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**Accessing handpump spare parts:  
a study of Northern Malawi**

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*Contrary to the author's expectations, lack of access to spare parts was not found to be a leading cause of Afridev hand pumps remaining broken in Northern Malawi. This paper presents the findings of a broad study of spare parts access in the region, exploring how rural communities access Afridev spare parts and how the location of those communities affects their ability to do so. Study results find no relationship between the distance from a community to the nearest spare parts retailer and the duration of a pump breakdown, nor that access to spare parts is a key limiter of waterpoint functionality. Findings suggest that community ownership, organization, and willingness to repair a waterpoint are the most significant factors affecting how quickly a pump is repaired. The study also investigates the functionality of the retail supply chain, finding that the private-sector in Malawi is responsive to community spare part needs.*

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**Background**

Under a Community-Based Management (CBM) model, communities are tasked with funds procurement and repair coordination for broken water pumps, although communities often face challenges in doing so in Northern Malawi. One key aspect of this was thought to be access to spare parts; however, an initial survey in September 2010 of 48 communities in Karonga district found that nearly 80% of communities with previous pump breakdowns had accessed spare parts. The remaining non-functional wells were either in the process of being repaired or had major breakdowns beyond the ability of the community to repair independently. This finding was contrary to the belief commonly held by NGOs and local government staff that spare parts access was a major challenge for communities in Northern Malawi. However, as all communities surveyed were within 20 km of trading centres stocking spare parts, it was hypothesized that the ease of accessing spare parts may depend on the location of a village. A larger study was therefore designed to verify this theory.

**Study objectives**

This study had two objectives: to determine the effect of distance from a spare parts retailer on the time it takes communities to repair Afridev hand pump breakdowns, and the effect of borehole pump density on spare part availability. The study was designed to test this in a large area, the expected finding being that more remote communities will take longer to repair broken pumps due to an increased difficulty of accessing spare parts:

***Hypothesis one:** If pump breakdown duration is chiefly affected by the difficulty of accessing spare parts then communities having to travel greater distances to access spare parts will take longer to repair broken pumps.*

Another possible explanation for the findings of the September 2010 Karonga survey was that the region surveyed may have unusually high numbers of communities demanding spare parts, increasing the prevalence of vendors stocking spare parts. This led to the hypothesis that access to spare parts could be much more difficult in areas of lower "pump density", where pump density is defined as the number of pumps within communities accessing a single trading centre for spare parts:

**Hypothesis two:** *If pump density affects the availability of spare parts then the variety and quantity of spare parts available in a trading centre will be greater in areas with higher numbers of pumps.*

By testing these two hypotheses, this study seeks to understand the conditions under which spare parts access hinders pump repair, and the conditions that enable a private-sector supply chain to overcome this challenge.

## Approach

The study includes four districts in Northern Malawi: Karonga, Nkhata Bay, Mzimba, and Rumphi. Afridev pumps are quite common in the region, being one of two nationally approved pump types. A detailed study through interviews in 63 communities was conducted in Karonga and Nkhata Bay districts to test the hypothesis that breakdown duration is related to the distance of a community from the nearest spare parts retailer. Communities chosen were sampled from all parts of each district, ranging from the most to least remote. The study targeted five communities in each district subdivison (TA<sup>1</sup>), although this number was adjusted depending on TA size and the availability of Afridev pumps in each TA. Interviews were conducted with either waterpoint committees or knowledgeable community members. All communities included could remember the details of at least one previous (or continuing) pump breakdown, but most could not remember multiple ones. Box 1 outlines the survey questions.

### Box 1. Information collected during community interviews

- The date and cause of the last breakdown;
- Breakdown duration (time without water);
- Location, cost, and travel time to purchase spare parts;
- How funds for repair were collected;
- The location and functionality of alternative waterpoints;
- What parts were purchased and at what cost;
- If difficulty accessing spare parts was an issue;
- GPS coordinates of the waterpoint; and
- Details on other breakdowns.

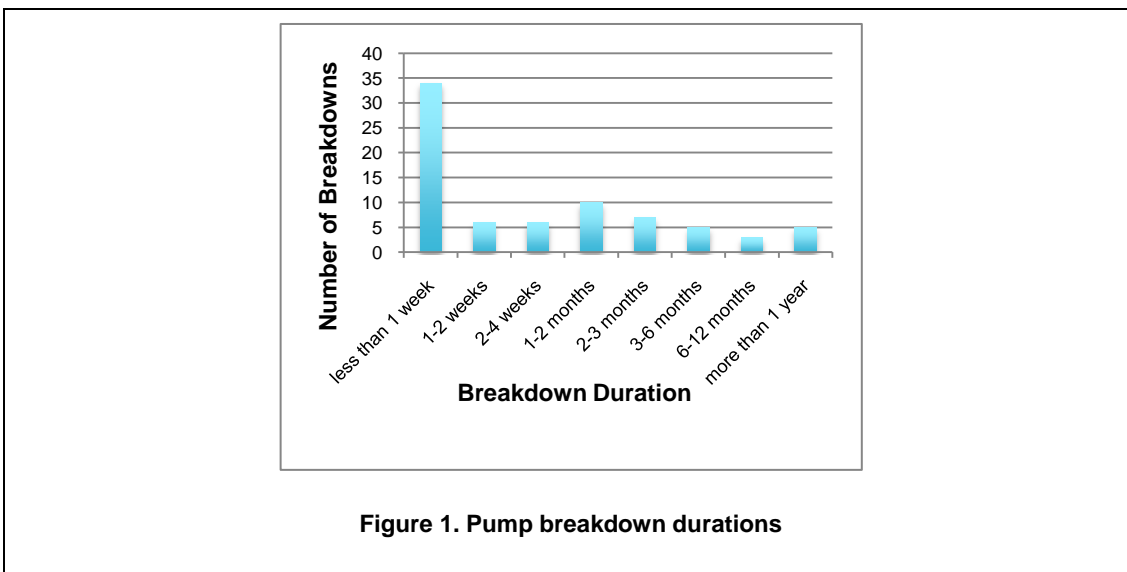
GPS coordinates of both shops and communities were analyzed using ArcView GIS software to calculate distances. The distance along a paved road to the last spare parts shop accessed for repair was added to the linear distance of the community to that paved road (when dirt road locations could not be approximated) to find the total distance from the village to the spare parts shop. All distances in this paper are one-way.

Testing the second hypothesis drew on all four districts. Each known spare parts retailer was visited to gather information on stock lists, quantities, prices, and GPS coordinates. Using the most recent complete waterpoint database for Malawi (from 2005), the linear distance from each Afridev to the nearest supply centre was calculated to determine the “catchment areas” of the various trading centres (assuming that communities will prefer to access their nearest retailer). The total number of pumps within a catchment area was then compared to the total value of spare parts available in that catchment area’s trading centre. The number of pumps will certainly have increased since 2005, but the historical figure can serve as a proportional approximation of the current condition.

## Findings: distance of communities to retailers

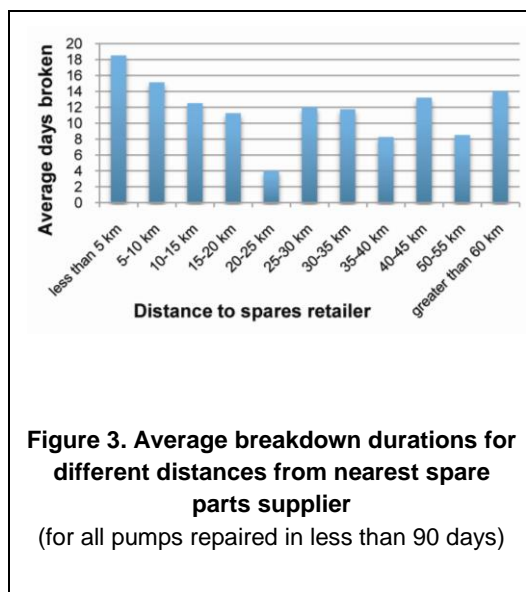
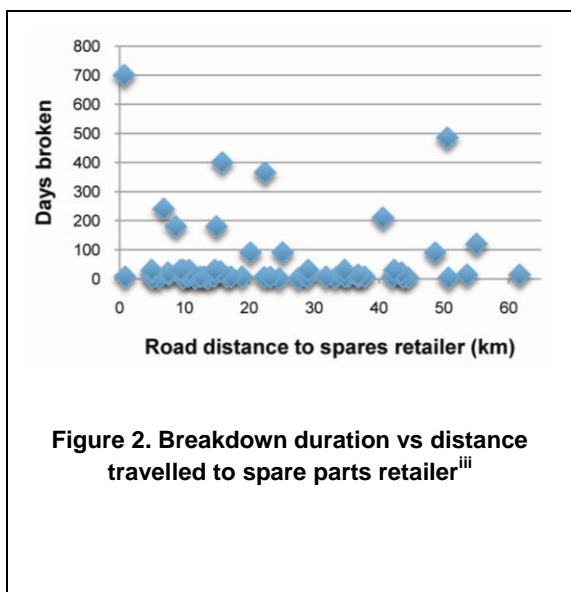
### Pump breakdown profile

If the distance of a community to their spare parts retailer affects the duration of pump breakdowns, expected results would show a distribution of pump breakdown durations, and longer breakdown durations for more distant communities. However, as shown in Figure 1, the majority of breakdowns (45%) were repaired in less than one week. Information on multiple breakdowns of the same waterpoint is included when available. For each repaired pump breakdown, communities purchased spare parts from a local supplier, with the exception of some pumps that continue to be broken for reasons unrelated to spare parts availability.



**Pump breakdown duration vs. distance from spare parts retailer**

As shown in Figure 2, there is no correlation between distance from spare parts retailer and pump breakdown duration. Both linear and logarithmic regression analyses were not significant at 5%. Analysis for travel cost and for travel time had similar plots, also yielding no distinct trends. For clarity, pumps with a breakdown duration of less than 90 days (the most common case) were examined separately in Figure 3. Again, no noticeable trends emerged.



**The challenge of accessing spare parts**

The first hypothesis was found to be incorrect – no relationship between distance from a spare parts supplier to a broken pump and the duration of a pump breakdown was apparent, and further confirmed by regression analysis (not significant at 5%). Most communities appear able to readily access spare parts as needed – 45% of them in less than one week. However, numerous outliers were found in the plot. These pumps have remained broken for long periods, but the length of the breakdown does not seemingly relate to distance, time, or travel cost to a spare parts retailer.

Of those communities who could remember clearly whether or not accessing spare parts had been a challenge, 60% of those surveyed have never had an issue. Interestingly, the few communities that did express any difficulty locating spare parts had lower pump breakdown durations on average. One of those

communities had even repaired their last breakdown in less than one day. The most commonly expressed challenge was that the trading centre nearest to the village did not have the part needed, and that a longer trip was required to obtain the replacement part in a bigger town. Despite this added effort, the task appears to be well within the capabilities of most communities.

### The “outlier” pumps

Of the 63 communities interviewed, only 13 had previous (or ongoing) pump breakdown times of 90 days or more. None of these villages, however, expressed difficulty in accessing spare parts. Table 1 below presents five typical cases.

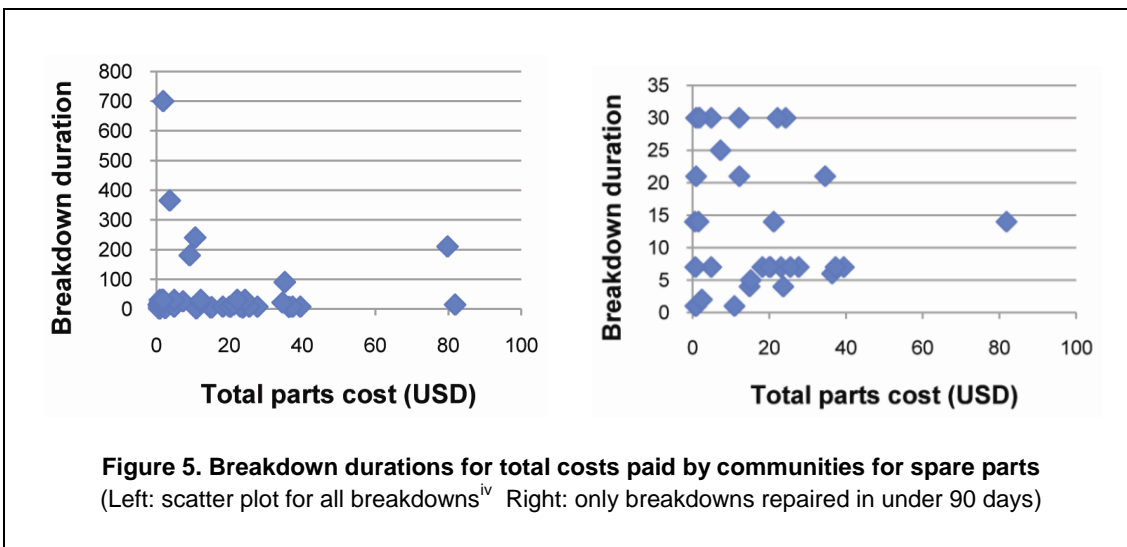
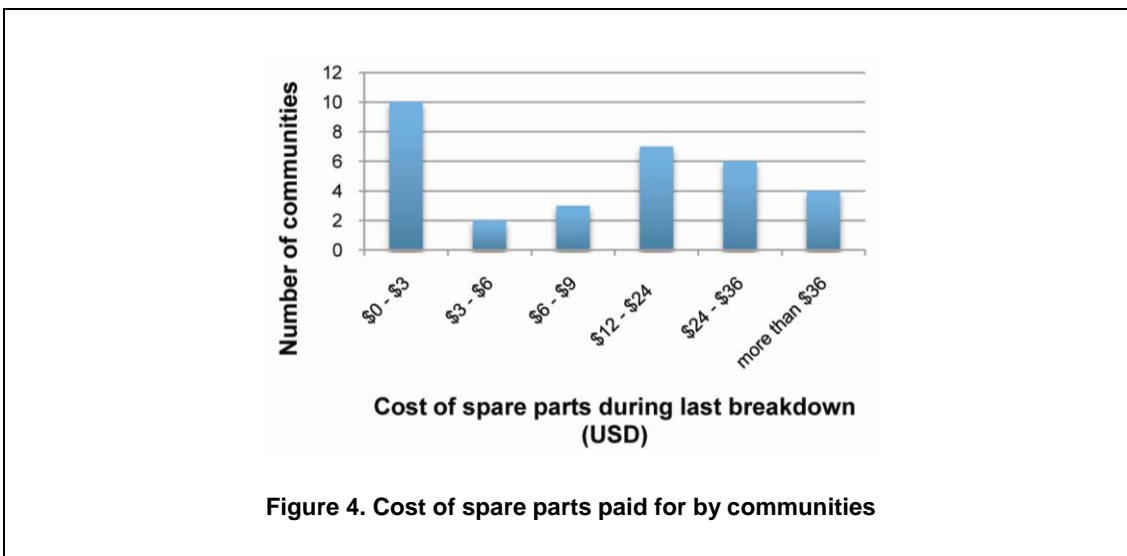
District	Village	Days broken	Comment on spare parts access
Nkhata Bay	Uledi	365	The community reported that finding spare parts is " <i>not difficult</i> ". The community can travel to either Mzuzu or Nkhata Bay if spare parts are not found in Mpamba.
Nkhata Bay	Chipunga	700	The community reported that: " <i>The issue is funds collection.</i> " They have written a letter of plea to the district government to assist with repair.
Nkhata Bay	Jumbo	240	The community cited raising funds as by far the biggest problem in repairing the pump.
Karonga	Kamtenthenga	180	The community reported that spare parts are available. The pump has stayed broken only because of challenges raising funds.
Karonga	Elia	400	Again, the community reported that they know where to buy the required part, and that it is in stock. Their problem is raising money. They are collecting water from a functioning pump nearby, which makes it difficult to see the need to repair the broken one.

### The challenge of fundraising

An overwhelming number of communities expressed difficulties with collecting contributions for pump spare parts. When asked, communities would sometimes begin by saying that finding spare parts is a problem, but further questioning would reveal that spare parts are known to be available in shops, and that the real issue is collecting funds. Because of this, one would expect most communities to only manage purchasing inexpensive parts, and for a correlation to exist between the cost of a repair and the breakdown duration of a pump. Figure 4 shows the total cost of spare parts purchased by communities during their last repair (assuming an exchange rate of 1 USD = 165 Malawi Kwacha (MK)).

The wide range of pump breakdown durations for different repair costs, shown in Figure 5, suggests that cost is not the chief factor in breakdown duration. Again, regression analysis of both plots in Figure 5 found no correlation at either 5%. However, the domain of most costs in Figure 5 is interesting. Most communities appear able to access spare parts and cover parts costs up to a value of MK 6,000 (~\$35 USD) but, as seen in the case of Kaziwa School (see Box 2), repair costs greatly exceeding this can be difficult for communities to manage.

The case of Kaziwa School suggests that there is a cost threshold beyond which communities greatly struggle to maintain their pumps, regardless of spare parts availability. Of the thirteen pumps with breakdown durations of 90 days or more, all but three require one or more new pump rods, cylinders, or rising mains – all high-cost items. As shown in Table 1, several of these communities (with long repair times) explicitly stated that funds are the problem. Unfortunately, cost estimates for repairing these broken pumps were usually not available, but further research in this area may show that a practical cost threshold for communities does exist.



**Box 2. Pump profile - Kaziwa School, Nkhata Bay**

The Kaziwa School borehole in Nkhata Bay district was struck by lightning in April 2010 and has been broken since. The reason is the cost of repair. Prior to this, the community had a preventative maintenance program, raising funds and replacing parts as needed prior to breakdowns. This practice kept the pump functioning continuously, without any breakdowns, from its installation in 1994 until the lightning strike. The cost of fixing the current problem, estimated at MK 31,000 (~\$190 USD), has been put to the community and they have been unable to raise the funds. The pump has been broken for over 8 months, and the school is using an open pit as its water source.

**The effect of community organization on pump breakdown durations**

With no other apparent correlations, the wide range of breakdown durations between communities with similar distances from stores and similar repair costs suggests that the main difference is the communities themselves. Under a community-based maintenance model, communities are tasked with self-organizing, collecting funds, and coordinating repairs. Communities that contribute to repair funds were asked how

frequently they collect money and, for the two most common responses, there is a distinct difference in pump repair times.

Differences in average breakdown durations were, unfortunately, not statistically significant at the 5% level due to a high degree of variability in responses and a relatively small sample size, but a clear distinction is noted in the percentage of breakdowns repaired within one week, as Table 2 demonstrates. This suggests that the level of community organization significantly effects pump breakdown duration. Communities that already have a collection scheme in place are more likely to have savings than communities that mobilize funds only after a breakdown – a likely proxy for the level of community organization.

**Table 2. Breakdown durations for different fee collection periods used by communities**

Fee collection period	Number of communities	Number of breakdowns repaired within 1 week	Percentage of breakdowns repaired within 1 week
Monthly	32	21	66%
Only when broken	14	5	36%

Community organization can be viewed as the degree of ownership that a community feels over its pump. Breakdown durations may rise where this level of ownership is reduced, as in the case of Chegama Village (see Box 3). Another observed cause of failing to repair a pump was in Elia Village, Karonga district, where the community was accessing another functioning pump nearby, and saw no need to repair their broken one. Factors such as these, though outside the scope of this study, appear to have a much more significant effect on pump breakdown duration than access to spare parts does. The emerging anecdotal evidence and other findings of this study suggest that further research is needed on how these other factors affect community ownership and organization, which may be the key variables influencing pump breakdown durations.

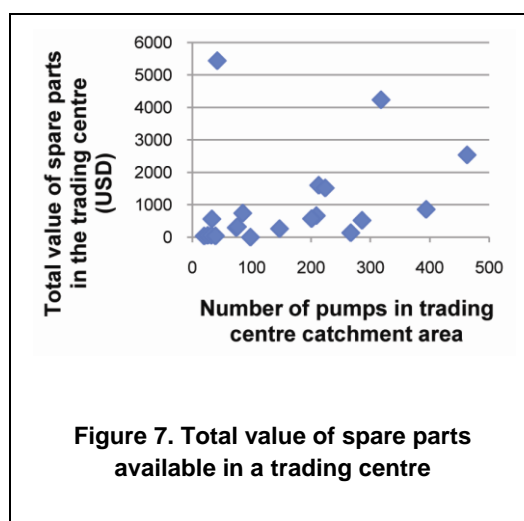
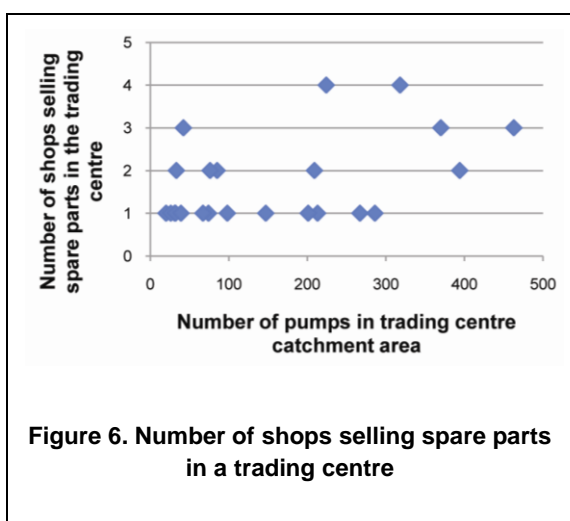
### **Box 3. Pump profile - Chegama Village, Karonga**

This borehole was installed in the late 1980s and its sixteen galvanized pump rods have since rusted. When it first broke last year, only two pump rods required replacing and the community was able to mobilize funds and repair the well within six days. When the other pump rods subsequently broke, the local Constituency Development Fund promised the community funding for repair, although this has yet to happen. The community has raised no money thus far and has no plans to repair the remaining rods. This case demonstrates how both high repair costs and a delegation of responsibility for repairs can demobilize an otherwise capable community.

### **Findings: the influence of pump densities on retailers**

The second hypothesis tested whether or not higher numbers of Afridev pumps proximate to a given trading centre led to a greater availability of spare parts in that centre. Some evidence was found to support the existence of this relationship, but not all communities were found to access the nearest spare parts vendor, even when spare parts were available. Community members from Chiwela Village travelled nearly twice as far as necessary (~100km in total), by-passing three other spare parts dealers stocking the required part during their last pump repair effort. In the case of Chiwela, an improved spare parts supply chain and access to knowledge about it would increase convenience, but not remove a key obstacle to pump repair. Their experience shows that when a community is motivated to repair a pump, travel distance to access spare parts is not a limiting issue.

A scatter plot showing the number of stores in 23 trading centres compared to the number of pumps within that trading centre's catchment area is presented in Figure 6. Catchment area is defined as the number of Afridev pumps closer to that spare parts retail location than any other location.



The data produces a significant correlation, and two trends can be recognized in this plot: the number of shops increases where more pumps are within a trading centre's catchment area, and some trading centres have high numbers of shops, despite relatively low pump densities in their areas. Linear regression analysis to examine the relationship between the number of shops and the number of pumps in a catchment area confirms the existence of a correlation – the number of pumps in a trading centre catchment area is a significant predictor of the number of shops selling spare parts in that trading centre at a 5% confidence level.

As expected, higher pump density correlates to more shops stocking spare parts, although some areas of low pump densities with high numbers of shops also exist. These retailers are in larger trading centres, and clearly emerge as outliers when plotting the total value of spare parts in a trading centre vs. the number of pumps in that catchment area, as shown in Figure 7.

The outlying centres have several things in common:

- They are the largest towns and are along major transportation routes;
- Many shops carrying hardware and a variety of other goods can be found there; and
- These centres have Chipiku Stores (see Box 4).

#### **Box 4. Chipiku Stores - the backbone of the spare parts supply chain**

Chipiku Stores is a widespread chain stocking hardware, agricultural inputs, and non-perishables. They are located throughout Malawi in almost all mid-sized to large trading centres and they are a chief supplier of spare parts. Their stock lists are also the most complete, and out of stock parts can be ordered in. Over a third of the communities interviewed had purchased spare parts from a Chipiku – nearly five times more than any other shop.

But the extent of Chipiku's contribution to the supply chain does not end with the communities. Several small retailers visited also acquired their stocks from Chipikus, acting as an intermediate seller. Market vendors and even other shops in the same trading centre were found to be purchasing their stocks from Chipiku. The supply chain provided by Chipiku allows other vendors to readily access spare parts in trading centres, which can increase the total number of shops and supply available where a Chipiku is present.

These factors make it more likely that community members will be travelling to these centres for reasons other than pump maintenance, making it more convenient to obtain spare parts in the major centre. Larger trading centres are a draw for wholesalers as well. Both Chipiku and Omega Trading wholesalers are based

in Mzuzu, Malawi's northernmost city. Because of familiarity with these larger trading centres, communities are also more likely to know stores stocking spare parts and be confident that at least one will carry the part they require for pump repair. This, in turn, drives up the number of communities accessing spare parts in centres outside of their own catchment area, possibly undermining the demand base of smaller shops selling spare parts to local clients. This is evidenced by cluster of retailers with a small total value of spare parts stock and a small number of pumps in the catchment areas shown in Figure 7. The small demand base and likelihood of being by-passed by communities en route to larger trading centres make it both unlikely, and possibly unnecessary, for these smaller stores to stock a large quantity and variety of spare parts.

## Conclusions

A functioning private-sector supply chain of Afridev spare parts exists in Northern Malawi and no correlation was found between pump breakdown duration and the distance of that community to their spare parts retailer. Additionally, the cost of spare parts was also not found to affect pump breakdown durations for costs below approximately USD\$35. Regardless of their distance from the nearest spare parts shop, communities are able to access these parts for pump repairs and commonly do so promptly. Rather than cost or travel distance, it is a community's ability to mobilize and take ownership over pump repair that seems to have the most noticeable effect on pump breakdown durations. The ability of a community to cover the cost of even a simple repair may be compromised by (a) an alternative water source that reduces the pertinence of repairing the broken well or (b) an ambiguous definition of responsibility where communities believe someone else will provide either funding or repair services. Access to spare parts, however, is not the chief constraint.

Pump densities were found to have a significant influence on the availability of shops carrying spare parts in a trading centre, indicating a functioning supply chain. It was also found that large towns on major transportation routes and with a Chipiku outlet will likely carry spare parts regardless of their local pump densities. This supply chain functions effectively due to a larger retailer with many outlets that can steward parts procurement. The presence of spare parts in these larger trading centres may, however, reduce the economic feasibility of retailers stocking large quantities and varieties of spare parts in smaller trading centres. While this may reduce the convenience of the supply chain for communities, it may not, in fact, reduce its overall effectiveness.

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## Notes

<sup>i</sup> Traditional Authority

<sup>ii</sup> Knowledge of spare parts retailers comes from sources in Malawi Government District Water Offices, previous field experience, and asking in trading centres.

<sup>iii</sup> One pump with a breakdown period of several years was excluded from the plot for clarity. It is also excluded from the left plot in Figure 5.

<sup>iv</sup> See note (iii)

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