procedures, damage of paved streets	1

Source: Interview result of Bahir Dar city utility infrastructure providing authorities and the city administration, on December 2011

Figure 4.12: The intensity of the city's utility infrastructures provision issue



Source: Interview result of Bahir Dar city utility infrastructure providing authorities and the city administration, on December 2011

From figure 4.12 the problem of the city utility infrastructure provision classified in to four major classes: law, medium, big and very big issue. Out of the five responding institutions three of them ranked the problem as big issue while the remaining two institutions categorized the problem under a very big issue.

The summary of the above cause-effect relationship table provides the most important causes and effects of the city utility infrastructure provision problem. Furthermore the table could represent the most common causes and effects of Ethiopian urban localities utility infrastructure provision problem.

4.4. The Role of the Municipality and Utility Infrastructure Providers in the Process of Sustainable Urban Utility Infrastructure Provision

In the process sustainable urban utility infrastructure in the city the municipality/city administration should know all the basic information about the city's utility infrastructure system. In addition to this, the municipality/city administration needs to set the standard of utilities spacing and the required space for each utility in different hierarchy of streets.

Furthermore, the municipality need to have the role of monitoring and controlling the utility infrastructure provision, guiding urban utility infrastructure networking system, coordinating utility infrastructure providing institutions and safeguarding the utilities and its infrastructure.

While the city utility infrastructure providing institutions will have the role of standardized installation of utility mains, protecting the wellbeing of utilities, providing accurate utility data for planners and decision makers, creating coordination with other utility authorities and the municipality, and updating utilities information.

On the other hand municipalities and utility authorities may need to transfer the utility infrastructure provision process to the other department/organization. Such organizations may have the role of coordination and integration of the city utility infrastructure provision process (planning, provision, management and maintenance). Therefore the department/organization might have the following responsibilities: utility data collection, processing and storing; made linkage utilities with urban land development, promoting the use of digital mapping technology, introducing a single information system among the partners and harmonizing the different standards and guidelines into comprehensive regulatory tools.

Table 4.6: Institutionally suggested roles and responsibilities of the city administration and its utility infrastructure providing institutions.

The city's utility infrastructure provision problem mitigation measures	
Prioritized roles and responsibilities of the city administration	Prioritized roles and responsibilities of the city utility infrastructure providing institutions
▼ Planning, monitoring and controlling of the utility infrastructure provision process. ▼ Executing institutional coordination ▼ Playing the leadership role ▼ Preparation of utility infrastructure provision standard	▼ Responsibly participating in the process ▼ Providing the city's utility infrastructure based on the city administration rules and regulations. ▼ Earlier announcement of individual authorities strategy to the municipality/city administration

Source: interviewed (on December, 2011) results of Bair Dar city utility infrastructure providing institutions and the city administration.

Furthermore, some of these institutions perceived the problem as so critical and they suggested the need of an independent institution from federal to local levels. So the monitoring and controlling of the overall urban utility infrastructure provision will be the role of this decentralized institution.

4.5. The Importance of the Problem for Municipalities, Utility Providing Institutions and Policy Makers

This study provided an imporatnt study results for policy makers, municipalities, utility authorities as well as professionals within the area of study.

For municipalities and utility institutions the study will provide the following benefits: for ease of common issue identification, promotes institutional coordination along with sustainableurban utility infrastructure provision, helps to reduce continuously relocation of utilities, the ease provision of utiltiy infrastructure, the simplicity of utilities adimanstration, the efficient use of resources.

On the other the policy makers could gain the following advantages: it will initiate an integrated utility infrastructure provision policy making, the result will used an input in the process of policy making on the other hand the poicy makers could gain a lot from the practical policy making experiences and recommendation results.

Besides to this; municipalities, utility authorities, policy makers and professionals could use the documant as an input for farther discussion, application and investigations. At the end the outcome of valid study result need to locate differnet utiltiy infrastructures in a sustainable way, provide quality of utiltiy facilities and services, reduce damage of properties and loss of resources.

In general the study could have financial/economical, quality of services and planning and institutional related benefits for municipalities, utility authorities and policy makers. Some of these benefits are:

1. It advances the efficiency of urban utility infrastructure provision through

- Joint planning and capital expenditure system
- Reduction in const of compensation and reinstatement
- Reduces incorrectly underground utilities search excavation

- Reduces intra-sectoral as well as land use conflicts
- Reduces outdoor wasting of working hours
- Improves the overall utilities networking, management and controlling system
- Reduces the time requirement for utility infrastructures design preparation

2. Improves the standard of urban utility infrastructure provision in terms of

- Utilities planning(alignment, location, spacing, depth and compatibility)
- Use of appropriate technology
- Well planed urban utility infrastructure provision
- Management performance
- Utility services and facilities to users
- Time spent for utility infrastructure installation and location
- Separately allocation of utilities from other land use functions

3. For comprehensive urban utility infrastructure provision through

- The use of an integrated utility infrastructure planning, provision and management techniques
- An inclusive urban utility infrastructure provision system
- The use of common standards and data integration techniques
- Access of reliable utility data/information

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

Utility refers to the set of 'technological system' which supports the easy movement of energy, water, waste and information and it is commonly named as public utility. Basically an integration of public utilities allows for more effective and efficient use of resources.

The study considered the problem of Ethiopian urban centres electric power, water supply, storm water drainage and telecommunication utility infrastructure provision. Here the phrase utility infrastructure provision is used to show the overall process of utility infrastructure planning, installation, management and maintenance aspects.

The work of Ethiopian urban centres utility infrastructure provision is well characterized by various defects. Which is resulted from process based defects, lack of integrated urban utility infrastructure policy, institutional, planning and technological related problems.

The process based defect is caused due to the inconsistency of utilities administration, decision making procedures, and unclear intra-sectoral roles and responsibilities. All such limitations effected on incompatibility of utilities and administrative functions, gap among utilities and urban land development, inconsistency in land use and utility infrastructure planning, and contradiction among utilities. Though, the problem principally defined in terms of the planning and institutional dimensions.

The planning dimension of the problem is illustrated as the usual work land use and utilities planning and plan realization. As though the land use plan of Bahir Dar city is revised about seven times, these plan were failed to realize in to the ground and most old and lately squatting neighbourhood areas of the city have been perpetuated spontaneously without proper intervention by these plan. Hence

development of the city greatly impacted by the implementation problem of these plans and incompatibly provision of utilities.

On the other hand inter and intra-sectoral relationship analysis reveals the institutional dimension of the problem. The lack of comprehensive city planning, an overlap of utilities, damage of public property, weak institutional coordination, inefficient use of public resources, high cost of compensation, procedural problems and inconsistency of performances are summarized as the most important planning and institutional dimensions of urban utility infrastructure provision problem.

As though the efficiency of the city development is very much distressed by the spread out of the power towers, improperly location of power substations, haphazardly location of utility poles, an overlap of utilities, and high cost of compensation. The provision of urban utility particularly in the informal and unplanned area is not guided either by modern urban development plans or not sustained by intra-sectoral coordination. Besides to this each utility authority proceeds as if it desires.

While the summary of the cause-effect relationship of the problem reveals the potential causes and associated effects of the problem. Consequently it provides an important study results to utility service providers, policy makers and professionals.

In broad the lack of a single formalized decision making system, procedure and common standard highly affects the work of municipalities, public properties, the quality and sustainability of utilities. Basically this may not be the fault of the local utility authorities but it may also be the fault of the city administration and the general institutional setup of urban utility infrastructure provision and land use planning systems in the national and regional levels of the country.

5.2.Recommendation

5.2.1. Introduction

In Ethiopia the process of intra-sectoral linkage between urban utility infrastructure providers and urban development partners is very much lower than what to be done. Consequently, this is time to explore more structured and harmonised planning and institutionalized solutions to the problem.

Thus this section suggested alternative solutions for the problem of urban utility infrastructure provision in the country. The policy, institutional, planning and technological constituents are the main dimensions of the recommendation to the problem.

5.2.2. General suggestion

This section argues that urban utility infrastructures are too important to be planned and managed in a sustainable way as importantly as their symbiotic roles in economical and social development as well as physical restructuring of urban areas. This emphasizes the importance of cross-cutting and integrated urban land and utility infrastructure development strategies. Besides to this the issue requires the concern of policy makers in respect to the formulation of a single formalized and comprehensive decision making procedures.

The alternative problem resolving options is better to focus on proactive urban utility infrastructure and urban development measures. While the policy makers need to have a clear understanding in the dynamic linkage among urban utilities, and utilities with urban land use.

Using a sound land use and utility infrastructure planning and plan implementation and intra-sectoral coordination municipalities and utility authorities should do a lot to maximize the planning, institutional, financial and quality of services related benefits. The joint performances need be applied within the overall process of utility infrastructure provision and urban development program.

For the rationality of harmonized urban utility infrastructure provision and urban land development policy, institutional, planning and technological issue are summarized as key constituents of the recommendation.

I. First of all policy makers need to formulate an integrated urban utility infrastructure policy. Consequently the formulation of the policy will be central to the solution. The policy should account the following points:

- Well thought political attention for the problem of urban utility infrastructure provision in the country
- The economic, social and spatial role of sustainable urban utility infrastructure provision
- The need of common legislative tools among utility authorities and municipalities.
- The impact of urban planning and plan implementation on sustainable urban utility infrastructure provision.
- The comprehensiveness of the policy and well consideration of the existing institutional setup.
- The compatibility of the policy across institutions and the importance of a single information based permitting system across the partners
- The importance of intra-sectoral and functional integrity and harmonization of standards and guidelines.
- The need of an independent and comprehensive urban utility infrastructure and land use planning organization/institution or department.
- The choice of the organization/department may be the operational urban planning institute or an exclusively decentralized new organization so as to take care of the overall integrated land use and utility infrastructure planning activities. The authorized organization/institution must be financed either jointly by the partners or by the federal and regional governments.

II. There must be strong institutional coordination among the partners. The coordination need to consider the following issues:

- An improvement of efficient use of resource and data standardization
- Development of joint utility infrastructure and land use development strategy
- Having common objectives
- Improvement of urban land and utility infrastructure management system through an establishment of scientific data base, sound investment on utilities and technologies.
- Updating of utilities information through asset management, service extension, systematic operation and maintenance of utilities.
- Municipalities and utility authorities should work together with respect to their roles and responsibilities to provide an integrated and efficient urban utility infrastructure services.
- Use multidisciplinary staff to prepare an integrated utility infrastructure and land use plan. The staff should encompass surveyors, urban planners, electrical engineers, civil engineers, urban designers, water engineers, sociologists, economists and other relevant professionals.

III. The planning dimensions of urban utility infrastructure provision problem must be addressed as the other constituents. Here the considerable points are depicted as follow:

- Utility partners must have suitable base map, regularly registered and stored utilities and land use information. Thus, it is so worth full to have strong link between the land use planning and utility mapping.
- On the other hand it is so vital to have common physical planning standards among the partners.
- The importance of comprehensive planning and digital mapping techniques is should be taken in to consideration.
- The independent organization should collect, store, process utility and land use data so as to prepare the comprehensive plane.

- The general standardized location/arrangement of utility mains/lines has to be accounted on the other hand the minimum recommended lateral clearance distances between adjacent utilities should be specified.

- The side of the streets is recommended to have sufficient width to allow space for all relevant utility infrastructure, landscape elements, indented parking spaces, future carriageway widening and cycle paths.

- The street side utilities are advised to install before the development of the area. If so this will reduce unnecessary expenses and utilities disruption

- The scale of the maps needs to be agreed among the partners and it is commonly recommended to use large scale (1:500 to 1:2500 scales) maps.

- The final map of utilities and land use plan should account the geographical coordinate system, unique colour for each utility line, utilities main, land marks, location of utilities, the northing direction, scale of maps and other relevant information.

IV. Computerized digital mapping system must be employed as the essential components of urban utility infrastructure provision. The considerable points are illustrated as follow:

- The wider-ranging contribution of GIS and other computerized technologies for urban utility infrastructure provision.

- The adaption/use of GIS technology must be applied with the interest of individual authorities' (the behaviour of individual utilities').

- The utility and land use authorities should realize GIS as an effective tool for utility and land use planning and management system.

- A t first a pilot GIS technology based urban utility infrastructure project should be tested in a certain urban localities.

- All the geo-referenced utility maps should realize in to the ground with the help of total-station, accurate GPS and other instruments

Declaration

This thesis is my original work and has not been presented for a degree in any other university, and that all sources of material used for the thesis have been duly acknowledged.

Yirsaw Zegeye

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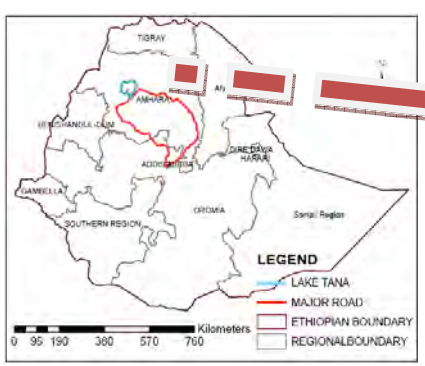
Annexes:

Figure A: Location Map of Bahir Dar City



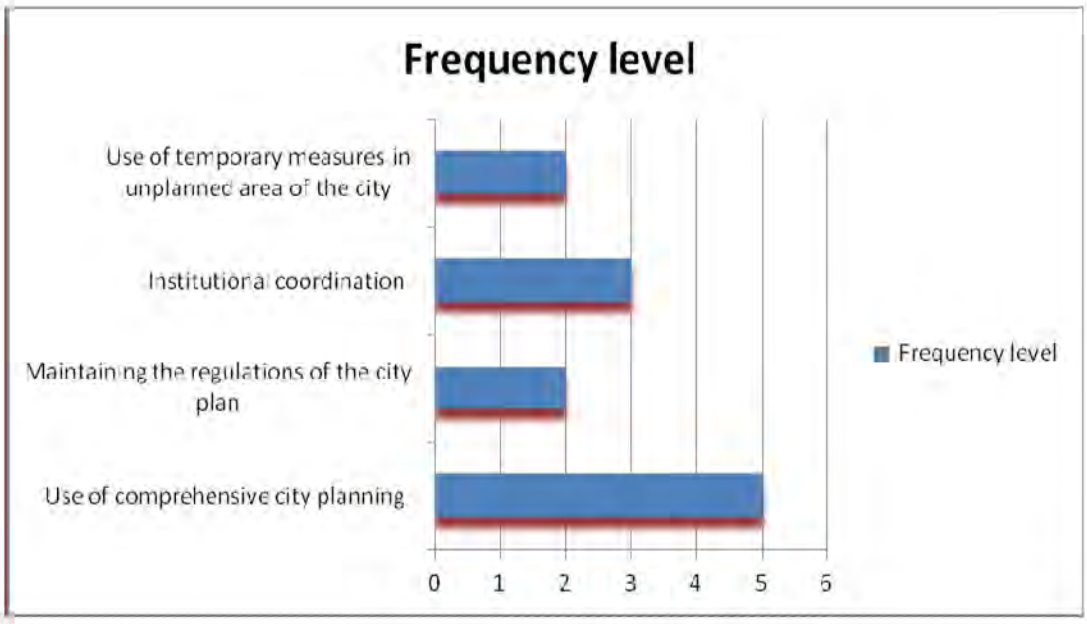
Location of Amhara Region with in Ethiopia

Location of Bahir Dar City with in Amhara region

Bahir Dar City

Source: The above two maps taken from Ethio-GI S while the Bahir Dar City map taken from Google

Figure B: Summary of Respondents' recommended solutions to reduce the city's utility infrastructure provision problem.



Source: an interviewed (on December 2011) result of Bahir Dar city utility infrastructures providing authorities and the city administration

1. Alternative Urban Utility Infrastructure Design Arrangement

Table A: Optional urban utility infrastructure design arrangement criteria in different hierarchy of streets.

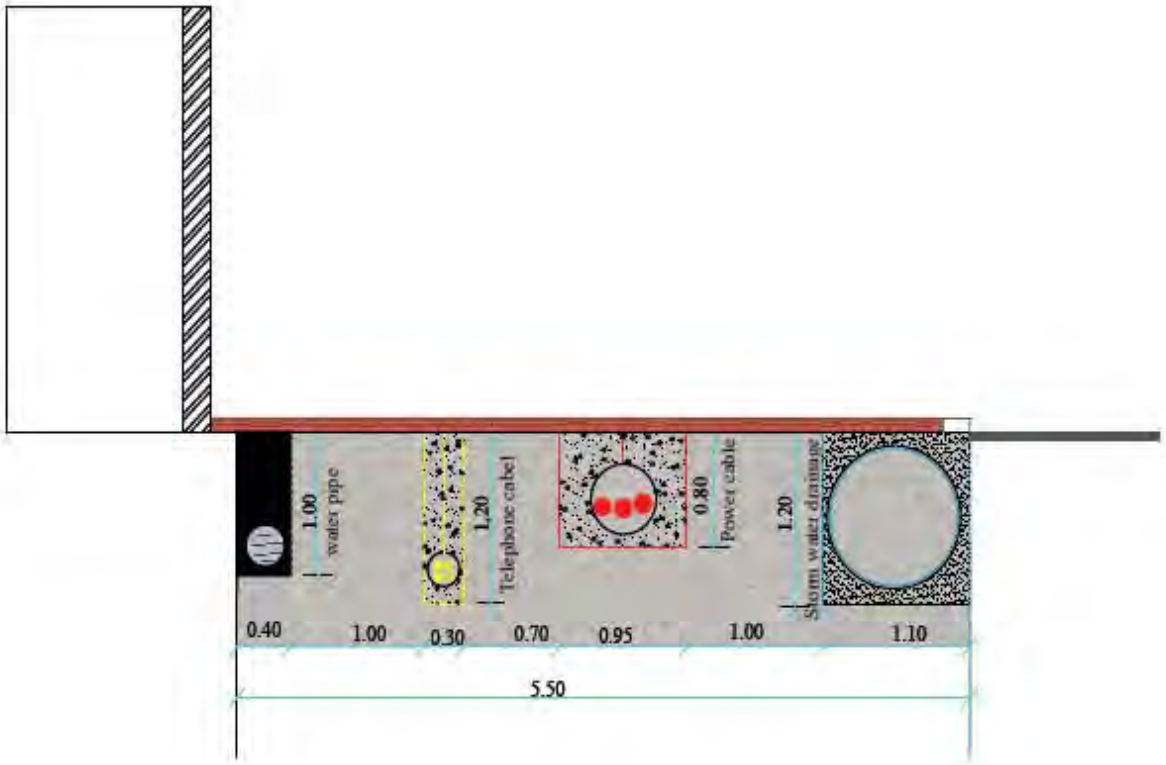
No.	Width of streets in meters	Shared width in meters		Each utilities center line location (Distance from the center of the street per depth of utility line) in meters.			
		Spacing for vehicles + median	Space for greenery & utilities in meters (along with walkways)	Drainage	Electric (overhead or underground)	Telephone(overhead or underground)	Water supply
1	**Arterial street:**						
	40	26+3=29	5.5 on both sides for utilities	15.05/1.2	17.10/0.80	18.45/1.20	19.80/1.00
	30	15.5 + 2.5=18	6 on both sides for greenery & utilities	9.50/1.10	12.475/0.80	13.75/1.20	14.85/1.0
	25	12 +3=15	5 on both sides for greenery & utilities	7.9/0.90	10.30/1.20	11.35/0.80	12.4/0.80
2	**Collector streets:**						

	20	10.5 +1.5=12	4 on both sides for greenery & utilities	6.35/0.60	7.975/1.20	8.95/0.80	9.90/0.80
	15	7 + 0=7	4 on both sides for greenery & utilities	3.80/0.50	5.375/1.20	6.40/0.80	7.35/0.70
3	**Local street :**						
	12	5.2 +0=5.2	3.4 on both sides only for utilities	2.85/0.40	4.25/0.9	5.10/0.70	5.92/0.70
	10	4 + 0=4	3 on both sides only for utilities	2.20/0.30	3.50/0.80	4.28/0.60	4.98/0.60
	8	3 + 0=3	2 .5 on both sides only for utilities	1.63/0.30	2.66/0.60	3.31/0.50	3.98/0.40

Note: In the centre of the median there is a possibility to install lengthen and large diameter water pipe lines.

Source: Self summary (on 2012) with the consideration of the Ethiopian Ministry of Construction and Urban Development and respective interviewed institutions urban utility infrastructure provision standards/criteria.

Figure C: The sample underground utility infrastructure design arrangement in 5.5 meter utilities and foot path spacing on each sides of 40 meter right of way width Streets (done based on table A :).



Source: Done on the bases of table A:

2. Questionnaires:

Questionnaires To: _____

Bahir Dar City

Instruction: please tick or give reliable answers for each questions presented as below.

Address: Keble _____

Sex & age: male _____ female _____ age _____

Profession: _____Diploma ____B.Sc./BA ____M.Sc./MA _____Other _____

You are working as: _____

Interview questions for water supply services provider:

1. The strategic water supply planning period or plan revision period of the service: _____years.

Why the planning period happen ___ years?

_____

_____

2. What are the major problems of the agency in the last five years, in the process of utility facility planning, provision and management (give the problems as ranking order of 1st, 2nd and 3rd)? _____

_____

_____

- What measures have been taken by the agency to solve these problems?

_____

_____

3. How do you express the existing problems and the relations between utility infrastructure (drainage, electric, water supply and telephone) providers and the municipality? _____

_____

_____

- What is the agency's suggestion to solve these utility infrastructure provision problems particularly in squatter settlement/unplanned urban area (with justification)?

_____

_____

- What will be the role of municipality's and the agency's in the process of alleviating these problems?

Role of municipality's:_____

_____

Role of your agency's:_____

_____

4. About utility map:

- Source: _____
- Who are your utility map planers/designers (Organization and Professional back ground): _____?
- Is the agency utility map prepared by digital mapping techniques?

a) yes ____ b) no ____

(If no, how do you prepare, _____)

- What soft ware does the agency used for the preparation/updating the map? _____
- Standard scale of the map: _____why the agency preferred to use this scale?

_____

5. The main cause for the shifting of water supply lines?

_____

_____

6. Does the agency have different standards to follow to design/plan and to install the facility (minimum distance from other utility facilities, construction, landscape elements, etc)?

   a) yes _____ b) no ____

- If yes**,** what standard did the agency use (designing, planning, installation)?

_____

_____

7. Is there specific proclamation for your agency on this utility facility provision?

   a) Yes _____ b) no _____

8. Do you know the general utility infrastructure provision standard of ORAAMP/urban planning? a) yes _____ b) no _____

- If yes, how do you evaluate it? OR let I give/tell you this standard, and then please tell me your evaluation? _____

_____

_____

9. Have you seen (do you know) other countries which have best practices in urban utility infrastructure provision? a) yes _____ b) no _____

- If yes, mention the name of the countries? _____

Why do you attracted?_____

_____

10. Is there institutional collaboration or dialogue experience between these agencies in utility infrastructure provision? a) Yes _____ b) no _____. If the answer is yes

- Who are the participants (agencies, administrative staffs, professionals)?

_____

- What issues raised? _____
- How do you see the importance of such collaboration or dialogue?

_____

Interview questions for drainage service provider:

1. The strategic drainage of surface water planning period or plan revision period of the service: _____years.

Why the planning period happen ___ years? _____

_____

2. What are the major problems of the agency in the last five years, in the process of utility facility planning, provision and management (give the problems as ranking order of 1st, 2nd and 3rd)? _____

_____

- What measures have been taken by the agency to solve these problems?

_____
_____

3. How do you express the existing problems and the relations between utility infrastructure (drainage, electric, water supply and telephone) providers and the municipality? _____

_____
_____

- What is the agency's suggestion to solve these utility infrastructure provision problems particularly in squatter settlement/unplanned urban area (with justification)?

_____
_____

- What will be the role of municipality's and the agency's in the process of alleviating these problems?

Role of municipality's:_____

_____

Role of your agency's:_____

_____

4. About utility map:

- Source: _____
- Who are your utility map planers/designers (Organization and Professional back ground): _____?
- Is the agency utility map prepared by digital mapping techniques?

a) yes ____ b) no ____ (If no, how do you prepare_____)

- What soft ware does the agency used for the preparation/updating of the map? _____

- Standard scale of the map: _____why the agency preferred to use this scale?

_____

5. The main cause for the shifting of drainage lines?

_____

_____

6. Does the agency have different standards to follow to design/plan and to install the facility (minimum distance from other utility facilities, construction, landscape elements, etc)?

   b) yes b) no

- If yes, what standard did you use (designing, planning, installation)?

_____

_____

7. Is there specific proclamation for your agency on utility facility provision?

   a) Yes b) no

8. Do you know the general utility infrastructure provision standard of ORAAMP/urban planning? a) yes _____ b) no _____

- If yes, how do you evaluate it? OR let I give/tell you this standard, and then please tell me your evaluation?

_____

_____

_____

9. Have you seen (do you know) other countries which have best practices in urban utility infrastructure provision? a) yes _____ b) no _____

- If yes, mention the name of the countries? _____

Why do you attracted?

_____

_____

10. Is there institutional collaboration or dialogue experience between these agencies in utility infrastructure provision? a) Yes _____ b) no _____. If the answer is yes

- Who are the participants (agencies, administrative staffs, professionals)?

_____

- What issues raised? _____
- How do you see the importance of such collaboration or dialogue?

_____

Interview questions for electricity services provider:

1. The strategic electricity distribution system planning period or plan revision period of the service: _____years.

Why the planning period happen ___ years? _____

_____

2. What are the major problems of the agency in the last five years, in the process of utility facility planning, provision and management (give the problems as ranking order of 1st, 2nd and 3rd)?_____

_____
_____

- What measures have been taken by the agency to solve these problems?
_____
_____

3. How do you express the existing problems and the relations between utility infrastructure (drainage, electric, water supply and telephone) providers and the municipality?
_____
_____
_____

- What is the agency's suggestion to solve these utility infrastructure provision problems particularly in squatter settlement/unplanned urban area (with justification)?
_____
_____
_____

- What will be the role of municipality's and the agency's in the process of alleviating these problems?

Role of municipality's:_____

_____

Role of your agency's:_____

_____

4. About utility map:

- Source: _____
- Who are your utility map planers/designers (Organization and Professional back ground):
_____?
- Is the agency utility map prepared by digital mapping techniques? a) yes __ b) no __

(If no, how do you prepare, _____)

- What soft ware does the agency used for the preparation/updating of the map? _____

- Standard scale of the map: _____why the agency preferred to use this scale?

_____

5. The main cause for the shifting of electric poles?

_____

_____

6. Does the agency have different standards to follow to design/plan and to install the facility (minimum distance from other utility facilities, construction, landscape elements, etc)?

c) yes _____ b) no _____

- If yes, what standard did you use (designing, planning, installation)?

_____

_____

7. Is there specific proclamation for your agency on utility facility provision?

a) Yes _____ b) no _____

8. Do you know the general utility infrastructure provision standard of ORAAMP/urban planning? a) yes _____ b) no _____

- If yes, how do you evaluate it? OR let I give/tell you this standard, and then please tell me your evaluation?

_____

_____

9. Have you seen (do you know) other countries which have best practices in urban utility infrastructure provision? a) yes _____ b) no _____

- If yes, mention the name of the countries? _____

Why do you attracted?_____

_____

10. Future plan of the agency to use other technology (underground based electric power provision)

- The reason to need to shift _____
- How it works? _____

11. Is there institutional collaboration or dialogue experience between these agencies in utility infrastructure provision? a) Yes _____ b) no _____. If the answer is yes

- Who are the participants (agencies, administrative staffs, professionals)?

_____

- What issues raised? _____
- How do you see the importance of such collaboration or dialogue?

_____

Interview questions for telephone services provider:

1. The strategic telephone services planning period or plan revision period of the srvice: _____years.

Why the planning period happen ___ years? _____

_____

2. What are the major problems of the agency in the last five years, in the process of utility facility planning, provision and management (give the problems as ranking order of 1st, 2nd and 3rd)?

_____

_____

- What measures have been taken by the agency to solve these problems?

_____

_____

3. How do you express the existing problems and the relations between utility infrastructure (drainage, electric, water supply and telephone) providers and the municipality?_____

_____

_____

- What is the agency's suggestion to solve these utility infrastructure provision problems particularly in squatter settlement/unplanned urban area (with justification)?

_____

_____

_____

- What will be the role of municipality's and the agency's in the process of alleviating these problems?

Role of municipality's:_____

_____

Role of your agency's:_____

_____

4. About utility map:

- Source: _____
- Who are your utility map planers/designers (Organization and Professional back ground):

_____?

- Is the agency utility map prepared by digital mapping techniques? a) yes ___b) no ____

(If no, how do you prepare, _____)

- What soft ware does the agency used for the preparation/updating of the map? _____

- Standard scale of the map: _____why the agency preferred to use this scale?

_____

5. The main cause for the shifting of telephone poles?

_____

_____

6. Does the agency have different standards to follow to design/plan and to install the facility (minimum distance from other utility facilities, construction, landscape elements, etc)?

   d) yes _____ b) no _____

- If yes**,** what standard did you use (designing, planning, installation)?

_____

_____

7. Is there specific proclamation for your agency on utility facility provision?

   a) Yes _____ b) no _____

8. Do you know the general utility infrastructure provision standard of ORAAMP/urban planning? a) yes _____ b) no _____

- If yes, how do you evaluate it? OR let I give/tell you this standard, and then please tell me your evaluation?

_____

_____

9. Have you seen (do you know) other countries which have best practices in urban utility infrastructure provision? a) yes _____ b) no _____

- If yes, mention the name of the countries? _____

Why do you attracted?_____

_____

10. Future plan of the agency to use/shift to other technology (underground based telephone facilities provision)

- The reason to need to shift _____
- How it works? _____

11. Is there institutional collaboration or dialogue experience between these agencies in utility infrastructure provision? a) Yes _____ b) no _____. If the answer is yes

- Who are the participants (agencies, administrative staffs, professionals)?

_____

- What issues raised? _____
- How do you see the importance of such collaboration or dialogue?

_____

- Interview questions for Bahir Dar city administration:

1. Do the municipality prepare different strategic municipal utility infrastructure plan for:

No:	Utilities	Yes or no answer		If yes, for how many years? ____ Why?
		Yes	No	
1	Water supply distribution?			_____,
2	Drainage (surface water)?			_____,
3	Electricity transmission and distributions?			_____,
4	Telephone distribution?			_____,

2. What are the major problems the municipality faces in the last five years, in the process of utility facility planning, provision and management (give the problems as ranking order of 1st, 2nd and 3rd)?

   _____
   _____
   _____

   - What measures have been taken by the municipality to solve these problems?

     _____
     _____
     _____

3. How the municipality express the existing problems and the relation between utility infrastructure (drainage, electric, water supply and telephone) providers and the municipality?

   _____
   _____
   _____

- What is the municipality's suggestion to solve these utility infrastructure provision problems particularly in squatter settlement/unplanned urban area (with reasoning)?

  _____
  _____
  _____

- What will be the role of municipality's and utility infrastructure providing agencies' in the process of alleviating these problems?

  Role of municipality's:

  _____

  _____

  Role of agencies': _____

  _____

4. What is the main reason for shifting of utility poles or water pipe/drainage lines?

   _____
   _____
   _____

5. Does the municipality have different standards to follow the installation of different utility infrastructures?

   e) yes _____ b) no _____

- If yes**,** what standard do you use?

_____
_____

6. What is the criterion of the municipality to give or not give compensation fee for relocation of utility infrastructure facilities?

_____
_____
_____

7. Does the municipality have specific proclamation for utility infrastructure provision?

   a) Yes _____ b) no _____

8. Do you know the general utility infrastructure provision standard of ORAAMP/urban planning? a) yes _____ b) no _____

- If yes, how do you evaluate it? OR let I give/tell you this standard, then please tell me your evaluation?

_____
_____
_____

9. Have you seen (do you know) other countries which have best practices in urban utility infrastructure provision? a) yes _____ b) no _____

- If yes, mansion the name of the countries? _____

  Why do you attracted?

_____
_____

10. Is there institutional collaboration or dialogue experience between these agencies in utility infrastructure provision? a) Yes _____ b) no _____. If the answer is yes

- Who are the participants (agencies, administrative staffs, professionals)?

_____

- What issues raised? _____
- How do you see the importance of such collaboration or dialogue?

_____

- Questionnaire for Bahir Dar city administration

1. Amount of compensation fees given for utility infrastructure providers in the last five years

Year (in Ethiopian calendar)	**Compensation fee in Eth. Birr for**		
	Fees for electric pole or line relocation	Fees for telephone pole or line relocation	Fees for water supply line relocation
1999			
2000			
2001			
2002			
2003			
Total quantity in birr			

3. Check List for Field survey:

- Improper installed utilities(water supply, drainage system, electricity & telephone lines/poles)
- Squatter settlement versus utility infrastructure installation
- Power substations and power towers
- Damaged paved street for water distribution & drainage
- Areas which has better utility infrastructure installation system
- Areas which is affected by lack of drainage & other utility facilities
- Improperly located utility poles and water pipes
- Surface water problematic area
- The effect of storm water drainage on other utility infrastructure
- The effect of utility infrastructure in urban land use
- The effect of utility infrastructure installation in the efficient urban land use.
- Drainage line sketching to prepare the digital superimpose utilities map