

# Left Behind:

## The Socioeconomic Barriers to Last-Mile Mobile Money Access in Kenya

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# The Reach Alliance

The Reach Alliance is a consortium of global universities — with partners in Ghana, South Africa, Mexico, Canada, United Kingdom, Australia, and Singapore — developing the leaders we need to solve urgent local challenges of the hard to reach — those underserved for geographic, administrative, or social reasons. Working in interdisciplinary teams, Reach’s globally minded students use rigorous research methods to identify innovative solutions to climate, public health, and economic challenges. The UN’s Sustainable Development Goals (SDGs) provide inspiration and a guiding framework. Research is conducted in collaboration with local communities and with guidance from university faculty members, building capacity and skills among Reach’s student researchers.

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Note: Authors are listed alphabetically with the faculty mentor listed last.

Cover photo: The people and local shops of Narok, Kenya. Traditional-style buildings with advertisements for Safaricom mobile phones. (photo by iStock)





# Acknowledgements

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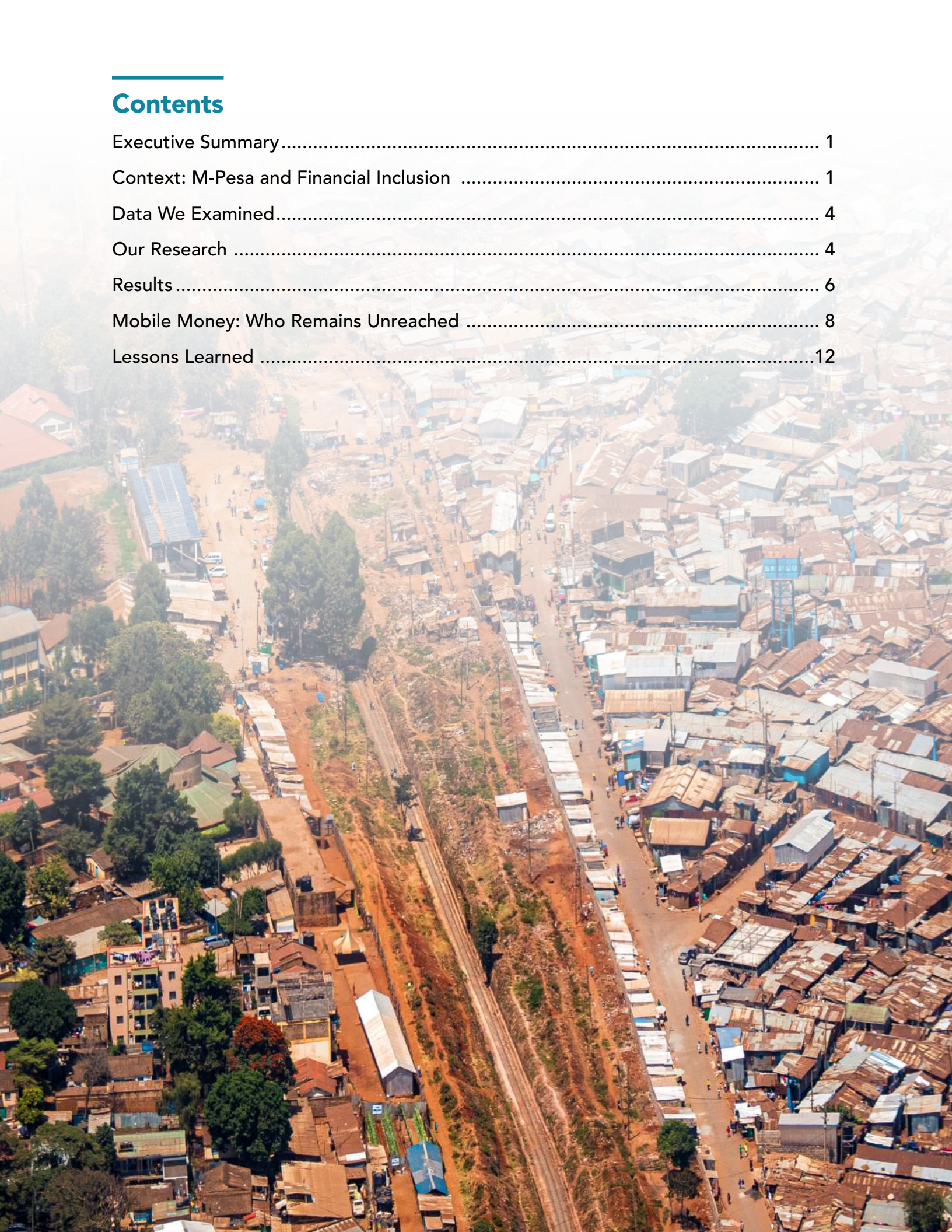
As researchers we acknowledge our position as settlers on the land on which the University of Toronto operates. For thousands of years, it has been the traditional land of the Huron-Wendat, the Seneca, and the Mississaugas of the Credit. Today, this land is still home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land. We are grateful to the Reach Alliance team for their guidance and mentorship throughout our research project.

This research was vetted by and received approval from the Ethics Review Board at the University of Toronto. The research was conducted virtually because it was deemed unsafe to travel for field work during the COVID-19 pandemic.

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**Figure 1.** M-Pesa was accessible through “feature phones” with SMS which were more common and cheaper to use than smartphones.

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## Executive Summary

M-Pesa launched in 2007 as the first mobile payment system in Kenya and it has been broadly adopted. Despite being hailed as a success story, M-Pesa still leaves behind some hard-to-reach populations. We used machine learning models to identify and understand the barriers to accessing mobile money in M-Pesa. We find that lack of cell ownership and government-issued identification remain the largest barriers. Demographic predictors of people’s exclusion include lack of education, low population density, and lower incomes. Surprisingly, ethnicity and religion are also significant, but variability in these features suggests that further research is necessary. Using only basic socioeconomic features, our best models predict user and non-user households with 89 per cent accuracy. This demonstrates that machine learning can be used to understand vulnerable populations and uncover the characteristics of those unreached

by mobile money so that they can be better reached.

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## Context: M-Pesa and Financial Inclusion

In Kenya, mobile money has been important to provide people with the ability to send remittances, pay for goods and services, and save their money. Researchers have praised the poverty-reduction benefits of mobile money, specifically market leader M-Pesa, and many platforms have celebrated the near ubiquitous adoption of these services in Kenya. However, not everyone has reaped the benefits. While M-Pesa has received significant attention as a business case study as well as for its effects on welfare, there has been limited focus on groups that do not use mobile money and why they don’t.<sup>1</sup> Using publicly available data from the country’s 2016 and 2019 FinAccess Household Surveys,

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1 Tavneet Suri and William Jack, “The Long-run Poverty and Gender Impacts of Mobile Money,” *Science*, 354, no. 6317 (2016): 1288–92.

our research offers an intuitive understanding of who does not use mobile money services. We use three statistical learning models to understand the factors that predict which individuals do not have registered mobile money accounts. These factors can aid in understanding what can be done to increase the reach of mobile money and contribute to progress on the United Nations Sustainable Development Goals (SDGs) — a universal call to action that seeks to ensure that everyone, globally, can thrive. Financial inclusion is crucial toward these ends.

M-Pesa in Kenya represents one of the most successful expansions of financial inclusion in the twenty-first century. Between 2011 and 2017, the percentage of adults in Kenya who owned a financial account almost doubled, rising from 42 to 82 per cent. This rapid increase in inclusion was driven largely by the introduction of “mobile wallets,” or mobile money, within the last 13 years, with M-Pesa being the first such service.<sup>2</sup> Launched by Safaricom in 2007, M-Pesa allows users to deposit and send money using SMS-based messaging on a cell phone.<sup>3</sup> The service tracks accounts and enables transactions through a partnership with the Commercial Bank of Africa, a strategy that leveraged the existing Safaricom telecom network. While it was originally established as a platform for only payments and transfers, M-Pesa has expanded to offer a range of financial products including microcredit and savings accounts. Although it is no longer the only mobile money service, it maintains a dominant hold on market share, representing 96.5 per cent of all mobile money accounts in the country in March 2023. In 2017, 73 per cent of all adults in Kenya had access to a mobile money account.<sup>4</sup>

Researchers describe a number of reasons for M-Pesa’s widespread success. The service’s association with the trusted Safaricom brand and its existing infrastructure allowed the product to spread quickly and easily. As the dominant telecom provider in Kenya prior to the launch of M-Pesa, Safaricom already stood as a well-known and reliable household name. Because many Kenyans were already customers of Safaricom when M-Pesa launched, they were more readily able to accept the product than if it were offered through new and independent channels. M-Pesa’s mobile phone integration meant that existing customers could use the new product with the devices and service providers that they were already engaged with. Safaricom’s pre-existing agent network, traditionally used to help users purchase air time, was similarly leveraged to spread the service easily and rapidly in both urban and rural areas.

Another key factor in the platform’s success was the regulatory landscape surrounding banking and innovation that existed during the service’s rollout. Support from regulatory bodies was conducive to its proliferation. Safaricom was classified as a nonbank financial entity, relieving it of some of the regulatory burdens required by other financial institutions.<sup>5</sup> Early in M-Pesa’s rollout, the Central Bank, along with the Government of Kenya, were encouraged by private-sector actors (including the Bill and Melinda Gates Foundation), as well as Financial Services Deepening (FSD) Kenya to keep a “wait and see approach” that allowed M-Pesa to operate in spite of the fact that it was technically in contravention of existing banking legislation that required deposit-taking institutions to be regulated as banks.

2 “Digital Access: The Future of Financial Inclusion in Africa,” International Finance Corporation, 14 May 2018. [↗](#)

3 “Mobile Currency in Kenya: The M-Pesa,” Centre for Public Impact, 21 March 2016. [↗](#)

4 “Digital Access.”

5 Njuguna Ndung’u, “M-Pesa — A Success Story of Digital Financial Inclusion,” Practioner’s Insight, University of Oxford, UK, July 2017.

Finally, M-Pesa's simplicity and low-cost nature meant that it presented a strong use case for individuals who had previously been financially excluded. Leveraging SMS rather than a smartphone app or internet-based service, which were limited and less accessible at the time, M-Pesa was accessible through "feature phones" and other more common mobile devices. This integration into pre-existing and common technology made M-Pesa both convenient and cheap to access for a wide portion of the population.<sup>6</sup>

However, despite the success of M-Pesa and its subsequent competitors at improving financial inclusion for a large portion of the population, another fraction of the country still remains financially excluded. Approximately 18 per cent of Kenyan adults have no access to formal financial services (including banking and mobile money) and just over a quarter of the adult population lacks a mobile money account.<sup>7</sup>

## Who Still Faces Financial Exclusion?




While there will always be a segment of the population that will not adopt mobile money by choice, there are also other reasons for the lack of adoption. First, those who live in "frontier" locations or regions with low population density have a hard time accessing mobile money because they lack access to mobile money

agents.<sup>8</sup> These agents need large transaction volumes and access to deposit-taking institutions for float management, so low-population-density regions are less lucrative for them.<sup>9</sup> Having a low income, being female, not having any form of education, and lacking the necessary government identification to sign up for the service are other factors affiliated with lower use of mobile money.<sup>10</sup>

When it comes to people's barriers to adopting mobile money there are few studies that use quantitative analysis to understand them. Within the development studies literature, machine-learning methods have become a prominent tool to understand factors underlying global challenges. Researchers have used machine-learning methodologies to understand microeconomic and social phenomena, including cell phone debt defaults, cell phone usage, and education.<sup>11</sup> Machine learning has also been used to analyze mobile money fraud detection and online banking adoption more generally.<sup>12</sup> With this work in mind, we wanted to apply quantitative analytical methods so we could better understand the barriers to adopting mobile money.

6 William Jack, Adam Ray, and Tavneet Suri, "Transaction Networks: Evidence from Mobile Money in Kenya," *American Economic Review*, 103, no. 3 (2013): 356–61.


7 "Digital Access: The Future of Financial Inclusion in Africa"; Leo Van Hove and Antoine Dubus, "M-PESA and Financial Inclusion in Kenya: Of Paying Comes Saving?" *Sustainability: Science Practice and Policy*, 11, no. 3 (2019): 568.

8 "Kenya Wave 5 Report," Fifth Annual Financial Inclusion Insights Tracker Survey, InterMedia, 2018;  Laura Muñoz Pérez, Michaella Allen, Christine Hougaard, and Barry Cooper, "The Evolution of Agent Networks in Africa," *Cenfri*, 27 March 2019;  Shalini Unnikrishnan, Jim Larson, Boriwat Pinradab, and Rachel Brown, "How Mobile Money Agents Can Expand Financial Inclusion," *BCG Global*, 14 February 2019. 

9 Pérez, Hougaard, and Cooper, "The Evolution of Agent Networks in Africa."

10 "Kenya Wave 5 Report"; Van Hove and Dubus, "M-PESA and Financial Inclusion in Kenya."

11 Maria De-Arteaga, William Herlands, Daniel B. Neill, and Artur Dubrawski, "Machine Learning for the Developing World," *ACM Transactions on Management Information Systems (TMIS)*, 9, no. 2 (2018): 1–14.

12 Francis Effirim Botchey, Zhen Qin, and Kwesi Hughes-Lartey, "Mobile Money Fraud Prediction—A Cross-Case Analysis on the Efficiency of Support Vector Machines, Gradient Boosted Decision Trees, and Naïve Bayes Algorithms," *Information: An International Interdisciplinary Journal*, 11, no. 8 (2020): ; Santiago Carbo-Valverde, Pedro Cuadros-Solas, and Francisco Rodríguez-Fernández, "A Machine Learning Approach to the Digitalization of Bank Customers: Evidence from Random and Causal Forests," *PloS One*, 15, no. 10 (2020): e0240362.

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## Data We Examined

We used cross-sectional data sets from Financial Services Deepening (FSD) Kenya’s 2016 and 2019 FinAccess Household Surveys (2016 and 2019 refer to when the surveys were published — the data were actually collected in the years prior).<sup>13</sup> These surveys were run collaboratively by the Central Bank of Kenya (CBK), the Kenyan National Bureau of Statistics (KNBS), and FSD Kenya. In both years, a representative and statistically sound sample was drawn from clusters randomly selected from the KNBS national household sample framework, the fifth National Sample Survey and Evaluation Program (NASSEP V). The 2015 and 2018 data sets contain 8,665 and 8,669 observations respectively. In 2015, 66 per cent of those surveyed were registered mobile money users, 2.9 per cent used to be but were no longer at the time of survey, and 31.1 per cent had never had any form of the service at all. In 2018, these groups made up 72.9, 3.2, and 23.9 per cent of the data set respectively.

Although the data sets are almost identically structured between years in terms of what variables are available, there are a few notable differences. In both years, the original mobile money variable asks whether or not the respondent is a registered user, and allows for people to say they used to be but no longer are. The language survey question asks for the interviewee’s preferred language. However, the grouping for language and religion varies slightly between years. Meru and Embu languages are grouped together in 2018 but were separate in 2015. This is also the case for Hindus and Sikhs under the religion variable. There are also language and religious groups that are not present in the 2015 data that are present in 2018 and vice versa. There were no Samburu, Rendille,



**Figure 2.** Assorted money transfer services and online payment platform brands, including M-Pesa. (iStock)

or Borana speakers in 2015, and no Kisii or Masai speakers in 2018.

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## Our Research

We hypothesized that several factors might influence the adoption of the mobile money services in Kenya and this guided our analytical process. For example, we considered:

- urban/rural clusters
- gender
- language
- religion
- marital status
- nearest type of financial service
- property ownership
- education
- formal government identification
- phone ownership
- household size
- age
- monthly income
- county population density

People in urban compared to rural locations might have different motivations for adoption. We included population density to evaluate this

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13 We use the collection years to refer to each data set.



## Household Surveys

A representative and statistically sound sample was drawn from clusters randomly selected from the KNBS national household sample framework.

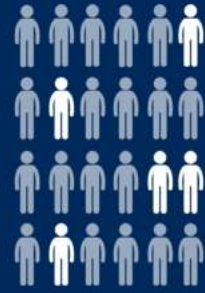
Within each cluster, a selection of households was randomly selected. At the household level, the individual selected for interview was randomly selected, provided that they were over the age of 16.



Random selection of clusters from the KNBS survey results



Random selection of households within selected clusters



Random selection of individuals within the selected households

## 2015 and 2018 Survey Results

Unreached population  
**24.1%**

The proportion of the sample that **do not** have registered mobile money accounts and are therefore "unreached" by mobile money services due to barriers in accessing mobile money in Kenya.

Reached Population  
**68.9%**

The proportion of the sample that **do** have registered mobile money accounts and are therefore "reached" by mobile money services.

Reached Population  
**75.9%**

The proportion of the sample that **do** have registered mobile money accounts and are therefore "reached" by mobile money services.

Unreached Population  
**31.1%**

The proportion of the sample that **do not** have registered mobile money accounts and are therefore "unreached" by mobile money services due to barriers in accessing mobile money in Kenya.

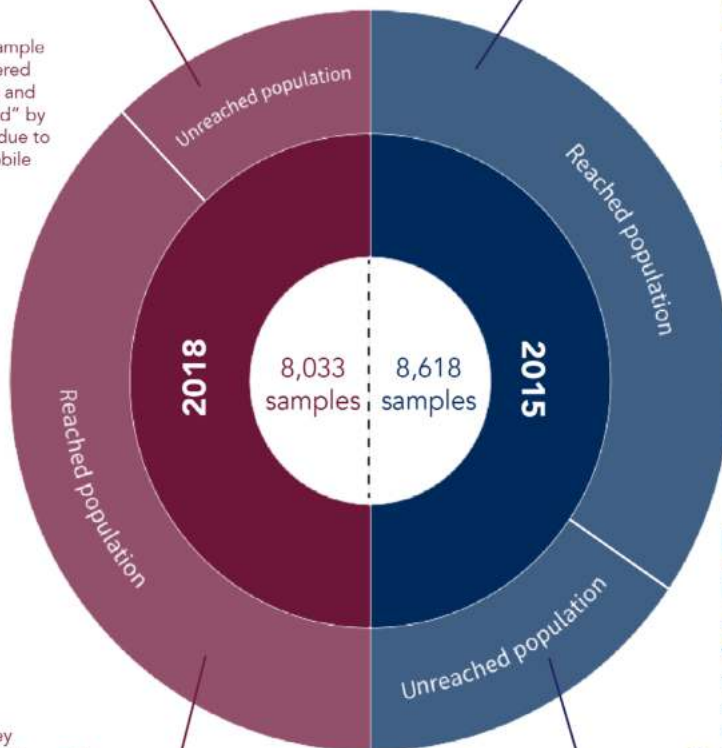


Figure 3. Publicly available data from the 2015 and 2018 FinAccess Household Surveys

factor and left out urban/rural clusters because it captured the same information. We also hypothesized that different socioeconomic factors could influence adoption and were important to include in the study, such as gender, age, language, religion, income, and education.

Formal identification and phone ownership could also be barriers so they were included in the analysis. The factors we removed from the analysis include marital status, property ownership, and household size. The nearest financial service was also excluded because we did not feel it was sufficiently interpretable. We tested the exclusion of these factors to ensure minimal impact on the results and we analyzed the data from 2015 and 2018 separately to easily enable all methods to be compared. We then compared the results between 2015 and 2018 to understand how economic development during this period may have influenced adoption.

These variables were included in the quantitative analysis to illuminate select demographic characteristics of populations that had not been reached by mobile money. We tried to identify the unreached population rather than the population that adopted mobile money. This is contrary to traditional adoption studies, but we feel it is appropriate to align with the SDG approach of including everyone, everywhere.

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## Results

We use multivariate linear regression, lasso logistic regression, and decision tree models to identify predictors of people who have been unreached by mobile money services in Kenya. Using multiple models provides a complete view of the relationships in the data. The linear regression model offers interpretable statements about correlations between dependent variables and mobile money use. The logistic regression model offers superior predictions for binary

classification and the fitted prediction value can be interpreted as a probability, unlike simple linear models which can produce negative predictions or values greater than 1. The decision tree adds insightful profiles of non-users and an intuitive algorithmic method for predicting non-use.

## Linear Regression

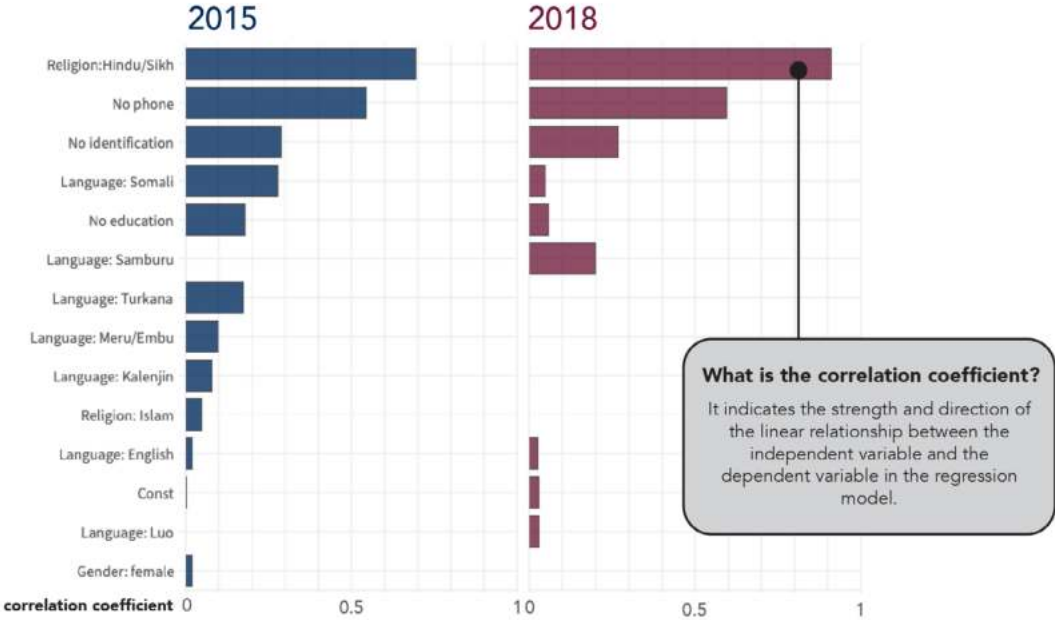
The binary variables we used in the final linear regression model are *phone use*, *formal identification*, *gender*, and *lack of education*. We include dummy variables denoting different primary languages and religions. *Age*, *population density* of the county, and *monthly income* are the continuous variables. The coefficients describe the correlation of a variable with being “unreached” by mobile money services so positive coefficients indicate a variable is correlated with being harder to reach. For continuous variables, we interpret this as the change in probability of being unreached, associated with a unit increase in the continuous variable. For categorical variables, we interpret the coefficient as describing the change in the probability of being unreached by mobile money associated with being in that category compared to a baseline category. For binary categorical variables, the baseline is simply the opposite value — women are compared to men and people with no phone are compared to those with a phone. For multi-class categorical variables like religion and language, the baseline variables we chose are the plurality categories, which are Christianity and Swahili respectively.

We found that being older, having a lower monthly income, and living in less densely populated counties are associated with being unreached by mobile money. However, income does not have a statistically significant correlation in 2015. Although the coefficients are small, particularly for income and population density, the loss of a Kenyan shilling or a person per square kilometre is a similarly small change. Looking at

# Quantitative analysis summary:

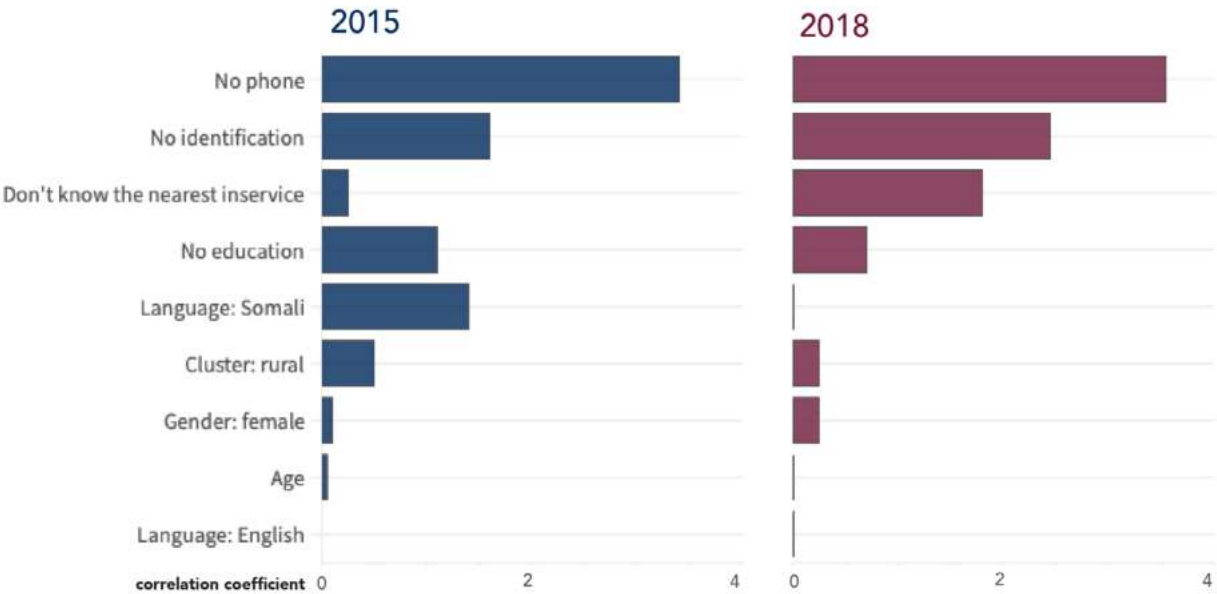
## Which factors determine access to Kenya's money mobile system?

**Linear regression statistical model:** Linear regression is used to predict continuous outcomes



Based on the value of the correlation coefficient, **not having a phone, identification, or education are significantly linked to being harder to reach in both years. Hinduism is also significantly linked to being harder to reach in both years.**

**Logistic regression statistical model:** Logistic regression is used to predict categorical outcomes



As in the case of linear regression, **not having a phone, identification, or education have high correlation coefficients and are linked to being harder to reach in both years.**

Figure 4. Quantitative analysis summary

the categorical variables, we see that having no phone, no formal identification, no education (i.e., not completing primary school), and being Hindu are strongly correlated with being unreachable by mobile money across years, even after controlling for the other characteristics in the regression. Having no mobile phone is associated with a 53.9 per cent increase in the probability of being unreachable in 2015, and a 60.2 per cent increase in 2018. Lack of formal identification is associated with a 28.7 per cent increase in the probability of being unreachable in 2015, and 34 per cent in 2018. Being Hindu is associated with a 69.5 per cent increase in this probability compared to being Christian in 2015, and being either Hindu or Sikh is associated with 90.9 per cent increase compared to being Christian in 2018. Somali speakers were 27.5 less likely than the Swahili speakers to have mobile money services in 2015 but more likely than Swahili speakers to have the service in 2018.

Not having a phone, identification, or education are significantly linked to being harder to reach in both years. Hinduism is also significantly linked to being harder to reach in both years. Other variables are not as significant and varied between data sets. The linear regression model predicts mobile money registration with accuracy rates of 86.6 and 89.2 per cent for 2015 and 2018 data respectively.

The most important feature in both 2015 and 2018 was owning a mobile phone. In 2015, however, preferring to speak Somali was the second most important feature, followed by

having identification, then monthly income. The importance of preferring to speak Somali is gone in 2018, similar to the other models, and having identification moves up to the second most important feature.

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## Mobile Money: Who Remains Unreached

In Kenya, mobile money services such as M-Pesa have achieved an unprecedented level of reach and assisted in the financial inclusion of millions of unbanked Kenyans.<sup>14</sup> A number of scholars have already explored the circumstances surrounding the success of mobile money, along with the demographics and behaviours of users.<sup>15</sup> As a complement to these studies, we aimed to fill a gap in the literature by understanding the characteristics associated with those who have yet to access mobile money. We did so by applying three statistical learning models — a multivariate linear regression, a lasso logistic regression, and decision tree models — to data collected from FSD Kenya's 2015 and 2018 FinAccess Household surveys.

Affirming the literature, all three of our models found that lacking a phone or government-issued identification were the two most significant factors associated with a lack of access to M-Pesa. This is intuitive, given that having a cell phone and ID are required to register for a mobile money account. Previous surveys of people without cell phones in Kenya suggest that they

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14 Jack, Ray, and Suri, "Transaction Networks"; Ndung'u, "M-Pesa — A Success Story."

15 Ahmad Hassan Ahmad, Christopher Green, and Fei Jiang, "Mobile Money, Financial Inclusion and Development: A Review with Reference to African Experience," *Journal of Economic Surveys*, 34, no. 4 (2020): 753–92; Addisu A. Lashitew, Rob van Tulder, and Yann Liasse, "Mobile Phones for Financial Inclusion: What Explains the Diffusion of Mobile Money Innovations?" *Research Policy*, 48, no. 5 (2019): 1201–1215; Jan Lepoutre and A. Oguntoye, "The (non-)emergence of Mobile Money Systems in Sub-Saharan Africa: A Comparative Multilevel Perspective of Kenya and Nigeria," *Technological Forecasting and Social Change*, 131 (2018): 262–275; Ignacio Mas and Olga Morawczynski, "Designing Mobile Money Services Lessons from M-PESA," *Innovations: Technology, Governance, Globalization*, 4, no. 2 (2009): 77–91; Ignacio Mas and Amolo Ng'weno, "Three Keys to M-PESA's Success: Branding, Channel Management and Pricing," *Journal of Payments Strategy and Systems*, 4, no. 4 (2010). 

would like to use mobile money,<sup>16</sup> so increasing cell phone ownership may help in granting access to mobile money and a path to financial inclusion for the unreached.

Curiously, 6.92 per cent of mobile money users in the data do not possess a phone and/or government ID. The presence of these users suggests a more complicated reality of mobile money use, which we can begin to piece together by first considering Kenya's exceptionally high phone ownership rate. Seventy-nine percent of adult Kenyans own at least one mobile phone, a figure significantly higher than the African average of 65 per cent.<sup>17</sup> Even more than personal ownership, many Kenyans have access to a phone through sharing arrangements within peer groups and family units, with 93.1 per cent of households owning at least one mobile phone.<sup>18</sup>

Few studies have attempted to profile phone-sharing mobile money users. However, qualitative studies of mobile use behaviours among women, the less-educated, people in rural areas, and remittance-receiving dependents incidentally suggest that these groups form a significant proportion of phone-sharing mobile money users.<sup>19</sup>

While more research is required to illuminate the nuances of mobile money access, what is apparent from these studies is that Kenyans have employed dexterity in circumventing the traditional barriers of ID and phone ownership. Not owning a phone or ID is not an insurmountable stop point for M-Pesa access. A significant number of Kenyans have access to the "starter materials" for mobile money — access to (not necessarily ownership of) a cell phone, a SIM card (and if not, the capacity to purchase one), and government ID.

While a precise estimate is not available, we can use SIM card subscriptions as a proxy. Since 1998, legislation in Kenya mandates that any person who registers for a SIM card must provide some form of ID. A person's demand for a SIM card suggests that they have access to a phone to use it. Independent of phone ownership, just over 95 per cent of adult Kenyans in 2018 had a mobile phone subscription.<sup>20</sup> This significantly exceeds even the estimated 79 per cent of Kenyan adults who were mobile money users in 2018.<sup>21</sup>

While these findings do not alter our research question, they add a key qualification. Given that more than 90 per cent of Kenyans conceivably have access to the starter materials for mobile money, it is worth asking who isn't using mobile money and why. Our analysis puts forward

16 William Jack, Tavneet Suri, and Mit Sloan, "The Economics of M-PESA," Unpublished paper, 2010.

17 "ICT Facts and Figures 2017," International Telecommunications Union (ITU) [🔗](#); Susan Wyche and Charles Steinfield, "Why Don't Farmers Use Cell Phones to Access Market Prices? Technology Affordances and Barriers to Market Information Services Adoption in Rural Kenya," *Information Technology for Development*, 22, no. 2 (2015): 320–33. [🔗](#)

18 Amy Wesolowski, Nathan Eagle, Abdisalan M. Noor, Robert W. Snow, and Caroline O. Buckee, "Heterogeneous Mobile Phone Ownership and Usage Patterns in Kenya," *PLoS One*, 7, no. 4 (2012): e35319; "Statistics (First Quarter Sector Statistics Report for the Financial Year 2015-2016)," Communications Authority of Kenya, 2015 [🔗](#); Susan Wyche, Nightingale Simiyu, and Martha E. Othieno, "Understanding Women's Mobile Phone Use in Rural Kenya: An Affordance-Based Approach" *Mobile Media and Communication*, 7, no. 1 (2019): 94–110

19 Susan Wyche, "Exploring Women's Everyday Mobile Phone Experiences in Nairobi, Kenya," *Interacting with Computers*, 29, no. 3 (2017): 391–402 [🔗](#); Susan Wyche, Tawanna R. Dillahunt, Nightingale Simiyu, and Sharon Alaka, "If God Gives Me the Chance I Will Design My Own Phone': Exploring Mobile Phone Repair and Postcolonial Approaches to Design in Rural Kenya," in *Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing* (2015), 463–73 [🔗](#); Wyche and Steinfield, "Why Don't Farmers Use Cell Phones to Access Market Prices?"

20 "First Quarter Sector Statistics Report For the Financial Year 2018/2019 (July — September 2018)," Communications Authority of Kenya, 2018. [🔗](#)

21 "The 2019 FinAccess Household Survey," Central Bank of Kenya, Financial Sector Deepening Kenya, Kenya National Bureau of Statistics, 2019. [🔗](#)



studies help to give a more precise illustration of how education can be related to mobile money use and access.

Researchers have examined the experience of Kenyan women and farmers as they interact with various mobile technologies. For example, Wyche, Simiyu, and Othieno found that phone churn (i.e., switching phones after a previous one's irretrievable breakdown) is significant among rural users, a finding affirmed by Wesolowski and colleagues.<sup>22</sup> This is a result of wide variation in the quality of phones, from counterfeits to third- or even fourth-hand sets. Aside from limited functionality (e.g., broken keypads), each phone has a different operating sequence for mobile money apps such as M-Pesa, so users have to relearn the app each time and cannot help each other.

In a 2018 paper, Susan Wyche and Jennifer Olson found through an ethnographic approach that the PIN-based system favoured by M-Pesa could be conceptually foreign.<sup>23</sup> Users often forgot PINs and retrieving or assigning a new PIN is time consuming because it requires a one- to two-hour trip to the nearest agent to fix. A person's education interacts in complicated ways with other forms of marginalization. We would not expect a woman living in the urban centre of Nairobi and a woman living in Central Turkana to face the same use cases, pressures, alternatives, or challenges in using mobile money.

Language and ethnicity may also complicate mobile money use. While neither the 2015 nor 2018 data sets collected information on ethnicity, participants were able to choose a preferred language to complete the survey from

a limited range of options. Most participants opted for English or Swahili, making the language preference variable an imperfect proxy for ethnicity. Despite this, we found results significant and strange enough that they invite further investigation. In 2015, Somali language-preference participants were significantly less likely to use M-Pesa, a trend sustained through all three of our models. In 2018, this trend disappears, and Somali preference participants are no different from those who chose to have the interview in Swahili.

We also examined data collected on the religious group of participants. In 2015, our linear regression suggests strong and significant associations between preferring to speak Luhya or Kalenjin or being Muslim and not using mobile money. This was not the case in 2018, however. Although Hindus and Sikhs are an exceptionally small minority in the survey, they were especially unlikely to be mobile money users in either 2015 or 2018.

Although these findings should be taken cautiously, we report them because they show some coherence with real-world trends that increasingly suggest that examining ethnic differences in mobile money use is worthy of investigation. Significant ethnic differences relate to ID possession in Kenya. A 2013 report by the Kenyan Human Rights Commission says that "the process of vetting Kenyan-Somalis, Nubians, and Kenyan Arabs [for identity cards] is discriminatory and violates the principle of equal treatment. Such a practice has no place in a democratic and pluralistic society."<sup>24</sup> In 2019, the country's nationwide push toward assigning a unique biometric ID for each citizen likely exacerbated these inequalities.<sup>25</sup> Given the importance of government ID to mobile money, examining the link

22 Wyche, Simiyu, and E. Othieno, "Understanding Women's Mobile Phone Use in Rural Kenya"; Wesolowski et al., "Heterogeneous Mobile Phone Ownership and Usage Patterns in Kenya."

23 Susan Wyche and Jennifer Olson, "Kenyan Women's Rural Realities, Mobile Internet Access, and 'Africa Rising'," *Information Technologies and International Development* (Special Section), 14 (2028): 33–47.

24 "An Identity Crisis? A Study on the Issuance of National Identity Cards in Kenya," Kenya National Commission on Human Rights, 2007. [↗](#)

25 Abdi Latif Dahir, "Kenya's New Digital IDs May Exclude Millions of Minorities," *The New York Times*, 28 January 2020. [↗](#)

between ethnicity and access should be of primary interest to future researchers.

## Potential Limitations: How Significant Is the Share of Non-users?

A potential limitation of this study may lie in our assumption of a “reached” and “unreached” binary. By framing all non-users as unreached, we presume that they do not have access to mobile money when there exists a second possibility — that they do have access but have self-selected out of mobile money use.<sup>26</sup> While it may be challenging to imagine people whose lives would not benefit from using mobile money, it is not possible to rule out such a choice a priori. The question remains about who these a people might be and how significant a share of non-users they form. From the perspective of policymakers and stakeholders, determining how significant the benefit-cost disparity is and what constructs it is important. That is, can a quick fix such as improving and standardizing the user interface of mobile money platforms alter the marginal benefit-cost trade-offs such that it now maximizes welfare for non-users to use mobile money? Examples of such non-users could include the elderly, for whom the cost of learning how to use their cell phones may simply not be justified by the marginal benefit of using mobile money. Future work might study the motivations, priorities, and behaviours of “atypical” mobile money users and non-users.

future where the “average person” is no longer a meaningful target in the task of reaching the hardest to reach. While it is a common misconception that quantitative methods are unable to yield insights into small, hard-to-reach populations, our study provides an example of how quantitative findings can work in tandem with qualitative approaches to produce powerful insights in describing these populations accurately and revealing factors that may influence why they are unreached. This research sheds light on the strongest predictors of lacking access to mobile money services, such as phone ownership and identification, and gives us a more precise understanding of how demographic characteristics, like region, religion, and language, interact with the likelihood of using mobile money. The aftershocks of COVID-19 no doubt caused distortions in existing socioeconomic trends of vulnerable groups that will need to be unpacked in the years to come. We hope that this type of mixed-methods approach can provide an example framework to help light the way forward.

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## Lessons Learned

Examining the exceptional reach of mobile money in Kenya allows us to ask questions for a

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26 Indrani Medhi, S.N. Nagasena Gautama, and Kentaro Toyama, “A Comparison of Mobile Money-Transfer UIs for Non-literate and Semi-literate Users,” *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (2009):1741–50; Indrani Medhi, Aishwarya Ratan, and Kentaro Toyama, “Mobile-Banking Adoption and Usage by Low-Literate, Low-Income Users in the Developing World,” in *Internationalization, Design and Global Development*, edited by N. Aykin (Berlin: Springer, 2009), 485–94; Kentaro Toyama, “Human-Computer Interaction and Global Development,” *Foundations and Trends in Human-Computer Interaction*, 4, no. 1 (2010): 1–79.



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## Research Team



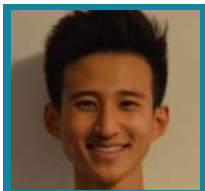
**Zachary Johnson** is an associate at 2048 Ventures, focused on companies building next-generation platforms to protect and enable workflows for critical digital and physical infrastructure (energy, robotics, cybersecurity, supply chain). He also served as director of the Global Ideas Institute at University of Toronto's Munk School of Global Affairs & Public Policy.



**Katie Kwang** graduated from University of Toronto with an honours BSc in psychology research and public policy (2023). She currently works as a senior executive in Singapore's Ministry of Culture, Community and Youth (MCCY) in the areas of policy and national identity in the Resilience and Engagement Division.



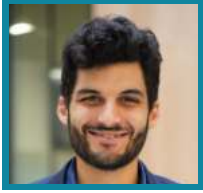
**Mariam Sharifi** has worked as a consultant at the Boston Consulting Group and as a technology advisory intern, she assisted in developing a proposal on smart city technology for a large city government, analyzing costs and feasibility for a variety of business and partnership models that would accelerate the deployment of smart city solutions. She is currently a strategic initiatives manager at Save the Children International in London.



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**Amy Bilton** is an associate professor in mechanical engineering and the director of the cross-disciplinary Centre for Global Engineering (CGEN) at the University of Toronto. Her research group, the Water and Energy Research Lab (WERL), focuses on developing innovative water and energy technologies that are geared toward global development. She has worked with industry and NGOs around the world, most notably in India, Bangladesh, Vietnam, Mexico, and Nicaragua. She has published over 30 peer reviewed journal articles in top journals such as *Science Advances*, *Nature Sustainability*, *Environmental Science*, and *World Development*. She completed her PhD and MS in aeronautics and astronautics at MIT and her BSc in engineering science (aerospace) from the University of Toronto. Amy received the prestigious Engineers Canada Young Engineer Achievement Award for her contributions toward engineering for global development.



**Ahmed Mahmoud** is the program manager for the Centre for Global Engineering (CGEN) at the University of Toronto and a lecturer on engineering and its role in global development. At CGEN, he works closely with engineering faculty to define research initiatives that tackle major global challenges, such as food insecurity, water scarcity, and energy poverty, and he helps connect those faculty with changemakers on the ground. In addition, he helps administer and oversee CGEN's student engagement opportunities, including the Global Engineering Capstone program, as well as the annual CGEN Fellowship, which places a recent engineering graduate with a social enterprise in the Global South. His research interests include engineering innovation in aquaculture, agriculture, remote monitoring and impact assessment.



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