Water, Sanitation and Disability in Rural West Africa

Enhancing Access and Use of WASH Facilities

A Summary Report of the Mali Water and Disabilities Study

March 2010

WATER, SANITATION AND DISABILITY IN WEST AFRICA

A SUMMARY REPORT OF THE MALI WATER AND DISABILITIES STUDY

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March, 2010

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ACKNOWLEDGEMENTS

This Study was conceived, implemented and brought to completion through the combined efforts of many people and institutions. The Conrad N. Hilton Foundation provided important financial support, along with guidance and encouragement from Dr. Braimah Apambire, Senior Program Officer, International Programs. Within World Vision International, Jean Baptiste Kamate, Regional Vice President, West Africa Region, played a key role in the early conception and implementation of the Study. World Vision U.S. provided matching funds, as well as consistent support from Mr. David Scheiman, Senior Director of Africa Programs, International Programs Group, and more recently from Mr. Ron Clemmer, WASH Specialist, International Programs Group. The entire staff of World Vision Mali provided invaluable moral and logistical support over the last three years. Of special mention are Mr. Fabiano Franz, National Director; Mr. Samuel Diarra, former MRWP Manager and presently the WASH-HD Regional Program Manager for the West Africa Region; Mr. Bob Burke, Resource Development and Programming Advisor; Mme. Maimouna N'Diaye, Coordinator, West Africa TDI; Mr. Dabere Dembele, Tominian Base Director and principal in-country coordinator for the Study; Mr. Kassoum Bagayogo, WASH Supervisor in Tominian; and Madame Bernice Poudiougu, WASH Supervisor in Koro. Other valuable institutional collaborators in Mali were Handicap International (notably Mr. Nicolas Charpentier, Program Director) and WaterAid. The support and introduction to disabled members of target communities which the Study received from Sister Alice Somda and the Sisters of the Annunciation in Mandiakuy, Mali was also invaluable. In Niger, Mr. Mamane Amadou, World Vision's NRWP Manager, provided important assistance to the Study. At Messiah College the Study was housed within the Collaboratory for Strategic Partnerships and Applied Research, through which much-needed logistical and accounting support was received. A number of faculty, staff and students gave extraordinary amounts of their time over the last three years to assure that research agendas were fulfilled and brought to completion. Aside from the author, the primary weight of this Study was carried by the students of the Mali Water and Disabilities Study Group, who gave enthusiastically and sacrificially of their time. These are all listed in the "contributors" section of the report.

More than any other group of individuals, this Study owes a profound debt of gratitude to the many disabled members of the Study's target communities in West Africa− who gave unselfishly of their time, energy and wisdom over the past three years. If there is any lasting impact from this Study, then it will surely be due to their willingness to have patiently and transparently shared, from the depths of their own personal experiences, the stories and insights, which so uniquely shaped the outcomes of this endeavor.

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ACRONYMS

ADP – Area development program

cfa – West African franc; the common currency in francophone Africa
($1 US = 480 cfa, as of 2009)

MRWP – Mali Rural Water Project

MWDS – Mali Water and Disabilities Study

NRWP – Niger Rural Water Project

PWD – Person with disability

SOACAP – Societé Africane de Chaussures et Articles en Plastique

WASH – Water, Sanitation and Hygiene

WAWI – West Africa Water Initiative

PREFACE

WHAT IS THE MALI WATER AND DISABILITIES STUDY?

The Mali Water and Disabilities Study was established to examine issues of access to and use of clean water and sanitation facilities by disabled persons within target communities of the West Africa Water Initiative. The three-year Study (2007-2009) was supported by the Conrad N. Hilton Foundation and jointly implemented by Messiah College and World Vision Mali. Messiah College provided conceptual leadership, conducted laboratory work at its campus facilities in the U.S., and sent faculty and student research teams to West Africa twice each year. World Vision Mali supported the Study with in-country logistics, community access and year-around field staff. The Study also partnered with local organizations such as Handicap International, WaterAid, and the Sisters of the Annunciation in Mandiakuy, Mali.

WHAT IS THE WEST AFRICA WATER INITIATIVE?

The West Africa Water Initiative, better known as WAWI, is a partnership of 13 international organizations which seeks to improve the well-being of rural communities by providing access to safe water and sanitation. Since the beginning of WAWI and WAWI's predecessor projects, some 1,600 village wells and hand-pumps, and 28,000 household latrines have been installed in the West African countries of Ghana, Mali and Niger.

WHAT IS THE PURPOSE OF THIS REPORT?

This report provides a summary of activities and findings of the Study. It is also intended to serve as a practical guide for WASH practitioners who seek to develop community WASH programs that are inclusive of disabled people in the West African region. The report provides a review of specific issues facing the disabled, details of the design and development of low-cost assistive technologies, as well as guidelines for engaging the disabled and the communities where they live.

FOR WHOM IS THE REPORT INTENDED?

The report is specifically targeted for practitioners working in WAWI target communities; notably WASH field staff of World Vision Area Development Programs. However, WASH practitioners from all NGOs and/or government ministries working in the region should find the report to be an informative and practical guide.

HOW IS THIS REPORT ORGANIZED?

The report begins with a brief background of the context of the Study. This is followed by the summary results of a survey which assessed: a) the extent and types of disability found in rural Mali, and b) the constraints faced by the disabled persons in accessing clean water and sanitation. A detailed review of simple, assistive technologies for water pumping, water transport, domestic water use, and latrine use makes up the core of this document. The report ends with suggestions for effective development and transfer of low-cost assistive technologies, and for establishing inclusive environments for the disabled within community WASH programs.

CHAPTER 1 INTRODUCTION

1.1 CHALLENGES OF THE DISABLED

West Africa is home to some of the poorest communities in the world. Within these communities, the disabled are often the most excluded and vulnerable. While disabled persons can usually be seen wherever one travels in the region, many are confined to their homes or are hidden away, leaving the visitor or field worker with a less-than-accurate impression of the extent of disability within these communities. The disabled are often the "hidden" poor, with many spending their lives marginalized by society, deprived of human dignity and hope for the future. Yet, the disabled are legitimate members of each community, be they infants, teenagers, adults or the elderly. They are people with names, hopes and dreams. As with all members of each community, these, too, are persons who seek the fulfillment of their unique aspirations and potential within society (figure 1.1).

Figure 1.1 This man has been blind since he was very young and was repeatedly refused admittance to any local public schools. Instead, his father taught him to farm. Unlike many other disabled persons, through the encouragement of his family, he was able to surmount his disability and the disabling attitudes of his community. Through his livelihood as a gardener, he successfully raised and secured education for his five sons.

In most communities, the disabled often have little or no access to the region's limited public services, such as health and education; and many community development initiatives do not include the needs of disabled—neither in project planning nor in project implementation. This often holds true for initiatives aimed at enhancing access to safe water and sanitation. Many of the disabled struggle daily to maintain minimum levels of personal hygiene, due in part to the daunting challenges of obtaining or using water and accessing sanitation facilities. These challenges are often multiple and complex. For example, superstructures which surround hand-pumps can impede access for those with limited mobility and those who are blind. The manipulation of hand-pumps can pose challenges, not only for the physically disabled, but also for the very young and the elderly. Transportation of water from the pump to the home can also pose a major challenge, as can the manipulation of water containers for domestic purposes (figure 1.2). Disabled women are particularly impacted by these limitations, as they live in a society where their domestic role and sense of self-worth are closely linked to the ability to draw water and manage it within the household. For many disabled and elderly persons, the simple use of a latrine can pose major physical obstacles and health risks. For some, traversing a yard or field to access a latrine can be challenging, especially during evening hours (figure 1.3). The blind often encounter special difficulties when accessing or using latrine structures. Those with lower body limitations are often compelled to traverse

Figure 1.2 With the loss of her leg many years ago, this widow walks with the assistance of a chair. She fetches water several times a day from the nearby well.

Figure 1.3 Without the use of her legs, this woman must traverse the ground with her hands and knees for all of her daily needs.

soiled platforms by crawling or dragging themselves, while others can find it difficult or impossible to maintain a squatting position. Those with limited arm or hand use may struggle to wash clothes or dishes, clean themselves following defecation, or to adequately rinse themselves while bathing.

Given these circumstances, the inclusion of disability considerations in the planning and implementation of WASH initiatives is strategically important within any community if all persons are to be served and to benefit. WASH programs which are inclusive of the disabled serve to enhance not only the health of the disabled and the community, but can also strategically serve to reduce social exclusion and affect much-needed changes in public attitudes and perceptions.

1.2 CONTEXT OF THE STUDY

STUDY SITES

The Mali Water and Disabilities Study was conceived as a 3-year pilot study, jointly implemented by Messiah College and World Vision Mali, and was conducted among target communities of the West Africa Water Initiative (WAWI) and World Vision's Mali Rural Water Project (MRWP). WAWI has generally focused on rural communities in West Africa. The communities of the rural Tominian Circle region of south-central Mali were selected as the pilot Study's principal site. World Vision Mali supports six Area Development Programs (ADPs) in this region. The area was selected by World Vision Mali not only because of its being a WAWI target region, its relative ease of access, and its central location in Mali, but also because it was deemed that its ADPs and communities were generally representative of WAWI's other rural target communities — not only in Mali, but in Niger and northern Ghana. While the focus of the research was in the communities around Tominian, other communities within and outside of Mali were visited regularly for comparative study. These included communities in the Bamako, Bla, Koro and Timbuktu regions of Mali, and the Niamey, Maradi, Zinder and Goure regions of Niger.

WAWI WATER AND SANITATION TECHNOLOGIES

WAWI interventions in the WASH sector generally involve the development of boreholes, equipped with India Mark II hand-pumps and a surrounding, concrete superstructure often including a raised platform, apron, protective walls and a separate laundry apron (figures 1.4 and 1.5). Sanitation facilities are generally developed around the dome-shaped, concrete sanplat latrine platforms (figure 1.6). While there are many other types of hand-pumps, superstructures and latrine facilities being employed in WASH programs around the world, the Study limited its work to facilitating access by the disabled to these technologies presently being used by WAWI. The Study also limited its work to exploring design enhancements which involve little or no increase in overall costs associated with the standard hand-pump, superstructure and latrine development packages used by WAWI.

Figure 1.4 A typical hand-pump and superstructure facility of the Mali Rural Water Project

Figure 1.5 A typical laundry apron, usually placed within a few meters of the pump, which provides a convenient and hygienic place for clothes washing.

Figure 1.6 Sanplat latrine platform promoted by World Vision Mali's WASH programs.

FOCUS ON THE PHYSICALLY DISABLED

The “disabled” in any community include all persons who encounter a disabling environment – be they disabled from birth, by disease or accident, or by age (i.e., the very young or the elderly). This also includes those with mental disabilities. The Study focused its work, however, on the *physically* disabled and/or those who find themselves physically limited from effective access to WASH facilities. The special needs of the mentally disabled were largely beyond the scope of the Study.

1.3 STUDY OBJECTIVES, PHASES AND DOMAINS OF INTERVENTION

OBJECTIVES

The three basic objectives of the 3-year Study were:

1. To conduct an assessment of the limitations and opportunities for access to and use of WASH facilities by disabled and elderly persons in communities served by WAWI.

2. To identify and develop simple low-cost alternatives to minimize identified constraints in a pilot project context.

3. To provide guidelines and recommendations to World Vision and WAWI to assure effective access to and use of clean water and sanitation facilities by the disabled.

STUDY PHASES

The Study's objectives were accomplished through the following phases (or steps):

1. **Formal Survey** — to determine incidence rates, types and categories of disability in target communities; and to assess disabled peoples' perceptions and constraints relative to water access and sanitation.
2. **Informal Surveys and Focus Groups** — to establish key constraints and research priorities as perceived by disabled persons.
3. **Development of Research Initiatives** — based on input from steps 1 and 2 above, and as a function of capacities of the implementing institutions (Messiah College and World Vision Mali).
4. **Research and Development** — of design and technology solutions, as well as guidelines; and as a function of iterations of subsequent field testing (step 5).

5. **Field Testing** — of prototypes and methods, involving multiple iterations of steps 4 and 5, which take place in Messiah College laboratories and ADP field sites.

6. **Site Visits** — conducted for the purpose of building upon other relevant experience in the West Africa Region and to assess relevance and transferability of designs and methods in geographic and social environments outside of the Tominian region (in the broader area of WAWI intervention).

7. **Summary Presentation and Final Reporting** — of Study outcomes given in on September 9, 2009, in Bamako, Mali at the WAWI Regional WASH Review.

DOMAINS OF INTERVENTION

The Study focused its work in three domains of intervention:

1. **Access and use of hand-pumps** — involving methods and technologies to facilitate use of hand-pumps, and a review of low-cost adaptations to superstructure entranceways, pump aprons, raised platforms, protective walls and laundry aprons.

2. **Transport and domestic use of water** — involving methods to enhance common forms of water transport and the management and use of water within the household.

3. **Access and use of latrines** — involving methods and low-cost technologies to facilitate the use of latrines (both improved and unimproved).

CHAPTER 2 ASSESSING THE CONSTRAINTS OF DISABILITY

2.1 THE SURVEY

Data on the extent and types of disabilities in many West African countries is generally limited, both quantitatively and qualitatively. So as to better understand issues related to disability in the Study's target area, a formal, baseline survey was conducted with the assistance of Handicap International Mali. Specifically, the survey was designed to provide a cross-sectional assessment of the scope of disabilities in relation to water and latrine use.

A cluster sampling method was employed with the individual household as the unit of sampling. The sample was determined on the basis of clusters with a probability of being selected proportional to the size of the cluster. Selection of the final 30 clusters (approximately one village each) from a total of 313 villages in the Tominian area was done through unrestricted random sampling. The goal was to have a sample of 900 households, 30 from each of the 30 clusters. (This sampling method followed World Vision's standard Transformational Development Indicators guidelines,)[1] The survey was conducted in two stages: first, the heads of households were interviewed with regards to household composition and whether persons with a disability (PWD) lived within the household; second, the PWD identified in stage one were interviewed with regards to their disability and access to water, hygiene and sanitation. *(Note: For the purpose of discussing the survey results in Chapter 2, persons with a disability will be referred to using the acronym "PWD".)*

The survey instrument was developed by Messiah College and Handicap International Mali, while conceptual and implementation oversight of the survey was done by Handicap International. World Vision Mali field staff and disabled persons from local communities were trained to conduct the survey (figures 2.1 and 2.2). Data compilation and initial analysis of the data was

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[1] Volume Seven: Methods – Survey Guidelines: A Guide to Implementation of the Household Survey. Development Resources Team. World Vision, Washington, D.C. (2002).

done by Handicap International, and followed with a comprehensive report.[2] Later in the Study, survey findings were presented and discussed among participatory focus groups of disabled persons to develop and refine research priorities.

Figure 2.1 Disabled volunteer with her survey documents. Disabled persons from target communities were trained to assist in the disability assessment among 900 households.

Figure 2.2 A trained disabled woman from the community and World Vision staff member interview a disabled man in one of the Study's target communities.

2.2 DISABILITY IN RURAL MALI

EXTENT AND TYPES OF DISABILITY

In the first stage of the survey, 870 households representing 7,532 persons were surveyed. Two-hundred-sixty PWD, representing about 3.5% of the general population were identified.[3] This number is lower than global estimate of the World Health Organization (10%), but is slightly higher than

[2] Study on Access to Water, Hygiene and Sanitation for People in a Disabling Situation in Mali. C. Horne, P. Debeaudrap, and N. Charpentier. Handicap International, Mali, 2007.

[3] This number (260) included 16 pregnant women who, by nature of their temporary condition, qualify as disabled. Much of the discussion in the second stage of the survey focuses on responses from the 244 respondents who are more or less permanently disabled.

levels reported by the Malian census bureau (2.7%).[4] According to various sources in Mali, the figure of 3.5% is probably lower than the national average. The Study's survey focused exclusively on rural areas, and it is generally known that urban centers tend to have higher populations of PWD due to their migration from rural areas to seek work or charitable support. While this number (3.5%) may not seem significant, it should be remembered that for a village of 250 persons (the average population of the surveyed villages), some 9 persons are disabled. For a village of 1,000 about 35 persons are challenged by disability. From a health standpoint (both for the individual and the community) these numbers are not insignificant. Furthermore, it should be remembered that clean water, sanitation and hygiene are not just a matter of health for PWD, but are an essential human right.

In the second stage of the survey, the PWD identified in the first stage were individually interviewed about the nature of their disabilities and the challenges they face relative to water hygiene and sanitation. The nature of disabilities can be complex, thus making categorization of disabilities equally complex. For the purposes of the survey, the categorization of disabilities is based on the International Classification of Functioning, Disability and Health (ICF) Version 2.1a Checklist.[5] From this classification, two general measures of disability were constructed: *basic action difficulty* (e.g., upper and lower body movement difficulty, seeing and hearing difficulty, and cognitive difficulty) and *complex activity limitation* which is more related to a person's restriction in full participation in social role activities (e.g., self-care, work or communication limitations).

Figure 2.3 details the types and percentages of disabilities reported (not including those who were pregnant). It should be noted here that each individual surveyed may have reported one or more disabilities, depending on their specific condition. About 65% of PWD interviewed reported some form

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[4] www.un.org/disabilities/ (Factsheet on Disabilities); *http://www.who.int/features/qa/16/;* Demographic and Health Survey, Government of Mali, 2001.

[5] *ICF Checklist Version 2.1a for International Classification of Functioning, Disability and Health. (www.who.int/**classifications**/icf/training/icfchecklist.pdf*), Sept. 2003.

of movement or self-care related difficulty, while about 30% indicated visual challenges. Persons with lower body difficulties most often cited challenges with walking and squatting, while those with upper body limitations cited issues of grasping and lifting objects as their greatest challenges. More than half of those with visual difficulties consider themselves moderately to completely blind. Combined, some 95% of PWD respondents indicated some form of physical disability(s), which can directly limit their access to and use of water and sanitation facilities. Only 12% of respondents regularly use any form of assistive devices (canes, crutches, hand-powered tricycles, etc.).

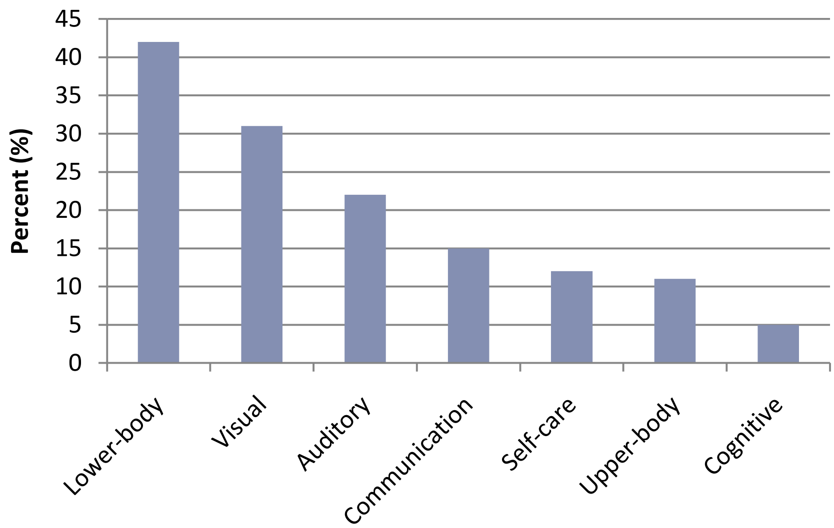


Figure 2.3 Major disabilities categories reported (n=244)

AGE DISTRIBUTION

Figure 2.4 depicts PWD respondents according to age group. Examination of the figure reveals a bi-modal distribution of PWD in the survey sample, with distribution peaks at 6-15 years and 56-70 years age groups. More specifically, the number of PWD is low from 0-5 years, peaks at 6-15 years, drops from 15-55 years, peaks again at 56-70 years, and then drops from 71 years onward. This bimodal distribution is an important aspect of disability issues in rural areas and most likely reflects the tendency of PWD to migrate towards urban centers in the search for work or charitable assistance as they enter their young adult years. Informal discussions with PWD during the Study confirm this hypothesis. It should also be noted that while lower-body, upper-body and auditory difficulties tend to occur earlier in the lives of surveyed PWD, the onset of visual difficulty is more associated with advancing age. In general, survey data indicates that between the ages of 6-15 years, young people become disabled from various diseases or accidents; in their mid teens to early 30's, many migrate to urban areas in search of livelihoods; and from age 56 years onward, more community members become disabled due to the effects of aging.

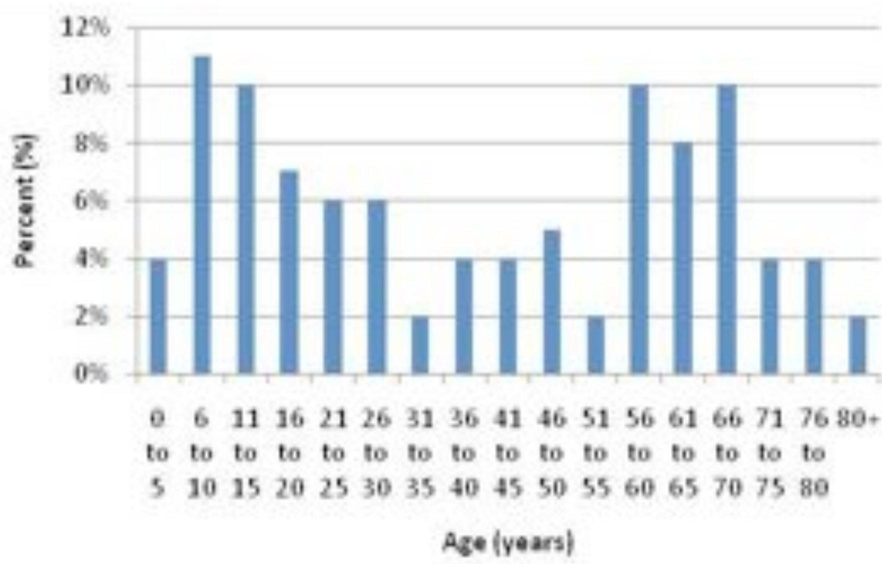


Figure 2.4 Age distribution of disabled people (n=244)

GENDER AND MARITAL STATUS

The survey indicated that there are about the same number of male and female PWD in the rural communities in the Tominian region. There are more single male than single female PWD, and conversely, more female PWD than males are widowed. It should be noted that disabled men often find it difficult to obtain a wife, as demonstration of being able to support a family is often a requisite of the woman's family. Conversely, there is a widely held traditional belief in many parts of West Africa that marriage to, or sexual relations with, a disabled woman can bring a man special powers. The proportion of married or once married PWD women (83%) is close to what is observed in the general population.[6]

EDUCATION

In the survey sample of PWD, only 11% had ever attended school, and the adult literacy rate of 18% for PWD is lower than the national level of 24% for those aged 15 years and older.[7] The data also indicate that there is no significant difference between men and women in education attainment.

LIVELIHOODS

About half of PWD (53%) above the age of 15 years indicated they had some form of livelihood, be it a revenue-generating activity (28%) or farming (38%), the latter being mostly men. For those who did not have a livelihood, most obtained their needs from family (89%), neighbors (28%) or through begging (7%).

2.3 ACCESS TO WATER AND SANITATION

WATER SOURCES

In spite of boreholes and pumps being installed in many villages in the Tominian area, the survey indicated that the main water source for 88% of households is an open well, with only 11% of households indicating that pumps are their main source. For many this is simply a matter of convenience, as households may often have open wells within or adjacent to their household compound enclosure. For PWD who fetch water, some 95% indicated the most common source to be an open well, largely due to proximity and convenience to their places of residence (figure 2.5).

[6] Demographic and Health Survey, Government of Mali, 2001.

[7] World Development Report, The World Bank, 2008.

Regarding improvements for wells, PWD suggested the installation of concrete aprons to reduce mud and water around wells (figure 2.6). Many disabled persons find stability difficult in wet or muddy ground. Others with lower-body limitations must sit on the ground while drawing water from wells. Other suggestions included the installation of permanent seats adjacent to the well, pulleys to aid water withdrawal, and lower protection walls to facilitate well access by PWD.

Figure 2.5 Typical open well in a village in Niger. The high usage and overcrowding, as well as the unwieldy infrastructure surrounding the well, makes access and use difficult for disabled persons.

Figure 2.6 Traditional village well in south-central Mali. Note the poorly constructed apron and the standing water and mud surrounding the well.

FETCHING WATER

Only 40 % of interviewed PWD reported that they fetch water (some more regularly or frequently than others). Among female PWD, some 44% never fetch water while 80% of male PWD report they never fetch water. Among the males, 36% indicated societal reasons (e.g., role divisions), while only 7% of females gave the same reason. Seventy percent of PWD with movement difficulty never fetch water; 66% of those with visual difficulty never fetch water; and 90+% of those with cognitive difficulty never fetch water. For all PWD who *do not* fetch water, figure 2.7 details the reasons given, with physical limitations and family's disapproval being the two most common reasons cited.

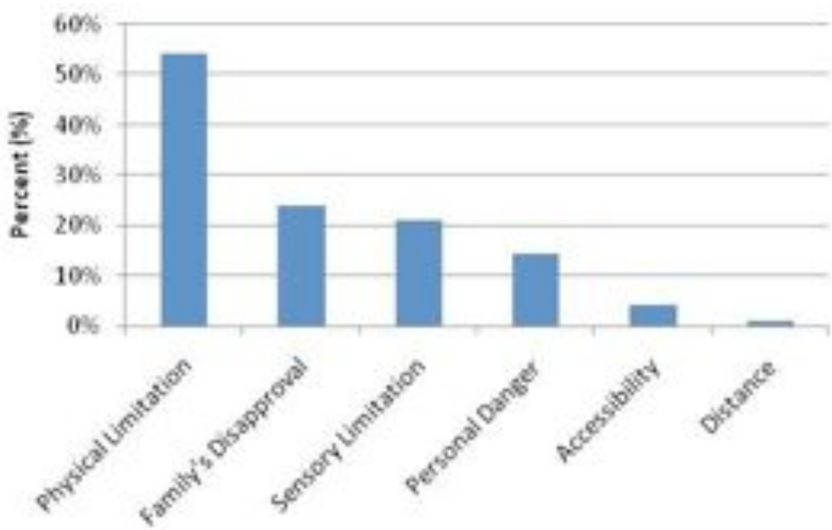


Figure 2.7 Primary obstacles for disabled persons who do not fetch water themselves. (n=158)

In the course of the Study it was common to hear of strong social biases against female PWD fetching water. Common reasons given by both family and community members were those of "inability "or "risk of personal injury"; although most female PWD in these cases disagreed and felt that the decision should be their own and not that of family or community (figure 2.8).

Figure 2.9 details the principal difficulties PWD face *when trying to transport water*. The most common issue is that of difficulty in transporting due to mobility limitations (48%) followed by lifting the water container to the head (40% of PWD who fetch water).

Suggestions from PWD regarding enhanced water transport included access to carts or tricycles outfitted with carrying racks for water containers. The main challenge with these technologies is their high cost.

Figure 2.8 This 17 year-old woman, blinded from diabetes at a very young age, explains how she slips out at night (against her parents' wishes) to practice drawing and carrying water from a village well in the hopes of one day fulfilling the expected roles of a married woman and mother.

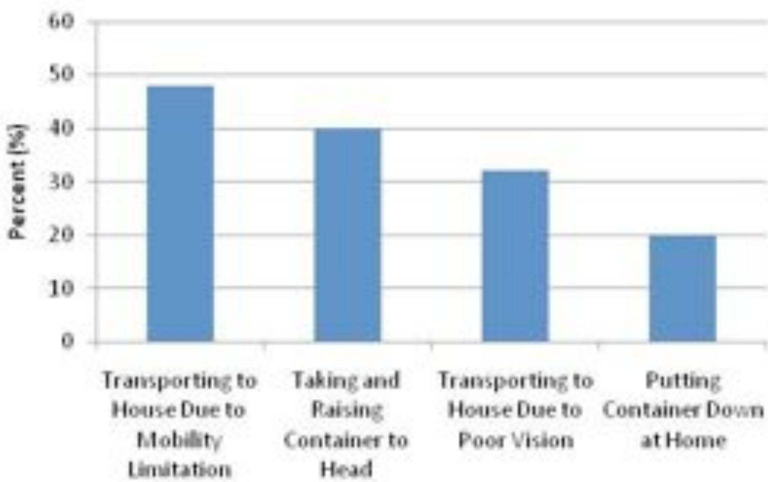


Figure 2.9 Difficulties encountered by disabled persons who fetch water themselves. (n=25)

WATER CONTAINERS

Typical containers for water transport for the general population in the Study area are metal and plastic buckets, open metal and plastic basins, and plastic jerry cans ("bidons") of 20-25 liters. All of these containers are most commonly carried on the head during transport. The most common container used by PWD is the plastic bucket (52%). Reasons given by PWD for the choice of container are given in figure 2.10, with ease of grasping and ease of manipulating while walking as the most common reasons.

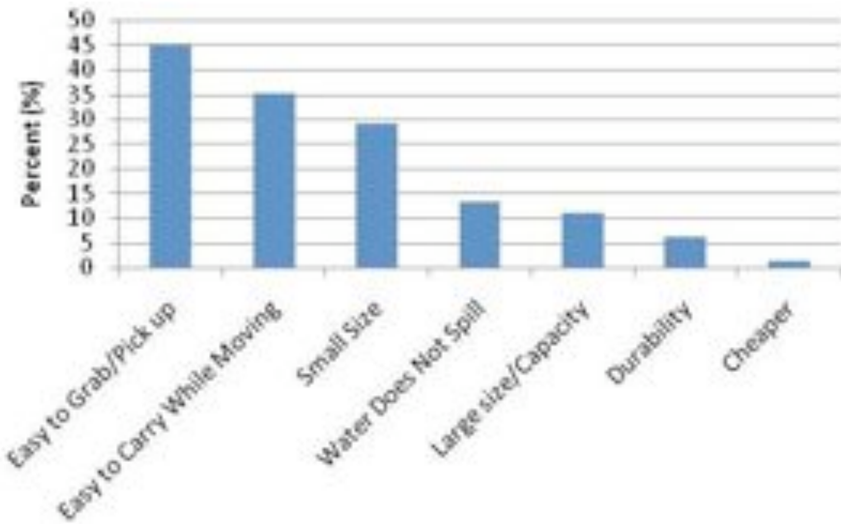


Figure 2.10 Reasons given by disabled persons for the choice of water container. (n=82)

At the same time, the most often cited problem while using containers is that of spillage during transport. Closer investigation revealed that most plastic buckets have relatively large rims which facilitate grasping and lifting onto the head, although water does spill frequently during transport. With the caps screwed on, plastic jerry cans have essentially no spillage, but due to their straight sides many PWD find them very difficult to grasp and lift to their heads (figures 2.11 and 2.12). In general, many PWD who fetch water try to avoid large volumes, with most limiting themselves to carrying 10-15 liters each trip. However, 50% of PWD who fetch water daily make more than 4 trips — considerably more than the typical 1-2 trips per day of most able-bodied persons.

Figure 2.11 Young girls carrying water with open plastic bucket and aluminum basin containers. Note the wide rims, which facilitate grasping.

Figure 2.12 A woman using a 25 liter plastic jerry can ("bidon") to carry water. Note the straight sides and absence of convenient handles.

DRAWING AND PUMPING WATER

Of the PWD who fetch water, most (90%) draw or pump the water themselves (figures 2.13 and 2.14). For those who do not draw or pump the water, nearly half reported the challenge of not being able to hold themselves in a stable position to draw with a rope and bucket or to manipulate the pump handle. Many of these are persons with lower-body disabilities. Others reported lack of upper-body strength to lift or operate the pump handle or the inability to mount the apron or platform surrounding the well or pump. These who do not draw or pump water for themselves report the need for assistance from others at the water source to fill their containers.

Figure 2.13 This young man, born with short forearms, demonstrates how he draws water from the family well.

Only 6% of all interviewed PWD reported using hand-pumps themselves. Most of these also reported the need to use two hands for pumping so as to stabilize themselves in an upright position (figure 2.15). A few PWD reported challenges of removing containers from under the water outlet of the pump and of lifting the full containers.

Figure 2.14 This woman with limited use of her left side (both arm and leg) demonstrates how she lifts water with her right arm, and then uses her weaker left foot to hold the cord after each lifting motion.

A common suggestion from PWD regarding pump use is that of improved handles to facilitate grasping while pumping. This suggestion was also common from the able-bodied.

Figure 2.15 A young disabled man trying to simultaneously pump and hold himself upright with his cane. In this position, he is unable to produce a steady flow from the pump.

BATHING

Most PWD reported washing themselves regularly. However, 37% reported difficulties when bathing. Figure 2.16 details the most frequently reported challenges while bathing, with getting water to the bath area being the most cited challenge. Sixty-two percent of those who reported bathing difficulties indicate they require assistance while bathing, most commonly citing difficulties with grasping or difficulties due to blindness (figure 2.17). Some PWD suggested better and/or higher seating stools for use when bathing.

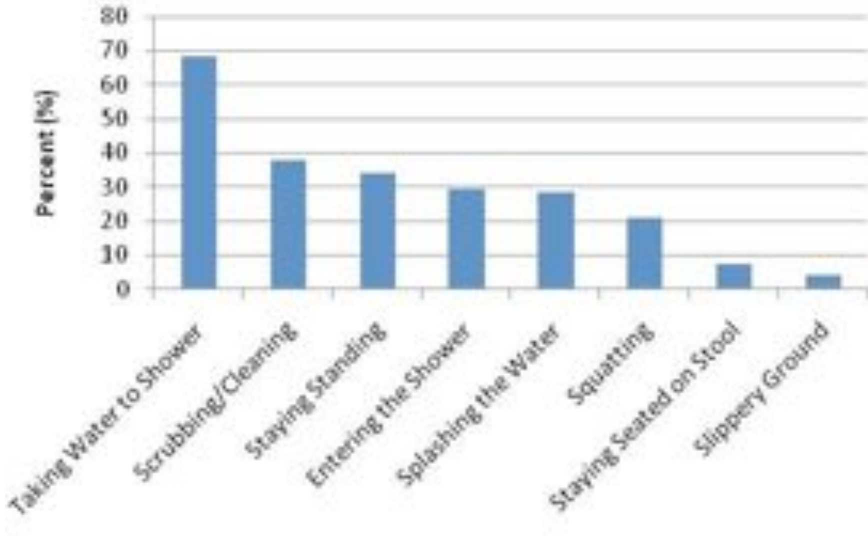


Figure 2.16 Difficulties encountered by disabled persons when bathing. (n=91)

Figure 2.17 For those with limited use of their hands, simple tasks such as scrubbing themselves while bathing, washing laundry or cleaning themselves after defecation can be difficult and result in poor hygiene.

DISHES AND LAUNDRY

Some 14% of all PWD (all women) indicated difficulties with the domestic chores of laundry and dishwashing. Figure 2.18 details the challenges cited by these women. Visual challenges (cited by the blind) and the standing position are the most common difficulties. Traditionally, in the effort to remain unsoiled and dry, most able-bodied women prefer to wash clothes from a standing position, while bending over the wash basin or bucket (figure 2.19). A number of female PWD, especially those with upper-body limitations, mentioned the challenge of pouring water from large containers for domestic water use. Suggestions for technologies to aid in this effort were often mentioned.

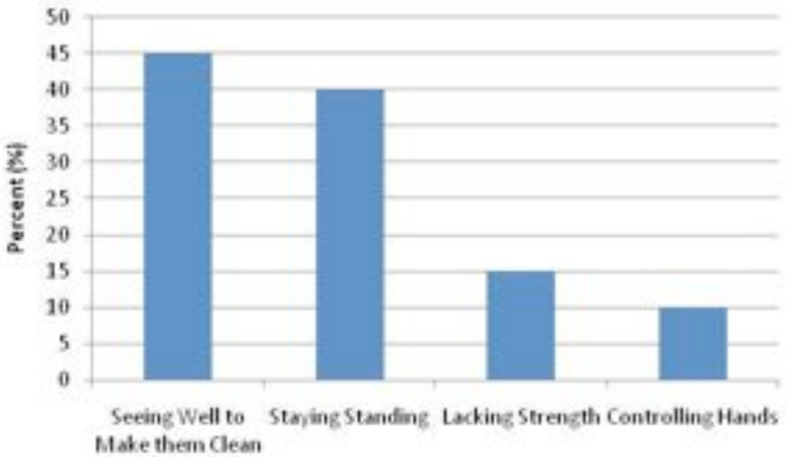


Figure 2.18 Difficulties encountered by disabled persons when doing dishes or laundry. (n=20)

Figure 2.19 Woman bending over basins as she washes clothes. Many disabled women are unable to maintain this posture, much less pour water from containers and effectively scrub clothes.

LATRINE USE

Conducting interviews among rural populations about habits of defecation is a sensitive matter at best, and care must be taken not only when conducting the interviews, but also when analyzing the data. Many individuals (both PWD and the able-bodied, alike) are often ashamed to admit that they do not have access to a latrine or that they experience any form of difficulty in the process of relieving themselves. Analysis and interpretation of collected survey data should therefore take these sensitivities into account.

In this part of rural Mali, more than 60% of households report they have no latrine. Approximately 35% or less of households have traditional latrines, (figure 2.20) with about 5% reporting they have some form of improved latrine such as the sanplat (figure 1.6). Fifty-eight percent of PWD report either not having or not using a latrine, with most having to go outside their place of residence to relieve themselves in adjacent fields or the bush.[8] In the wet season, PWD report they do not have as far to walk as they often use the crop fields adjacent to their residence for privacy, although at this time they may face the challenge of mud or water

Figure 2.20 A typical traditional latrine in Mali. Note the circular rim of a clay pot used to line the latrine hole. The rock slab near the drainage hole in the upper part of the photo is the area typically used for bathing. Use of latrines and bathing areas pose special physical and hygienic challenges for disabled persons, especially if the floor is muddy, poorly drained or unkempt by the rest of the household.

[8] However, Informal interviews conducted subsequent to the formal survey indicate that the number of PWD who do not use a latrine is probably higher than the number reported during the formal survey.

on the ground. In the dry season, PWD must go further (usually to the bush) to find places of privacy. For this reason, many report waiting until the hours of darkness to relieve themselves. Some PWD, and the elderly in particular, who do not have access to a latrine, prefer to use a chamber pot (usually a simple bowl or a bucket) rather than walk great distances, especially in the evening hours. Among these PWD who report they do not use a latrine, 14% indicated challenges of accessing latrines were the main reason for non-use.

Among all surveyed PWD, 42% indicate they use a latrine regularly. Of these PWD who use a latrine regularly, 80% report having a traditional latrine, while others report having some form of improved latrine. Among latrine-using PWD, 85% report having to touch the ground while accessing the latrine or to stabilize themselves when squatting (figure 2.21). Only 14% of these report using an assistive device (e.g., a cane). About a quarter of latrine-using PWD report having significant challenges in the access to and use of latrines. These are detailed in figure 2.22, with 54% reporting visual difficulties, followed by needing assistance from others and the difficulty of traversing muddy floors (30% each).[9]

Figure 2.21 A woman with severe deformities in both legs demonstrates how she must use her arms and hands to stabilize herself when squatting. This can be unhygienic when using a latrine and limits the freedom of arm or hand use when cleaning oneself following latrine use.

Suggestions from PWD on latrine improvement included improved or concrete flooring, technologies which help avoid the need to sit directly on the latrine hole, handles or support devices to assist in squatting, and devices to aid blind persons in locating the hole.

[9] It should be remembered that the majority of latrines do not have concrete flooring. Most households with latrines also use the same area for bathing, which results in wet flooring. Furthermore, latrine floors may often be wet during months of the wet season.

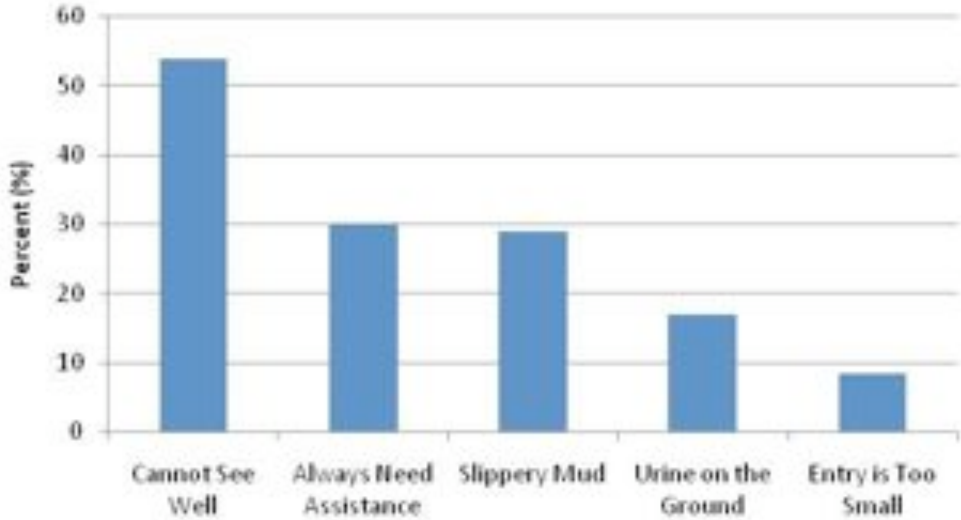


Figure 2.22 Challenges encountered by disabled persons in accessing and using latrines. (n=24)

CHAPTER 3 CHARACTERISTICS OF HAND-PUMP USE

3.1 ASSESSMENT METHODOLOGY AND SITE SELECTION

Before the challenges facing disabled persons could be adequately understood, a more comprehensive understanding of pump use by the general population was needed. In the effort to better understand how community members use pumps and the dynamics of user and pump interaction, time-lapse photography was used to monitor MRWP-installed hand-pumps in several locations. A camera was placed at a height of 4 meters and about 5-8 meters distant from the superstructure of selected pumps. Whenever possible, the camera and its support structure were placed in locations which did not interfere with normal human traffic in and around the pump superstructure. The camera, which was powered by a small solar panel, was then set to take photographs of the pump and superstructure three times each minute throughout the day. In this way, a full record of daytime pump use was recorded from sunrise to sunset. Pump use data was then retrieved from the photograph series taken at different villages during different periods of the year.

Two villages in different geographical and ethnic areas were selected for pump monitoring using this method. The first village, Yasso, is located in the Tominian area with a population of about 1,000, largely of “Bwa” ethnicity. The water table in Yasso is at about 15 meters, and the pump is outfitted with a single, straight handle (figure 3.1). Since the village has multiple sources of water, the use of the hand-pump is generally one of convenience or user preference. Pump monitoring took place in the month of June during the

Figure 3.1 A WAWI-MRWP hand-pump at Yasso, Tominian region, Mali.

region's hottest season. The second village, Gama, is located in the more arid Koro region of Mali with a population of about 600, mostly of "Dogon" ethnicity. The water table in the area ranges from about 60-80 meters, and the pump is outfitted with a weighted T-handle to facilitate water lifting from such depths (figure 3.2). Gama has no open wells (the nearest being some 6 km distant), and the borehole and pump is the village's only source of drinking water. The pump at Gama therefore incurs much heavier usage than the pump in Yasso. The Gama pump was monitored in the cooler, dry season month of January.

Figure 3.2 A WAWI-MRWP hand-pump at Gama, Koro region, Mali, equipped with weighted T-handle.

3.2 MONITORING RESULTS OF VILLAGE HAND-PUMPS

NUMBERS, AGE AND GENDER OF PUMP USERS

Figures 3.3 and 3.4 provide details of the age distribution and gender of pump users in Yasso and Gama, respectively, while table 3.1 provides some comparative numbers from both figures. In Yasso, there were about 173 principal pump users each day.[10] Except for the early morning and late

[10] "Principal user" refers to a single individual coming to the pump with his/her water container(s). It does not include other persons, such as children, who may accompany and/or assist the principal user. The total number of principal users refers to the number of times any person came to the pump and filled one or more containers. If an individual used the pump more than once, each visit to the pump would be counted separately to arrive at the total "principal user" count.

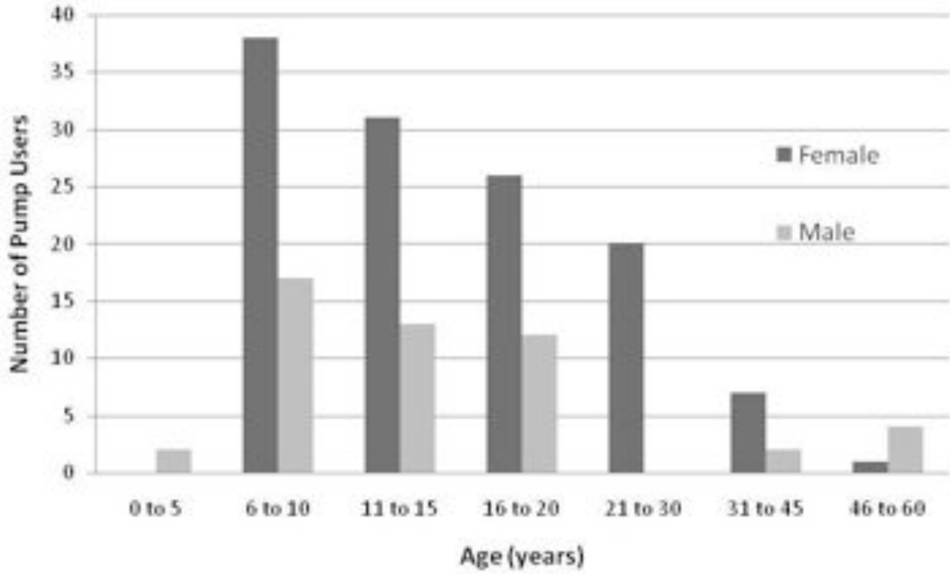


Figure 3.3 Age distribution and gender of pump users in Yasso.

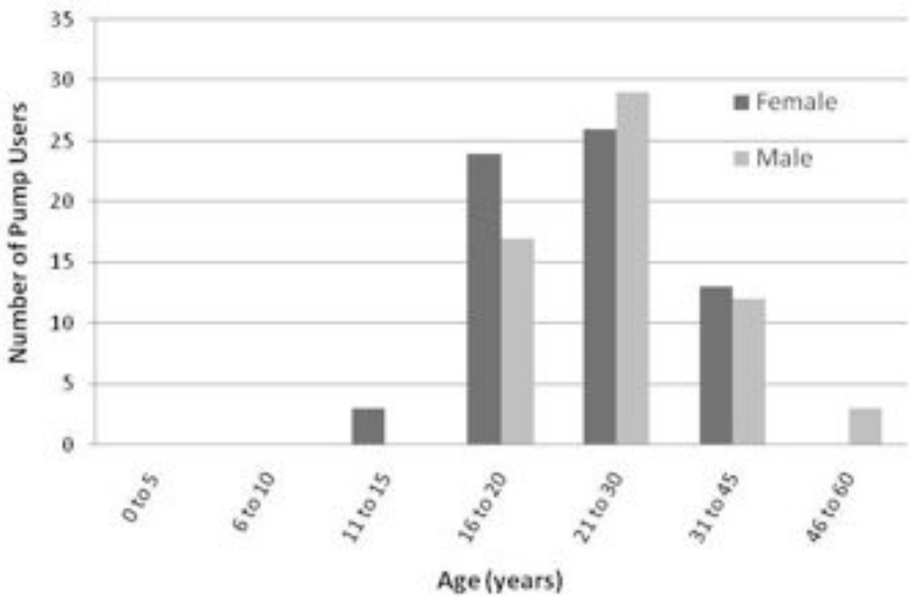


Figure 3.4 Age distribution and gender of pump users in Gama.

afternoon the pump did not incur heavy use, and in the middle of the day there were periods of no use. Filling time for most containers was about 1-3 minutes, with some people using the pump more than once in the course of the day. At Yasso it was found that 80% of pump users were aged 6-20 years, with 71% of users being female and 29 % being male. Examination of figure 3.3 reveals that users under the age of 5 years were few. But users aged 6-10 years were the most frequent users of the pump, with usage tapering off until about mid-life (which is about 30 years of age, as average life expectancy in Mali is less than 50 years).[11] The figure shows that the number of female users was twice that of males. However, after the age of 20 years (the approximate age of marriage for men in rural areas), male usage of pumps dropped to zero, while female usage remained high for the 21-30 year age group. Following this, male use of the pump slowly began to increase, eventually surpassing women in the 46-60 year range. It is also important note that nearly 60% of principal pump users were between the ages of 6-15 years. Since the water table is relatively close to the surface, pumping was not excessively strenuous. This may well be the reason that many families in Yasso send their children to fetch water. At the same time, actual grasping and manipulation of the straight pump handle can still be difficult for some able-bodied persons, especially children and the elderly.

The characteristics of pump use at Gama (figure 3.4) varied significantly from Yasso, as highlighted in table 3.1. At Gama, pumping and container filling required more time and strength due to the depth of the water table. Furthermore, the hand-pump was the only source of potable water in the village, and pump use generally occurred throughout all 24 hours of each day. During the monitored day-time hours there were about 127 principal users, with typical pumping times at 4-6 minutes.[12] Only 35% of pump users were under the age of 20 years, with the majority falling in the 21-30 year age group. The number of male and female users was about the same. In general, significantly more older adults and men engaged in pump use at Gama than Yasso — largely due to the greater competition for water (600 persons with

[11] Human Development Report 2009, UNDP.

[12] The filling time of 4-6 minutes often involved the filling of more than one container.

one water source) and the greater physical requirement to pump water from greater depths (thus more adults using the pump). The more common cultural norm of women and youth fetching water may therefore be put aside due to both the high demand and physical requirement for obtaining water. In addition to the greater physical strength required for pumping, once having waited in the queue for pump use, it is more advantageous to fill larger or multiple containers. Men are more physically equipped not only to perform the pumping, but also to transport heavier loads of water.

Table 3.1 Number, age and gender data of hand-pump users at monitored sites in Yasso and Gama.

	Yasso	Gama
Number of water sources in village (wells & pumps)	>5	1
Depth to water table	≈15m	60-80m
Principal pump users each day	173	127
Female pump users	71%	52%
Male pump users	29%	48%
Pump users ages ≤20 years	80%	35%
Pump users ages ≥21 years	20%	65%

WATER PUMPING

Figure 3.5 provides information on the number of persons doing the actual pumping at Yasso. Often one or more other persons may have assisted the user, or simply have done the pumping for the person having his/her container filled. Fifty-three percent of the time, the principal user pumped alone; 37% of the time the principal user was assisted by one or more other persons; and 10% of the time one or more others did all the pumping for the user. In general, pumping occurred in many forms, and practices were highly variable. The person(s) pumping may have often moved from side to side, used one or two hands, or changed hand positions repeatedly. At Yasso, where a straight handle is used, 90% of those pumping stood either to the left or right side of the handle to pump, while only 5% stood at the end of the pump handle while pumping.

At Gama (figure 3.6), 33% of the time the principal user pumped alone; 63% of the time the user was assisted by one or more persons; and only 4% of the time did others do all the pumping for the user. Here it was more common to see community members assisting one another, probably due to the greater effort required to pump water.

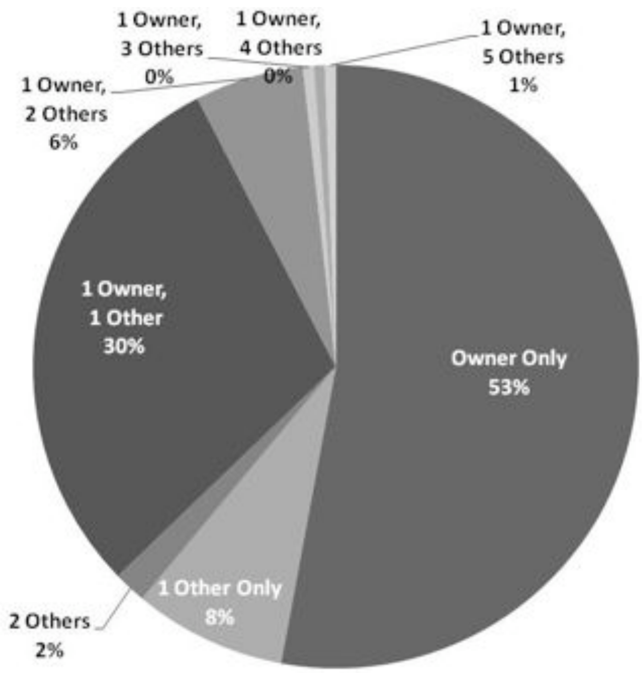


Figure 3. 5 Number of people doing the actual pumping for each container filled at Yasso, as percentage of total number of pump users each day.

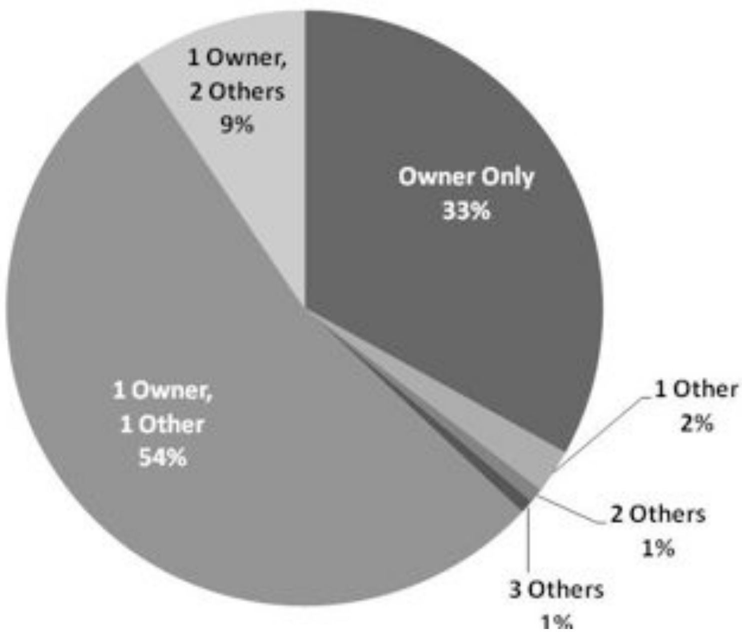


Figure 3. 6 Number of people doing the actual pumping for each container filled at Gama, as percentage of total number of pump users each day.

ACCOMPANYING PERSONS

About 74% of those who came to the Yasso pump came alone, while 26% came with one or more persons accompanying them. The ages of those who accompanied the principal user were 0-5 years (33%), 6-10 years (46%), 11-15 years (15%) and 16-30 years (6%). The most common age group (6-10 years) were usually children of the principal user who came along to assist in carrying filled water containers. At Gama, 83% of users came to the pump alone, while 17% were accompanied. Ninety-two percent of those who accompanied the principal user at Gama were 0-5 years of age. At Gama, it was usually infants accompanying their mothers to the well, rather than older children coming to assist. Furthermore, larger and heavier containers were more commonly used at Gama, requiring adults for transport (see next section on water containers). It should also be added that, due in part to its high usage, the pump at Gama is managed by a community water committee that enforces pump use rules more rigorously than at Yasso. As such, unnecessary accompaniment to the pump at Gama may be discouraged.

WATER CONTAINERS

Table 3.2 details the number and volumes of containers brought by users to the pumps at Yasso and Gama. In general, most users at Yasso tended to bring one container of 20 liters, while nearly half of users at Gama brought two or more and prefer the larger 25-liter containers. Easier access to the pump at Yasso facilitated the use of lighter containers on a more frequent basis, while the higher pump usage, waiting times, and more difficult pumping made the use of larger containers more practical at Gama.

Table 3.2 Number and volume of containers used at Yasso and Gama, as % of users.

Number of Containers brought by each pump user	**Yasso**	**Gama**
1	85%	52%
2	14%	46%
3+	1%	2%
Volume of Containers	Yasso	Gama
25 liters	0%	77%
20 liters	64%	16%
< 20 liters	33%	7%

Figures 3.7 and 3.8 provide details at both villages on the types of water containers used by each person visiting the pump, and the gender of the user.

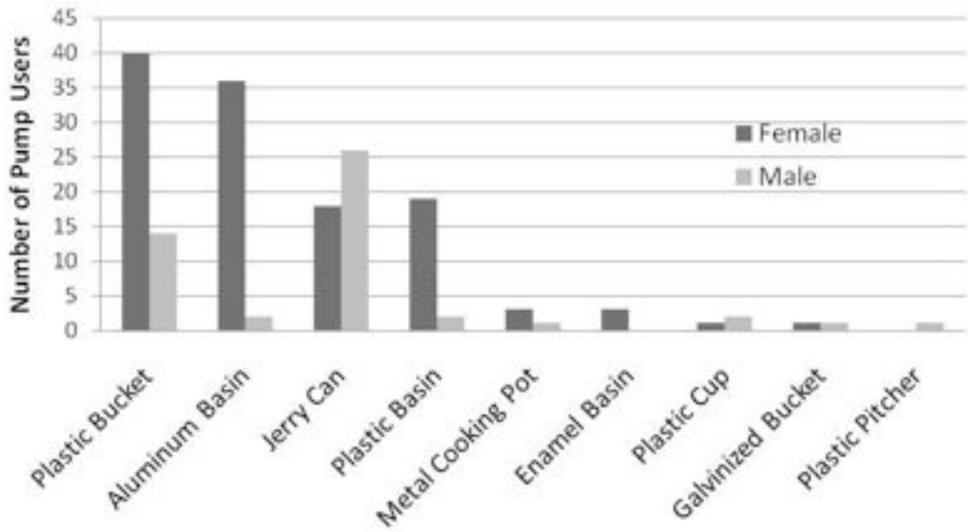


Figure 3.7 Container types and gender of container owners at Yasso.

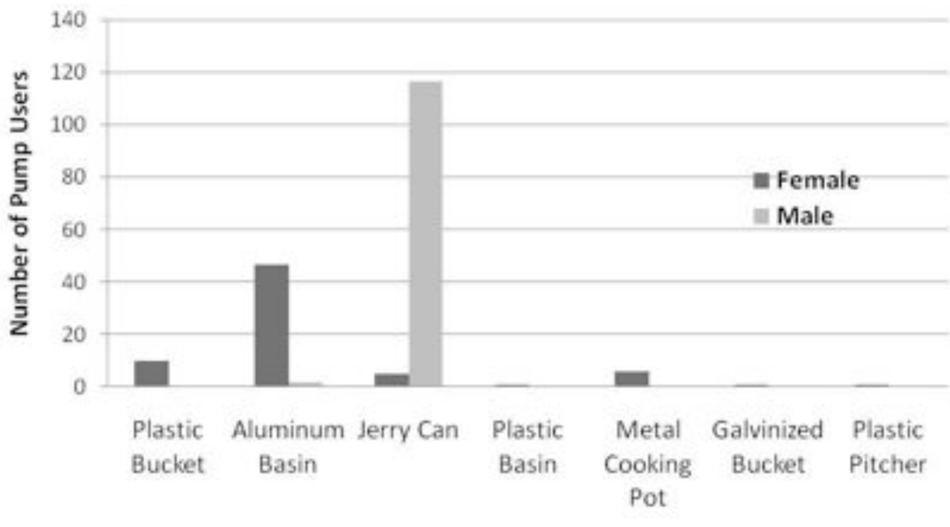


Figure 3.8 Container types and gender of container owners at Gama.

The most common container used by females at Yasso was the plastic bucket, followed by an open, aluminum basin. At Gama, men preferred to use the larger 20-25 jerry can ("bidon"), while women preferred the larger aluminum basin (see figures 2.11 and 2.12 for examples). As has already been mentioned earlier in the report, plastic buckets (15-20 liters) are relatively low-cost and have a wide rim which facilitates lifting it to the head for transport. The larger open basins (20-25 liters) also have wide rims which facilitate lifting, but due to the added weight, the user often needs assistance from another person to lift it to the head and to lower it once the user has arrived at the place of residence. One negative aspect is that they often incur spillage during transport. Plastic jerry cans (or "bidons", 20-25 liters) have small mouths with screw-on caps. These are preferred by many male users and some females (usually young adult females). These do not incur spillage, but are more difficult to lift and lower due to their smooth sides and heavy weight when full. Younger and elderly users may often bring an assortment of other smaller volume containers.

3.3 IMPLICATIONS FOR THE DISABLED

Hand-pumps and associated superstructures are generally designed to accommodate the size and muscular capacity of healthy, able-bodied adults. As a result, not only the disabled, but many children and elderly people may find themselves disadvantaged — encountering physical challenges in the manipulation of hand-pumps (i.e., in a "disabling" situation). This is especially true in geographic areas which have deeper water tables. It is not uncommon to see children and teenagers "jumping" on the downward stroke in order to exert sufficient pressure on the pump handle. And many elderly persons seek out younger household members or neighbors to fetch water from the pump, rather than trying to pump water for themselves. Many who try to pump must often switch positions due to fatigue or discomfort. Once at the hand-pump, it is not uncommon for other persons to assist pump users, and many disabled persons benefit from this practice. This is a helpful aspect of pump use in the community, but it means that many disabled persons are limited to using hand-pumps during periods of higher use (so as to be assured of finding others there to assist in pumping or lifting the container to their heads). High use periods generally occur in the early morning and late afternoon hours, which then may mean longer waiting times at the pump for the disabled (figure 3.9).

Figure 3.9 A typical WAWI hand-pump in Niger. High use, crowding and long waiting times can be a disincentive for pump use for many disabled persons.

Most able-bodied persons bring multiple containers or larger single containers of 20-25 liters, while most disabled persons rarely bring more than one water container to the pump, and it is usually a container of only 10-15 liters capacity. The combination of waiting time at the pump and multiple trips (due to lower container volumes) can serve as a major disincentive for hand-pump use. Survey results indicate that PWD are then compelled to make more frequent trips to the pump or they must simply make do with less water (figure 3.10).

Figure 3.10 This young woman, born with severe weakness in her arms and legs, can only lift and carry a maximum of 10-15 liters in her cooking pot ("marmite") on each trip from the pump, necessitating multiple trips to the pump each day.

Many able-bodied women prefer to use plastic buckets due to the ease of grasping and lifting. In section 2.3, survey data indicated that most disabled women who fetch water also prefer the same, as grasping (for lifting and lowering) and pouring (once at their place of residence) is easier for them with this container. The dynamics of user and pump interaction, as well as these implications for those with disabilities, are important issues which will be incorporated into the discussion of challenges for the disabled as they relate to pumps and associated superstructures (Chapter 4) and water transport and domestic use (Chapter 5).

CHAPTER 4 PUMPS AND ASSOCIATED SUPERSTRUCTURES

4.1 CHALLENGES

PUMP SITE LOCATION

Most community members regard the installation of a borehole, a hand-pump and protective superstructure in their village as a welcome addition. It represents a reliable source of clean water that can be easily accessed by all. But while disabled persons may welcome the addition of a new borehole and hand-pump in their community, their perceptions regarding their own participation in its use may differ greatly from those of the rest of the community. In some communities, the pump may be located just outside the village, or near a school on the edge of town. For most people this means a few minutes' walk, but for the disabled it can preclude their daily use of the pump. In many parts of West Africa, soils are sandy, making the approach on footpaths, with crutches or cane, or by tricycle or wheelchair very difficult. Returning home from the pump in sandy areas can be even more challenging given the added weight of the full water container on one's tricycle or on one's head.

ENTERING AND EXITING THE SUPERSTRUCTURE

When arriving at the superstructure, disabled persons often find the entrance step up to the pump apron or the step up to the pump platform to be a significant impediment, and even more of an obstacle when descending with a full container (figure 4.1). The use of a cane or crutches can actually increase the challenge and risk of negotiating even a small step. If the superstructure is not well-drained, wet floor surfaces can be slippery and dangerous for those with mobility challenges and will soil those who must walk using both hands and legs. Those using a manually-powered tricycle must dismount with their container adjacent to the superstructure and traverse ground which is often wet or very hot (a major challenge if walking on all fours). Upon reaching the superstructure they are required to negotiate the various steps and platforms, fill their containers and re-negotiate these obstacles with a full container.

Figure 4.1 A hand-pump and protective superstructure in Niger, with two entry steps and a pump support platform inside the enclosure. A disabled member of the community can find the three steps challenging to negotiate, especially when carrying a container full of water.

MANIPULATING THE HAND-PUMP

The India Mark II hand-pump has a long, slender handle just over one meter in length. For maximum efficiency, the user is supposed to stand at the end of the handle directly facing the pump and grasp the rounded end of the handle with both hands. However, this stance can be awkward and uncomfortable even for able-bodied persons and very challenging for persons with physical disabilities. Observations have indicated that most users stand to the left or right side of the pump handle during operation (figure 3.1). According to the pump designers, however, this stance is less efficient due to the reduced leverage caused by the hands being placed closer to the pivot point. This handle is designed primarily to minimize wear and tear on the pump, while ergonomic considerations are secondary. For areas with deeper water tables, the India Mark II hand-pumps are outfitted with a weighted T-handle attached to the end of the handle. The increased weight of the pump handle adds leverage and allows for easier lifting of the water from the deeper well. The T-handle design also lets the user stand at the end of the pump handle while pumping, in a more comfortable two-handed grip (figure 3.2). For shallower wells, however, this T-handle is too heavy and would make the pump mechanics worse for the user.

For those with lower-body limitations, positioning oneself correctly for adequate pumping is important. If pumping in an upright position, some disabled persons need support for stability if they are to be able to focus their strength on manipulating the pump handle (figure 4.2). Others find the concrete pump support platform too narrow and face the possibility of slipping or stepping off the edge while trying to pump. Those who cannot stand upright must sit on the ground and reach up to the handle for pumping. Pumping in this position does not provide sufficient leverage to adequately manipulate the pump handle for sustained periods, often resulting in fatigue. Furthermore, sitting on the ground often results in the disabled person becoming soiled and wet (figure 4.3).

Figure 4.2 This young mother and polio victim can only walk with the aid of crutches, but she uses the pump handle to steady herself, freeing her hands for pumping. She is unable, however, to produce a steady pump flow because much of her strength is used to stabilize herself, leaving little strength for stroking the pump handle.

For those with upper-body limitations, standing is generally not a problem. However, grasping and manipulating the pump handle for stroking can pose challenges, mostly related to fatigue. Able-bodied persons may change their hand positions frequently, as well as the side from which they pump, in order to gain leverage and reduce muscle fatigue. Many users rely on assistance from others for pumping (figure 4.4).

Figure 4.3 This young man finds that he gets more leverage for pumping by sitting on the ground than by staying erect with the aid of his cane. However, since his leverage on the handle is not good, he still struggles to maintain a steady flow rate. At times, the platform floor may be wet or soiled when he comes to use the pump.

Figure 4.4 Two women in Niger assist one another with pumping.

MANIPULATING WATER CONTAINERS AT THE PUMP

Superstructure design around the pump outlet is often variable. If the outlet is on a raised platform, the water container must be lifted off the platform after being filled, which is an added challenge for many disabled persons. In some cases the water container must be placed in a drainage depression under the outlet, requiring that the full container be lifted up 10-20 cm to the normal level of the apron before it can be transported (figure 1.4). In other cases, the space between the pump outlet and the apron floor is limited, requiring that containers be slid in and out from under the outlet, adding another constraint to the challenges faced by the disabled pump user. Once the container is filled, most disabled persons with either lower- or upper-body limitations find it challenging to lift the container to their head for transport. In most cases, they must rely on others at the pump for assistance.

USE OF LAUNDRY APRONS

Laundry aprons are somewhat easier to access than most pump superstructures. For a disabled person to enter the apron area, she must traverse the raised edges (i.e., low protection) wall of about 30 cm with her containers of water and laundry. Perhaps more challenging is that much of the apron area may be wet or soiled from other people's use (figure 4.5). Most people wash clothes from a standing position, while bending over their washing containers. Many disabled persons with lower-body limitations may find it difficult to stand and wash, and are therefore compelled to sit while doing their laundry.

Figure 4.5 A well-used laundry apron in Mali. Many disabled persons are unable to stand and wash their clothes and must sit on the ground or on available seating. This apron provides no functional seating above the wet floor.

4.2 CONSIDERATIONS FOR PUMP SITE LOCATION

The selection of a site for borehole drilling and placement of a hand-pump depends primarily on where water can be found. Secondary considerations may include strategic placement relative to other water sources in the community, preferences of the community, access by well drilling rigs, locations where local pump supervision can be assured, or the preference to place the well near another public service such as a clinic or a village school (often situated on the outskirts of the village). The criteria for site selection may be multiple and may vary significantly from one community to another. Rarely are the needs of the disabled included in this decision-making process. But their needs should be considered whenever possible.

A primary issue which concerns many of the disabled is that of proximity to places of residence. For example, placement of a hand-pump adjacent to a school on the edge of the village may greatly serve the students and prepare future generations to be more hygiene conscious, and such a location may be accessible to most able-bodied persons from the village. But it may well preclude use by many disabled persons in the community. Compromise placement halfway between the school and village may still meet the needs of the school and hygiene training for youth, but its closer location to places of residence will encourage greater use by all, including the disabled.

If the hand-pump is to be placed at some distance from places of residence, then consideration should be given to placement near maintained roads or pathways which can facilitate access by disabled persons, especially those using assistive devices such as crutches or tricycles. Avoiding the necessity for the disabled to traverse muddy or sandy areas to access a hand-pump is important. The same holds true for areas with ditches or seasonal drainage ways. Strategic placement of small, simple bridges or culverts over these points can greatly serve to enhance everyone’s access and use of the hand-pump.

4.3 ENHANCED PUMP SUPERSTRUCTURES

Pump superstructures serve the purpose of protecting the borehole pump and facilitating access and use of the pump by community users. A well-designed superstructure will facilitate the drainage of excess water away from the pump area, reduce the accumulation of sand or mud around the pump, and protect the pump area from livestock intrusion. In addition to protecting the pump and enhancing hygiene in the pump area, superstructures should also be designed to facilitate access and use of the pump by all users in the community. Designs used by WAWI vary from country to country, generally as a function of government standards for pump superstructures and structural enhancements developed through the process of adapting to local environmental and social contexts. These superstructures generally include a support platform for the pump and a wide apron around the support platform which is enclosed with a protecting wall. The Study focused its work on exploring design enhancements for the superstructures most typically used by the MRWP in Mali. This design basically involves a rectangular superstructure (approximately 3-4 m by 3-4 m) with support platform, apron and enclosing wall; with entrances and entrance protection walls on opposite sides. Suggested design enhancements, while specific to the Mali superstructures, should be generally applicable to other designs found in neighboring countries.

ENTRANCEWAYS

Most entranceways to the superstructure require a step of 15-30 cm up to the apron level. The addition of a ramp on one of the entranceways can greatly facilitate access by disabled persons on foot or using a tricycle. The entranceway should have both an entrance and exit ramp, located between the entranceway protection wall and the enclosure wall, so as to facilitate the entrance and exit of tricycles (figures 4.6, 4.7 and 4.8). The level portion, between the entrance and exit ramps, should be at the same level as the enclosed apron and be long enough (at least 1.7 m) to park the tricycle while the user dismounts to pump water. Linear depressions of 1-2 cm depth running the width of the level portion at the top of each ramp and placed where the front and rear wheels will be stationary in the level portion can also

Figure 4.6 Pedestrian and tricycle access and egress ramp for a pump superstructure. Note the two parallel depressions at the top of the ramps for stabilizing the rear and forward wheels of a parked tricycle.

Figure 4.7 Side view of a pump superstructure access ramp.

Figure 4.8 A disabled woman uses the access ramp to access the pump superstructure entrance.

serve to prevent the tricycle from rolling down the ramp. There should also be sufficient ramp width (at least 1 m) to assure free movement of the tricycle between the entrance protection wall and the enclosure wall. Ramps should not have a slope in excess of 7% so as to assure that disabled pedestrians or tricycle users can easily ascend or descend. The adjoining entrance through the enclosure wall should be at least 0.8 m. (However, should this entrance be widened, then the external protection wall should be lengthened accordingly so as to discourage entrance of livestock and minimize the collection of wind-borne sand within the principal enclosure.) Design dimensions of the ramped entrance on the superstructure model developed by the Study can be seen in Appendix 1.[13] It should be noted that this diagram in Appendix 1 only depicts the above-ground design; all ramps should be constructed with adequate foundations to reduce cracking and premature deterioration.

APRONS, PLATFORMS AND FLOOR SLOPE

In the effort to assure adequate drainage of excess water, the slope of concrete aprons around the pumps is often very high. In some superstructures, the pump apron was observed to be of varying shape and slope as one approached the pump. Others were observed to have portions of their aprons with slopes in excess of 20%. While such slopes will assure adequate drainage and can be easily traversed by most able-bodied persons, excessive or varying apron slopes can prevent pump use by the disabled, as well as pose risks of injury by those who do attempt to use the pump. Whenever possible, slopes within protective walls should be consistent (i.e., non-varying) and not exceed 5%. Even a pump apron with a well-laid slope of 3% can adequately drain excess pump water. It is strongly recommended that all superstructures be built without any abrupt change in elevation (i.e., steps of platforms) within the enclosed area, and that aprons be raised to the same level as the pump support platform whenever possible. After borehole completion, installation of hand-pumps includes the placement of a supporting concrete platform around the base of the pump. When the superstructure is added, the apron level should equal that of the supporting

[13] The superstructure designs in Appendix 1 also include specifications for pump seats and handle attachments which are discussed in section 4.4.

platform so as to assure a completely level access area around the pump (although slightly sloped at 5% or less) (figure 4.9).

Figure 4.9 A pump superstructure apron filled to the same level as the pump support platform and the entrance ramp. Pump superstructures with no steps or abrupt elevation changes at the ground level can greatly enhance pump access by disabled persons. (Note: the shallow drainage channel running across the floor of the entranceway does not represent any change in floor level.)

PROTECTIVE WALLS

Pump superstructures in Mali can be subject to a great deal of wear and tear, due to heavy usage by the community and unrestricted livestock seeking water. Protective walls are often the most vulnerable. In the past, protective walls have often been built using concrete brick construction. The effects of animal drawn carts, large livestock bumping against the walls, and people sitting or climbing on the walls often result in the failure of these walls within a few years. The use of re-enforced, poured concrete for wall construction is recommended, and can serve to greatly enhance wall strength and durability. In addition to protecting the pump and the apron area, enclosure walls can also be designed and constructed to assist pump users. If walls are 1.5 m or less, people *will* climb and sit on the walls. However, reducing the wall height and increasing its width can result in a stronger, more stable wall that can also serve as temporary seating for those waiting for the pump. Lower walls with a height that is between the waist and shoulders of an adult can also serve to help raise heavy water containers to the head of the user. Many women, and especially the disabled, need assistance from others when lifting heavy water containers to their heads in a single move. With lower walls, the user can first lift the container and place it on the top of the wall. Then she can reposition her grasp and lift it to her head in a second movement. During the Study, disabled women with both lower- and upper-body limitations were often observed using superstructure walls in this way, provided the walls were sufficiently low (figure 4.10).

Figure 4.10 By separating the lifting motion into two less strenuous steps, lower enclosure walls can be used to facilitate lifting heavy water containers to the head for transport (i.e., lifting from floor to wall, then from wall to head).

GENERAL RECOMMENDATIONS

Overall, the superstructure should not only serve to *protect* the pump and its environment, but it should also *facilitate* use of the pump by all community members. In the future, WASH programs need to be more intentional about the construction of pump superstructures which are not only *protective* in nature, but which are also *facilitative* in their design. A diagram of the standard MRWP superstructure improved with widened entranceways, ramps and level apron area can be seen in figure 4.11. Design dimensions for this improved superstructure which was developed during the Study are found in Appendix 1.

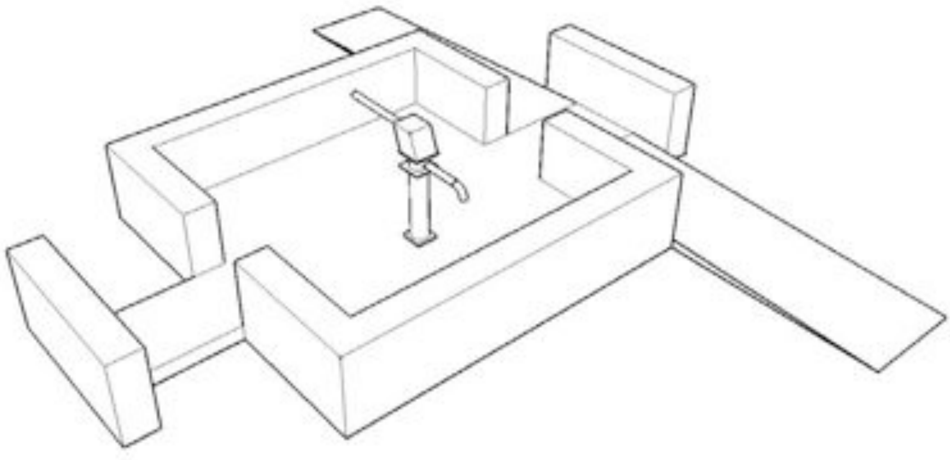


Figure 4.11 A pump superstructure with simple enhancements (access ramps, level floor with a slight slope for drainage, and wide, low enclosure walls) can facilitate access by both disabled and able-bodied persons. (See Appendix 1 for dimensions.)

4.4 ENHANCED PUMP USE

PUMP HANDLE ATTACHMENTS

For the straight pump handle used with shallow water tables, the Study sought to improve the design so that both able-bodied and disabled users could pump water with greater efficiency and comfort. With input from both formal and informal surveys, and from the time lapse photography, multiple variations of improved handle design were explored and tested. Prototype development and testing involved both short-term trials with both disabled and able-bodied persons, as well as multiple six-month trials with prototypes placed on village pumps (figures 4.12 and 4.13). From this work, two simple models are proposed by the Study.

Figure 4.12 A woman with lower-body disability assists with preliminary testing of a T-handle prototype attachment.

Figure 4.13 A woman with an infant on her back uses a rectangular-handle attachment during a six-month trial in a local village.

For hand-pumps equipped with the straight handle, a simple, light-weight T-handle accessory was developed using steel tubing with a single bolt attachment (figure 4.14). This provides users with a more optimal, comfortable and easier two-handed grasp of the pump handle. Since pumping is performed at the end of the pump handle, there is greater leverage for maximum lift of water. A second, rectangular-handle accessory was also developed which not only allows for two-handed pumping from the end of the handle but also allows for one or more persons to pump from the end of the handle or on both sides of the handle simultaneously. This not only facilitates pumping from the side, it allows for weaker persons to be

Figure 4.14 The T-handle accessory can be easily fabricated by local metalworkers and is attached to the pump handle with a single bolt. (Note: Use of two, superimposed nuts can serve to reduce the risk of nuts working loose with pump handle use.)

easily assisted while pumping. Both types of handles were tested at multiple sites where straight handle hand-pumps were installed, and both were met with overwhelming acceptance by both able-bodied and disabled members of the community.

As with the straight handle, users of the T-handle and the rectangular-handle would grasp in a variety of ways, often switching their grasps during pumping. Most users would pump from the end when using either type of handle accessory. But with the rectangular-handle, many would also pump from one side or the other. Some persons using the T-handle would stand to the side and place one hand on the shaft of the main pump handle and the other hand on the end of the T-portion. In both cases, this grip creates a torque around the handle pivot bearing that is not present when the pump is not used with the handle accessory. *It should be remembered that in some cases such attachments could increase wear on the bearing, although the extent of this potential wear is unknown.*[14] *However, this torque is the same that occurs with the use of the standard Mark II weighted T-handle used on deeper wells.*

Both the T-handle and rectangular-handle attachments were designed to be easily fabricated by local metalworkers and with locally available materials.

[14] Performance data collected on the India Mark II pump indicated the maximum force exerted on the handle for a 7-m well was 13 kg-f (128 N), and for a 25-m well the maximum force was 20 kg-f (196 N). If the entire maximum force was exerted by one hand gripping the end of the T-handle attachment, then there would be 26 – 39 N·m of torque about the bearing. More research is needed to determine if this range of torque would cause undue or abnormally early wear on the steel bearing.

Ease and reliability of fabrication by local metalworkers was also tested during the course of the Study. Diagrams and specifications for these handle attachments are found in Appendices 2 and 3.

PUMP SEATING

While most disabled persons found that the handle attachments greatly facilitated their ability to manipulate the hand-pumps, many, and especially those with lower-body limitations, still needed more stability while operating the pumps. Various options were investigated, including vertical posts which a disabled person could lean against while pumping. These options did not, however, provide solutions for those who are not able to stand upright. To accommodate all forms of lower-body limitations, various types of seat design which would enhance the use of both straight- and accessory-handle attachments were investigated. As with the handle attachments, seat prototype development and testing involved both short-term trials with both disabled and able-bodied persons (figure 4.15), as well as multiple six-month trials with prototypes placed at village pumps. For the T-handle, testing showed that a simple, vertical concrete seat of about 45 cm height, placed some 14 cm behind the end of the horizontally positioned handle, can serve to greatly enhance pumping by physically disabled persons, the elderly and youth (figures 4.16 and 4.17). Able-bodied adults who choose not to use the end-seat can stand in front, behind or to one side of the seat. However, it can

Figure 4.15 Disabled women from the local community assist in preliminary tests of end-seat positioning and height.

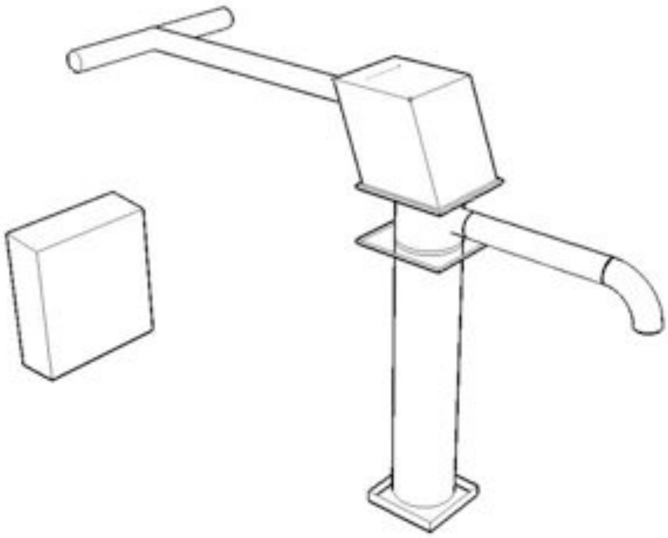


Figure 4.16 A diagram of the completed combination of the end-seat and T-handle attachment.

Figure 4.17 A woman with lower-body disability uses the completed combination of the end-seat and T-handle attachment.

impede normal standing positions behind the T-handle for larger able-bodied adults. Yet, there is no evidence that its presence increases pumping fatigue of able-bodied adults. For a disabled person having little or no use of their legs, mounting a 45 cm seat can be challenging if there is not some form of adjacent support. For this reason, it is recommended that the rear enclosure wall be positioned no greater than 35 cm from the rear of the seat. This distance allows sufficient room for human traffic behind the seat, but it is also within reach for those who need support or leverage while lifting themselves onto the pump seat.

In one village, six months after having installed a T-handle and seat, a survey was conducted among 45 able-bodied community members, most of whom use the pump twice daily. While most said the seat was "not necessary" for them (and 15 indicated it was a source of difficulty), the majority preferred having the changes (T-handle with seat) to just the straight handle. The implication is that for most able-bodied adults, the advantage of having a T-handle outweighs the disadvantage of the seat location where they would normally stand. Fifty-six percent of respondents indicated they normally stand behind the T-handle (either in front or behind the seat) using both hands to grasp (figure 4.18). The remaining 44% either stand to the side or use both positions while pumping. Fifty-one percent indicated they use the seat occasionally (e.g., when tired) or regularly, while 49% never use the seat. All disabled persons in the community who use the pump (approximately 11 in number) indicated strong approval of the seat and T-handle. *The implication here is that while the great majority of able-bodied users prefer the T-handle, many find the seat un-necessary. Yet they do not find it significantly cumbersome.*[15]

Figure 4.18 A village girl demonstrates use of the T-handle while standing in front of the end-seat.

[15] Another option for an end-seat with the T-handle accessory is the placement of the seat within the rear enclosure wall. Incorporating or embedding the seat in the rear wall can save on material cost, but it precludes a space behind the seat for human traffic to move freely from one side of the pump handle to the other when the pump is in use.

When asked for suggestions for improvement, many of the above mentioned respondents suggested moving the seat to the side. However, the position of a seat to the side of the handle precludes effective use of the T-handle for those on the seat. Several positions of side seats were therefore tested using the rectangular-handle which is easier to manipulate from the side. It was found that pump seating located fully to the side of the handle did not allow for many disabled persons a grasp of sufficient leverage on the pump handle, especially in cases where there was a deep water table requiring more strenuous pumping. The most effective side seat was found to be situated halfway between a fully rear seat position and a fully side seat position (positioned at about 45° from the length of the pump handle, as seen in figures 4.19, 4.20 and 4.21). The seat in this position provides adequate space for users to pump from a standing position at the end of the pump handle, while allowing those who must use the seat to get better leverage towards the far end of the pump handle. However, it was found that use of this seat position and the rectangular-handle, does not provide disabled users the same amount of leverage as when pumping from a true end seat with a T-handle. Nevertheless, it can serve as a compromise position if the majority of community users are opposed to a seat position located at the end of the pump handle.

Figure 4.19 A disabled woman assists with preliminary testing of side-seat positioning.

In this position, the "side-seat" is adjacent to the corner of the protective enclosure walls, and therefore out of reach for those who need leverage while mounting the seat. Furthermore, it was found that the angle at which the rectangle-handle is grasped from this seat does not provide as much stability while pumping as the T-handle. As a result, a short step at the

Figure 4.20 A disabled woman, with lower-body disability and limited use of one arm, assists in testing the positioning of a side-seat with a rectangular-handle attachment.

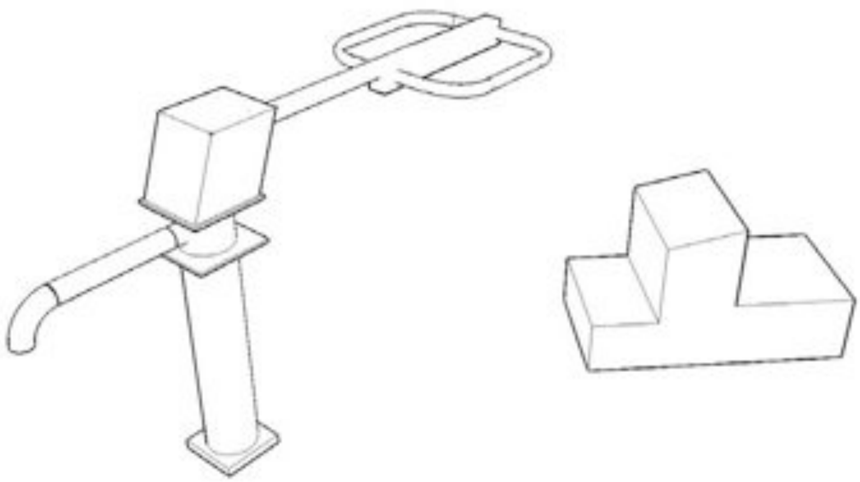


Figure 4.21 Diagram of the completed combination of the side-seat with a rectangular-handle attachment. (Note: The height of the front step, seat and rear step should be 15 cm, 45 cm and 20 cm, respectively. The depth of the front and rear steps should be about 20 cm and 35 cm, respectively.)

rear of the seat for mounting and a short step in front of the seat for foot/leg stability while pumping can greatly facilitate the stability of those using this particular arrangement of seat and pump handle accessory (figures 4.21 and 4.22).

If rear or side seats are to be installed, it is recommended that they be constructed of re-enforced concrete and embedded in the floor of the enclosure, so as to assure longevity. Diagrams and specifications are provided in Appendix 1 for both the end-seat and side-seat.

Figure 4.22 An able-bodied man demonstrates use of the pump equipped with the completed side-seat and rectangle-handle attachment. The side-seat is positioned at about 45° from the pump handle, with a high approach step in the rear and a lower leg/foot stabilizer in the front.

4.5 ENHANCED LAUNDRY APRONS

Only very simple enhancements are needed to make laundry aprons more accessible to disabled persons. Raised seating can be added to either the raised edges of the apron or at points within the apron itself. Points along the edges of the apron can be raised to about 30 cm *above the floor of the cement apron* (figure 4.23). This can provide for disabled women seating which is easily accessible and does not require them to traverse the wet floor of the apron. Raised seats of 30 cm or less can be placed within the apron area, but this requires that users traverse the apron floor and it can restrict cleaning of the apron if there are multiple seats. Whenever possible, care should be given not to place laundry aprons too far from the hand-pump, so as to reduce the distance that disabled persons must transport water when doing laundry.

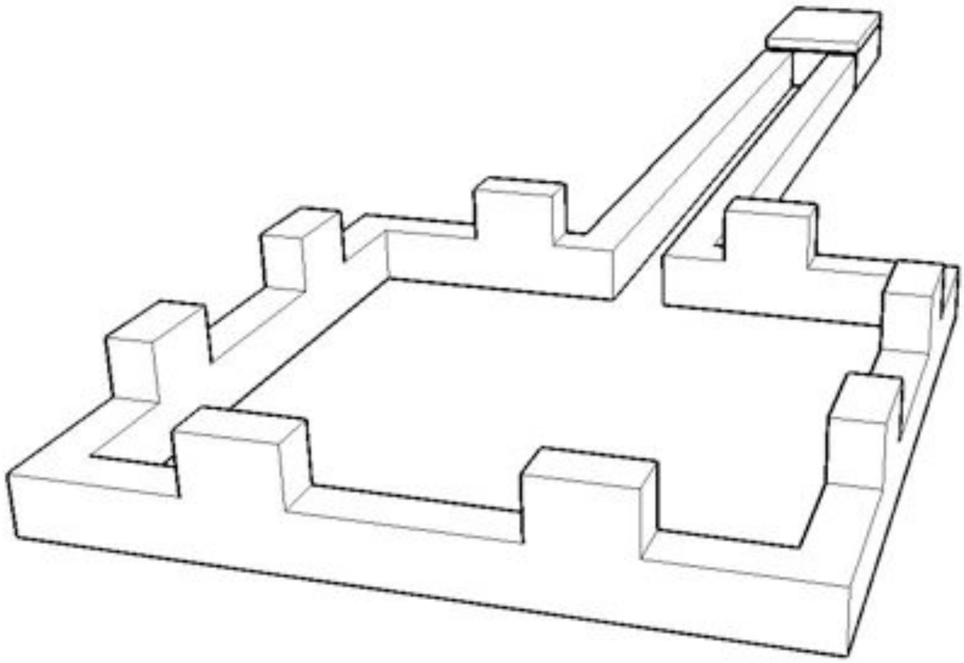


Figure 4.23 Standard laundry aprons can be improved for use by the disabled when raised seating is added to the standard infrastructure (as seen in this diagram along the raised edges of the apron).

CHAPTER 5 WATER TRANSPORT AND DOMESTIC USE

5.1 CHALLENGES

WATER CONTAINERS

The types of containers used for carrying water tend to vary somewhat among countries and regions within each country. Aside from personal preferences, selection of containers usually depends upon what is manufactured locally or imported, and upon the types of containers available on the market which are surplus from other forms of import. A common example from this latter category is the robust, HDPE plastic jerry can or large "bidon" of 20-25 liters in which cooking oil is imported.[16] These are commonly resold in local markets for use in water transport and storage. Most West African countries also have one or two industries which produce plastic containers (buckets, basins, kettles and an assortment of smaller containers such as cups and bowls). These are most commonly made of polypropylene. Galvanized buckets and aluminum basins are also available in most local markets. In Mali, the most commonly used containers for water transport are the plastic bucket, both plastic and aluminum open basins, and the plastic jerry can (as explained in sections 2.3 and 3.2). As discussed in previous sections, plastic buckets and open basins are preferred because of their wide rims which are easy to grasp and which facilitate lifting and lowering when the container is full (figure 2.11). They are also easier to manipulate when pouring the transported water into other storage containers at the place of residence. The principal challenge with these open containers, especially for the disabled, is that spillage can easily occur if they are not held very steadily while being carried. Such spillage often occurs when upper-body disability limits how firmly the container can be grasped, or when lower-body disability results in an unsteady or irregular walk or gait (figures 5.1 and 5.2). Many disabled women who use these open containers intentionally fill them only about two-thirds full to avoid spillage, but this can require more frequent trips to the pump. The plastic jerry can has a much smaller opening with a screw-on cap, thus

[16] HDPE plastic – High Density Polyethylene plastic

precluding spillage. Many disabled persons indicate they would prefer to use the large jerry can, but the challenges are that these cans require more precise placement under the pump outlet for filling (often requiring a funnel). The jerry can is more difficult to either lift to the head or carry by hand because of the small handle at the top end and the straight sides. When full, these can be very heavy, and after filling the sides are often wet which can make grasping even more difficult (figure 5.3).

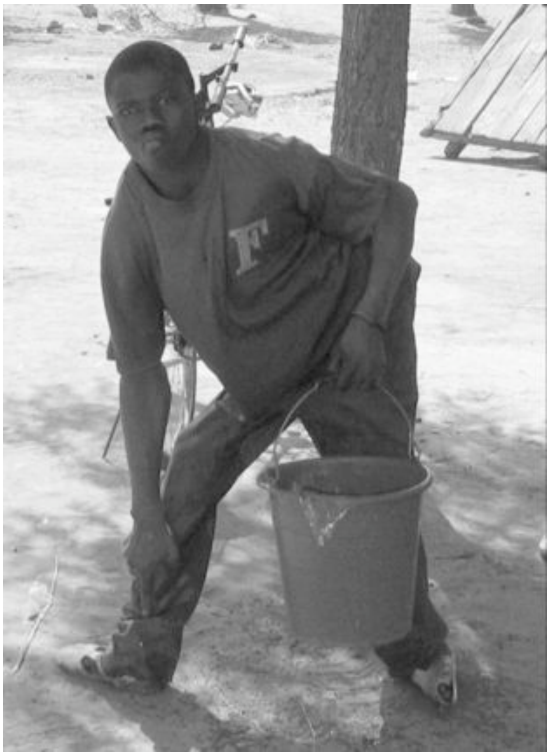


Figure 5.1 A young man with cerebral palsy carries water in a bucket. Note the water spilling as he steps forward.

Figure 5.2 This young girl, disabled in her right leg from an unsanitary injection during her infancy, carries water daily to her home. Due to her unsteady gait she can only fill her basin one-half to three-quarters full to avoid water spillage.

Figure 5.3 Typical jerry can ("bidon") used for water transport. These have a small screw-on cap, a single top-end handle, and straight sides. Large volumes (20-25 liters) can be carried with these durable jerry cans, but their straight sides, lack of side handles and weight when full can make them difficult to handle.

WATER TRANSPORT

The transport of water can pose a major challenge for the disabled and the able-bodied when distances are long and containers are heavy. For those who can afford wheeled equipment (carts, wheelbarrows, etc.) and have the ability to operate them, the effort is made much easier. Even with wheeled transport, sandy ground conditions, eroded waterways and ditches can make these forms of transport difficult. But most community members cannot afford such equipment and must carry the water themselves or depend upon another household member or neighbor to transport the water for them.

As mentioned earlier, adequate grasping and excessive spillage from common containers is a major problem for many disabled persons. This is especially true for persons who use assistive devices to walk or to transport themselves. Persons using a cane or crutches can find it very difficult to grasp both the container and the assistive device. Bucket handles, which are usually very thin, are somewhat easier to grasp while simultaneously grasping a crutch or cane with the same hand. But spillage can be significant as the bucket tends to bounce with the use of the crutch or cane (figure 5.4). The thick and centrally located handle of jerry cans is usually more difficult to grasp while also grasping a crutch or cane, rendering it almost impossible to carry a full container in this manner (figure 5.5).

Figure 5.4 While this young man is able to grasp both his cane and the thin metal handle of the bucket, he is limited in the amount of water he can transport. If the bucket is more than a third full, water will spill; the weight of the handle in his hand becomes painful, and his grasp is difficult to maintain.

Figure 5.5 Grasping a crutch handle and a jerry can handle with the same hand is possible; but this young woman found that she could not maintain her grasp and walk even when the jerry can was only a third full.

Tricycles can be used to transport water, but most are not well designed for this purpose, even when they are equipped with a carrying rack behind the seat. The rack is often too high for many disabled persons to reach with a full container. Furthermore, once the container is placed on this rack, the container can be very unstable during transport due to the rack's high center of gravity (figure 5.6). Most persons using tricycles for water transport place the water container on the platform at their feet if there is room, as the center of gravity is lower and the container is considerably more stable during transport. Unfortunately, most tricycles do not have foot-platforms designed with sufficient space for easy carriage of a water container.

Figure 5.6 Many tricycles for the disabled are built with carrying racks behind the seat; but their height and position behind the seat can make lifting difficult and transport unstable for full water containers.

DOMESTIC WATER USE

For the disabled, water management within the home can pose multiple challenges. This is especially true for women, as many of their domestic responsibilities involve the use of water. Once water from the pump or well has been transported to the home, it is eventually poured from its container into a more permanent storage container (such as a storage barrel or a clay drinking pot), or, its contents are divided among other multiple containers used for various household chores (e.g., washing of clothes or dishes, bathing or toilet use). For some, simply transporting water from one area of the house to another can be difficult (figures 5.7 and 5.8). For those with limitations in their arms or

Figure 5.7 Disabled since birth, this woman balances water containers on her head for transport around the home.

hands, the washing of clothes, dishes, children or themselves can be problematic. Many women cited the problem of simply pouring water (whether from a lack of strength to lift the container or the inability to grasp it properly) to be a major constraint (figures 5.9 and 5.10). Most find buckets somewhat easier to grasp and pour than jerry cans, but prolonged use of open buckets can result in exposed and eventually contaminated water. When using water indoors, spillage from poor handling of containers can result in wet, muddy and unsanitary floors. For bathing, many disabled persons not only need someone to carry a bucket of water to the bathing area, but they may also need assistance in lathering, scrubbing and rinsing themselves (figure 5.11). This is often true of the elderly. In spite of their best efforts to surmount their limitations, disabled women who carry the burden of managing these household affairs may often put the entire household at risk from poor hygiene: dishes and clothes may not be cleaned properly, children may not be given frequent baths, and hand-washing may be infrequent.

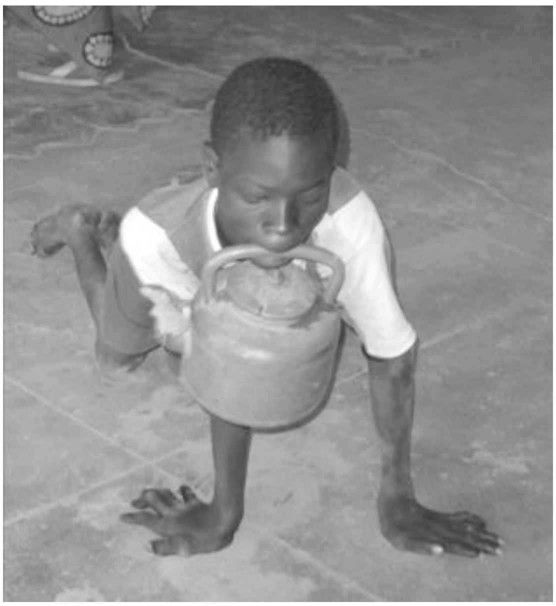


Figure 5.8 A boy demonstrates how he carries water for personal cleaning when he goes to the latrine.

Figure 5.9 Unable to bend her elbow or use her hand as the result of a stroke affecting her right side, a mother of several young children demonstrates the challenge of pouring a bucket of water with one functioning arm and hand. With her paralyzed right arm, she stabilizes the receiving basin.

Figure 5.10 As a child, this woman's hand was severely fractured and poorly treated. She demonstrates the difficulty of grasping and pouring with only one functional hand. Using her disabled left hand to support containers can be painful, and so she prefers softer plastic containers rather than harder metal ones.

Figure 5.11 A husband and father of five demonstrates how he transports water around the home. When carrying water for his bath, he places the bucket handle around his neck. When carrying smaller amounts of water short distances, he grasps the bucket handle with his teeth. Shoes placed on his hands prevent them from becoming soiled in the latrine or bathing area.

5.2 ENHANCING WATER TRANSPORT AND DOMESTIC USE

WATER CONTAINERS — HOLDERS FOR IMPROVED GRASPING

Among water containers that are locally available, the plastic jerry can is the most robust container that prevents loss of water from spillage. But it can be heavy and difficult to grasp and carry. During the Study, methods to enhance grasping and lifting of these jerry cans were explored and tested. Various types of rope or nylon webbing holders (or "porte-bidons") were developed and tested. While rope holders can help, they must be made of a water resistant material to avoid deterioration. Tying and knotting must be done well to assure a consistently firm fit on the jerry can. Heating and partial melting of the knots can help assure their hold over time. Nylon webbing can be used to make tighter, more secure holder (figure 5.12). Rope and webbing are available in most markets, and local metalworkers or artisans can assist with sewing the webbing. These holders can be usually be made for about 100-300 cfa, depending on the quality of the material. It should be noted that these do not provide a "rigid" grasp, yet grasping (and therefore lifting and pouring) is improved with these holders. They may need frequent tightening and repair. Furthermore, the nylon begins to degrade from sunlight exposure within a year or so, requiring replacement.

Figure 5.12 Testing of a jerry can holder ("porte-bidon") made from nylon webbing sewn around the container to facilitate grasping and manipulation.

In the effort to provide for plastic jerry cans a more rigid grasp of greater durability, various types of metal holders (or "porte-bidons") equipped with handles were also developed and tested (figure 5.13). These do not need to be fabricated with heavy gauge material. Light gauge metal, such as small (1-2 cm) flat iron can be used effectively if fitted and welded properly. Handle attachments should be placed on opposite sides of the container at about 60-70% of the total height. Care should be given to avoiding overly thin or sharp-edged material for the handles, to prevent pain when grasping and lifting full containers. These metal handles can be wrapped in a cloth material to reduce painful grasping. Locally available, jerry cans come in a variety of sizes, and care should be taken to obtain careful measurements when fabricating the holder. In general, it is best to measure the exterior dimension of the jerry can *when it is full of water*, as some expansion occurs. Jerry cans should fit firmly within the holder when full but be easily removable when the container is empty. The bottom of these metal holders should allow for sufficient space for the plastic underside of the container to rest directly on the head of the carrier. A metal band running across the center of this space can be painful to the head when one is carrying a full container. These holders can be fabricated by local metalworkers for about 1,000-2,500 cfa, depending on the quality of material. This represents a considerable expense for many local persons, but a well-built holder should outlast the life of the container by several years. Furthermore, the holder can serve to prolong the life of the jerry can if used properly (figure 5.14).

Figure 5.13 Testing an early prototype of a metal jerry can holder ("porte-bidon"). While functional, this holder's handles were placed too high along the sides, making it difficult for users with short arms.

Figure 5.14 One of the final prototypes of jerry can holders ("porte-bidon") developed during the Study. Note the minimal amount of metal used and the handles placed on the narrower sides of the container for greater ease of lifting on and off the head.

A lower-cost option for rigid holders for jerry cans was explored using the same material and fabrication process as is used in the fabrication of local wooden furniture. The Tominian area of Mali is known for its production of traditionally made chairs, benches and tables by artisans using local wood and a steaming process for treating and bending the wood. Variations of this practice are found in other regions throughout West Africa. Rawhide is soaked and then used to attach wooden parts. As it dries, the rawhide shrinks, providing very firm and rigid attachments. However, the rawhide is susceptible to water, so thin gauge wire (also available in most regional markets in West Africa) was effectively substituted for the rawhide. These wooden holders provide perhaps the easiest and most comfortable grasp for disabled persons, and their cost is about 300-500 cfa. The life of these holders is considerably less than the metal holders, but the wire attachments are all that require occasional maintenance (figure 5.15).

Figure 5.15 A wooden prototype of jerry can holder ("porte-bidon"). These are considerably less costly than metal holders but are not as robust. This prototype is equipped with side handles almost twice the necessary width.

WATER CONTAINERS — PLASTIC MOLDING AND WELDING FOR IMPROVED GRASPING

Other methods of enhancing the grasping and lifting of plastic containers involve changes made to locally available containers through molding or plastic welding. These options were extensively explored and tested in Messiah College laboratories and with local artisan involvement in Mali. Most plastic containers that are manufactured locally are made from polypropylene and cannot be remolded or welded easily by local artisans because the containers are thin-walled and the plastic has a somewhat narrow range of temperature in which it can be molded or welded. As a result, given the rudimentary tools and limited temperature control available to local metalworkers and artisans, it is very easy to excessively deform or puncture the plastic during the process. Handles or grasping points can be glued to these containers with some success, but the necessary glues are expensive and hard to come by in many parts of West Africa.

Locally available containers made of HDPE (high density polyethylene) plastic can be welded or molded somewhat more easily. These containers — such as the large 20-25 liter jerry cans in which cooking oil is imported — tend to be thicker-walled, are more robust and are usually imported. Re-molding or welding of these HDPE plastics can be done successfully by local artisans with adequate practice, as the range of temperature that can be used is somewhat wider than that for polypropylene. Most initial attempts result in excessively thin walls on the container or in puncture. However, the process can be mastered over time with repeated practice. In general, pre-heated metal tools, which are specially formed for the type of molding desired, are the best means for *re-molding* these plastics. Heating of these tools can be accomplished using heated charcoal. In some cases, light pre-heating of the container can enhance the molding process, but this is best achieved with a blow torch. Once the process is mastered, various forms of protuberance or bulge can be molded into the sides of the container which can reduce hand slippage and facilitate lifting. In the case of jerry cans, tools for this process must be developed which can be manipulated from the interior of the container through its small orifice.

"*Welding*" other pieces of HDPE plastic to the outside of HDPE containers to form a protuberance or handle to assist in grasping and lifting is perhaps more easily mastered by local artisans. The method requires:

1) heating a flat plate of metal (a thin strip of aluminum can suffice) to about 300 °C;

2) the rapid, brief placement of the heated metal strip firmly between the two surfaces to be welded in order to heat them;

3) the rapid removal of the heated metal plate; and

4) the immediate application of high pressure for about 3-4 minutes to assure proper welding between the two plastic surfaces.

Figure 5.16 Heating the thin flat strip of metal (e.g. aluminum) which will be placed briefly between the container and the handle to be attached. This step will heat both sides for welding.

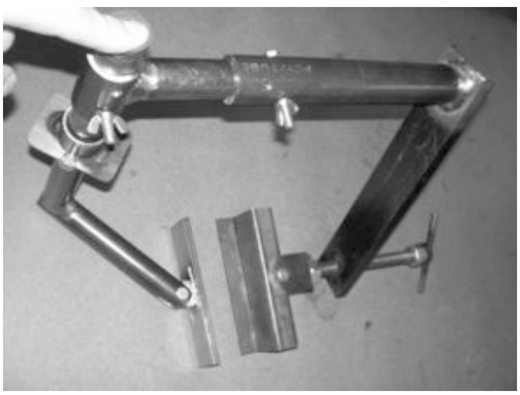


Figure 5.17 The pressure clamp developed for HDPE plastic welding of handles to jerry cans. The left arm is inserted into the jerry can, while the right arm applies pressure on the outside of the container.

The metal is easily heated on a bed of charcoal (figure 5.16). However, producing the required high pressure on both sides of the surfaces to be welded requires an adequate tool, as such pressure can generally not be produced manually. For the purposes of welding handles to plastic jerry cans, a simple pressure clamp was developed which can easily be replicated by local metalworkers (figure 5.17). A portion of this clamp is inserted through the opening to provide pressure from the inside of the container, and another portion of the clamp provides pressure from the outside on the piece to be welded to the container (figures 5.18, 5.19, and 5.20). The design specifications for this clamp are provided in Appendix 4. For this method to work properly, both the container and the handle must be HDPE plastic. Once handles are welded to both sides of the container, all sharp edges should be rounded with sand paper to avoid painful grasping (figures 5.21 and 5.22).

Figure 5.18 Once the heated metal plate has been inserted briefly between the container and the handle (white piece), the pressure screw is ready for immediate tightening.

Figure 5.19 A close-up view of the external pressure plate on the handle (white piece) to be welded to the container.

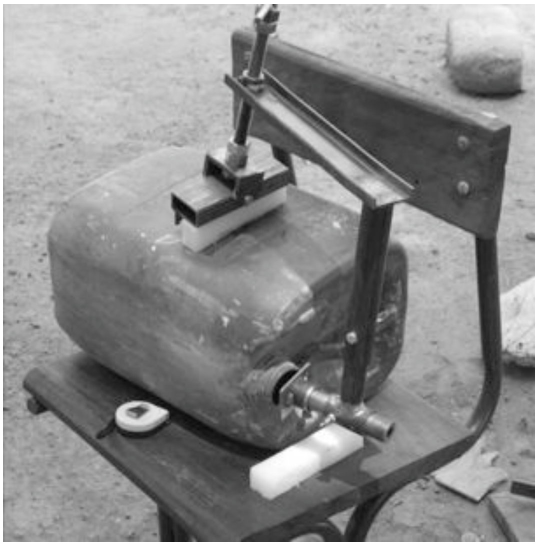


Figure 5.20 The pressure clamp is used by a local metalworker to weld handles to jerry cans for distribution and testing among disabled persons in the target communities.

Figure 5.21 A view of the completed handle welding process on a jerry can.

Figure 5.22 A local metalworker demonstrates the strength of the completed weld between the handle and jerry can.

It should also be noted that during the Study, discussions were held with the managers of the SOACAP (Societe Africane de Chaussures et Articles en Plastique), the principal manufacturers of plastic containers in Mali. Discussions were focused on the need for “universal design” type containers which better accommodate the needs of all users, including the disabled. In the past, “standard” molds have been purchased for SOACAP’s principal water containers. The production of buckets, jerry cans and other containers which are facilitative and easier to grasp and transport would require assistance in the new design features of the containers, and the production of new molds (each costing at least $50,000). Future initiatives in the region which are targeted at enhancing water use by everyone (including the disabled and the elderly) would do well to consider the benefits of assisting an enterprise such as SOACAP in developing “universal design” types of containers for local markets.

TRANSPORTING WATER

The transport of water for domestic use is a major challenge for all people, the able-bodied and the disabled alike, because of the volumes which must be carried and the distances over which it must be transported. In addition, the costs involved in the manufacture of devices which can reduce the physical effort involved carrying water are a financial burden. Considerable research has been dedicated to this issue, and this research continues. But by nature of the complexity and cost of developing equipment for water transport, this particular area of work was beyond the immediate scope of the Study. However, a number of considerations and recommendations relating to *existing practices* were developed.

As mentioned earlier in section 4.2, strategic borehole and pump site selection can serve to reduce difficulties of water transport for disabled persons — specifically, locations closer to places of residence and where adequate road or pathway access exists. Both distance and the condition of the terrain that must be traversed affect a disabled person's ability to access water.

Increasingly various public and private services are making hand-powered tricycles available for the disabled in many West African countries. While the majority demand far exceeds the supply for this form of transport, the number of persons in both urban and rural communities who have tricycles steadily increases each year. Various designs for these are used, but most do not take into consideration the need to transport heavy water containers. While many are equipped with a carrying rack behind the seat, new designs are needed which can easily and safely accommodate water containers on the foot platform. In many designs, the principal support shaft (which connects the front wheel support to the rear frame) often intersects the foot platform at its center, making placement of objects between the feet difficult (figure 5.23). New and innovative designs to rethink how tricycles can be better adapted to transport water are needed (figure 5.24).

Figure 5.23 A disabled woman uses the foot platform of her tricycle to transport water, as the low center of gravity enhances container stability and reduces splashing, but the placement of the container leaves little room for her legs. Notice how the support frame intersects the center of the foot platform, limiting space for carrying objects.

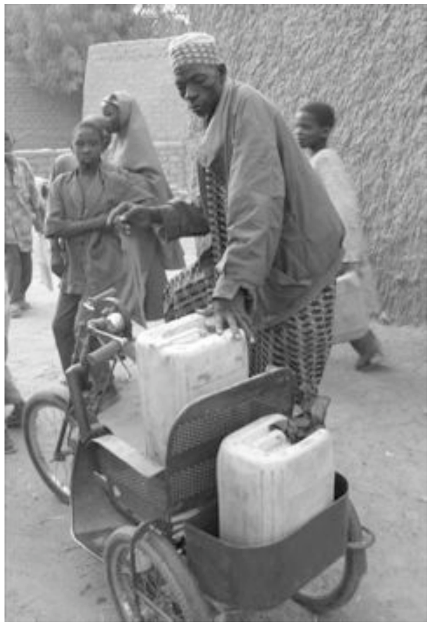


Figure 5.24 A disabled man in Niger uses his well-designed (and costly) tricycle to transport multiple containers. One container is placed in a low-hung, rear rack that is well enclosed, and another is positioned toward the rear portion of his seat.

If disabled persons have access to animals of burden (e.g., donkeys), animal-pulled carts, wheelbarrows, etc., these can be used to facilitate transport (figure 5.25). But most cannot afford these items and many are unable to use them due to their physical limitations. From region to region, different means of innovative transport can be found. Disabled men or older children may use donkeys or even bicycles to assist in transporting water (figure 5.26). With bicycles, containers can be attached by a short cord draped over the bicycle which is then pushed to the place of residence (figure 5.27). If the disability is not too severe, a shoulder cross bar can be used to facilitate the transport water (figure 5.28). Many other such examples can be found across the West Africa region. However, in addition to posing new and unique physical challenges, many of transport methods, when applied in regions or cultural contexts where they are foreign, may conflict with local norms and expectations, creating new social challenges for the disabled.

Figure 5.25 Wheelbarrows can be used to facilitate the transport of heavy water containers, but they also require strength and coordination that may be beyond the capacity of many disabled persons.

Figure 5.26 Animals, such as this donkey in Niger, are used in many areas to facilitate water transport.

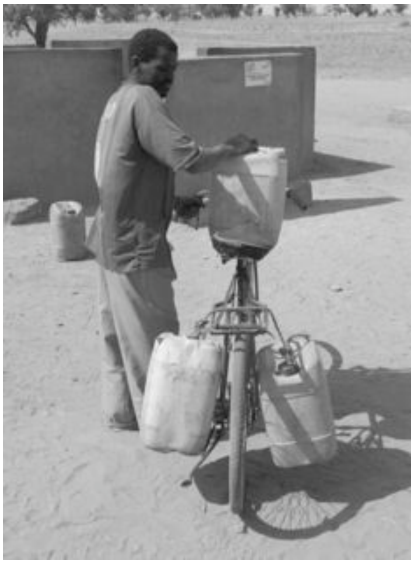


Figure 5.27 This man uses his bicycle to transport multiple water containers. Once the containers are loaded, he simply pushes the bicycle back to his home.

Figure 5.28 In some parts of West Africa, dual containers are transported using a shoulder yoke. This method can enhance water transport for some disabled persons; especially those with upper body limitations (in their arms or hands).

During the Study, consideration was given to two other forms of transport: a) the development of backpacks or to ergonomic means of easily attaching water containers to a person's back; and b) the use of rolling containers such as the "hippo-roller".[17] Methods for carrying water on one's back lacked popular support by disabled persons in target communities. While hippo-rollers can greatly facilitate the transport of larger quantities of water (e.g. 90 liters), they can still pose challenges for the disabled in filling, pulling/pushing and emptying. Furthermore, the cost of either local fabrication or importation remains well beyond the means of most disabled persons in target communities. In general, the development of new or improved devices such as these, which are both sustainable and cost-effective, requires significant resources and time — both of which were assessed to be beyond those of the Study.

DOMESTIC WATER USE — METAL TIPPERS FOR CONTAINERS

The distribution of water from a transported container for usage to smaller containers is a central part of the daily management of water in the household. The difficulty of pouring from heavy containers, such as 20-25 liter buckets and jerry cans, was a common concern cited by disabled women in the Study's target area. This difficulty can be reduced through the use of appropriately designed pouring devices or "tippers." Various forms of these have been developed for different types and sizes of containers elsewhere in the world (figure 5.29). Several models were developed and tested with a view to developing tippers that could be: a) used with locally available containers, b) manufactured by local artisans, and c) made available at a reasonable cost. Prototypes for testing were developed for buckets and jerry

Figure 5.29 A small tipper used to pour liquids into a drinking glass. This simple device was developed for persons with unsteady or weak grasping ability.

[17] www.hippowater.org

cans with the assistance of local metalworkers and with input from disabled women in the community (figures 5.30, 5.31 and 5.32).

Figure 5.30 A disabled woman tests an early jerry can tipper prototype. Note the overly wide base of the support frame, which impedes good placement of the receiving container directly under the jerry can outlet. The tipper also lacks a handle at the base of the holder, requiring awkward handling from the top of the jerry can.

Figure 5.31 Jerry can tipper prototype fabricated in Niger with square, light gauge, iron tubing.

Figure 5.32 Metal bucket tipper being used by a woman having the use of only one arm.

While functional designs may vary depending on container type and personal preferences, the recommended designs for the bucket and jerry can tipper are depicted in figures 5.33 and 5.34, respectively.

Figure 5.33 Basic design for the metal bucket tipper, including the circular bucket "holder" and the supporting "A" frame base. The holder and A-frame support are joined on either side at a single pivot point.

Figure 5.34 Basic design for the metal jerry can tipper, including the rectangular bucket "holder" and the supporting "A" frame base. The holder and A-frame support are joined on either side at a single pivot point.

For the most cost effective tippers, small, light gauge flat iron and rebar should be used.[18] During fabrication the following guidelines should be carefully observed:

1. The container (bucket or jerry can) should be filled with water before measuring the dimensions for the "holder" or "housing" portion of the container, otherwise the full container will not fit properly in the housing once it is made. NOTE: It is imperative that the filled container fits properly to the bottom of the holder when placed in the tipper, otherwise it will not be stable while in use.
2. The height of the holder should be about 85-90% of the height of the container. For example, if a jerry can is 54 cm in height, the holder should have a total height of about 47-49 cm.
3. The pivot point should be placed on the frame of the container holder at a point above the base of the holder equal to about 55-60% of the height of a jerry can, and 65% of the height of a bucket. In other words, if a jerry can is 54 cm in height, then 55-60% of the height is about 30-32 cm. The pivot point on the side of the holder should then be placed at 30-32 cm above the base of the holder.
4. The support frame (or A-frame), which supports the container holder, should be attached to the holder pivot point at the support frame's apex. The support frame should be sufficiently tall so as to allow for at least 7 cm free space between the ground surface and the bottom of the holder frame. This will allow the container to be pivoted (or poured) without its corners touching the ground.
5. For a jerry can, the base length of the supporting A-frame should be at least equal to the base length of the container; for a bucket, it should be equal to the top diameter of the container. The base length of the supporting A-frame can exceed these dimensions slightly. If base length is less than these dimensions, then the support frame will not be sufficiently stable. If it greatly exceeds these dimensions, then the support frame will interfere with the proper placement of the receiving container placed on

[18] "Rebar" refers to standard steel rod with ridges for use in reinforced concrete.

the floor at the base of the tipper. The base width of the supporting A-frame should be about 2-4 cm wider than the width of the jerry can or 2-4 cm wider than the diameter of the bucket at the point where pivoting occurs.

6. The holder and support frame should be connected at both pivot points on either side of the tipper using a small bolt and nut. Once the nut has been loosely attached to the bolt, so that the holder can swing freely, the nut should then be welded in place to the bolt. This will insure that the nut will not eventually work its way off the bolt.
7. To facilitate pouring by disabled persons, a small handle should be attached on one side at the extreme base of the holder.

Figures 5.35 and 5.36 depict final versions of the jerry can tipper. If properly used, the metal tipper should last for several years. Only the pivot bolt may need replacement from time to time, depending on the frequency of tipper use. Metal tippers are durable and stable and can be manufactured by local metalworkers for about 2,500 cfa or less.

Figure 5.35 Final version of a jerry can tipper.

Figure 5.36 Final version of a jerry can tipper being demonstrated.

A wooden version of the container tipper made by local artisans was also developed for the bucket and jerry can. These can be fabricated for a third or less of the cost of the metal tippers (about 500-1000 cfa). Local, steam-treated wood is used and constructed with locally available wire. (The typically used rawhide does not hold well when wet.)

Figure 5.37 An early prototype of the wooden bucket tipper, made by local artisans in the Tominian region of Mali.

Figure 5.38 One of the final prototypes of the wooden bucket tipper, using local wood attached with thin metal wire.

Prototypes are depicted in figures 5.37, 5.38 and 5.39. These tippers can be made using basically the same principles and dimensions as those for metal tippers (the 7 guideline steps detailed above). It should be noted that aside from the pivot point, no bolts, nails or screws are used in fabrication. Due to its weight-bearing use and daily manipulation, along with the presence of water, the use of these metal items are not advised. Over time, wired joints tend to maintain a more durable structure than do more common carpentry items such as nails and screws.

Figure 5.39 A final prototype of the wooden jerry can tipper.

The two primary challenges with this type of construction are: a) the proper placement of the pivot point on the holder; and b) the wear and tear, which occurs on the pivot point during use. When locating the pivot point on the bucket or jerry can holder (step 3 above), the center of gravity (or mass) must be considered in addition to the dimensions. Since these are of handmade construction, the weight distribution of the holder may not be symmetrical with respect to the holder's dimensions. Even if the right dimensions are used, the completed tipper can be off-weight (and therefore suspend unevenly) due to variations of weight distribution resulting from the simple wood construction. The rectangular nature of jerry can holders makes this problem less common and easier to resolve. The circular shape of the bucket tippers often results in a more uneven weight distribution in the holder. For the artisan, it is particularly important that a balanced pivot line (the imaginary line running between pivot points across the circular wood frame) is well established across the upper ring of the bucket holder frame. Simple, practiced handling of the container holder to feel for the center of gravity can greatly help when determining the optimal pivot points.

Given its wood construction, reducing wear on the pivot point is crucial. Several options were tested, including "wood against wood" pivoting, but problems of balance and free movement were encountered. A common, metal bolt provides the simplest way to obtain both balance and free movement. However, the placement of a moving bolt through the wood support frame results in premature wear on the wood. To minimize this wear, a durable housing or "sheath" for the bolt, which can be inserted into the wooden support frame, is needed. The simplest solution found was the use of discarded metal door hinges, with the flat plate portion removed (figure 5.40).

Figure 5.40 The sheath portion of a discarded metal hinge can be removed, inserted into the wooden support frame of a tipper, and serve as a protective sheath for the pivot bolt; thus reducing wear and tear on wooden parts.

Figure 5.41 Circular hinge housing or sheath being inserted into the support frame of the tipper.

Once the flat portion has been removed using a metal saw, the circular hinge housing can be firmly inserted into a small hole drilled in the support frame (figure 5.41). This will serve as a protective sheath for the bolt and should fit very firmly in the drilled hole so as to avoid movement against the wood. A bolt can then be fixed to the holder and inserted in the support frame housing to facilitate free pivoting without creating wear on any wooden parts. The bolt should be of sufficiently small diameter so as to rotate freely within the metal sheath. If properly placed, the pivot (both bolt and housing) should only need replacing once or twice each year, depending on the frequency of use.

As with metal tippers, it is also important to take measurements of the water container when it is full, before fabrication of the tipper, so as to assure easy placement and removal of the container from the tipper (figure 5.42). Furthermore, since these are fabricated with wood and wire, it is important that sufficient bracing is firmly built into the support frame to reduce wobble and enhance stability of the tipper when it is in use. (Note the “X” cross bracing at the base of the support frame in figures 5.43 and 5.44.)

Figure 5.42 It is important before fabricating tippers to take measurements from containers when they are full (and thus expanded). This will assure easy placement and removal of the container in the completed tipper.

Figure 5.43 Woman with limited upper-body mobility uses a wooden jerry can tipper in the home.

Figure 5.44 Young woman demonstrates the use of a wooden bucket tipper.

DOMESTIC USE — OTHER CONSIDERATIONS

Many disabled persons find innovative ways to manage and move water within their place of residence. Some may grasp the container in their mouths, or place bucket handles over their necks to facilitate transport of water within the home (figures 5.8 and 5.11). Simple measures can be employed to facilitate these actions. For small, plastic kettles used for hand washing or cleaning after defecation, slings made of rope or cord can be attached so that users can carry containers over the neck or shoulder rather than with their mouths. Cord or rope slings can also be used with a number of other containers, such as small 5-10 liter jerry cans (“bidons”) with screw- on lids.

For bathing, most disabled persons will sit on a small stool adjacent to a bucket of water. Splashing water from the bucket onto the body does not require lifting the water to any significant height (such as if the person were standing over the bucket). However, if the person has limited use of one or both hands, then rinsing can be challenging. Leprosy victims who have lost their fingers may particularly face such challenges. Simple adaptations to a small, plastic cup or gourd, using a cord or strip of rubber (from an old tire inner tube) can allow the cup to be attached to the impaired hand or arm for enhanced use in rinsing. Few disabled persons in the Study area employed the use of adapted brushes for bathing. While the Study did not specifically develop bathing devices, simple adaptations to available brushes could easily be used to aid those who are challenged while bathing. Long-handled attachments to brushes can easily be fabricated by local artisans, metalworkers and/or carpenters at little cost. Furthermore, brushes attached to the wall structure of bathing areas are easily installed and can also facilitate bathing by those who are impaired.

CHAPTER 6 SANITATION AND LATRINE USE

6.1 CHALLENGES

WHEN THERE IS NO LATRINE

More than 60% of rural households in the Study target area reported they have no latrine. Thirty-five percent reported the presence of a traditional latrine, with about 5% having some form of improved latrine (section 2.3). While many household members may urinate in the drainage of the "bathing" area of the household, most people go outside their homes to defecate (usually to the "bush" or adjacent crop fields). The lack of latrines in most households causes unique challenges for disabled persons. Those with mobility limitations are often faced with the need to regularly traverse significant distances. For many disabled persons, transporting water for personal cleaning (in addition to walking, crawling or pedaling) can also be difficult. Many are unable to do so which increases the risks from poor hygiene—risks not only for themselves but also for those with whom they live. Many disabled and elderly persons choose to wait until after nightfall to relieve themselves, as they are not required to travel as far to find a place of concealment. This was found to be especially common for those with visual impairment, since in the daytime it is difficult for them to discern whether or not they are properly concealed. However, this practice carries with it the risk of encountering poisonous snakes or scorpions, or incurring other types of bodily harm. Those with lower-body limitations are challenged with maintaining an adequate squatting position if there is no one to assist them (figure 6.1). Others, especially the feeble

Figure 6.1 A woman, with severely restricted use of her legs, demonstrates how she positions her head against a tree, so as to stabilize herself when defecating and to free her hands for personal cleaning.

or those with severe mobility limitations, choose to relieve themselves in a small receptacle, usually requiring disposal by another member of the household. For many of these persons, defecation into a container can also pose problems — especially those who are unable to squat on their own, which generally requires the assistance of another person.

LATRINE STRUCTURES

While the presence of a household latrine can serve to enhance levels of hygiene in the household and the community, in general, it does not necessarily insure enhanced levels of hygiene for a disabled member of the household. For some, simply traversing the courtyard to reach the latrine can be problematic, especially in the evening hours when it is difficult to see one's way (figure 6.2). Many elderly disabled persons expressed fear of leaving their rooms at night to negotiate the courtyard and latrine structure without assistance. Negotiating the latrine entranceway to safely arrive at the latrine hole was also mentioned as a problem due to the lack of hand support along the walls or the challenge of traversing the latrine floor if the person has to crawl. This can be even more troublesome if the individual must also carry a water container for cleaning (figure 5.8). Many disabled persons complained about latrine floors being too muddy (from rainfall or bathing) or soiled (usually from urine as a result of improper latrine use, figure 6.3). For those who must crawl on all fours, many mentioned that traversing floors can be painful, usually due to pebbles or stones in latrines with earthen flooring or unswept cement flooring.

Figure 6.2 An elderly disabled woman uses a cane to traverse the courtyard of her home. While she feels at ease doing this in the daytime, she is reluctant to try this in the dark.

Figure 6.3 A sanplat latrine soiled by urine from improper use and poor drainage.

SPECIAL CHALLENGES FOR THE VISUALLY IMPAIRED

For the visually impaired, traversing the courtyard and the latrine structure can be difficult, much as it is for persons with other forms of disability. Most challenging for the visually impaired is locating the latrine hole and positioning themselves accurately over the latrine hole in a squatting position. In both Niger and Mali, it was noted that most persons with significant visual impairment simply use their unprotected hands (figure 6.4). In some cases it was found that blind persons will use their feet to locate the hole, but they will often then resort to using their hands to position themselves when squatting. In a very few cases, blind persons use a cane to assist in locating the hole. But this is not common practice, and in many places there is actually resistance to the use of canes.

Figure 6.4 A blind man, who has had access to an improved, sanplat latrine for several years, demonstrates how he locates the latrine hole by feeling with his hands. This practice puts him and his family at risk from poor hygiene.

SQUATTING AND CLEANING

Perhaps the most challenging aspect of latrine use by disabled persons in the Study's target communities is that of squatting and cleaning. Disabled persons with lower-body limitations often have difficulty in one or more of the following actions: a) lowering themselves to a squatting position; b) maintaining a squatting position without the support of their hands (figure 2.21); c) cleaning themselves after defecation; and d) raising themselves to a standing position when finished. If the disabled person is not using an assistive device (such as a cane or crutches), then lowering and raising themselves from a squatting position can be difficult, if not impossible. Many with severe lower-body limitations cited the need for assistance in lowering and raising themselves when they visit the latrine. Many more mentioned having to sit directly on the latrine seat (or hole, in some cases) due to an inability to maintain a squatting position. This is not only painful for most, but given the soiled nature of many household latrines, extremely unhygienic (figures 6.5 and 6.6). Furthermore, these same individuals must struggle to sufficiently raise themselves so as to adequately clean themselves following defecation. This is often done by leaning to the left or right to gain adequate clearance between the buttocks and latrine hole.

Figure 6.5 A traditional latrine used by a disabled person who, due to lack of adequate leg strength, must sit directly on the hole. Note the rim of the hole (the remains of an old metal container) is flush with the ground surface so as to minimize discomfort when the user is seated on the ground.

Persons with upper-body limitations generally have little difficulty in squatting, but they may struggle to adequately clean themselves following defecation. Normally, while still squatting, an individual will pour water from a small container into his cupped hand with which he will then rinse himself. For some disabled persons, grasping and manipulating the water container for cleaning can be cumbersome (figure 2.17). Cupping the hand to capture water, as well as for rinsing, can be even more challenging for those with limited use of their arms or hands (figure 6.7). While children who are disabled in this way usually receive assistance from their parents or siblings, adults must generally manage for themselves. As a result, many struggle to maintain adequate personal hygiene and health, due to the inability to adequately clean themselves following latrine use.

Figure 6.6 This disabled man, with limited use of his legs, must crawl on all fours to visit his traditional household latrine. Here he demonstrates how he temporarily places dried mud bricks around the latrine hole to better place himself for latrine use without becoming soiled.

Figure 6.7 Having lost her fingers from leprosy, maintaining personal hygiene after latrine use is an extreme challenge for this woman– as she is unable to hold water in her hands for cleaning. She is only able to pour water with her left hand. With her right hand placed between her thighs, she then pours water on her upper right arm, allowing it to run down her arm to her right hand with which she attempts to rinse herself.

6.2 IMPROVING LATRINE STRUCTURES

SITE LOCATION

Most household latrines are placed within the household compound, while others may be placed just outside the household units. When promoting the use of improved latrines, households should be encouraged to give careful consideration to ease of accessibility when there is a disabled person among their members — especially if mobility is a concern. Locating the latrine outside the household compound or at the end of the courtyard far from where the disabled person lodges can limit their access. When planning the addition of a latrine, household leaders should be encouraged to involve the disabled member in discussions on latrine site location. During the Study, it was observed that this form of inclusion is often overlooked.

WALLS AND SUPPORT ACCESSORIES

The use of latrines by disabled and elderly persons can be facilitated by hand support along the walls of latrines. This assists them not only in entering the latrine, but also in lowering and raising themselves to and from a squatting position. Hand supports can also provide stability while squatting. If the latrine is outside the home, a disabled person may use an assistive device (such as a tricycle, cane or crutches) which may need to be left outside the latrine. In such cases the individual will need support within the latrine. For both traditional and improved latrines, wall size, dimensions and construction material are highly variable among households. Wall height usually ranges from 1 – 2 meters, entranceway widths from 50 – 100 cm, and interior space dimensions from 2 – 5 m^2. Wall construction material (from lowest to highest cost) may be woven grass mats strung between posts, simple dried clay brick (with and without a cement plaster covering[19]), quarried and dried laterite brick, or cement block.

[19] When installing a sanplat latrine, many households will also put cement plaster over the dried, clay brick enclosure walls. While this may provide some protection from rainfall in the first year or two, it was observed that the benefit/cost of this practice is somewhat marginal. Cement is very expensive and rarely does the cement plaster last more than a season or two, especially when poorly applied.

Many disabled persons can be assisted with handhold accessories attached to or embedded in latrine walls. While handhold accessories can be placed in clay brick walls, there are several challenges in doing this. Dried, clay brick construction is not strong, so any hand accessories should be embedded and pass through the entire thickness of the wall, so as to insure that they do not pull out when used. Accessories made from wood generally do not last long as they are subject to termite infestation (unless the wood is well treated, which can be costly). Metal handhold accessories have a considerably longer life but can be expensive for local consumers. It was noted that some disabled and elderly persons will use exposed brick in the interior walls of the latrine for support. This situation is usually found where the brick wall has not been fully plastered after construction (figure 6.8). This leaves the brick edges exposed for hand use support (but in some cases it also leaves the wall more susceptible to erosion from seasonal rains. When available, dried laterite brick is much more resistant to deterioration and provides a much sturdier wall that can more easily support handhold accessories.[20] It costs about twice that of dried clay brick but is still only about one-tenth the cost of cement block. Cement block wall construction is usually well beyond the means of most households, but its strength can support most forms of handholds, including those made from wood as it impedes termite infestation.

Figure 6.8 Exposed clay brick walls in the interior of latrines, while subject to deterioration by seasonal rains, can provide helpful handholds and support for some disabled and elderly persons.

A simpler and more cost-effective option for installing handholds in latrine walls is the simple practice of turning bricks sideways during wall construction at points where holds

[20] Lateritic brick is not available in all regions. Bricks are quarried from beds of laterite and then dried in the sun for several days. Some laterite structures can last almost as long as some cement block structures.

are needed. Bricks can be turned outwards to provide handhold support for both entering the structure and for squatting. (A diagram of the Study prototype can be seen in figure 6.9, and a photo of the entranceway of a low-cost prototype with these handholds and constructed with laterite brick and clay mortar can be seen in figure 6.10.) Protruding bricks should be placed at hand level on both walls of the entranceway, and should continue around the main interior wall to the latrine. At the latrine, protruding bricks can be placed at lower levels on either side of the latrine to facilitate squatting.

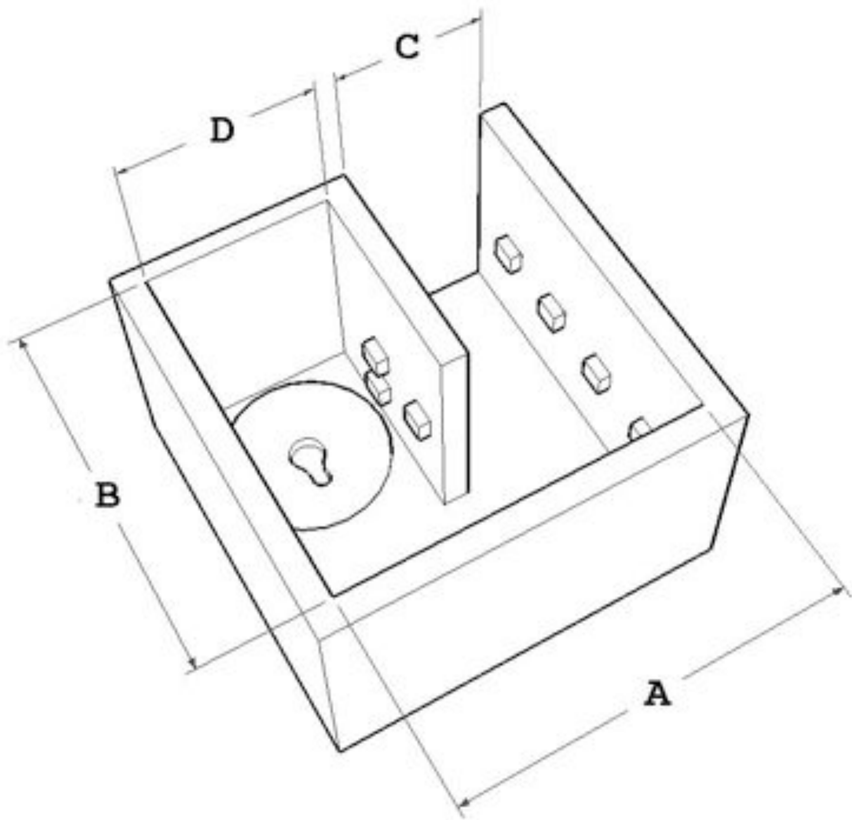


Figure 6.9 Diagram of a proposed latrine structure prototype. Entranceway wall dimensions facilitate use of both walls for support using one or both arms. Protruding bricks are placed along the walls to facilitate entrance access and squatting. With proposed dimensions, the enclosure area is optimized for latrine and bathing use, but with a minimum of space and therefore minimum required expenditure for materials. Wall height can be variable depending on preference and resources, although 2 m is recommended. (Recommended dimensions: A = 2.3 m, B = 2.2 m, C = 0.8 m, D = 1.3 m)

Figure 6.10 The entranceway of a latrine made from laterite brick and clay mortar. Note the protruding bricks (placed sideways) which provide handhold support for latrine users.

The dimensions of latrine entranceways and interior space are also important when considering the needs of the disabled. As mentioned earlier in this report, most latrines also serve as bathing areas for the household, and optimal space usage for both latrine and bathing should be considered when developing a low-cost, disability-friendly design. Many households are reluctant to invest in latrines simply due to the cost. During the Study it was found that most latrines are poorly designed with respect to space usage (and therefore costs of materials), and many latrines were found to have a floor space in excess of what is needed for latrine and bathing use. This results in unnecessary expenditure for construction materials. The Study examined multiple designs and prototypes for latrine layout. Figure 6.9 provides a diagram of a proposed prototype which is adequate for household latrine and bathing use, but which can also reduce overall costs of construction and facilitate use by disabled person. Suggested dimensions are provided. For some disabled persons, the entranceways of some existing latrines are too narrow to easily negotiate (some being 50 cm or less). Accessing these with crutches or cane can be difficult. Contrarily, many entranceways are excessively wide, precluding the possibility of effectively placing one's hands on both entrance walls for support. An entranceway of about 80 cm facilitates the use of walls on both sides for support, yet is sufficiently wide for those needing to use assistive devices. Placement of protruding bricks can further serve to assist those needing support. The 1.3 m width allows sufficient space for the placement of a 1.2 meter diameter sanplat latrine cover yet is sufficiently narrow so that both adjacent walls can be used for support when squatting. Sufficient space for bathing is provided in front of the sanplat latrine. So as to reduce muddy or soiled ground as one approaches the latrine, drainage should ideally be placed along the “B” wall somewhere between the front of the latrine and the “A-B” corner. Interior floor slope should then allow for proper drainage toward the drainage outlet which runs under the wall enclosure (figure 6.11).

Figure 6.11 A latrine prototype using the design depicted in figure 6.9. Note protruding bricks to facilitate lowering to and rising from a squatting position, with a bathing stool in the foreground. Drainage under the enclosure wall is located just outside the photo on the left wall, just below the bathing stool. (Note that this prototype uses laterite brick and cement mortar. High quality clay can also be used for effective mortar with laterite brick, for considerably lower cost.)

FLOORING

Latrine (and bathing area) flooring needs to be well-drained so that rainfall, bathing or latrine area cleaning does not result in a soggy or muddy floor. Many traditional latrines do not have a prepared floor, just dirt flooring as is found in most household courtyards. Concrete flooring is probably the most hygienic and easy to maintain, and perhaps the most appropriate for disabled persons. But it is also expensive and beyond the means of many rural households.[21] If local stone is available, stone paving of latrine floors can enhance drainage and alleviate the problem of mud. This low-cost option should be more frequently promoted, but the practice is rarely seen, even in areas with abundant stone. If stone paving is used, the ground should be well tamped beforehand, and flat paving stones should ideally be underlain with sand. Without a sand base, frequent wetting of the floor can result in mud rising between the paving stones, as well as an uneven settling of the stones. Even with stone paving, some disabled persons with limited mobility can find such floors too uneven and difficult to traverse. Disabled persons who must crawl on all fours often report that traversing a stone floor can be particularly painful to the hands and knees.

Options other than concrete flooring or stone paving are needed in areas where materials are too costly or unavailable, or where concrete or stone may pose challenges or discomfort to the disabled member of the household. One alternative is the use of gravel, which is available at relatively low cost in most

[21] However, if extra cement is available following fabrication of a sanplat, and its installment on a stabilized latrine pit, preference should be given to using this for latrine flooring, rather than for cement blocks or wall plastering. During the Study, it was found in many areas that proposed latrine design called for un-necessary amounts of cement which are generally beyond the means of most households. Often extra cement was called for to stabilize latrine pits, when this could be accomplished with fewer concrete blocks and mortar than proposed. Furthermore, where local stone is available, these can be substituted for concrete blocks. Some proposed designs also called for concrete block walls, or at least cement-plastered clay brick walls, and concrete flooring. This practice often discourages interest in sanplat latrines due to high total costs, when often all that is minimally necessary is sufficient concrete for the sanplat (latrine platform) and perhaps a little cement for pit stabilization. If necessary, walls and flooring can be built with local materials not requiring a cash investment.

regions.[22] As with stone paving, the ground surface should be well tamped and overlain with at least 5-10 cm of tamped sand before placing a 5-8 cm layer of gravel. If gravel is placed directly on the ground surface, mud will eventually rise to the gravel surface — largely as a result of repeated wetting and continual traffic in the latrine enclosure. Both the sand and gravel layer will also facilitate drainage and more rapid drying of the latrine floor. For disabled persons with limited mobility, this type of low-cost flooring is more even and less painful than stone paving. Figure 6.11 depicts a sanplat latrine with a laterite gravel floor.

The extent of the curvature or rounded shape of the sanplat may vary depending on the method of fabrication and the form used. Some sanplats have a very rounded shape which can be difficult for some disabled and elderly persons to mount, given the sloped surface. In other cases, the ground level around the sanplat is so low that the outer edge of the sanplat creates a small step of about 5-10 cm which can be an impediment to the visually impaired or those with limited mobility. In both cases, it is recommended that the ground surface in the latrine be filled to a level around the sanplat where the outer edges are completely covered and the slope encountered on the sanplat is minimal.

SANPLAT AND DRAINAGE ORIENTATION

In many households it was observed that limited consideration was given to orientation of the sanplat (relative to the enclosure area) when placed over the latrine pit. Often it was found that the combination of sanplat orientation and latrine drainage resulted in the need to traverse soiled or wet ground when approaching the latrine hole. While this is not an issue with most able-bodied persons, it can serve as a disincentive for latrine use by disabled persons. In many areas, it is preferable to have the sanplat facing the entranceway so that users can be aware of the approach of others who may not be aware that the latrine is in use. In other areas, religious tradition suggests that it is improper for individuals to face east while using the latrine. In such cases the sanplat may be oriented in a north, west, or southward

[22] Various types of gravel are available from region to region, but lateritic gravel is perhaps the most commonly available in WAWI target areas.

direction with little regard for orientation to the latrine entrance or the direction of drainage. When building the latrine structure and when orienting the sanplat, cultural and religious norms such as these should be given consideration. At the same time, orientation relative to the entranceway, drainage slope, and the drainage point out of the enclosure should also be considered. Even with hygiene training, many households fail to maintain latrines that are not soiled, especially with urine, which often runs off the sanplat to the floor of the latrine. Users, and especially the disabled, should be able to approach the latrine hole without having to directly traverse the soiled floor of the latrine or the typically soiled portion of the sanplat. The floor slope and the drainage point (out of the enclosure) should also be situated *in such a manner as to drain wet and soiled areas away from the direct path of users who approach the latrine hole*.

LOCATING THE LATRINE HOLE FOR THE VISUALLY IMPAIRED

The use of some type of hand covering, such as gloves made from inner tube rubber, to assist the physically disabled or the visually impaired with latrine use is a common practice in many parts of the world. A cane is also commonly used in parts of the world by the visually impaired to locate the latrine hole. However, neither form of assistance for latrine use is commonly practiced by the majority of visually impaired persons in most communities visited during the Study (in both Mali and Niger). Among some ethnic groups, the cane is commonly used by elderly men after they reach the age of 60-65 years; an example being the Dogon in the Koro region of Mali. In such cases, visually impaired men will use their canes when accessing latrines. But this is not typical in most places; and efforts to encourage the use of canes among the visually impaired in some rural areas have been unsuccessful.[23] Nevertheless, a cane kept at the entrance to the latrine can serve as a safe and effective tool for locating the latrine hole for those who need such assistance. And such use should be encouraged, whenever possible.

[23] For many years field professionally trained personnel from the center "Handicappé en Avant" near Diapaga, Burkina Faso, have tried to train blind adults in the use of simple canes for walking and finding direction. But after more than 10 years, this has met with only limited success.

Another, simple, low-cost method for assisting the visually impaired was tested during the Study. This involves the use of string weighted with stones as seen in figure 6.12. A string is suspended across the walls adjacent to the sanplat using stones attached to both ends. A second string is attached at the center of the cross string, directly above the latrine hole. This vertical string is then weighted at its low end with another stone and is lowered into the latrine hole some 40-50 cm below the surface of the sanplat. This vertical string is permanently fixed in this position and should not be removed (as the lower end will be soiled) except for repair (figure 6.13.)

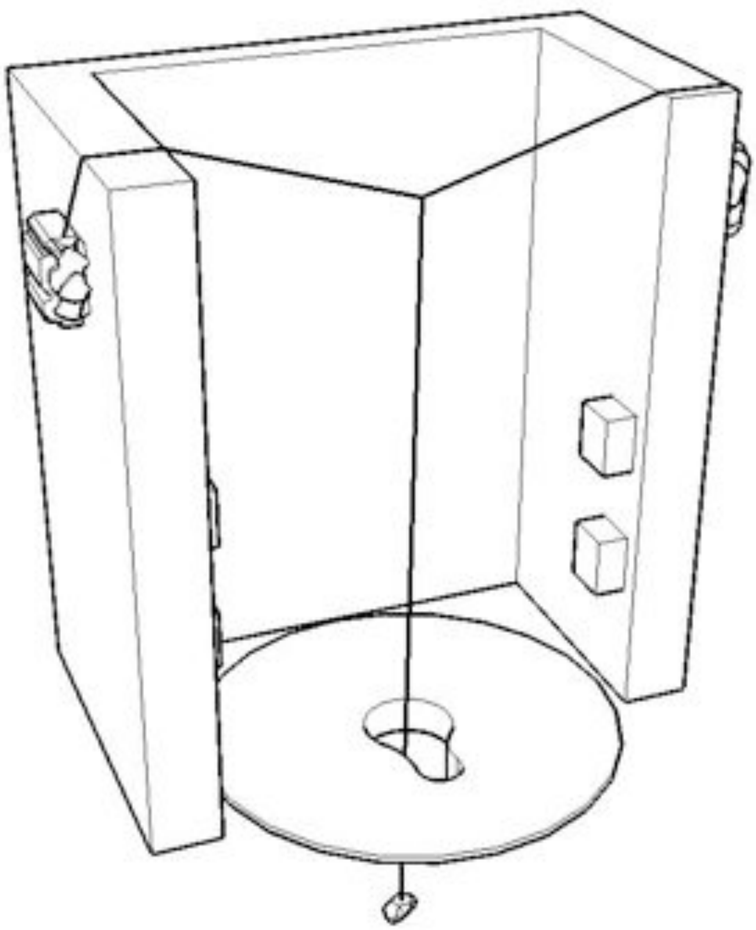


Figure 6.12 A simple, low-cost system using weighted string to assist visually impaired persons in locating and positioning themselves relative to the latrine hole.

Figure 6.13 A sanplat latrine with cover, equipped with a vertically placed string for assisting the visually impaired in hole location and body positioning when squatting.

The visually impaired person can locate this string and the general location of the latrine hole with an outstretched hand. When descending to a squatting position he can then keep one hand on the string for accurate body positioning over the hole. As he squats, the string under tension will give way to the side while he remains in the squatting position. This system was tested for 12 months and was found to be easily mastered by blind adults. One concern was that other household members would remove the string or that curious children in the household would play with it or otherwise disturb the weighted string system. However, after one year of testing in a household that included a blind father with a spouse and several young children (to whom the string's purpose had been explained), not a single incidence of disturbance was reported. To reduce the frequency of repair, the string material should ideally be resistant to deterioration from wetting and from ultra-violet rays from the sun. For testing during the Study, a low-cost, UV resistant cord was used.

6.3 LATRINE SEATING – ASSISTANCE FOR SQUATTING, CLEANING AND WALKING

One of the most often cited challenges related to sanitation and latrine use is that of squatting and cleaning especially for those with encumbering lower-body disabilities. For this reason, the Study examined a range of simple technologies which can serve to minimize these challenges, while enhancing hygiene and facilitating latrine access. *The design and testing of these technologies focused primarily on the provision of adequate seating, but also on assisting with mobility and personal cleaning*.

CLAY TERRA COTTA SEATS

In the effort to provide a low-cost solution for disabled persons who lack sufficient lower-body strength to squat, the fabrication of fired-clay seats was explored. Many moderate sized villages and towns have skilled, traditional potters who produce terra cotta containers for water transport and storage. The Study worked with a potter in Tominan to develop and test several prototypes for use with both traditional latrines and the sanplat (figures 6.14 and 6.15). Some practice is required to shape seats that can support the weight of a person yet have sufficiently thin walls to assure proper firing. These seats can be produced for about 400-1,500 cfa each. While disabled individuals had varying preferences for seat height, the recommended standard height for these is 15-20 cm.

Figure 6.14 Terra cotta (baked earth) latrine seat for traditional latrines; fabricated by a local potter.

Figure 6.15 Terra cotta (baked earth) latrine seat for sanplat latrines; fabricated by a local potter.

Circular seats for traditional latrines should have a diameter of about 25 cm, but this can vary depending on the size and shape of the traditional latrine. Terra cotta seats for the sanplat should be fabricated by simply following the dimensions of the latrine opening. The top rim should also have wide and well-rounded edges to provide greater comfort to the user.

Figure 6.16 Terra cotta latrine seat in use on a sanplat latrine in the home of a polio victim. When not in use, the seat is moved to the side of the enclosure for storage.

There was a largely favorable response from disabled persons assigned these seats for testing over a period of 6 months. In addition to no longer having to sit directly on the latrine hole, the low cost and ease of local fabrication was particularly appealing. Also the seats are very weather resistant and can be left in the latrines year round (figure 6.16).

Several minor challenges were noted. The seats are heavy and must be placed and removed with each use so that other family members can use the latrine. In some cases, another family member assisted in placing and removing the clay seat. The seats can be brittle and must be handled with some care to avoid breakage if dropped. Since the fired clay is hard, some persons cited mild discomfort when seated. While personal cleaning is made somewhat easier and more hygienic than when seated directly on the hole, some individuals still struggled with this as it is still difficult to reach one's buttocks with a cupped handful of water. To facilitate the cleaning process, the seat would need to be made with an opening for hand access. Doing so, however, would compromise the structural integrity of the seat.

Similar and stronger seats could be made with concrete, requiring the development of molds. While this method does merit further investigation, the cost of cement could make these seats prohibitively expensive for local clients. (See discussion on seating for the visually impaired later in this section.)

METAL LATRINE CHAIRS

The Study worked extensively with local metalworkers and disabled volunteers to develop simple, durable devices to assist with squatting, cleaning and mobility. A wide variety of chairs was developed and tested over a period of 18 months, with the assistance of both male and female volunteers from target communities (figures 6.17, 6.18 and 6.19).

Figure 6.17 An early metal latrine chair prototype developed during the Study. While functional and sturdy, this design with an enclosed seat and adjacent bracing limits hand access for cleaning (either from the front or from the rear).

Figure 6.18 The development and improvement of latrine seat prototypes involves close collaboration with disabled members of the community.

Figure 6.19 This early latrine chair prototype was developed for use by a disabled person needing assistance to walk from her room to the household latrine and to squat while using the latrine. The handles are made at a height which can easily be grasped from an upright, walking position. The handles and other side bracing provide support for lowering and raising herself from the latrine.

As individual disabilities and needs vary, there is not a single, universal design that is recommended above others. However, there are a number of guidelines which were developed to assist in the fabrication of appropriate latrine chairs:

1. Input from Disabled Persons: It is very important that information is exchanged between disabled persons and artisans when designing and fabricating latrines. Metalworkers and artisans must take the time to listen and understand the constraints and limitations of the disabled client. Information on the type and extent of disability, personal latrine use habits, cleaning practices and personal preferences are all important issues which should be taken into consideration. It is equally important that the disabled persons understand the artisans' limits and constraints in fabricating such seats (figure 6.20).

Figure 6.20 A local metalworker and disabled client discuss potential improvements for a latrine chair. Direct and frequent exchanges between fabricators and clients are essential for the effective development of locally made assistive devices.

2. Chair and seat height: The distance from the ground level to the level of the rounded seat should normally be about 20 cm. This height is based on user preferences and the need to keep the chair seat relatively close to the latrine opening so as to avoid possible soiling of the latrine surface (figures 6.21, 6.22 and 6.23). If there is an object the seat must fit over (such as in figure 6.21) or if the individual needs a higher position due to a physical limitation, then the seat can be positioned higher.

3. Seat dimensions: As can be seen the completed prototypes in figures 6.21, 6.22 and 6.23, seat design can take various forms. For adults, appropriate seat width should range from 15-25 cm, with most persons usually preferring a width of 20-25 cm width. The length of the seat portion of the chair should be about 30 cm. It should also be noted from the figures that all latrine seats are

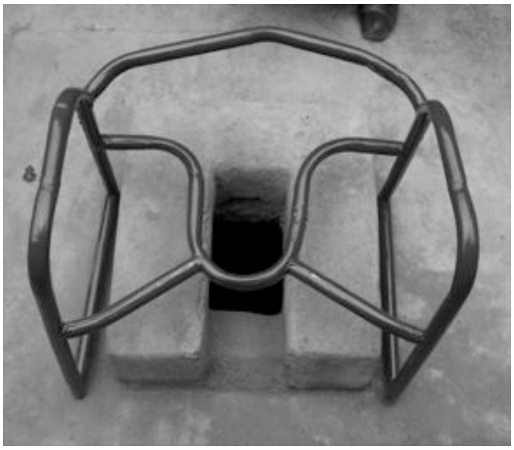


Figure 6.21 A typical metal latrine chair, designed for personal cleaning from the rear. Note the curved rear brace which provides easy arm and hand access for cleaning.

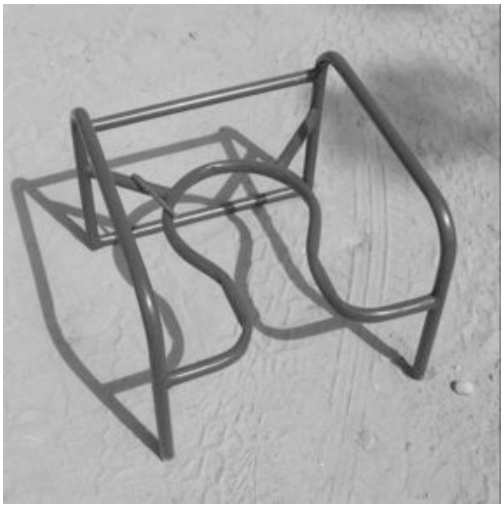


Figure 6.22 This metal latrine chair is fabricated with a standard seat for front cleaning. This seat functions well on hard surfaces, but the stand-alone front legs may sink into the ground if used on an earthen surface.

Figure 6.23 Equipped with bracing below the seat level, this chair is designed for cleaning from the rear (note the curved brace in the rear), but can also be turned around and used by those wishing to clean from the front.

open at one end. This opening is necessary to facilitate hand access for cleaning and rinsing after defecation. The seat opening does not need to be larger than the maximum width of the seat. In most cases, it should actually be somewhat smaller, as seen in figures 6.22 and 6.23. Early chair prototypes were built with circular (or enclosed) seating and did not include these openings (figures 6.17 and 6.19). User feedback quickly indicated that this design impeded effective hand access and cleaning, and the future designs were adapted accordingly.

4. Cleaning preferences: Depending on local customs, personal habits and/or upbringing, individuals may clean themselves either from the front or the back. Informal interviews in the Study's target communities indicated that preferences for front versus rear cleaning were about equally divided among the population, and there was no significant difference between men's and women's preferences. Design differences can be seen in figure 6.21 (a chair for rear cleaning) and figure 6.22 (a chair for front cleaning). The chair in figure 6.23 has cross brace support below the seat level and can therefore be used for either back or front cleaning.

5. Chair width and depth: The total chair width should normally not exceed much more than 50 cm, as greater width can make access difficult when passing through the entranceways of many latrines. The depth of most chairs (i.e., the distance from the front to the back of the chair) will need to be slightly more than the length of the seat portion of the chair. Typical depths may range from 35-45 cm.

6. Support, stability and bracing: Latrine seats must be sturdily built so as to support the full weight of regular adult usage. For this reason, adequate bracing within the frame of the seat is necessary. Support bracing can take several forms, as seen in the figures, but some guidelines should be considered. Bracing above the seat level is usually placed at the back of the seat (figures 6.21 and 6.22). However in the case of rear cleaning (figure 6.21) the brace should allow for unhindered arm and hand access for cleaning (thus the "bend" in the rear brace in figure 6.21). The same holds true for bracing placed below the seat level. (Note the curved brace beyond the open end of the seat in figure 6.23.) Consideration must also be given to stability. The chair in figure 6.22 can be used on a hard surface, but if it is used on an earthen

surface the chair's front legs will likely sink into the soil with the full weight of the user. Low-placed braces between chair legs, as seen in figures 6.23 and figure 6.24, can serve to enhance seat stability and prevent chair legs from sinking in the soil surface. Rounded seat frames (figures 6.20 and 6.23) serve to reduce the cost of welding, but when placed on a hard, flat surface some users find the seat tends to rock backwards. If this design is used, then the base length of the side frame should be sufficiently long so as to prevent that instability.

Figure 6.24 Low placed support bracing on the side of this latrine seat makes it more stable and less likely to sink in the ground if used on an earthen surface (such as is found in most traditional latrines).

7. Handles: The handles on each side of the latrine seat are used primarily for proper placement of the seat and for lowering and raising oneself from the seat. The height of the side handles will therefore depend on the strength and preferences of the user. For most users, the handles should extend approximately twice the height of the seat (usually 40-45 cm). However, some disabled and elderly persons can benefit from higher side handles which will allow them to use the chair as a walking aid. (The early chair prototype in figure 6.19 was designed to function both as a latrine seat and a walking aid for a polio victim.) When used in this manner, the individual can leave their assistive device (tricycle, crutches, etc.) outside the latrine and enter without becoming soiled from the latrine or bathing area floor. Chair handles that will be used to assist with walking should be about 65-70 cm in height.

8. <u>Other uses:</u> The latrine chairs described in this section were designed primarily to assist disabled persons in accessing and using improved and traditional latrines. But in the course of the Study, it was found that disabled individuals found many other uses for them. Many disabled persons do not have latrines in their household, but found the latrine chairs helpful when relieving themselves using a container (figure 6.25), or in the fields or bush outside the home. While this practice may not enhance sanitary conditions in areas around the village, it does serve to enhance the personal hygiene of the disabled persons using the chairs. Some disabled individuals reported using their tricycles to transport their latrine chairs on trips to the bush (figure 6.26). Those who are capable of walking with the assistance of high handles often found the latrine seat useful as an assistive device for walking about the home during the day. Given the strong, durable nature of these chairs, many disabled persons also use them as seats for bathing. The chairs are frequently stored in the latrine and bathing area, and can therefore easily double as an assistive device for both latrine use and bathing.

Figure 6.25 For the many disabled persons who do not have a pit latrine in their home, latrine seats can facilitate defecation and enhance personal hygiene in the process. A recent stroke victim uses this chair with a receptacle.

Figure 6.26 The light latrine chair can be easily transported on the rear carrying rack of most tricycles. This is particularly useful for tricycle owners who do not have latrines in their homes.

Aside from their assistive advantages for the disabled, the metal latrine chairs developed during the Study can be fabricated by local metalworkers, and they are comfortable, portable, strong, resilient and degrade little when exposed to water and sun. Their primary disadvantage is their cost, which generally ranges from 4,000 – 10,000 cfa, depending on the type of design and the amount of metal and welding involved. Without some form of assistance this cost is prohibitive for most disabled persons in rural communities of Mali.

WOODEN LATRINE CHAIRS

As with metal container tippers, the Study examined lower-cost options for latrine seat design and fabrication. Local wood-working artisans in the Tominian region used metal latrine seat models to develop lower-cost wooden versions. Various models were developed, tested and improved over a two-year period. *The same 8 guidelines listed above also generally apply to the development of the wooden version of the latrine chair.* These can be produced by local artisans for a cost of about 1,000- 2,500 cfa, depending on the size of the chair and the amount of material used. A standard model which can be used by the majority of disabled persons with lower-body limitations was developed and is referred to as the “Chaise Bagayogo” (figure 6.27). [24] A diagram and recommended dimensions are provided in figures 6.28 and 6.29. This wood design of the latrine chair has the advantages of being low-cost, lightweight and easily portable, and weather resistant. This particular design is also easily usable for either front or rear cleaning (depending on which way the chair is turned), as there are no cross braces above the seat level.

[24] The “Chaise Bagayogo” has gained popular interest and support for its practical use in assisting disabled persons in the Study’s target communities. The chair is named after Mr. Kassoum Bagayogo, World Vision WASH agent working in the Study’s target area, who entertained the original idea of using local wood artisans to develop lower cost assistive devices for disabled persons.

Figure 6.27 Chaise Bagayogo: The standard-sized wooden latrine seat developed by the Study which can be used from either direction, depending on preference for front or rear cleaning. The chair is light, sturdy, locally fabricated and low-cost.

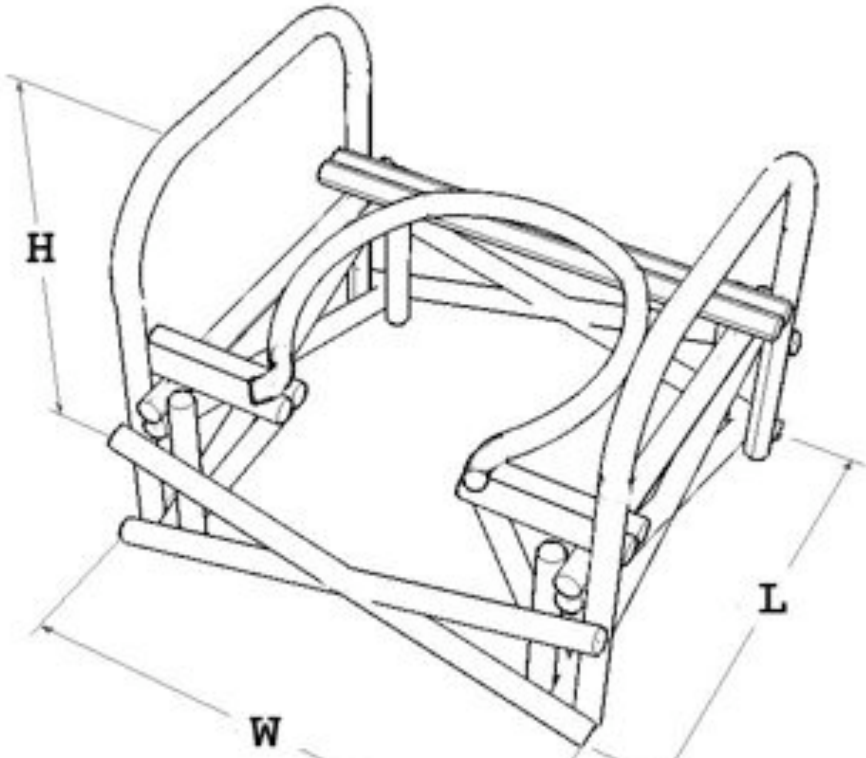


Figure 6.28 Chaise Bagayogo: Design diagram with recommended dimensions. W = 51 cm, L (depth) = 42 cm, H = 40 cm (with 20 cm to the seat level).

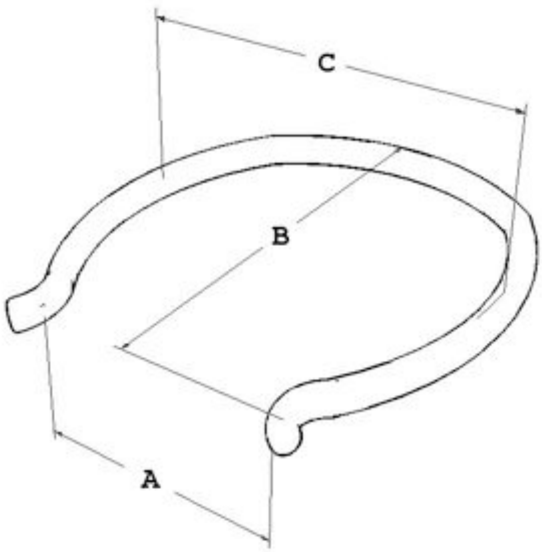


Figure 6.29 Chaise Bagayogo: Recommended dimensions for the chair seat. A = 18 cm, B = 30 cm, C = 25 cm.

Considerations which are specific to the fabrication of this wooden latrine chair are as follows:

Binding: Typical binding used by local artisans is rawhide, which is wetted, bound and then dried for shrinking to form a very tight bind for wooden joints. As with container tippers, chairs made using rawhide must be kept out of the rain, thus preventing storage of the chair in the latrine during the wet season. A more preferable option is the use of thin gauge metal wire to create a more weather resistant binding.

Comfort: Comfort is an important, if not necessary, aspect of appropriate latrine chair design. Wire or rawhide binding used to attach the seat rim to the chair can be uncomfortable when sat upon. This discomfort can be overcome if grooves are first cut in the wood before binding takes place. When the seat is attached to the chair frame, the wire binding can then be embedded in the pre-cut grooves to provide a smoother seat surface. The cut ends of the wood sections which will come in contact with the individual when seated should also be rounded to create smoother and more comfortable edges.

Bracing and support: So as to assure solid support and resilience over time, the chair should be well supported with adequate bracing. Figure 6.28 depicts cross-bracing between the chair legs on three sides, and seat support braces on the fourth side where the seat is opened.

Repairs: Repeated use and long-term exposure to rain and sun can reduce the strength of wire binding over time. Tightening or replacement of the wire binding may need to be done every 2-3 years if the chair is typically stored outside in the open latrine area. The wood, however, should last for several years without needing replacement (figure 6.30).

Figure 6.30 Wooden latrine chairs made with wire binding can be stored in the latrine area for easy access and use.

As with metal latrine chairs, wooden chairs can also be fabricated for a variety of conditions and needs, with variations in both seat and handle height being the most common. On occasion, a disabled client may ask for a seat that is higher or one that is larger or smaller than the standard model described in figure 6.28. Some disabled persons also need an assistive device for walking and will request a chair with higher handles (figures 6.31 and 6.32). Whenever chairs are made with larger dimensions, care needs to be given to the entranceway width of the latrine that will be used — as some chairs may be too wide for convenient entrance to the latrine (figure 6.33).

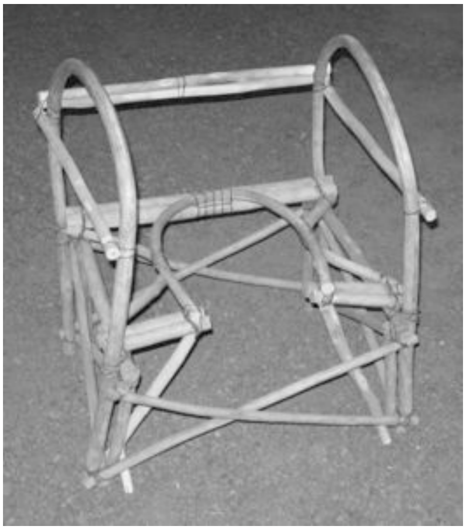


Figure 6.31 Wooden latrine chairs can be made with higher handles to assist with walking short distances. This chair is built for front cleaning and is equipped not only with high handles but also with a raised seat for those who have particular difficulty in lowering and raising themselves from a lower seated position.

Figure 6.32 A wooden seat built for rear cleaning positioned over a sanplat latrine. It is also designed with high handles to assist with walking.

Figure 6.33 Wooden chairs must be built with the size of the latrine entranceway in mind; or latrine entrance ways need to be constructed to accommodate passage by assistive devices. This latrine chair must be lifted above the latrine entranceway.

Many disabled persons, and especially the elderly, are unable or unwilling to leave their home or bedchamber to relieve themselves. In such cases they are obliged to use some type of container in which to capture the human waste. Low-cost wooden seats adapted for use with these containers can serve to greatly facilitate this process (as depicted in figure 6.25 with a metal chair). While smaller containers can easily be used with the standard wooden chair model (figure 6.28), some individuals may prefer larger containers and/or higher seats. In such cases, the cross bracing can be left off of the lower back side of the chair to facilitate placement or removal of the container. Figure 6.34 depicts such a seat with an open back side, and figure 6.35 depicts the chair's use in the bedchamber of a disabled, elderly man.

Figure 6.34 Latrine chairs can be built to easily accommodate receptacles for home-bound users. This chair, designed for front cleaning, is equipped with an open back to facilitate placement and removal of the receptacle.

Figure 6.35 Having lost his sight and leg from diabetes, this elderly, homebound man demonstrates the use of his latrine seat within his bedchamber.

SEATING FOR THE VISUALLY IMPAIRED

Many persons with lower-body limitations may also be visually impaired. Quite frequently, these are elderly people. In such cases these people are in need of a portable latrine chair to assist with squatting, but the challenge of accurate placement of the seat over the latrine can be problematic. In many such cases, these persons must rely on household members' assistance for proper placement of the chair. Otherwise, the individual could use a chair equipped with a sizable container underneath, thus alleviating the need for accuracy in the placement of the chair. WaterAid Mali developed a concrete seat for the blind which can also assist people with these combined disabilities (figures 6.36 and 6.37). This seat can be placed over a sanplat latrine and can be easily located and used by the visually impaired. The seat of about 30-35 cm height is also easily used by those with lower-body limitations. This type of seat is ideally used in cases where the disabled individual is the sole user of the latrine. Since the seat is intended to be placed permanently over the sanplat, other users of the latrine are also compelled to use the seat – requiring major changes of habit by the able–bodied and the risk of having the seat soiled by less enthusiastic or less careful users.

Figure 6.36 A cement latrine seat designed by WaterAid Mali for use by the visually impaired.

Figure 6.37 The mold built by WaterAid for fabricating the cement latrine seat for the visually impaired.

CHAPTER 7 PRACTICAL SUGGESTIONS FOR IMPLEMENTING INCLUSIVE WASH PROGRAMS

7.1 ENGAGING INSTITUTIONS AND COMMUNITIES

The successful implementation of WASH programs that are inclusive of people disabled requires institutions that are *informed* and *committed* to the process. An important aspect of that process are the institutions' ability to engage communities and effect changes in long-held attitudes and perceptions regarding disabled people. But change in perceptions and attitudes does not begin with the target communities; it must begin within the institutions themselves. Only when implementing institutions and their staff are informed and experience their own shift in perceptions, will they be able to effectively do the same for the communities they serve. Effecting change in communities where WASH programs are being implemented requires action that is both intentional and strategic in nature. Listed below are several practical suggestions that will help institutions, and their partner communities, become more effectively engaged in establishing inclusive WASH programs:

1. **Informed and sensitized program staff** – Most NGO staff working in development have only a limited understanding of the extent and special needs of the disabled in the communities their programs serve. Developing a more appreciative understanding and awareness among program staff at the outset is imperative. Inviting disability specialists or related organizations (e.g., Handicap International) to come and brief program staff on the status and needs of the disabled in target areas can be an important first step. Participants should not only be WASH practitioners, but other key program participants, including managers and others in leadership. This should preferably be done at the national level within the institution, and later at regional and local levels. At the local level, field visits to disability-related programs can be a helpful introduction to this area of work for program staff.

2. **Establishing contacts with others directly involved in disability work** – At the regional and local program levels it can be helpful to make contact with clinics, medical personnel, clergy, NGOs, or government entities (e.g., the ministry of social affairs) who are already engaged in some manner or another

with disabled people in the area. These key persons (or offices) can provide a helpful introduction to existing disability initiatives.

3. **Establishing local contact with disability groups** – Within target communities, WASH program staff should seek out contact with local "associations" of disabled persons. Such associations (formal or informal) often exist in towns with populations of 1,500 or more. Cultivating direct exposure of program staff to groups of disabled persons is very important. Staff should be encouraged to participate in some of the group gatherings and become acquainted with their leaders.

4. **Assessing disability and WASH-related needs in the community** – Within smaller communities (or neighborhoods) where there will be direct WASH-related intervention, the program should take the time to conduct a simple (if not informal) assessment of disability (assessing existing organizations/associations, present or past initiatives, approximate number of disabled adults and children in the area, and existing WASH practices among them, etc.). Establishing a time and venue to meet with disabled members of the community will always draw some people the first time. But rarely will the first assembly comprise the majority of disabled people in the community. In time, however, disabled persons (and their families) will begin to understand that the WASH program is serious about wishing to engage participation from disabled community members. As this happens, the number of disabled persons who participate will usually grow significantly.

5. **Promoting inclusive practices** – At the community level, WASH programs need to articulate from the beginning their wishes and intention of assuring inclusion of disabled persons. If there are to be planning or organizational committees with community representation, then someone representing disabled persons should be included. For example, if there is community participation in the selection of the site for a borehole and pump, then the disabled should also have a voice in the matter. This also holds true for training and long-term management of WASH facilities. If a water- or pump-management committee is to be trained and put in place, then it is strategic that someone from among the disabled be represented on this committee on a permanent basis – especially if it is a community of 500- 1,000 or more. As the WASH program nurtures and promotes the community management of

WASH facilities, it should also nurture the development of inclusive rules and bylaws that enhance access to WASH facilities by the disabled. For example, a water management committee charged with overseeing the operation of a recently installed hand-pump, may adopt and implement the practice of allowing disabled persons to move to the front of queues at hand-pumps. Promoting community practices which aid the disabled in such ways can also serve to change attitudes and perceptions long held by the community.

6. **Promoting exchange and giving disabled persons a voice in the community** – WASH programs should also take the lead in facilitating exchanges between disabled community members and community leaders – exchanges which often do not take place on their own. This helps to give the disabled a voice in their communities and it sends a strong message that the WASH program values the input and contribution of the disabled – again, serving as a catalyst for changing perceptions and attitudes within the community.

7.2 LOCAL DEVELOPMENT AND TRANSFER OF ASSISTIVE TECHNOLOGIES

The "physical" nature of many disabilities necessarily requires "physical" enhancements in a disabled person's environment if they are to be fully "included" and participants in that environment. Such is the case with water and sanitation facilities. Not only must perceptions and attitudes in the community, *and in the implementing agency*, be altered for WASH programs to be truly inclusive, but appropriate and assistive technologies must also be part of the package. For many WASH practitioners, technology development may not be their area of expertise. Fewer still, will have a depth of expertise in both technology and the social sciences; and developing assistive technological enhancements, which must also be appropriate to the culture and habits of users, may be very new and unfamiliar terrain. What is certain is that a) it will take time for the process to be effective, and b) the process can be greatly facilitated through the establishment of a learning culture and environment within the program, as was emphasized in the previous section. The following practical guidelines will help to create such an environment where technologies (and technological enhancements) can be developed and used to create WASH facilities that are inclusive of disabled members of the program's target communities.

1. **Pump superstructure builders** – If the WASH program engages a building contractor or entrepreneur to construct its pump superstructures, then time should be taken to review with them (preferably before a contract is signed) the importance the program places on assuring inclusive environments. These contractors must clearly understand that this is a priority aspect of the program. Reviewing photos and diagrams of appropriate structures can be helpful. If possible, taking them to visit appropriately constructed superstructures in other regions can be especially helpful. If such a visit is organized, then arranging for contractor personnel to meet with disabled community members who have been benefiting from these enhanced superstructures can further serve to facilitate their understanding of the important nature of this type of work. In communities where the contractor is to build, it is also helpful for one or two representatives from among the disabled in the community to be introduced to contractor personnel, and for conferral and exchange to be encouraged during the construction process.

2. **Metalworkers** – When a WASH program seeks out a local metalworker (menuisier) to assist in developing and fabricating assistive technologies (e.g., latrine seats, bucket tippers, etc.), time should be taken to assess his appropriateness for the task. Does he have a genuine interest in more than just gaining from a contract with the WASH program? Is he innovative? Does he relate well with local clients? Is he inquisitive? Does he take the time to ask questions about clients' preferences, etc.? The choice of individual is important to the success of this aspect of the program. If possible, a few hours should be taken with the metalworker in the presence of several disabled members of the community to talk about technological innovation for the disabled. This will help WASH program staff to assess how well he communicates, listens and interacts with disabled people. At the same time, a careful assessment of the availability of local material for the proposed task is also important. Many materials are more available than others, and this may vary from region to region. Once selected, it is important to allocate resources from the WASH program budget, so the metalworker can become sufficiently adept and practiced in fabricating assistive devices. This process can easily

take 6 months to a year or more, depending on the types of devices he produces and the materials he has to work with (figure 7.1).

Figure 7.1 A metalworker in Tominan, Mali trains his assistants in aspects of plastic welding, metal container tipper fabrication and the placement of metal pivot sheaths in wooden container tippers. Provision of resources to assist artisans to develop prototypes and to become proficient in fabrication processes of assistive devices can be an important aspect of WASH programs seeking to make such technologies available in local markets.

3. **Wood workers/artisans** – As with the metalworker, the same type of assessment should be made in the search for local wood artisans who can assist with developing low-cost, wood versions of these assistive technologies. It should be remembered that these are not "carpenters", but traditional wood workers with indigenous experience in developing local household items (e.g., chairs, tables, stools, beds, etc.) from local resources. Local material, which is used in their craft, should also be examined carefully. The type and the treatment of local wood products may vary greatly from region to region. Selected wood artisans will need to be innovative in reproducing assistive technologies with local products that may have very different properties from the products used in the original technologies. For example, wooden latrine chairs in the Tominian area of Mali were made using a traditional process of steamed, bent branches cut while still green from the forest (e.g., figure 6.27). In eastern Niger, such branches are not available – only the straight, unbendable sections of palm branches which are traditionally used to fabricate local furniture. Artisans in Niger attempted to replicate the latrine chair from Mali (figure 6.27) using only these straight sections of palm branch. The result is seen in figure 7.2. This is a reasonably functional model as a first prototype, and with continued innovation and

refinement a fully functional model could be developed for diffusion and use among disabled persons in eastern Niger.

Figure 7.2 Raw material and local craftsmanship may vary from region to region in West Africa. Local artisans in the Zinder area of Niger developed this initial latrine seat prototype using dried palm branches and wire.

4. **Assistive technologies and cultural practices** – WASH program staff need to be aware of, and sensitive to, cultural practices and habits which may be related to aspects of assistive technology development and transfer. Such practices and habits can vary widely between regions. For example, some ethnic groups place high value on personal hygiene, while other groups do not. The perceived need for technologies which can assist disabled persons to enhance hygiene may therefore be viewed differently among different groups. As mentioned earlier in this report, a traditional custom among the Dogon is the use of canes by elderly men. For elderly men who are disabled, the cane is often used as an assistive device for locating latrines and for squatting. In such cases, new assistive devices for locating latrine holes or for squatting may not be as necessary as in areas where cane use is not customary. In many parts of Niger, the use of wooden shoulder yokes are common for carrying multiple water containers (see figure 5.28) and can be used by some disabled persons to facilitate water transport. However, the practice is not customary in parts of south-central Mali, and an attempt to introduce this practice as an assistive means of transport for the disabled could be rejected (at least initially) for cultural reasons. Inadvertent assumptions about practices in one region, based on assumptions practiced in another, can result in low adoption rates of some developed technologies and/or WASH-related practices. An in-depth understanding of these types of cultural preferences and practices by WASH practitioners is therefore needed if effective technology adaptation or transfer is to take place.

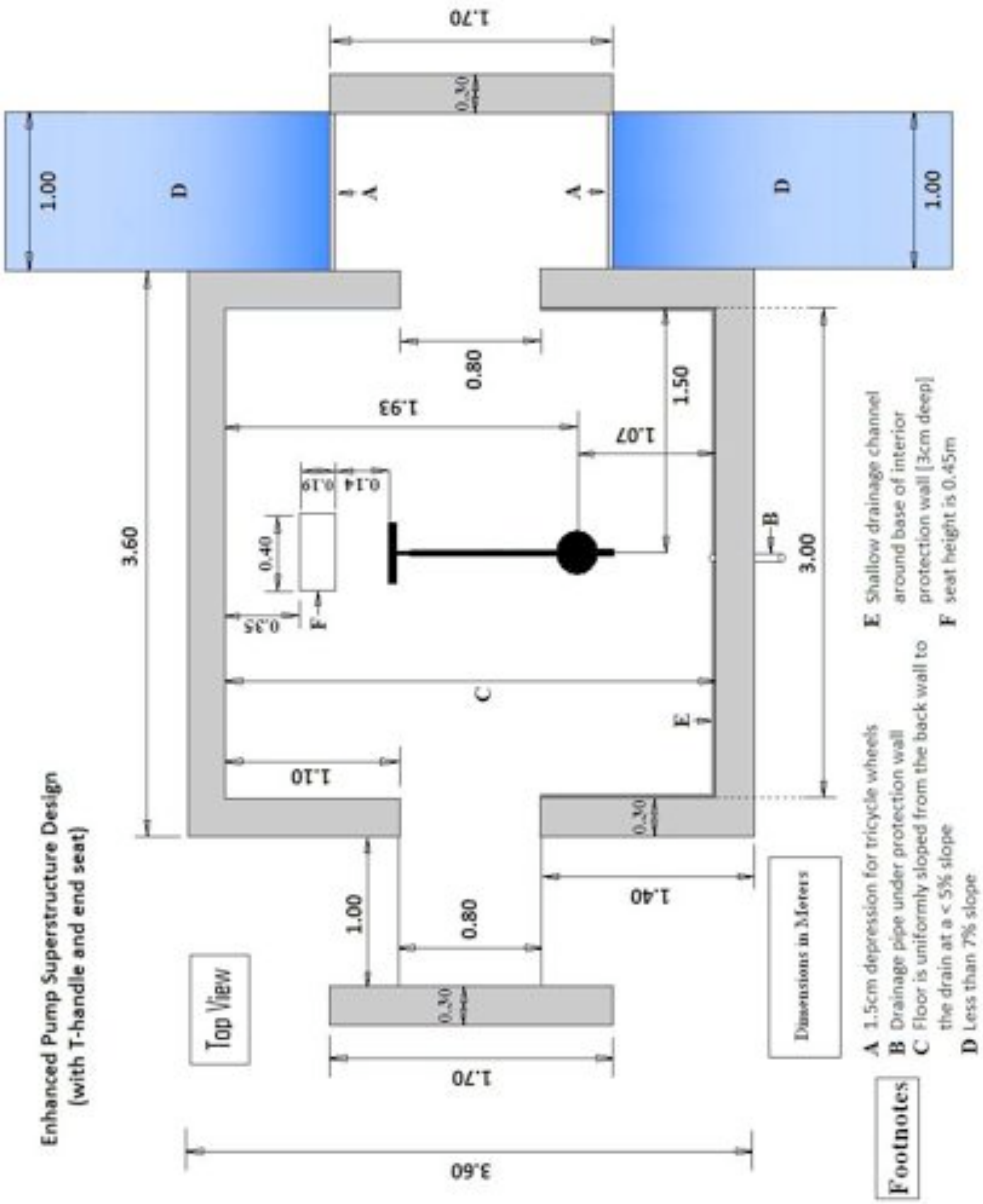
5. **Facilitating exchange** – WASH programs can play a key role in facilitating needed exchange among the key groups that should be involved in the local development and transfer of assistive technologies. Time and resources for these exchanges should be built into WASH program strategy and budgets. As artisans begin to explore the development of assistive technologies, exchanges between them and disabled members of the community need to be facilitated on a regular basis. These exchanges can be very fruitful and play an important role in developing technologies that will be readily adopted by potential users. The exchanges provide the artisans direct, first-hand feedback on preferences and constraints faced by the disabled, as well as suggestions for improving early prototypes (figure 7.3). It can also serve to accelerate the timeframe for making such technologies available in the public market place. Exchanges are also needed between artisans. This provides them the important opportunity to compare experiences and share insights they have learned as they have developed their respective prototypes (figure 7.4). It is often assumed that these types of exchanges may happen naturally over time, but in reality, distances, time and costs usually preclude this happening. WASH programs will do well to be intentional about facilitating and financing such exchange, as the costs are relatively low and the benefits high.

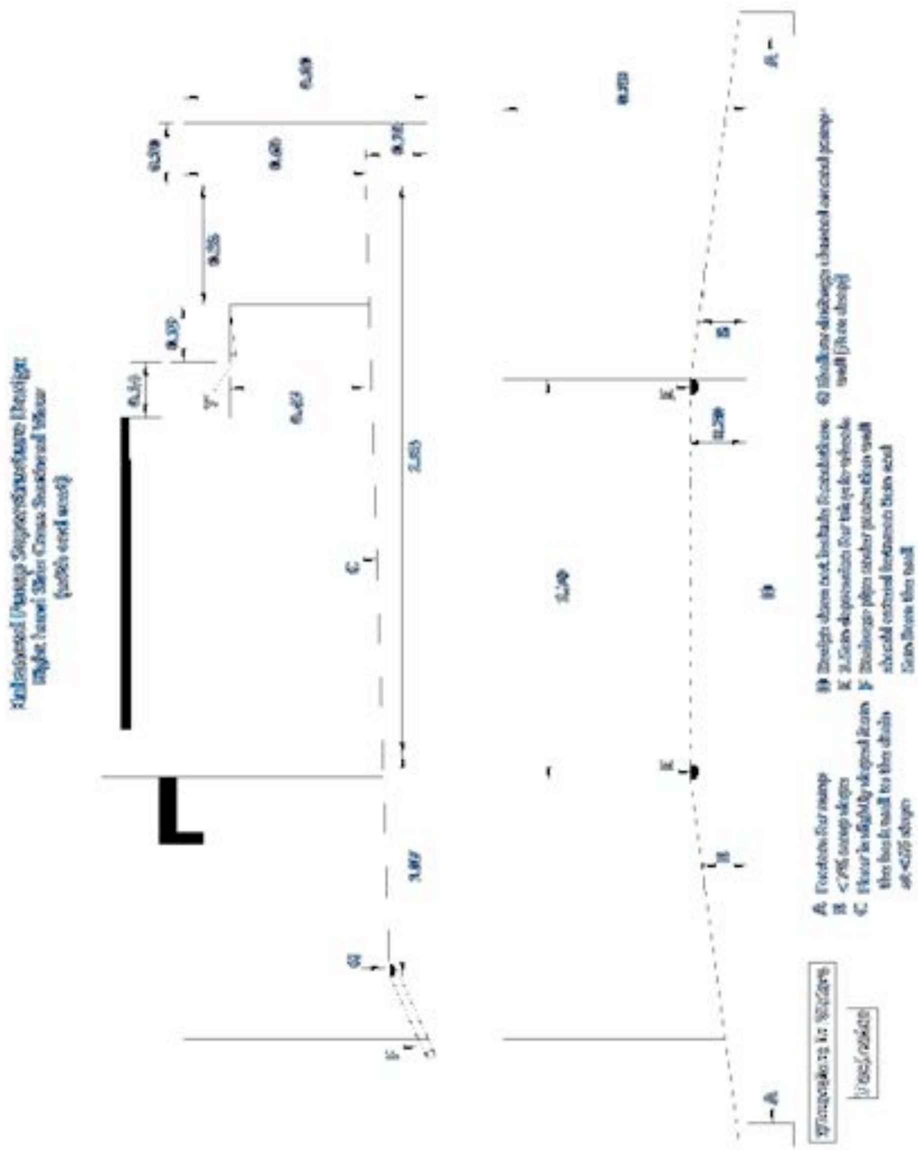
Figure 7.3 A range of latrine seats and container tippers are presented at a day-long meeting between a local "association of handicapped persons", local artisans, and Study staff. The purpose of such meetings is to encourage and facilitate the exchange of ideas between disabled clients and those fabricating assistive devices locally.

Figure 7.4 A wood artisan and metalworker from the Tominian area in Mali confer on aspects of fabricating both metal and wooden versions of a bucket tipper.

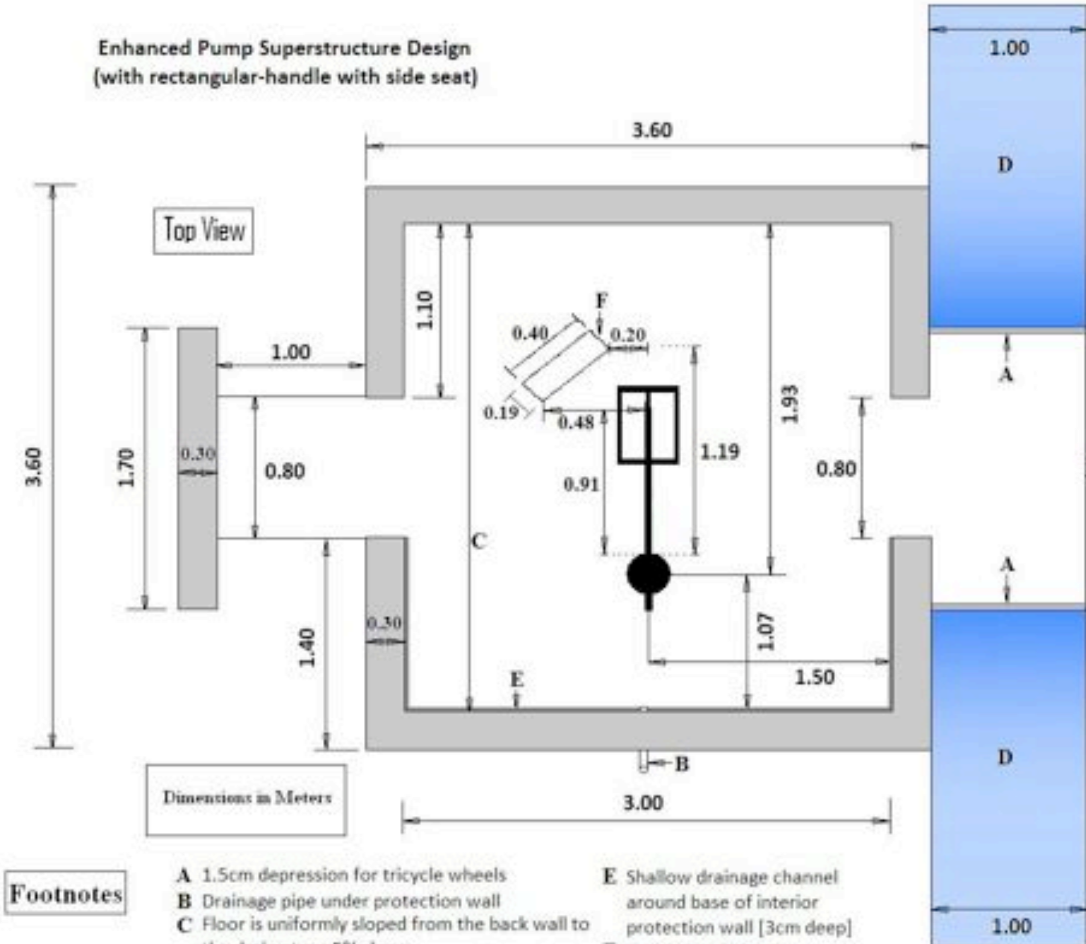
APPENDICES

APPENDIX 1 PUMP SUPERSTRUCTURE





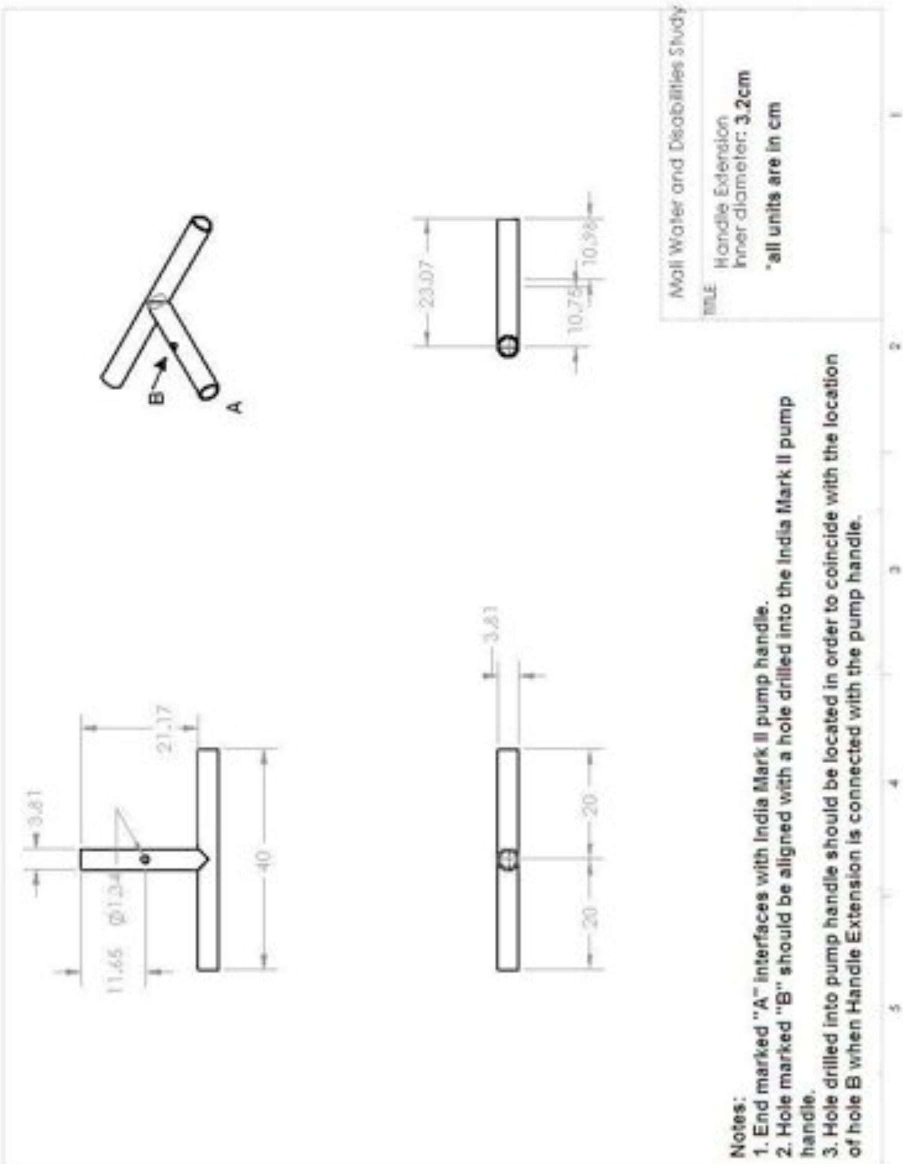
Enhanced Pump Superstructure Design
(with rectangular-handle with side seat)



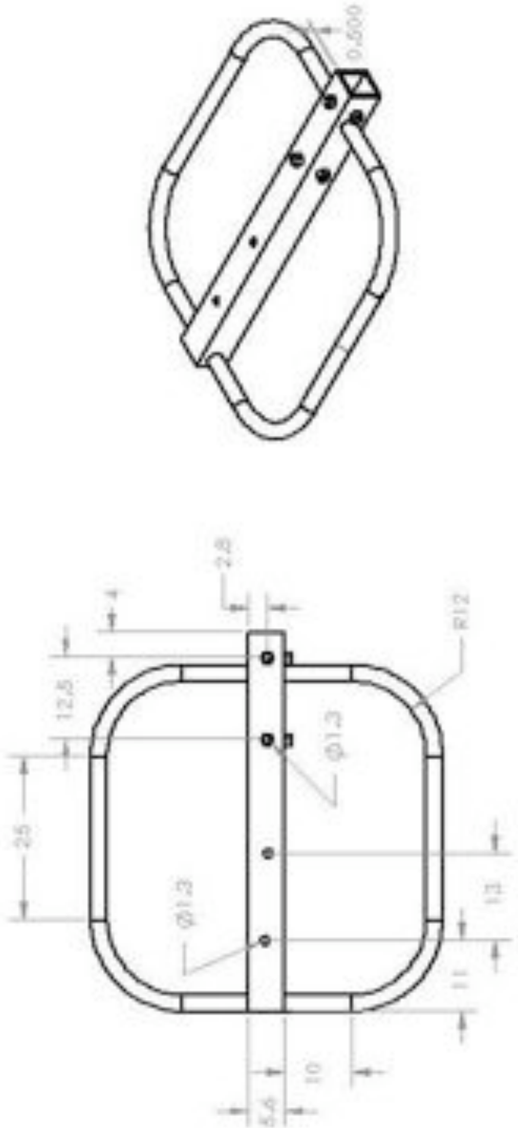
Footnotes

A 1.5cm depression for tricycle wheels
B Drainage pipe under protection wall
C Floor is uniformly sloped from the back wall to the drain at a < 5% slope
D Less than 7% ramp slope
E Shallow drainage channel around base of interior protection wall [3cm deep]
F seat height is 0.45m

APPENDIX 2 T-HANDLE PUMP ATTACHMENT



APPENDIX 3 RECTANGLE-HANDLE PUMP ATTACHMENT

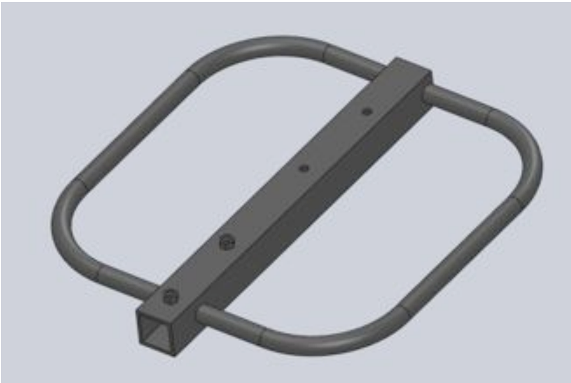


Rectangular Pump Handle Extension for the India Mark II Water Pump

Notes:
All units are in centimeters
The inner diameter of the round tubing is 2.4cm, with a wall thickness of approx. 0.25 cm
The square tubing is 5.6 cm square, with wall thickness of 0.5 cm.
The end of the handle with the nuts on it interfaces with the India Mark II pump.

See "Manufacturing Process" for additional notes.

Manufacturing Process for “Rectangle” India Mark II pump handle extension



Parts:

Part A: Center

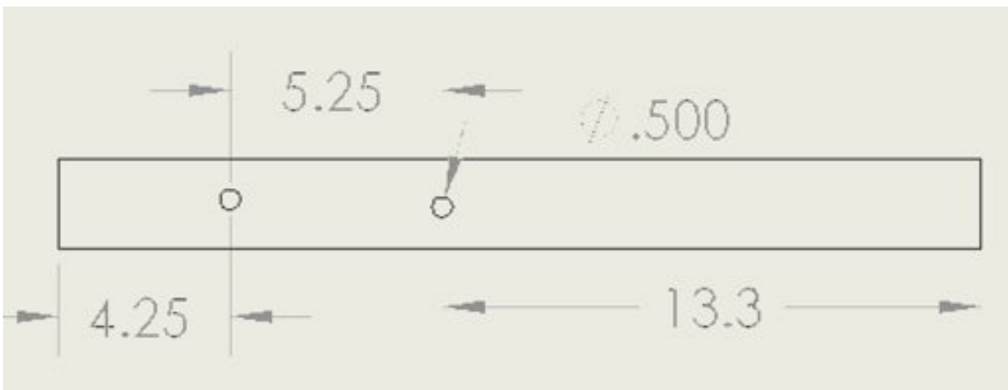
Part B: Side 1

Part C: Side 2

To make Part A

Materials:
1 piece of square tubing, between 5.5 and 6 cm inner diameter (allows for differences in dimensions of India Mark II pump handle), wall thickness should be 0.5 cm.
4 metric hex nuts, M12 -1.75

Procedure:
Cut the tubing to 58 cm long
Choose one side of the piece of tubing. Call this the "**top**". Call the opposing side of the tubing the "**bottom**".
Choose one of the remaining sides of the piece of tubing. Call this "**side 1**". Call the opposing side of the tubing "**side 2**".
You now have the four sides of the tubing labeled **top**, **bottom**, **side 1**, and **side 2**.
Turn the tubing so that **top** is facing up.
Drill two 1.3 cm holes in the tubing, all the way through both sides (**top** and **bottom**), as shown in the figure below.
The holes should be about 5.25 cm apart and about 11 cm from one end of the tubing.
These will be called **hole 1** and **hole 2**.

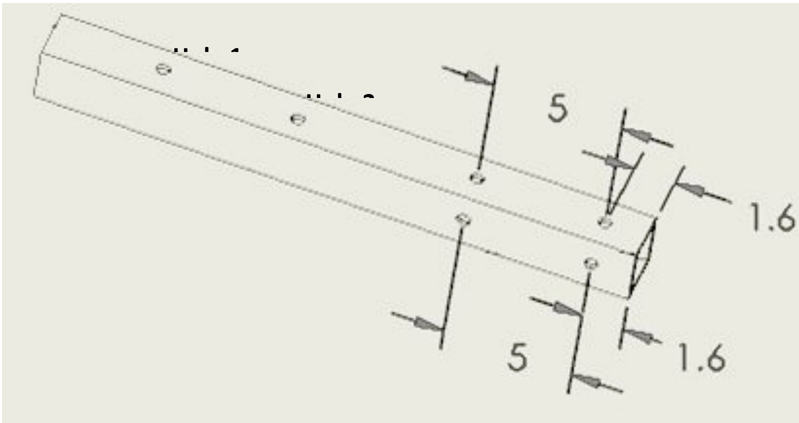


Drawing with dimensions for making Part A, Center.

Now drill two more 1.3 cm holes in the tubing that only go through **top**. Do **NOT** drill through the side called **bottom**. The holes should be about 12.5 cm apart and about 4 cm from the other end of the tubing, as shown in the figure below.
These will be called **hole 3** and **hole 4**.

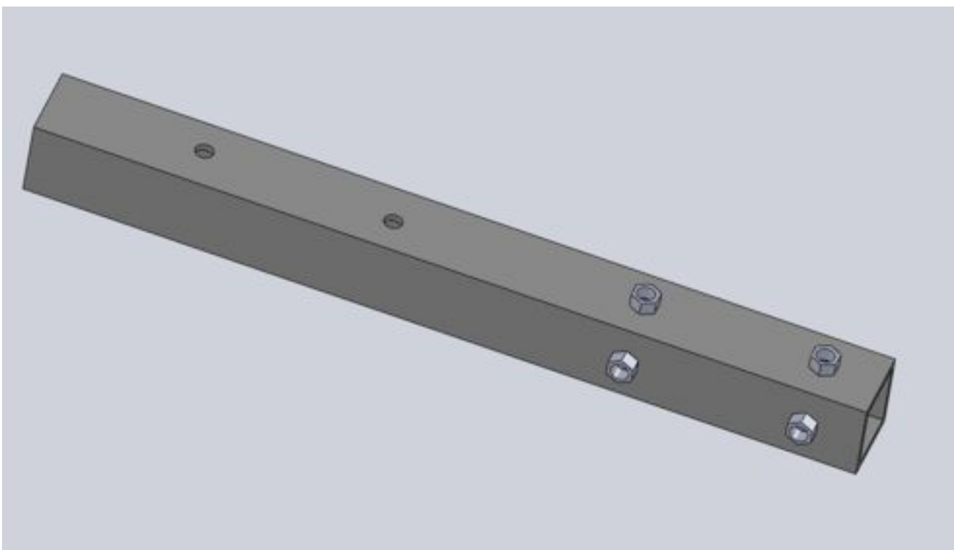
Now turn the piece of tubing so that **side 1** is facing up.

Drill two 1.3 cm holes in the tubing that only go through **side 1**. Do NOT drill through **side 2**.
The two 1.3 cm holes should look identical to **hole 3** and **hole 4**, only on **side 1** instead of on **top**.
These will be called **hole 5** and **hole 6**.



Drawing with dimensions of Part A, with holes 3, 4, 5, and 6 added

Now, take the 4 metric hex nuts, M12-1.75, and weld one each on top of **hole 3, hole 4, hole 5,** and **hole 6**.
The final part, Center, should look like the figure below.



Drawing of Part A, Center

<u>**To make Part B**</u>

Materials:
1 piece of round tubing, 2.4 cm inner diameter*, approximately 90 cm long

*the wall thickness of the tubing should be determined by the manufacturer. Increased thickness will make manufacturing more difficult, but will increase durability.

Procedure:
Measure 10 cm from one end of the tubing. This is point A
Starting from point A, use a tube bender to bend the tube in to a 90 degree arc, with a 12 cm radius.
Locate the end of the bend. This is point B.
From point B, measure 25 cm. This is point C.
Starting from point C, use a tube bender to bend the tube into a 90 degree arc, with a 12 cm radius.
Locate the end of the bend. This is point D.
From point D, measure 10 cm. This is point E.

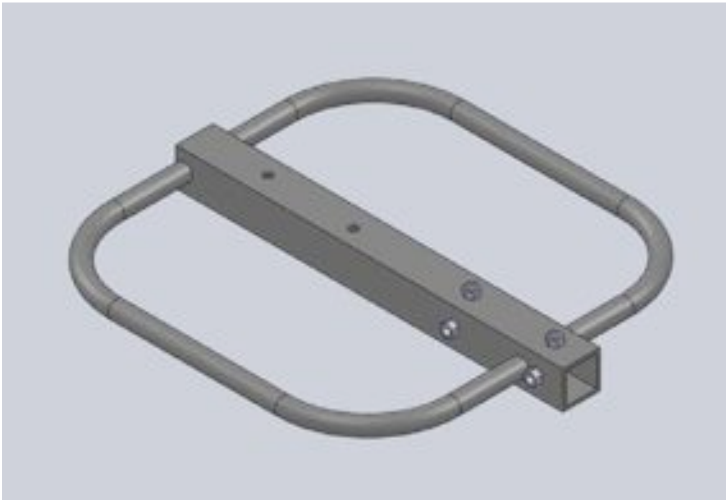
The tubing should now form a complete “U” shape, with the two ends parallel to each other.
Cut off the end with extra material at point E.
See figure below.

<u>To make Part C</u>

Repeat the procedure for making **Part B**.

<u>To assemble the Pump Handle Extension</u>

Weld parts **B** and **C** to part **A**, as shown below.



Drawing of the assembled handle extension

<u>To implement “Oval” pump handle extension on India Mark II pump</u>

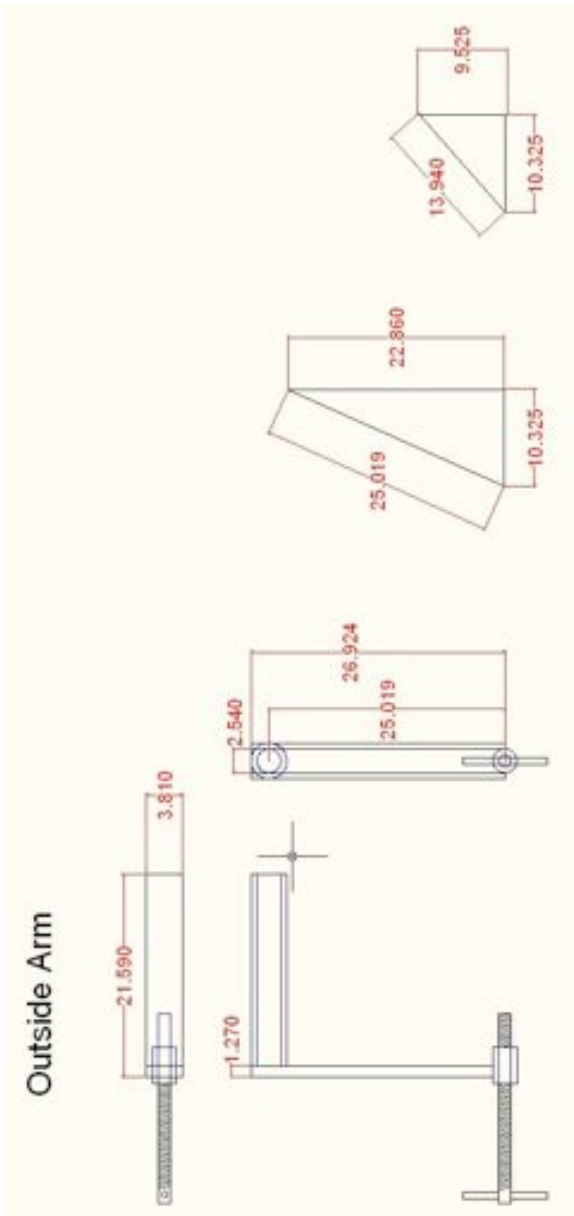
Materials:
6 metric M12-1.75 bolts
6 metric M12-1.75 hex nuts

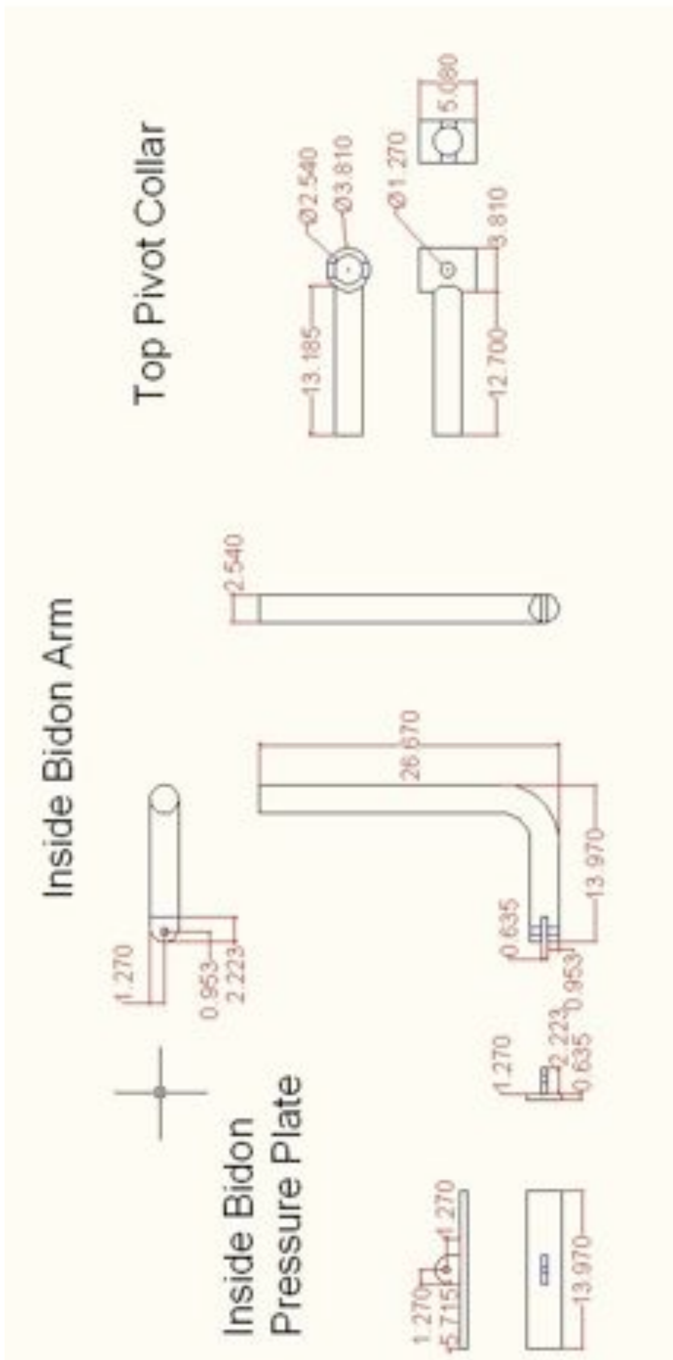
Procedure:
Slide pump handle extension onto pump handle, with **hole 1** and **hole 2** further away from the pump base.
Insert a 1.27cm diameter bolt through **hole 1**, through the India Mark II pump handle, and out the other side of the handle extension.*
Fasten the bolt with a nut.
Repeat with **hole 2**.

*It may be necessary to drill through the India Mark II pump handle, in order to implement the bolts that pass through **hole 1** and **hole 2**.

Screw a metric M12 -1.75 hex nut onto each of the remaining 4 bolts.
Screw one bolt (with the hex nut on it) into each of **hole 3, 4, 5** and **6**.
You should screw down the 4 bolts until they force the handle extension to fit snuggly on to the India Mark II pump handle.
They should force the pump handle against two of the sides of the pump handle extension.

APPENDIX 4 PLASTIC WELDING PRESSURE CLAMP




Top Pivot Collar
13.185
Ø2.540
Ø3.810
Ø1.270
5.080
12.700
3.810
Inside Bidon Arm
2.540
26.670
13.970
0.635
0.953
1.270
0.953
2.223
Inside Bidon
Pressure Plate
1.270
2.223
0.635
1.270
5.715
1.270
13.970

RESOURCES

FOR MORE INFORMATION ON THE MALI WATER AND DISABILITIES STUDY

1. For general information on programmatic and conceptual matters related to the Study, inquiries can be sent to:

   The Collaboratory for Strategic Partnerships and Applied Research
   Messiah College
   Box 3034
   One College Avenue
   Grantham, PA 17027, U.S.A.
   Telephone: (1) 717 796 1800, extension 7226
   e-mail: Collaboratory@ messiah.edu
   Web site: http://www.messiah.edu/collaboratory

2. For general information related to the target area of the Study, inquiries can be sent to:

   World Vision Base Tominian
   B.P. 03, Tominian
   Mali
   Telephone: (223) 21 37 50 22/23

3. For more detailed information or assistance on the fabrication of pump handle accessories, metal bucket tippers, pivot hinges for wooden tippers, plastic welding for bidon handles, and metal latrine seats, inquiries can be sent to:

   Mr. Levi KEITA, menuisier
   s/c World Vision Base Tominan
   Cell: (223) 66 90 32 44
   Note: Mr. Levi collaborated with the Study as its principal metalworker/menuisier.

4. For information related to the local fabrication of wooden latrine seats or tippers inquiries can be sent to:

   World Vision Base Tominian, or

   The Sisters of the Annunciation at Mandiakuy
   B.P. 48, San
   Mali
   Telephone: (223) 21 37 51 61

Note: The Study utilized the assistance of traditional wood working artisans in the village of Dobwo in the Tominan Circle to fabricate wooden latrine seats and tippers. Mr. Zephyrin Diarra , traditional artisan, was the Study's principal collaborator in Dobwo. He can be contacted through either of the above sources.

OTHER USEFUL RESOURCES AND PUBLICATIONS

1. Handicap International Mali implemented the formal survey portion of the Study. A published report on the initial survey results is available from their office in Bamako.

   Handicap International
   Trokorobougou SEMA Rue 306 - Porte 1045
   BP E2299, Bamako
   Mali
   Tel: (223) 292 13 51 or (223) 292 11
   Email: directeur@handicapmali.org
   Document title: **"Study on Access to Water, Hygiene and Sanitation for People in a Disabling Situation in Mali – Data Analysis"**

2. WaterAid Mali has conducted some important work with the visually impaired at their field site near Tienfala, Mali. WaterAid can be contacted at the following address.

WaterAid
ACI 2000 Hamdallaye
BP. 97, Bamako
Mali
Tel: 223-229-5450
Fax: 223-229-5451
Email: mali@wateraid.org

3. In 2005 the Water, Engineering and Development Center (WEDC), at Loughborough University in the UK, published: **“Water and Sanitation for Disabled People”**, by Hazel Jones and Bob Reed. This is a very useful and practical text which incorporates examples and case studies from around the word. The document can be obtained from WEDC at: *wedc.lboro.ac.uk*

Water, Sanitation and Disability in Rural West Africa

Enhancing Access and Use of WASH Facilities

A Summary Report of the Mali Water and Disabilities Study

March 2010

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