Water Hand Pump Spare Parts and Maintenance Supply Chain Analysis

Democratic Republic of Congo

Final Report

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Concern Worldwide for the WASH Consortium DRC

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1. List of Acronyms

ACF	*Action Contre La Faim*
ACTED	*l'Agence d'Aide à la Coopération Technique et au Développement*
CDF	Congolese Franc
DFID	Department for International Development
DRC	Democratic Republic of Congo
GNI	Gross National Income
HH	Household
INGO	International Non-governmental Organization
LBB	Lubumbashi
MSP	Maintenance Service Provider
RWSN	Rural Water Supply Network
SNHR	*Service National d'Hydraulique Rurale*
UNEP	United Nations Environment Programme
UNDP	United Nations Development Programme
UNICEF	United Nations
WMC	Water Management Committee
WSP	Water and Sanitation Program
ZdS	*Zone de Santé*

2. Executive Summary

Although sustainability challenges of hand pumps has been well documented (Carter, et al 2010, RWSN 2009), hand pumps remain a preferred rural water solution for many international non-governmental organizations (INGOs) and UN agencies. In 2009, the Rural Water Supply Network surveyed hand pump utilization and functionality across Sub-Saharan Africa. Of the 350,000 hand pumps identified across twenty countries, roughly 36% were not functioning at the time of the survey. The DRC had the highest rate of non-functioning pumps, with 67% of hand pumps reported as non-operational by the 2009 survey (see Figure 9). Community operated and managed hand pump systems, however, remain a preferred technology for many INGOs targeting remote rural areas. With millions of dollars of continued hand pump investment, understanding the causes of hand pump system poor performance is essential to achieve improved sustainability and expected return on donor investments (value for money). Several factors contribute to the poor performance of community-managed hand pump systems, including poor quality of hand pump hardware, inadequate engineering of wells, inability of rural water management committees to operate, maintain, and repair hand pumps, and the quality and availability of spare parts (Carter et al 2010). In a 2013 survey of water service practitioners in government, INGOs, private sector and other development partners, RWSN found that parts failure was the primary cause of hand pump poor performance (Figure 10). This in and of itself is not surprising. However, the opinion that inadequate maintenance was the second-most important cause of hand pump failure is more interesting, and certainly contributes to a high rate of parts failure. Hand pump parts and components will inevitably fail over time. How water management committees and NGOs plan, prepare, and manage for necessary maintenance and spare parts replacement, however, determines whether hand pump systems are sustainable in the medium and long term.

Hand Pump Spare Parts Supply Chain in the DRC

AO met with WASH DRC stakeholders to present the objectives of this study and to receive feedback on initial hypotheses and the research plan. While stakeholders confirmed that the inability of water management committees to collect sufficient user fees and a dearth of trained mechanics/technicians are important challenges to sustainability, stakeholders ranked access to spare parts as the most important hand pump sustainability challenge in the DRC. A recent UNICEF study researching the spare parts supply chain in Eastern DRC (Orientale, Sud Kivu and Maniema provinces) similarly concluded that no supply chain exists in three of five regions studied, with the other two regions only being served by cross-border suppliers in Uganda.[1] Interviews with water management committees (WMCs) during survey instrument testing in Bandundu province (Popokabaka) further indicated that WMCs had no knowledge of where to obtain spare parts apart from their NGO partners, and no hand pump or spare parts suppliers were identified in Popokabaka city. In Kalemie and Mbulula, WMC interviews also indicated that NGO knowledge of suppliers was not being effectively communicated to WMC partners.

[1] *Supply chain analysis of hand pumps and spare parts in Eastern Democratic Republic of Congo*, A-Aqua for UNICEF, May 2014.

In order to confirm the hypothesis that no spare parts supply chain exists in the DRC, AO consultants began a market-canvassing exercise in major DRC population centers including Kinshasa, Lubumbashi, and Goma. Market canvassing involves 'store-to-store' research in relevant supply clusters such as construction materials to identify spare parts suppliers that may be operating below the NGO radar. Simultaneously, AO consultants began a similar exercise in secondary market centers such as Manono, and subsequently in Kalemie, Bukavu, Lodja, and Impfondo (supplying Equateur province) to investigate possible trade corridor nodes. The rationale of this approach was to investigate existing trade corridors in the South (Lubumbashi), East (Goma and Bukavu), West (Kinshasa), and Northwest (Impfondo). The counter-factual was that if spare parts suppliers exist, they must be importing from established cross-border trading centers.

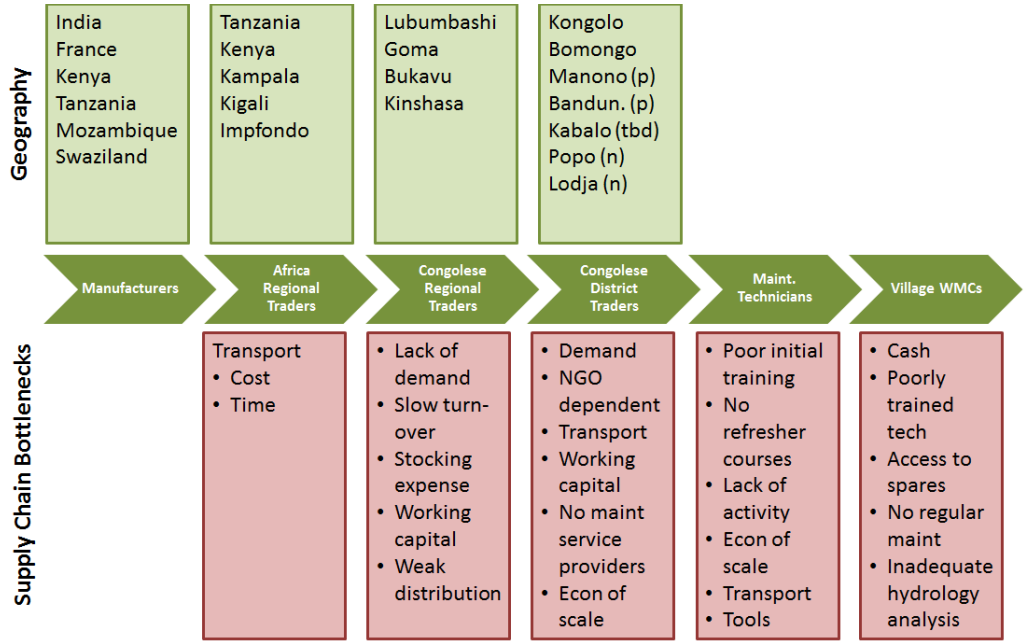
The result of this exercise was the identification of **twelve active spare parts suppliers, seven intermittent suppliers, four past suppliers** willing to stock again, and three suppliers with interest to enter the hand pump supply parts business. The four past suppliers were previously stocking spare parts to fulfill existing NGO procurement contracts and to supply expected follow-on contracts that did not ultimately materialize. These suppliers stated that a signed-contract was not required to re-engage in stocking, but merely the communication of likely procurement requirements by NGOs for the upcoming quarter would be enough for them to begin stocking again. The suppliers interested in stocking spare parts are hardware suppliers who have knowledge of where to procure hand pumps and spare parts, but currently do not stock because of the perception of slow turn-over and uncertain demand (both from WMCs and INGOs).

Hand pump and spare part manufacturers are located in India, France, Kenya, Swaziland, and Mozambique (see Figure 1 for geographic detail for each value chain actor), but most INGOs are purchasing both hand pumps and spare parts directly from manufacturers in India (green arrow). WMCs are almost exclusively supplied by INGOs either through initial spare part stocks that are typically depleted within two years, or through post-construction spare parts provision. The heavy reliance of WMCs on INGOs for spare parts is not sustainable and is hindering the organic development of the spare parts supply chain (see Section 5.5). Despite hypotheses to the contrary, however, an underdeveloped but functioning spare parts supply chain does exist in the DRC. Large provincial suppliers such as Africa Business (Lubumbashi), Bon Berger (Goma), and JP Lwarhoga Lipadi (Bukavu), are purchasing spare parts from regional traders in Nairobi, Tanzania, and to a lesser degree Swaziland. The procurement of spare parts via regional traders adds additional transportation and margin costs that render local supply uncompetitive (see Section 5.6). Provincial supplier direct procurement from manufacturers would decrease their cost-basis, increase competitiveness, and generate sufficient margins to motivate increased stock levels, linkages which should be facilitated by INGOS.

A key conclusion of this study is that the spare parts market in the DRC suffers from a "NGO-induced demand-side market failure". The natural development of a private sector spare parts supply chain has been constrained due to the heavy reliance of WMCs on NGO-procured and supplied spare parts, and the direct purchase of hand pumps and spare parts from manufacturers outside of the DRC or even Africa. Low turn-

over of spare parts makes it difficult for suppliers to stock spare parts, as most are reluctant to tie-up working capital in items that they will not sell relatively quickly.

Figure 1: Summary of spare parts supply chain bottlenecks in the DRC



Other key constraints to a well-functioning spare parts supply chain include:

- **High cost of transport** between regional spare parts traders in Dar Es Salaam, Nairobi, and other locations to major DRC trade hubs (Lumbubashi, Goma, etc.).
- **Long transport times** from African regional traders to DRC suppliers.
- Real and perceived **lack of demand** for spare parts (part of the NGO-induced demand-side market failure).
- **Slow-turn over** and **high-stocking costs** constrain the volume of spare parts stocked by DRC suppliers.
- In some cases, a **lack of working capital** also constrains stocking rates.
- A **poor internal distribution network** leads to a concentration of spare parts in major DRC trading hubs, but virtually no access to spare parts in interior locations.
- **Poor road network** increases deliver times and transport costs.
- A **lack of private maintenance service providers** constrains demand for spare parts.
- A **lack of economies of scale**, caused in part by long distances between hand pump water points, increases cost and reduces profitability of would-be maintenance service providers.
- **Low technical capacity** of Water Management Committees (WMC) and maintenance service providers reduces spare parts demand, as these actors remain dependent upon NGOs for problem diagnostics and spare parts provision. **Low quality of initial training** of pump technicians (no hands-on training, for example) limits capacity, and **technical refresher courses are not adequately supplied**.
- The **lack of regular maintenance** of hand pumps leads to a classic "build and fail" syndrome, whereby deferred maintenance leads to catastrophic system failure requiring higher repair costs than if regular preventative maintenance had been conducted.

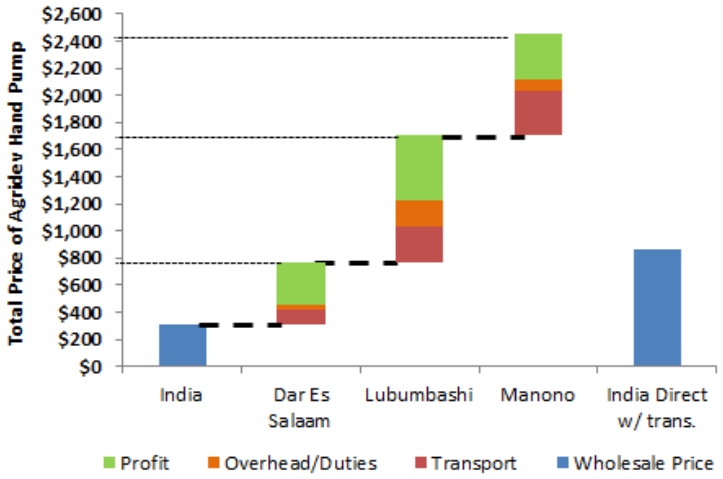
- Many NGOs are **not conducting adequate hydrology and/or geologic analyses** to determine optimal well locations and to determine flow rates during the dry-season. This has led to 20% of new hand pump water points not functioning properly from their inception in Katanga.

Cost-benefit of Local Procurement

Direct procurement of hand pumps and spare parts by INGOs is in part driven by the high cost of local procurement under the current market structure. Figure 2 details cost components of retail prices at various points along the hand pump supply chain from India to Manono town in Katanga province. Costs are broken down into: cost of goods sold (manufacturer price plus intermediate supplier costs), transportation, overhead and duties, and profit. The $1,702 price for an Afridev hand pump in Lubumbashi is based upon actual prices from Africa Business. Other cost components are estimated based upon conversations with suppliers and interpolation, with the exception of Lubumbashi (LBB) to Manono transport costs, which are based upon actual costs as of July 2014. If an INGO operating in Manono were to procure an Afridev hand pump from a local trader, it would pay approximately $2,450 given current the current market structure and volume levels. This compares to a total cost of $859 (including interior transport) if the INGO were to purchase hand pumps directly from the manufacturer in India (based upon an actual recent procurement). Despite the economic development benefits of local procurement, the INGO would have a difficult time justifying the higher cost of local procurement to its donor.

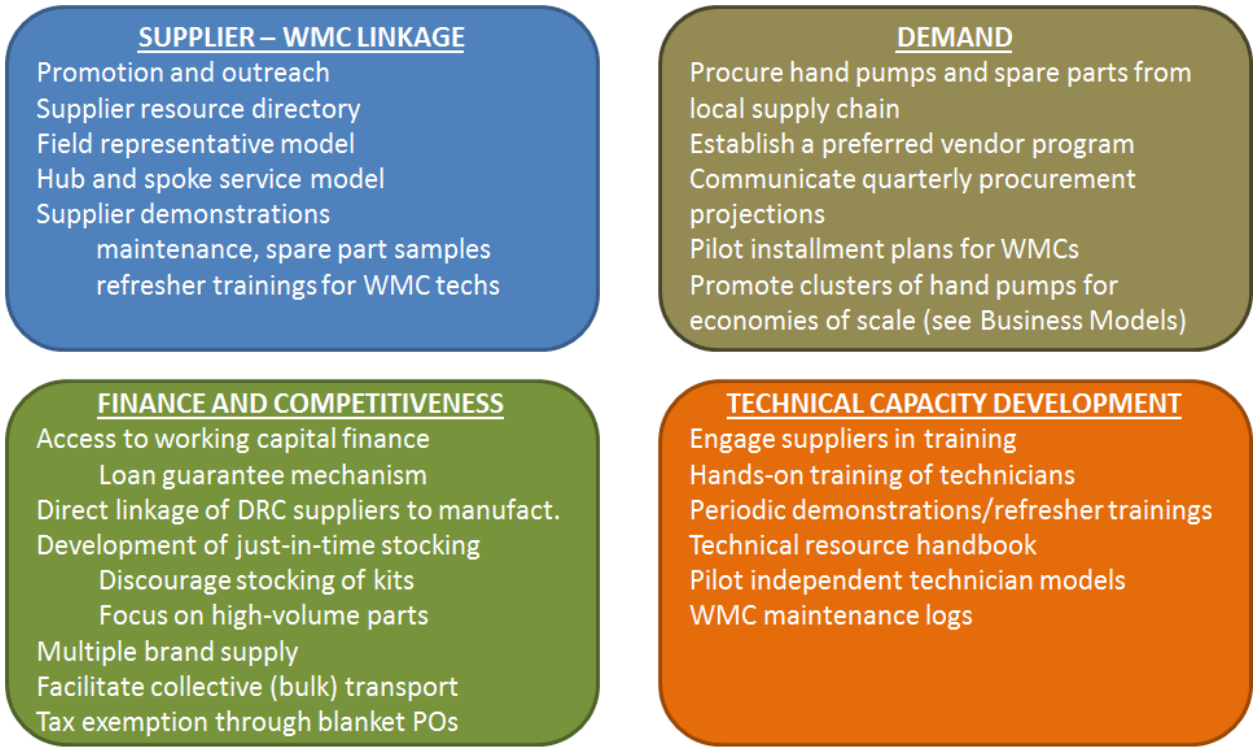
As described in detail in Section 5.6, the high cost of local procurement is driven by two primary factors: 1) the low-volume of hand pump purchases and 2); lack of direct linkages between local suppliers and manufacturers. Several suppliers including Africa Business in Lubumbashi stated that they include significant profit margins (between 28% and 100%) in their retail prices to compensate for low-turnover and stocking risk (risk that the item might not sell). The lack of direct procurement relationships between Congolese suppliers and pump and parts manufacturers is inefficient as profit margin and transportation costs for traders in Dar Es Salaam, for example, and neighboring trade hubs (Kampala, Kigali, Buguaraa) are included in final retail prices in the DRC.

Figure 2: Cost differential between local and direct procurement of hand pumps



However, if purchase volumes were increased and direct trade linkages established, the cost of a locally procured hand pump would drop from $2,400 to $997 per unit, or only $138 more than purchasing direct from manufacturers in India. Key recommendations to support a stronger supply chain of hand pumps and spare parts are: 1) facilitate direct linkages between provincial suppliers and manufacturers; 2) facilitate reasonable

Figure 3: Summary of Spare Part Supply Chain Recommendations



terms from manufacturers (based upon prevailing INGO terms); 3) advocate for tax exempt status for spare parts stocked on a speculative basis; 4) increase spare parts purchase volumes to obtain lower prices and most importantly, 4); procure spare parts from provincial and local suppliers. Other supply chain recommendations are summarized in Figure 3.

Demand for Hand Pump Spare Parts

Water management committees and their members represent the demand side of the supply chain equation. Without sufficient, sustained demand, supply chains will not develop or will atrophy into non-existence. As such, an important component of this study is to assess the capacity of water management committees to sustainably manage water systems, including the collection of user fees to pay for repairs and spare parts. Although low incomes in rural areas impacts user ability to pay for water, the ability of WMCs to collect user fees, and user willingness to pay those fees, is ultimately predicated upon quality service delivery, transparency, and communication. AO interviewed 33 water management committees in 29 villages in order to understand the opportunities and challenges from WMC sustainability. AO consultants interviewed four types of WMCs: 1) established WMCs with functional hand pumps; 2) established WMCs with non-functional pumps; 3) newly established WMCs with planned water point improvements (mostly hand pumps) and 4); WMCs undergoing reform and transition.

Although WMC capacity is certainly improving through WASH RDC activities, the base level of WMC capacity is extremely low. WMCs still require significant training in several key areas such as organizational management, financial management, transparency, and the ability to

maintain and repair hand pump water points. Even those WMCs who have been engaged in several iterations of NGO training, such as the Lukuato WMC in Manono territory who has been trained by GoI, ACTED, and now Concern, still lack management plans, roles and responsibilities of committee members, operations plans, and business plans that could help WMCs project expected maintenance and repair expenditures and user fees. Although the sequencing of WASH RDC interventions is logical given the concern about raising community expectations and the strategy to leverage water point improvement to motivate behavior change, the delay in WMC organizational and financial management trainings results in WMCs who do not have the necessary capacity to effectively manage newly installed water systems. Therefore, an important recommendation is to reconsider the sequencing of WMC and community trainings to at least begin developing basic management skills *prior* to the installation of improved water points. An important component of these pre-installation trainings should include the development of user fee rates and collection strategies and community sensitization regarding the need to pay for water services. The WASH DRC program conducts such water fee sensitizations currently, but often very late in the WMC development process. Earlier trainings on organizational and financial management could be conducted in parallel with the current 12-step development process.

Other Conclusions Regarding WMC Capacity

Organizational Capacity: Basic organizational management training needed

- Roles and responsibilities
- Basic operations plan (authority structure, voting rights)
- Reinforced member selection criteria
- Communications strategy (esp. for user fees)
- Balance of power
- Infrastructure ownership

Transparency: WMCs have a credibility problem. Strategies to increase transparency and credibility include:

- Monthly community meetings
- Report on revenue collected
- Use of fees
- Water point functionality (breakdowns, actions to repair)
- Create visible community benefits
    - Small vegetable gardens
    - Rotating credit schemes

Governance challenges:

- Lack of community mandate
    - Communications and outreach need to be improved
- Arbitrary influence of Chief
    - Need vehicles and approaches for advocacy
- Classic collective action problem
- Accountability
- Not empowered to enforce rules
- Formal and informal taxation

Quality service provision challenges:

- Few WMCs recognize they sell a service, not water per se
- Quality service leads to higher fees
- Lack technical knowledge for maintenance & repairs
- Dependency on NGOs
- Lack of knowledge where to buy spare parts
- Need to implement a water service scorecard (by community)
- Technical challenges:
    - Dug/shallow well most common cause of failure
    - Low-flow, no-flow during dry season hurts credibility and user willingness to pay in the long-term
    - No one pump type fails more than others
    - Cylinder breakage/cracking a common reported problem

Fee generation:

Challenges

- No service quality-fee link
- Lack of transparency reduces willingness to pay
- Average fees at CDF 300 per month
- Only 20% of households are paying
- Monthly fee structure problematic:
    - Fees not dependent on water use (wastage)

  - Collection for non-paying users
  - Evidence of side-selling (could be an opportunity)
- User fees should be set per jerry can
- Monthly revenue should average CDF 60,000 per month (see Demand Section)
- In reality most, most collecting 9,000 – 15,000 per month
- Reports of NGO staff recommending CDF 300 ceiling
- Chiefs, police, district officials using water for free

Opportunities

- For areas of poor access, households paying CDF 200 – 500 per jerry can for someone to fetch water
- At least 4 of the 33 WMCs charging or plan to charge between CDF 100 to CDF 300 per jerry can
- Public water system failure reducing resistance to fees for maintenance, repairs, and spare parts

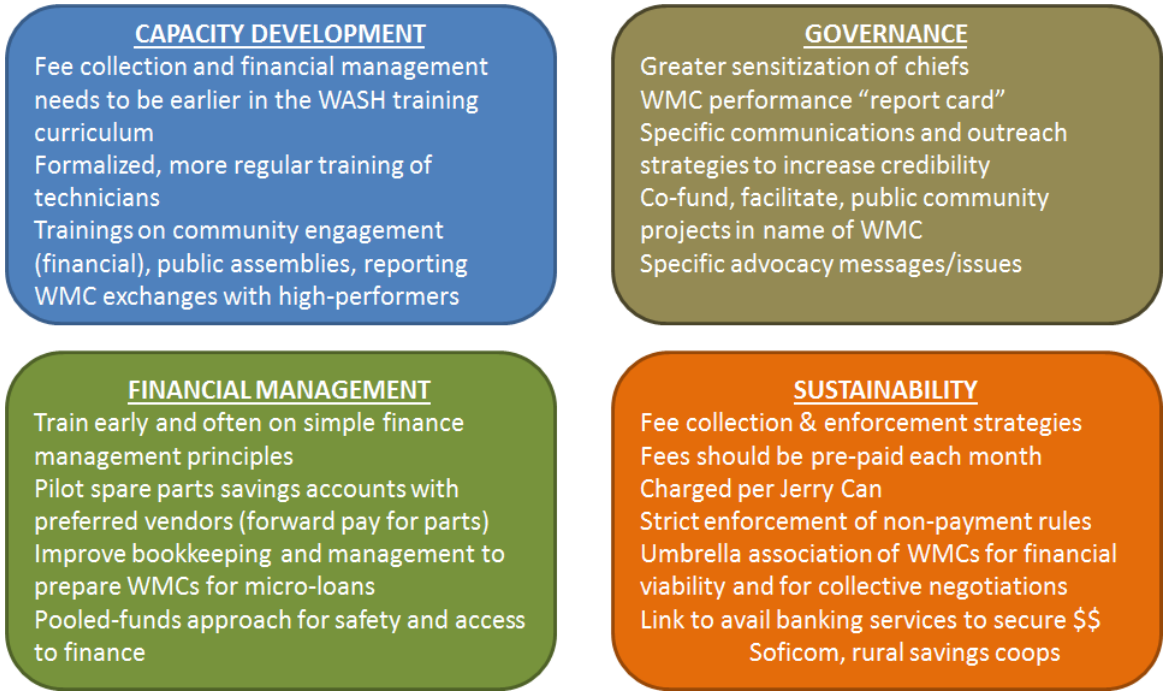
Financial management:

- Most WMCs keeping cash books
- But lack of reconciliation procedures
- Other risks:
- No periodic cash count to verify amounts
  - Inadequate expenditure consensus
  - Many incidents of theft or unauthorized use
  - Threat of theft, informal taxation, or even violence if amounts are sizeable
  - Access to banking services a challenge
  - No financial planning/business planning
  - Treasurers rarely maintain funds

Summary of Recommendations Related to WMC Capacity

Recommendations to strengthen Water Management Committees are focused on Capacity Development, Governance, Financial Management and Sustainability, and are summarized in Figure 4 below:

Figure 4: Summary of Recommendations or WMC Improvement



User Ability to Pay for Water Service

A critical comonent of WMC sustainability is the ability and willingness to pay adequate user fees to cover at the very least routine maintenance and repair costs. The very low income levels of rural villages and a lack of a culture of paying for water present obstacles to collecting adequate user fees. However, financial analyses and individual household economic surveys of current and potential WASH RDC project areas suggest that water user households have the financial wherewithal to pay sustainable fees. A second question, perhaps more relevant question, is whether users are *willing* to pay fees and how this willingness can be increased.

AO analyzed household income data from secondary sources and conducted household economic surveys in target WASH RDC villages to determine feasible water user fees (ability) and to understand what percentage of households pay user fees charged by active WMCs. Figure 5 demonstrates maximum feasible water fee calculations based upon monthly GNI per capita, average household size, income distribution, and the alternative 'affordability thresholds'. The UNDP has recommended an affordability threshold for clean water at 3% of gross income for developing countries. Concern Worldwide currently assumes a 2% ability to pay in its business model. The World Bank reports an average GNI per capita of $680 for the DRC in 2013. UN Habitat estimates average DRC household size at 6.85 (2010). This equates to an average monthly household income of $388. However, as with most developing countries, the DRC has extremely high income inequality. The bottom 10% of the population only captures 2.2% of total income, and the bottom 20% only 5.5%. Using income distribution per percentile, AO calculated the average monthly household income per quintile and for the bottom 10%. According to these calculations, the bottom 10% of DRC households earns approximately $58 per month. With an average household size of 6.85 people per household, this equates to $8.54 per person per month, or $0.28 per day. The standard definition of extreme poverty is $1 per person per day.

However, affordability thresholds of 2% (Concern WW) and 3% (UNDP), result in maximum monthly tariffs of 1,055 CDF and 1,583 CDF, respectively. These amounts are much higher than current de facto targets of 300 CDF per month.

Figure 5: Analysis of maximum attainable water user fees in the DRC based upon income data and UNDP affordability thresholds

COUNTRY	AVERAGE MONTHLY INCOME/CAPITA	AVERAGE HH SIZE	AVERAGE MONTHLY HH INCOME	BOTTOM 10%	BOTTOM 20%	SECOND 20%	THIRD 20%	FOURTH 20%	HIGHEST 20%	QUINTILE TOTAL/ AVG.
Distribution of Income		**(A)**	**(B)**		**(C) % of GDP Earned by Quintile**					
DRC	$57	6.85	$388	2.2%	5.5%	9.2%	13.8%	20.9%	50.6%	100%
Population In Quinitiles (D)										
DRC				6,751,368	13,502,735	13,502,735	13,502,735	13,502,735	13,502,735	67,513,677
Population x Distribution x Monthly HH Income (B x C x D)										
DRC				$57,654,430	$286,699,755	$482,200,685	$722,776,896	$1,097,530,689	$2,652,103,766	$5,241,311,791
Monthly Disposable Income Per Quintile (B x C x D)/(A)										
DRC				$58	$145	$245	$367	$557	$1,345	$388.17
Maximum Monthly Water Tarrifs per Affordability Thresholds										
	UNDP:	**3%**								
DRC ($USD)				**$1.75**	**$4.36**	**$7.34**	**$11.00**	**$16.70**	**$40.36**	**$11.65**
DRC (CDF)	Exchange rate:	902		**CDF 1,583**	**CDF 3,936**	**CDF 6,619**	**CDF 9,922**	**CDF 15,067**	**CDF 36,407**	**CDF 10,504**
	Concern WW:	**2%**								
DRC ($USD)				**$1.17**	**$2.91**	**$4.89**	**$7.33**	**$11.14**	**$26.91**	**$7.76**
DRC (CDF)	Exchange rate:	902		**CDF 1,055**	**CDF 2,624**	**CDF 4,413**	**CDF 6,615**	**CDF 10,044**	**CDF 24,271**	**CDF 7,003**

A second approach to estimating maximum attainable water user fees is to apply the affordability threshold to actual income data collected by AO. Figure 6 summarizes average household income data collected from Iyembi village in Bandundu province. Iyembi households reported a median monthly household income of just over 35,000 CDF (roughly US$39). If we assume an affordability threshold (the maximum amount that a household can pay for water without sacrificing other household expenditures such as food or school fees) of 3%, the maximum attainable monthly water user fee is 1,050 CDF (US$1.16). If a 2% affordability threshold is used, this number

Figure 6: Maximum attainable water user fees based upon AO survey data

	Average Household Gross Income Per Month			
	Low	**High**	**Mean**	**Median**
Avg. Gross Monthly HH Income	**CDF 30,000**	**CDF 450,000**	**CDF 99,167**	**CDF 35,000**
In USD:	**$33.26**	**$498.89**	**$109.94**	**$38.80**
Water Affordability Index (UNDP)	**3%**			
Max Monthly Water Fees:	**CDF 900**	CDF 13,500	CDF 2,975	**CDF 1,050**
In USD:	**$1.00**	$14.97	$3.30	**$1.16**
Water Affordability Index (UNDP)	**2%**			
Max Monthly Water Fees:	**CDF 600**	CDF 9,000	CDF 1,983	**CDF 700**
In USD:	**$0.67**	$9.98	$2.20	**$0.78**

drops to 700 CDF (US$0.78), which is still more than double the 300 CDF per month recommended by many NGOs.

Alternative Spare Parts and Maintenance Business Models

Another component of this study is to investigate the feasibility of alternative business models for spare parts supply and maintenance and repair services. AO identified seven potential business models including: 1) an integrated supply/service model; 2) independent for-profit maintenance service providers; 3) consignment-based authorized dealers; 4) the current model of WMC spare parts procurement and repair; 5) public-private model utilizing Zone de Santé health center networks; 6) the establishment of physical subsidiaries of current suppliers and 7); the facilitation of creative finance mechanisms. As part of this analysis, AO also conducted a minimum density analysis to determine maintenance service provider break-even points and financial feasibility.

Figure 7: Summary of alternative business models considered

Integrated supply/ service model	• Suppliers employ field techs on commission basis • Multiple income streams
Independent service companies	• Feasible with minimum cluster (200 – 400 pumps) • Difficult to cover overhead if 100% service and parts
Authorized-dealers	• Existing suppliers who stock on behalf of spare parts traders • Consignment, partial consignment, commission
100% WMC	• Technical expertise a challenge • Finance for spare parts still an issue, lack of frequency
Public-private (zone de santé)	• Leverage health center network for forward stocking • Training HC staff in repair and maintenance, extra income stream
Sub-offices	• Physical subsidiaries of larger DRC traders • Inefficient, overhead high, need sufficient volume
Creative finance mechanisms	• Working capital to increase spare parts stocking • Loan guarantee fund to catalyze private finance

Integrated Supply/Service Model

One approach to improve the access to spare parts in remote areas and increase supplier access to markets is for suppliers to train and deploy community-based field techs who operate on a commission basis. A commission arrangement lowers the financial burden and risk profile for suppliers who are reluctant to increase overhead (via salaried employees) to pursue what they consider to be an unproven and inconsistent market. Commission arrangements also incentivize performance, as field agents are only paid when spare parts are procured and maintenance and repairs conducted. This provides motivation for more frequent site visits and timely response to WMC service requests. Revenues from service visits and repairs also generate a secondary income stream for spare parts suppliers. Although this model is promising, it is not without challenges. Turn-over and volume of service calls will continue to be an issue for both field agents and suppliers. Transportation and access to remote villages is another challenge. Field agents will need motorcycles to conduct frequent site visits and to respond quickly to WMC service calls. Suppliers will be reluctant to spend working capital on transportation assets, especially

until demand is proven. One strategy to mitigate this challenge is to facilitate access to finance for suppliers so that the cost of transportation assets can be absorbed over-time. Field agents could also potentially buy the motorcycles from supply companies on a lease-to-own basis. Another option is the facilitation of a small leasing company that is able to procure (potentially through finance) transportation assets and lease them to supply companies. As with other models, the geographic density of WMCs, frequency of maintenance and repair service calls, and ultimately the volume of spare parts purchased will determine the financial feasibility of this model.

For-profit Maintenance Service Providers

Another approach to strengthen the spare parts supply chain is to facilitate the creation of independent, for-profit maintenance service providers (MSP). This small service companies would be ideally situated in district centers that allow them to employ a 'hub and spoke' approach whereby they can cost-effective service WMCs within a 50-kilometer radius. Profitability will largely be determined by the density of WMCs within their service area, which will drive the number of service calls received (see 6.2 minimum WMC density analysis). This model has several advantages over WMC-based repair and maintenance. By servicing dozens or even hundreds of hand pumps in a specific geographic area, MSP technicians will have sufficient volume to specialize in repair and maintenance services. This should allow for higher-quality service as technicians maintain and improve their technical knowledge through practice and gain experience with a greater diversity of hand pump failure and repair types. The profit motive inherent in the MSP model will also likely force MSPs to achieve greater cost and operational efficiencies that ultimately can be passed on to WMCs via lower service fees. To mitigate the related risk of MSPs conducting unnecessary repairs or replacing functional parts, WMCs will still need to maintain one or two pump technicians on the committee to verify MSP technician diagnostics and recommended repair interventions.

The biggest challenge to the feasibility of the MSP model is the volume of business and revenue generation. Without sufficient density within realistic service areas, MSPs will not achieve adequate sales volumes to cover overhead costs, including transportation. As such, MSP mini-feasibility studies should be conducted by WASH RDC partners to determine if planned service areas surpass break-even thresholds. Initial estimates for minimum density suggest that 340 pumps within a 100 kilometer radius is the break-even point for MSPs. Additionally, future site selection for hand pump installation by WASH RDC and other stakeholders should consider facilitating water service corridors. Although a remote community may be in dire need of an improved water source, large distances to population centers and spare parts and service supply may render any intervention unsustainable in the medium and long term. NGOs should target new villages proximate to other WMCs, and along existing trade routes that will help link new WMC to supply networks.

Authorized Dealer Model

Unlike larger suppliers like Africa Business, JP Lwarhoga, and Bon Berger, district-level hardware suppliers do not have the working capital to stock spare parts. One possible solution is to link district-level suppliers such as Satelii d' enterprise (Kolongo) and URSS (Manono) to larger

provincial suppliers through an authorized dealer model. Under this model, provincial suppliers would forward stock hand pump spare parts on consignment at district supply stores. As parts are sold, sales proceeds would be forwarded to provincial suppliers (via Soficom, for example) less district supplier profit. Although provincial suppliers state that they are not stocking larger inventories of spare parts due to low turn-over and that they do not want to tie up working capital in slow moving stock, they are not actually capital constrained. Every large provincial supplier indicated that working capital is not their constraint, but lack of demand. They would rather invest capital in higher-volume products. The solid cash position of provincial suppliers allows them to consign spare parts to district level suppliers. The biggest challenge to this model is a lack of trust between provincial and district suppliers, and the risk that district suppliers would sell stock and not transit proceeds to provincial suppliers. INGOs could play an important risk reduction role by facilitating linkages between district suppliers and provincial suppliers, and by providing partial payment guarantees. INGOs could warranty that district suppliers will transmit sales proceeds of consigned stock, and take responsibility for 75% of the value of stock sold in the event that district suppliers do not pay. While this approach is still based upon INGO involvement in the supply chain, it increases long-term sustainability by addressing market inefficiencies and risk profiles. As a history of successful transactions and payment history is established, payment guarantees can be reduced and eventually eliminated.

WMC Service Model

The current service provision model is not working effectively. Essentially NGOs train one or two technicians within Water Management Committees to conduct routine maintenance, repairs, and in theory, to procure spare parts. In reality, WMC technicians do not have the required skills to diagnose and address many hand pump break downs and have virtually no knowledge of where to procure spare parts. Given the low frequency of repairs, many WMC technicians reported that the skills they developed from initial trainings diminish over time due to inactivity. WMC technicians also report that refresher trainings from NGOs and other sources are not available. Despite its challenges, WMC-based maintenance and repair will continue. WASH DRC partners and other NGOs can improve the WMC model by more aggressively linking WMC hand pump technicians with suppliers identified in Section 5. Technical capacity trainings need to be hands on (not theoretical), and technicians should be encouraged to attend refresher trainings every 6 – 9 months. Another recommendation is to deepen the expertise of the most entrepreneurial WMC technicians and facilitate increased coverage to 3 – 5 WMCs to increase repair and maintenance frequency, effectively encouraging them to operate as micro-businesses. A portion of water user fees should be used to pay for the time of WMC technicians, including preventative maintenance. If small financial incentives can help professionalize WMC hand pump technicians.

Public-Private Partnership with Zones de Santé

Another interesting business model that has met with almost universal resistance from WASH RDC staff members is a public-private partnership between suppliers, maintenance service providers, and Zones de Santé. A key supply chain bottleneck is the absence of a spare parts distribution network. The lack of demand for spare parts and related slow turn-over of parts inventories have discouraged suppliers from investing distribution networks. Until INGOs increase local procurement and effectively link WMCs to parts suppliers, suppliers will not invest

time, energy, or money into district-level stocking solutions. Supplier perception of low demand precludes them from establishing sub-offices in further out locations.

Zones de Santé (ZdS) are heavily involved in water point improvement including the installation of hand pumps. ZdS also have an impressive network of health centers that collectively represent the largest distribution network in the DRC. The WASH RDC program could facilitate a public-private partnership whereby health centers stock inventories of common hand pump spare parts. Margins on the sale of spare parts would create an additional income stream for health centers, while positioning spare parts stock closer to WMCs. INGOs could provide start-up capital for initial spare parts stock at health centers, facilitate finance to ZdS for parts stocking, or catalyze consignment agreements with large provincial suppliers. Chefs de ZdS in Popokabaka and Manono expressed interest in the public-private model, and are open to further discussions and/or negotiations.

Supply Company Sub-Offices

One business model discussed with large provincial suppliers is the establishment of wholly owned district sub-offices. These would be small parts depots that position spare parts inventories closer to WMCs. District sub-offices would increase the market presence of provincial suppliers, helping to increase WMC knowledge spare parts supply locations. Given current volume levels, however, provincial suppliers expressed reluctance to spend capital on shop improvements, staff salaries, transportation costs to maintain forward stocks, and the additional investment in spare parts supply stock itself. Provincial suppliers were much more enthusiastic about commission-based field technician and authorized dealer models. Africa Business, for example, indicated that if higher volume levels of spare parts sales were more certain, they would consider opening small depots at interior locations such as Manono and even Kongolo.

Creative Finance Mechanisms

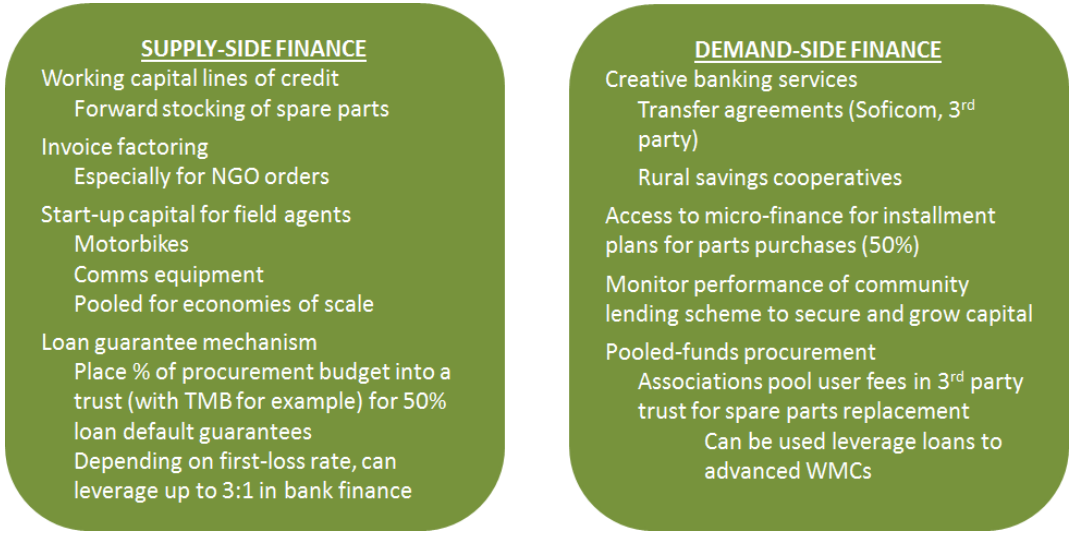
Creative finance mechanisms will be required to address several bottlenecks in the spare parts supply chain and to catalyze increased stocking levels at both provincial and district levels. Figure 8 summarizes how potential finance mechanisms can facilitate improved supply chain efficiency. Finance mechanisms have been organized into supply-side finance and demand-side finance.

Supply-side Finance Mechanisms

Provincial suppliers interviewed stat that working capital is not a constraint to stocking larger and more diverse inventories. If they were better able to predict purchase demand with greater certainty, they are prepared to increase stocking levels. This is not the case, however, for smaller district-level supplies. Ideally INGOs and WMCs are able to procure spare parts from district centers to reduce long lead times. As it stands, most spare parts stocks are in large urban centers such as Goma and Lubumbashi. In addition to a reported lack of demand for spare parts, district suppliers list a lack of working capital as an important constraint to stocking spare parts. WASH RDC should invest time, energy, and

resources to facilitate supplier access to working capital lines of credit. This can be achieved through relationship building (introducing preferred suppliers to local bank branches and bank head offices), a commitment to procure spare parts through district suppliers, and most aggressively, by providing partial loan guarantees to reduce bank risk to achieve more favorable interest rates and to catalyze initial loans that will help establish a history of successful repayment.

Figure 8: Creative finance mechanisms for the DRC spare parts supply chain



Another finance mechanism is invoice factoring. Suppliers mentioned that even when INGOs do procure from them, it often takes months to receive final payment. This ties up working capital that could otherwise be invested in the next round of spare parts inventories. In addition to expediting local supplier payments, WASH RDC partners could facilitate invoice factoring with local banks whereby banks pay suppliers 80% of the outstanding *approved* invoice against an INGO guarantee to pay. INGOs would forward invoice payments to banks directly, who would then pay suppliers their remaining 20% less interest (determined by volume and risk).

Maintenance service providers, an important potential actor in the spare parts and maintenance supply chain, will require both start-up and working capital. Start-up capital is needed for transportation (motorcycles) and communications equipment, a generator, office set-up, and an initial stock of most high-demand spare parts. Working capital is needed for base salaries, fuel, and supplies. As with supplier finance, WASH RDC partners should facilitate start-up capital loans through relationship building, a guaranteed volume level (at least temporarily), and even loan guarantees to catalyze private finance to private maintenance service providers. If commercial banks are unwilling to issue loans to MSP start-ups, WASH RDC partners should consider establishing a modest MSP capital fund that can issue at least a few loans to support the development of MSPs and to provide 'proof of concept'. Repayment of principal and interest by MSPs to the fund can then be redirected back to standard program line items. Although this second approach does present at least a moderate-level of risk to the WASH RDC program, the potential benefit from an active, private MSP network outweighs this risk and may ultimately reduce program costs through the efficient provision of maintenance services.

The establishment of a WASH RDC loan guarantee fund will likely have the greatest impact on higher stocking levels by DRC suppliers. WASH RDC should place a significant percentage of its procurement budget into a trust fund that can be utilized to provide partial loan guarantees to commercial banks for working capital loans to provincial and district suppliers. In Latin America, such guarantee funds are legal trusts (or *fideicomisos*), often managed by banks themselves. Further investigation into Congolese trust law is required to determine what type of legal entity would best suit the establishment, ownership, and management of such a fund. Commercial banks are reluctant to extend credit to the water sector as it is not an established area of focus (such as automobile loans, business expansion loans, etc.). Spare parts suppliers do not have track records with commercial banks, increasing the risk profile of the sector to commercial banks. In order to facilitate working capital loans for spare parts stock, WASH RDC should offer a partial loan repayment guarantee that lowers supplier risk profiles and facilitates the provision of credit. Loan repayment guarantees typically cover between 50% and 80% of loans issued to beneficiaries, depending upon the level of risk involved and the efficacy of commercial bank engagement with lenders. Money is only disbursed out of the loan guarantee fund if suppliers fail to repay loans.[2] Depending upon the expected default rate, the fund can guarantee a total loan portfolio value at several times the actual amount of the guarantee fund. After the initial cycles of guarantee and repayment are completed, guarantee levels can be reduced (percentage of loan value guaranteed) and eventually eliminated. Such a guarantee mechanism has the potential to stimulate increased stocking levels and the overall volume of the spare parts trade. Increased spare parts supply and access will likely have a multiplier effect whereby INGO and WMC awareness of spare parts suppliers increases, leading to increased volumes of local spare parts procurement. This in turns increases supplier motivation to stock and the working capital necessary to do so.

Demand-side Finance Mechanisms

Several demand-side constraints can also be addressed through creative finance mechanisms. One key challenge facing WMCs is securing water user fees collected. Currently, WMC cash reserves are maintained in plastic pouches in the home of treasurers and WMC presidents. This is problematic for several reasons. First, unsecured cash reserves increase the temptation of the unauthorized use of WMC funds by committee members. Second, the risk of informal taxation by village chiefs and other authorities is increased if cash is on-hand. Third, as cash reserves increase, WMCs (especially in insecure, remote areas) risk theft from bandit groups. The real and perceived lack of banking services makes it difficult for WMCs to deposit water user fees into secure accounts. WASH RDC and other water sector actors can address this constraint by improving access to banking services by: 1) improving the information flow to WMCs regarding existing services (Manono example); 2) establishing an agreement with Soficom to establish small transfer depots in further out population centers; 3) promoting the use of rural savings cooperatives after more favorable terms are negotiated on behalf of WASH RDC WMCs and 4); promoting the use of mobile-phone banking in areas that have cell coverage (e.g. the Kenyan Mpesa model).

[2] See the AO report *Motivational Capital: Financing Water Service Improvement in Latin America. Feasibility Study for a Water Service Capital Facility* (2014), funded by CRS LACRO for further technical details on how loan guarantee mechanisms may contribute to improved water service and how they may be best managed.

A second strategy to reduce the risk of WMC-maintained cash reserves is to establish a community revolving loan fund that is capitalized by water user fees. Such a small loan revolving fund would also improve community opinions of WMCs, thereby increasing their mandate to operate water points and collect fees. A certain percentage of water user fees could be lent to community members for productive use such as purchasing agricultural inputs, starting small-poultry enterprises, small bicycle and motorcycle repair shops, and other micro-enterprise opportunities. Community members would then repay loans at low interest rates (to help grow WMC capital), which would in turn be lent to other community members. Although a risk of non-repayment exists, the revolving nature of the WMC community fund encourages collective enforcement of repayment, as other community members interested in loans put pressure on current loan holders to adhere to repayment agreements. Similar social pressure would help mitigate the risk of theft by community members. With WMC cash reserves in the hands of multiple borrowers from the community, lower amounts of WMC cash-on-hand also mitigates the risk of informal taxation.

Another demand-side finance mechanism is micro-finance for spare parts purchases. AO found several examples of non-functional hand pumps that were not repaired due to inadequate funds to buy spare parts. In some cases, WMCs did not have the necessary funds due to the under-collection of water user fees or the mismanagement of WMC funds, or both, but in other cases, WMCs had not been in existence long enough to build adequate reserves. Direct spare part procurement by WMCs from district and provincial suppliers can be increased by linking WMCs to micro-finance institutions for small, short-term loans. Although micro-finance is expensive, WMCs expressed interest in this mechanism as it would allow them to pay for spare parts over time. A six-month repayment period should be sufficient to allow WMCs to make micro-loan payments out of future user fees.

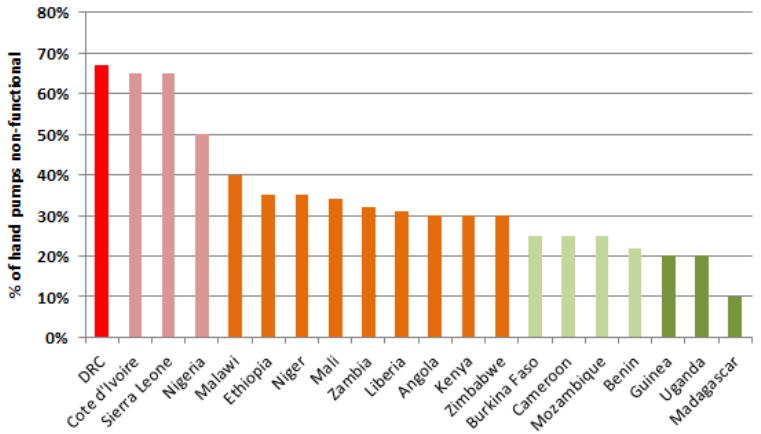
Lastly, a pooled-funds approach can help increase WMC negotiating power and help increase security of cash reserves. This mechanism functions by WMCs place a significant percentage of monthly water user fees into a third-party managed spare parts replacement trust. TMB and other commercial banks offer trust management services, and are capable of providing prudential supervision and enforcement of WMC-determined disbursement criteria. These 'pooled' funds would be disbursed upon request and approval by a democratically selected group of WMC trustees for the procurement of spare parts and payment of maintenance and repair services. The fund could also be used to leverage other outside credit.

Subsequent sections of this report provide greater detail for each of the topics discussed above, including the minimum density model for private maintenance service providers.

3. Background and Objectives

The Democratic Republic of Congo (DRC) is one of the least developed countries in the world, ranking 186th of 187 countries on the United Nations (UN) Human Development Index.[3] Its Gross National Income (GNI) per capita totaled $444 in 2013[4], and only 46.5% of its population has access to improved water sources. Access to improved water sources drops to 29% in rural areas[5], one of lowest access rates in Sub-Saharan Africa. With over 52% of Africa's surface water reserves, the DRC water crisis is driven by poor governance, the lack of investment in existing and new water infrastructure, and the near collapse of water, sanitation, and health (WASH) services due to decades of conflict and political instability.[6] Of the estimated $55 million per year invested in improved water service, roughly 95% is funded by international donors.[7] Of this $55 million, roughly $25 to $30 million was invested in rural water services, including a significant investment in bore holes and dug wells utilizing hand pump technology.[8] Although sustainability challenges of hand pumps has been well documented (Carter, et al 2010, RWSN 2009), hand pumps remain a preferred rural water solution for many international non-governmental organizations (INGOs) and UN agencies. In 2009, the Rural Water Supply Network surveyed hand pump utilization and functionality across Sub-Saharan Africa. Of the 350,000 hand pumps identified across twenty countries, roughly 36% were not functioning at the time of the survey. The DRC had the highest rate of non-functioning pumps, with 67% of hand pumps reported as non-operational by the 2009 survey (see Figure 9). Community operated and managed hand pump systems, however, remain a preferred technology for many INGOs targeting remote rural areas. With millions of dollars of continued hand pump investment, understanding the causes of hand pump system poor performance is essential to achieve improved sustainability and expected return on donor investments (value for money). Several factors contribute to the poor

Figure 9: Rate of hand pump failure by country in 2009 per RWSN



[3] *2013 Human Development Report.* United Nations Development Programme. Retrieved from http://hdr.undp.org/en/content/table-1-human-development-index-and-its-components.

[4] Ibid.

[5] World Development Indicators 2013. World Bank.

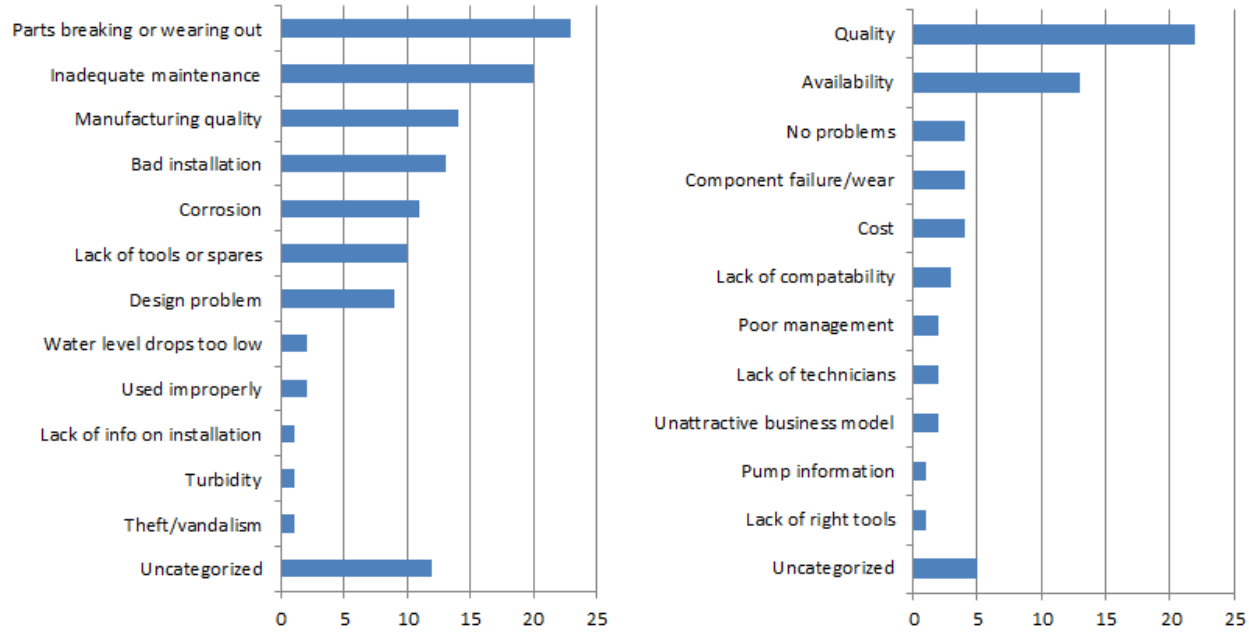
[6] *Water Issues in the Democratic Republic of Congo: Challenges and Opportunities.* United Nations Environment Program (UNEP). January 2011.

[7] Water Supply and Sanitation in the Democratic Republic of Congo: Turning Finance into Services for 2015 and Beyond. An AMCOW Country Status Overview. Water and Sanitation Program (World Bank). 2011.

[8] One weakness of the rural water sector in the DRC is the lack of comprehensive tracking of investment in water service infrastructure. As such, the exact distribution of investment per water service technology (e.g., piped schemes versus hand pumps). However, we estimate that investments in hand pumps have represented at least 50% of investment, and potentially as high as 75%.

performance of community-managed hand pump systems, including poor quality of hand pump hardware, inadequate engineering of wells, inability of rural water management committees to operate, maintain, and repair hand pumps, and the quality and availability of spare parts (Carter et al 2010). In a 2013 survey of water service practitioners in government, INGOs, private sector and other development partners, RWSN found that parts failure was the primary cause of hand pump poor performance (Figure 10). This in and of itself is not surprising. However, the opinion that inadequate maintenance was the second-most important cause of hand pump failure is more interesting, and certainly contributes to a high rate of parts failure. Hand pump parts and components will inevitably fail over time. How water management committees and NGOs plan, prepare, and manage for necessary maintenance and spare parts replacement, however, determines whether hand pump systems are sustainable in the medium and long term. The second graph summarizes spare parts problems faced by practitioners surveyed. Quality was ranked as the top challenge to spare part replacement and continued hand pump functionality, with the availability of spare parts ranked second.

Figure 10: Ranking of hand pump faults and spare parts problems (RWSN 2013)



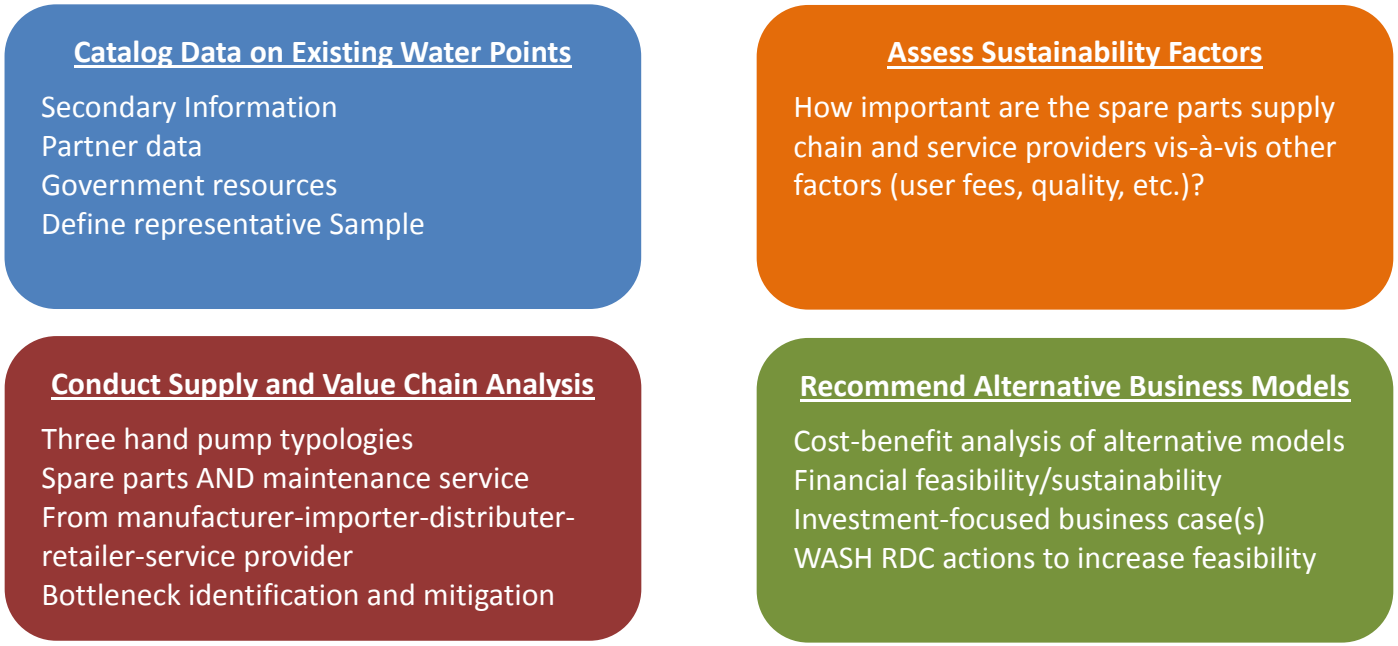
The WASH DRC Consortium

Concern Worldwide is the lead member of the DRC WASH Consortium, which brings together five International Non-Governmental Organizations (INGOs)implementing a four year Water, Sanitation Hygiene (WASH) program funded by the Department for International Development (DFID) of the Government of United Kingdom in six provinces of DRC. Implementation of the program commenced in July 2013. Among some of the key planned outputs will be up to 733 community managed water points, of which up to 70% will be boreholes or shallow wells equipped with hand pumps.

Given the planned volume of hand pumps to be installed under the WASH DRC program, the poor performance of hand pumps in the DRC (67% not functioning in 2009), and the opinion that poor quality and access to spare parts drives poor hand pump performance, Concern Worldwide has asked Absolute Options (AO) to conduct a Hand Pump Spare Parts and Maintenance Supply Chain study for the DRC. The objectives of this

study are to catalog data on existing water points in the DRC, assess sustainability factors for hand pumps, conduct a comprehensive supply and value chain analysis, and to recommend alternative business models that have the potential to improve sustainability.

Figure 11: Objectives of the Hand Pump Spare Parts and Maintenance Supply Chain Study



Key Research Questions

Key research questions guiding this study also include:

- What are the approximate numbers of hand pumps in target provinces by model/type and what are their functionality ratings? What is the financial and managerial capacity of water management committees (WMCs) to engage in a private sector spare parts/maintenance supply chain?
- What spare parts providers and/or maintenance providers currently operate in country?
- What are the main barriers to a well-functioning maintenance and spare parts supply chain?
- Community motivation to participate in a private-sector maintenance regime, including willingness to pay?
- What models/type of pumps are most likely to succeed?
- What measures are necessary to attract private sector actors and institutional investors?

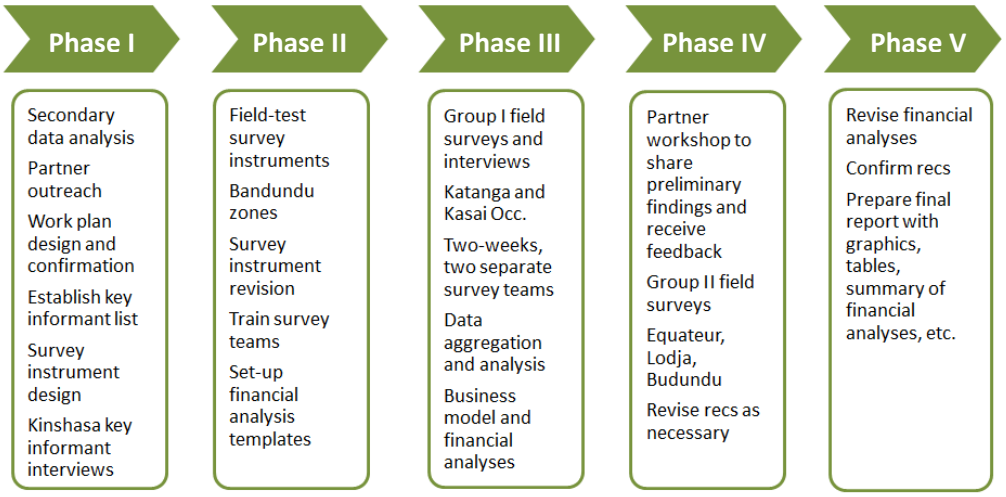
- How can the findings and conclusions from recent UNICEF research be leveraged?
- How should current WASH programs adapt based upon findings and conclusions from the study?

As hand pumps continue to be a popular intervention to improve access to safe water, the findings and conclusions from this study not only inform WASH DRC consortium program activities, but also contribute to the wider dialogue on sustainable access to water in developing countries. Although the focus of this study is on the availability, cost, quality, and access to spare parts for hand pumps, this study also offers important findings regarding water management committee capacity, market distortions, and the financial performance of alternative supply mechanisms.

4. Methodology

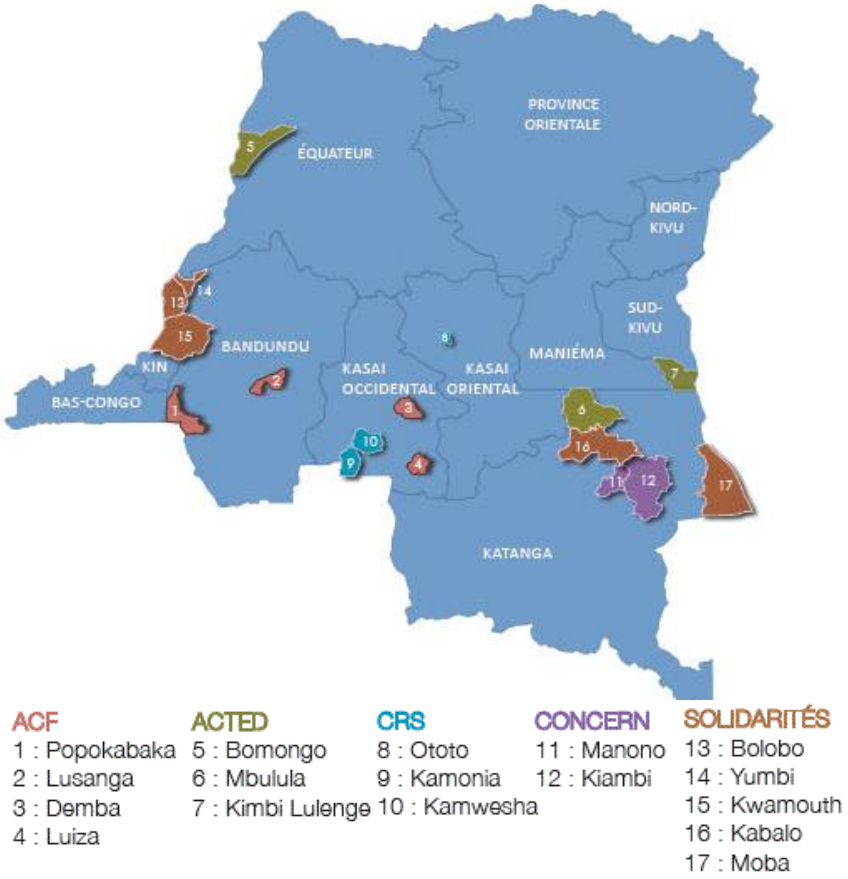
AO utilized a combination of qualitative and quantitative approaches to accomplish the objectives of this study. Primary research techniques included semi-structured interviews with key informants, separate focus group discussions with water management committees and water user groups, and quantitative household income surveys. Quantitative analyses such as discounted cash flow (DCF) financial modeling, price and profit capture analyses, density break-even analyses, and cost-benefit sensitivity modeling were utilized test research conclusions and provide evidence-based recommendations. Secondary research was conducted to identify potential water system business models, to conduct case studies, and draw upon industry expertise regarding sustainable water service delivery in rural areas. AO utilized a phased approach to ensure the efficacy of field survey instruments, sequence desk research and key informant interviews to inform field research, and to solicit feedback on preliminary findings, conclusions, and recommendations from WASH Consortium RDC partners and other stakeholders. Over the course of seven-weeks, AO consultants visited six of nine active WASH Consortium RDC Zones de Sante, including: Popokabaka, Manono, Kiambi, Lodja, Bomongo, and Kwamouth (Mushi). The AO team also conducted water management committee (WMC) interviews in peri-urban Kalemie, interviewed the Program Manager for Mbulula (Kongolo), and conducted detailed market surveys in Lubumbashi, Kalemie town, Bukavu, Goma, Kinshasa, and Impfondo (Republic of Congo). The AO team visited 29 villages, conducted 33 WMC

Figure 12: Overview of Research Methodology



focus groups, 10 water user focus groups, 54 individual household surveys, and 38 key informant interviews. Stakeholders for key informant interviews included 28 recent, active, or potential spare parts suppliers, five *Chefs de Zone de Sante*, KfW, UNICEF, the World Bank (WSP), Vergnet, and Trust Merchant Bank. Data from field interviews were aggregated into three separate databases to allow for both macro and segmented data analysis. Survey instruments, detailed interview lists, and financial models are included as appendices for reference.

Figure 13: Geographic coverage of the WASH DRC Consortium



4.1 Research Execution Challenges

Although the AO consulting team conducted research and analysis for nearly two months, only 33 water management committees were profiled. Long travel times between survey sites, unpredictable flight schedules, and flight cancellations made it difficult to reach all targeted districts and villages. While travel logistics is always challenging in the DRC, public holidays and unanticipated maintenance-related flight cancellations made travel to the interior of the country even more difficult. The AO team, in consultation with Concern WW staff, remained flexible throughout the study by revising field visit schedules, adding key informant interviews to locations where AO staff were forced to stay longer than anticipated, and by coordinating closely with WASH RDC consortium partners.

A second major challenge to conducting this study was the dearth of accurate, consistent data regarding existing hand pumps. The most comprehensive data are from the November 2011 STUDI International report prepared on behalf the *Le Projet d'alimentation en eau potable et d'assainissement en milieu semi-urbain* (PEASU). This study identified over 2,200 hand pumps across eleven DRC provinces, including data on functionality. However, no information was collected regarding hand pump makes and models, and functionality data was collected for only 60% of pumps identified. The WASH DRC consortium also collected data on the type and functionality of water points in districts where the program is active. Although this data indicates the type of water points impacted by the project, and some information on the make and model of hand pumps, WASH data are focused only on program-targeted districts, and several WASH DRC partners

had yet to begin installation of improved water points, most of which focusing on non-hand pump interventions. Data on approximately 46 hand pump water points were available through WASH data. The lack of comprehensive, accurate data on hand pump water point installations, pump technology, and functionality made it nearly impossible to draw conclusions regarding the functionality of hand pumps by make and model (India Mark II versus Afrideve, for example) as required by the scope of work of this study. More importantly, the lack of data on existing hand pumps hinders the planning of future water points and the establishment of private service providers of hand pump maintenance and repair as clusters of hand pump water points are difficult to identify.

5. Supply Chain Analysis

5.1 Supply Chain Overview

AO met with WASH DRC stakeholders to present the objectives of this study and to receive feedback on initial hypotheses and the research plan. While stakeholders confirmed that the inability of water management committees to collect sufficient user fees and a dearth of trained mechanics/technicians are important challenges to sustainability, stakeholders ranked access to spare parts as the most important hand pump sustainability challenge in the DRC. A recent UNICEF study researching the spare parts supply chain in Eastern DRC (Orientale, Sud Kivu and Maniema provinces) similarly concluded that no supply chain exists in three of five regions studied, with the other two regions only being served by cross-border suppliers in Uganda.[9] Interviews with water management committees (WMCs) during survey instrument testing in Bandundu province (Popokabaka) further indicated that WMCs had no knowledge of where to obtain spare parts apart from their NGO partners, and no hand pump or spare parts suppliers were identified in Popokabaka city. In Kalemie and Mbulula, WMC interviews also indicated that NGO knowledge of suppliers was not being effectively communicated to WMC partners.

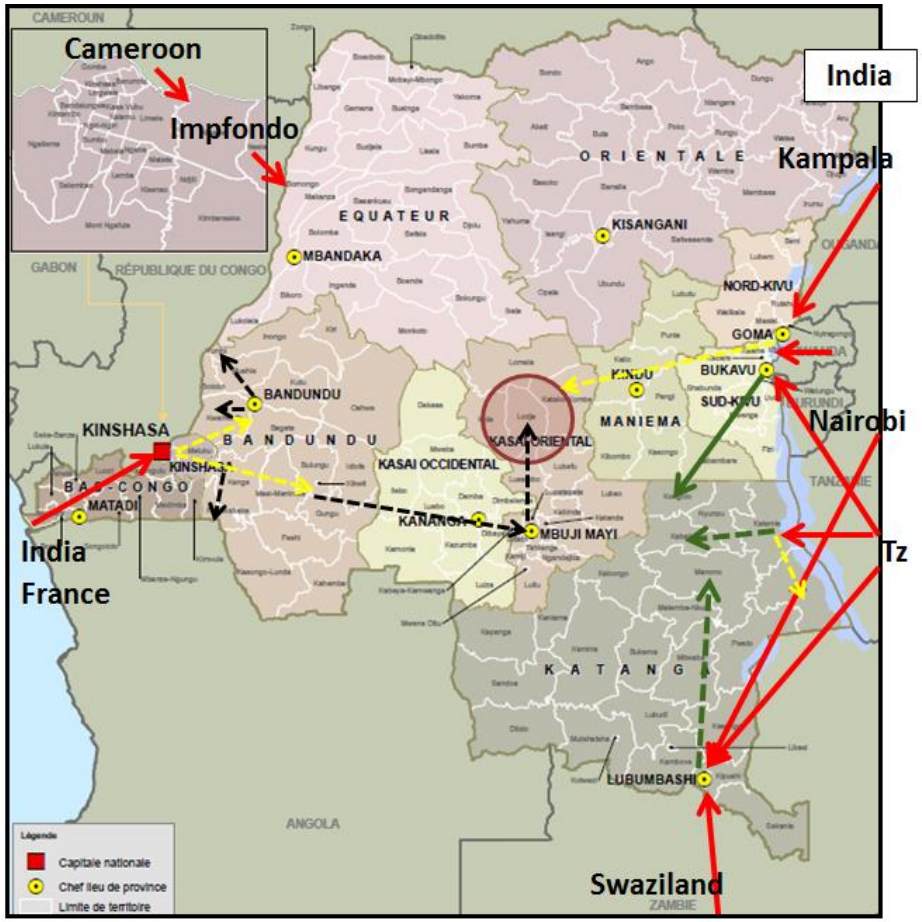
In order to confirm the hypothesis that no spare parts supply chain exists in the DRC, AO consultants began a market-canvassing exercise in major DRC population centers including Kinshasa, Lubumbashi, and Goma. Market canvassing involves 'store-to-store' research in relevant supply clusters such as construction materials to identify spare parts suppliers that may be operating below the NGO radar. Simultaneously, AO consultants began a similar exercise in secondary market centers such as Manono, and subsequently in Kalemie, Bukavu, Lodja, and Impfondo (supplying Equateur province) to investigate possible trade corridor nodes. The rationale of this approach was to investigate existing trade corridors in the South (Lubumbashi), East (Goma and Bukavu), West (Kinshasa), and Northwest (Impfondo). The counter-factual was that if spare parts suppliers exist, they must be importing from established cross-border trading centers.

The result of this exercise was the identification of twelve active spare parts suppliers, seven intermittent suppliers, four past suppliers willing to stock again, and three suppliers with interest to enter the hand pump supply parts business. The four past suppliers were previously stocking spare parts to fulfill existing NGO procurement contracts and to supply expected follow-on contracts that did not ultimately materialize. These suppliers stated that a signed-contract was not required to re-engage in stocking, but merely the communication of likely procurement requirements by NGOs for the upcoming quarter would be enough for them to begin stocking again. The suppliers interested in stocking spare parts are hardware suppliers who have knowledge of where to procure hand pumps and spare parts, but currently do not stock because of the perception of slow turn-over and uncertain demand (both from WMCs and INGOs).

[9] *Supply chain analysis of hand pumps and spare parts in Eastern Democratic Republic of Congo*, A-Aqua for UNICEF, May 2014.

Two primary spare parts supply chain corridors were identified. First, Lubumbashi has the highest number of active suppliers with four. Lubumbashi suppliers are sourcing spare parts from traders in Nairobi, Tanzania, and from a manufacturer in Swaziland (Tri-Manzi (PTY) Ltd.). The largest Lubumbashi supplier is Africa Business, who reports having sold to Concern Worldwide and ACTED. AO consultants visited the Africa Business warehouse to confirm dozens of India Mark II and Afridev hand pumps and spare parts kits in stock. Other suppliers include Congostore 1 – Geovanhie, Mutachi and Africa Solutions, who are sourcing spare parts primarily from Tanzania and India (Africa Solutions). The second primary spare parts supply chain corridor is anchored in Goma. AO identified two active spare parts suppliers in Goma (Bon Berger and Shalom), and three suppliers who intermittently carry spare parts based upon NGO orders and anticipated demand. These suppliers are selling primarily to Oxfam GB and Solidarités. Bukavu represents a smaller, but active, secondary spare parts corridor. JP Lwarhoga Lipadi is actively selling hand pumps and spare parts to ACTED, primarily for Kongolo projects. Lipadi has hundreds of spare parts in stock for both India Mark II and Afridev pumps.

Figure 14: Primary, secondary, and potential spare parts supply corridors in the DRC



Three other potential supply corridors exist through Kalemie, Kinshasa, and Impfondo. In Kalemie, WMCs identified K-Hamie as a local supplier who occasionally stocks spare parts. K-Hamie is one of the largest hardware and construction suppliers in Kalemie, and has supplied hand pumps and spare parts to ACTED and Solidarités in the past, and is willing to begin stocking on speculation (without a contract in place) if he knows the projected level of demand for spares from NGOs and WMCs. K-Hamie sources hand pumps and spare parts from traders in Tanzania, who, in turn, are buying directly from manufacturers in India. Kinshasa, somewhat surprisingly, only has two active spare parts suppliers. First, Getraco, who exclusively sells and maintains Vergnet hand pumps, actively stocks spare parts although exact inventory and price information was not available. Second, Africa Solutions, a mining supply and drilling company headquartered in

Lubumbashi, had forty complete spare parts kits in stock as of August 2014. Africa Solutions sources exclusively from India Mark II and Afridev manufacturers in India. Lastly, two active suppliers were identified in Impfondo who report selling hand pumps and spare parts to ACTED in Equateur province. La Joie and Ali both report sourcing spare parts for India Mark II and Afridev pumps from Cameroon.

Figure 14 highilights primary, secondry, and potential spare parts supply corridors in the DRC. Red arrows represent external trade flows through Lubumbashi, Goma, Bukavu, Kinshasa and Impfondo. Green solid arrows represent actual internal trade flows and green dashed arrows represent past or intermittant trade flows. Yellow arrows represent medium-potential internal trade flows and black dashed arrows represent lower-potential internal trade flows. Facilitating the start-up of spare parts suppliers in these corridors will be difficult, and will likely require special incentives to engage in spare parts stocking. Potential incentives may include guaranteed purchase contracts for an initial period of time (perhaps 12 months), access to lower cost finance to limit working capital risk, and possibly consignment arrangements with larger suppliers

Figure 15: Hand pump and spare parts suppliers in the DRC as of August 2014.

SUPPLIER NAME	TYPE	CURRENT STATUS	LOCATION	HAND PUMP STOCK				SPARE PARTS STOCK					SP STOCK RATING	PRIMARY SOURCE	MANUFACTURER LOCATION	PAST CLIENTS
				IM II	IM III	AFD	VGNT	IM II	IM III	AFD	VGNT	Tools				
Africa Business	Large Reg.	Actively Stocking	Lubumbashi	20	0	30	0	21 kits	0	13 kits	0	6	5	Swaziland, Nairobi	Swaziland, India	Concern, ACTED
Solutions for Africa	Large Reg.	Actively Stocking	Lubumbashi	0	0	25	0	0	0	0	0	0	1	India	India	ACTED, GOL
Solutions for Africa - Kin	Med. Reg.	Actively Stocking	Kinshasha	20	0	20	0	20 Kits	0	20 Kits	0	0	4	India	India	Private
Congostore 1 - Geovahnie	Large Reg.	Actively Stocking	Lubumbashi	75	0	0	0	75 Kits	0	0	0	0	4	Tanzania	India	Multiple
Mutachi	Large Reg.	Actively Stocking	Lubumbashi	10	0	30	0	10 Kits	0	30 Kits	0	0	4	Tanzania	India	Multiple
Meli Melo	Small Reg.	Actively Stocking	Bukavu	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3	Tanzania, Nairobi	Kenya, India	ACTED
JP Lwarhoga Lipadi	Small Reg.	Actively Stocking	Bukavu	26	0	29	0	100+	0	100+	0	0	4	Tanzania	India	ACTED
Getraco (Vergnet)	Large Nat.	Actively Stocking	Kinshasha	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	4	France	tbd	Unicef
Bon Berger	Large Reg.	Actively Stocking	Goma	0	0	0	0	17 kits	0	6 kits	0	0	2	Kampala	Kenya, India	Oxfam GB
Shalom	Large Reg.	Actively Stocking	Goma	0	0	13	0	0	0	13 SP	0	0	2	Kampala, Nairobi	Kenya, India	WV, Solidarites
La Joie	Small Reg.	Actively Stocking	Impfondo	4	0	0	0	4 Kits	0	0	0	0	2	Cameroon	India	ACTED
Ali	Small Reg.	Actively Stocking	Impfondo	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2	Cameroon	India	n/a
New Construct	Large Reg.	Intermittant	Kinshasha	65	0	0	0	0	0	0	0	0	0	Tanzania	India	n/a
Lasha	Small Reg.	Intermittant	Kinshasha	10	0	0	0	0	0	0	0	0	0	Tawain, Turkey	India	n/a
Enterprise den de dieux	Small Local	Intermittant	Kongolo	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	Bukavu, Tz	India	ACTED
Satelii d' enterprise	Small Local	Intermittant	Kongolo	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	Bukavu, Tz	India	ACTED
Tumaini	Large Reg.	Intermittant	Goma	0	0	0	0	0	0	0	0	0	0	Kampala, Nairobi	Kenya, India	Oxfam GB
La Mann Blanche du Ciel	Large Reg.	Intermittant	Goma	1	1	1	0	0	0	1 SP	0	0	1	Kampala, Nairobi	Kenya, India	Oxfam GB
La Joie II	Large Reg.	Intermittant	Goma	0	0	3	0	0	0	0	0	0	0	Kampala	Kenya	Multiple
Quing-Material	Med. Reg.	Past supplier, IS	Kinshasha	2	0	0	0	0	0	0	0	0	0	India	India	n/a
K-Hamie	Small Reg.	Past supplier, NS	Kalemie	0	0	0	0	0	0	0	0	0	0	Tanzania	India	ACTED
URSS	Med. Local	Past supplier, NS	Manono	0	0	0	0	0	0	0	0	0	0	Lubumbashi	India	ACTED, Gol
Mugisho	Small Reg.	Past Supplier, NS	Bukavu	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	Tanzania	India	ACTED
Paulin	Small Local	Open to 50/50	Manono	0	0	0	0	0	0	0	0	0	0	n/a	n/a	None
Quin-Mat	Large Reg.	Potential Supplier	Lubumbashi	0	0	0	0	0	0	0	0	0	0	None	None	None
Nkulu	Small Local	Potential Supplier	Manono	0	0	0	0	0	0	0	0	0	0	Lubumbashi	India	ACTED

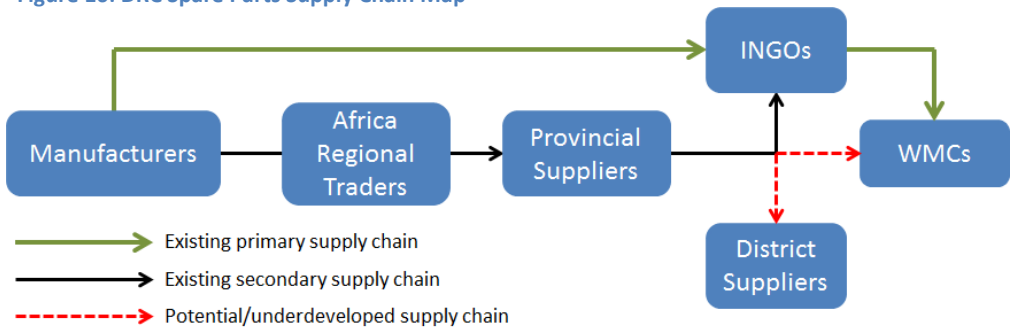
operating in major trade hubs (Lubumbashi, Goma, etc.). Figure 15 details a comprehensive list of spare parts suppliers identified. Suppliers were categorized as actively stocking, intermittent stocking, past suppliers, and potential suppliers. Although active spare parts suppliers were unwilling to share full inventory and price lists, AO consultants conducted spot checks of supplier warehouses and stock rooms to verify that suppliers were actually stocking, and to take a preliminary inventory of spare parts on hand.

The second column of the table describes the type of supplier by size and reach. For example, 'Large Reg.' signifies a large regional supplier, 'Large Nat.' represents a large national retailer, and so on. Only Getraco, the exclusive supplier of Vergnet pumps and spare parts has true national reach. Several suppliers such as Africa Business (Lubumbashi trade corridor), Bon Berger (Goma trade corridor), and New Construct (Kinshasa trade corridor) are large suppliers who serve their respective regions. All of the Bukavu suppliers identified are classified as small suppliers with regional reach, although JP Lwarhoga Lipadi has the capital to supply large orders of hand pumps and spare parts. Lipadi chooses not to regularly stock large quantities of spare parts due to slow turn-over which ties up his working capital. Similar to K-Hamie in Kalemie, Lipadi specifically stated that if he could project NGO and WMC spare parts procurement needs with a reasonable degree of accuracy, he would be willing to carry greater quantities of parts on a speculative basis.

5.2 Spare Parts Supply Chain Map

Figure 16 is a basic schematic of the DRC hand pump spare parts supply chain. Manufacturers are located in India, France, Kenya, Swaziland, and Mozambique (see Figure 9 for geographic detail for each value chain actor), but most INGOs are purchasing both hand pumps and spare parts directly from manufacturers in India (green arrow). WMCs are almost exclusively supplied by INGOs either through initial spare part stocks that are typically depleted within two years, or through post-construction spare parts provision. The heavy reliance of WMCs on INGOs for spare parts is not sustainable and is hindering the organic development of the spare parts supply chain (see Section 5.5). Despite hypotheses to the contrary, however, an underdeveloped but functioning spare parts supply chain does exist in the DRC. Large provincial suppliers such as Africa Business (Lubumbashi), Bon Berger (Goma), and JP Lwarhoga Lipadi (Bukavu), are purchasing spare parts from regional traders in Nairobi, Tanzania, and to a lesser degree Swaziland. The procurement of spare parts via regional traders adds additional transportation and margin costs that render local supply uncompetitive (see Section 5.6). Provincial supplier direct procurement from manufacturers would decrease their cost-basis, increase competitiveness, and generate sufficient margins to motivate increased stock levels, linkages which should be facilitated by INGOS.

Figure 16: DRC Spare Parts Supply Chain Map

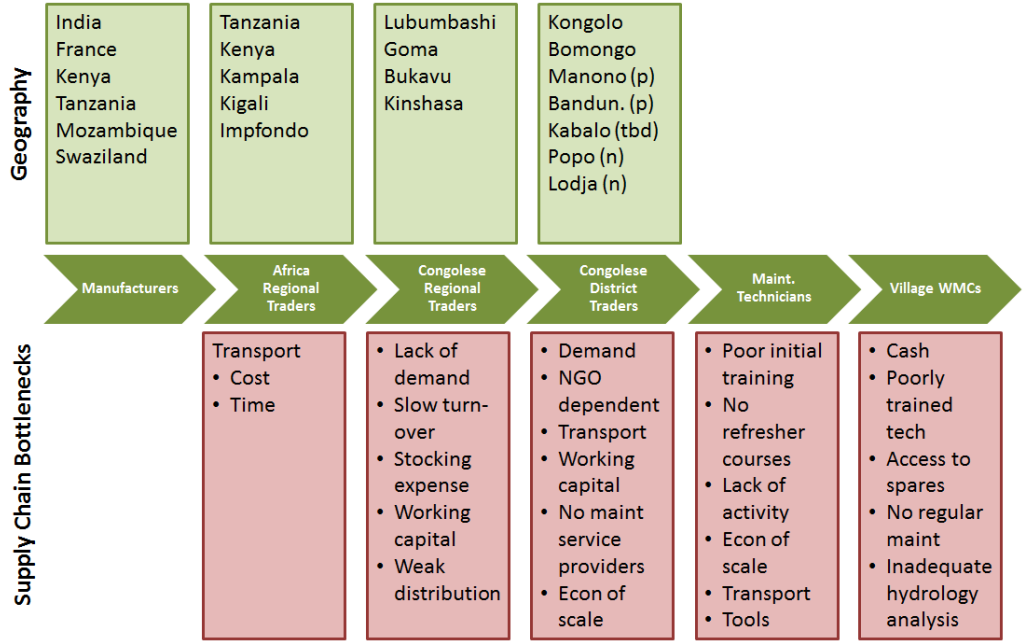


Provincial suppliers are supplying INGOs who procure at least some of their hand pump and spare part requirements locally, such as ACTED and Solidarites. Suppliers such as Africa Business have maintained sizeable spare parts inventories for the past two years in anticipation of increased demand from INGOs, which they say has yet to materialize. Provincial suppliers also sell to district-level suppliers on a limited basis. Specific examples identified include Enterprise den dieux and Satelii d' Enterprise in Kongolo. URSS in Manono has supplied ACTED in the past, but they report purchasing spare parts from regional traders in Tanzania. The few active district suppliers identified sell to INGOs, and sell to WMCs directly only very rarely (every two years or so). Black arrows in Figure 8 demonstrate existing, but secondary supply chains, and red arrows depict supply chain links that are non-existent, due in large part to heavy INGO intervention in the spare parts supply sector. Specific bottlenecks were identified along each step in the supply chain, and are summarized in Section 5.3.

5.3 Spare Parts Supply Chain Bottlenecks

Although an active supply chain for hand pump spare parts exists in the DRC, several bottlenecks are preventing from the supply chain from operating efficiently and in more diverse geographic areas. Figure 17 summarizes key bottlenecks for each actor in the spare parts supply chain. The top half of the figure identifies primary geographic locations of supply chain actors. Hand pump manufacturers in international (India, France) and regional (Nairobi, Dar Es Salaam, Mozambique) locations are providing an adequate supply of hand pumps and spare parts, and do not represent a supply chain bottleneck. Poor transportation infrastructure between African Regional Traders and their Congolese counterparts, however, is adding significant cost that discourages local and regional procurement by INGOs in the DRC (see Figures 21 to 25 for cost analyses). An additional constraint is the delivery time from Africa regional traders to the DRC, with Congolese suppliers reporting an average delivery time of one month to primary trading hubs (Lubumbashi, Goma, Bukavu). Suppliers report that poor transportation infrastructure is the primary cause of long delivery times, as most spare parts are transported overland. Customs clearance procedures at DRC border crossings, however, are surprisingly efficient with an average clearance time of four days.

Figure 17: Spare parts supply chain bottlenecks in the DRC (August 2014)



Congolese Regional Traders such as Africa Business (Lubumbashi), Bon Berger (Goma), and JP Lwarhoga Lipadi (Bukavu) face several bottlenecks that constrain their ability to stock adequate inventories of spare parts. First, the slow turn-over of spare parts creates supplier reluctance to tie-up working capital in items that may not sell for several months, or even years. Suppliers consistently reported that their primary reason for not stocking more parts was the lack of demand from INGOs and WMCs. Suppliers also report that the lack of predictability of INGO and WMC demand is also an important factor constraining stock levels. Unpredictable order patterns (volume and timing, not pump manufacturer type) increase supplier risk that spare parts purchased for inventory (prior to client orders) will remain unsold. This is a classic supply chain failure whereby buyers (INGOs and WMCs) report that they are unable to procure needed spare parts locally due to lack of availability and suppliers report that insufficient market demand limits their willingness to stock spare parts (see Section 5.5 below for an analysis of the impact of international procurement of spare parts by INGOs). An additional bottleneck at the Congolese Regional Trader level is a weak distribution network to smaller traders in the interior of the country. These regional traders tend to supply INGO clients directly, without using provincial or community-level traders or sales agents. The lack of provincial and local distribution networks increases delivery times (from one week for local procurement to more than one month for regional procurement) and hurts supplier ability to effectively market spare parts inventories to clients operating outside of large regional trading centers (e.g., Lubumbashi). The lack of these networks is unique to hand pump and spare parts, as other products tend to have higher volumes and suppliers have developed networks of interior (community-level) retail clients.

The next group of actors in the spare parts supply chain, Congolese District Traders, also face several constraints to increased spare parts inventories and efficient supply to village-level clients. Similar to larger regional traders, district suppliers report that the lack of demand for spare parts drives their stocking decisions. Several district traders know where and how to procure parts from Congolese and international suppliers, but are choosing not to stock because of the slow turn-over of spare parts. The risk of slow sales is increased by limited working capital available to most district traders. Although improved access to finance would encourage increased spare parts stocking, district suppliers report that they would still be wary of stocking spare parts due to low demand. District suppliers who either currently stock spare parts (Enterprise den de dieux and Satelli d' enterprise in Kongolo), or who have stocked spare parts in the past, are almost completely dependent upon INGOs for sales. This heavy NGO dependence, driven by WMC inability to procure spares directly, impedes a natural market development that renders the supply chain inefficient and currently unstainable. An additional bottleneck for district suppliers is the dearth of maintenance service providers. The lack of well trained technicians within WMC's and as private service providers limits the knowledge and promotion of spare parts inventories that are often only hours away from hand pumps in need of repair.

Most WMC technicians have no practical (hands-on) training, are unable to assess the cause of pump failures, and believe that the only source of spare parts is the NGO who funded hand-pump installation.

Maintenance service providers themselves are key actors in the spare parts supply chain. They include WMC technicians, independent technicians, and most often, NGO staff members who serve as de facto technicians for WMCs. Nearly all of the 29 WMCs interviewed by AO consultants included at least one pump technician among its membership. Most WMC technicians report having received training from NGOs sponsoring hand pump water point development. However, the content, methodology, and frequency of trainings are not adequately developing technical expertise necessary to maintain and repair hand pumps. Most WMC technicians note that they received only one training that typically did not involve practical, hands-on exercises. Several pump technicians mentioned that they have yet to actually open a pump head. In addition to the low technical capacity of most WMC pump technicians, only one WMC technician knew where to purchase spare parts in the event of break down. When asked where they would procure spare parts, most technicians said they would call the NGO who installed the pump. NGOs clearly have a responsibility to not only train technicians, but to ensure that technicians are aware of where they can procure spare parts independent of NGO contact. The lack of market linkages between pump technicians and existing suppliers represents a significant bottleneck in the supply chain that results in prolonged periods of non-operation and the slow turn-over of spare parts constraining supplier ability to stock larger quantities. Approximately half of the WMCs interviewed did not have their hand pump tool kits. Many share one tool kit with three or for other WMCs within a 15 kilometer radius, and the loss of tools during rotation is common. WMC's should be encouraged to assign responsibility for tool kits to a single individual, and possibly require modest cash deposits when tool kits are loaned to neighboring WMCs. The key conclusion is that WMC pump technicians are still dependent upon NGO technical staff for repairs and spare parts sourcing.

Several factors also constrain the development independent maintenance service providers. One alternative business model explored in Section 7 is the provision of maintenance and repair services by for-profit small enterprises. First, large distances between hand pump water point clusters increases transportation costs for maintenance visits and repair calls. The lack of hand pump clusters also reduces the number of hand pumps that can realistically be serviced by a provider, and reduces the overall volume of maintenance and repair activity. Low maintenance and repair volumes result in lower revenues and high unit costs (e.g., cost per repair). Infrequent repairs also force 'for fee' providers to pursue other income opportunities reducing their immediate availability when their services are needed. Additional livelihood activities include bicycle and motorcycle repair, small-scale trade, and even agriculture. Repair infrequency also reduces the technical readiness of WMC pump technicians as the skills they do have dull over time. Lastly, independent service providers, and certainly WMC technicians, are not able to achieve sufficient economies of scale to stock even the most frequently need spare parts (i.e., O-rings, bearings). The lack of economies of scale at the community level translates into poor economies of scale at the district and provincial level, which further impacts the propensity of larger regional suppliers to increase spare parts inventories. Lastly, direct NGO procurement of spare parts from manufacturers creates competition for potential independent service providers who rely upon profit margins from spare parts sales to cover operating costs and overhead.

Finally, water management committees represent the final link in the spare parts supply chain. As the technical and managerial capacity of WMCs is critical factor in the sustainable provision of hand pump water services to community members, we have devoted a separate section of

this report to discuss our analysis of current WMC capacity and opportunities to improve their management, operations, and sustainability. Key bottlenecks constraining cost-effective and timely procurement of spare parts by WMCs include: 1) poor technical knowledge; 2) failure to charge *and* collect adequate user fees (often due to readily available alternative water supplies, even though deemed unsafe); 3) poor financial management; 4) inadequate regular maintenance; 5) lack of market information regarding spare parts procurement and 6); an over-reliance on INGOs for repair services and spare parts procurement.

Quality and Functionality of Different Hand Pump Makes and Models

One objective of this study is to determine if poor manufacturer quality is driving high failure rates of hand pumps in the DRC, and to determine if any one model has higher failure rates than others. The most common hand pump models in use are India Mark II and Afridev pumps. One functioning India Mark III pump was identified in the 29 villages surveyed. We found no evidence that any one pump type fails more often than others. We also found little evidence that poor manufacturer quality was a significant cause hand pump system failure. Field observations indicate that high failure rates and low functionality rates are due primarily to the lack of regular maintenance, low WMC technical capacity, the lack of market linkages to spare parts suppliers, poor engineering of the well itself, and inadequate hydrology and geologic analyses prior to well drilling and installation of hand pumps. A common finding was that NGOs have been installing hand pump water points without proper analysis of water-table depth, flow rates, especially during the dry season. This has led to the under-performance or non-performance of hand pump water points only months after installation. For example, roughly 20% of hand pumps surveyed in Bandundu and Katanga provinces never functioned properly, with well depletion occurring within the first two to three weeks of operation. Many WMCs also reported that hand pumps failed during the first few weeks of the dry season. As water levels diminish during the dry season, community members continue to operate the pumps even with extremely low water flows. This may be causing extraordinary stress on hand pumps including continual pumping without water and the introduction of high levels of sediment into pump components. Surveys also indicate that shallow dug wells fail more often than deeper boreholes, although a high percentage of bore hole hand pumps are failing too. In this case, hand pump 'failure' does not mean a lack of water during the dry season, but rather that hand pumps initially broke down during the dry season and did not return to functionality as water levels increased in the subsequent rainy season. Proper hydrology analyses prior to hand pump installation is critical to the success and medium-term sustainability of hand pump water points. As discussed in Section 6, poorly designed wells (including poor site selection) that do not provide water during the dry season (when drinking

Villagers question a community mobilizer about a hand pump water point installed by a previous INGO that has never properly functioned.

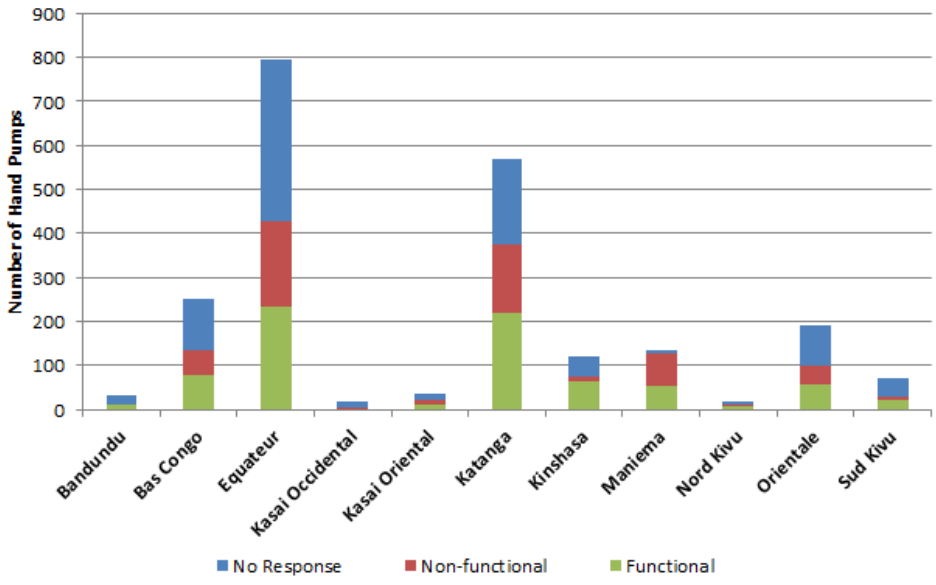
water is obviously most needed) significantly impacts water user confidence in the hand pump system and severely limits their willingness to pay for water services.

5.4 Existing Utilization of Hand Pump Water Points in the DRC

AO was tasked with quantifying the number and location of water points using hand pumps in the DRC using secondary data. One objective of this analysis is to assess the durability of different hand pump makes and models. The lack of comprehensive data regarding the make and models of hand pumps installed in the DRC has rendered this objective impossible. However, a quick review of the data that does exist does provide insight into the overall number of hand pump installations, density per province, and high-level (although incomplete) data regarding hand pump failure rates.

The most comprehensive data set is from the 2011 STUDI International[10] survey of water and sanitation conditions of almost 7,000 villages. STUDI found that over 2,200 hand pump water points exist across eleven DRC provinces.

Figure 18: Number of hand pumps by province and functionality; 2011 (STUDI International)



Of this total, no functionality data was available for over 920 hand pumps. Of the approximately 1,300 with functionality data, over 500 were found to be non-functional for a failure rate of 43%. The STUDI International survey did not include information on the types of pumps installed. As such, it is not possible to draw conclusions as to the durability/failure rate per hand pump type.

According to the STUDI survey, Equateur has the greatest number of hand pump water points with just under 800 pumps. Katanga province is next with roughly 550 hand pumps installed. Failure rates for both provinces are consistent with failure rates nation-wide.

AO also analyzed data from WASH RDC surveys of hand pumps installed or assisted by consortium partners, or previously existing hand pumps in WASH RDC target areas (Manono).

[10] *ELABORATION DU PLAN NATIONAL D'ALIMENTATION ENEAU POTABLE ET D'ASSAINISSEMENT EN MILIEU RURAL ET SEMI-URBAIN « A L'HORIZON 2015 » CEP-O / PEASU*, STUDI International, 2011.

Very few WASH RDC partners reported installing or assisting hand pump water points. Of eight ACF water points in Bandundu provinces, all were protected (but not community managed) springs. ACTED reported no hand pumps out of its 60 water points in Katanga and 24 water points in Equateur. At the time of the WASH RDC survey, CRS had yet to install or improve any water points, and Solidarites reported only one hand pump (an India Mark II), which was not functional. Only Concern Worldwide provided data on hand pump water points. Concern reported 45 Afridev hand pumps in Manono district (not including Manono town), all of which were functional at the time of the survey. This 0% failure rate is likely due to the newness of hand pumps surveyed, with the oldest pump being installed in 2010 and the majority being installed in 2011. For the 24 hand pumps surveyed in Manono town (no data on make and model provided), 17 were functional with other hand pumps either not functioning or only functioning during the rainy season.

Lastly, AO identified 16 hand pumps managed by the 33 WMCs surveyed. Of these, eight were Afridev pumps, seven were India Mark II pumps, and one was a Vergnet pump. Although the sample size is too small to draw any meaningful conclusions about failure rates by hand pump make and model, half of the Afridev pumps were not functional, all seven India Mark II pumps were functioning, and the single Vergnet pump was no functioning. Functionality was not dependent on the age of the water point, as the Afridev and India Mark II pumps had almost the same age profile with the oldest water point being 2007 and with a median installation year of 2010.

5.5 NGO-induced Demand-side Market Failure

INGO direct procurement of hand pumps and spare parts from manufacturers deprives the supply chain of demand and liquidity necessary to sustain a properly functioning supply chain. Although previous INGO procurements from Congolese suppliers helped develop supplier sourcing knowledge and minimum stocking levels, a lack of consistent demand has prevented what would otherwise be an organic development of an interior supply network. One reason why INGO procurement of spare parts (and hand pumps) has diminished is that INGOs have been able to procure spare parts directly from manufacturers at much lower prices (even with transportation). Continued WMC reliance on INGOs for spare parts further contributes to the underdeveloped supply chain, as an additional source of spare parts demand has essentially been 'crowded-out' by continued INGO spare parts provision. Of the 33 WMCs interviewed (with pump installation dates ranging from 2006 to 2014, and a median installation year of 2013), only one example of a self-motivated hand pump water point repair was identified. In June of 2014, the Myumba (Katanga province) village WMC was able to diagnose which pump component had failed (a bearing), procured the needed part from Manono town two hours away, and completed the repair all within one week. When asked how the WMC was able to carry out the repair without external support, the WMC technician responded that 'since no NGOs have operated in their village for several years, we knew they would have to find a solution on their own.' The technician had previously travelled to Manono town to show hardware suppliers a spare parts list the WMC received at installation to investigate what was available. Although suppliers continued to stock only the most common of spare parts, such as O-rings and bearings, the initiative of the technician is an indication of what is possible if INGOs shift from direct procurement to a finance and facilitation role.

Figure 19: INGO direct procurement deprives the supply chain of liquidity and demand-pull.

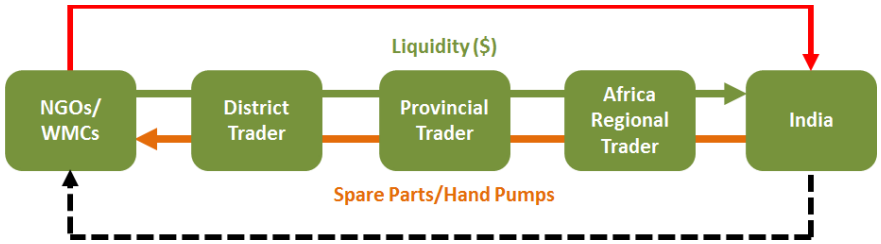


Figure 20: Common themes from spare parts suppliers.

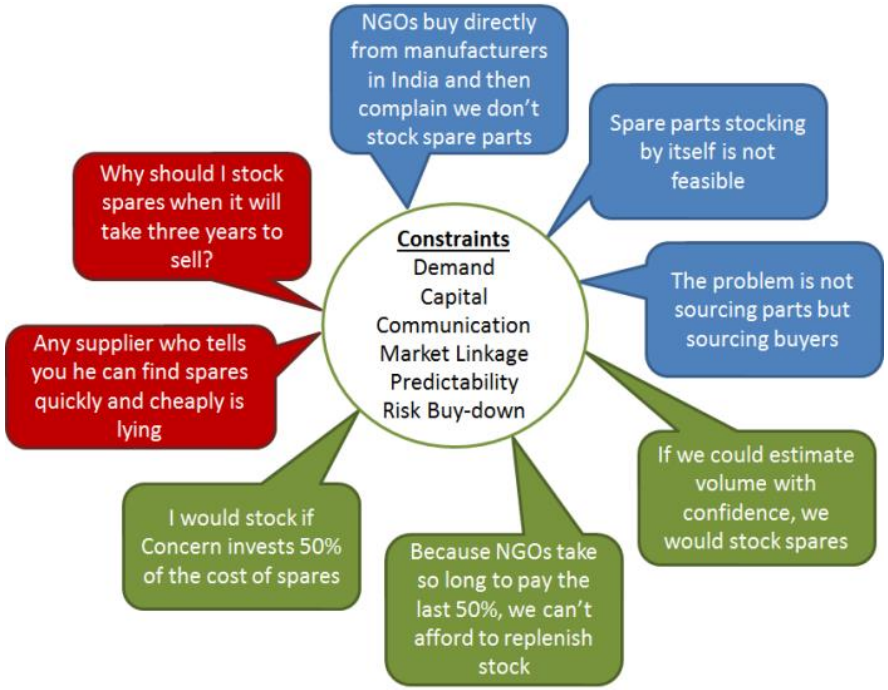


Figure 19 depicts procurement of hand pumps and spare parts

directly from manufacturers (black and red arrows), liquidity is removed from the DRC spare parts supply chain (green arrow). Regional traders, provincial traders (e.g., Africa Business), and district traders (e.g., URSS in Manono) are unwilling to stock spare parts inventories (orange arrow). Direct INGO procurement is contributing to a classic market failure whereby buyers claim that inadequate supply exists to meet demand, and suppliers claim that low demand prevents them from stocking larger and more diverse inventories. INGOs, therefore, should strive to procure from local suppliers whenever possible, even if it means paying higher prices. It is also important to note that increased access to finance for suppliers, in combination with or in lieu of direct procurement, would not necessarily increase spare parts stocks as suppliers are reluctant to accept risks associated with loan and interest payments if volume and consistency are uncertain.

Common themes from spare parts suppliers (highlighted by Figure 20) include:

Demand: All suppliers mentioned that low demand for spare parts discourages them from increased stocking.

Capital: Although not a solution by itself, increased access to working capital and creative finance mechanisms (consignment) would help suppliers (especially local and district suppliers) to carry more stock.

Communication/predictability: Regular communication of spare parts procurement projections from INGOs and WMCs will develop confidence needed to increase spare parts stocks and to help suppliers manage their cash flow by better matching supply and demand levels.

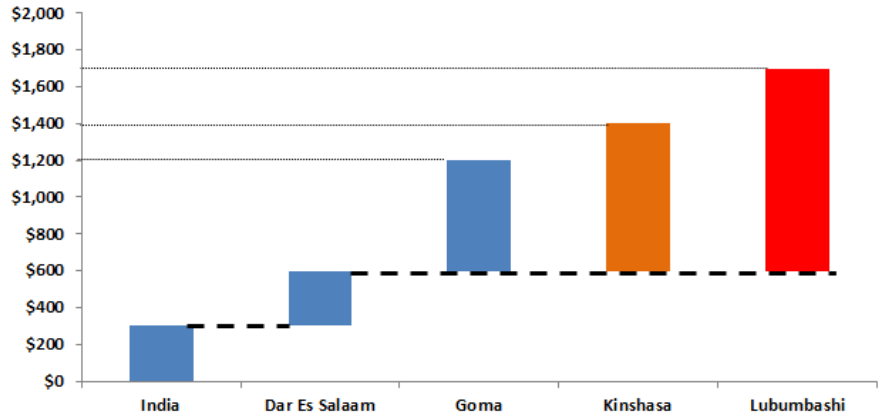
Market Linkage: Greater effort needs to be made to connect WMCs directly to local, district and provincial-level spare parts suppliers. A simple Supplier Directory with contact information would be helpful to remote WMCs who currently have no knowledge that spare parts are available in country. Similarly, local and district hardware suppliers who have the wherewithal to stock hand pump spare parts also have little knowledge about larger spare parts wholesalers operating in Lubumbashi, Goma, and Bukavu. Introductions via business-to-business (B2B) networking events will increase knowledge, familiarity, and trust throughout the supplier chain. B2B networking events have proven an effective means to increase confidence and generate business relationships in finance and international trade sectors in numerous developing countries. In the DRC hand pump spare parts sector, the resulting increase in familiarity and trust can help catalyze creative stocking and finance mechanisms such as consignment, commission-based sales, and co-investment by different suppliers in increased spare parts inventories.

Risk buy-down: Common themes communicated by spare parts suppliers all relate to the question of market risk. Provincial (and some district) suppliers have the knowledge, capacity, and financial wherewithal to stock adequate supplies of spare parts for INGO and WMC clients, but *choose* not to do so because they lack the confidence that sales volumes will justify the investment of working capital. INGOs could catalyze increased stocking by reducing the real and perceived risk of spare parts suppliers. Risk buy-down is a finance term typically associated with insurance and time arbitrage. For the spare parts supply chain, risk buy-down could include creative solutions such as payment of stocking fees that could be refunded upon purchase, co-financing of spare parts inventories of local and district traders, and by publishing quarterly or bi-annual projections of future spare parts purchases.

5.6 Supply Chain Cost Analysis and Profit Capture

INGO decisions to procure directly from manufacturers are driven to a large degree by the high cost of local procurement. INGOs must responsibly manage donor resources and are often constrained by 'lowest cost' procurement policies, and policies requiring international procurement for items exceeding cost thresholds. AO conducted a supply chain cost analysis to better understand the costs and benefits of local procurement. We began with an analysis of hand pump costs due to a better availability of data down to the village level. Costs presented in this section are based upon actual INGO procurements in Katanga province and conversations with Congolese regional traders (e.g., Africa Business). Figure 21 summarizes the cost of a new Afridev hand pump at various procurement locations. The cost graph demonstrates the high cost of procuring locally, as the point-of-sale cost of locally procured hand pumps is $600 to $1,100 more expensive than wholesale prices in Dar es Salaam ($612) and $800 to $1,400 than wholesale prices in India ($306). Although profit margins certainly influence the final retail prices of hand pumps in the DRC, other factors such as transportation costs, overhead and duties, and unfavorable purchase terms with intermediate suppliers also contribute to high local costs.

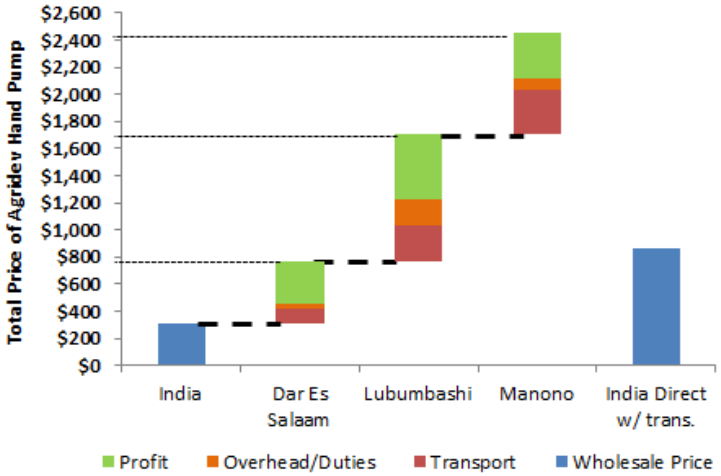
Figure 21: Comparative cost of an Afridev hand pump by procurement location.



The point-of-sale costs in Figure 21 above represent the cost of procuring hand pumps in the source markets identified. For example, if a Congolese trader were to travel to Dar Es Salaam to buy a hand pump, he would on average pay approximately $612 for the pump based upon conversations with Dar traders. However, review of purchase contracts indicate the Congolese suppliers are paying $765 on average before transportation and import duty costs. This suggests that Dar Es Salaam traders are charging above wholesale for pumps due to the relatively low purchase volume of Congolese suppliers. Figure 22 details cost components of retail prices at various points along the hand pump supply chain from India to Manono town in Katanga province. Costs are broken down into: cost of goods sold (manufacturer price plus intermediate supplier costs), transportation, overhead and duties, and profit. The $1,702 price for an Afridev hand pump in Lubumbashi is based upon actual prices from Africa Business. Other cost components are estimated based upon conversations with suppliers and interpolation, with the exception of Lubumbashi (LBB) to Manono transport costs, which are based upon actual costs as of July 2014. If an INGO operating in Manono were to procure an Afridev hand pump from a local trader, it would pay approximately $2,450 given current the current market structure and volume levels. This compares to a total cost of $859 (including interior transport) if the INGO were to purchase hand pumps directly from the

manufacturer in India (based upon an actual recent procurement). Despite the economic development benefits of local procurement, the INGO would have a difficult time justifying the higher cost of local procurement to its donor.

Figure 22: Cost and profit analysis for the DRC hand pump supply chain – Status Quo 2014



SQ full supply chain with district trader (Low Volume)

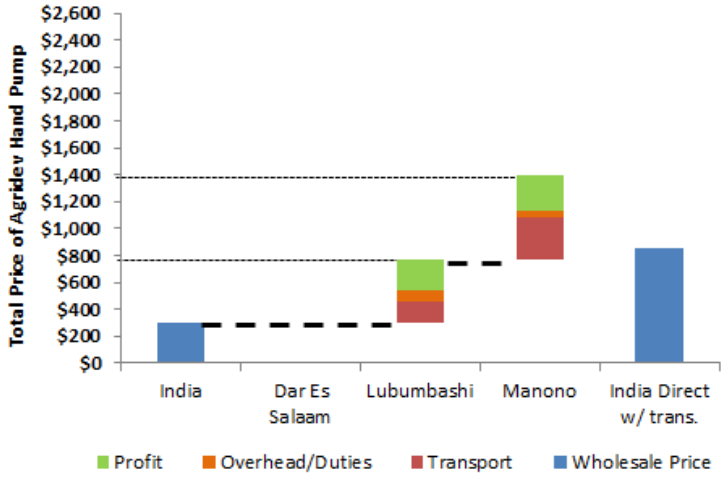
	India	Dar E.S.	LBB Trader	MNN Trader	India Direct
Manufacturer Price	$306.00	$306.00	$765.00	$1,702.13	$859.00
Transport	$0.00	$107.10	$267.75	$324.00	
Overhead/duties	$0.00	$45.90	$191.25	$85.11	
Profit	$0.00	$306.00	$478.13	$340.43	
Total Price	**$306.00**	**$765.00**	**$1,702.13**	**$2,451.66**	**$859.00**
Proft Margin	**n/a**	**40.0%**	**28.1%**	**13.9%**	

An additional conclusion from the analysis of status quo costs and profit capture is that the LBB trader in this example is making $478 of profit per hand pump, the largest profit capture along the supply chain in absolute terms. In percentage terms, Dar Es Salaam traders currently have the highest profit *margins* along the supply chain at 40%, compared to 28.1% for LBB traders, and only 14% for local traders. Interviews with district traders in Manono indicate that they would forgo their typical mark-up of 50% to capture larger absolute profit amounts. District traders noted that they require between $200 and $350 of profit on each pump (depending on volume) to stock hand pumps in Manono. If purchase volumes were increase and were more predictable, both Congolese regional trades (Africa Business) and district traders would be willing to cut profit margins.

Import duties also represent a significant cost to regional suppliers bringing hand pumps (and spare parts) across borders. For a typical LBB trader, they have to pay roughly $150 in duties and informal 'fees' to quickly clear a $765 hand pump (a 20% tax). One trader in Goma is now charging $2,300 for an Afridev pump (without volume discount) in order to cover new import duties (up from $1,200). Although other traders are still selling pumps at $1,200, they likely have found alternative means to avoid formal duties. Traders are only able to secure legal tax exemptions if an INGO has issued a purchase order. Any hand pumps or spare parts purchased for future stocking purposes are required to pay

import duties. Import duties represent an additional constraint to increased spare parts stocking levels. This represents an important advocacy opportunity for INGOs and WMCs, who should negotiate tax free status for hand pumps and spare parts that stocked for future sale by suppliers. If NGOs issue a purchase order for spare parts to local suppliers (or if they important directly from abroad), they qualify for duty-free status. However, suppliers who want to stock spare parts of which 95% will likely be sold to NGOs for the same projects are subject to import duties.

Figure 23: Supply chain cost and profit analysis if provincial traders source directly from manufacturers (low volume).

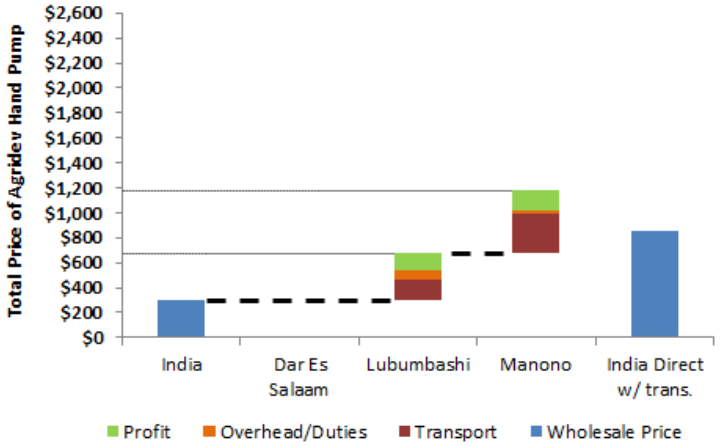


Provincial trader direct from India, district trader (low volume)

	India	Dar E.S.	LBB Trader	MNN Trader	India Direct
Manufacturer Price	$306.00	$0.00	$306.00	$765.00	$859.00
Transport	$0.00	$0.00	$153.00	$324.00	
Overhead/duties	$0.00	$0.00	$76.50	$38.25	
Profit	$0.00	$0.00	$229.50	$267.75	
Total Price	**$306.00**	**$0.00**	**$765.00**	**$1,395.00**	**$859.00**
Proft Margin	**n/a**	**n/a**	**30.0%**	**19.2%**	

The second cost scenario analyzes the impact on pricing and supplier profit if Congolese suppliers are linked directly to manufacturers (in India) instead of procuring from Dar Es Salaam traders. As with the status quo scenario, costs are based on delivery of hand pumps to an INGO in Manono. Figure 23 above details the cost components and profit capture of each actor in the hand pump supply chain, assuming continued low purchase volumes. The final price of a delivered hand pump in Manono procured through a district (local) trader drops from $2,450 to $1,395 if Congolese regional traders are linked directly with manufacturers in India. Cost savings are achieved by bypassing costs and profit associated with Dar Es Salaam traders, and a lower cost basis upon which profit, overhead and duties are calculated. Although absolute per unit profit for the LBB trader drops from $478 to $230, their profit margin actually increases. Profit margins for the Manono trader in this scenario similarly jump from 14% to just over 19%. The resulting final price of $1,395, while much improved over the status quo, is still 62% higher than prices obtained by INGOs when procuring directly from the manufacturer, and would likely still be difficult to justify. However, if local procurement volumes increase and suppliers are better able to predict INGO procurement pipelines, further savings can be achieved.

Figure 24: Supply chain cost and profit analysis if provincial traders source directly from manufacturers (high volume)



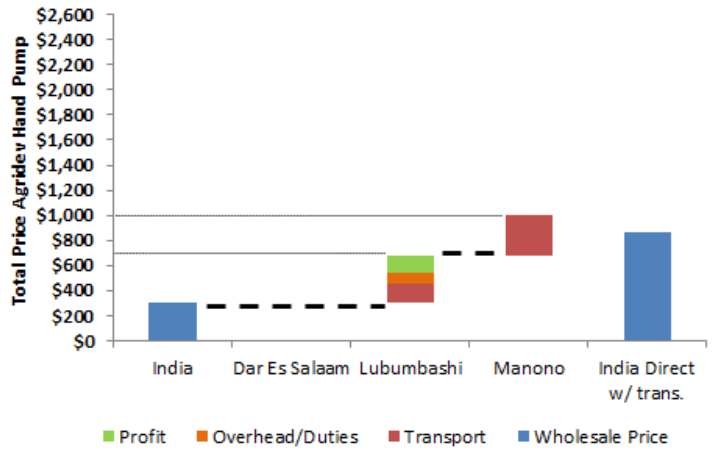
Provincial trader direct from India, district trader (higher volume)

	India	Dar E.S.	LBB Trader	MNN Trader	India Direct
Manufacturer Price	$306.00	$0.00	$306.00	$673.20	$859.00
Transport	$0.00	$0.00	$153.00	$324.00	
Overhead/duties	$0.00	$0.00	$76.50	$15.30	
Profit	$0.00	$0.00	$137.70	$168.30	
Total Price	**$306.00**	**$0.00**	**$673.20**	**$1,180.80**	**$859.00**
Proft Margin	**n/a**	**n/a**	**20.5%**	**14.3%**	

Figure 24 summarizes cost, profit and price projections if volumes are increased (same as procurement chain as scenario two with higher volumes). Under this scenario, the total price of an Afridev hand pump procured through a district trader in Manono is now $1,181, as regional and district traders accept lower profit margins in exchange for higher volumes and faster turn-over. These potential profit margins have been discussed with traders such as Africa Business and are acceptable in principle. However, the total price of $673.20 FOB Lubumbashi is predicated upon the directly linkage of the LBB trader with the manufacturer in India, and also assumes manufacturers are willing to agree to the same pricing and transportation cost terms as previously give to INGO clients. The per unit price difference between local procurement and international procurement is now only $322 (compared to $1,591 under status quo conditions and $536 under the improved linkage, low volume scenario). This price differential is likely acceptable to most donors, especially if the positive impact on spare parts supply at provincial and district levels is clearly communicated. The injection of liquidity into the supply chain should also be specifically communicated, as $306 of the $322 price differential remains within the Congolese economy in the form of trader profits.

If INGOs still have a difficult time justifying the higher cost of local procurement versus procuring directly from manufacturers, an additional strategy is bypass district-level suppliers to procure directly from provincial suppliers. Figure 25 summarizes cost, profit, and price projections of an INGO in Manono procuring Afridev hand pumps from a Lubumbashi supplier at relatively high volumes. This scenario assumes that the LBB supplier requires the same profit margins as in scenario three. Additional costs for delivery in Manono in this scenario are only for transportation costs and are based on actual transportation costs as of July 2014. Under this scenario, the final delivered price of a hand pump

Figure 25: Supply chain cost and profit analysis if provincial traders source directly from manufacturers (no district trader, high volume)



Provincial trader direct from India, no district trader (higher volume)

	India	Dar E.S.	LBB Trader	FOB MNN	India Direct
Manufacturer Price	$306.00	$0.00	$306.00	$673.20	$859.00
Transport	$0.00	$0.00	$153.00	$324.00	
Overhead/duties	$0.00	$0.00	$76.50	$0.00	
Profit	$0.00	$0.00	$137.70	$0.00	
Total Price	**$306.00**	**$0.00**	**$673.20**	**$997.20**	**$859.00**
Proft Margin	**n/a**	**n/a**	**20.5%**	**n/a**	

drops to $997, or only $138 higher than international procurement. The resulting 13.8% increase in costs over international procurement should be easily justifiable given the significant positive impact this small percent price increase would have on the spare parts supply chain.

Translating the Supply Chain Cost and Profit Capture Analysis to Spare Parts and Other WASH DRC Provinces

Due to the availability of excellent cost data at the provincial and district level, we chose to model value addition (marginal costs) and profits for the hand pump supply chain from India to Lubumbashi to Manono in Katanga province. We also had excellent access to Africa Business, based in Lubumbashi, who graciously shared costs of goods sold and profit data. Conversations with Africa Business indicate that nearly identical cost and profit dynamics are at work in the spare parts supply chain. The only tangible difference is the absolute value of costs and profit levels, but cost percentages and margins remain largely the same. The key conclusions and recommendations for the hand pump cost and profit analysis hold true for spare parts, including: 1) facilitate direct linkages between provincial suppliers and manufacturers; 2) facilitate reasonable terms from manufacturers (based upon prevailing INGO terms); 3) advocate for tax exempt status for spare parts stocked on a speculative basis; 4) increase spare parts purchase volumes to obtain lower prices and most importantly, 4); procure spare parts from provincial and local suppliers.

An additional recommendation from this exercise is that INGOs need to improve the transparency and fairness of their procurement processes. One key reason why AO was not able to obtain detailed spare parts information from Congolese suppliers is that they have a high degree of mistrust of INGO procurement procedures. Four suppliers (two in Goma and two in Bukavu) specifically mentioned that unfair procurement practices discourage their stocking of larger spare parts inventories. According to these suppliers, unless they have someone on the "inside", they are not able to secure contracts. INGO procurement officers only procure from known connections in order to receive benefit from procurements. While these allegations could not be verified, the fact that some suppliers hold these beliefs is problematic in and of itself.

6. Demand Analysis: Water Management Committees and User Ability to Pay

6.1 Water Management Committee Capacity Analysis

Water management committees and their members represent the demand side of the supply chain equation. Without sufficient, sustained demand, supply chains will not develop or will atrophy into non-existence. As such, an important component of this study is to assess the capacity of water management committees to sustainably manage water systems, including the collection of user fees to pay for repairs and spare parts. Although low incomes in rural areas impacts user ability to pay for water, the ability of WMCs to collect user fees, and user willingness to pay those fees, is ultimately predicated upon quality service delivery, transparency, and communication. AO interviewed 33 water management committees in 29 villages in order to understand the opportunities and challenges from WMC sustainability. AO consultants interviewed four types of WMCs: 1) established WMCs with functional hand pumps; 2) established WMCs with non-functional pumps; 3) newly established WMCs with planned water point improvements (mostly hand pumps) and 4); WMCs undergoing reform and transition.

Figure 26: WMC capacity analysis subject areas.

The objectives of the WMC capacity analysis include:

- Assess the management capacity of WMCs;
- Determine ability to generate water user fees;
- Identify weaknesses in service provision
- Identify common/persistent technical problems;
- Confirm business model revenue assumptions;
- Identify alternative business models;
- Identify success/failure factors.

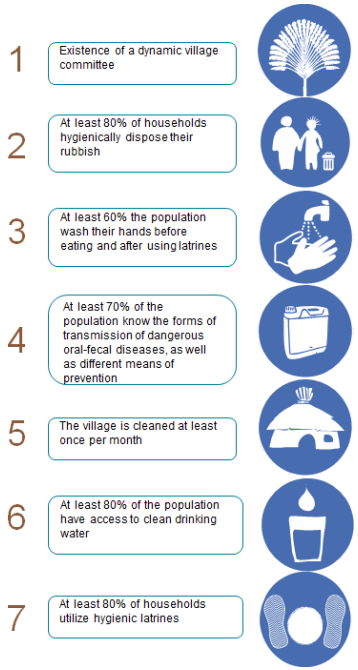
AO organized its analysis of WMCs into six subject areas, including:

- Organizational capacity;
- Transparency and communication;
- Governance;
- Service provision quality;
- Fee generation;
- Financial management.

Overall Conclusions

Although WMC capacity is certainly improving through WASH RDC activities, the base level of WMC capacity is extremely low. WMCs still require significant training in several key areas such as organizational management, financial management, transparency, and the ability to maintain and repair hand pump water points. Even those WMCs who have been engaged in several iterations of NGO training, such as the Lukuato WMC in Manono territory who has been trained by GoI, ACTED, and now Concern, still lack management plans, roles and responsibilities of committee members, operations plans, and business plans that could help WMCs project expected maintenance and repair expenditures and user fees. Although the sequencing of WASH RDC interventions is logical given the concern about raising community expectations and the strategy to leverage water point improvement to motivate behavior change, the delay in WMC organizational and financial management trainings results in WMCs who do not have the necessary capacity to effectively manage newly installed water systems. Therefore, an important recommendation is to reconsider the sequencing of WMC and community trainings to at least begin developing basic management skills *prior* to the installation of improved water points. An important component of these pre-installation trainings should include the development of user fee rates and collection strategies and community sensitization regarding the need to pay for water services. The WASH DRC program conducts such water fee sensitizations currently, but often very late in the WMC development process. Earlier trainings on organizational and financial management could be conducted in parallel with the current 12-step development process. Although such trainings will certainly raise community expectations regarding the probability of water point improvement, the benefits of better trained WMCs at the initiation of water service provision far outweighs the cost of disappointing communities who do not qualify for certification because they do not demonstrate sufficient progress towards the 7 norms with their own resources and have not developed a viable Business Plan for any of the technical options proposed.

Figure 27: WASH DRC seven norms for certification



Organizational Capacity

None of the 33 WMCs interviewed have a formal management and operations plan in place. A few of the more established WMCs have rough guidelines regarding management procedures, but committee members considered the policies in their management plan as something they have to comply with in order to satisfy NGOs. Most WMCs demonstrated very little ownership, or even understanding, of their management and operations guidelines. WASH RDC and other water programs need to invest a greater amount of time and energy in developing the management capacity of WMCs. This includes specific modules on why rules, regulations, and policies governing the organization are important, and a process whereby the WMCs themselves are more actively engaged in the formulation of policies. Specific policies that need to be

reinforced include decision making mechanisms (member voting procedures), clearly specified roles and responsibilities of each committee member, procedures for membership selection and a rotating presidency, and clearly defined authority structures and a system that allows for greater checks and balances on the power and control of WMC presidents. Additional areas of organizational strengthening legal status of WMCs, ownership of the water system infrastructure, and communication strategies especially related to payment of water fees. Even with low literacy levels and very little experience with collective management approaches, WMCs have the potential to effectively and sustainably manage community water points if the benefits of improved management are evident, and if training and sensitization initiatives have adequate (long-term) timelines to achieve their objectives.

Transparency and Communication

WMCs have a credibility problem with water users. Water user focus groups indicated that communities are not connecting the payment of water fees to continued water service provision, and generally water users expressed very little faith in the stewardship of funds collected. Some water users believed that money collected was going directly to the payment of stipends to committee members, and that when the time comes to purchase spare parts to conduct necessary repairs, the WMC will not have sufficient cash on hand to finance repairs. While mismanagement of finances is certainly an issue for some WMCs, other WMCs that appear to be managing cash well suffer from the same lack of credibility and trust from their water users. This lack of trust directly impacts the willing of users to pay for water consumed, as evidenced with an average user payment rate (% of users who actually pay fees) of 46%. Three of the fifteen active WMCs interviewed have payment rates below 10%, and six of fifteen had user payment rates below 33%.

Several actions can help increase user confidence in their WMCs. First, WMCs should hold quarterly community-wide meetings to discuss revenues collected, confirmation of cash reserve balances (preferably confirmed by a third party), description of any use of funds, report on pump functionality, report maintenance and repair activities during the quarter, and the communication of upcoming WMC plans such as communal gardens, goat rearing, or other income generating activities that bolster the WMC financial position. Next, WMCs need to adopt communications plans that reinforce the purpose of user fees, the benefits of clean drinking water, and an outreach plan to promote WMC activities and to improve water user attitudes and opinions of WMCs. Such communication prior to the installation of water points is critical to motivate higher user fees and user fee payment rates necessary to achieve financial sustainability. Lastly, WMCs could increase credibility by establishing tangible

Figure 28: The newly formed Kanteba WMC is doing an effective job of communicating WMC objectives to community members.

community projects and services at the initiation of new water points. Examples include establishing community gardens, or even establishing revolving credit funds from water fees collected that can be lent out to non-WMC community members. INGOs can facilitate user engagement strategies to strengthen WMCs by relying upon other successful models such as village savings and lending associations, small agricultural producer organizations, or even WMC analogs from Central America.

Governance

The poor performance of most WMCs represents a classic collective action problem. Users see water provision as a public good, and are often unwilling to pay their 'fair share' of maintenance and repair costs. With open access, a lack of enforcement of non-payment rules, local authorities who refuse to pay for water, and WMCs operating without clear community mandates, the overall governance of most WMCs interviewed is extremely poor. Although related to organizational capacity and transparency, governance is a broader concept that involves community mandates of WMCs, enabling support and actions of local authorities, and the spirit with which WMCs conduct their daily business. Those WMC members who are not truly dedicated to the effective and efficient provision of water services should be quickly replaced (per policies and procedures outlined in management and operation plans. Some WMC members seemed to not understand the importance of their activities nor the social benefit improved water points generate for the community. This includes examples of WMC leadership operating water points as a source of personal income generation. One WMC in Manono Town, for example, reported that the elected president of the WMC had been by the owner of the land where a well and hand pump had been installed. The land owner blocked community access to the water point until the WMC agreed to install him as president and demanded that all fees must be paid directly to him. The WMC had no knowledge of how much revenue had been collected, if a cash reserve actually existed, and no financial reports were being prepared. As a result, the number of households willing to pay user fees has dropped by over 50%, with many households returning to the use of unimproved traditional water sources.

Several other governance issues were observed during this study. In Tabacongo village in Kalemie, the area chief collects a 10,000 Franc annual tax from each of the six WMCs operating in the area. Further, relatives of the chief, government officials, and police reportedly collect barrels of water from the hand pump and refuse to pay any water fees. Most WMCs also lack the power to enforce non-payment rules, a situation exacerbated by the lack of community mandates for WMCs to manage water systems and collect fees. WMCs need to establish advocacy mechanisms in order to counter inappropriate actions by local authorities and to better communicate to water users the consequences of not paying user fees or providing non-paying friends and relatives with water.

Although governance is a difficult concept to teach, training modules on leadership and civil service combined with clearly defined procedures for WMC member selection and removal will help improve WMC governance, and in turn, water user confidence and trust in WMCs.[11]

Quality Service Provision

We know from the 2009 RWSN research that only 33% of water hand pumps in the DRC are functioning. Although sector-wide conclusions regarding pump functionality and performance cannot be drawn from AO WMC interviews as a significant number of communities were selected due to the presence of non-functioning pumps (selecting on the dependent variable), over half of WMCs visited reported either low flow rates, dry season non-operation, or poor quality water (Tabacongo village, Kalemie). Some of this poor pump performance can be attributed to inadequate hydrology analyses prior to pump installation, but in other instances pumps are operating well below capacity because they have not been maintained properly or were in disrepair (but still functioning). In these instances, WMCs did not seem concerned with poor performance and did not have concrete plans on how to resolve the situation. As long as at least some water was flowing, the WMCs seemed to think that no intervention was required.

AO consultants asked WMCs what product they sell to their communities. Roughly 40% WMCs did not perceive themselves as selling anything and roughly 60% stated that they were selling water. Only the Imbela WMC in Bandundu province (ACF) stated specifically that they are selling a 'service' which provides clean, safe drinking water. WMCs generally are not connecting continued water service quality to water user fees and payment rates. Similarly, water users themselves are not connecting water fee payments to sustainable water service provision and quality. The lack of understanding of both groups of the virtuous cycle of quality service provision and water fee revenues jeopardizes the long-term sustainability of community-managed water systems. To mitigate this, important quality service provision themes should be incorporated into WMC trainings, and the user fee-service provision link should be incorporated into WMC communications and community outreach activities.

Figure 29: Service quality and revenue virtuous cycle

Water Fee Generation

WMC success with charging adequate water user fees on a consistent basis is the primary determinant of the spare parts supply chain sustainability. Without adequate revenues, WMCs will not have the financial resources necessary to conduct regular maintenance, purchase spare parts, and conduct necessary repairs. Several stakeholders stated that rural water users are not able to pay sufficient water fees for

[11] See "Social and Economic Impacts of *Tuungune*: Final Report on the Effects of a Community Driven Reconstruction Program in Eastern Democratic Republic of Congo" for important lessons learned regarding community governance of public goods, especially the Result I: Governance section beginning on page 42 of the report.

WMCs to be financially sustainable. Given the importance of this issue to the overall sustainability of the spare parts supply chain, we have dedicated Section 6.2 to a discussion of user ability and willingness to pay. However, several conclusions can be drawn from WMC interviews. First, user willingness to pay water fees is reduced by poor quality service provision (low water flows), service interruption during the dry season, and the lack of transparency of water revenue management. Next, WMCs need to improve the enforcement of non-payment rules, as only 46% of households actually pay fees, with some communities having payment rates below 10%. WMCs should consider charging fees at the beginning of each month, or in two bi-weekly installments (for affordability) to encourage more regular payment of fees. The structure of user fees also needs to be improved. User fees are not currently connected to actual water usages. Households pay a flat monthly fee for unlimited water usages. Not only does this lead to wastage and over-consumption, but also encourages the practice of paying families fetching water for non-paying neighbors and even side-selling of water to other villages. In Kakinga village, the WMC reported that some community members were collected large amounts of water (20 – 30 jerry cans) for transport and sale to neighboring villages. While this practice does represent a potential opportunity for revenue enhancement (the sale of water to other villages), it currently strains existing water resources and reduces contributions to WMC spare parts reserves. WMCs should be encouraged to charge fees based upon per jerry can consumption. Per jerry can fees can be set at reasonable levels (20 – 50 Francs per can) so that the overall burden on paying households is not increased by usage-based fees. The benefit of charging per jerry can is that households will collect only what they can use, will be less inclined to supply non-paying households, and will mitigate the frequency of water side-selling.

Section 6.2 will demonstrate that users are able to pay sufficient water fees to cover routine maintenance, spare parts, and repair costs. The primary question, however, is whether users are willing to pay. Despite WMC challenges to collect adequate user fees, several positive indications of sustained demand were identified during this study. The average monthly water fee of the fifteen active WMCs interviewed is 306 Francs per month. The Tabacongo WMC outside of Kalemie is charging 1,000 Francs per month per household, and several WMCs are collecting or plan to collect 500 Francs per month per household. These include Siloma (actual) and Kakelwa (planned) in Kiambi, Luba (planned) outside of Manono, and Joseph (actual) outside of Kalemie. Not surprisingly areas with severe water shortages are more willing to pay for water services than others. In Luba (Manono) some households are paying 500 Francs *per jerry can* to have others fetch water for them. Kanteba water users expressed an interest in paying up to 200 Francs per jerry can. In Lodja, where access to clean water is also poor, potential water users in three new WMCs expressed a willingness to pay between 1,500 and 2,000 Francs per month for consistent drinking water supply.

Financial Management

The weakest area of WMC capacity is financial management. WMCs lack policies and procedures to adequately track revenues, identify non-payers, account for WMC expenditures, and to reconcile actual cash reserves on a periodic basis. Several examples of fund misuse, unauthorized expenditure by a WMC member, and complete non-transparency of cash management were encountered. WMCs do not have financial management plans, do not have clearly specified expenditure approval procedures, and do not adequately secure cash reserves (e.g.,

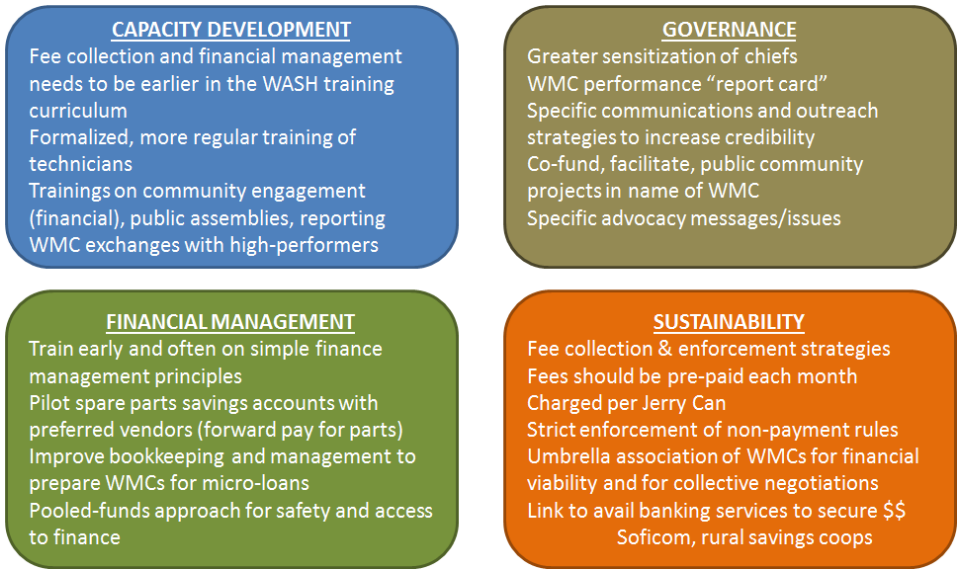
maintain cash in plastic bags in a WMC member house). When AO consultants inquired as to what training WMCs had received in financial management, the most common response was that no financial management training had been received or that the training has not yet taken place. Newly formed WMCs are beginning water point operations and fee collections without having received proper financial management training. The WASH DRC program must ensure that WMCs are trained in advance of water point operations. Other financial management risks include the lack of banking services that result in the maintenance of large sums of cash that is subject to misuse, theft, or outright expropriation. The example of banking services in Manono Town in Katanga province is important because it highlights that while limited, financial services in fact exist in most medium-sized territory centers. NGOs could significantly reduce the risk of theft and misappropriation of funds by facilitating WMC use of such financial services. Low revenue WMCs can further be clustered to obtain more favorable banking service rates and to initiate collective supervision of individual WMC funds.

Example of banking solutions from Manono Town

NGO staff members and WMC members noted that no banking services existed in Manono town. However, upon deeper investigation several options for cash management and banking services exist. A rural savings cooperative is in operation, Soficom (a wire transfer service) has a branch, and traders use a local mining company to transfer funds to receivers in Lubumbashi.

6.2 Summary of Recommendations for WMC Capacity Development

Figure 30: Summary of recommendations to improve WMC capacity and water system sustainability



WASH RDC partners and other water service stakeholders can take several actions to improve the capacity of WMCs and to improve the overall sustainability of community-managed water systems. Figure 30 summarizes key recommendations for improved capacity development, governance, financial management, and overall financial viability.

6.3 User Ability to Pay Water Fees

A critical component of WMC sustainability is the ability and willingness to pay adequate user fees to cover at the very least routine maintenance and repair costs. The very low income levels of rural villages and a lack of a culture of paying for water present obstacles to collecting adequate user fees. However, financial analyses and individual household economic surveys of current and potential WASH RDC project areas suggest that water user households have the financial wherewithal to pay sustainable fees. A second question, perhaps more relevant question, is whether users are *willing* to pay fees and how this willingness can be increased.

Figure 31: WASH RDC Sustainability Matrix – ability of communities to cover long-term water system costs

Expense	Example	Assessment of business plan/ability of community to cover long-term costs		
Operating and maintenance expenses	Lubricant, water management committee costs, small spare parts	YES	YES	NO
Rehabilitation expenses excluding capital infrastructure replacement at the end of the life cycle (15 – 20 years)	Hand pump cylinder replacement	YES	NO	NO
Rehabilitation expenses including complete capital infrastructure replacement after the end of the life cycle (after 15 -20 years)	Complete water point refurbishment/replacement	NO	NO	NO

The WASH RDC sustainability matrix (Figure 31) outlines three levels of cost coverage. Communities at Level 1, for example, are able to pay for routine operating and maintenance expenses such as lubricant, expenses related to Water Management Committees, and small spare parts. The three columns at the left of the figure signify three typologies of communities: 1) higher-capacity communities that have the capacity to pay for Level 1 and Level 2 expenses; 2) communities that are only able to cover Level 1 expenses and 3); communities that are not able to even cover basic costs associated with Level 1 expenses. The WASH RDC program targets communities that can cover at least Level 1 expenses, and preferably Level 1 and 2 expenses. Those communities who are not able to pay for any level do not qualify for improved water points (correctly so).[12]

AO analyzed household income data from secondary sources and conducted household economic surveys in target WASH RDC villages to determine feasible water user fees (ability) and to understand what percentage of households pay user fees charged by active WMCs. Figure 32 demonstrates maximum feasible water fee calculations based upon monthly GNI per capita, average household size, income distribution, and the alternative 'affordability thresholds'. The UNDP has recommended an affordability threshold for clean water at 3% of gross income for developing countries. Concern Worldwide currently assumes a 2% ability to pay in its business model. The World Bank reports an average GNI per capita of $680 for the DRC in 2013. UN Habitat estimates average DRC household size at 6.85 (2010). This equates to an average monthly

[12] Moriarty, P.; Smits, S.; Butterworth, J. and Franceys, R. 2013. Trends in rural water supply: Towards a service delivery approach. Water Alternatives 6(3): 329-349. Volmue 6, Issue 3. Water Alternatives – 2013.

household income of $388. However, as with most developing countries, the DRC has extremely high income inequality. The bottom 10% of the population only captures 2.2% of total income, and the bottom 20% only 5.5%. Using income distribution per percentile, AO calculated the average monthly household income per quintile and for the bottom 10%. According to these calculations, the bottom 10% of DRC households earns approximately $58 per month. With an average household size of 6.85 people per household, this equates to $8.54 per person per month, or $0.28 per day. The standard definition of extreme poverty is $1 per person per day. However, affordability thresholds of 2% (Concern WW) and 3% (UNDP), result in maximum monthly tariffs of 1,055 CDF and 1,583 CDF, respectively. These amounts are much higher than current de facto targets of 300 CDF per month.

Figure 32: Maximum feasible household water fees by income group in the DRC

COUNTRY	AVERAGE MONTHLY INCOME/CAPITA	AVERAGE HH SIZE	AVERAGE MONTHLY HH INCOME	BOTTOM 10%	BOTTOM 20%	SECOND 20%	THIRD 20%	FOURTH 20%	HIGHEST 20%	QUINTILE TOTAL/ AVG.
Distribution of Income		**(A)**	**(B)**				**(C) % of GDP Earned by Quintile**			
DRC	$57	6.85	$388	2.2%	5.5%	9.2%	13.8%	20.9%	50.6%	100%
Population In Quinitiles (D)										
DRC				6,751,368	13,502,735	13,502,735	13,502,735	13,502,735	13,502,735	67,513,677
Population x Distribution x Monthly HH Income (B x C x D)										
DRC				$57,654,430	$286,699,755	$482,200,685	$722,776,896	$1,097,530,689	$2,652,103,766	$5,241,311,791
Monthly Disposable Income Per Quintile (B x C x D)/(A)										
DRC				$58	$145	$245	$367	$557	$1,345	$388.17
Maximum Monthly Water Tarrifs per Affordability Thresholds										
	UNDP:	**3%**								
DRC ($USD)				**$1.75**	**$4.36**	**$7.34**	**$11.00**	**$16.70**	**$40.36**	**$11.65**
DRC (CDF)	Exchange rate:	902		**CDF 1,583**	**CDF 3,936**	**CDF 6,619**	**CDF 9,922**	**CDF 15,067**	**CDF 36,407**	**CDF 10,504**
	Concern WW:	**2%**								
DRC ($USD)				**$1.17**	**$2.91**	**$4.89**	**$7.33**	**$11.14**	**$26.91**	**$7.76**
DRC (CDF)	Exchange rate:	902		**CDF 1,055**	**CDF 2,624**	**CDF 4,413**	**CDF 6,615**	**CDF 10,044**	**CDF 24,271**	**CDF 7,003**

The argument could be made that households living in WASH RDC target villages earn even less income than the bottom 10% average of $58 per household. In addition to spare parts supply chain research, AO also conducted 54 household economic surveys to estimate income levels in WASH RDC target villages. Of the 54 household economic surveys, 47 households were able to estimate monthly household incomes. The lowest income household (Iyembi village, Popokabaka, Bandundu) is earning CDF 30,000 (or $33 per month). The highest income household (Libanda village, Bomongo, Equateur) is earning CDF 960,000 per month ($1,064). The average monthly income for all 47 households interviewed is CDF 250,823 ($278), and the median monthly income is CDF 145,000 ($161), both well above household monthly income

estimates for the bottom 10%. The average household size for this sample was 8 persons per household. The median monthly income of CDF 145,000 for the 47 households providing information, the resulting maximum water fees are CDF 4,350 or $4.82 per month.

Figure 33: Maximum potential water user fees based upon AO HH economic surveys – all households surveyed

	Average Household Gross Income Per Month			
	Low	High	Mean	Median
Avg. Gross Monthly HH Income	CDF 30,000	CDF 960,000	CDF 250,823	CDF 145,000
In USD:	$33.26	$1,064.30	$278.07	$160.75
Water Affordability Index (UNDP)	3%			
Max Monthly Water Fees:	CDF 900	CDF 28,800	CDF 7,525	CDF 4,350
In USD:	$1.00	$31.93	$8.34	$4.82
Water Affordability Index (Concern WW)	2%			
Max Monthly Water Fees:	CDF 600	CDF 19,200	CDF 5,016	CDF 2,900
In USD:	$0.67	$21.29	$5.56	$3.22

However, such a small survey size likely results in sample bias. Self-selection by households for involvement in economic surveys (and to attend community meetings regarding water services) likely led to the participation of wealthier households in the surveys. An analysis of the lowest income area surveyed (Iyembi village, Popokabaka, Bandundu province) may reflect more accurate household incomes as analogs for the majority of WASH RDC program areas.

Figure 34 summarizes monthly income data for households surveyed in Iyembi village. The lowest income household still earns CDF 30,000 per month ($33). However, the highest income earning household earns CDF 450,000 (down from CDF 960,000 for the entire sample), the mean monthly household income drops to CDF 99,167 (down from CDF 250,823), and the median drops to CDF 35,000 (down from CDF 145,000 for the entire sample).

Figure 34: Maximum potential water user fees based upon AO HH economic surveys – Iyembi village data

	Average Household Gross Income Per Month			
	Low	High	Mean	Median
Avg. Gross Monthly HH Income	CDF 30,000	CDF 450,000	CDF 99,167	CDF 35,000
In USD:	$33.26	$498.89	$109.94	$38.80
Water Affordability Index (UNDP)	3%			
Max Monthly Water Fees:	CDF 900	CDF 13,500	CDF 2,975	CDF 1,050
In USD:	$1.00	$14.97	$3.30	$1.16
Water Affordability Index (UNDP)	2%			
Max Monthly Water Fees:	CDF 600	CDF 9,000	CDF 1,983	CDF 700
In USD:	$0.67	$9.98	$2.20	$0.78

Using the median household monthly income from Iyembi village and assuming the Concern WW affordability threshold of 2%, maximum feasible user fees should be CDF 700 per month. This compares with CDF 300 per month that WASH RDC partners appear to be recommending to WMCs.

Several water user groups interviewed indicated that monthly user fees of CDF 500 to CDF 1000 are acceptable (Lodja), and others indicated fees of CDF 200 *per jerry can* as acceptable

(Luba and Kanteba villages in Katanga). While these data are encouraging, it is important to note that these areas are either dry or have no access to clean water currently. Villagers often indicate higher user fees during feasibility conversations only to reject fees once improved water points are actually installed.

Setting the highest possible water fees is important to increase the sustainability of new hand pump water systems. Concern WW has conducted a cash flow analysis (business model) to project likely WMC revenues over the course of a typical year. Overall, AO found the assumptions in the Concern business model to be quite conservative, with the exception of expected default rates. Concern WW assumes, for example, a default rate of 10%. Based upon WMC interviews, AO believes this number is closer to 50% (46.7% average non-payment rate for the 33 WMCs interviewed. We also found the median number of households to be 195, which is lower than the 350 households assumed in the Concern model. Figure 35 provides a comparative analysis of Concern WW WMC revenue projections versus projections based upon household survey data and higher non-payment rates.

Figure 35: Alternative annual water tariff revenue models

		AO	
	Partner BP	**SQ**	**Improved**
Mean number of HH per Village	365	195	195
Median HH income per month	$15	$33	$33
% of income for water	2.5%	3%	3%
Nominal payable per HH per Month (USD)	$0.38	$0.99	$0.99
Nominal payable per HH per Month (CDF)	CDF 338	CDF 893	CDF 893
Vulnerable (unable to pay)	15%	15%	15%
Default	10%	50%	20%
Migration from village	10%	10%	10%
Migration into village	5%	5%	5%
Total Paying Households	255.5	58.5	117
Projected monthly water tarrif revenue	$95.81	$57.92	$115.83
Number of normal or high demand months	8	8	8
Projected Annual Revenue from Water Tarrif	**$766.50**	**$463.32**	**$926.64**

7. Alternative Business Models

7.1 Feasibility Analysis of Alternative Spare Parts and Maintenance Service Business Models

Another component of this study is to investigate the feasibility of alternative business models for spare parts supply and maintenance and repair services. AO identified seven potential business models including: 1) an integrated supply/service model; 2) independent for-profit maintenance service providers; 3) consignment-based authorized dealers; 4) the current model of WMC spare parts procurement and repair; 5) public-private model utilizing Zone de Santé health center networks; 6) the establishment of physical subsidiaries of current suppliers and 7); the facilitation of creative finance mechanisms. As part of this analysis, AO also conducted a minimum density analysis to determine maintenance service provider break-even points and financial feasibility.

Figure 36: Summary of alternative business models considered

Integrated supply/ service model	• Suppliers employ field techs on commission basis • Multiple income streams
Independent service companies	• Feasible with minimum cluster (200 – 400 pumps) • Difficult to cover overhead if 100% service and parts
Authorized-dealers	• Existing suppliers who stock on behalf of spare parts traders • Consignment, partial consignment, commission
100% WMC	• Technical expertise a challenge • Finance for spare parts still an issue, lack of frequency
Public-private (zone de santé)	• Leverage health center network for forward stocking • Training HC staff in repair and maintenance, extra income stream
Sub-offices	• Physical subsidiaries of larger DRC traders • Inefficient, overhead high, need sufficient volume
Creative finance mechanisms	• Working capital to increase spare parts stocking • Loan guarantee fund to catalyze private finance

Integrated Supply/Service Model

One approach to improve the access to spare parts in remote areas and increase supplier access to markets is for suppliers to train and deploy community-based field techs who operate on a commission basis. A commission arrangement lowers the financial burden and risk profile for suppliers who are reluctant to increase overhead (via salaried employees) to pursue what they consider to be an unproven and inconsistent market. Commission arrangements also incentivize performance, as field agents are only paid when spare parts are procured and maintenance and repairs conducted. This provides motivation for more frequent site visits and timely response to WMC service requests. Revenues from service visits and repairs also generate a secondary income stream for spare parts suppliers. Although this model is promising, it is not without challenges. Turn-over and volume of service calls will continue to be an issue for both field agents and suppliers. Transportation and access to remote villages is another challenge. Field agents will need motorcycles to conduct frequent site visits and to respond quickly to WMC service calls. Suppliers will be reluctant to spend working capital on transportation assets, especially until

demand is proven. One strategy to mitigate this challenge is to facilitate access to finance for suppliers so that the cost of transportation assets can be absorbed over-time. Field agents could also potentially buy the motorcycles from supply companies on a lease-to-own basis. Another option is the facilitation of a small leasing company that is able to procure (potentially through finance) transportation assets and lease them to supply companies. As with other models, the geographic density of WMCs, frequency of maintenance and repair service calls, and ultimately the volume of spare parts purchased will determine the financial feasibility of this model.

For-profit Maintenance Service Providers

Another approach to strengthen the spare parts supply chain is to facilitate the creation of independent, for-profit maintenance service providers (MSP). This small service companies would be ideally situated in district centers that allow them to employ a 'hub and spoke' approach whereby they can cost-effective service WMCs within a 50-kilometer radius. Profitability will largely be determined by the density of WMCs within their service area, which will drive the number of service calls received (see 6.2 minimum WMC density analysis). This model has several advantages over WMC-based repair and maintenance. By servicing dozens or even hundreds of hand pumps in a specific geographic area, MSP technicians will have sufficient volume to specialize in repair and maintenance services. This should allow for higher-quality service as technicians maintain and improve their technical knowledge through practice and gain experience with a greater diversity of hand pump failure and repair types. The profit motive inherent in the MSP model will also likely force MSPs to achieve greater cost and operational efficiencies that ultimately can be passed on to WMCs via lower service fees. To mitigate the related risk of MSPs conducting unnecessary repairs or replacing functional parts, WMCs will still need to maintain one or two pump technicians on the committee to verify MSP technician diagnostics and recommended repair interventions.

The biggest challenge to the feasibility of the MSP model is the volume of business and revenue generation. Without sufficient density within realistic service areas, MSPs will not achieve adequate sales volumes to cover overhead costs, including transportation. As such, MSP mini-feasibility studies should be conducted by WASH RDC partners to determine if planned service areas surpass break-even thresholds. Initial estimates for minimum density suggest that 340 pumps within a 100 kilometer radius is the break-even point for MSPs. Additionally, future site selection for hand pump installation by WASH RDC and other stakeholders should consider facilitating water service corridors. Although a remote community may be in dire need of an improved water source, large distances to population centers and spare parts and service supply may render any intervention unsustainable in the medium and long term. NGOs should target new villages proximate to other WMCs, and along existing trade routes that will help link new WMC to supply networks.

An additional challenge to the MSP model is the start-up capital requirement. MSPs will require motorcycles, an initial stock of spare parts, a small workshop/office space, basic office equipment including at least one computer, a generator, and working capital for base salaries, fuel, and spare parts purchases (at least required up-front payments). At the very least, a basic ICT solution will need to be developed to monitor

technician visits, log maintenance requests and repairs, and manage basic business operations, even if full offices are not established. Projected start-up cost for a small MSP is $10,150. To catalyze the MSP model, WASH RDC partners will need to facilitate access to finance for potential operators. Although conversations with banks indicate a preliminary interest in lending to MSPs (and spare parts suppliers), a creative approach to finance facilitation is needed. Another option would to identify MSPs from existing businesses (bicycle and motorcycle mechanics, hardware suppliers, etc.) so that maintenance service provision is an ancillary (but profitable) income stream to on-going business activities.

Authorized Dealer Model

Unlike larger suppliers like Africa Business, JP Lwarhoga, and Bon Berger, district-level hardware suppliers do not have the working capital to stock spare parts. One possible solution is to link district-level suppliers such as Satelii d' enterprise (Kolongo) and URSS (Manono) to larger provincial suppliers through an authorized dealer model. Under this model, provincial suppliers would forward stock hand pump spare parts on consignment at district supply stores. As parts are sold, sales proceeds would be forwarded to provincial suppliers (via Soficom, for example) less district supplier profit. Although provincial suppliers state that they are not stocking larger inventories of spare parts due to low turn-over and that they do not want to tie up working capital in slow moving stock, they are not actually capital constrained. Every large provincial supplier indicated that working capital is not their constraint, but lack of demand. They would rather invest capital in higher-volume products. The solid cash position of provincial suppliers allows them to consign spare parts to district level suppliers. The biggest challenge to this model is a lack of trust between provincial and district suppliers, and the risk that district suppliers would sell stock and not transit proceeds to provincial suppliers. INGOs could play an important risk reduction role by facilitating linkages between district suppliers and provincial suppliers, and by providing partial payment guarantees. INGOs could warranty that district suppliers will transmit sales proceeds of consigned stock, and take responsibility for 75% of the value of stock sold in the event that district suppliers do not pay. While this approach is still based upon INGO involvement in the supply chain, it increases long-term sustainability by addressing market inefficiencies and risk profiles. As a history of successful transactions and payment history is established, payment guarantees can be reduced and eventually eliminated.

WMC Service Model

The current service provision model is not working effectively. Essentially NGOs train one or two technicians within Water Management Committees to conduct routine maintenance, repairs, and in theory, to procure spare parts. In reality, WMC technicians do not have the required skills to diagnose and address many hand pump break downs and have virtually no knowledge of where to procure spare parts. Given the low frequency of repairs, many WMC technicians reported that the skills they developed from initial trainings diminish over time due to inactivity. WMC technicians also report that refresher trainings from NGOs and other sources are not available. Despite its challenges, WMC-based maintenance and repair will continue. WASH DRC partners and other NGOs can improve the WMC model by more aggressively linking WMC hand pump technicians with suppliers identified in Section 5. Technical capacity trainings need to be hands on (not theoretical), and technicians should be encouraged to attend refresher trainings every 6 – 9 months. Another recommendation is to deepen the expertise of the

most entrepreneurial WMC technicians and facilitate increased coverage to 3 – 5 WMCs to increase repair and maintenance frequency, effectively encouraging them to operate as micro-businesses. A portion of water user fees should be used to pay for the time of WMC technicians, including preventative maintenance. If small financial incentives can help professionalize WMC hand pump technicians.

Public-Private Partnership with Zones de Santé

Another interesting business model that has met with almost universal resistance from WASH RDC staff members is a public-private partnership between suppliers, maintenance service providers, and Zones de Santé. A key supply chain bottleneck is the absence of a spare parts distribution network. The lack of demand for spare parts and related slow turn-over of parts inventories have discouraged suppliers from investing distribution networks. Until INGOs increase local procurement and effectively link WMCs to parts suppliers, suppliers will not invest time, energy, or money into district-level stocking solutions. Supplier perception of low demand precludes them from establishing sub-offices in further out locations.

Zones de Santé (ZdS) are heavily involved in water point improvement including the installation of hand pumps. ZdS also have an impressive network of health centers that collectively represent the largest distribution network in the DRC. The WASH RDC program could facilitate a public-private partnership whereby health centers stock inventories of common hand pump spare parts. Margins on the sale of spare parts would create an additional income stream for health centers, while positioning spare parts stock closer to WMCs. INGOs could provide start-up capital for initial spare parts stock at health centers, facilitate finance to ZdS for parts stocking, or catalyze consignment agreements with large provincial suppliers. Chefs de ZdS in Popokabaka and Manono expressed interest in the public-private model, and are open to further discussions and/or negotiations.

The reaction of most INGO staff members, however, has been almost universally negative. They expressed concern that proceeds from the sale of initial parts stocks are not likely to be invested in re-stocking. They see the arrangement as an unsustainable model that would survive one or maybe two turn-over cycles. Another concern is that if the model were successful, government agencies would likely usurp the model to benefit from income streams and starve the system of operating capital needed for continual restocking. The risk of informal and formal taxation of the system also exists. Despite these challenges, the interest of Chefs de ZdS and the critical need for a spare parts distribution network warrant further investigation of this business model. This interest can be supported by starting with small pilots under government-NGO agreement to establish and adhere to monitoring mechanisms and financial transparency. WASH sector development is rarely achieved without some level of government commitment, which can be encouraged by small-scale practical demonstrations of the benefits (to communities, but also to agency officials) of improved WASH initiative management and governance.

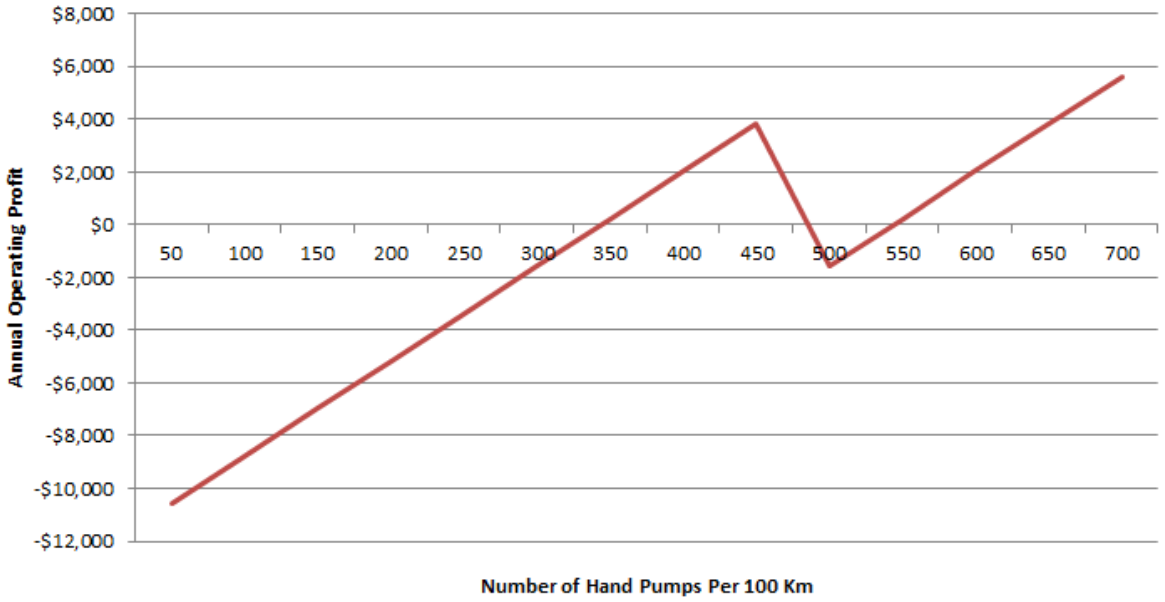
Supply Company Sub-Offices

One business model discussed with large provincial suppliers is the establishment of wholly owned district sub-offices. These would be small parts depots that position spare parts inventories closer to WMCs. District sub-offices would increase the market presence of provincial suppliers, helping to increase WMC knowledge spare parts supply locations. Given current volume levels, however, provincial suppliers expressed reluctance to spend capital on shop improvements, staff salaries, transportation costs to maintain forward stocks, and the additional investment in spare parts supply stock itself. Provincial suppliers were much more enthusiastic about commission-based field technician and authorized dealer models. Africa Business, for example, indicated that if higher volume levels of spare parts sales were more certain, they would consider opening small depots at interior locations such as Manono and even Kongolo.

7.2 Minimum Hand Pump Density Analysis

A key question regarding the sustainability of the spare parts and maintenance supply chain is what minimum density of hand pumps is required in order for independent maintenance service providers to be profitable. AO has developed a financial modelling tool to estimate break-even densities for given geographic areas. The model projects revenue, operating costs, and start-up costs for various densities. For the base model, a maintenance coverage radius of 100 kilometers is assumed. This is based upon conversations with World Up, the only for-profit hand pump maintenance service provider identified. World Up reports that a service center can cover a 200 kilometer radius, but a 100 kilometer radius was assumed to be conservative. Revenues are generated by profit margins on spare parts sales (30%) and service call fees ($10 per diagnostic, maintenance, or repair visit). The model assumes that routine maintenance and small spare part replacement takes place once every six months, and major spare part replacement (such as a cylinder) once every two years. Operating costs are comprised of salaries, motorcycle fuel and maintenance, office rent, communications, and generator fuel.

Figure 37: Annual operating profit of an independent maintenance service provider at four visits per technician per day



The number of technicians employed is calculated based on the number of visits each technician can conduct in a given day. The base model assumes four visits per technician per day. This means that 100 hand pumps would require 200 minor repair visits and 50 major repair visits in a year. This equals roughly 21 visits per month. Twenty-one visits per month can be therefore be serviced by one technician, who is capable of conducting four visits per day for 26 days. The straight calculation actually yields a requirement of 0.2 technicians, but this calculation is rounded up to the nearest integer to reflect full salary units. Based upon these assumptions, the minimum density of hand pumps required for a 10% operating profit is 382 pumps for a 100 kilometer radius. The actual break-even density is 344 pumps per 100 kilometers. Several iterations of the model were conducted in order to project annual operating profit at various hand pump densities. The drop in profitability between 450 – 500 pumps is due to the addition of a second-technician required to meet service call volumes. The second salary is not covered by service and spare parts sales revenue until densities of 550 – 600 pumps. Figure 38 is an actual example of the minimum density financial model, with the number of pumps set to generate a 10% annual operating profit.

Figure 38: Minimum-density financial model – base case

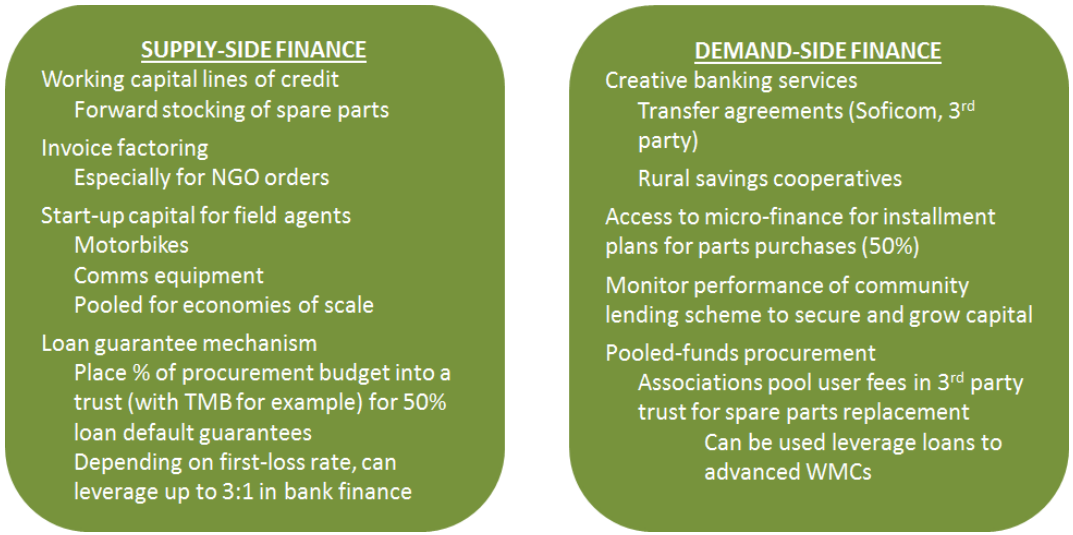
ITEM			UNITS	TOTAL	YEARS 1	2	3	4	5	6	7	8	9	10
ASSUMPTIONS														
Coverage radius		100	km											
Number of hand pumps		382	units											
Site visits per day per technician		4	ea											
Frequency of repair														
Minor repair (e.g., small spare parts)	every	0.5	years		764	764	764	764	764	764	764	764	764	764
Major repair (e.g., cylinder)	every	2	years		191	191	191	191	191	191	191	191	191	191
REVENUE														
Average price of small spare parts kit		$7.50	kit		$5,729	$5,729	$5,729	$5,729	$5,729	$5,729	$5,729	$5,729	$5,729	$5,729
Average price of a major replacement part		$43.50	150mm		$8,308	$8,308	$8,308	$8,308	$8,308	$8,308	$8,308	$8,308	$8,308	$8,308
Total Sales Volume					**$14,037**	**$14,037**	**$14,037**	**$14,037**	**$14,037**	**$14,037**	**$14,037**	**$14,037**	**$14,037**	**$14,037**
Commission on Parts		30%		$42,112	$4,211	$4,211	$4,211	$4,211	$4,211	$4,211	$4,211	$4,211	$4,211	$4,211
Service call fees		$10.00	ea	$95,491	$9,549	$9,549	$9,549	$9,549	$9,549	$9,549	$9,549	$9,549	$9,549	$9,549
Total Revenue					**$13,760**	**$13,760**	**$13,760**	**$13,760**	**$13,760**	**$13,760**	**$13,760**	**$13,760**	**$13,760**	**$13,760**
COSTS														
Operating Costs														
Salaries (rounded up to next integer) (variable)	1	600	/month	$72,000	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200
Fuel/Motorbike Maintenance (variable)	1	3.16	/day	$9,859	$986	$986	$986	$986	$986	$986	$986	$986	$986	$986
Office	1	200	/month	$24,000	$2,400	$2,400	$2,400	$2,400	$2,400	$2,400	$2,400	$2,400	$2,400	$2,400
Communications	1	50	/month	$6,000	$600	$600	$600	$600	$600	$600	$600	$600	$600	$600
Generator Fuel	1	100	/month	$12,000	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200
Total Operating Costs				$123,859	$12,386	$12,386	$12,386	$12,386	$12,386	$12,386	$12,386	$12,386	$12,386	$12,386
Operating Profit		**10.0%**		**$13,744**	**$1,374**	**$1,374**	**$1,374**	**$1,374**	**$1,374**	**$1,374**	**$1,374**	**$1,374**	**$1,374**	**$1,374**
Capital Costs														
Motorcyles	1	$2,500		$5,000	$2,500	$0	$0	$0	$2,500	$0	$0	$0	$0	$0
Generator	1	$1,500		$1,500	$1,500	$0	$0	$0	$0	$0	$0	$0	$0	$0
Laptop	1	$750		$1,500	$750	$0	$0	$0	$750	$0	$0	$0	$0	$0
Office set-up	1	$500		$500	$500	$0	$0	$0	$0	$0	$0	$0	$0	$0
Satellite Phones	1	$1,200		$2,400	$1,200	$0	$0	$0	$1,200	$0	$0	$0	$0	$0
Total Capital Costs				$10,900	$6,450	$0	$0	$0	$4,450	$0	$0	$0	$0	$0
NET PROFIT				$2,844	**($5,076)**	**$1,374**	**$1,374**	**$1,374**	**($3,076)**	**$1,374**	**$1,374**	**$1,374**	**$1,374**	**$1,374**
Internal Rate of Return		**9%**												

8. Other Recommendations

8.1 Access to Finance and Banking Services

Creative finance mechanisms will be required to address several bottlenecks in the spare parts supply chain and to catalyze increased stocking levels at both provincial and district levels. Figure 39 summarizes how potential finance mechanisms can facilitate improved supply chain efficiency. Finance mechanisms have been organized into supply-side finance and demand-side finance.

Figure 39: Creative finance mechanisms for the DRC spare parts supply chain



Supply-side Finance Mechanisms

Provincial suppliers interviewed stat that working capital is not a constraint to stocking larger and more diverse inventories. If they were better able to predict purchase demand with greater certainty, they are prepared to increase stocking levels. This is not the case, however, for smaller district-level supplies. Ideally INGOs and WMCs are able to procure spare parts from district centers to reduce long lead times. As it stands, most spare parts stocks are in large urban centers such as Goma and Lubumbashi. In addition to a reported lack of demand for spare parts, district suppliers list a lack of working capital as an important constraint to stocking spare parts. WASH RDC should invest time, energy, and resources to facilitate supplier access to working capital lines of credit. This can be achieved through relationship building (introducing preferred suppliers to local bank branches and bank head offices), a commitment to procure spare parts through district suppliers, and most aggressively, by providing partial loan guarantees to reduce bank risk to achieve more favorable interest rates and to catalyze initial loans that will help establish a history of successful repayment.

Another finance mechanism is invoice factoring. Suppliers mentioned that even when INGOs do procure from them, it often takes months to receive final payment. This ties up working capital that could otherwise be invested in the next round of spare parts inventories. In addition to expediting local supplier payments, WASH RDC partners could facilitate invoice factoring with local banks whereby banks pay suppliers 80% of the outstanding *approved* invoice against an INGO guarantee to pay. INGOs would forward invoice payments to banks directly, who would then pay suppliers their remaining 20% less interest (determined by volume and risk).

Maintenance service providers, an important potential actor in the spare parts and maintenance supply chain, will require both start-up and working capital. Start-up capital is needed for transportation (motorcycles) and communications equipment, a generator, office set-up, and an initial stock of most high-demand spare parts. Working capital is needed for base salaries, fuel, and supplies. As with supplier finance, WASH RDC partners should facilitate start-up capital loans through relationship building, a guaranteed volume level (at least temporarily), and even loan guarantees to catalyze private finance to private maintenance service providers. If commercial banks are unwilling to issue loans to MSP start-ups, WASH RDC partners should consider establishing a modest MSP capital fund that can issue at least a few loans to support the development of MSPs and to provide 'proof of concept'. Repayment of principal and interest by MSPs to the fund can then be redirected back to standard program line items. Although this second approach does present at least a moderate-level of risk to the WASH RDC program, the potential benefit from an active, private MSP network outweighs this risk and may ultimately reduce program costs through the efficient provision of maintenance services.

The establishment of a WASH RDC loan guarantee fund will likely have the greatest impact on higher stocking levels by DRC suppliers. WASH RDC should place a significant percentage of its procurement budget into a trust fund that can be utilized to provide partial loan guarantees to commercial banks for working capital loans to provincial and district suppliers. In Latin America, such guarantee funds are legal trusts (or *fideicomisos*), often managed by banks themselves. Further investigation into Congolese trust law is required to determine what type of legal entity would best suit the establishment, ownership, and management of such a fund. Commercial banks are reluctant to extend credit to the water sector as it is not an established area of focus (such as automobile loans, business expansion loans, etc.). Spare parts suppliers do not have track records with commercial banks, increasing the risk profile of the sector to commercial banks. In order to facilitate working capital loans for spare parts stock, WASH RDC should offer a partial loan repayment guarantee that lowers supplier risk profiles and facilitates the provision of credit. Loan repayment guarantees typically cover between 50% and 80% of loans issued to beneficiaries, depending upon the level of risk involved and the efficacy of commercial bank engagement with lenders. Money is only disbursed out of the loan guarantee fund if suppliers fail to repay loans.[13] Depending upon the expected default rate, the fund can guarantee a total loan portfolio value at several times the actual amount of the guarantee fund. After the initial cycles of guarantee and repayment are completed, guarantee levels can be reduced (percentage of loan value guaranteed) and eventually eliminated. Such a guarantee mechanism has the potential to stimulate increased stocking levels and the overall volume of the spare parts trade. Increased spare parts supply and access will likely have a multiplier effect whereby INGO and WMC awareness of spare parts suppliers increases, leading to increased volumes of local spare parts procurement. This in turns increases supplier motivation to stock and the working capital necessary to do so.

[13] See the AO report *Motivational Capital: Financing Water Service Improvement in Latin America. Feasibility Study for a Water Service Capital Facility* (2014), funded by CRS LACRO for further technical details on how loan guarantee mechanisms may contribute to improved water service and how they may be best managed.

Demand-side Finance Mechanisms

Several demand-side constraints can also be addressed through creative finance mechanisms. One key challenge facing WMCs is securing water user fees collected. Currently, WMC cash reserves are maintained in plastic pouches in the home of treasurers and WMC presidents. This is problematic for several reasons. First, unsecured cash reserves increase the temptation of the unauthorized use of WMC funds by committee members. Second, the risk of informal taxation by village chiefs and other authorities is increased if cash is on-hand. Third, as cash reserves increase, WMCs (especially in insecure, remote areas) risk theft from bandit groups. The real and perceived lack of banking services makes it difficult for WMCs to deposit water user fees into secure accounts. WASH RDC and other water sector actors can address this constraint by improving access to banking services by: 1) improving the information flow to WMCs regarding existing services (Manono example); 2) establishing an agreement with Soficom to establish small transfer depots in further out population centers; 3) promoting the use of rural savings cooperatives after more favorable terms are negotiated on behalf of WASH RDC WMCs and 4); promoting the use of mobile-phone banking in areas that have cell coverage (e.g. the Kenyan Mpesa model).

A second strategy to reduce the risk of WMC-maintained cash reserves is to establish a community revolving loan fund that is capitalized by water user fees. Such a small loan revolving fund would also improve community opinions of WMCs, thereby increasing their mandate to operate water points and collect fees. A certain percentage of water user fees could be lent to community members for productive use such as purchasing agricultural inputs, starting small-poultry enterprises, small bicycle and motorcycle repair shops, and other micro-enterprise opportunities. Community members would then repay loans at low interest rates (to help grow WMC capital), which would in turn be lent to other community members. Although a risk of non-repayment exists, the revolving nature of the WMC community fund encourages collective enforcement of repayment, as other community members interested in loans put pressure on current loan holders to adhere to repayment agreements. Similar social pressure would help mitigate the risk of theft by community members. With WMC cash reserves in the hands of multiple borrowers from the community, lower amounts of WMC cash-on-hand also mitigates the risk of informal taxation.

Another demand-side finance mechanism is micro-finance for spare parts purchases. AO found several examples of non-functional hand pumps that were not repaired due to inadequate funds to buy spare parts. In some cases, WMCs did not have the necessary funds due to the under-collection of water user fees or the mismanagement of WMC funds, or both, but in other cases, WMCs had not been in existence long enough to build adequate reserves. Direct spare part procurement by WMCs from district and provincial suppliers can be increased by linking WMCs to micro-finance institutions for small, short-term loans. Although micro-finance is expensive, WMCs expressed interest in this mechanism as it would allow them to pay for spare parts over time. A six-month repayment period should be sufficient to allow WMCs to make micro-loan payments out of future user fees.

Lastly, a pooled-funds approach can help increase WMC negotiating power and help increase security of cash reserves. This mechanism functions by WMCs place a significant percentage of monthly water user fees into a third-party managed spare parts replacement trust. TMB and other commercial banks offer trust management services, and are capable of providing prudential supervision and enforcement of WMC-determined disbursement criteria. These 'pooled' funds would be disbursed upon request and approval by a democratically selected group of WMC trustees for the procurement of spare parts and payment of maintenance and repair services. The fund could also be used to leverage other outside credit.

8.2 Key Advocacy and Outreach Issues

Although the WASH RDC program has advocacy built into its program design, most advocacy activities to date have focused on partner and donor communications. The spare parts and maintenance supply chain offers several opportunities to expand project communications to include targeted, strategic advocacy initiatives. Several spare parts supply chain bottlenecks are exacerbated by poor governance, the lack of a strong community mandate for most WMCs, formal and informal taxation, high import duties, and water user reluctance to pay fees. Some of these issues are due to poor-quality service delivery by WMCs, but others are directly related to public policy and the behavior and actions of public officials. Figure 40 summarizes key advocacy and outreach issues facing WASH RDC WMCs. The table identifies the issue, the target audience for advocacy initiatives, and a menu of advocacy tools and strategies to effect positive behavior change. These include, but not limited to, sustainability and feasibility analyses, position papers, coordinated INGO advocacy and outreach, public roundtables, face-to-face meetings, radio spots, case studies, and village-level communication strategies such as posters and word-of-mouth campaigns.

Figure 40: Summary of key WASH RDC advocacy issues

Advocacy Issue	Target Audience	Advocacy Strategy
Tax exemption for hand pumps and spare parts suppliers	Ministry of Finance Office de douanes et assises	Sustainability analysis Position papers NGO-coordination Public roundtables
WMC taxation (formal and informal) by village chiefs	District officials Village chiefs Water users	Face-to-face advocacy Top-down pressure Radio spots
Free water usage for police, family of chef, officials	Public officials, chiefs, district officials	Radio spots Peer-to-peer advocacy
Legal status of WMCs (for ownership of infrastructure, right to charge fees)	District, provincial and national authorities	Cost-benefit analysis Face-to-face advocacy Position papers Case studies
Increased political support for water fees	District and village authorities	Face-to-face advocacy Case studies Radio spots
Increased willingness to pay for water fees	Village water users	Radio spots Village-to-village visits Increased sensitization

One example of a high-impact advocacy issue is the levy of import duties on hand pumps and spare parts. Unless a supplier has a signed purchase order, he must pay duties

on all hand pumps and spare parts at commercially tradeable tariff levels. This added cost discourages suppliers from increasing spare parts inventories and significantly decreases (up to 20%) price competiveness. As the end users of non-contract spare parts inventory are ultimately INGOs and WMCs, suppliers of spare parts should not be subject to import duties. This is a classic opportunity for community, INGO, and donor advocacy. A simple cost-benefit analysis demonstrating the negative impact of such duties should be conducted in combination with face-to-face meetings with public officials, position papers, and public roundtable discussions with the national media in attendance.