

Abstract Title	Water safety impacts of the delegated management model of urban water service delivery in Kisumu, Kenya: a post hoc evaluation
Topic	<p>X Improving water quality</p> <p>O Resilient water systems</p> <p>O Circular solutions: Reuse, Recover and Recycle</p> <p>O Transitions in water, agro/food and energy</p>
Challenges and Solutions	Challenges and solutions
Author(s), highlight corresponding author	<p>1.Lorna Grace Okotto, Jaramogi Oginga Odinga University of Science and Technology, Kenya</p> <p>2. Joseph Okotto-Okotto, Victoria Institute for Research on Environment and Development International, Kenya</p> <p>3.Jim Wright, University of Southampton, UK</p> <p>4.Name, Surname, Affiliation, Country</p>
Abstract	<p>Background: The delegated management model (DMM) is a pro-poor urban programme through which a utility delegates service delivery responsibility to one or more micro-operators. This model is currently operational in several countries including cities in Kenya, Mozambique and Tanzania. Whilst studies have assessed its impacts on revenue recovery, supply interruptions, service coverage, and tariff affordability, evidence on its water safety impacts is lacking.</p> <p>Objective: This study therefore aims to assess DMM's impact on point-of-storage water safety among kiosk water consumers in Kisumu city, Kenya via a post-hoc evaluation study.</p> <p>Methods: A random sample was selected of 10 DMM and matched 10 control enumeration areas (EAs), using coarsened exact matching to control for neighbourhood characteristics including population density, sanitation, and water access. Selection of neighbouring EAs was avoided to avoid potential spatial spill-over effects. Within each area, all 87 kiosks were sampled with 11 hand-cart vendors and 250 household customers recruited from</p>

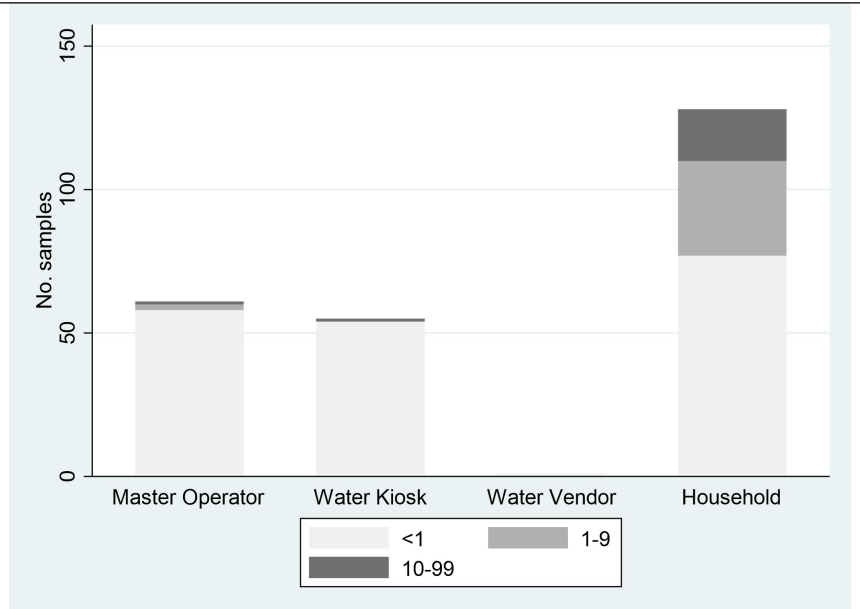
kiosks. All participants were interviewed alongside master operators responsible for local water service delivery in DMM areas and asked about water interruptions, storage, treatment, handling and pricing. Water samples were tested for thermotolerant coliforms at each point in the supply chain. Logistic regression was used to test for significant differences in stored water contamination (defined as thermotolerant coliforms  $\geq 1$ cfu/100ml) between DMM and control areas, controlling for known risk factors for water contamination which included sanitation, hygiene, overcrowded housing, non-durable housing and lack of solid waste management services.

Results: Whilst almost all kiosk and all hand-cart samples had no detectable thermotolerant coliforms, there was significant recontamination of household stored water in both DMM and non-DMM areas (Figure 1). However, controlling for other risk factors, the odds of household stored water contamination were significantly lower ( $p=0.010$ ) in DMM areas compared to non-DMM areas. The association between thermotolerant coliform contamination with other risk factors varied between DMM and non-DMM areas. In DMM areas only, the 43% of households that lacked solid waste services had significantly higher odds of contaminated stored water (adjusted odds ratio, AOR; 24.1;  $p=0.01$ ;  $n=100$ ). For DMM areas only, the odds of household stored water contamination was significantly lower ( $p=0.034$ ) for the 34% of households that had no Soap/handwashing facility (AOR: 0.4;  $P=0.034$ ;  $n=100$ ). In DMM areas, it proved difficult to recruit hand-cart vendors from kiosks with only two found operating, suggesting that DMM had brought kiosks closer to households, reducing water recontamination risk associated with hand-cart vendors. However, significantly more (37% of 54) kiosk operators in DMM areas reported water being sometimes or rarely available from the networks they were connected to, compared to 15% of 33 kiosk operators in control areas ( $p=0.03$ ). Households also reported paying significantly more (KSh5.2, \$0.037) for 20 litres of kiosk water in DMM areas compared to control areas (KSh4.3, \$0.031,  $n=226$ ,  $p=0.03$ ).

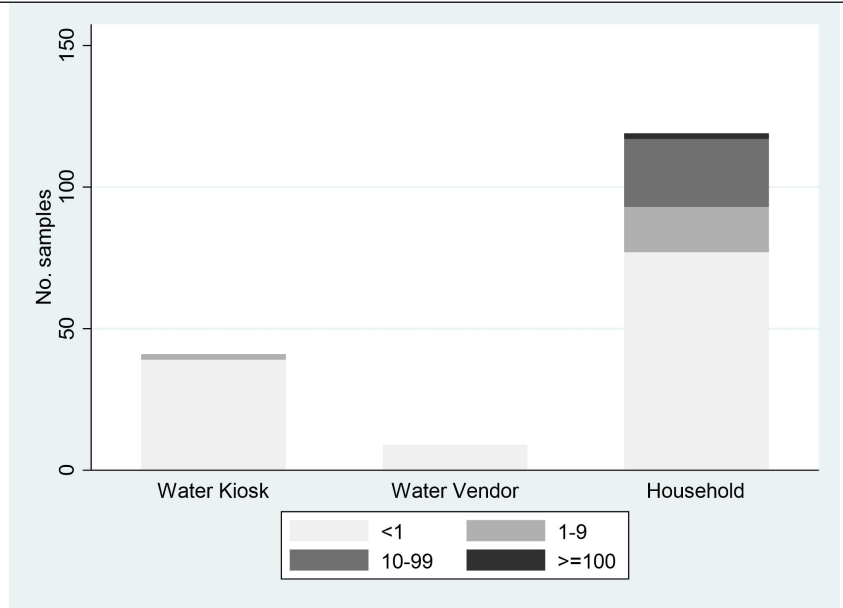
Conclusion: We found that all kiosk and all hand-cart samples had no detectable thermotolerant

coliforms in both DMM and Non DMM areas. However, recontamination of household stored water remained high in both areas, but lower than historically reported by previous studies in Kisumu. These areas also had fewer hand-cart vendors operating, compared to previous studies, reducing a potential recontamination risk. However, households in DMM areas reported higher prices and kiosk operators greater supply continuity problems, suggesting difficulties in maintaining affordable services in the long-term. Thus, whilst there is evidence for some water safety benefits from DMM, recontamination of household stored water and ensuring affordable pricing remain ongoing long-term challenges for this pro-poor service delivery model.

Figures/diagrams/illustrations



(a)



(b)

Figure 1: Thermotolerant coliform counts (colony forming units, cfu/100mL) in water samples taken from KIWASCO-managed pipelines, Master Operator-managed pipelines, water kiosks, water vendors, and household stored water in (a) areas under delegated management and (b) control areas not under delegated management