A Comparison of Wash Area and Soak Pit Construction: The Changing Nature of Urban, Rural, and Peri-Urban Linkages in Sikasso, Mali

By

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This report “A Comparison of Wash Area and Soak Pit Construction: The Changing Nature of Urban, Rural, and Peri-Urban Linkages in Sikasso, Mali” is hereby approved in partial fulfillment of the requirements for the Degree of MASTER OF SCIENCE IN ENVIRONMENTAL ENGINEERING.

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Preface

This report is based on the 26 months I spent living in Mali, West Africa while serving as a Peace Corps Volunteer during August 2002 through October 2004. I worked as a water sanitation engineer in the city of Sikasso, the capital of the southern region of Sikasso.

This report is submitted to complete my master's degree in Environmental Engineering from the Master's International Program in Civil and Environmental Engineering at Michigan Technological University. It centers on the sanitation work I completed within Sikasso, near Sikasso, and the times I had the honor to get out of the city. Moreover, this report explains my experiences with the construction of wash areas and soak pits over a variety of constraints.

Table of Contents

List of Figures

List of Tables

Acknowledgements

I would like to dedicate this report to Andre and Victoria Togo, my closest and most wonderful friends in Mali, without whose support and patience, I might never have stayed the entire two years in Peace Corps and learned as much as I did.

Also, I will never forget my incredible and brave husband, Jeff, who was just as crazy as I was to go to Mali. Had it not been for Jeff and his presence, I would not have been taken seriously enough to do any work over there whatsoever.

Dr. James R. Mihelcic, my advisor in more ways than one, I will be forever indebted. He kept me calm, helped me find ways to deal when frustration reached its peak, and always reminded me that there's a need for creative engineers in the developing world. I would also like to thank Peg Gale, Alex Mayer, and Tom Van Dam, my graduate committee, for their support of the Master's International Program and for their contact throughout my three years involvement with Michigan Technological University. In addition, I would like to thank the National Science Foundation's GK-12 Program with local schools that funded my time at Michigan Technological University.

Last, but most definitely not least, I must thank all the friends and family who sent letters and packages (with cookies!) and gave Jeff and I support while we were in Mali. Those are the people that pulled me through the tough, "I want to go home," days. And I am very glad that I stayed. Ala ka here to an fe.

Abstract

Mali is a developing country with large water supply and sanitation needs and constraints. My Peace Corps service from August 2002 through October 2004 focused on improving the health of Malians through improved sanitation with the construction of wash areas and soak pits and hygiene education.

While living in Sikasso amongst its 150,000 residents, I learned how cultural and non-technical constraints affected sanitation improvements. Wash area and soak pit project implementation may involve a variety of people and factors, each influenced by their geographic locations: urban, rural, or peri-urban. By having the opportunity to work at all three locations with residents, government workers, business owners, women, and youth, the implementation differences became apparent. These locations have different geographic, socio-economic, organizational, and political factors that contribute to the policy makers, private sector, and beneficiary roles.

In this report, the relationship between geographic location, project implementation process, and ten factors were analyzed. In the urban case study, major influential factors included the presence of aid money, education, and concentration of pollution. The greater part of the urban project is carried out by the policy makers, indicating a "top-down" approach to development. In the rural case study, the major influential factors were the presence of aid money, decentralization, and the mobility of people. In contrast, the beneficiaries take the larger role of project facilitation in a more "bottom-up" method. Like the rural setting, the peri-urban case study also indicated a "bottom-up" approach to work affected by factors, such as ownership of property, the standards and costs of living, and education. In addition to policy makers, private sector, and beneficiary roles and relationships, manual of practice and funding is also discussed in the context of implementation of sanitation engineering projects.

1.0 Introduction and Objectives

Urbanization can be an important source of health problems. Thirty to sixty percent of the urban population lack adequate housing with sanitary facilities, drainage systems, and piping for clean water.

UNEP, 2000

This chapter provides the objectives of study and an explanation of my stimulus to further study and explain the differences between urban, peri-urban, and rural areas of the third world in the realm of water supply and sanitation.

1.1 Background and Motivation

Many people in the world, and especially those in developing countries, have water but still die because of its poor quality or the irregular quantity available to them (Pickford, 1991). The thought of people with water, yet poor access, quality, or quantity, is one of the reasons that motivated me to do water sanitation work with the Peace Corps in Mali, West Africa. As I was trained in the water sanitation sector during the fall of 2002, I studied practical solutions to rural problems. After preparing for my own two years in a village, I ended up in the second largest city working with a government office. I quickly learned in my "village" of 150,000 people that the water and sanitation situation is different than the rural situation I had expected, and to say the least, vast.

When Peace Corps placed me in Sikasso, capital of the third region in Mali, I was amazed to see how many families and concessions (walled group of houses and/or several families) did not take advantage of easier access to improved water and sanitation. Everyone, including Peace Corps staff, told me, "Oh, you're in Sikasso. You'll have tap water and electricity there. Everyone does." Well, they do not, and in many cases, they cannot afford it. In Sikasso, I lived in a representative Malian house and used a latrine and a well for water like all the residents on my street (see Figures 1 and 2). Through my experiences in Mali, I've noticed that access often exists; the means

Figure 1: My House and Latrine in Ouayerma Extension, Sikasso

Figure 2: My Concession's Well in Ouayerma, Sikasso

however, often do not. Therefore, urban dwellers are frequently forced into an extremely concentrated water and sanitation problem, pressured by urbanization. I became quickly discouraged with the nature of my situation, and became aware that I lived in a peri-urban area, which could not be defined or explained by either urban or rural, but a combination of the two. In addition, rural volunteers tend to have access to cheap materials and groups of people willing to work together to find solutions; urban volunteers face a clash between the public and private sectors, no one feeling responsible for improvements, and having to pay for every material, down to the last stone in concrete. After research, probing, and making contacts to find solutions to urban and peri-urban sanitation problems, I found I was not the only one attempting to do urban and peri-urban development work with rural training. It was apparent that urban water and sanitation, and especially peri-urban, are somewhat new and dynamic sectors in the developing world.

Many development projects in the realm of water and sanitation focus on the rural areas, which have less access to improved water supply than urban areas. Yet it does not necessarily mean that those living in urban or peri-urban areas actually have improved and safe water supplies. Believing that living in an urbanized area means you have, what we consider in America, baseline necessities, is a common myth. Many people cannot afford or are not connected to clean water facilities and continue to use untreated well water. Some do not even have proper evacuation of gray water and rainwater, creating frequent standing water and mosquito problems. With over a third of Mali's population located in urban areas and the constant influx of people moving into urban areas, it is important to recognize the needs for improvement and the differences in doing so. As Africa's urban populations grow by 5 – 10 percent annually – rates as fast as those anywhere in the world – so too grows the need for critical, historically informed analysis of both the emerging narratives and policies concerning the African urban environment and the concrete ways in which people experience environmental change in urban areas (Freidberg, 2001).

There are many differences between the urban, rural, and peri-urban geographic locations, and in order to deal with the sanitation problems in them, we must better understand the culture and way of life above all else. In effect, the goal is to improve training, preparation, and implementation of sanitation work. The outcome is that there is just as much water and sanitation work to be done in each of these geographic areas; there exists different politics, socio-economic, and organizational constraints to deal with. Neither situation can be misunderstood as urbanization trends pressure engineers to make quick, more informed decisions and designs to improve the world's health through water supply and sanitation.

1.2 Objectives of Study

The objectives of this report are to:

- Present a background and context into which this report fits in order to further explain the importance of urban, rural, and peri-urban understanding;
- Identify and discuss several factors influencing the differences between urban, rural, and peri-urban sanitation; and
- Illustrate the socio-economic, political, and organizational differences that affect sanitation practices in urban, rural, and peri-urban areas in Mali by presenting and discussing three case study wash area and soak pit constructions.

In order to understand the politics, socio-economics, and organization of an urban, rural, and peri-urban area, it is necessary to first understand the histories, observations, and attitudes involved. In addition, it is helpful to compare this information with case study examples in order to improve upon training and future solutions.

Chapter 2 provides the history and background information of Mali, including demographical, historical, political, and economic overviews. This section also contains information concerning the condition of water and sanitation work in Mali, as well as the

organizational context that sanitation work falls and Mali's history of access to improved water and sanitation in urban and rural areas. Finally, a summary of Peace Corps Mali's Water Sanitation Project Plan is presented.

Chapter 3 provides research and observation details, related topics, and implementation of information collection along with some clarifications of definitions of significant terms used within this report.

Chapter 4 presents ten factors of influence responsible for urban, rural, and peri-urban sanitation work differences. Also, an account of an urban vs. rural vs. peri-urban project case study is described and discussed to further explain how the factors of influence come into play in the implementation of sanitation projects.

Chapter 5 reviews the information presented and what it means to the sanitation sector. It also provides recommendations for further exploration and research of this topic.

2.0 Background of Mali and Peace Corps Project Plan

In the realm of Nature, there is nothing purposeless, trivial, or unnecessary.

Maimonides

2.1 Geographical and Environmental

The Republic of Mali (shown in Figure 3) is the largest country in West Africa, measuring over 12 million square kilometers, which covers an area greater than Texas, Oklahoma, and New Mexico combined. It is a landlocked country bounded by Algeria to the northeast, Mauritania to the northwest, Senegal to the west, Guinea to the southeast, Ivory Coast and Burkina Faso to the south, and Niger to the east.

Figure 3: Republic of Mali, West Africa Map

Source: CIA, 2004

Mali is divided into three natural climatic areas: the southern, Savannah; the central, Sahel; and the northern, Sahara Desert. The south is relatively well watered, to allow

farming without intense irrigation and, as a result, the most densely populated. The north lies within the Sahara Desert, covering over half the country's land area. Between these two areas is the semi-desert Sahel Zone, consisting of the floodplains of the Niger Delta, where rainfall can fluctuate drastically. Mali is relatively flat except for the south, where the Futa Djallon Highlands and Manding Mountains of Guinea rise to the east creating the Bandiagra Plateau and Hombori Mountains near Mopti. In addition, Mali has two major rivers, the Niger, which flows north to northeast through Mali, and the Senegal, located in the western, Kayes region.

Mali's most urgent environmental issue is desertification, with the Mopti and Gao regions being particularly affected. The causes include population pressures, poverty, and a high demand on wood for fuel and building, and overgrazing.

The rainy season begins in June and lasts until September, however, it varies between the dry north and wetter south, receiving between 200-800 mm of rainfall per year in the Sahel. The hot season begins in March and ends approximately in May, in which temperatures may frequently exceed 40°C (Fitzpatrick, et al., 1999; Fitzpatrick, et al., 2002).

2.2 Demographics: People and Culture

Mali's population is approximately 12 million people (CIA, 2004) with a population growth rate of 2.9 % (this rate would be higher if it didn't have the world's second highest infant mortality rate: 164 per 1,000 live births). There are more than 20 tribal groups in Mali, each with its distinct language, territory, and social infrastructure. The majority of these ethnic groups are Negroid, with approximately 50% of the population belonging to the Mande group, including the Bambara, Malinke, and Sarakole. Other groups include the Peul or Fula (17%), Voltaic (12%), Songhai (6%), and Tuareg and Moor (10%). Approximate locations of Mali's main ethnic groups are located in Figure 4. The majority of the population is Muslim (90%), with some following traditional African beliefs (9%), and Christianity (1%). It is common for intermarriage to occur

between ethnic groups, the common tie being Islam, however it is taboo for some groups (e.g. between Dogon and Bozo).

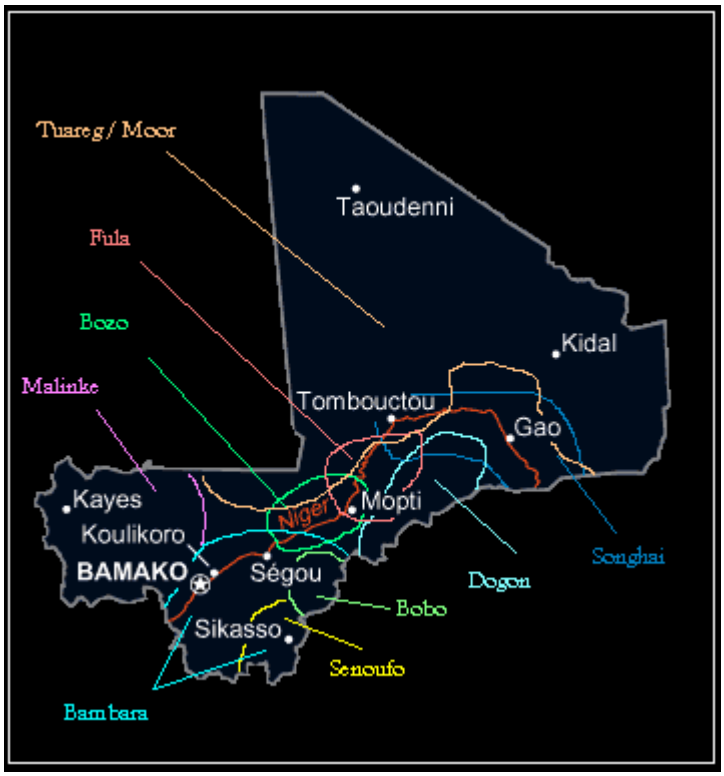

Figure 4: Approximate Location of Ethnic Groups in Mali

Source: Adapted from CIA, 2004

Approximately 80% of Malians are tied to the land (directly or indirectly), which may explain literacy rates of 50% for men and 30% for women. Most of the population lives in Mali's fertile south, while the vast Sahara and semi-desert areas (60% of Mali) contains just 10% of the population. French is the official language, but the most widely spoken language belongs to the Mande group with 60% of the population speaking Bambara. Other languages spoken in Mali include Peul, Malinke, Bobo, Songhai, Tamashek, Wolof, Senoufo, and Samago (Peace Corps Mali, 2002).

Over the centuries (until French colonialism began), many of Mali's ethnic groups created massive kingdoms, at the expense of defeat and enslaving other ethnic groups. Instead of being a source of contention between these groups, despite their roles as

former enslavers and slaves, a “cousinage” or “joking cousins” relationship exists. People from different ethnic groups will commonly tease and make jokes at ethnic stereotypes and past conduct (Fitzpatrick, et al., 2002).

2.3 History

According to archaeological evidence such as rock paintings and carvings, northern Mali has been inhabited since 50,000 BC when the Sahara Desert was fertile grassland. By 5,000 BC, farming had begun and by 500 BC, iron was being used. Within 200 years, large organized settlements had developed, such as those of Djenne in the Mopti region, so by the 6th century AD, there were secure foundations for the trade that powered Mali’s three great empires, all formed by different ethnic groups involving themselves with the trans-Saharan trade in gold, salt, and slaves. Until the 11th century, the Empire of Ghana covered much of what is now Mali and Senegal. The great Empire of Mali followed in the 14th century, which covered the Atlantic coast to modern Nigeria, and developed Timbuktu as a great center of commerce and Islamic culture. The Empire of Songhai came next, but Moroccan mercenaries destroyed it in the late 16th century. During this time, European ships were arriving on the West African coast, breaking the trans-Saharan trade routes and the monopolies of the Sahel kingdoms.

After a brief control by the Bambara Empire of Segou, Mali became a part of French West Africa in the 19th century. Remnants of this colonial era are still noticeable today (e.g. the 1,200 km Dakar-Bamako train line), however, Mali remained the poor neighbor of Senegal and the Ivory Coast as France’s chief interest was in developing Mali as a source of cheap cash crops, such as rice and cotton, for export (Peace Corps Mali, 2002; Fitzpatrick, et al., 2002).

2.4 Government and Politics

Becoming independent of France in 1960, the Sudanese Republic and Senegal became known as the Mali Federation. When Senegal withdrew after only a few months, what

formerly made up the Sudanese Republic was renamed Mali. For the next 8 years, Modibo Keita ruled an unsuccessful period of one-party state socialism, and newly formed state corporations took control of the economy. In 1968, Moussa Traore overthrew Keita with his army officers, and continued to develop Soviet-style socialism. From 1970 to 1990 five coup attempts were made against Traore, and in 1991, rule by dictatorship was ended. Mali became a transitional government that allowed a multiparty political system, resulting in the first democratic presidential election to occur the next year. Now, 147 assembly members stand for election every five years. After his reelection in 1997, President Alpha Konare continued to push through political and economic reforms and to fight corruption. In keeping with Mali's two-term constitutional limit, he stepped down in 2002 and was succeeded by Amadou Toure (Fizpatrick, et al., 2002).

2.5 Economy

Currently, Mali is among the 10 poorest countries in the world (with a per capita GDP of US $277) due to a high percentage of desert or semi-desert land area. Its economy is dominated by agriculture, which accounts for 47% of the GDP, with activity largely confined to the areas irrigated by the Niger River. Millet and rice are grown for domestic consumption while export crops are cotton and groundnuts (peanuts). Mali is now the second largest producer of cotton (40% of its exports) in Africa and vulnerable to fluctuations in world prices. During the trans-Saharan trade (shown in Figure 5), gold and salt were important trade items, and cities like Timbuktu and Djenne were large economic hubs. Gold continues to be commercially mined and economic reports indicate Mali is Africa’s third largest producer with revenues keeping the government’s finances relatively healthy. However, the nation still suffers from a negative balance of trade, effects of international debt repayments, and being heavily dependant on foreign aid. Mali has a national debt of US $3 billion, which costs the government US $64 million a year, as much as it spends on education (Fitzpatrick, et al., 2002).

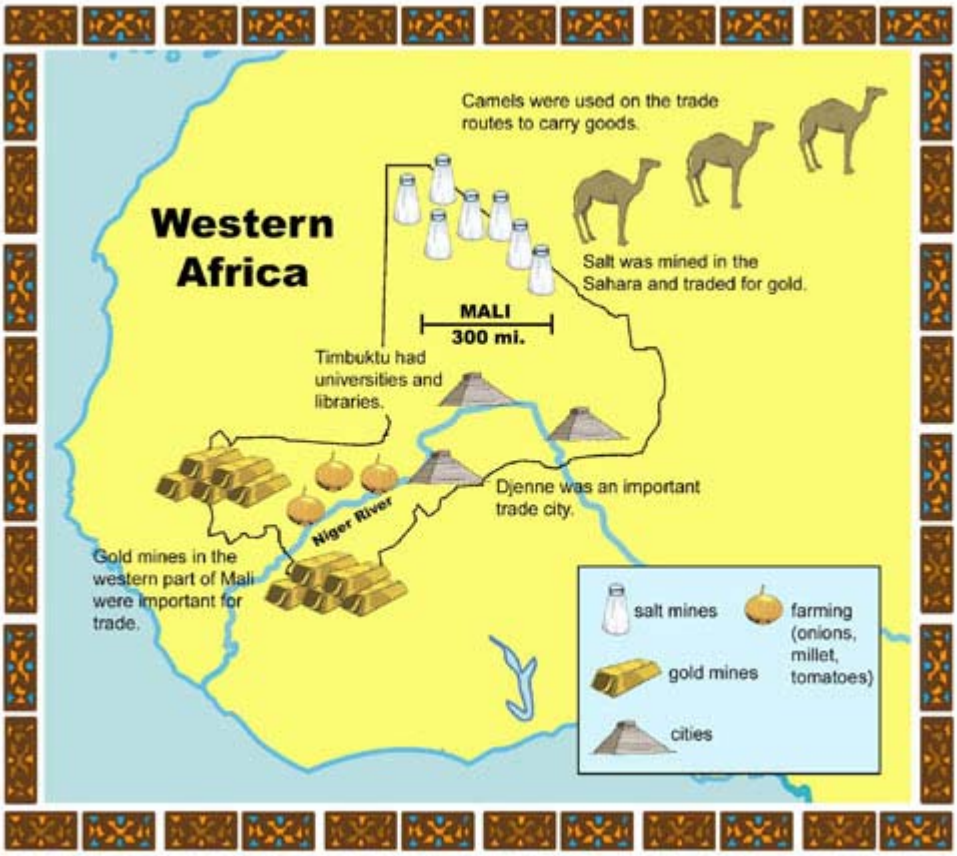

Figure 5: History of Mali's Economy

Source: Virginia Department of Education, 2002

2.6 Sanitation Organizational Context and History of Access in Mali

In Mali, there are three operational levels concerning sanitation work: the policy makers, the private sector, and the beneficiaries. In order to understand the process in which projects and sanitation and hygiene efforts are implemented, it is necessary to examine the different groups involved and their specific roles.

2.6.1 Government and Policy Makers

Within the government of the Republic of Mali two agencies exist that seek to give complete water and sanitation coverage to all citizens, urban, rural, and peri-urban. Both

the Ministry of the Environment and the Ministry of Health have responsibilities pertaining to maintenance, improvement, regulation, and evaluation of water and sanitation, the former relating more to the environment and environmental change, the latter relating more to the management of health centers and related hygiene activities. Under each Ministry, sub-agencies also exist in order to implement and be responsible for certain activities.

For example, the Ministry of the Environment manages the Office of Hydrology and Energy, the Office of Mining and Geology, and the Office of Sanitation and Pollution Control. The Ministry of Health directs Regional Offices of Health and the Socio-Sanitaire, under which the Social Service and the Hygiene and Sanitation Service operate in relation to the health centers, called CSCOMs (Centre de Sante Communitaire). Historically, the government first created the Ministry of Health to be responsible for all health, water, and sanitation-related activities, but as environmental and health issues have increased, there was a need to separate health and sanitation into two, separately organized Ministries. Separating the health work from the water and sanitation work has been very difficult, as they are very related. With the coming of more private and non-governmental organizations and decentralization of the government, competition and confusion has resulted between agencies and organizations. Currently, the Ministry of the Environment concentrates on hard technology relating to design and construction of water and sanitation infrastructure and environmental regulation, and the Ministry of Health concentrates on softer technology relating to hygiene education and water quality testing.

The roles of both Ministries includes the maintenance of existing technology and knowledge of water and sanitation as their work progresses, improvement of infrastructure and levels of education by the implementation of inter- and intra-government-funded projects, regulation of activities carried out by the private sector, and evaluation of their progress within the sector. Non-Governmental Organizations (NGOs) may also fit into the category of policy makers and have similar roles, specifically, in the implementation of education and technology-based projects.

2.6.2 The Private Sector

Governments everywhere have an increasingly large challenge in improving access to good quality, reasonably priced water and sanitation services for their citizens. According to Stottmann (2000), over one billion people are without safe water, almost two billion lack adequate sanitation, and the waste of over 4 billion is discharged with inadequate or no treatment. Whatever percentage of access to water supply or sanitation a country may have, service and maintenance are not often included. In many cases, and it applies in Mali, existing water and sanitation infrastructure needs to be either replaced or rehabilitated.

With urbanization increasing at the current rate (over the next 25 years, the world population is likely to increase 40 - 50%) an additional 2.5 billion people will need these water and sanitation services, creating a need for governments to spend up to 1% of their GDP to take on the challenge. These needs may account for government spending of US $50 billion per year, not including unaccounted for or unrecorded water losses of 40-60%, adding US $10 billion to the total figure per year. As a result, governments have priorities of reducing consumption, conserving water services, efficiency improvement to combat waste by leakage, making networks and plants work better while consuming fewer chemicals and less energy to battle the technical inefficiencies, poor management, and low productivity. With this in mind, governments are looking towards the private sector to leverage these financial and managerial capacities (Stottmann, 2000).

In general, Stottmann (2000) gives several objectives that governments look to the private sector to complete:

- Acquire technical/managerial expertise
- Better technologies to improve economic efficiency in operating performance and use of capital investment
- Inject investment capital into the sector or gain access to private capital markets

- Insulate the water supply/sanitation sector from short-term political intervention in utility operations and limit opportunities for intervention by powerful interest groups
- Turn around/restructure failing public enterprises

In many cases, the private sector may serve as a provider of theories (water and wastewater); contractor/consultant; supplier of equipment, materials, and services; manager of the operation of utilities; and in providing finance for investments. The private sector may also be responsible for all phases of water and wastewater infrastructure projects.

In Mali, the government has set up several opportunity organizations, called GIEs (Groupement d'Interet Economique), to serve as the private sector in its hope of decentralization. A citizen may decide to own a GIE, and with the correct legal proceedings (constitution, proof of objectives and goals), will be recognized by the government officially to be eligible for technical assistance from sector agencies. A GIE may be official or un-official, this decision being up to the owner, but either way, their main goal is to make money doing public service work. Most GIEs in Mali deal with sanitation work, like solid waste collection and infrastructure construction, but some GIEs exist that act as savings and loan facilities for village farmers or assist in natural resource management projects.

Also within the category of the private sector exist Non-Profit Organizations (NPOs) which may implement similar small-scale activities like GIEs. In some cases of larger projects, these NPOs can also coordinate activities along with NGOs, and therefore, may fall into the category of policy makers. Both NGOs and NPOs roles' may switch depending on the size and purpose of the project (i.e. when executing initiatives in agreement with the national government's plan, these organizations will fall into the role of policy maker, rather than private sector).

2.6.3 Beneficiaries

The beneficiaries are those that receive the benefit (American Heritage College Dictionary, 2003), and in this case, the benefit of either water supply or sanitation improvements. In Figure 6, the beneficiaries pictured received the use of a wash area and soak pit system in order to wash dishes and clothes without creating huge inundated areas in proximity to their homes. Within the water sanitation sector, beneficiaries may or may not be involved in the process of a project monetarily or physically, but they will always need to show some sort of interest or realization of a need before the project can begin. A beneficiary's main role is to act on their interest or need, and through a certain process, dependant on many factors, they will receive benefits from some sort of improvement to their quality of life.

Figure 6: Beneficiaries of a Wash Area (Ouayerma, Sikasso)

2.6.4 History of Access to Improved Water Sources and Sanitation in Mali

Since 1980, there have been several reviews of Mali's percentage of urban and rural population with access to improved drinking water and sanitation, as shown in Table 1. Through the World Health Organization and UNICEF, the history of access has been documented through different reviews, surveys, monitoring reports, and assessments, although the percentages do not show reliable trends (i.e. Mali's urban water supply reported as 55%, 100%, and 41% of the total urban population in 1987, 1990, and 1992, respectively), which could be an indicator of the dynamic population changes in the

Percent of Urban and Rural Population Having Access to Improved Water and Sanitation in Mali	Water Supply		Sanitation	
Source	**Urban**	**Rural**	**Urban**	**Rural**
The International Drinking Water Supply and Sanitation Decade. Review of National Baseline Data (as of December 1980). WHO 1984	37	0	79	0
The International Drinking Water Supply and Sanitation Decade. Review of National Progress (as of December 1983). WHO 1986	46	8	91	3
The International Drinking Water Supply and Sanitation Decade. Review of Mid-Decade Progress (as of December 1985). WHO 1987	46	10	90	3
Mali Demographic and Health Survey 1987	55	51	95	63
The International Drinking Water Supply and Sanitation Decade. Review of National Progress (as of December 1988). WHO 1990	100	36	94	5
The International Drinking Water Supply and Sanitation Decade. End of Decade Review (as of December 1990). WHO 1992	41	4	81	10
Water Supply and Sanitation Sector Monitoring Report 1993 (Sector Status as of 31 December 1991)	53	53	N/A	N/A
Water Supply and Sanitation Sector Monitoring Report 1996 (Sector Status as of 31 December 1994) WHO/UNICEF 1996	36	38	58	21
Mali Demographic and Health Survey 1995	77	57	94	60
Global Water Supply and Sanitation Assessment 2000. Water Supply and Sanitation Sector Questionnaire WHO 2000	74	70	82	4

Table 1: History of Reports Evaluating Access to Improved Water and Sanitation in Mali

Source: WHO/UNICEF JMP for Water Supply and Sanitation, 2001

developing world. Not until the Global Water Supply and Sanitation Assessment Report (WHO, 2000) did these organizations begin to use proper definitions and methodology in

order to record this information; in the developing world, this report was a milestone from which documentation can continue to improve. Before 2000, many of these reports were based on national data from Mali's government and utilities, which left much to "guesstimate."

As a result, it may be necessary to investigate each individual source in order to find out Mali's true situation. From experience, observation, and more recent documentation, like the Global Water Supply and Sanitation Assessment Report, the current situation can be inferred. Generally, access to improved drinking water in rural and urban areas is increasing slowly, but access to improved sanitation is decreasing in rural areas. In urban areas, access to improved sanitation is decreasing, as well, but on a grand scale since infrastructure is not keeping up with urbanization (WHO, 2000). Additionally, there is no formal and current distinction between urban and peri-urban areas in assessments of water and sanitation, so it is unsure whether peri-urban areas have been included in the surveys of urban areas, rural areas, or at all.

2.7 Peace Corps Mali Water Sanitation Project Plan

Peace Corps has had a volunteer presence in Mali since April 1971. Past volunteers focused on drought projects, poultry raising, vegetable production, water resources management, and agricultural extension. Recently, Peace Corps Volunteers have improved and developed wells and vegetable gardens in six regions and in the district of Bamako. Working sectors in Mali include natural resource management, water sanitation, agriculture, health education, small business development, and HIV/AIDS education in order to address the priority development needs the Malians have identified: food production, water availability, environmental conservation, basic education, small income generation, and preventative health care.

The water sanitation project began with well construction for village water supply and intensive Guinea Worm eradication, but is now moving towards a more health and sanitation-oriented program. Currently, the sector project is focused on building

capacities at local levels in order to improve management of limited water resources and environmental sanitation by means of appropriate technology, skills, and knowledge.

In 2003, the water sanitation project was redesigned by volunteers to differentiate between rural and urban-type goals and skills. Since a volunteer's training is based on what tasks and work they will ultimately do during their two years, the new water and sanitation project training was also changed to better prepare those volunteers who might need to understand politics and urban procedures, rather than construction processes.

Prior to my arrival in Sikasso, there had been four volunteers all working with the Regional Hydrologic and Energy Office (DRHE – Direction Regionale d'Hydraulique et Energie) under the Environmental Ministry. These volunteers had assisted the DRHE office on a variety of research and water projects including recording soil filtration rates in Sikasso, mapping the existing sewers, a dam design in a small village for irrigation, and collecting flood plain data of a local river. During my two-year stay in Sikasso, I worked with two government offices, the Office of Sanitation and Pollution Control under the Environmental Ministry (DRACPN – Direction Regionale d'Assainissement et Controle des Pollutions et des Nuisances) and the Hygiene and Sanitation Service under the Health Ministry (SHA – Service Hygiene et l'Assainissement). In working with these two organizations, I was involved with the construction of sewers and rainwater collectors, writing technical briefs on sewage and wastewater management, hygiene education, and testing local water sources.

3.0 Information Collection and Context

Honest differences are often a healthy sign of progress.

Mahatma Gandhi

This chapter briefly explains the research approach, definitions of terms, and information collection processes used in this report. It also provides an overview of related topics in order to explain the significance and present a context into which this report fits.

3.1 Approach to Research

During my two-year stay in Mali, I was mostly involved with sanitation work, rather than water supply. The majority of my work focused on building wash areas and soak pits in order to reduce the problems associated with poor drainage from washing. From this work, I recognized how the same project is implemented in different ways depending on the nature of the site. In brief, I recognized some factors that accounted for the differences in the execution of wash area/soak pit projects, specifically, in urban, peri-urban, and rural areas in the region of Sikasso, Mali. I aim to take these factors and discuss them as they apply to each construction that I document within this report.

3.2 Definitions of Terms

In order to understand what is meant by several terms used in this report, a context of definition is given below. As cultures in the developing world differ, these definitions are based on organizations that write them, and cannot represent all definitions that may apply or be adapted locally.

3.2.1 Urban

Many organizations, such as WHO or UNICEF, apply the national classification system used by the United States Census Bureau in defining “urban” when implementing surveys

and censuses. As this report is only as good as its resources, it is then necessary to explain what the current standards are for classifying a geographic area as “urban.” In general, for the Census 2000, the Census Bureau classified as "urban" all territory, population, and housing units located within an urbanized area (UA) or an urban cluster (UC). It delineates UA and UC boundaries to encompass densely settled territory, which consists of:

- core census block groups or blocks that have a population density of at least 1,000 people per square mile and
- surrounding census blocks that have an overall density of at least 500 people per square mile

In addition, under certain conditions, less densely settled territory may be part of each UA or UC (U.S. Census Bureau, 2000). Although there are more detailed classification systems for urban areas, such as Beale Codes, Metro Status Codes, and Locale Codes, normally, “urban” is indicative of population density. These other systems of classification allow counties (or communes or circles, as in the case of this report) to be organized by several degrees of urbanicity, indicating a trend towards peri-urban classification.

3.2.2 Rural

As in Section 3.2.1, it is also necessary to understand what is meant by the term, “rural,” in contrasting geographic areas. In general, The Census Bureau's classification of "rural" consists of all territory, population, and housing units located outside of UAs and UCs. Geographic entities, such as census tracts, counties, metropolitan areas, and the territory outside metropolitan areas, often are "split" between urban and rural territory, and the population and housing units they contain often are partly classified as urban and partly classified as rural (U.S. Census Bureau, 2000).

3.2.3 Peri-Urban

The border between urban and rural areas used to be considered as a clear-cut line in the landscape; clear-cut both in the physical and organizational sense. However, increasingly it is recognized that rural and urban features tend to coexist within cities and beyond their limits. The interface between urban and rural domains, or the peri-urban area, as it is more often called, is under continuous change, driven by the expanding urban areas and the (still) strong linkages with the rural hinterland. Urban population growth has now overtaken migration in terms of influx of persons in the peri-urban area. Still, one can speak of a meeting of two worlds, the rural and urban, since migration is still quite substantial. This distinction between urban and rural territories is insufficient to characterize the communities and the landscape of peri-urban areas as "border" territories. There is still a call for a clearer definition of the peri-urban area, peri-urban interface, or rural-urban fringe, but the fact that rural and urban features should be seen as co-existing within and along cities seems to be gaining support (Van Veenhuizen, 2003). Peri-urban also refers to areas of rapid urbanization. North of Bamako, the capital of Mali, lays the peri-urban area of Dialakorodji with 12,000 inhabitants. Its dense population, substantial proportions of migrants from the surrounding region and the capital (former residents looking for low cost accommodation), and close economic ties to Bamako defines Dialakorodji as a peri-urban area (GRAD, 2001).

3.2.4 Access

In this report, as in many current publications, access is defined using technology as an indicator. In Table 2, definitions of "improved" and "not improved" are thus based on the assumption that one technology is better for health than another, implying that "improved" water and sanitation designate safe water and sanitation. Although defining access as "improved" or "not improved" simplifies the meaning, there are contradictions to every situation. For example, in some locations an unprotected household well may provide a better supply of water, both in terms of quantity and quality of water, than a household connection, which may be subject to intermittence and poor water quality

(WHO, 2000). Countries and household situations vary, but a universal definition, such as Table 2, is often utilized for research and comparison.

Water Supply	Sanitation
IMPROVED	
Household Connection	Connection to a Public Sewer
Public Standpipe	Connection to a Septic System
Borehole	Pour-flush Latrine
Protected Dug Well	Simple Pit Latrine
Protected Spring	Ventilated Improved Pit Latrine
Rainwater Collection	
NOT IMPROVED	
Unprotected Well	Service or Bucket Latrines
Unprotected Spring	(where excreta are manually removed)
Vendor-provided Water	Public Latrines
Bottled Water	Open Latrine
Tanker Truck Provision of Water	

Table 2: Technologies Considered to be "Improved" and "Not Improved"

Source: WHO Global 2000 Water Supply and Sanitation Assessment

It is argued in the 2003 joint report by twenty-three UN agencies, Water for People, Water for Life, that methodology should be further developed so that progress can be assessed by measuring the numbers of people with access to "safe and sufficient" water and "safe and convenient" sanitation that meets basic welfare and hygiene needs. The issue is not whether people have access to water and provision for sanitation, but whether the water supplies are safe, sufficient for their needs, and easily accessed at a price they can afford and whether they have a quality of provision for sanitation that eliminates contact with human excreta and wastewater by making available toilets that are convenient, clean, easily accessed and affordable by all.

3.3 Overview of Related Topics

Urbanization is one of the critical global trends shaping the future. By 2025, two-thirds of the world's people will live in cities. Only one third of the world's population was urban 35 years ago. More than 150,000 people are being added to urban populations in developing countries every day (WRI, et al., 1996). And with 30 to 60% of the urban populations lacking adequate sanitary conditions, these percentages are expected to increase since local and city authorities often lack the resources, knowledge, trained personnel and financial capacity needed to meet their responsibilities in providing services and amenities essential for healthy living (UNEP, 2000). Figures 7 and 8 show the increasing trends of urbanization within Mali and the global regions of the world, respectively. These trends in urbanization along with a decreasing trend in access to sanitation (refer to Table 1) bring to light the grave situation of urban sanitation in low-income countries.

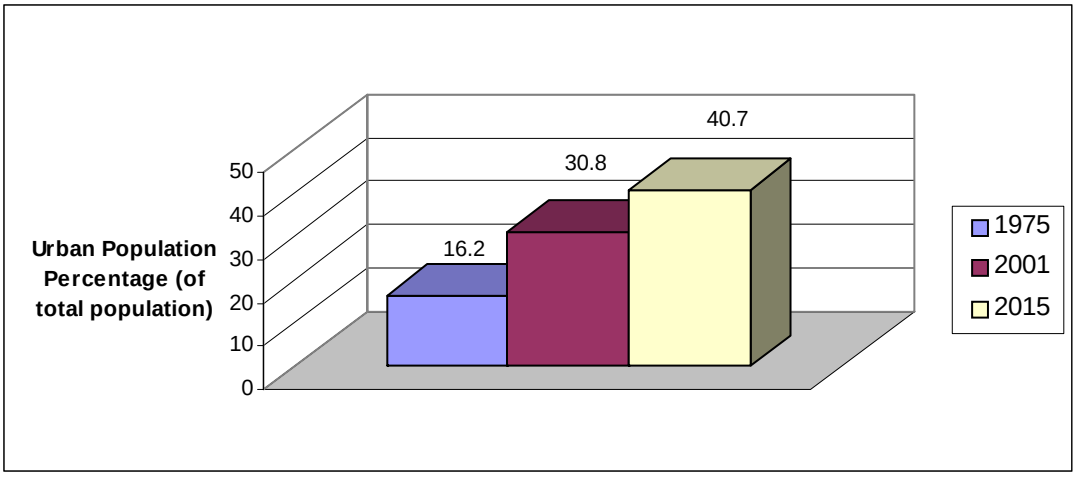

Figure 7: Mali's Urban Population Growth

Source: UNDP, 2003

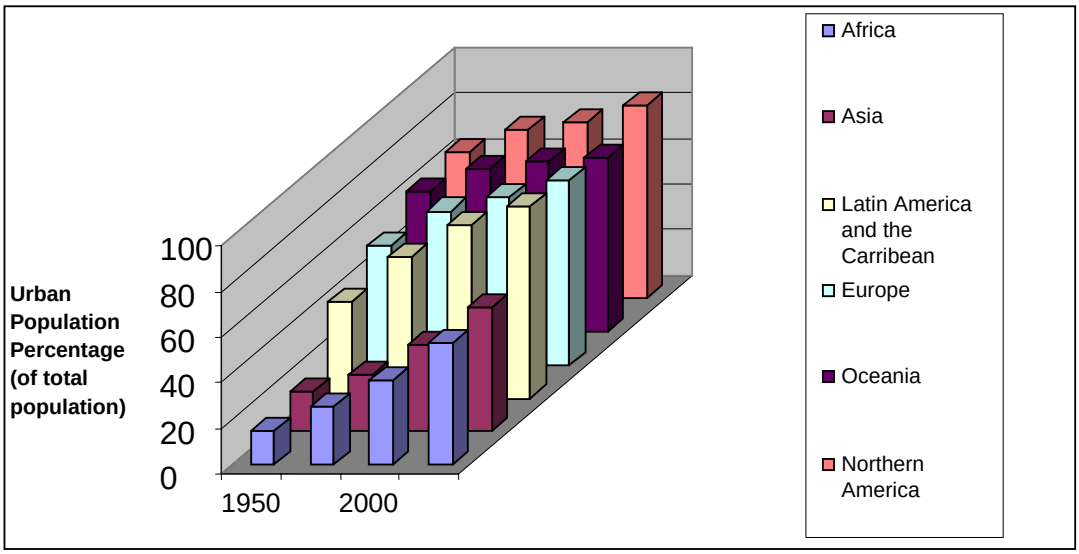

Figure 8: Global Urban Population Growth by Region

Source: UNDESA, 2002

Lower-income countries have particularly difficult problems. They have less water and sanitation infrastructure than high- and middle-income countries. Likewise, their institutions and management systems are generally underdeveloped, and their overall capacity to deliver reasonable water and sanitation services is very low. Big cities generally have some water and sanitation infrastructure in their central areas, and in many cases this is being improved and expanded by the introduction of private concessionaires or improved public utility operations. However, in many peri-urban areas of large cities and in most smaller urban centers, water and sanitation infrastructure is very limited, and there are problems with industrial pollution – often difficult to control as they stem from many small-scale operations. The overall result is widespread microbial and chemical pollution of water sources in and around cities (UN- WWAP, 2003), and an increase in health impacts of inadequate provision. As inadequate provision increases, so does the threat of human contamination from fecal-oral pathogens, high child mortality rates, diarrhoeal diseases, and malaria. Many disease vectors, such as house flies, fleas, lice, and cockroaches, thrive where there is poor drainage and inadequate provision for rubbish collection, sanitation, and piped water.

Satterthwaite (2002) describes a time during the 1960s and 1970s when there was recognition among international agencies that most of their projects were bringing little or no benefit to poor rural dwellers. At this time, 75 percent of the population of low and middle-income nations was situated in rural areas. So, these agencies set new priorities that gave agriculture and rural livelihoods more importance, but at the same time, these changes resulted in an "anti-urban" sentiment. As a result, urban poverty was ignored or was assumed to be irrelevant, and affected the key role that well-governed urban centers had in supporting more prosperous economies. This situation continues to the present, even though the urban population in Africa, Asia, and Latin America has grown by 200 percent since 1970 while the rural population has grown by only 44 percent.

Even today, if you were to ask most development specialists which population is better off: urban or rural, they would respond with, "urban, definitely. They are healthier, better housed, better educated, and with access to a wider range of services and opportunities." Not always, and so the myth continues, especially since aggregate statistics comparing rural and urban populations support this (Satterthwaite, 2002).

For example, statistics on infant and child mortality rates are often used to exemplify an "urban advantage," but it is necessary to be careful in interpreting these because of large differences between different districts in urban centers. Those living in tenements or squatter settlements (common in third-world, peri-urban areas) in the largest cities may have infant or child mortality rates as high as those suffered by poor rural dwellers. These rates could vary by a factor of 20 within the city, itself. In many low-income countries, there are still child mortality rates between 100 and 200 per 1,000 live births. In 1995, Mali's urban child mortality rate was 172 deaths per 1,000 births, and rates were found to have an increasing trend during the years of 1987 to 1995. This is also true of Madagascar, Zambia, and Zimbabwe in their urban areas (Satterthwaite, 2002).

Urban populations are often said to enjoy large advantages over rural populations in access to water and sanitation. Yet it is common for 50 percent or more of a city's population to be unserved by water taps in their home or yard and for more than 75

percent to have inadequate provision for sanitation (UN-Habitat, 2003). Less than 10 percent of the populations in most African cities have provision for sanitation that is safe and convenient. Several cities and most smaller urban centers have no sewers or any other means of public provision for sanitation. Additionally, perhaps at least 100 million urban dwellers in low and middle income countries have no toilet facilities they can use or afford and have to defecate on open land or into scrap paper or plastic bags (UN-Habitat, 2003).

MALI	(Population in thousands)				WATER SUPPLY COVERAGE			SANITATION COVERAGE		
					PERCENTAGE OF POPULATION					
	Year	Total Population	Urban Population	Rural Population	% urban	% rural	% total	% urban	% rural	% total
	1990	8843	2105	6738	65	52	55	95	62	70
	2000	11234	3375	7859	74	61	65	93	58	69

Table 3: Water Supply and Sanitation Coverage, 1990 and 2000

Source: WHO Global 2000 Water Supply and Sanitation Assessment

As depicted in Table 3 by the World Health Organization, urban water supply and sanitation within Mali in 1990 and 2000 is shown to have a higher coverage by population than the rural areas. But what these facts may not illustrate is the meaning of coverage, access, methodology of research to gather this information, or the culture involved. Increasingly, it is necessary to turn to definitions in assessing what these statistics say about water and sanitation provisions.

Many studies explaining who has improved provision for water and sanitation use the same definition for urban and rural areas, and may not even include peri-urban areas as a separate geographic area, which can skew statistics. But having a water tap within 100 meters is not the same situation in rural, urban, and peri-urban areas. There may be 100 persons per tap in a rural area and up to 5,000 people per tap in squatter settlement on the outskirts of a city. It is obvious that the urban/peri-urban setting may be more concentrated with the same access. Moreover, having access to a pit latrine is not the same in a rural setting where it is used by one family and can be sited to avoid

contaminating water sources. Again, there may be 50 households sharing it in the urban/peri-urban setting and there is so much fecal matter that is very difficult to protect water sources from contamination. Many urban and peri-urban communities have so little space per person that there is no room to fit toilets into each person's home or concession.

At present, the fact that most urban populations of Africa, Asia, and Latin America have access to improved water and sanitation is only true because the standards for improved provision are set so low. If "adequate" water supply meant a water tap within or next to each home with a safe and regular supply, most of the urban population of Africa and Asia and a large part of the urban population in Latin America would not meet the standard. If the standard for sanitation was "easy access to a good quality toilet and hand washing facilities with provision for the safe disposal of excreta," most of the urban population of Africa and Asia would lack it (Satterthwaite, 2002; UN-WWAP, 2003).

In addition to looking at definitions, it is vital to look at other factors that might influence these publications. With water and sanitation being included within the health sector, there are many factors that can account for a change in one's health, so these factors must also be taken into account when making assessments of developing countries' status. Figure 9 provides some examples of factors, such as the prosperity of the national economy, service provision, and the knowledge of health-enhancing behavior, that may influence a person's health. These background, underlying, and intermediary factors may vary in each geographic, explaining the discrepancies between urban, peri-urban, and rural water and sanitation situations. According to Jorge Hardoy, author of The Poor Die Young, these politics, socio-economic, and organizational constraints explain the level of health of an individual. The contrasting factors in each environment, whether urban, rural, or peri-urban may be the reason several publications support bias towards geographic areas, as the nature of each location is misunderstood.

The sustainability of both urban and rural areas is affected by the dynamic and changing flows of commodities, capital, natural resources, people, and pollution in the peri-urban

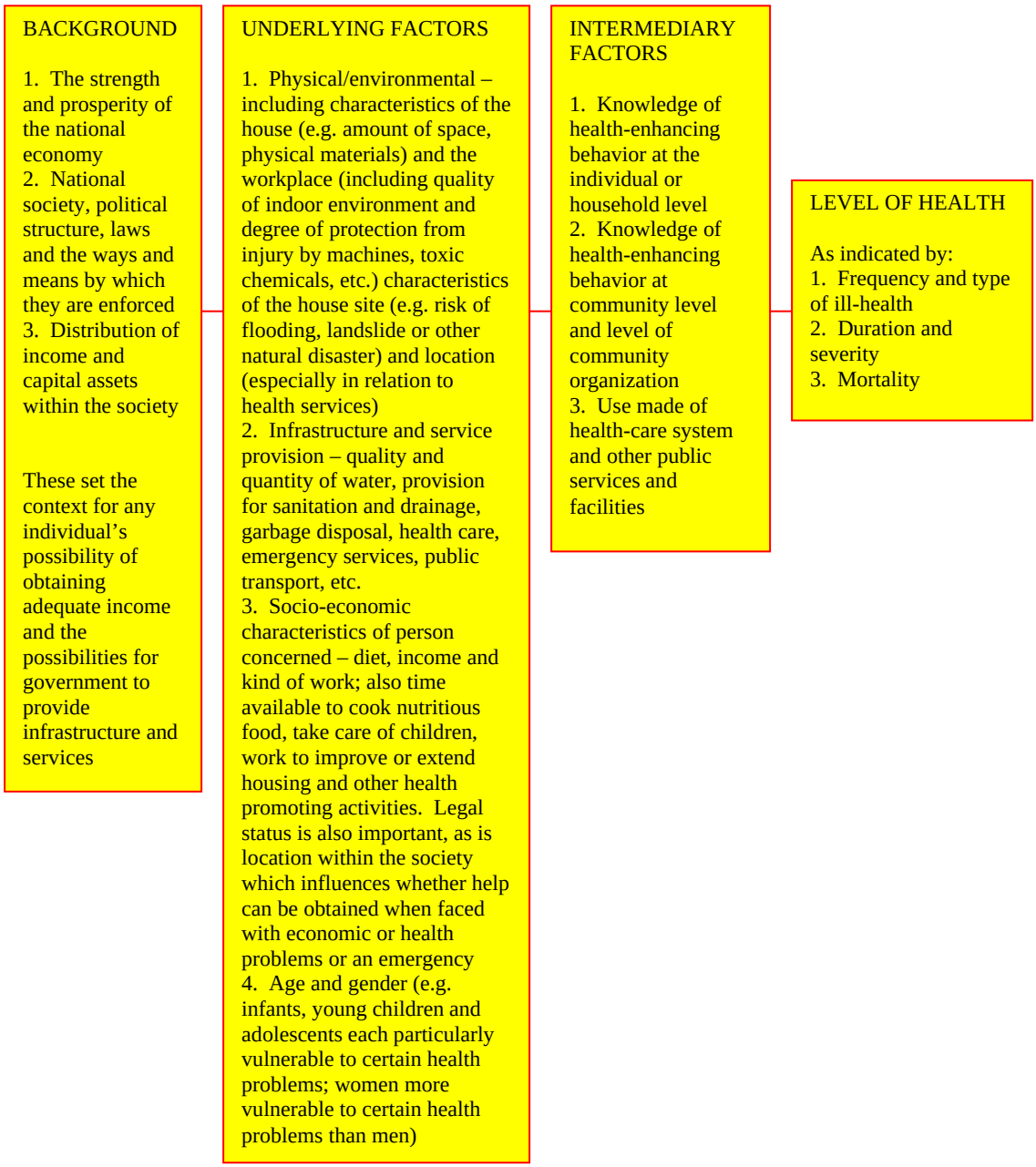

Figure 9: Examples of the Political, Socio-Economic, and Organizational Factors which Influence a Person's Health

Source: J.E. Hardoy, et al., 1990

interface. Despite this fact, development policy and systems of governance continue to treat rural and urban development as independent, largely unconnected sectors (Van Veenhuizen, 2003). Understanding urban, rural, and peri-urban areas distinctively, along with their constraints and abilities to influence each other, will allow future sanitation project planning to improve, internally, and externally within the health sector. With the forces of urbanization, the complicated links and differences between these three areas are only beginning.

3.4 Implementation of information collection

During my experiences with wash areas and soak pits, I took notes on beneficiary's, private-sector workers, and government employees' attitudes and standards of practice as I had the benefit of being directly and indirectly exposed to working with all three levels. By having the opportunity to work in urban, rural, and peri-urban areas with residents, government workers, business owners, women, and youth, the implementation differences became apparent. I also noted actions versus words of those I talked with, listened to people's "stories" of work, mobilization, and lifestyles. Additionally, I asked questions at offices that I visited and wanted to see if others' experiences with sanitation work matched my own or those of other volunteers and development workers. A list of some examples of questions asked is given in Table 4. In addition, a list of contact people and organizations in Table 5 gives a brief overview of the diversity of opinions and observations. This report is not solely my own observation and research, but it represents slices of life during Sikasso, Mali's urbanization in 2002-2004.

In looking at several publications, even from the same organization, inconsistency between urban and rural information is evident and confusing. Publications may reinforce an idea of either "urban bias" or "rural bias," when peri-urban areas may be the reason for skewed statistics and reports. For this reason, I believe this paper reinforces a context of research that is relatively new by making a distinction between three areas, instead of two. In effect, I will focus on more recent (post - 2000) publications and journals for support of true urban and, especially, peri-urban depictions. In cases where I

discuss urbanization, histories and trends, development theory, and myths, I will not make a discrepancy in the date of publication.

I believe this urbanization trend has created a "forced peri-urban" zone within many cities, like Sikasso, reinforcing the idea that peri-urban areas may be new to consider within the sanitation sector. In many publications, urban and rural are the only zones analyzed (as in the case of Mali in Table 1 and Table 3), but within these urban statistics exists almost rural neighborhoods on the periphery of the city itself.

Question	Subject
Does the government of Mali address sanitation issues?	Politics; Sanitation
Do you rent or own property?	Ownership
How many places have you lived?	Mobility
How does the cost of living compare in Sikasso?	Standard of Living
What do you use your concession area for?	Lifestyle
Do you have a paid job?	Economics; Lifestyle
What is your educational background?	Education
Do you think the infrastructure in Sikasso is adequate?	Lifestyle
Have you ever seen a map of Sikasso?	Lifestyle; Education
Is aid money vital for improvements?	Economics; Ideology
Do you wash your hands with soap?	Lifestyle
How is the quality and quantity of your water?	Water Supply
Do you have a soak pit?	Sanitation; Lifestyle
Do you have a wash area?	Sanitation; Lifestyle
Do you have a latrine?	Sanitation; Lifestyle
Are your neighbors clean?	Ideology; Sanitation
What do you think about the government?	Politics
How often do you get malaria?	Health

Table 4: Overview of Posed Questions During Consultations

Consulted Resources	Number of People*	Credential, Experience, or Background
Sanitation and Pollution Control Office	8	Government Workers in Foresty, Environmental Policy, Sanitation, and Education
Hydrology and Energy Office	20	Government Workers in Geology and Hydrology, Truck Drivers, Technicians in Water Supply
Hygiene and Sanitation Office	5	Government Workers in Sanitation and Water Supply
Women in Ouayerma Extension (Peri-Urban) Neighborhood	20	Daily Experience as Health Providers to Families, Residents of Peri-Urban Area
Women Owners of GIEs	4	Director of Private Business
Men Owners of GIEs	7	Directors of Private Business
Sikasso Trash Collectors	6	Work Experience in Sanitation Sector
Social Service	4	Government Workers in Community Development
Doctors at Health Centers (Urban)	5	Work Experience in Health Sector
Doctors at Health Centers (Rural)	10	Work Experience in Health Sector
Sikasso Children (Urban and Peri-Urban)	45	Assistance to Mothers as Health Providers
Rural Elders	22	Understanding of Rural Histories and Changes
Traditional Healer (Rural)	1	Work Experience in Health Sector
Women Food Vendors (Urban)	8	Private Business Owner
Shop Owners (Men and Women)	10	Private Business Owner
Employees of Local Non-Governmental Organization (NGO)	6	Work Experience in Health and Sanitation Sectors
Socio-Economic Office	4	Work Experience with Sikasso Residents and Local Economics
Regional Youth Camp Attendees	21	Above-Average Students
Farmers (Urban, Rural, and Peri-Urban Residents)	50	Understanding of Agricultural Change and Needs
Agricultural Extension Agents	3	Understanding of Agricultural Change and Needs
Missionaries (Urban and Rural)	6	Understanding of Local Politics
Refugees from West Africa	30	Experience in Mobility and Tragedy
Natural Resource Management Extension Agents	4	Understanding of Local Resources and Environmental Sustainability
Urban Planning Office	5	Government and Local Work Experience in Infrastructure Design
Total People Consulted	**304**	

*in many cases, the number of people consulted at a given source is constant, although some approximations must be made for those sources where the number of people consulted varied (i.e. an office setting)

Table 5: Overview of Government Workers, Offices, Private Businesses, and Beneficiaries Consulted

4.0 Results and Discussion

Society adopts the solution if it is compatible with the society's values and other technologies.

Jared Diamond

Guns, Germs, and Steel, (1999)

This chapter seeks to illustrate the socio-economic, political, and organizational differences that affect sanitation practices in urban, rural, and peri-urban areas in Mali, West Africa. To facilitate the understanding of these differences, influential factors and three case study examples are presented and discussed.

4.1 Factors of Influence

Using my personal experiences, readings, and contacts with sanitation workers and organizations (refer to Tables 4 and 5 in Section 3.4) in Mali, I have found the sanitation conditions and procedures to be much different, in reality and in recorded research and writings, for urban, rural, and peri-urban areas. Statistics show bias and myth contrary to the observed conditions of everyday life. In a grand scope, these urban, peri-urban, and rural areas experience a difference in organization, society, economics, politics, geography, and ideology. These conditions (as listed in Table 6) are discussed, specifically, in order to bring to an end the bias and myth so present in our records and to understand what scope culture takes on sanitation work in the developing world.

In these sections, I often mention the importance of people "improving their sanitation situations." With this phrase, I am referring to the mass sum of activities, access, and especially infrastructure, which can realize a positive and safe effect on the health and hygiene of the individual. This may include building a wash area (sewage evacuation), soak pit (wastewater management), latrine (fecal evacuation), or improving wells (drinking water protection). Other examples were listed in Table 2 in Section 3.2.4.

Section	Factor of Influence	Category of Influence
4.1.1	Disorganized Governance Due to Decentralization	Organization; Politics
4.1.2	Ownership of Property	Economics; Ideology
4.1.3	Standard of Living and Related Costs	Economics
4.1.4	Population Mobility and Change of Lifestyle	Society
4.1.5	Limited Physical Space for Infrastructure	Geographical
4.1.6	Evolving Work Roles for Men and Women	Society; Ideology
4.1.7	Education and Communication	Organization; Society
4.1.8	Concentration of Pollution	Geographical
4.1.9	Record Keeping	Organizational
4.1.10	Presence of Aid Money and Foreign Organizations	Ideology; Economics; Politics

Table 6: List of Socio-Economic, Political, and Organizational Factors of Influence in Mali

4.1.1 Disorganized Governance Due to Decentralization

Organization is the act or process of putting together in an orderly, functional, and structured whole (American Heritage College Dictionary, 1993). Organization is a key element to any group of people having a favorable outcome or to work with and among other groups. In the developing world, there are always work and project needs, as is the nature of the situation. In order for needs to be realized correctly and the project to go from idea to implementation, several groups of people must be involved in all steps, otherwise, something gets missed, and the project fails. In other words, a well-managed and organized project can lead to potable water, reduction of standing water, or a market clean-up; an improvement in health. Good governance is priceless in low-income nations.

In Mali, regions are divided into circles, and circles are divided into communes. For each commune, there is a capital town with a mayor's office and the surrounding villages use it as their office. There may be anywhere from ten to twenty villages within a commune, and areas of communes vary widely throughout Mali. Within each village, there are men

and women's leaders, which work with the mayor of the commune, who, in turn, works with the mayor of the circle, who works with the governor of the region. Not only are there political leaders within geographic areas, but there are also several agencies within the government that are responsible for the management of education, environment, health, tourism, etc, which work with these leaders. Several different groups of people are involved in order to implement any kind of project, which has allowed all levels of workers to learn an important lesson during the 1990s: recognizing the benefits of combining expert knowledge with local knowledge. When the government of Mali began the process of decentralization in the 1990s (its operational phase with local elections began in May and June of 1999), their goal was to move towards a more bottom-up approach to governance, by combining the experience, knowledge, and understanding of various local groups and people, and increase participation of the beneficiaries.

In the urban setting, governance can especially become confusing and haphazard as a result of the number of groups involved and working within the same geographic area. Some groups are favorable to decentralization, namely the private sector, but others, like the government offices, were trained and only know the top-down approach to things. Especially between the Ministry of the Environment and the Ministry of Health, there is much overlap in work, in addition to the changes of approach to work. In the end, problems with miscommunication and misunderstanding of roles and acceptable approaches of work and ethics add to the timescale of project implementation. In the rural setting, decentralization has begun to encourage small groups to act for themselves. Men's and women's groups within villages can become organized and work together to find solutions to their problems on a micro-level. In some cases, villages will designate special groups for specific concerns, like a health committee being in charge of needs evaluation and implementation of ways to reduce malaria. Within the smaller rural setting, these different groups of people can record the specific roles and responsibilities of each group. In Figure 10, ineffective decentralization in sanitation projects is shown in relation to the health in squatter settlements, which are often located in peri-urban areas.

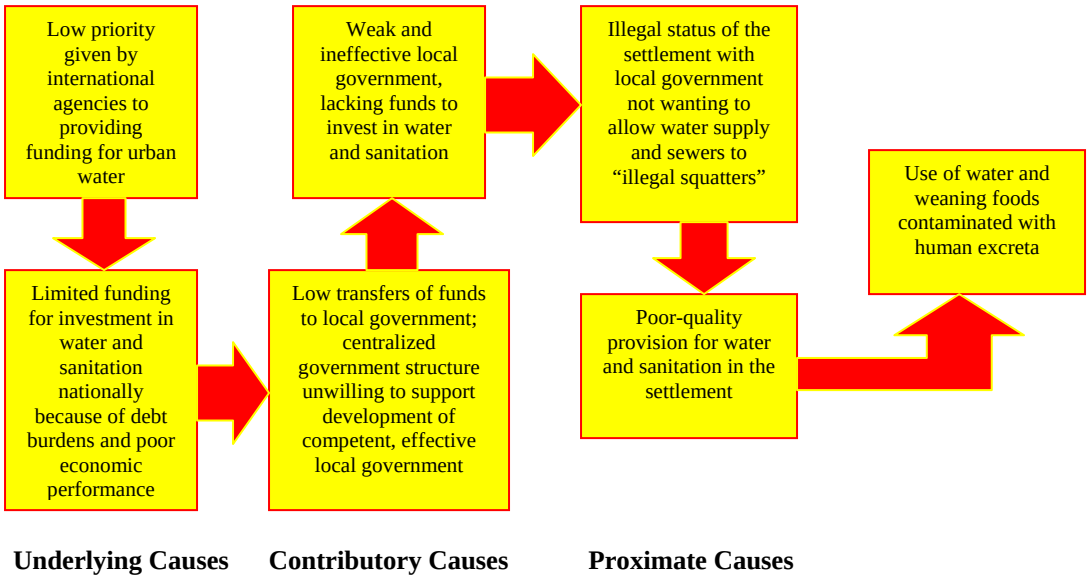

Figure 10: Examples of Causes for the Prevalence of Diarrhoeal Diseases in a Squatter Settlement

Source: UNICEF, 2003

Poor governance is shown as underlying, contributory, and proximate causes of diarrhea. In peri-urban areas, decentralization is affecting citizens on each side; some getting caught in the disorganization of the roles and some feeling encouraged by the new school of thought. What results is a slower acceptance that can, hopefully, serve as an interface of theory for urban and rural areas to decentralize completely.

4.1.2 Ownership of Property

Mali has a complex and evolving land tenure system. The main characteristic is the co-existence of different types of rights. The State is the overall trustee of all land within the national boundaries and has absolute authority over its allocation. At the local level, there is often a mixture of customary and statutory rights. In broad terms, customary rights (land management and allocation by traditional authorities such as village chiefs and village councils) are more likely to apply to rural areas, whereas statutory rights (formalized land titling and registration) are more likely to dominate in urban centers. However, formal and informal market transactions are increasingly important under both systems (especially in peri-urban areas where the two systems often overlap). Under

customary tenure, non-landowners can access land through a variety of secondary rights arrangements, ranging from share-cropping to tenancy to borrowing of land. These arrangements are especially important for low-income farmers and for migrants, who are often excluded from land allocation under customary tenure, but are increasingly under strain as land becomes scarcer and its value increases. In Mali, middle-and higher-income urban residents tend to displace under-capitalized small farmers (Bah, 2003).

Not only do farmers and migrants face difficulties with land allocation, but also those moving into urban centers contend with the realities of owning their own property and not feeling tied to their place of residence. In a rural (non-including peri-urban areas) setting, residents, using formal and informal market transactions, eventually own land for farming or building houses. In an urban setting, land can be scarce and expensive, forcing most low and middle-income families to find rental property and pressuring nearby farmers to relocate or choose a peri-urban existence.

In Sikasso, Mali, the number of renters far outweighs the number of property owners (as a result of high cost of living within an urban area and regular transit of residents), creating a high percentage of people who have an attitude of not feeling tied to the place they live. In order to improve your sanitation situation, ownership of land and a feeling of responsibility is needed. Many major improvements to sanitation include an improvement of land, as well, and if residents feel no tie to their property or no responsibility to do so, then sanitation improvements have no priority.
Not only do residents feel no responsibility to enhance their own hygiene or sanitation situation (either by infrastructure or otherwise), but the owners themselves give no incentive to their tenants to make improvements. Rarely will a property owner pay for improvements since they themselves do not live there. At least in a rural setting, residents are working towards an eventual ownership situation, therefore, improvements of any kind, are worthwhile. In an urban setting, an attitude of “live today” and “fend for yourself” prevails, creating conflict between groups or individuals. Moreover, ownership in an urban and peri-urban area is directly related to the individual’s general health, whereas, the situation is more simplified in rural areas. The threat of eviction (since

many live in illegal settlements or have low-incomes and are unable to pay rent) has serious health impacts, as well as, the stress and know-how of government regulations in regard to location, size, materials, and structure.

4.1.3 Standard of Living and Related Costs

As implied, in order for residents to improve their own sanitation situation, they must be pro-active to make it happen themselves. The problem occurs, as it usually does, when economy is involved. In the developing world, living in a rural setting means some things are free, but in an urban center and peri-urban area, the beneficiary must pay for everything as standards and prices increase. And it goes for most of the world that the cost of living in urban centers exceeds that of rural areas, making it economically difficult for those in urban centers to be responsible for improving their sanitation situations. In Mali, the per capita gross domestic product is US $277, while in the United States, it is $37,800 (CIA, 2004).

Most nations have a single income-based poverty line that is used in rural and urban areas. This implies that the income needed to avoid poverty is the same everywhere (whether in large cities, smaller urban centers or rural areas). But the cost of living (or of many basic needs or the cost of avoiding poverty) is much higher in large cities. Income-based poverty lines are usually tied to the cost of a minimum food basket with 15 to 30 percent added for 'non-food' essentials. This implies that the cost of non-food essentials is not very high. But many empirical studies have shown the high costs paid by particular urban groups for public transport, schools, housing, access to water (and in some instances, like Sikasso, to sanitation and garbage collection), food (if food is more expensive), health-care, energy, and child-care (Bah, 2003).

Table 7 presents an overview of considerations between urban, peri-urban, and rural cost of living. In general, urban and peri-urban costs are higher than rural area costs, but there are exceptions to every situation, depending on variables like frequency of travel needs, health of the individual and location of health centers, and proximity to open space. For

Expense	Urban	Rural	Peri-Urban
Transport	-Demand for Travel to Multiple, Far Destinations Each Day	-Low Cost Unless Travel to Health Center is Far and Often	-Larger Distance due to Living in Periphery Area
Schools	-Government Schools Require Uniforms, Meals, Exam Fees, and Transport -Private School Cost is More and Some Are Forced to Attend Due to Limited Government Schools	-Little or Cost of Supplies Only	-Same as Urban with Added Distance Costs for Travel
Housing	- Rent Payments - Cost of Land and Materials For Self-Built Home	-Cement/Metal Cost, if used, or No Cost	-Same as Urban With Added Distance Costs for Materials
Access to Improved Water, Sanitation, and Garbage Collection	- Piped Water Payments (10-20% of Income) - Payment for Hauling Garbage to Designated Areas - Usage of Public Latrine (5-10% of Income)	-Free Since Water and Space is Available	-If Available, Same as Urban, If Not, Added Cost of Buying Water and Sanitation
Food	- Limited Space for Growing Food or Raising Livestock -Market Costs High Due to Shipping	-Local Farming	-Market Costs and, In Cases, Limited Farming
Health-care	- Public/Private Examinations and Pharmacy Bills	-Depends on Frequency and Desire of Use of Health-Care Centers	-Same as Urban
Energy	- Payments for Obtaining Wood and Charcoal Within the City - Extra Cost for Gas or Electricity, If Needed	-Low Due to Proximity to Open Land	-Low if Gathering of Wood Takes Place -High if Buying Charcoal Shipped in From Rural Areas and Transport Back to Home -Cost of Gas/Electricity, If Available/Needed
Child-Care	- Reciprocity at Community Level When All Adult Members Have to Work (No Low-Cost or No-Cost Solutions)	-No Cost; Assistance Given/Taken from Neighbors	-Same as Urban

Table 7: Overview of Considerations for Cost of Living in Urban, Rural, and Peri-Urban Areas

example, if an individual in a small village becomes ill and needs to travel a long distance to a health center and buy medicine, the result can be costly. On the other hand, the close proximity of urban and peri-urban residents to health-centers and pharmacies may create an increase demand for doctors' visits and buying various medicines.

4.1.4 Population Mobility and Change of Lifestyle

As stated, people are rapidly moving into urban areas. By 2025, the world's cities will be home to 5 billion with 90% of growth coming in developing nations (UNEP, 2000). In Mali specifically, you will find people from far-away villages, Ivory Coast, Burkina Faso, Guinea, Sierra Leone, Niger, Senegal, and Mauritania in its cities (sometimes a large number of refugees, as well). This large movement of people affects the urban and peri-urban society in two major ways: one being a misunderstanding of city lifestyle and two being the reinforcement of people not having ties to the places they live since it is not their original home (or not being able to attain ownership quickly). When people move into urban areas from villages, they may not be aware of the ways to keep things clean due to space constraints or how to use latrines. Not only is the lifestyle different, but with a high population mobility, people do not get to know each other as well, resulting in mistrust and less opportunities to work together. In Sikasso, people from all over West Africa and within Mali move in and out of small neighborhoods on a monthly basis.

In addition, when people move from rural areas to other rural areas, the residents will usually take the newcomer in as part of their family. In West Africa, it is customary for smaller villages to take care of new people or families until they understand the local lifestyle and can survive on their own. People feel less obliged in urban areas to guide new residents. You sink or swim in the city. Peri-urban areas, once again, can be a combination of urban and rural ideas. There, you may find squatters, refugees, civil servants, and landowners all living in propinquity: original citizens and newcomers. Some feel obliged to give everyone their personal space, and others feel the need to take care of their neighbors, in relation to amount of time they have lived in the area. As rural

migrants settle into a peri-urban area long-standing, attitudes begin to reflect that of the urban residents with time.

4.1.5 Limited Physical Space for Infrastructure

There are basic infrastructure features that do not exist in the third world but are needed, such as gutters, rainwater collectors, latrines, and gray water removal systems (e.g. wash area and soak pit). When there is limited space, solving problems that require space in their solution, such as a construction project, will be difficult. Infrastructure requires space.

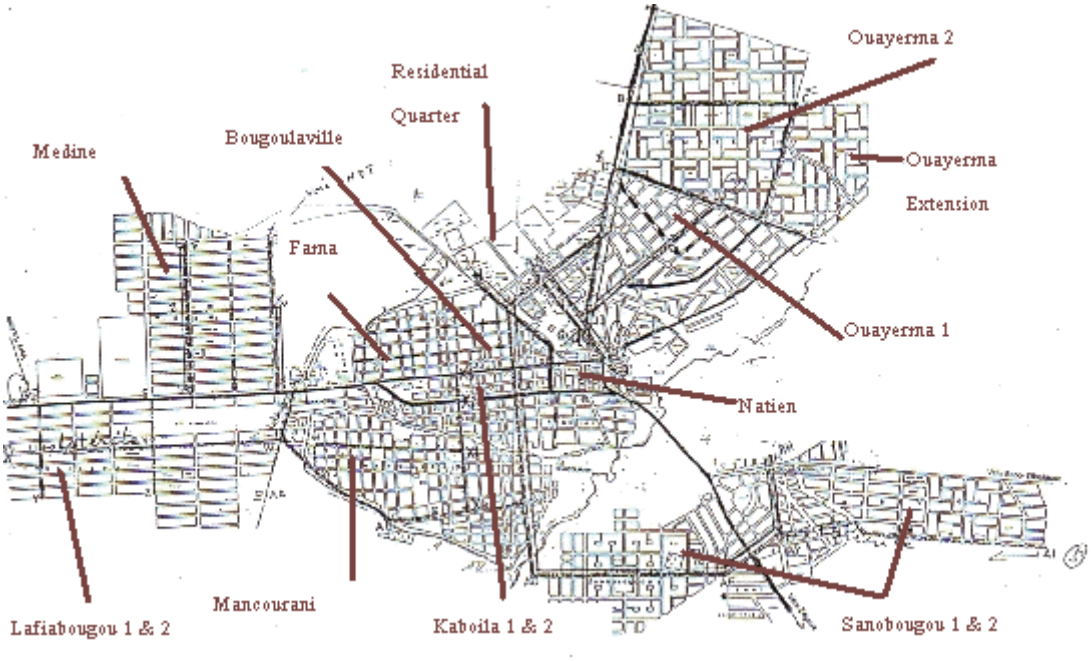

Figure 11: Map of the City of Sikasso with Neighborhoods

Sikasso, like many urban centers, grew from the inside out, like a circle. Located in the center of town, near the major commercial and market areas (See Figure 11) is a neighborhood called Bougoulaville, which started as a small village and added other close villages or neighborhoods, to make the 15 neighborhoods that make up Sikasso. Since Sikasso is known as the "breadbasket" of Mali for shipping many fruits and vegetables to other parts of the country, it grew rapidly. But with its rapid expansion, neighborhoods like Bougoulaville suffered and became dirtier with time. Small gutters

were built among some of the streets of Bougoulaville at one time, but they could not handle the frequency and quantity of wastewater coming out of the concentrated family concessions, thus, they were slowly buried and destroyed. Even today, there is not room for the proper reconstruction of gutters, shallow sewers, or small-bore sewers, and sewage floods into the streets, especially during rainstorms. Other solutions, such as an underground French drain system (underground, small diameter piping to save space), have been proposed to improve Bougoulaville, but unless they are built correctly to handle the quantity of wastewater produced, the system will become buried and destroyed like the first. Other factors, such as the level of education, ownership, population mobility, and the high concentration of pollution will continue to multiply the space issue, and paired with level of maintenance required makes the urban, and in some cases, peri-urban areas, complex.

In rural areas in Mali, when a woman has finished washing clothes or dishes, she throws the dirty water outside the house to dry in several different places. By distributing the wastewater over several areas in time, the environment can handle its filtration without much assistance. In extreme cases, wash areas and soak pits can be built to augment the problem of increased sewage. Peri-urban areas are characterized by level of infrastructure of the city, itself. In Sikasso, there are peri-urban areas with and without infrastructure. Those with working infrastructure, such as gutters, remain cleaner than those without infrastructure or destroyed infrastructure like that of Bougoulaville. In many cases, urbanization has occurred at such a high rate, that space is gone even in the periphery of the city and given away to all types of housing, without amenities.

4.1.6 Evolving Work Roles for Men and Women

In conjunction with population mobility is also a change of work roles for men and women in urban, peri-urban, and rural areas. The trends in urbanization, creating influxes of people from rural to urban and peri-urban zones have resulted in new lifestyles, as well. The people moving into new areas not only have to learn how to adapt to a different lifestyle, but their need to compensate for added costs adds and changes

their work responsibilities. In Table 7, the cost of living in urban and peri-urban areas was shown to be generally more than that in rural areas. Since most non-food items must be purchased, a family must earn a living outside of farming. Both men and women must change from being subsistence cultivators to paid workers or entrepreneurs. Traditionally and above all in rural areas, women stay in the concession all day to take care of the home and family. As people leave the rural area to live in the urban areas, responsibilities may increase for those left behind as less people stay to work the fields. Then again, family members who move to urban areas may send money back to the village to compensate for their absence, resulting in little net change. Time to work is exchanged for money directly, since added costs on a daily basis are kept to a minimum.

As people move to the urban and peri-urban areas, men and women find additional paid income to relieve compensation of added costs. Farming on a large scale is not possible due to limited space. Especially in cases when education for children is more costly, it is out of the question for women not to work or find ways of finding income, usually through learning a new skill or finding a product to sell. It is common for both men and women to earn money by becoming merchants of some type.

For example, in Dialakorodji, a peri-urban area of the capital of Bamako, Mali, average incomes are low, and work roles exist based on gender. For men, lack of farmland, fierce competition in the informal sector and unemployment following the closure of several factories in Bamako has led to an ongoing decline in incomes and living standards. For women, who traditionally have limited access to farmland, the proximity of Bamako's markets has increased their opportunities to engage in petty trading of agricultural produce from neighboring villages, bringing about some improvement in their incomes (GRAD, 2001). As these work roles change, extra time that was common in villages is eaten up by the possibilities of earning extra money, resulting in less time for childcare and family freedom, and moreover, proper hygiene of the family.

4.1.7 Education and Communication

Education and communication contribute to the level of organization of a group of people or organization. Without a level of knowledge or ability to communicate, these groups can become very disorganized. Acknowledging that being organized is a key element to a group of people or organizations being successful in making improvements, education and communication become just as important. Additionally, Hardoy (1990) states that the proportion of children who die young tends to be lower, the better educated the mother, so education affects not only the organization of a community, but the health, as well.

Imagine sitting in a sitting in a classroom with 100 other students, several from different ethnic groups, and all fighting for the attention of one teacher. Maybe in attending a large conference, several attendees complain that all information should be translated into each dialect that they speak. These are very common situations in Mali, as concentration of people increases, the chance of good communication decreases, thus, affecting levels of education for all. In Sikasso alone, 10 main ethnic groups exist, making communication difficult since several languages exist between ethnic groups. Other regions in Mali even make fun of those residents in Sikasso speaking the Bambara language since it had become a Bambara dialect of Sikasso with influences from French, Senoufo, and Samago, the prominent ethnic groups other than Bambara. Often, due to the concentration of different languages, low literacy rate (46.4% according to CIA, 2004), misunderstanding and miscommunication is inevitable. These situations affect schools, government offices, important meetings within municipalities, and women's groups. Even local gossip creates believed myths, and oral traditions confuse the gossip, myths, and actual news. In addition, Mali being a landlocked country affects the rate of information and technology that flows to its people. Radio remains an important part of a Malian's life in order to keep up with news and the ability to understand current events.

In rural areas, town meetings and schools are responsible for a smaller number of people; therefore to even communication to the public is, by nature, simpler. Most rural areas

also have one decided language to perform business and important tasks in (even if everyday spoken languages differ), so there is little conflict of understanding in that manner. Their schools may service 30 students per teacher as opposed to 150 per teacher in urban areas. Villages may even designate one person, like a traditional Griot, to visit with each family to communicate current news and make announcements. Griots know family histories and understand how to reach people on a local level.

In urban and peri-urban areas, Griots also exist, but intermittently and at a small cost (usually for blessings and ceremonies), indicating these residents' desire to hold on to rural traditions of communication. Once the population density increases, Griots may get lost in the crowd and confusion between ethnic groups like the rest of the urban and peri-urban residents. And so, calling residents together for meetings is a struggle due to time constraints between large numbers of diverse people with diverse levels of education, not to mention the difficulty of getting people to come to meetings on time. Affecting the urban and peri-urban level of education is the common (especially among female-headed households) practice of fostering children at home as a cost-cutting measure. The high costs of education in urban schools may push parents to return children to rural areas where schools and other related expenses are relatively cheaper (Owuor, 2004).

4.1.8 Concentration of Pollution

One of the reasons that infrastructures such as gutters, landfills, rainwater collectors, toilets, sinks, septic tanks, and wastewater and drinking water treatment systems were created is due to the environment not being able to handle the increased quantity, concentration, and frequency of our own pollution. In Sikasso, residents such as Hawa Wan, note that "[Sikasso] is a large city, and the infrastructures in place do not respond to the demands of the population" when rain and sewage flood the streets near her house (Ahrens, 2004). When societies moved from hunter gathering or nomadic societies to more static, permanent living conditions, they had to find ways of dealing with waste and becoming more sanitary.

Since more people in higher densities affect the amount of excreta produced, increasing the transmission of communicable diseases, there is a call for more innovative clean-up strategies, as well as dealing with the consequences of industrial pollution in some areas. In the same case as section 4.1.5, when women throw their wastewater outside to drain naturally, the environment can handle the concentrations of pollution, but without space to do so, such as in urban, and sometimes, peri-urban areas, throwing wastewater outside could anger a neighbor who thinks considerations for space and health are important. They do not want to walk through someone else's dishwater, bathing water, or child's excreta.

In rural areas, not only can the environment normally filter everyday pollution (relatively compared to the population density in urban and peri-urban settlements), but it is also expected by residents to spread the pollution out. Throw the dishwater into the street, but go to the bushes to defecate. Peri-urban and, especially urban, residents do not have the luxury of this understanding. Depending on the population density and type of neighbors in peri-urban areas, concentration of pollution may not affect their daily lives, as it does in urban centers since squatters and new residents have expectations of the worst conditions anyway (as the last to receive utilities and infrastructure) and have desensitized attitudes towards pollution as receivers of urban pollution leftovers (e.g. solid waste that is brought to peri-urban rubbish sites before burning as in Figure 12).

Concerning the impact of population density on health, Root (1997) found a correlation between population density and under-five mortality in Zimbabwe. In his study, it was determined that the children in the Ndebele provinces had 45% lower mortality rate due to diarrhea and malaria than the Shona provinces, which had much higher population densities. Root (1997) also examined the possibility of differences in culture and health care provision by the government and found no relation.

Figure 12: Solid Waste Collection Site and Burning in Peri-Urban Neighborhood (Ouayerma, Mali)

4.1.9 Record Keeping

During project planning, it is customary to do research and/or brainstorm ideas. In order to do research, records, libraries, and resources are vital to gain more information about whatever topic or question that you have. Without records, reinventing the wheel is a common task. Going back to the idea of a French drain project in Sikasso in section 4.1.5, it would be difficult to design such a project without slope or soil data. Maps alone are a treasure in Mali and in many distant places. Even development organizations and businesses do not document their past work, research, budgets, so their history dies with the passing of employees.

Development work, or any kind of project for that matter, is difficult to build from square one, especially when you know someone has already done what you are doing. In urban areas, most government offices and privately owned businesses lose documents, if they have them at all, when people borrow or steal them, therefore, the information is lost for

the future. In rural areas, the gathering of elders may not keep many written records, but they do not have much else to remember, except their history, to be told, respected, and passed on to their children. This process may be expedited by the traditional Griots, village chiefs, and committee members (usually elders or those with education) whose job is to pass information to residents or those doing improvements within the area.

In the case of peri-urban areas, records may be recorded and remembered, but the turnover of residents seems to be so high that the history is lost within a relatively short time. Eventually, peri-urban areas are consumed by the urban center, adding to the lost records in whole and a new peri-urban geographic with no records.

4.1.10 Presence of Aid Money and Foreign Organizations

Everyday in Mali, you see a white SUV. Everyone sees it and knows it means aid money, help, assistance, and in many cases, an excuse not to act for themselves. Many people grow up being taught that they are poor, and as a result, need some other person, preferably a white person, to help and give money. This common lesson results in a culture of accepted dismotivation. They may need a soak pit to get rid of that stagnant pool beside their house and protect their water source, but instead of acting themselves to find a solution, they will wait 10 years for an NGO (Non-Governmental Organization) to come and build it for them for free with foreign aid money. And they will wait because the likelihood of a free gift is high. Mali like many low-income countries has a history of dependence upon aid money for livelihood. Mali receives $500 million in foreign aid annually, which represents 25% of its gross domestic product (Koenker, 2000).

Additionally, a large number of foreign-sponsored development efforts have failed in Africa because so many of the resources devoted to them have been absorbed by government departments (and often by corrupt leaders and officials) and by contracts given to consultants and corporations from aid-giving countries (Oates, 1999). These efforts have also created an arena in which people who are already relatively rich and powerful compete for access to aid money. In fact, many development planners seem to

be under pressure to make their budgets as large as possible to bring in larger "administrative charges" for the organizations involved, and personal and organizational kudos are closely related to the size of a budget being proposed or administered. Added to this pressure is the fact that development-aid agencies will generally not consider proposals for spending small sums of money or for long-term spending, apparently because the costs of processing the paperwork and holding meetings over small amounts of money are felt to be too high. Aid agencies like to make plans and commitments for periods of only a few years – commonly three to five, yet what is needed for effective, sustainable development is the expenditure of small amounts of money for extended periods. Furthermore, in many development reports, planners stress the need to "empower" local people, using a form of paternalism, which seems to be deep-rooted in Third World development projects, planned and implemented by highly educated middle-class Westerners. This paternalism has made many citizens of the Third World feel just like it indicates: helpless, needy children.

With all the other geographic, demographic, and socio-economic pressures, it comes as no surprise that people do not help themselves sometimes. It's difficult for people to understand the transfer of skills and sustainability as being important, when survival is their top priority each day. Once they see an easy solution, it may be engrained in their memories as the only type of solution. In urban areas, it is more realistic to think that aid money could come your way since NGO offices and development workers' modern lives are in their view daily. For those in rural areas, aid money is a type of myth that only happens to those villages so surprisingly picked to flood aid money into. They hear about aid projects, hope, and soon forget, but the urban residents hear the French and see the white SUV everyday. Peri-urban residents also have similar attitudes and motivations as urban residents towards aid money since many have jobs within the city and visit the markets each week. They also see the offices, cars, and hear the language of development.

4.2 Rural, Urban, and Peri-Urban Project Comparison

According to Hardoy, et al. (1990), a typical neighborhood drainage improvement program passes through four principal phases: initiation, planning, construction, and maintenance. The first two phases are fundamental, as they determine all that follows. Initiation of a program may arise from the community's own identification of the need for better drainage, possibly after a particularly serious flood or as a result of drainage improvements in other neighborhoods. Water is often an initial starting point for community initiatives, as the essential nature of the issues means they are widely understood (UN-WWAP, 2003). In many cases, however, some external agency such as the municipality, a political party, a non-governmental organization, or a concerned individual such as a teacher or health worker catalyzes the identification. This phase involves identification of the need for drainage, formation of a consensus regarding the scope of the problem and the desired solution, and establishment of the drainage committee, at least on an interim basis. Where the initiative comes from outside, it is also likely to include a certain amount of work in the community to develop awareness of the problem and mobilize support for a drainage program.

Planning is the most important phase of all, as it involves the most fundamental decisions. The more decisions that can be taken in the planning stage, the better it is for the future of the program. The most basic decision for the community is whether to implement the drainage program on a formal basis through the local authorities, or to attempt a "do-it-yourself" project on their own. Formal drainage projects tend to be expensive, so that the first task of the drainage committee is to lobby and persuade the local authority to agree to support the program, unless of course the authority itself initiated the scheme. The authority will usually have to obtain finance from some other agency, which is likely to require a feasibility study and design by a consulting engineer before a contractor is given the job ob building the new drainage system. All this takes time – typically 3-10 years- and the community may prefer to carry out some "do-it-yourself" interim measures themselves, while they wait. Whichever approach is followed, it is important to define not only the layout and design of the new drainage

system but also the community's role in the construction and maintenance phases, and how its contribution is to be organized.

In Mali, a typical and simple improvement, usually on an interim basis, to sanitation in all regions is a wash area and/or soak pit project. Since there is often a problem with sewage and gray water evacuation (see Figure 13), but little space or money for full septic or sewer installations, appropriate technology solutions have proven the construction of a wash area and soak pit to be worthy.

Figure 13: Stagnant Water from Dishwashing (Ouayerma, Sikasso)

Using examples from in and around Sikasso, Mali, the process and factors involved in planning and building a wash area and soak pit are explained in the following sections. The urban example is taken directly from a process observed in Sikasso, the rural example is taken from Sokourani, a small village outside of Sikasso, and the peri-urban example is taken from the neighborhood of Ouayerma, located on the periphery of Sikasso. Each example explains the same project in terms of a contrasting environment.

A typical wash area and soak pit design, of course, depends on the number of people using it and the frequency of use. With each increase in population, the surface area of the wash area and the volume of the soak pit must increase. A wash area can be described as a slanted, walled concrete slab that feeds into the soak pit through a length of PVC pipe. Soak pits are makeshift septic systems in Mali and in much of the

developing world (sometimes referred to as soakage pits, leach pits, or soakaways). They consist of a hole in the ground near the area of drainage, filled with layers of sand, gravel, and rock to encourage timely seepage of sewage and gray water. In Figure 14, the wash area and soak pit design from Sokourani is presented and followed by a manual of practice design for soak pits in Figures 15 and 16 and the construction process of the wash area in Ouayerma in Figure 17. A full construction brief of wash area and soak pit construction in Mali is given in Appendix A.

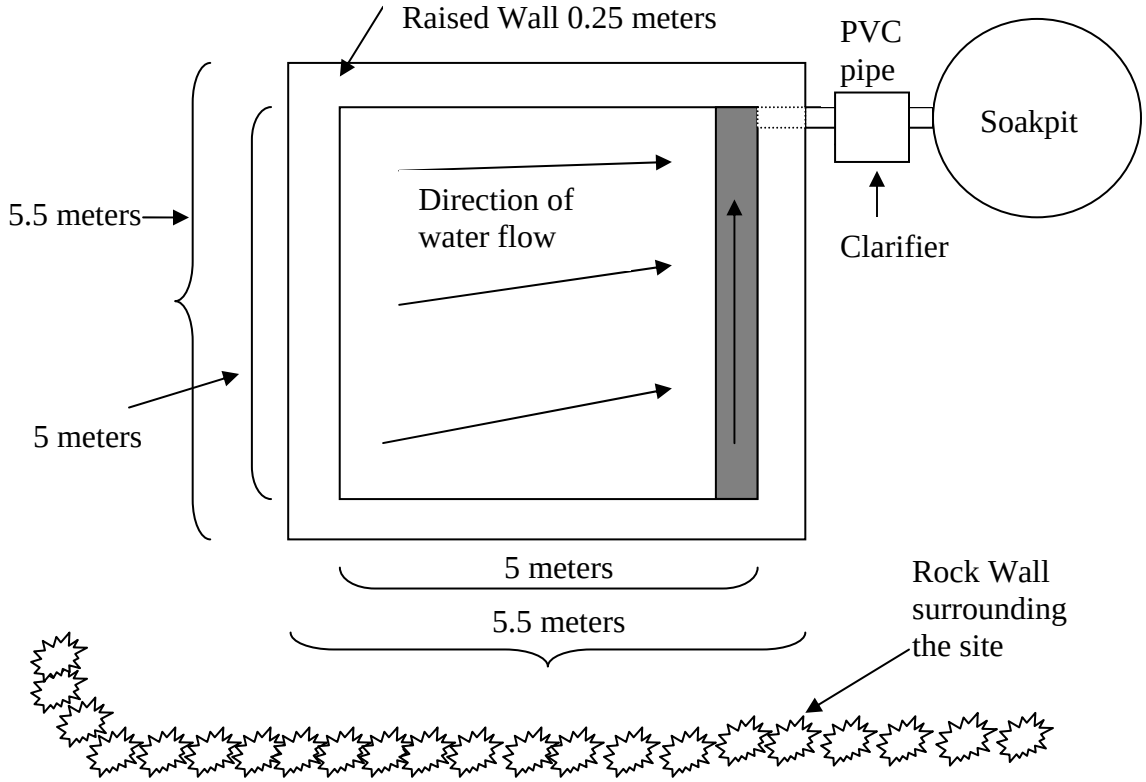

Figure 14: Wash Area and Soak Pit Design (Sokourani)

Source: Adapted from Dutcher, 2004

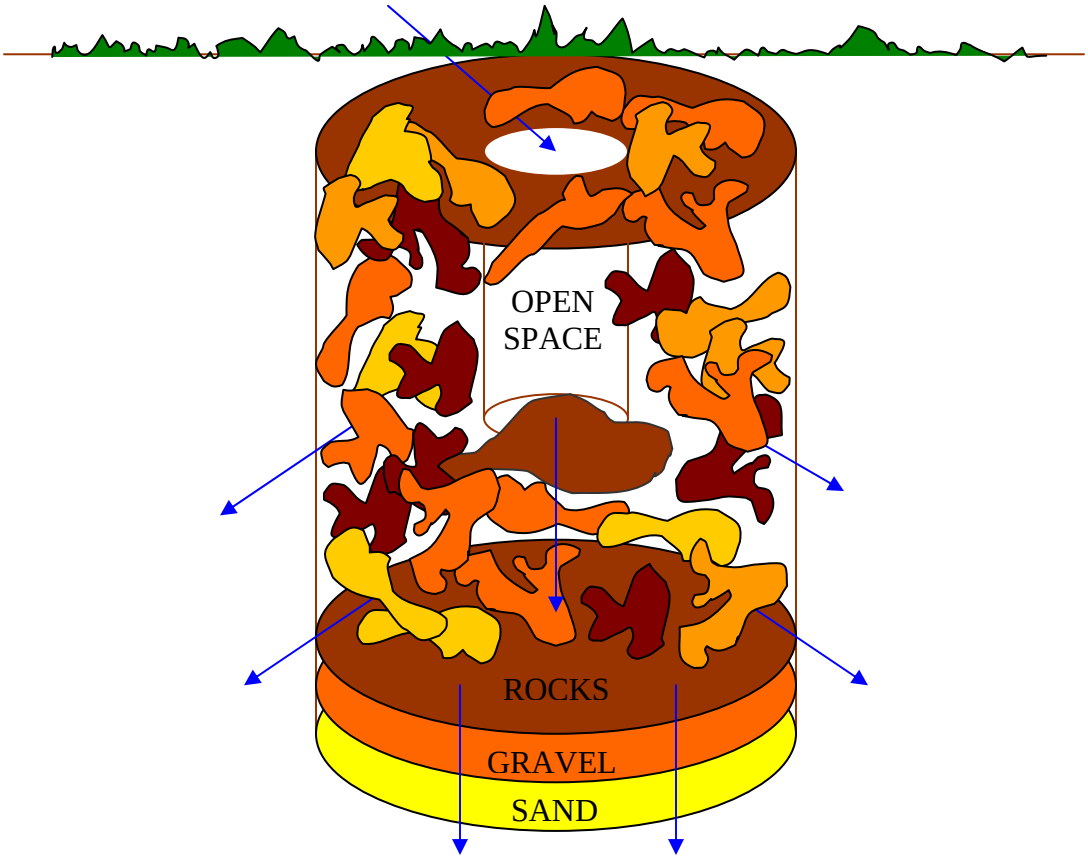

Figure 15: Soak Pit Design

Figure 16: Open Soak Pit with Installed PVC Pipe (Ouayerma, Mali)

Figure 17: Wash Area Construction (Ouayerma, Sikasso)

4.2.1 Project Flowcharts and Overview

In the following section, three flowcharts present the project process of constructing a wash area and soak pit in the city of Sikasso, the neighborhood of Ouayerma Extension on the outside of Sikasso, and the village of Sokourani, north of Sikasso. Each flowchart is generalized in order to exemplify the construction process in any urban, rural, or peri-urban area, yet they are based on specific case studies. In Table 8, an overview of the differences between each geographic location is presented in order to demonstrate the scale and background of each situation. Figures 18, 19, and 20 illustrate the flowcharts of the urban, rural, and peri-urban project processes, respectively.

	Sikasso	Sokourani	Ouayerma Extension
Geographic	Urban	Rural	Peri-Urban
Location	Capital of 3rd (in the Southeast) Region of Mali	80 Kilometers Northwest of Sikasso	Northeast Neighborhood on Periphery of Sikasso
Policy Makers	DRACPN	varies*	varies*
Private Sector	GIEs	varies*	GIEs
Beneficiaries	residents	residents	residents
Initiating Group	Belgium/Government of Mali	Health Committee	Women within Concession
Majority Involvement	Policy Makers	Beneficiaries	Beneficiaries
Population	5 – 60**	800	55 (One Concession)
Reason for Construction	African Cup of Nations	Malaria Prevention	General Cleanliness/Health
Funding Source	Belgium/Individuals	USAID/Residents	Landowner
Design Scale	1/Concession: wash area: 1 1/2 meters^2 circular soak pit: 2 meters deep, 1 1/2 meters diameter	1/Village: wash area: 5 1/2 meters^2 circular soak pit: 2 1/2 meters deep, 2 meters diameter	1/Concession: wash area: 1 1/2 meters^2 rectangular soak pit: 2 meters deep, 2 meters^2
Approximate Cost	US $300	US $220	US $76

*indicates that, in each case, no specific party was involved, but in general, can vary

**Projet Belge provides 500 wash area and soak pit constructions for those concessions of people who sign-up to be part of the project. In Sikasso, concession populations range from 5 people (single family) to 60 people (multiple families)

Table 8: Overview of Sikasso, Sokourani, and Ouayerma Extension Wash Area and Soak Pit Projects

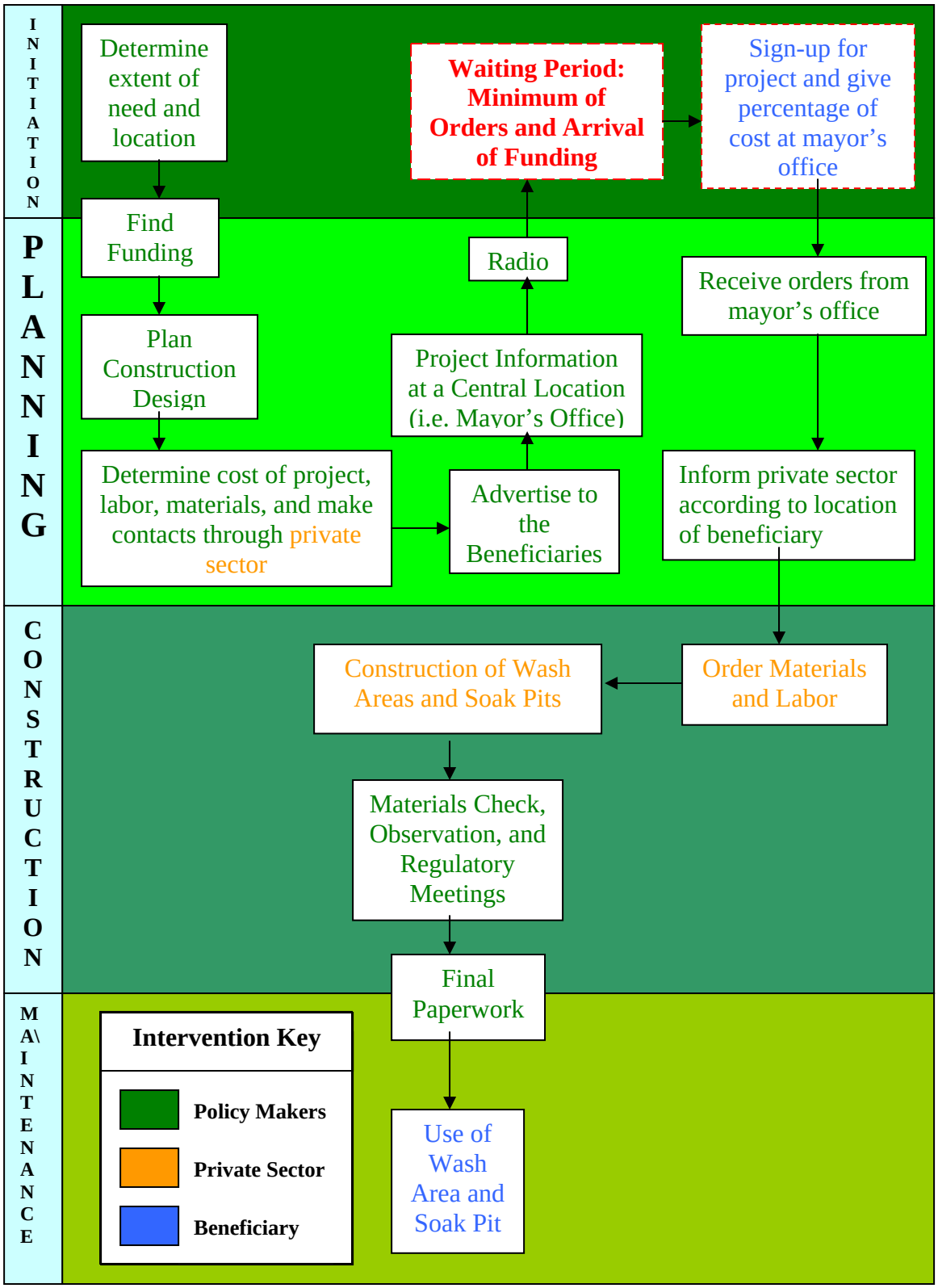

Figure 18: Flowchart of Urban Project Process

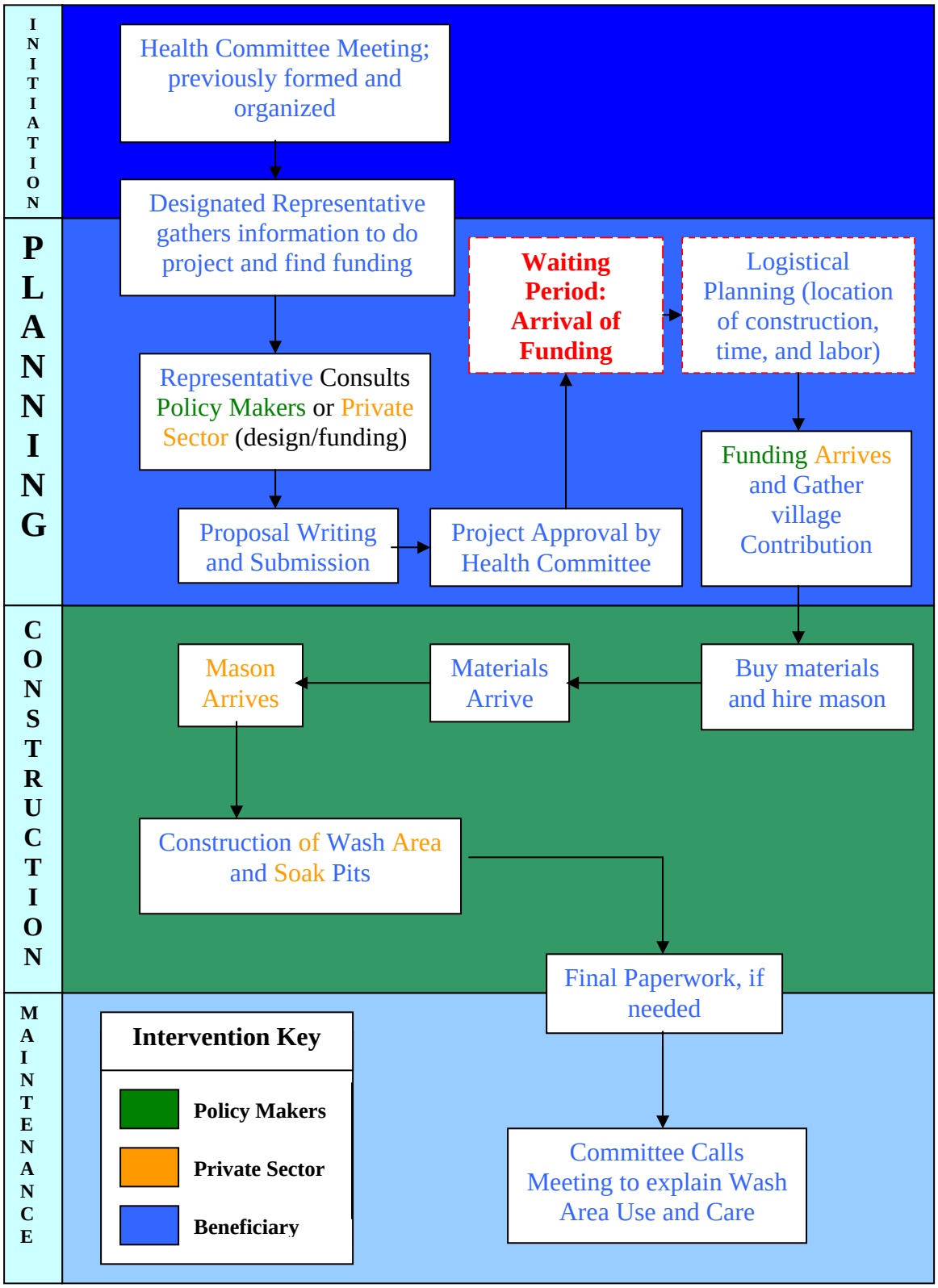

Figure 19: Flowchart of Rural Project Process

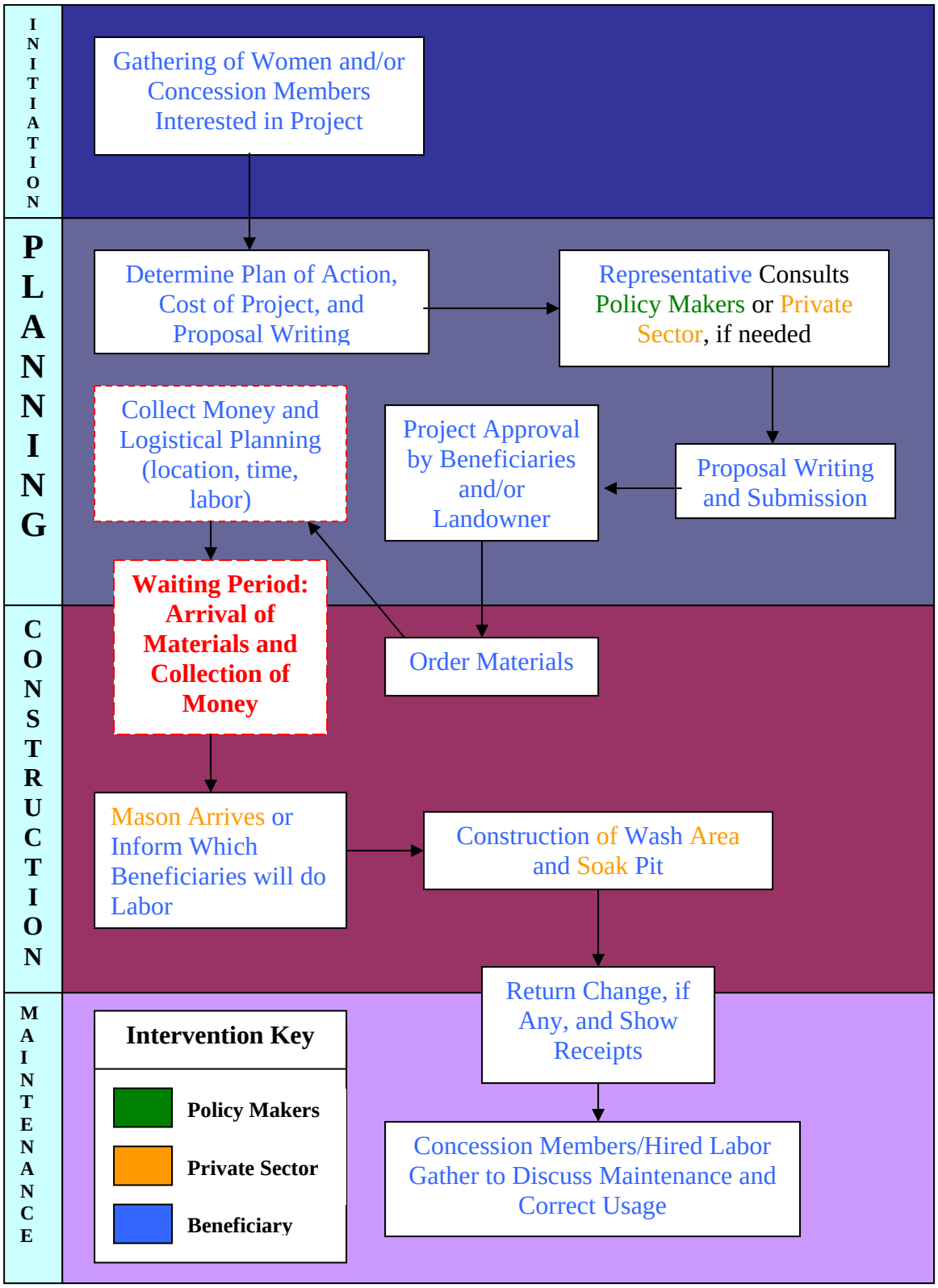

Figure 20: Flowchart of Peri-Urban Project Process

4.2.2 Case Study Descriptions

In order to understand how a project occurs in different settings, it is necessary to look at some real-life examples. For the urban project process, the basis for the flowchart is a project that occurred within the city of Sikasso, called Projet Belge. In this project, the government of Mali received funding from the nation of Belgium in order to improve the sanitation infrastructure in the capital, Bamako, and the second largest city, Sikasso. Projet Belge will eventually include the construction of a landfill, recycling center, equipment to improve solid waste collection, and 500 wash areas and soak pit systems (to those who sign-up and pay a percentage to be included). This project was/is managed by the Office of Sanitation and Pollution Control under the Environmental Ministry.

In the first flowchart in Figure 18, the process of building a wash area and soak pit project in an urban environment is visually presented. Through representative colors and with arrows, the flowchart shows the roles that the three parties (policy makers, private sector, and beneficiaries) involved take from beginning to end stages of the project. In the urban setting, typically the policy makers, such as a government office, will determine a need the type of project. In this case, the government office decides that the city needs more wash areas and soak pits in order to deal with the increased sewage and wastewater problem. The government office will then create a design for the project and work with the private sector to determine the cost for labor and materials. After the government office finds funding to implement the project as subsidized, they will begin to advertise through the mayor's office and radio the opportunity for any beneficiary to sign up and take part in the project (to have a wash area and soak pit built for them). Once the funding has arrived and the minimum number of beneficiaries have signed up and paid for their percentage of the project (the government office will designate a minimum number of participants before they will actually begin or do the project at all), the government office will assign the individual beneficiaries to the private sectors to begin construction. The private sector will order materials and labor and construct the wash area and soak pit at the beneficiary's location. During construction, the government office will regulate the progress and state of work, including materials check and

observations. When the construction is complete, the beneficiary will use the wash area and soak pit and the government office will pay the private sector and do the final paperwork for the funding organization and their base organization. In the urban setting, the majority of the project is carried out by the policy makers, indicated by the majority of green in the flowchart.

For the rural project process, the flowchart is based on a project that occurred within the village of Sokourani (meaning "little, new house" in Bambara, the local language), located 80 kilometers northwest of Sikasso. In this project, the village of Sokourani wanted to improve the area that women used for washing clothes and dishes near the pump. Since many women (approximately 50 per day) came to the pump to gather water and wash, a large stagnant pool of runoff had formed and become a breeding area for mosquitoes. Sokourani's health committee asked several Peace Corps volunteers to assist them in the management of a wash area and soak pit project in order to reduce their wastewater drainage problem.

In the second flowchart in Figure 19, the process of building a wash area and soak pit project in a rural environment is illustrated. Through representative colors and with arrows, the flowchart shows the roles that the three parties (policy makers, private sector, and beneficiaries) involved take from beginning to end stages of the project. In the rural setting, the beneficiaries, in this case, the village residents, will begin by holding meetings (within the framework of an already-organized, health committee) to discuss the need to reduce their sewage and wastewater. Typically, the health committee will designate a key person to find information for a solution and project design/proposal of the wash area and soak pit and find funding. The designated representative of the health committee may consult either a government office or private sector office for assistance with design and/or funding. When the representative finishes the project design/proposal, a health committee meeting will be held for its approval and planning of location and time of construction. After a waiting period for funding to arrive from either a government office or private sector office, the village will gather their monetary contribution and begin to buy materials and hire a mason (unless a village mason offers

assistance free of charge). When the mason, or village workers, and materials arrive at the construction site, the wash area and soak pit work will begin, and the health committee will oversee the work. Following the completion of construction, the health committee will call a village meeting to explain the use and care of the wash area and soak pit. If needed, the village, or designated representative, will do final paperwork to give to the funding donor. In the rural setting, the beneficiaries themselves carry out the majority of the project work, represented by a majority of blue within the flowchart.

For the peri-urban project process, the basis of the flowchart is a project that occurred in a concession in the neighborhood of Ouayerma Extension, at the edge of the city of Sikasso is charted. In this concession, there were approximately nine different households (eight women, nine men, and thirty-eight children) living within the walled enclosure at one time. The high density of people in a small area had created a strain on the infiltration of the soil for throwing out wastewater and at dish washing areas. The women and men constantly complained of muddy soil and puddles with mosquitoes near the shared well and all wanted to see a more sanitary way to rid the area of wastewater. With the collaboration of the residents, the landowner, and several Peace Corps volunteers, a wash area and soak pit were constructed.

In the third flowchart in Figure 20, the process of building a wash area and soak pit project in a peri- urban environment is presented. Through representative colors and with arrows, the flowchart shows the roles that the three parties (policy makers, private sector, and beneficiaries) involved take from beginning to end stages of the project. In the peri-urban setting, the beneficiaries, in this case, the residents of a concession located on the periphery of a city, will begin by holding meetings to discuss the need to reduce their sewage and wastewater. A first meeting will most likely be made up mostly of women (to discuss need), especially if it takes places during the day, when men are away at their jobs, and will be continued at night when all residents are more available. This group of residents will determine a plan of action to build a wash area and/or soak pit, according to their needs and verify if outside assistance is needed from a government office or private sector office to write a proposal/make a design. When the plan of action is completed,

either the residents will agree to implement the project and move on or a formal proposal is written to submit to the landowner for funding. After approval from the residents and/or landowner, materials will be ordered for delivery and during this waiting period, the residents will begin to collect money throughout the concession or from the landowner. In addition, the waiting period for materials is also a time that final discussion is made on the final time and place of the construction. Once money is collected, the residents inform the labor force (either amongst themselves or if they decided to hire labor from a private sector office) of the time and place of the project and construction begins. Once the wash area and soak pit is complete, the residents and/or hired labor will gather for a meeting to discuss its care, maintenance, and correct usage. If any money is left over, it will be redistributed amongst the residents or given back to the landowner with receipts. In the peri- urban setting, the beneficiaries themselves carry out the majority of the project work, represented by a majority of blue within the flowchart.

As already stated, the urban project process is primarily "top-down," while the rural and peri-urban project processes are principally "bottom-up," with this observation resulting in the largest difference between the three examples. In the urban example, the policy makers decide what is both the need and process to implement the project, even though the project itself does not directly affect the policy makers (they themselves do not use the constructed wash area and soak pit). However, individuals decide whether or not they would like to be involved in the project depending on the advertising within the city. In contrast, the beneficiaries in the rural and peri-urban cases decide what is the need and process to implement a project that does, in fact, directly affect them. These rural and peri-urban beneficiaries are involved in a majority of the project process, but in the urban case, the beneficiaries take on the role of a customer by paying the policy makers and private sector to complete their need (i.e. they are taking advantage of the opportunity presented to them by the government).

Also interesting to note in these examples is that the private sector is dependant upon the policy makers and the beneficiaries to find work and keep their business fruitful. Not in

any of the examples does the private sector initiate their business, but it depends on either the policy makers or beneficiaries to ask a specific job of them. In the urban example, the private sector is only asked for assistance with a cost estimate (although the policy makers have the right to make changes) and is told by the policy makers where to work and what to build. In the rural example, the private sector is only needed if they are asked to assist the beneficiaries with funding or finding workers. In the peri-urban example, the private sector may not be needed at all, unless the beneficiaries want some outside assistance with their design or in hiring labor. In many rural and peri-urban project cases in Mali, the private sector is rarely involved at all. Either the rural village or peri-urban beneficiaries/landowner does all the work themselves or they may have a contact at a private sector office, who off the record, helps them find funding or gives advice on their project design. In the urban setting, the private sector does all the labor while the policy makers oversee their work. In all cases, the private sector has very different roles, while in the urban case, the policy makers are the lords of management and, in the rural and peri-urban case, the beneficiaries control the project.

Concerning manual of practice for wash area and soak pit projects, there are some differences that may occur, but these differences are a result of space, soil type, and available funds, rather than urban, rural, and peri-urban environment. Wash areas may differ in size, shape, and preferred design, but usually these variables are directly related to the wants, needs, and preferences of the women using the wash area. For example, some wash areas are large enough for only one person to stand on if it is a personal wash area. Others are large enough for five women to use at once in order for women to work together. Soak pits may also differ in size and shape, but the basic design of layers of sand, gravel, and rocks, as shown in Figure 15, remains the same. Depending on quantity of wastewater or space available for building, the soak pit may be deeper, wider, or rectangular, rather than circular. Soak pits may also be covered in a traditional (sticks, leaves, plastic, mud) or improved manner (concrete slab) depending on money available or location. For example, a soak pit serving a small family's latrine may only need to be 1 ½ meters deep and 1 meter in diameter if the soil is sandy, but if the soak pit drains a village pump in rocky, clayey soil, the soak pit, may need to be 3 meters deep and 2

meters in diameter and covered with a concrete slab to add stability against passing donkey carts. Quality of construction may vary, although, most masons and private sector laborers learned similar methods of practice. In the specific cases of Sokourani and Ouayerma Extension, the same mason assisted in the construction. In Sikasso, the masons and private sector laborers vary depending on location of the 500 constructions.

In the case of Sikasso, the wash area and soak pit design was determined by the policy makers (i.e. DRACPN, the Sanitation and Pollution Control Office), and will be carried out identically for each individual that requests one (up to 500). In the peri-urban case, the wash area is the same design, but the soak pit was built larger to withstand an increase in wastewater due to many people living within the concession. Contrastingly, the cost is lower than the urban case since the labor involved in the construction was given by the residents. In the urban case, the private sector must be paid for the labor concerned. In the rural case, the wash area was larger to allow for several women to use the wash area at once, since it served an entire village. Many of the materials, like gravel and sand, were donated by the village, so the cause for the majority of the cost of the project was the cement that had to be bought.

Not only does each of these examples differ in their primary control of the project, but each of them also differs in funding and funding process. In the urban case, funding primarily comes from foreign aid. In order for governments and their offices to implement the projects at the level of design they require for follow-up assessments, the project must be somewhat subsidized. For example, Projet Belge required that all wash areas and soak pits be the same size and design, even if money could be saved based on the location's variables (i.e. soil type or space available). Additionally, most urban residents do not have the time or confidence in contributing to the construction process, so the cost increases with the hiring of the private sector to do the labor. In the rural case, a small percentage of the funding (anywhere from 10 – 33%) comes from the beneficiaries and the rest comes from requests to government offices for national budget money. Most villages, as in the case of Sokourani, cannot afford to pay for improvements to sanitation without some monetary help, but realize the importance of

input. If villages cannot pay as much as they would like, they may also contribute labor or food. In the peri-urban case, it could go either way: like the urban or rural, but it is usually a little of both processes combined. In the instance of Ouayerma, the landowner, also a beneficiary (but does not live on-location), funded the wash area and soak pit, as it is an improvement to land and increases its value. The residents of the concession saw an immediate need, but did not have the money to contribute or anticipate saving for the future. With the landowner's funding and the residents' labor, input, and organization, the project could be realized.

4.3 Discussion of Factors of Influence on Case Studies

In this section, the factors of influence's effect on the implementation of sanitation projects are discussed. Using the example of the wash area and soak pit project for each geographic area, the link between engineering and culture is brought into view.

In the rural example of Sokourani, a health committee initiated the wash area and soak pit project. Due to decentralization in Mali, information has been filtered down to local levels allowing rural residents to raise their knowledge of possibilities. In effect, the residents of Sokourani were aware of the potential of gaining assistance through aid money to the point of being pro-active in beginning the project. In many rural areas, people may not initiate projects, unless they know there is a good possibility that their actions will be fruitful. Additionally, through residents moving to urban areas, like Sikasso, knowledge and ideas had been carried back to the village, reinforcing ideas of improvement. The residents of Sokourani felt it was important to improve the areas around their pump for health reasons and felt responsible to act when they knew of the possibility of assistance. Since the area near the pump was used frequently, the pollution was gathering in one space and creating a dangerous and dirty cesspool, surrounded by mosquitoes. During the dry season, when farmers' work is decreased, it is possible to use this work force for other efforts, such as the construction of the wash area and soak pit. With the open space around the pump area, materials, money, and food contributions from the village, it was decided to implement the project in June of 2004. The total cost

was kept low due to these contributions, space for the construction was available, and time was allotted for the residents to work together with several volunteers. By working with an organized committee and representative, the process was recorded in the village for future reference. In addition, the committee was able to educate the residents about the purpose and maintenance of the wash area and soak pit, reinforcing the importance of hygiene and cleanliness.

In this case study, the most catalytic factors were the presence of aid money, decentralization, and mobility of people by affecting Sokourani's society and organization. Interesting to note is that decentralization worked in a very positive way in this small village in that its residents became more informed of how to make their own improvements. The government of Mali moving responsibilities to smaller, local groups and organizations (e.g. within the city of Sikasso 80 kilometers away) has spread knowledge. Reinforcing this factor was that of the mobility of the village's own people, who also carried information and ideas into the area from the urban centers. The availability of aid money worked in positive and negative ways in Sokourani. It was positive in that the thought of available assistance was enough to motivate the residents to act, but negative in that they never thought to fully fund themselves, reinforcing the idea of dependence. But this project implementation, like those of organized villages, is an example of moving slowly towards sustainability, instead of doing so in one large step.

In the urban example of Sikasso, the government of Mali initiated the wash area and soak pit project by receiving funding from Belgium, as part of a larger sanitation improvement scheme during the Cup of African Nations, a continent-wide soccer tournament held in Mali in 2002. In Sikasso, the national government put the Sanitation and Pollution Control Office (DRACPN) as head of the design and implementation processes of Projet Belge in order to improve the city of Sikasso's abundant wastewater problem. As in Sokourani, many cesspools were found throughout the city, making Sikasso attractive to malaria-infected mosquitoes. Due to decentralization, the private sector was involved in order to complete the constructions and assist the policy makers with the cost estimate, although confusion between roles exist (i.e. some GIEs build soak pits on their own

without regulations). Those residents that feel responsible to improve their property, either renters or landowners, will respond to the policy makers' offer to build a subsidized wash area and soak pit system. The cost of design, materials, materials transport, and labor (estimated at US $300) is more than most residents can afford or budget. Additionally, most residents have no knowledge or time to build soak pits or wash areas due to changed work roles and responsibilities and have long day jobs within the city. If the policy makers investigate each requested improvement and space exists for the construction, the soil filtration rate is high, the need for improvement is high (high concentration of wastewater/pollution), and the beneficiary is willing to pay 30% of the total cost, then their name is added to the list of 500 allowable wash area and soak pit constructions under Projet Belge. As constructions begin across the city, other residents may learn the importance of wash areas, soak pits, and lifestyle changes by observance and talking with the beneficiaries, therefore spreading knowledge within Sikasso. The policy makers may or may not keep a record of their designs and regulations throughout the project, but they will return final paperwork (usually a financial report) to the national government for Belgium's records.

The main influences for the urban wash area and soak pit project were the presence of aid money, education, and the concentration of pollution. When the Cup of African Nations was known to come to Mali, the national government wanted the major cities cleaned up in order to impress tourists and guests traveling to support their team. Had the pollution in cities like Sikasso, Kayes, and Bamako not been a huge problem, Belgium might not have become involved. Belgium's interest in cleaning up Mali worked in their favor, as well as making infrastructure changes possible. Such a large-funded project gained much publicity and, is still today, working to improve Mali's sanitation. As a result, many more people have gained insights into sanitation and become educated on its relationship to health.

In the peri-urban case study, a small concession of people initiated an interest in improving the dirty and poorly drained areas within their living space. Like the other two case studies, stagnant water became a problem for the residents in the neighborhood of

Ouayerma Extension in Sikasso. Through factors like decentralization (local government workers lived within the concession), education, and population mobility (the concession contained people from many regions), knowledge of the situation was common, so improvements held a high importance. Working against the need to act on building a wash area and soak pit were residents not feeling responsible to improve the property themselves (all residents were renters); possibilities of waiting for foreign aid; not able to afford the cost of materials, transport of materials, or labor; limited space within the concession for construction; and high quantities of wastewater and low soil filtration. Through the landowner working with several representatives of the concession, the construction was funded, cost was kept low, and residents took turns contributing labor, though many residents' daily schedules and jobs conflicted with the process. Since population mobility is high in peri-urban areas, it is certain that knowledge and history of this particular project within the community will not be preserved.

Highly influencing the peri-urban case study were ownership of property, standard of living and costs, and education. On the positive side, being near an urban center meant the residents of Ouayerma had increased knowledge and education of sanitation and its influences on a person's health. Therefore, it was common for them to understand the need for a wash area and soak pit when their wastewater quantity kept increasing as families became more concentrated. On the negative side, their location affected their work roles and ability to keep up with the standard of living they were educated about. Most people had busy lives in order to make ends meet, and extra time for sanitation improvements, despite their education, were not a priority. Also as a result of cost, most residents were renters, giving them no extra incentive to improve the wastewater problem, unless the landowner worked with them directly to alleviate conflicting financial issues. Those living in Ouayerma Extension experience a very rural type of lifestyle paired with the disadvantages of living near an urban center.

5.0 Conclusions and Recommendations

Nothing is ever quiet, except for fools.

Alan Paton

Cry, the Beloved Country, (1948)

This section offers conclusions and recommendations, based on the full experience with the wash area and soak pit constructions described in this report.

The construction of wash areas and soak pits were a simple, yet little known technology to me before working in and around Sikasso, Mali. Over the course of my involvement with several constructions, I learned about their importance, design, construction, and maintenance. During each process, whether urban, rural, or peri-urban, logical thinking and solutions had to be set aside to consider cultural issues, and especially the influential factors discussed in this report. Together with Malians, we exchanged knowledge of project implementation.

Eventually, Projet Belge will realize 500 wash areas and soak pits in the city of Sikasso, affecting uncountable residents. The project within the concession in the neighborhood of Ouayerma serves up to 10 families, and north of Sikasso in Sokourani, the wash area and soak pit serves the entire village of 800 residents in 18 concessions.

By understanding the project implementation differences, engineers and development workers can make better decisions about global sanitation for the future. This understanding reinforces a high priority on culture during project planning, as the factors of influence indicate in regard to each project flowchart. Even though each flowchart is based on a specific geographic case, it is suggested that they illustrate reproducible results within urban, rural, and peri-urban areas beyond the scope of this report.

With the current trends in urbanization, understanding project implementation in urban, rural, and peri-urban areas is vital. The flowcharts within this report prove that urban,

rural, and peri-urban project implementation involve very different technical and cultural planning, so often forgotten by Westerners involved in water supply and sanitation projects. Specifically, due to urbanization, peri-urban areas are growing along with their dangerous squatter and congested housing conditions. These areas need the help that engineers can give, if they have proper understanding of the conditions. Colburn (2002) worries that the rapid growth of cities has led to an atomization of society: an absence of community, a lack of infrastructure (public goods), an inability of governors to offer needed social services, an ugly side-by-side contrast of munificence and poverty, a concentration of pollution, and an impoverished rural sector that is increasingly neglected.

Additionally, economic crises are forcing governments to cut their social expenditure, resulting in cuts of already inadequate spending in water, sanitation, garbage collection, and health care. At the base of many of the sanitation problems is economics, whether in urban, rural, or peri-urban areas. In order to improve sanitation, income-generating projects may need to be implemented simultaneously. Especially when considering the linkages (i.e. agriculture) that urban centers have on peri-urban, and then, rural livelihoods, income plays a large role in sanitation benefits. By understanding the big picture, water supply and sanitation projects will prove successful. In particular, Malians want development workers to understand their lifestyles and culture.

In addition to my experiences with wash area and soak pit constructions, I would have liked to produce some statistics or further study on the success rate, maintenance, and additional manuals of practice, such as pipe soak pits for high water tables. A summary of suggested design and additional factors to consider in the future is listed in Table 9. Despite the immediate improvements that wash areas and soak pits bring, I have encountered some problems along the way, both technical and cultural. In particular, I would have liked to implement more clarifier-type work (construction of small, settling tanks between the wash area and soak pit to prevent solids from flowing into the soak pit), along with these constructions, as well, and study their influence and understanding amongst urban, rural, and peri-urban communities.

Geographic	Design	Influential Factor
Urban	Connection to Treatment Facility	Modern Capitalism – in Relation to GIEs
Rural	Clarifier Maintenance	Risk-Taking Behavior
Peri-Urban	Pipe or Trench Soak Pits for Low Soil Infiltration	Availability of Labor and Individualism

Table 9: Future Construction and Needs

Moreover, if the differences between urban, rural, and peri-urban areas are to be studied further, more factors of influences must be considered, particularly dealing with differences in receptivity of technology. The ten factors in this report are indicative of Mali, and moreover, near the city of Sikasso, in southern Mali. By understanding more about life expectancy, availability of labor, property laws, individualism, risk-taking behaviors, tolerance of diverse views, religion, modern capitalism, war, climate, and resources, there would be an even fuller understanding to the success rates of water supply and sanitation projects in urban, rural, and peri-urban areas.

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APPENDIX A

THE STEP-BY-STEP WASH AREA…and a Soak Pit on the Side

Description of Project:

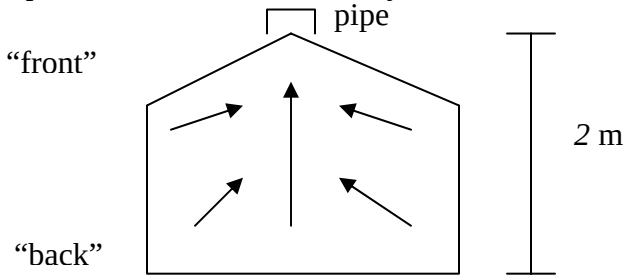
A pentagon-shaped, sloped, concrete slab within the dimensions of 2.0 meters by 2.0 meters will drain into a pipe into a soak pit with a volume of 8 meters cubed. This wash area and soak pit was calculated for use in one large concession of about 10 families.

List of Materials Needed:

Sand	Picks	Rope
Bags of Cement	Dabbas (W. Africa)	Rock Hammer
Gravel	Buckets	PCV pipe
Rocks	Plushes	
Shovels	Trowels	

Steps:

1. First things first…so there is a need for a wash area? Make sure you gather the women together to decide on the placement and size. If they don't agree, they won't use it.
2. Do all your calculations and order materials. You will need shovels, picks, dabbas, buckets, plushes, and trowels.
3. Clean off the soak pit area of weeds and loose rocks. Lay out the area (pentagon-shaped) to be sloped with string.
4. If your soil is as hard as rock, put 3-4 buckets of water on top to let it sink in.
5. Dig down the marked off area about 10 centimeters. Try to make it level, but the important thing is that the back slopes towards the front where the pipe will drain.
6. Fill the dug out area with softball-sized rocks. Again, make sure the rock slopes back to front. These rocks will later support the concrete to stay sloped. Also, make the rocks slope from the sides inward so your direction of water is as follows:



top view

7. Break the rocks with a hammer to create a homogeneous layer with a few spaces- this reduces the amount of concrete needed and reduces cost.
8. If you have extra gravel, fill in spaces with it.
9. Once the rocks are sloped well and are similar sizes, begin mixing concrete.

10. Lay a 5 cm layer of concrete down on rocks to create a smooth sloped slab. Pat slab with plush so the water rises to the top.
11. Let the slab dry about 2 hours.
12. Mix mortar. You will lay out the back 3 walls first. Place a 1-2 cm layer of mortar on one edge of the slab where the wall is to be built. Select softball sized rocks and place them successively on top of the mortar layer. Use additional mortar and a plush to make the inside wall of the wash area smooth. Don't forget to fully cover all exposed rock surfaces! Repeat for the remaining 2 walls.
13. Use remaining concrete or mix more as needed to place on the outside walls for reinforcement. Use mortar to cover all rocks in the walls and to smooth out surfaces and corners.
14. Once the hole (or trench, as the situation may be for those with a high water table) is finished, place the pipe leading into the soak pit. You have a choice to place a piece of screen on the end of the pipe to keep dirt, small rocks, food particles, etc. from flowing into the soak pit.
15. Build the front two walls directing the water towards the pipe exactly like the other 3 walls, using a layer of mortar, softball-sized rocks, and finishing with mortar and concrete.
16. When you are finished, the wash area should be fully enclosed by 5 walls with a surface sloping into the pipe. Let the completed wash area dry one day.
17. In order to create a smooth floor surface, clean off all loose rocks and dirt off the slab. Mix additional mortar with very clean sand and a high cement content. Wet the slab and lay a 1 cm layer of mortar over the entire floor with a trowel and plush. Sprinkle loose cement over the surface and "mist" with water. Smooth out the surface with the trowel and let it dry smooth as glass. Note: As long as the floor drains into the pipe, you have a working, wash area. It is your choice as to how smooth or "pretty" to make the floor area. You can use as much mortar or loose cement as you want to keep smoothing out the surface.
18. Keep concrete and mortar areas watered for 3 days at least, but a week is best to build up concrete strength and durability. This is usually an issue of how long you can keep people from using it.
19. Don't forget to complete your soak pit and cover it before people use the wash area (See Annex).
20. HOORAY! You have finished! Continue teaching people about upkeep of the wash area by not wearing shoes when working on the wash area, cleaning the screen, and sweeping the surface daily.

ANNEX

Soak pit Quick Steps:

1. Dig your soak pit hole the calculated dimensions.
2. If your soak pit area is very sandy, you also may need to line the hole with bricks for additional wall support.
3. Lay a 4 cm layer of sand on the bottom floor.
4. Lay a 4 cm layer of gravel over the sand layer.
5. Fill the hole with rocks until the height of the end of the pipe from the wash area.
6. Under the end of the pipe (which should reach the radius/center of the top view), place a good, flat rock in order to encourage the spread of the outflow of the pipe throughout the rocks in the soak pit.
7. Leave an empty space around the flat rock and end of pipe, creating a “hole” surrounded by rocks.
8. Continue to completely fill the rest of the soak pit with rocks. Place rocks over the pipe, but not touching, to protect it from upper pressure and cover your middle “hole” with a top rock as well.
9. Cover soak pit with sticks, rice sack or plastic, and mud. Make sure mud area is compacted and strong. Note: This is the “village,” cheap way.
10. If soak pit area is a high traffic zone (i.e. cars, donkey carts, heavy items), you may need to cast a concrete slab with rebar to cover it, instead of sticks and mud.

Soak Pit Dimensions and Notes:

- For families, you can generally build a good soak pit with a 1 meter diameter and 1 ½ meters depth.
- For village or full concession use, build one AT LEAST 2 meters diameter and 2 meters deep.
- Some Considerations:
    1. Soil infiltration? Soil Type?
       --If you have sandy soil, the water will drain quicker than a more clayey soil, but it is not as supportive on the walls. So clayey soils tend to need a bigger soak pit to compensate for the slow infiltration.
    2. Amount of water outflow?
       --The number of people using the wash area affects outflow. Are people dumping other water down the pipe as well? If so, you might want to increase the size of your soak pit.
    3. Does water have particulates? Soap only?
       --Water with particulates in it will fill your soak pit hole quickly! In this case, you might need to add a makeshift settling tank or clarifier before the water drains into the soak pit. You could also add screen to your pipe and periodically clean the surface to facilitate drainage without problematic solids.

- It has been found that in areas with bad infiltration and hard soils, layers of sand and gravel in the bottom of the soak pit help to maintain the bottom of your hole by creating spaces for continual water flow and seepage. If your soil drinks a lot of water, you will have nothing to worry about, and might be able to fill it with only rock. Clay and rocky soil definitely needs these sand and gravel layers to do the job right.

Don't Forget Maintenance!

The life cycle of a soak pit is generally 3-5 years (although the wash area may last longer since it is mainly a concrete slab – if children misuse it or large herd animals walk on it, this may decrease it's life cycle). How you cover your soak pit may increase or decrease this cycle. If you choose the traditional, village way to cover your soak pit, the cost is cheaper initially, but 3 or 5 years later, it may need to be opened up, cleaned out, and re-filled with the layers of sand, gravel, and rocks. Opening up layers of sticks and mud may be difficult, or may have decomposed in a way that eventually clogs the PVC pipe. Using the improved cover (a cast, concrete slab) makes opening up the soak pit easier in the future, if there are problems. The improved cover also ensures that the open space in the middle of the soak pit stays open for encouraged seeping of the wastewater. Keep in mind that just because your soak pit has a problem, does not mean that you need to start from the beginning again. Soak pits may be opened, cleaned out (spreading out small amounts of the wastewater over large areas for fast seepage), and re-filled with the same rocks. Put on your gloves (that wastewater can be dangerous!) and re-use the same hole!

Materials Calculations-Looking at the example of the 2m by 2m wash area

In no way are these calculations, estimations, and assumptions the perfect answer for all situations. This information is meant to be shared in order to assist other "jibagans" in their materials' estimations.

"What kind of concrete and mortar goes where?" "Well…this is what we did!"

Concrete:	Wash Area Surface and Wall Support	1:3:5 mixture
Mortar 1:	Wall Placement and Finishing Pipe Placement and Finishing	1:4 mixture
Mortar 2:	Wash Area Floor Finishing	1:2 mixture

Cement Calculations and where the numbers come from:

***1:3:5 Mix** *Assume a 5 cm layer of concrete on wash area surface

$\mathbf{V_1}$ = Volume of wash area surface = 200 cm x 200 x 5 cm = **200,000 $\mathbf{cm^3}$**
Assume 1/3 more volume to account for the wall support
$\mathbf{V_t}$ = Total Volume of Concrete Needed = 200,000 cm^3 + 1/3(200,000) = **266,666 $\mathbf{cm^3}$**

compaction losses

$$\mathbf{U} = \text{Unit Weight of Concrete} = \frac{(V_t)(1.5)(1.1)}{\text{(Mix sum)}} = \frac{439{,}999}{9} = \mathbf{48{,}888.8\ cm^3}$$

Add numbers of mix

*dry cement is 1200 –1440 kg/m^3 in unit weight, we chose 1300 kg/m^3

$$\text{Cement needed for 1:3:5 mix} = 48{,}888.8\ cm^3 \times \frac{(1\ m)^3}{(100\ cm)^3} \times \frac{1300\ kg}{m^3} = \mathbf{63.5\ kg}$$

***1:4 Mix** *Assume 1/5 of V_1 to calculate V_t

$\mathbf{V_t}$ = 1/5(200,000) = **40,000 $\mathbf{cm^3}$**

$$\mathbf{U} = \frac{66000}{5}\ cm^3 = \mathbf{13{,}200\ cm^3}$$

$$\text{Cement needed for 1:4 mix} = 13{,}200\ cm^3 \times \frac{(1\ m)^3}{(100\ cm)^3} \times \frac{1300kg}{m^3} = \mathbf{17.2\ kg}$$

***1:2 Mix** *Assume 2 cm layer to finish floor surface

$\mathbf{V_1 = V_t}$ = 200 cm x 200 cm x 2 cm = **80,000 $\mathbf{cm^3}$**

U = $\frac{132{,}000}{3}$ cm^3 = **44,000 $\mathbf{cm^3}$**

Cement needed for 1:2 mix = 44,000 cm^3 x $\frac{(1\ m)^3}{(100\ cm)^3}$ x $\frac{1300kg}{m^3}$ = **57.2 kg**

Summary of Cement Use in Terms of Buckets and Bags									
Phases	**Cement (buckets)**		**Sand (buckets)**		**Gravel (buckets)**		**Mix Descriptions**		**Cement Use in bags (1 bag = 50kg)**
	Concrete	**Mortar**	**Concrete**	**Mortar**	**Concrete**	**Mortar**	**Concrete**	**Mortar**	
Floor + first 3 walls	3	1	9	4	15	0	1:3:5	1:4	1 1/3 bags
Back 2 walls + pipe placement	1/2	1	1 1/2	2	2 1/2	0	1:3:5	1:2	1/3 bag
Floor finishing	0	1	0	2	0	0	N/A	1:2	1/3 bag
Total Used	6.5 buckets		18.5 buckets		17.5 buckets				2 bags

And Finally…what was actually ordered:

Matériaux	Quantité	Unité	Coût
Sac de Ciment	2 sacs	5,500	11,000
Tuyau PVC, D100 cm	1,5 m	1,500	2,250
Gravier	3 charrettes	1,000	3,000
Sable	2 charrettes	1,000	2,000
Roches	1 voiture	20,000	20,000
		TOTAL	38,250

***Originally, it was thought to need 15 donkey carts of rocks, equaling 1 car of rocks*

The total materials used for the wash area and soak pit separately are:

Wash Area

2 bags cement
2 donkey carts of rocks
2 ½ donkey carts of gravel
2 ½ donkey carts of sand

Soak Pit

½ donkey carts of sand
½ donkey carts of gravel
7 donkey carts of rocks
1 ½ m PCV pipe
Piece of plastic, 2x2 meters

**Note: the estimations of sand and gravel were based on the assumption that materials filling 3 cement-sized bag could fit on one donkey cart:
Therefore, 1:3:5 mix = 2 bags of cement, 6 bags of sand, and 10 bags of gravel, meaning about 2 donkey carts of sand, and 3 donkey carts of gravel