Fall 2010

Life on the Periphery: The Effects of Urbanization on Health in a Bidonville in Bamako, Mali

Adrienne Epstein dit Raki Bah
SIT Study Abroad

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Mali: Health, Gender, and Community Empowerment

Independent Study Project

Project Advisor: Sounda Ibrahima Siré Traoré

Acknowledgements

I would like to thank M. Traoré, my advisor and the extremely dedicated coordinator of PACAPSI, who patiently explained to me the differences between a "traditional," "semi-modern," and "modern" latrine, who created a day-to-day schedule for my ISP so I would not get off track, and who encouraged and supported my work daily. His unyielding devotion to improving the lives of Sikoro residents is truly remarkable.

I also must thank Souleymane, my translator and friend, who led me around a 95-degree and sunny Sikoro relentlessly, teaching me new Bambara phrases and laughing at my inability to handle the heat, not to mention sitting through nearly fifty interviews.

To the families of Sikoro, thank you for welcoming me into your homes and sharing with me your grievances and concerns about water and sanitation, and for always finding a way to make fun of me for not speaking any Fulani*even* with the last name "Bah."

Thank you to the members of Mali Health Organizing Project for finding me a temporary host family in Sikoro.

I of course must give a huge thank you to the Bah family forhousing me for the past three months; the endless games of UNO and numerous attempts to braid my hair (without my consent) will certainly be missed.

And finally, thank you to our teeny tiny group and the professors and staff of SIT for being such great classmates, instructors, travel mates, and friends.

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I. Introduction

A Staggering Trend

In the past decade, the world has crossed a threshold that a century ago would have seemed unimaginable: the majority of the global population now lives in cities.A startling pattern of rapid urbanization began in the final decades of the 20th century and continues today at a striking pace. The percentage of the global population residing in urban areas increased from 32 percent in 1955 to 47 percent in 2002, and is expected to reach 65 percent in 2015.[1]This trend is particularly notable in the developing world, where an arrival of rural migrants in search of labor has caused the urban population to explode; between 1970 and 1996, the number of cities in developing countries with a population of greater than one million increased from 83 to 221.[2]The "rural exodus" and resulting urban population boom has created grave problems for infrastructure systems in many cities, which simply cannot support the rapid influx of people. Resulting problems vary, ranging from the struggle to provide adequate education to an increasing number of students, to attempting to provide a management system that can dispose of solid waste generated by the population. The city of Bamako, Mali, is an eloquent exampleof a city struggling with its growing population. The government of Bamako faces grave problemsin its ability to provide both potable water and a waste management system to support its large numbers. As a result, a multitude of local and foreign NGOs have established themselves to make up for the government's failure to provide basic public services. Despite their efforts, the city is simply too large and expanding too quickly to be supported by these organizations, and severe problems associated with human health have stemmed from the population's growing numbers. This study is designed to identify these problems, ascertain their causes, and evaluate

[1](Moore, Gould and Keary 2003)
[2](Moore, Gould and Keary 2003)

current public and private efforts in place aimed at improving sanitation and access to water in Sikoro, one of the poorest neighborhoods on the fringes of Bamako.

Global Urbanization: The Why and the How

While the pattern of rapid urban growth has varying causes in different regions across the globe, numerous generalizations can be made as to why this trend is occurring at such a staggering pace in the developing world. Overall improvements of medical care, such as the development of new vaccinations and methods of disease control, have resulted in a natural increase inglobal population numbers. This has had particular effects in developing countries, where medical advances have helped hinder infectious diseases such malaria and tuberculosis, and, along with lowering the death rate, healthcareimprovements have succeeded in lowering the infant mortality rate. The resulting natural population growth has put strain on the environment, principally in rural areas where space is limited but necessary for livelihoods. Despite this, much of this natural population increase occurs in rural areas, where parents find economic security in having a large number of children and where the infant mortality rate is high, thus having a large number of children is seen as necessary to guarantee a sizeable family.

This increase in rural populations puts strain on theland, which cannot support such high numbers of people. Consequently, availability of cultivablefarmland is one cause for the phenomenon known as the“rural exodus,” since land simply cannot support the rapid rate of population growth. Other economic factors also contribute to the rural-urban migration trend. A fluctuation of world market prices ofagricultural exportspressures agrarian workers, sincea farmer’s income can vary greatly depending on the world economy, thus economic security is difficult to come by. In addition, structural adjustment programs (SAP), instated in Africa by the

World Bank and in International Monetary Fund in the 1980s, led to a decrease in governmental investment in agriculture. Under SAP, global trade liberalization has caused in influx of cheap imports into many developing countries, making it difficult if not impossible to sell locally grown and unsubsidized products at a competitive price.[3]The divestment in the agricultural sector has put rural populations at an apparent disadvantage to the urban population, which has access to water, education, healthcare, and other services tending to clusterin cities. This uneven development between urban centers and rural areas is yet another factor contributing to the rapid urbanization of the developing world.

While this pattern is a global phenomenon, it is particularly stark in Africa, where urban population growth rate is at a striking 4.87 percent.[4]All of the aforementioned causes for the rural migration are particularly pronounced in Africa, a continent crippled by its years of colonization and weak governments. The importation of cheap crops from Asia, such as rice, puts local rice farms at a loss, since they cannot compete with the heavily subsidized goods sold at very low prices. Additionally, SAP in African countrieshad detrimental effects on rural farmers, who once relied on government subsidies and investments for their livelihoods. It is for this reason that in 1900, Africa was 5 percent urban, and by 1996 that number had increased to 39 percent.[5]

[3](Boadi, et al. 2005), p 470
[4](Boadi, et al. 2005), p 466
[5](Boadi, et al. 2005), p 467

II. Urbanization and Health in the Developing World

Intra-Urban Inequalities

The unprecedented influx of people into urban centers throughout Africa has injurious effects on the cities' infrastructure and social services, which are struggling to grow at the same rate as the cities' populations.

In theory, access to public services is significantly better in urban centers than in rural areas. Citieshave more public services, and therefore general health is betteras access to healthcare is significantly improved. Furthermore, an increase in both income and level of human development are correlated with urban growth.Cities in the developing world account for between 50 and 80 percent of the country's GNP, and child survival rates are higher in cities because of greater access to healthcare.[6]

However, rapid urban growth in the developing world is often unplanned and thereforeputs a number of strains on society. While physical proximity to healthcare centers may be improved by living in a city, this does not necessarily mean that overall healthcare is improved. Development is extremely uneven in cities; some neighborhoods may prosper, but others certainly do not. Intra-urban inequalities are substantial. In 1996 the United Nations Population Fund estimated that 41 percent of urban populations in sub-Saharan Africa were living in poverty.[7] The urban poor are said to be threatened by the "double burden" of disease: the first burden related to lack of development, such as access to safe drinking water and adequate sanitation, while the other burden is related to the modernization of cities, such as air pollution and road accidents.[8]

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[6](Moore, Gould and Keary 2003), p 270
[7](Boadi, et al. 2005), p 476
[8](Boadi, et al. 2005), p 487

Additionally, rapid urban growth results in settlement on marginal land, causing danger to its inhabitants. Construction of new homes tends to be rapid and of poor quality, resulting in tenement housing extremely vulnerable to the elements. Dwellings are normally crowded, and this close proximity of people increases contact with the air and surfaces that other people breathe on and touch, worsening the spread of infectious diseases. It is estimated that between 30 and 60 percent of urban dwellers in Africa inhabit slums.[9]

Pollution and Environmental Degradation

Environmental degradation caused by rapid urbanization poses a major threat to human health. Air pollution, both indoor from burning coal and outdoor from automobiles, presents a major problem and causes respiratory disease, asthma, and chronic obstructive pulmonary disease. Problems associated with sanitation and providing adequate sanitary infrastructure, such as available landfill space and waste management, create major issues in cities. The buildup of solid waste can prevent adequate water drainage, creating stagnant water pools serving as a breeding site for vectors of infectious disease, such as malaria.[10]

Waste pollution is another fundamental problem associated with urbanization in the Global South. The rise in the consumption of resources that occurs in growing cities also results in an increase in waste generation. Weak policies and resources result in little to no waste management in most cities in sub-Saharan Africa. It is estimated that between 20 and 80 percent of solid waste in African cities is dumped into open spaces, water bodies, and surface drains.[11] Disposal of sewage causes a major problem; since most residents use pit latrines, untreated

[9](Boadi, et al. 2005), p 475
[10](Moore, Gould and Keary 2003)
[11](Boadi, et al. 2005), p 474

human waste oftentimes ends up in surface drains and water, further worsening the spread of disease.

Population Demand Outstrips Supply: Access to Potable Water

It could be deemed "obvious" that infrastructure inrapidly growing cities cannot keep up with rapid population growth. This manifests itself in many aspects, but can easily be seen in the provision of potable water to residents. With no direct access to running water, inhabitants of slums and shantytowns most often utilize a common pump or well. This reliance on a shared water source increases risk for contamination. While having a water source within 100 meters of a household is considered adequate provision of water, the 1993 Global Urban Indicators data show that a quarter of households in a number of cities in developing countries did not have access to water within 200 meters from their dwellings.[12] Thus, since families usually need to travelsome distance to the common water supply, practices such as hand washing, cleaning food and utensils, bathing, and washing laundry are limited.[13] Waterborne illnesses, such as dysentery, intestinal worms, and diarrhea, are thus more likely to be spread in such conditions.

One major struggle that families in rapidly urbanizing cities face is the issue of quality versus quantity of water. While some families may have easy access to a well, that water may not be potable, and thus they need to travel a further distance to obtain drinking water. It is estimated that at least 30-40 liters of water are needed per person per day if adequate drinking, cooking, cleaning, and basic hygiene are taken into account.[14] Traveling more than 100 meters from water source to household has tremendously prohibitive effects on this basic human need, and thus hygienic practices go ignored. Additionally, when water is not directly piped into a

[12](Shi 2000), p 2
[13](Moore, Gould and Keary 2003)
[14](Bartlett 2003), p 60

household, it must be stored in containers, which significantly increases its chance for contamination and for the spread of disease.

Particularly vulnerable to such illnesses are children. Approximately 84 percent of global diarrheal disease affects children under the age of five, and such illnesses are especially fatal amongst this age group.[15]Although cities that have adequate provision of piped water, waste management, and drainage systems experience remarkably low infant mortality rates, in cities without adequate provision, mortality rates are generally 10 to 20 times higher.[16] Children are especially vulnerable due to their underdeveloped immune systems and because of the inherit link between unsanitary conditions and malnutrition.A recent study by the World Health Organization found an inverse correlation between infant mortality and access to sewerage and piped water in rapidly growing Third World cities.[17]These facts alone suggest that unplanned and rapid urban growth creates significant difficulties in providing potable water to inhabitants, and this has particularly detrimental effects on the livelihoods on children.

III. Bamako, Mali: A Model City

Bamako, Mali, is a "poster child" for this trend of rapid urbanization in cities throughout Africa. Mali has the third highest birth rate in the world, with 46.44 live births per 1,000 population.[18] Bamako, the capital of Mali, located in the country's southern region, is currently the fastest growing city in Africa and sixth in the world.[19] Overall, 32 percent of the population of Mali resides in urban areas, with an annual rate of change of 4.8 percent.[20]Although not fully

[15](Bartlett 2003), p 58
[16](Bartlett 2003), p 58
[17](Shi 2000), p 14
[18] (CIA World Factbook 2010)
[19](IRIN 2007)
[20] (CIA World Factbook 2010)

known, the population of Bamako is currently estimated between 1,500,000 and 2,000,000 people.[21] This rapid population growth can primarily be attributed to rural-urban migration. An NGO in Kayes, a region in the western part of the country bordering Senegal, estimated a 40 percent population loss from 1993 to 2002, and attributed this loss to the fact that those people moved to Bamako in search of jobs.[22]

The rapid influx of people into Bamako puts significant strain on the city's infrastructure and healthcare systems. Currently, the CIA World Factbook lists the major diseases in Mali as: bacterial and protozoal diarrhea, hepatitis A, and typhoid fever (water or foodborne), malaria (vector borne), and meningococcal meningitis (respiratory disease).[23] According to the literature, each of these illnesses can – and most likely will – be exacerbated by rapid urban growth. Food and waterborne diseases are intensified by a lack of access to potable water and sewerage and by an increase in solid waste. Malaria is worsened by the increase in standing water caused by a deficiency of sewerage systems, creating yearlong breeding grounds for disease-carrying mosquitos. Respiratory diseases are exacerbated by air pollution; outdoor, caused by automobiles, and indoor, caused by burning coals and solid waste, notably plastic.

Waste Management and Sanitation

One major struggle faced by the government of Bamako is attempting to supply adequate waste management and sanitation programs to its booming population. A study in 2007 found that only 40 percent of municipal solid waste is removed from the city.[24] This is primarily due to the insufficient funds provided to authorities charged with ensuring the collection and disposal of

[21](Samake, et al. 2009), p 81
[22](IRIN 2007)
[23] (CIA World Factbook 2010)
[24](Samake, et al. 2009), p 84

urban wastes. The Malian system of decentralization, instated in the early 1990s with the hope of instilling local governance and independence in the regions of Mali, broke the country up into autonomous urban and rural communes (municipalities), *cercles* (counties), and regions. Bamako itself is split up into six urban communes, each with a mayor charged with the duty of waste management and disposal.[25] While this system was designed to give autonomy to the different regions of Mali, it has in fact caused serious problems due to a lack of distribution of resources, one major example being the lack of funds to provide adequate waste management. The current budget for management of solid wastes is 400 million FCFA/year,[26] while it is estimated that 1.425 billion FCFA/year is actually needed.[27]

Because the government lacks in its ability to provide adequate waste management, private institutions have had to step in. Small enterprises called *Groupements d'Intérêts Economiques* (GIEs) are most often utilized as a replacement for the government. They consist of either a tractor or a donkey and cart and, for a fee of approximately $3.00 - $4.00 a month, pick up solid waste door-to-door once a week.[28] The waste is taken out of the city and informally sold to farmers who sort out the organic matter and scatter it on their fields. The remaining inorganic material gets stored in dumps, which are essentially unprotected fields outside of the city.

These small, private enterprises do not provide enough to support the population of Bamako. Thus, litter in the roads, gutters, and empty lots is ubiquitous and has damaging effects on human health, as it provides a breeding ground for disease carrying agents like rodents and insects. Additionally, the lack of an adequate sewerage system in Bamako similarly harms

[25](USAID 1998), p 5
[26]$813,406.35 USD
[27](Samake, et al. 2009), p 84
[28](Eaton and Hilhorst 2003), p 54

human health, since untreated human excrement is often dumped into surface drains and pits, providing an ideal location for disease-carrying pathogens.

Water Provision

Another major hurdle for the government of Bamako is the provision of water to its residents. Currently one company, Énergie du Mali (EDM), is in charge of providing both water and electricity water to the residents of Mali as a whole. While technically private company, the government ownsthe majority of its shares and, in effect, it is a part of the government. The company has struggled significantly with the city's growing numbers, and the water supply system's infrastructure simply cannot grow at such a pace.

The difficulties faced by residents of Bamako in terms of access to running water can create severe problems to human health. When families must travel some distance to collect water, basic hygienic practices such as hand washing and utensil cleaning often go ignored. Additionally, improper storage of water often increases chance for contamination. Waterborne illnesses, such as intestinal worms and diarrhea, are spread rapidly due tothis, and most vulnerable to such illnesses are children. Many rapidly growing neighborhoods, commonly on the periphery of Bamako, do not provide piped water to households. One example of such neighborhoods is Sikoro, a neighborhood in Commune I on the outskirts of the city.

Life on the Fringes: Mékin-Sikoro

Mékin-Sikoro, or Sikoro, is a neighborhood situated in Commune I on the Northeast edges of Bamako, perched on the steep hills of the Manding Mountains. This peri-urban neighborhood on the fringes of Bamako is currently experiencing tremendous rapid population

growth. Sikoro began as a village, founded in 1830 by farmers migrating from Kayeslooking for arable land. Beginning in the 1980s, the rural exodus and ensuing population boom in Bamako caused the limits of the city to reach Sikoro and for the once small village to become a neighborhood on the periphery of the city. Today, Sikoro is part of Commune I of Bamako, and is situated eight kilometers from the city center. Despite this, Sikoro has retained several characteristics of village life, such as its own traditional village governance system. The 2004 census estimated the population of Sikoro to be 26,221, but today that number is assumed to have risen to between 35,000 and 40,000 inhabitants.[29]

Due to Sikoro's geographic location on the steep hills of the Manding Mountains, the neighborhood is extremely inaccessible, and therefore the provision of public services is a great challenge. The neighborhood essentially occupies the side of a hill, from bottom to top. None of the roads in Sikoro are paved, and many of them are of such poor quality that automobiles cannot pass. Running water is nearly impossible to come by in the neighborhood; as little as 3 percent of residents have piped water in their homes.[30] Unmistakably the two largest problems that the neighborhood faces are access to water and adequate sanitation.

Access to Water in Sikoro

Piped water access in households in Sikoro is virtually impossible to come by. Only 3 percent of residents have a flushing toilet, while the other 97 percent of the population uses pit latrines.[31] Access to potable drinking water is therefore a challenge for the residents of Sikoro. There are currently 23 *borne fontaines*, or public faucets, scattered around the neighborhood. Prices vary at each public faucet and depend on the proprietor, as they are privately owned; they

[29](GIE DORA 2009)
[30](GIE DORA 2009)
[31](GIE DORA 2009)

range from 10 FCFA to 50 FCFA per 20 liters.[32] These faucets are welldispersed in the "center" of the neighborhood, but the distribution of them becomes significantly poorer further up the hill. The largest problem is that the faucets are virtually inaccessible to the majority of schools in the neighborhood. In addition to these faucets, there are three large public wells, or *puits à grand diamètre,* located at higher elevation for those residing on the hill, yet the safety of drinking this water is questionable. The wells however can be utilized free of charge. Aside from these public sources, many households have smaller "traditional" wells in their compounds, although this water is not potable and is only used for cleaning and laundry.

Despite the efforts of the government and multiple NGOs in the neighborhood, access to drinkable water remains a major problem for the residents of Sikoro. During the dry season, between March and May, many of the wells dry up and the faucets experience multiple *coupures*, or "cut-offs," throughout the day. Women are often forced to wake up in the middle of the night to collect water for the following day. Additionally, households on the top of the hill face serious problems with accessibility, for even the wells designed for families on the hill are some distance away at a lower altitude, down treacherous pathways and cliffs.

Sanitation in Sikoro

In addition to access to potable drinking water, sanitation is inevitably one of the largest problems faced by residents of Sikoro. The neighborhood government and several NGOs have taken a number of actions, ranging from constructing a drainage system to providing proper equipment and organization to GIEs. Despite their efforts, however, inadequate sanitation

[32]Between 5¢ to 25¢ USD

remains a major concern for the residents of Sikoro, and has significant negative effects on human health.

Many factors impede the recent efforts of the government and NGOs. For example, despite efforts to construct adequate drainage systems, the neighborhood is simply too large and expanding too quickly to provide drainage for the entire area. For this reason, 57 percent of families recently interviewed are forced to dump their used water into the street.[33] The problem of solid waste management is significantly difficult to improve in Sikoro, for the closest *dépôt final* for GIEs to deliver waste is seven kilometers from the quartier. While a *dépôt final* was set to be allotted within the neighborhood, the booming population and resulting overcrowding has prevented it.

Although GIEs are the only means of solid waste removal, the entire neighborhood population does not subscribe to one because they are out of some families' means, costing 1500 FCFA[34] per month. Additionally, the state of the roads creates problems for GIEs, as they are ill-equipped with simply a donkey or tractor pulling a trailer, and therefore cannot reach a number of households in the neighborhood. These misfortunes cause the community of Sikoro to amass serious amounts of litter. The build-up of solid waste in the recently constructed gutters prevents the water's ability to flow, creating pools of unsanitary standing water, uncovered and open to children playing next to them and people walking by. These unsanitary conditions are breeding grounds for disease-spreading pathogens and vectors.

[33](GIE DORA 2009)
[34] $3.00 USD

A Project for Sanitation and Access to Water: PACAPSI

In 2006, a partnership between an array of organizations in the neighborhood gave birth to the *Projet d'Amélioration des Conditions de vie des Populations de Sikoro* (PACAPSI). This partnership is between *l'Association de Développement de Quartier-Club des Amis de Mékin Sikoro* (ADQ-CAMS), a youth organization aimed at educating the *quartier*'s children, *la Fondation CEAR d'Espagne*, a Spanish NGO that provides funding, and the local government of Commune I. In its first phase, from 2006-2010, PACAPSI succeeded in completing a variety of tasks aimed at ameliorating the neighborhood's sanitation. For example, a system of gutters was constructed to collect the high volume of water that flows down the cliffs during the rainy season. Along with gutters, a paved bridge connecting the neighborhood to the bordering quarter, Hippodrome, was constructed, making the community significantly more accessible. Additionally, PACAPSI has supplied six GIEs with proper equipment and organization, creating a baseline price and dividing the enterprises into sectors so that they no longer need to compete with one another. The organization has done a great deal of work in educating youth of the neighborhood, establishing programs in schools that teach about basic hygienic practices such as hand washing. Currently, PACAPSI is working on several projects: the provision of potable water to schools in the neighborhood, the construction of a sewer system, and the realization of a global study in the neighborhood to understand the major problems related to sanitation and access to water.

IV. The Study: Urban Growth, Sanitation, and Measures for Improvement

Purpose

This study is aimed at better understanding the intricate relationships between urban growth, sanitation, access to potable water, and the spread of disease in the peri-urban neighborhood of Sikoro. To complete this task, I spent three weeks in November 2010 working with PACAPSI, designing a research project that could help me answer these questions.

Methodology

My first approach for this study was to complete basic background research on Sikoro. I did this by revising studiespreviously conducted by PACAPSI. By reviewing these studies and additional documents provided by the *centre de santé communautaire*(CSCOM) in Sikoro, I was able to gather background information about the history, demography, andinfrastructure systems of the neighborhood, and also gain understanding of the most prevalent diseases in the area.

The second approach was to administer a questionnaire to families in Sikoro. The neighborhood was divided into four quadrants and twelve families dispersed throughout each sector were selected for interviewing, thus forty-eight families in total were questioned. The survey administered contained questions involving where families obtain their water, how many times a day water is collected, how much money is spent on water, where families dispose of their solid waste, and how they empty their pit latrines once they are full.[35]

Finally, I was able to formally interview both the mayor of Sikoro and the mayor of Commune I to learn about the governmental efforts being taken to improve sanitation and access

[35] For the questionnaire in its entirety, see the Appendix.

to water in Sikoro.With these three approaches, my aim was to gain a better understanding of the problems faced by the neighborhood, the residents' perceptions of these problems, and the effectiveness of actions taken both by the private and public sectors.

Results

Residents of Sikoro

The results of the questionnaire[36] vary greatly between each of the four sectors, as the problems faced by families differ depending on geographic location. I will thus begin by summarizing the generalizations for each sector, and finish by giving the overall results for the neighborhood as a whole.

Sector 1

Sector 1, located in the northeast corner of the neighborhood, is the area where PACAPSI is located. Although the neighborhood is some distance up the hill, it is by no means near the top. The area is quite crowded, but most of the homes are accessible by dirt roads.

Access to potable drinking water in this area is not a significant problem; 91.7 percent of families interviewed use a public faucet and 81.8 percent do not perceive it to be far from their home. The major issue in this sector is the crowds at the public faucets, due to the high numbers of residentsin the area. In fact, 62.5 percent of interviewees said that it takes them over two hours to collect water due to time spent waiting in line. Since most families said that they collect water one to three times each day, the amount of time spent on this task is truly detrimental and interruptive in the course of their day.

[36] For the results in their entirety, see the Appendix.

Additionally, the dry season, which occurs between the months of March and May, affects this sector negatively enormously, as 72.7 percent of interviewees said that they need to travel to a public faucet farther away due to shut-offs. Most often, the public faucets at higher elevations are cut off during the dry season for the lower volume of water cannot reach a high altitude, and families are forced to travel down the hill to wait in even longer lines and to transport the heavy water back up to their homes.

Because road access is fairly well maintained in this sector, trash pick-up and emptying latrines do not pose particular problems to its residents. Seventy-five percent of interviewees said that they use the services of a GIE to dispose of their solid waste. Additionally, 58.3 percent of interviewees have utilized spiros[37] to empty out their pit latrines, while another 25 percent have not yet had to empty them. Thus, while Sector 1 does not face great problems with accessibility to water and to public services, the crowded population density does cause a great number of grievances to its inhabitants.

Sector 2

Sector 2 is the located in the southeast quadrant of the neighborhood at a low altitude, bordering the more "modern" neighborhood, Hippodrome. Due to its more "central" location and the fact that it is one of the older sections of the neighborhood, the frequency and spacing of public faucets in this area is significantly better than in other areas of the quarter. Additionally, since the neighborhood is at a lower altitude and close to the Banconi River, digging wells is fairly easy. In fact, 91.7 percent of interviewees have their own private wells in their compounds. However, this water is not potable, and 100 percent of those surveyed travel to a public faucet

[37] Spiros is a service hired to vacuum filled up pit latrines.

for drinking water. Fortunately for residents of Sector 2, shut-offs during the dry season are uncommon at such a low altitude, thus traveling to another source is not necessary.

Trash pick-up, however, causes serious problems for the residents of Sector 2. Although 66.7 percent of interviewees subscribe to a GIE, nearly all of them said that tractor hardly ever comes and that they are oftentimes forced to dispose of their waste in the street or in the neighboring Banconi River. The reason for this problematic GIE is unclear, since nearly all of the houses are accessible by the road. The only assumption that I can draw is that the GIE that isresponsible for serving this sector is disorganized and inefficient.

Sector 3

This sector of Sikoro, the southwest quadrant, is, like Sector 2, of lower altitude than other areas of Sikoro. However, unlike Sector 2, the area is significantly less crowded and in fact is a very new area called the *zone de recasement*. Beginning in the early 1990s when Sikoro was enveloped by the rapidly expanding Bamako, a program called the *lotissement* was instated by the government. Before the *lotissement*, there were no streets in Sikoro; the program's main goal was to create roads so that the area could become more accessible to the rest of the city. To achieve this objective, many houses were torn down and those displaced were meant to be relocated to this *zone de recasement*. However, many refused to move and reconstructed their homes in the same location. A second phase of the *lotissement* is presently occurring in Sikoro, and houses with giant "X"s painted on them, to signify that they must be torn down, are ubiquitous.[38] Thus, although the average time spent in Sikoro for this sector is quite high, at 19 years, six of the families interviewed had been there for less than five years, so it truly is the "new" part of Sikoro.

[38](Guindo 2010)

Unfortunately, although this area was allotted for displaced people to be located, infrastructure systems have not yet been constructed. Most notable is the lack of public faucets in the neighborhood. Of those interviewed, 41.7 percent of residents perceived the public faucet to be far from their house, and 50 percent said it takes them over an hour to collect water. Twenty-five percent of interviewees use the services of a delivery person to bring their water by donkey and cart because the public faucet is too far, raising their expenditures significantly. Additionally, because this area is more "removed" from central Sikoro, GIEs are more difficult to come by, and 31.7 percent of those interviewed are forced to use another method of waste disposal – either by burning, dumping in the street, or leaving trash in the empty lots in the *zone de recasement.*

Sector 4

Sector 4 is by far the most geographically isolated of the four quadrants, as it encompasses the homes situated on the cliffs at the top of the hill. Thus, both access to potable water and proper trash disposal are difficult in this isolated area. Fortunately three large, public wells are located in this sector, and serve the residents at higher altitudes. The newest well was created only two years ago, funded by the president's wife. Many residents still have to travel a significant distance over cliffs to reach the well and to haul the water back to their homes. Additionally, although the wells do not fully dry up during the dry season, oftentimes the water level is only high enough in the middle of the night, thus women have to wake up in very early hours of the morning to collect it. Families who use the public wells for water of all uses (drinking, cleaning, etc.) save significant amounts of money, for the well water is accessible free of charge.

Generalizations: Sectors 1-4

Expenditures: Time and Money

In general, families in Sikoro spend a great deal of their time and of their monetary worth on obtaining water. To acquire potable drinking water, 40.5 percent of interviewees spend over one hour each trip, and most families travel to the public faucets two to three times a day. Thus, obtaining drinking water is a time consuming necessity for the inhabitants of Sikoro.

Since 87.5 percent of interviewees drink water from the public faucet, families also spend a great deal of money on their drinking water. This is not so much a problem with water for utilization, as 56.2 percent use wells free of charge, yet during the dry season the private wells do not function. Thus, between the months of March and May, 87.2 percent of families must pay for their drinking water, and 10.6 percent of those interviewed spend over 1000 FCFA[39] on water every day, an extreme expense for families living in Sikoro.

In addition to expenditures on water, families in Sikoro spend a great deal of money on both trash disposal and on the emptying of their latrines. An encouragingly high 70.8 percent of families use the services of a GIE, but many of the remaining 29.2 percent do not because they cannot afford the 1500 FCFA monthly fee. Spiros, the service that vacuums latrines, is quite expensive, ranging from 15,000 to 30,000 FCFA[40] depending upon the size of the latrine. Thus, for families in Sikoro that utilize both a GIE and spiros and that obtain their water from the public faucet, a great deal of their income is spent.

[39] $2.00 USD
[40] $30.00 to $60.00 USD

Family Roles

In the vast majority of households, it is the women and the children who are assumed the task of obtaining water for the family. In fact, not one household said that the *chef de la famille*, or father figure, collects water. Nearly 30 percent of families interviewed send the women, 12.8 percent send the children, and 23.4 percent send both the women and the children of the family to collect water. Thus, it is clear that family roles are quite strictly defined in this regard, and that it is almost always the job of the women and children to obtain water for the family.

Water Storage

Since only one of the forty-eight families interviewed has piped water in their household, the rest of the families are forced to store their water after it is obtained. Most households use large, metal barrels for water for utilization (such as cleaning, laundry, and washing), while they store their drinking water in covered twenty-liter plastic bottles, or in large, ceramic jars.

The Dry Season

The overall largest grievance for the residents of Sikoro in terms of obtaining water is the devastating obstacles faced during the dry season, between March and May. All families that rely on a private well for their non-potable water, 45.8 percent of those interviewed, cannot use this source during these months, for the wells dry up. Additionally, most public faucets up the hill are frequently cut-off, since the lower volume of water cannot reach a high altitude, thus those residents are forced to travel downhill. Those that rely on the large, public wells at the top of the hill are often forced to wake up on the middle of the night to collect water, since during the

daytime those wells dry up as well. Nearly 49 percent of those interviewed must travel to another source to obtain their water during these months.

Thus, expenditures of both time and money are worsened during the dry season. Crowds at the public faucets are significantly larger since families at higher altitudes must travel down to the bottom of the hill and because those that normally use private wells must rely solely on the public faucets. Oftentimes families are forced to go into the neighboring quarter, Hippodrome. Many families said therefore that it can take over three hours to get water, and oftentimes they must go in the middle of the night when the faucets are not cut off. Additionally, many families are forced to spend more money on water during the dry season, since public faucetsare their only option when the wells are not functioning. Families also need more drinking water due to the intense heat. Consequently, generally all of the problems faced by families in terms of water provision are magnified between March and May.

Measures Taken by the Local Government

In addition to the questionnaire, I was able to interview several government officials: the "traditional" mayor of Sikoro, the representative of Sikoro in the *Mairie* of Commune I, and a worker for the Ministry of Sanitation, Pollution, and Environment, to learn more about governmental efforts toward improving the sanitation and access to water in the neighborhood.

Mayor of Sikoro: "Traditional" Governance

The Mayor of Sikoro, Ampiri (dit Jacques) Guindo, was elected in 2009 by popular vote. His governance is a vestige of the traditional village governance system that was in place before Sikoro became a neighborhood of Bamako. He works in conjunctionwith the Mayor of Commune I, although his governance is autonomous.

Due to the Malian system of decentralization, it is somewhat unclear which governing body is supposed to rule over questions of sanitation. According to Mayor Guindo, all levels of government are expected to take some responsibility for providing adequate sanitation infrastructure, yet coordination is lacking, especially in Bamako, where communes are virtually autonomous and thus do not organize with one another. Thus, it appears that while all are supposed to take responsibility, no one does because they expect someone else to take care of it. Although the system of decentralization did divide powers, it was not particularly effective in dividing the resources needed to carry out those powers.[41]

Mayor Guindo's abilities are extremely limited due to his lack of resources. The government of Commune I has not contributed significantly to Sikoro since it is peripheral to the rest of the city and with no industry and therefore, to Commune I, a low priority with very little reason for investment. For this reason, Mayor Guindo said, "Je n'ai pas vu un franc à contribution à l'assainissement à Sikoro."[42]In terms of potable water, the government has provided some infrastructure, such as the public faucets and wells, but as Mayor Guindo put it, "Ce n'est pas suffisent."[43]

This lack of monetary resources is crippling to the local government. For this reason, Mayor Guindo has not been able to create any programs aimed at ameliorating sanitation in the neighborhood. Thus, Sikoro relies solely on the work of private NGOS, like PACAPSI, and GIEs to provide all of their sanitation infrastructure and waste management. The Mayor does, however, attempt to provide some support and organization to GIEs. Nevertheless, this support is limited, since what the GIEs actually need is more funding to improve their ability to serve the

[41] Sounda Ibrihima Siré Traoré, Coordinator of PACAPSI, Interviewed by Adrienne Epstein, November 11, 2010.
[42] "I have not seen one franc contributed to sanitation in Sikoro." Ampiri Guindo, Local Mayor of Sikoro, Interviewed by Adrienne Epstein, November 25, 2010.
[43] "It is not sufficient." Ampiri Guindo, Local Mayor of Sikoro, Interviewed by Adrienne Epstein, November 25, 2010.

population, and the local government simply cannot provide it. All that Mayor Guindo can offer the GIEs is advice when there are problems, such as when a conflict arises between two enterprises or when there is no space to store the waste before bringing it to the *dépôt final.*

Since PACAPSI is essentially the only structure in place to improve sanitation in the neighborhood, a great deal of coordination exists between the organization and the local government. Frequent meetings occur between the coordinator of PACAPSI and Mayor Guindo. Each time PACAPSI starts a new project or receives results from a study in the neighborhood, the mayor is informed and given details. Therefore, the actions taken by PACAPSI are central to the mayor's political agenda for sanitation. As of now, the funding for PACAPSI is anticipated to terminate in 2011, and thus the government is expected to take on and maintain everything created by PACAPSI, such as the new gutters and sewer systems. When asked about this undertaking, Mayor Guindo was adamant that his government can and will preserve and maintain PACAPSI's successes. "Aider la PACAPSI à aider, à protéger. S'il n'y a pas de suivi, ce n'est pas la peine."[44]

Mairie of Commune I

At the Commune I's "town hall," or *mairie*, I was able to speak with both the representative of Sikoro to Commune I and an employee of the Service of Sanitation, Pollution, and Environment to learn what is being done at a level broader than the "traditional" governance. Commune I consists of nine neighborhoods in the northeast corner of Bamako, including Sikoro.

The level of the commune does have a program that includes measures aimed at improving sanitation in the community called the *Programme de Développement Economique,*

[44] "Aid PAPCAPSI to help and protect. If there is no following, it is not worth it." Ampiri Guindo, Local Mayor of Sikoro, Interviewed by Adrienne Epstein, November 25, 2010.

Sociale et Culturelle (PDESC). This program, although not specifically intended to improve sanitation and water provision, contains measures such as constructing more public faucets and cleaning out the drainage systems. All neighborhoods of Commune I are included in this plan, including Sikoro.

Like Mayor Guindo, interviewees at the *mairie* made it clear higher levels of the government give very little to the Communefor programs to improve sanitation and access to water. Only once a year, during the rainy season, the government performs maintenance on the four major gutters in the commune, but this is not nearly sufficient for the amount of waste and litter that builds up over time. Aside from this yearly project, the government provides no support, and "c'est les ONGs qui font le reste."[45]

Thus, a great deal of coordination between the government and the private sector is imperative to ensure an effective provision of sanitation measures and potable water. With the system of decentralization, it is the level of the commune that must provide solid waste management. The Mairie of Commune I thus collaborates a great deal with GIEs to warrant efficient solid waste management. The communal government has broken each private GIE up into 34 sectors, so that there is no longer competition between them. Each GIE has a contract with the commune; in this contract are rules that the GIEs must follow, and in return the local government handles all residents' complaints, or the "customer service" side. According to Monsieur Ouologuem, the employee of the Service of Sanitation, Pollution, and Environment, thanks to PACPASI, GIEs are extremely organized and efficient in Sikoro in comparison to the other neighborhoods of the commune.[46] However, GIEs are underequipped and in desperate need

[45] "It's the NGOs that do the rest." Seydo Ouologuem, Employee of the *Service d'Assainissement, Control de Pollution et de Nuisance*, Interviewed by Adrienne Epstein, November 29, 2010.
[46](Ouologuem 2010)

of resources that the communal government cannot provide, thus waste management remains a major problem for the commune.

The communal government also coordinates a great deal with NGOs such as PACAPSI. Since the resources of the government are limited, in Sikoro, the representative to the commune expresses his needs to NGOs, and the NGOs then execute them. The actions of NGOs therefore have a large place in the communal political agenda. The *mairie* also recognizes its duty preserve NGO programs or infrastructure, such as maintaining the gutters and drainage systems constructed by PACAPSI. "La mairie est la gardienne des infrastructures ; la mairie a les yeux ouverts aux problèmes,"[47] said Sidiky Coulibaly, the representative of Sikoro.

Nearly all NGOs in the commune have a contract with the local government, and their efforts are included as a part of the PDESC. The NGOs must therefore inform the *mairie* of their financial and technical data and results every four months. However, when I went to interview Monsieur Ouologuem, he in fact complained to me that Monsieur Traoré, the coordinator of PACAPSI, had not turned in his report. At the end of my interview, he approached M. Traoré about it, and Traoré brushed him off, seeming rather irritated. As we were leaving, M. Traoré explained to me that he had in fact turned his report in to M. Coulibaly, the representative of Sikoro to the *mairie* of Commune I, and that it was *his* responsibility to hand the reports over to his associate. Thus, it is clear there is a lack of dialogue at several levels, both within the *mairie* and between PACAPSI and the representative of Sikoro, revealing how complex a relationship between an NGO and the government truly is.

[47] "The *mairie* is the guardian of infrastructure; the *mairie* has its eyes open to problems." Sidiky Coulibaly, Representative of Sikoro at the Mairie of Commune I, Interviewed by Adrienne Epstein, November 29, 2010. (Coulibaly 2010)

Analysis

Implications for Human Health

Although not explicit, the findings of this study suggest a link between poor sanitation andnearly half of theprevalentsicknesses in Sikoro. Between 2007 and the first six months of 2010, 48.9 percent of illnesses treated at the CSCOM in Sikoro fell under the category of "illnesses caused by inadequate sanitation."[48]Waterborne illnesses,including intestinal worms and diarrhea, are undoubtedly spread by improper sanitation and are exceedingly prevalent in in the neighborhood. Additionally, vector-borne illnesses exacerbated by the presence of unsanitary, standing water, are a serious cause for concern. Of these illnesses, malaria is by far the most grave. The pools of stagnant water created by huge amounts of waste built up in both the Banconi River and the neighborhood's drainage systems create yearlong breeding grounds for disease-carrying mosquitos. In 2009, malaria represented 84.6 percent of those illnesses caused by inadequate sanitary conditions.[49] An improvement in the neighborhood's sanitary conditions and water provision could allow for a drastic decrease in the prevalence of these fully preventable maladies.

One major problem and potential cause for numerous waterborne illnesses in Sikoro is water storage. Since piped water is essentially impossible to come by, and nearly all families are forced to travel to a source outside of the household to obtain water, it then of coursemust be stored in containers before use.Practically all families interviewed in this studykeep their water in plastic covered bottles, large metal barrels, and ceramic jars. Any storage of water prior to use creates a number of opportunities for contamination, especially in households with small children, who often put unclean hands or water scoops in storage containers. A number of studies

[48] Illnesses caused by inadequate sanitation are defined as: malaria, diarrhea, intestinal worms, cholera, and food poisoning. (Ouedraogo 2010), p 27
[49]. (Ouedraogo 2010), p 28

have shown a link between stored water and the spread of waterborne illnesses. For example, in a neighborhood of Abidjan, Cote d'Ivoire, *E. coli w*as found in 1 percent of piped water samples, but in 41 percentof stored water samples.[50] A study in a slum of Nairobi, Kenya, found that uncovered water containers were the most significant factor influencing a child's recovery from a diarrheal illness.[51] Thus, the absence of piped water and the resulting need for storage is most likely a cause for many preventable illnesses in Sikoro.

In addition to not having a faucet, most families in Sikoro do not have access to a flushing toilet, and 97 percent of residents use pit latrines. Although a latrine that is properly maintained, paved, and emptied out does not create serious sanitary problems, small children are still unlikely to use it. Separate studies from Malawi, Nepal, Burkina Faso and India have found that children rarely use latrines before they are six or eight because of the risk of falling into the pit.[52]Instead, children urinate and defecate where they feel safer: in the household courtyard, in the street, or into a container. This clearly creates opportunities for people to come into contact with fecal matter and a space for the breeding of disease-spreading pathogens. In addition, "traditional" latrines, or those that are not paved and simply consist of a hole in the ground, cause serious problems, since waste can be absorbed into the soil. These latrines are also problematic in Sikoro because they cannot be emptied out by spiros, the vacuuming service, creating problems when the waste is to be disposed. Thus, again, the lack of piped water in Sikoromost likely perpetuates the spread of illness.

Finally, water drainage is a major concern for human health, and is particularly pertinent in Sikoro, a neighborhood perched on a steep hill. Trash built-up in the gutters and drains is commonly found throughout the neighborhood, and pools of uncovered, unsanitary water are

[50](Bartlett 2003), p 64
[51](Bartlett 2003), p 64
[52](Bartlett 2003), p 65

ubiquitous.In this study, 10.4 of households interviewed dispose of their trash in the street, and another 8.3 percent in empty lots or the Banconi River. Households aside, people walking in the street with waste to dispose of have no choice but to either hold onto it or throw it in the road; the latter is often chosen since public trashcans do not exist. Malaria, previously a concern only during the rainy season, is now a year-long threat due to these pools of standing water. In 2009, there were 3,980 cases of malaria treated at the CSCOM in Sikoro.[53]There is no question that the incidence rate of this illness is increased by year-long pools of stagnant water throughout the neighborhooddue to the build-up of solid waste.

Family Roles

As previously mentioned, the results from this study suggest that there are well-established roles for whichfamily members are responsible for obtaining water. This strict definition of family roles has the potential to inflict serious negative effects. The youth of households are quite often responsible for this task; 36.2 percent of families interviewed responded that they send their children to collect the family's water. Since the amount of time it takes to obtain water in Sikoro is notably large – 40.5 percent of interviewees spend over one hour each trip – young children's daily lives are consumed with this task, potentially affecting school attendance and playtime.

Similarly, women's lives are often restricted by their duty to obtain water for the family. More than half of families send the women of the household to collect water. Again, the amount of time spent on this task restricts women's lives, since it oftentimes takes over an hour every day, multiple times a day. This duty is significantly more time consuming during the dry season, when many women have to travel greater distances or wake up in the middle of the night to

[53](Ouedraogo 2010), p 27

travel to the public faucet. As not one family said that the men are responsible for getting water, it is clear that this is a deeply rooted aspect of family structure in Sikoro, and raises questions of gender inequality in Malian society.

Function of Government

There is no question that the local government of Commune I is extremely limited due to its lack of means, as "le gouvernement ne met aucune ressource"[54] towards sanitation measures. However, it is true that within its limits, the communal government does make efforts toward improving sanitation and hygiene in the neighborhood by rallying and organizing GIEs and by coordinating with NGOs.

Based on my interviews, I perceived some level of tension between the "traditional" Mayor Guindo and the *Mairie* of Commune I. Mayor Guindo explained to me that "Sikoro n'est pas une priorité pour la mairie"[55] primarily because Sikoro's current representative does not do his job well. However, when I spoke with the government officials at the *mairie,* they said that Sikoro is included in all of the government plans towards improving sanitation and access to water, and that in fact the situation is better in Sikoro than it is in other neighborhoods in the Commune I. Sikoro was included in the PDESC, and according to the *mairie*'s records, has benefited greatly from the program over the past five years.

The fact that the government of Commune I relies on NGOs provide the majority of sanitation measures that are truly the government's responsibility is both a blessing and a curse. Without NGOs like PACAPSI, the residents of neighborhoods like Sikoro would have no programs or services aimed at improving sanitation. The government can express its needs to PACAPSI, and the organization can, within its discretion, use its funding from the

[54] "The government does not give any resources" (Ouologuem 2010)
[55] "Sikoro is not a priority for the *mairie*" (Guindo 2010)

Spanishgovernment to carry them out. In an ideal situation the local government is content, and the residents of Sikoro benefit greatly.

However, there are also great dangers that can result from NGOs performing the government's job. When organizations like PACAPSI construct gutters, equip GIEs, and run school campaigns about sanitation, the government is suddenly "off the hook" and no longer needs to perform its duties. Thus, resources that could have gone to public programs are no longer needed. This is especially dangerous in a country like Mali, where corruption not unheard of. The most recent Corruption Perceptions Index for 2010 ranked Mali 116th out of 178, earning score of 2.7, with 10 being least corrupt and 1 being corrupt.[56]Administrative officials can reassure themselves that a private organization will "take care of it," and thus there is no harm in taking governmental resources for themselves.

Additionally, the government may not be holding up its end of the bargain with PACAPSI. M. Traoré recounted to me a story about when he asked the *mairie* to designate an area to serve as a *dépotoir de transport*, or dump site, for GIEs. This site would act as a temporary location for waste to be stored, before bringing it to the *depot final* seven kilometers away. The government asked Traoré to compile a list of empty lots to serve as potential sites. Traoré complied, and provided the government with their list; however, before he could remind the government about designating the site, they had already sold off all of the pieces of land.[57] Thus, it is unclear whether the government's goal is truly to improve sanitation in the neighborhood or simply to make money.

Despite these setbacks, it is true that the *mairie* of the Commune I has pledged to preserve the established achievements of PACAPSI, and that PACPASI's programs have a place

[56] (Transparency International 2010)
[57](Traore 2010)

in their political agenda. The success of NGOs does certainly depend on their relationship with the local government; without a discourse, an NGO can only go so far.

V. For the Future

Coordination on Multiple Scales

As it is clear that the predicament of resources for the Malian government will not be solved in the near future, it is imperative that the government and private institutions coordinate. Without a discourse between these bodies, the efficiency of NGO programs will be significantly reduced. Not only must the government inform organizations of their needs, but NGOs must relay their plans and results to the government. In addition, discourse within the *mairie* must be improved. The different offices must coordinate to assure that their competence as a government.

There is of course a danger if a partnership between an NGO and the local government becomes too close, for the government can begin to rely on the organization and not perform the duties expected of them. Unfortunately, this trend seems to have some relevance in the case of Sikoro. Because of the presence of PACAPSI in the neighborhood, the government has left the NGO to organize and equip GIEs on their own, without government oversight. Problems have arisen, notably when the government failed to designate a temporary dump site, a task that they easily could have completed. Since PACAPSI, a well-established and efficient NGO, exists in Sikoro, the government has seemed to have turned away from the neighborhood's sanitary problems and left them for PACAPSI to handle virtually on their own.

One solution to such a danger is to plan for future government absorption of the NGO. In the case of PACAPSI, it is clear that the government is not yet ready to take on such an expense. However, by creating a long-term proposal that plans into the next decade, there is potential that

the Mairie of Commune I could prepare to budget for such a program and begin to provide the sanitation infrastructure programs that PACASPI offers today. Absorption is especially relevant in this case because PACAPSI provides many services that the government is responsible to provide, but that it does not.

Educational Campaigns: A Band-Aid over a Bullet Wound?

Many argue that to improve sanitation practices in cities like Bamako, hygienic education is the answer, and that improved provision of water does not suffice. PACAPSI has created eighteen *comités d'hygiène*, groups of schoolchildren who are trained to provide lessons to their classmates on basic hygiene such as hand washing. However, while these programs are necessary to ensure that basic hygiene is respected, studies show that provision of running water is significantly more important than education. A study in Burkina Faso on factors influencing hygienic behavior showed the location of the water source was significantly more important than health education, income, maternal education or culture.[58] Thus, educational campaigns are only successful when coupled with improved provision of potable water. In the case of Sikoro, water sources such as *borne fontaines* and public wells must be increased to lower the distance necessary for each family to travel for water, and only then will lessons on hygienic practices have a large effect.

Improving Access

One solution that could assist in combatting a multitude of problems related to water provision and sanitation is improving access in Sikoro. Paving those roads that already exist and

[58](Bartlett 2003), p 68

creating roads that lead to areas of the neighborhood currently inaccessible would change the *quartier* drastically. Paved roads allow for sufficient water drainage, preventing thepresence of pools of stagnant water currently throughout Sikoro, and thus would lower the incidence rate of malaria and other vector borne illnesses. An upgraded road system would also allow for GIEs to access homes in the neighborhood, notably those at the top of the hill, even with their inadequate equipment. Thus, the problem of litter would be significantly ameliorated, which could prevent the spread of many illnesses. Finally, if roads are improved, traveling to get water would not be as daunting a task. If those women and children at the top of the hill had to walk down a road instead of a treacherous cliff side, their lives would be bettered drastically. Of course, creating and paving a system of roads in a peripheral neighborhood perched on a steep hill is a hugeeconomic undertaking. However, as paving would solve such a wide range of issues currently plaguing the neighborhood and would last a significant time into the future, it is an investment worth making.

VI. Conclusion

In Bamako, Mali, the peripheral neighborhood of Sikoro is growing at an explosive rate and does not appear to be slowing down. This rapid growth, coupled with the area's inaccessible geographic location, has created serious problems for the neighborhood's infrastructure systems. As such, residents struggle with things that many of us take for granted, such as where to obtain water and how to dispose of solid waste. The combination of a crowded neighborhood, an improper drainage system, a problem of litter, and a lack of piped water creates serious consequences for human health. The lack of government finances has forced private institutions to step in, such as GIEs and NGOs like PACAPSI. Unfortunately, the existence of these private

structures has permitted the government step back from its duties and allowed NGOs to take over.

As this is an extremely complicated issue with a multitude of factors to take into account, there is no one "answer." However, one potential solution is to plan for future state absorption of PACAPSI. This is not currently possible due to the government's lack of funds, but even creating a plan for the government to eventually absorb PACAPSI some time in the future would force the government to take more responsibility for and gain more knowledge of Sikoro's sanitary and potable waternecessities.

Improving access to and within Sikoro would change the issues surrounding sanitation and access to water considerably. Although this is a great investment, it could save hundreds of thousands of dollars spent on curing illnesses caused by improper sanitation, cleaning out clogged drains and the Banconi River, and equipping GIEs. This is one solution to many problems in the neighborhood.

Unfortunately, as Sikoro and the rest of Bamako continue to expand at an unprecedented rate, these problems will not disappear and will most likely worsen. Mercifully for residents of Bamako, food, water, and vector-borne illnesses are fully preventable. However, it is imperative that greater efforts are taken to improve the sanitary conditions and increase the number of potable water sources in the city to prevent the spread of these diseases. Both the city government and the private sector have a duty to better the city's conditions. Without improvements to Bamako's infrastructure, the residents of this booming city are in great danger of falling ill with otherwise fully preventable illnesses, which is truly indefensible.

Suggestions for Further Research:

This topic is growing as quickly as cities themselves. With more time, I would have liked to expand this project to other neighborhoods in Bamako growing at rapid rates but that are less peripheral and geographically isolated than Sikoro, perhaps on the south side of the Niger River. It would be interesting to compare the different problems residents face and the prevalence of illness between neighborhoods. Also, there is of course the option to expand this topic to other cities that are growing at unprecedented rates across the globe and attempt to draw parallels to their situations with that of Bamako. Furthermore, it would be beneficial to spend more time researching the link between illness and poor sanitation in Sikoro. This would require spending more time at the CSCOM, speaking with doctors and nurses about their perceptions of the causes of illness and whether they believe improved sanitation and access to potable water would change incidence rates, and interviewing families about their basic hygienic practices, such hand washing and where their children use the bathroom. Finally, researching the effectiveness of educational programs such as PACASI's *comités d'hygiène* would be fascinating. This would help to determine whether educational programs suffice when water provision is inadequate, or whether improved provision is imperative. Since urbanization is a trend that is not slowing down, research is desperately needed to ensure the future safety of public health for cities, namely in the developing world.

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Appendix

Questionnaire

Country: Mali

City: District de Bamako

Commune: Commune I

Neighborhood: Sikoro

Date: _____ Sector: _____

Person(s): _____

1. How long have you lived in Sikoro? _____
2. How many people live in your household? _____

A-Water Provision

1. Where do you obtain water for laundry, bathing, dishwashing, etc.?

   Private faucet ☐ Public faucet ☐ Public well ☐ Pump ☐ Traditional well ☐

   b. It far from your home? _____

   c. If so, how long does it take for you to collect?
   _____

   d. Do you pay for this water? _____

   e. If so, how much do you spend daily?
   _____

1. Where do you obtain drinking water?

   Private faucet ☐ Public faucet ☐ Public well ☐ Pump ☐ Traditional well ☐

   a. Is it far from your home? _____

   b. If so, how long does it take to collect?
   _____

   c. Do you pay for this water? _____

d. If so, how much do you spend each day on drinking water?

Dry season: _____FCFA/day ; Other seasons: _____FCFA/day

2. Does your water source change during the dry season?

_____
_____

3. How many times do you collect water each day? _____

4. Normally, who in the family collects the water?

The women ☐ The father ☐ The children ☐ Other_____

5. Where and how do you store water in your home?

_____
_____

B. Management of Solid and Liquid Waste

1. Do you use a GIE to collect your solid waste? Yes ☐ No ☐

If no, where do you dispose of your solid waste?

In the street ☐ In the compound ☐ Burn it ☐ In trenches ☐ Other_____

2. How do you empty your latrine when it is full?

Spiros ☐ Hole ☐ In the street ☐ Other_____

a. If not spiros, why?

_____
_____

Results

Sector 1 (12 families)

Average family size: 16 people

Average time in Sikoro: 17 years

Source of water for utilization (cleaning, washing, laundry, etc.)

Private Faucet	8.3%
Public Faucet	50%
Public Well	0%
Pump	0%
Private (Traditional) Well	25%
Multiple sources	16.7%

Is this source far from your home?

Yes: 0%

No: 100%

If the source is far, on average, how long does it take you to collect water? (6 responses)

30 minutes or less	16.7%
Between 30 minutes and 1 hour	0%
Between 1 hour and 2 hours	16.7%
More than 2 hours	66.7%

How much do you spend on water for utilization?

Does not pay	33.3%
100 FCFA or less	8.3%
101 – 200 FCFA	0%
201 – 300 FCFA	33.3%
301 – 500 FCFA	8.3%
501 – 1000 FCFA	0%
More than 1000 FCFA	16.7%

Source of drinking water

Private Faucet	8.3%
Public Faucet	91.7%
Public Well	0%
Pump	0%
Private (Traditional) Well	0%
Multiple sources	0%

Is this source far from your home?

Yes: 18.2%

No: 81.8%

If it is far, how long does it take you to collect drinking water? (8 responses)

30 minutes or less	25%
Between 30 minutes and 1 hour	0%
Between 1 hour and 2 hours	12.5%
More than 2 hours	62.5%

How much do you spend on drinking water daily?

	Dry season	**Other seasons**
Does not pay	9.1%	8.3%
100 FCFA or less	9.1%	25%
101 – 200 FCFA	18.2%	8.3%
201 – 300 FCFA	36.4%	33.3%
301 – 500 FCFA	9.1%	8.3%
501 – 1000 FCFA	0%	0%
More than 1000 FCFA	18.2%	16.7%

Must you change where you get your water during the dry season?

Yes: 72.7%

No: 17.3%

Who in the family collects the water?

The women	18.2%
The father	0%
The children	27.3%
The maid	28.2%
A delivery person	9.1%
The women and the children	27.3%

Management of solid waste

GIE	75%
In the street	8.3%
In the household compound	0%
Burn it	0%
In a trench	16.7%
Other	0%

The emptying of pit latrines

Spiros	58.3%
A hole	16.7%
In the street	0%
It has not yet been full	25%

Sector 2 (12 Families)

Average Family Size: 22 people

Average Years in Sikoro: 30 years

Source of water for utilization (cleaning, washing, laundry, etc.)

Private Faucet	0%
Public Faucet	8.3%
Public Well	0%
Pump	0%
Private (Traditional) Well	91.7%
Multiple sources	0%

Is this source far from your home?

Yes: 0%

No: 100%

If the source is far, on average, how long does it take you to collect water? (0 responses)

30 minutes or less	
Between 30 minutes and 1 hour	
More than 1 hour but lessthan 2 hours	
More than 2 hours	

How much do you spend on water for utilization?

Does not pay	91.7%
100 FCFA or less	0%
101 – 200 FCFA	8.3%
201 – 300 FCFA	0%
301 – 500 FCFA	0%
501 – 1000 FCFA	0%
More than 1000 FCFA	0%

Source of drinking water

Private Faucet	0%
Public Faucet	100%
Public Well	0%
Pump	0%
Private (Traditional) Well	0%
Multiple sources	0%

Is this source far from your home?

Yes: 0%

No: 100%

If it is far, how long does it take you to collect drinking water? (10 responses)

30 minutes or less	90%
Between 30 minutes and 1 hour	10%
Between 1 hour and 2 hours	0%
More than 2 hours	0%

How much do you spend on drinking water daily?

	Dry season	**Other seasons**
Does not pay	0%	0%
100 FCFA or less	45.5%	45.5%
101 – 200 FCFA	45.5%	45.5%
201 – 300 FCFA	9.1%	9.1%
301 – 500 FCFA	0%	0%
501 – 1000 FCFA	0%	0%
More than 1000 FCFA	0%	0%

Must you change where you get your water during the dry season?

Yes: 8.3%

No: 91.7%

Who in the family collects the water?

The women	50%
The father	0%
The children	16.7%
The maid	25%
A delivery person	0%
The women and the children	8.3%
Whomever can	0%

Management of solid waste

GIE	66.7%
In the street	25%
In the household compound	0%
Burn it	0%
In a trench	0%
Other	8.3%

The emptying of pit latrines

Spiros	66.7%
A hole	16.7%
In the street	0%
It has not yet been full	16.7%

Sector 3 (12 Families)

Average Family Size: 14 people

Average Years in Sikoro: 19 years

Source of water for utilization (cleaning, washing, laundry, etc.)

Private Faucet	0%
Public Faucet	58.3%
Public Well	0%
Pump	0%
Private (Traditional) Well	41.7%
Multiple sources	0%

Is this source far from your home?

Yes: 16.7%

No: 83.3%

If the source is far, on average, how long does it take you to collect water? (6 responses)

30 minutes or less	16.7%
Between 30 minutes and 1 hour	16.7%
More than 1 hour but less than 2 hours	50%
More than 2 hours	16.7%

How much do you spend on water for utilization?

Does not pay	41.7%
100 FCFA or less	8.3%
101 – 200 FCFA	16.7%
201 – 300 FCFA	33.3%
301 – 500 FCFA	0%
501 – 1000 FCFA	8.3%
More than 1000 FCFA	0%

Source of drinking water

Private Faucet	0%
Public Faucet	100%
Public Well	0%
Pump	0%
Private (Traditional) Well	0%
Multiple sources	0%

Is this source far from your home?

Yes: 41.7%

No: 58.3%

If it is far, how long does it take you to collect drinking water? (10 responses)

30 minutes or less	30%
Between 30 minutes and 1 hour	20%
Between 1 hour and 2 hours	40%
More than 2 hours	10%

How much do you spend on drinking water daily?

	Dry season	**Other seasons**
Does not pay	0%	0%
100 FCFA or less	8.3%	33.3%
101 – 200 FCFA	16.7%	16.7%
201 – 300 FCFA	25%	25%
301 – 500 FCFA	25%	8.3%
501 – 1000 FCFA	8.3%	8.3%
More than 1000 FCFA	16.7%	8.3%

Must you change where you get your water during the dry season?

Yes: 50%

No: 50%

Who in the family collects the water?

The women	25%
The father	0%
The children	0%
The maid	16.7%
A delivery person	25%
The women and the children	25%
Whomever can	8.3%

Management of solid waste

GIE	58.3%
In the street	0%
In the household compound	0%
Burn it	16.7%
In a trench	8.3%
Other	16.7%

The emptying of pit latrines

Spiros	41.7%
A hole	16.7%
In the street	0%
It has not yet been full	41.7%

Sector 4 (12 Families)

Average Family Size: 23 people

Average Years in Sikoro: 22 years

Source of water for utilization (cleaning, washing, laundry, etc.)

Private Faucet	0%
Public Faucet	25%
Public Well	41.7%
Pump	0%
Private (Traditional) Well	25%
Multiple sources	8.3%

Is this source far from your home?

Yes: 33.3%

No: 66.7%

If the source is far, on average, how long does it take you to collect water? (6 responses)

30 minutes or less	50%
Between 30 minutes and 1 hour	33.3%
More than 1 hour but less than 2 hours	0%
More than 2 hours	16.7%

How much do you spend on water for utilization?

Does not pay	66.7%
100 FCFA or less	8.3%
101 – 200 FCFA	0%
201 – 300 FCFA	25%
301 – 500 FCFA	0%
501 – 1000 FCFA	0%
More than 1000 FCFA	0%

Source of drinking water

Private Faucet	0%
Public Faucet	58.3%
Public Well	33.3%
Pump	0%
Private (Traditional) Well	0%
Multiple sources	8.3%

Is this source far from your home?

Yes: 18.2%

No: 81.8%

If it is far, how long does it take you to collect drinking water? (9 responses)

30 minutes or less	44.4%
Between 30 minutes and 1 hour	11.1%
Between 1 hour and 2 hours	22.2%
More than 2 hours	22.2%

How much do you spend on drinking water daily?

	Dry season	**Other seasons**
Does not pay	33.3%	33.3%
100 FCFA or less	8.3%	16.7%
101 – 200 FCFA	8.3%	0%
201 – 300 FCFA	25%	33.3%
301 – 500 FCFA	8.3%	8.3%
501 – 1000 FCFA	8.3%	0%
More than 1000 FCFA	8.3%	8.3%

Must you change where you get your water during the dry season?

Yes: 66.6%

No: 33.3%

Who in the family collects the water?

The women	33.3%
The father	0%
The children	8.3%
The maid	0%
A delivery person	16.7%
The women and the children	25%
Whomever can	16.7%

Management of solid waste

GIE	83.3%
In the street	8.3%
In the household compound	0%
Burn it	8.3%
In a trench	0%
Other	0%

The emptying of pit latrines

Spiros	50%
A hole	25%
In the street	0%
It has not yet been full	25%

Sectors 1-4 (48 Families)

Average Family Size: 19 people

Average Years in Sikoro: 22 years

Source of water for utilization (cleaning, washing, laundry, etc.)

Private Faucet	2.1%
Public Faucet	35.4%
Public Well	10.4%
Pump	0%
Private (Traditional) Well	45.8%
Multiple sources	6.3%

Is this source far from your home?

Yes: 10.6%

No: 89.4%

If the source is far, on average, how long does it take you to collect water? (18 responses)

30 minutes or less	27.8%
Between 30 minutes and 1 hour	16.7%
More than 1 hour but less than 2 hours	22.2%
More than 2 hours	33.3%

How much do you spend on water for utilization?

Does not pay	58.3%
100 FCFA or less	6.3%
101 – 200 FCFA	6.3%
201 – 300 FCFA	20.8%
301 – 500 FCFA	2.1%
501 – 1000 FCFA	4.2%
More than 1000 FCFA	2.1%

Source of drinking water

Private Faucet	2.1%
Public Faucet	87.5%
Public Well	8.3%
Pump	0%
Private (Traditional) Well	0%
Multiple sources	2.1%

Is this source far from your home?

Yes: 27.7%

No: 72.3%

If it is far, how long does it take you to collect drinking water? (37 responses)

30 minutes or less	45.9%
Between 30 minutes and 1 hour	13.5%
Between 1 hour and 2 hours	18.9%
More than 2 hours	21.6%

How much do you spend on drinking water daily?

	Dry season (41 responses)	**Other seasons (42 responses)**
Does not pay	12.8%	12.5%
100 FCFA or less	19.2%	29.2%
101 – 200 FCFA	21.3%	16.7%
201 – 300 FCFA	21.3%	22.9%
301 – 500 FCFA	8.5%	8.3%
501 – 1000 FCFA	6.4%	2.1%
More than 1000 FCFA	10.6%	8.3%

Must you change where you get your water during the dry season?

Yes: 48.9%

No: 51.1%

Who in the family collects the water?

The women	29.8%
The father	0%
The children	12.8%
The maid	14.9%
A delivery person	12.8%
The women ET The children	23.4%
Whomever can	6.4%

Management of solid waste

GIE	70.8%
In the street	10.4%
In the household compound	0%
Burn it	6.3%
In a trench	4.2%
Other	8.3%

The emptying of pit latrines

Spiros	50%
A hole	18.8%
In the street	0%
It has not yet been full	31.3%