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Focus:

Impact assessment of a drinking water supply project in Kinshasa

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In 2017, only 42% of the population in the Democratic Republic of Congo (DRC) had access to drinking water (WHO & UNICEF, 2017)[1] although the country has the largest hydrological resources on the African continent. The situation is often worse on the outskirts of large cities where infrastructures remain largely lacking in the face of very rapid population growth. This insufficient access to quality water prevents households from collecting a sufficient quantity of drinking water easily, leading to waterborne diseases, poor hygiene conditions, and time-consuming water chores.

To respond to these issues, the AFD has been funding the PILAEP project (Promotion of Innovative Methods for Access to Drinking Water) in Kinshasa since 2008. Its objective is to set up autonomous drinking water systems in peri-urban areas that are not connected to the Kinshasa water supply network. The project relies on a community management method through ASUREPs (Associations of Drinking Water Network Users) at the neighborhood level, and aims for each household to be located within 250m of a standpipe. The price of water is set by each ASUREP, and the revenue generated must at least cover the energy needed to operate the boreholes, the salaries of the standpipe personnel, and maintenance costs.

When a new phase of the project started in 2017 (PILAEP 2), extending to 26 new neighborhoods on the outskirts of the city, the AFD and the DRC Ministry of Finance wanted to implement a rigorous, scientific assessment of the impact of the program on the health, employment, and education of the target population, and on the governance of the neighborhoods concerned. The Dial team and the DRC National Institute of Statistics were tasked with this assessment.

This assessment was challenging on several counts. While similar project impact assessments had already been conducted in rural areas, few studies had been carried out in an urban or peri-urban context, which posed specific challenges. Kinshasa is one of the largest African megalopolises and its population growth is one of the fastest on the continent. Indeed, in addition to the urbanization dynamics, there are migration flows that are linked to the various conflicts that rack the country (in the regions of Kasaï

[1]WHO/UNICEF (2017). Joint Monitoring Programme for Water Supply, Sanitation and Hygiene, Annual report.

or Kivu). The city's urbanization process has been characterized by urban sprawl, with the creation of new residential areas ever further from the city center. Our study took place in the town of N'Selé, which is located in the far east of the city, one of the poorest peripheral areas of the agglomeration (with an incidence of poverty between 80 and 95%, according to Batana et al., 2021). The population there is extremely mobile: a third of the households surveyed at the start of the study had moved out of their neighborhoods in the 3 years that followed. For the study, such mobility can be problematic, since it reduces the number of observations over time and therefore the statistical significance of the assessment. It could also be a source of bias in the estimate, in particular if this mobility is selective or caused directly or indirectly by the installation of standpipes. Infrastructure projects such as PILAEP are indeed likely to attract new inhabitants and to increase land pressure and prices, thus creating a phenomenon of gentrification that forces the poorest households to leave while a more affluent population moves in. It thus seemed essential to collect specific data allowing us to document this dynamic, and to determine, among other things, who ultimately benefited from the project.

Furthermore, unlike many assessments carried out in contexts characterized by a lack of water resources (whether of good quality or not), the study was carried out in a tropical environment with multiple water sources, whose quality is admittedly most often poor, but which are frequently used by households to meet their needs. Some of these sources are free and freely accessible, but their abundance varies depending on the season: this is the case for rainwater, which most Kinshasa households collect and store using containers on their plots of land, or surface water (rivers, backwater etc.). In addition to these sources, there is captured groundwater which users most often must pay for and/or whose access is restricted, but which is less seasonal. Understanding the determinants of households' choices in terms of water supply, the complementary or substitutable nature of the different water sources, and the dynamics of water availability in the neighborhoods concerned (new catchment structures, new watercourses that may appear – or disappear – at any time) therefore appeared to be an important dimension, in addition to the analysis of the impact of the PILAEP project itself.

The assessment protocol was therefore based on extensive data collection between 2018 and 2021 in ten districts on the outskirts of Kinshasa: four which benefited from the project and six (adjacent to the first four) which did not. The data collection was comprised of: two exhaustive population counts in each of these ten districts at 3-year intervals; two exhaustive

surveys of the population's water supply sources which were located and photographed; four survey waves on a representative sample of 3,000 households (a baseline survey, two follow-up surveys, and an endline survey), two telephone tracking surveys, and a representative survey of 1,000 households that moved to the districts between 2018 and 2021, after the panel sample was drawn.

This rich data collection process carried out with the INS allowed us to gather detailed data, most of which were georeferenced. On the one hand, the impact of the PILAEP project on the beneficiaries could thus be analyzed through two approaches: difference in differences and instrumental variables. It was also possible to finely analyze the water demand of Kinshasa households, and the mobility of households on the outskirts of a large African capital. A first report presenting the initial results of the baseline survey was published by the AFD in 2020 (Boaz et al., 2020), and it will be followed in fall 2022 by a second report presenting the detailed results of the assessment. We present some of the main lessons learned here.

Denser neighborhoods, accompanied by slow structural gentrification

Between 2018 and 2021, the neighborhoods studied changed significantly. The number of households residing there rose sharply by 29%, from 12,362 to 15,985. This phenomenon of densification was less marked in the PILAEP project beneficiary neighborhoods (+12.3%) than in the non-beneficiary ones (+58.7%), which were less populated at the start of the period. It seems likely that these differences are the result of dynamics external to the PILAEP project, and rather reflect an urbanization process: households moving from rural areas to peripheral zones that were not saturated yet or only slightly so.

This rapid population growth was accompanied by very high mobility: 31% of households residing in the neighborhoods concerned by the study in 2018 no longer lived there in 2021, while 51% of households identified in these neighborhoods in 2021 did not live there in 2018. Comparing the households that left the area with those that remained or arrived more recently shows that if a phenomenon of gentrification is at play, it is not very marked. Indeed, the households present in the area in 2018 and in 2021 appear to have been better off than those that left, with regard to the characteristics of their housing and the number of durable goods that they owned. They were also better off than the new arrivals who most often

settled on the periphery of the neighborhoods, far from the boreholes and standpipes. Nevertheless, some of these new households' characteristics suggest that they were better off than those who left the area: their housing was less precarious, and they rented or owned it, while many of those who left were merely custodians. Speaking of gentrification remains however questionable and, in any case, nothing points to a more marked gentrification in the neighborhoods benefiting from the PILAEP project. The share of households that were included in the baseline sample and left the study area, in other words the attrition, is notably not significantly different between the treatment and control neighborhoods.

A quasi-public water supply service faced with the emergence of a private service

The exhaustive survey of water sources carried out in 2018 and 2021 shows a significant improvement in the quality and number of sources available in the neighborhoods over this period. The number of boreholes and standpipes distributing groundwater thus increased sharply, from 34 to 169 in 3 years. This increase, which was much faster than the population growth, is explained by two phenomena: the PILAEP 2 project in beneficiary neighborhoods, and the massive drilling of boreholes by other actors, particularly in non-beneficiary neighborhoods.

In recent years, low-cost drilling technologies from India have developed and spread to the African continent. With the growing demand, the abundance of water resources, the shortcomings of public services, and the lack of control, the sale of pumped water has become a profitable, even lucrative business on the outskirts of the city. Some neighborhoods have thus seen such boreholes proliferate: a majority of them is managed privately, while the rest are managed by NGOs or religious organizations. Few of these boreholes were built in the PILAEP project neighborhoods, where competition with PILAEP standpipes probably made this activity less or even not profitable.

The proliferation of private boreholes has been a major challenge for the impact assessment of the PILAEP project: treatment households (located near a PILAEP standpipe) are compared to households that did not benefit from the project, but had access to somewhat comparable supply sources. It is therefore no longer really a question of assessing the impact on the population of improved access to groundwater, but rather comparing the impact of access to water through the PILAEP model to access via other supply sources including private boreholes. Comparing these two models

therefore appears to be a relevant question, especially since private boreholes have been multiplying in many developing countries where the public service is failing, a phenomenon that is still poorly documented.

In terms of quality, at first sight nothing allows distinguishing water from private boreholes from that from PILAEP boreholes: whatever the type of borehole, the water that came out of the tap was clear and seemed "clean." However, it is likely that there were differences in chemical and bacteriological quality. In this area of the city where waste is not collected but buried, the quality of groundwater is highly dependent on the depth from which it is taken. As the cost of boreholes increases proportionally with their depth, it is likely that private owners, who are not subject to quality controls, draw water from relatively shallow levels (10 to 30 meters deep according to local information). PILAEP boreholes were drilled according to precise specifications: the wells were dug more than 100m deep, and the quality of the water was tested regularly. Although households were poorly informed about the quality of the water they consumed, they perceived this difference, since they considered the quality of PILAEP water to be significantly better than that from private boreholes. On the other hand, they did not note any real difference in terms of availability (operation) or insecurity.[2]

The location of PILAEP standpipes within neighborhoods is another difference with private boreholes. In the beneficiary neighborhoods, standpipes were built so that they would serve all households. In fact, by the end of the construction work, in 2021, 90% of households were actually located within 250m of a standpipe. Non-PILAEP boreholes are located in more strategic places: more urbanized areas, serving more affluent households. A positive correlation can thus be observed between the wealth of households, measured by the durable goods owned, and their proximity to a borehole in the non-beneficiary neighborhoods, while this correlation is zero in the PILAEP neighborhoods.

Despite these differences, the price of water was on average identical for both models, around 4FC per liter. This price is relatively high given the low household income in these neighborhoods. The water expenditure associated with a consumption of 20L/day/person (basic access according to the WHO) is estimated at 6% of the median income observed in the sample (1,315 FC/day/person). This price is high in view of the literature on water (affordability) which recommends that the share of the budget

[2]Women who collect water can be victims of violence at water sources, especially when they are remote.

devoted to water and sanitation should not exceed 3 to 6% of the household budget.[3,4] This may help explain why some of the households located near a PILAEP standpipe or a private borehole did not get their water there. However, this price ensured the sustainability of ASUREPs.

What impact has the PILAEP project had?

Given the dynamics observed across the area studied, the results of the assessment of the impact of the PILAEP project on intermediate outcome variables (access to water, quantity consumed per day and per person, etc.) and final outcome variables (health, time devoted to education or work, etc.) is more mixed than expected by the project developers.

Focusing first on intermediate outcome variables, our analysis shows that access to water improved considerably between the two survey dates in all the neighborhoods, but progressed faster and more markedly in those covered by the PILAEP project. This result is robust regardless of the econometric specification used.[5] The use of improved water sources progressed similarly in the two groups of neighborhoods. Nevertheless, the distance traveled by household water collectors in the neighborhoods covered by the project reduced more sharply, as did the time devoted to collection (with nearly 1 hour per day saved on average). In addition, the quantity of water collected per day and per person increased significantly and more quickly among households in the PILAEP neighborhoods, as did the quantity of water used for personal care.

The multiplication of improved water sources within the neighborhoods (through the PILAEP project or the construction of private boreholes) made it possible to significantly reduce the feeling of insecurity at water sources experienced by the individuals in charge of collecting water (who were mostly women or girls), with no significant difference between treatment and control households. On the other hand, the satisfaction with regard to supply sources increased more rapidly among treatment households than among control households. 67% of treatment households said that they were (very) satisfied with their access to drinking water in 2021, whereas only 38% were in 2018, compared to 54% and 38% respectively among

[3]This threshold was exceeded for more than half of the households in the sample.
[4]See Amrose et al. (2015) and Hutton (2012).
[5]Three specifications are used to estimate these impacts: a simple difference-in-differences specification, in which a household is considered treated if it lived within 250m of a standpipe in 2021; a second difference-in-differences specification using the same definition of treatment and taking into account trends specific to each neighborhood; and a third instrumental variable specification, in which the treatment, defined as getting water from a PILAEP standpipe, is instrumented by the distance between a household and the nearest standpipe.

control households. From the point of view of household water supply, the project therefore seems to have had a positive impact.

Regarding final outcome variables, our findings however suggest more limited effects. First of all, they indicate a marginal impact of the project on physical or mental health. Indeed, while our data suggest an overall improvement in physical health, in particular among children under 10, this improvement is not more marked in the neighborhoods covered by the PILAEP project or among households that used standpipes than in other neighborhoods or among households using other water sources. A 5 percentage point drop in the reported incidence of diarrhea in the two weeks leading up to the survey occurred in both groups. This observation applies to the general state of health or illness in the month leading up to the survey. This does not mean that the PILAEP program had no effect, but rather that it failed to generate a health improvement dynamic that was significantly different from that in the non-beneficiary neighborhoods where boreholes were massively drilled between 2018 and 2021.

Furthermore, the PILAEP 2 project did not have a notable effect on the mental health and well-being of the populations. Although the feeling of well-being and good mood among households in beneficiary neighborhoods seems to have progressed more rapidly than among those in non-beneficiary neighborhoods, and even more markedly for those who got their water from PILAEP standpipes, the other indicators (stress, happiness, and satisfaction) do not allow identifying a clear effect. The data therefore indicate that the changes in stress and well-being observed can rather be explained by the dynamics that were specific to the neighborhoods (potentially linked to urbanization).

Given the significant impact of the PILAEP project on reducing the time spent collecting water and the incidence of diarrhea, we then examined the extent to which children's school attendance (under 20 years old) and absenteeism changed over the period, especially for those (37%) who were involved in water collection in 2018. Our results show an increase in school attendance and a concomitant decline in absenteeism between the two survey waves in similar proportions in both neighborhood groups. The PILAEP project therefore did not "make a difference." These results hold whether analyzing the entire sample of children or disaggregated samples by sex, age category, or degree of involvement in water collection.

The same type of conclusion can be drawn for employment and the number of hours devoted to income-generating activities. Overall, our results show

that the project did not have a significant impact on women's employment, whether at the extensive or intensive margin, even when focusing on women who said in the baseline survey that they participated in water collection.

Finally, an important component of the PILAEP 2 project is the autonomous management of water resources through ASUREPs. Thanks to our data, we were able to assess the participation of the population in these ASUREPs, the trust it placed in them, the perception of corruption within them, as well as the role they played in the neighborhoods, regarding governance in general and that of water in particular. Our results show that the installation of standpipes and the creation of ASUREPs contributed to improving water governance, but had no perceptible effects on other institutions and their perception by the population of the neighborhoods concerned. The households in these neighborhoods, and in particular those who actually got their water from standpipes, trusted ASUREPs overall, and significantly more so than the households in the control neighborhoods. In particular, the former felt that ASUREPs were less corrupt than public companies such as the *Société Nationale d'Électricité* (SNEL, the electricity company) or the *Régie Nationale de Distribution de l'Eau* (REGIDESO, the water company).

Conclusion

In this impact assessment, we have attempted to build on the various challenges stemming from the context of the study and the nature of the project. Adding new data collection mechanisms to the initial protocol has allowed us to analyze and better understand the mobility of households and the slow gentrification of the Kinshasa outskirts, and to study the evolution of water supply and demand in detail. The data reveal the emergence of a private water supply service in certain non-beneficiary neighborhoods, and allow analyzing household choices in terms of water collection and consumption.

The PILAEP 2 project has considerably improved access to water for the population living on the Kinshasa outskirts. In view of the observations in the neighborhoods that were not covered by the project, it can be assumed that in the absence of PILAEP, a private water distribution service would have emerged, offering water of uncertain quality, at a relatively high and fluctuating price, at distribution points in already relatively privileged areas. Despite the contributions of the PILAEP model compared to the private model, and despite its positive impact on the water supply of the treatment

households, the study has not identified any differentiated impact of this model on health (for children and adults), on school attendance, or on the employment of women. Further in-depth analyses of each of these results must nevertheless be conducted to better understand the underlying mechanisms.

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