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# **MAPPING MOBILE MONEY POTENTIAL IN WEST AFRICA**

A GEOSPATIAL DECISION-MAKING FRAMEWORK FOR FINANCIAL  
INCLUSION VIA MOBILE MONEY EXPANSION

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## Introduction

The rapid expansion of mobile money technology has significantly contributed to financial inclusion in the developing world. Over the past 17 years, it has emerged as a transformative solution, offering easier and lower-cost access to financial services such as low-cost bills payments, remittances, savings and social transfers for middle- and low-income populations.<sup>1</sup> Traditional banking infrastructure often struggles to reach remote and underprivileged regions, leaving a substantial gap in financial accessibility. Mobile money, with its lower transaction costs and simplified process, has the potential to bridge this divide.<sup>2</sup> However, despite its remarkable growth, there are still challenges to overcome. Many factors, including digital and traditional literacy, physical distance from agents, and lack of access to electricity, isolate large segments of the population from fully benefiting from mobile money services.

One of the universal challenges in expanding mobile money is the availability of agents. These agents play a critical role in the mobile money ecosystem, serving as the link between digital wallets and physical cash. A geospatial decision-making approach provides an opportunity for mobile money operators (MMOs) to implement data-driven agent placement. By integrating spatial data such as population demographics, infrastructure, and economic indicators, this approach can help prioritize areas where agent placement would maximize network efficiency and financial sustainability for the mobile money operator as well as increased financial inclusion nationwide.

This paper aims to investigate the criteria guiding cash-in cash-out (CICO)-based MMO expansion spatially within the West African Economic and Monetary Union (WAEMU) due to the shared regulatory framework and similar developmental contexts of its composite countries. It proposes a theoretical geospatial approach to agent placement that optimizes network growth and enhances accessibility for underserved populations. This framework can serve as a generalizable, public domain framework that can be used by regulators; a “superset” model. As one of the most financially excluded countries in the WAEMU region, this paper then looks at Niger as a case study to demonstrate the practical implementation of using geospatial tools to capitalize on mobile money potential for financial inclusion.

Furthermore, the paper explores how this geospatial approach could assist regulators in achieving their financial inclusion targets. By leveraging the power of geospatial modeling, governments and mobile money operators can make informed decisions, expanding agent networks to reach more people and ultimately promoting financial inclusion for all. Through the development of this framework, the paper seeks to encourage stakeholders to explore new avenues for mobile money uptake and foster financial empowerment for unserved and under-served communities.

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<sup>1</sup> “State of the Industry Report on Mobile Money 2023,” 6, 28.

<sup>2</sup> Kendall and Voorhies, “The Mobile-Finance Revolution; How Cell Phones Can Spur Development.”

## 1A: The context in West Africa

This paper focuses on the West African Economic and Monetary Union, comprised of Benin, Guinea-Bissau, Burkina Faso, Côte d’Ivoire, Mali, Niger, Senegal and Togo, as the region of analysis. Within WAEMU, monetary policy is standardized across all 8 countries. The regulatory context is mobile-money friendly, with differences existing at the country level only with regards to deposit-taking institutions and mobile money service providers and incentives provided by individual MMOs. In WAEMU alone, mobile money has grown more than 900 percent between 2011 and 2017.<sup>3</sup> In Côte d’Ivoire, Burkina Faso, Senegal and Mali, mobile money accounts are more prolific than bank accounts.

Despite remarkable growth in WAEMU countries, mobile money does not always reach those who would benefit most. Digital and traditional literacy, physical distance from agents, lack of access to electricity and other factors isolates large swaths of populations from mobile money. The GSMA Mobile Money Deployment Tracker highlights that in Sub-Saharan Africa, 64 percent of the rural population lives more than 5 kilometers from the nearest mobile money agent.<sup>4</sup> Lack of access to reliable electricity further compounds the issue, since charging mobile phones is challenging off-grid or underserved areas. These factors, among others, collectively isolate large segments of the population and particularly the poorest from fully benefiting from the potential of mobile money services.

## 1B: The agent challenge

While mobile money expansion faces numerous challenges varying in magnitude across different country contexts, a universal challenge is access to agents. Per the GSMA, nearly two-thirds of incoming transactions are performed by mobile money agents, making them a critical bottleneck for accessibility to mobile money as a whole.<sup>5</sup> A study by Aker et al. demonstrates that – at least in the case of Niger – despite perception of mobile money as being more affordable and trustworthy than existing channels of financial activity, agent access was the primary barrier to uptake.<sup>6</sup>

## 1C: Paper structure

This paper aims to first investigate the criteria by which CICO-based mobile money operators expand spatially, secondly proposes a theoretical approach to expansion that entails using geospatial data to identify the most feasible areas to place mobile money agents to bridge the accessibility gap, and lastly suggests how this geospatial approach would benefit regulators in achieving financial inclusion targets. The geospatial approach integrates spatial data, including population demographics, infrastructure, and economic indicators to identify and prioritize areas where agent placement would maximize network efficiency, ensuring wide coverage and accessibility for underserved populations as well as financial sustainability for the mobile money operator. *Mobile money operators and governments can harness the power of geospatial modeling to make informed decisions regarding agent placement to ultimately optimize network growth and expand*

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<sup>3</sup> Gourène and Soumaré, “Are Mobile Money and Financial Accounts Complementary?,” 5–6.

<sup>4</sup> “Network Infrastructure and Policy Deployment Tracker.”

<sup>5</sup> “State of the Industry Report on Mobile Money 2023,” 16.

<sup>6</sup> Aker, Prina, and Welch, “Migration, Money Transfers, and Mobile Money,” 589.

*financial inclusion. By providing a framework by which stakeholders can observe areas that can support mobile money uptake, this paper hopes to encourage the expansion of agent networks to reach more people.*

This paper is organized as follows:

- **Section 1** provides an introduction to the paper, mobile money in WAEMU and the importance of agents to achieving financial inclusion.
  - **Section 2** describes different strategies by which MMOs have rolled out their agent networks and to what MMOs have applied geospatial tools.
  - **Section 3** outlines a GIS-based framework for identifying where mobile money can be invested, including contention points.
  - **Section 4** applies the framework developed in Section 3 to the case study of Niger.
  - **Section 5** proposes opportunities for regulators to implement centralized agent network modeling and advocates for improved collection of critical datasets.
  - **Section 6** concludes by discussing further analysis that could be done to improve and build upon the proposed framework.
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## Section 2: The landscape of mobile money roll-out in WAEMU

This section outlines the landscape of mobile money roll-out in the WAEMU region, examining the involvement of major players such as banks, Mobile Network Operators (MNOs), and fin-tech-led money institutions. By first exploring the regulatory context surrounding these initiatives and then shedding light on critical spatial strategies employed by these players, this section provides a comprehensive understanding of the factors shaping mobile money expansion in the region and its impact on financial inclusion.

### 2A: Regulatory context

Within WAEMU countries, digital financial services (DFS) regulation has standardized by the Banque Centrale des Etats de l’Afrique de l’Ouest (BCEAO). Until 2015, regulation was stringent regarding Know Your Customer (KYC) requirements that made it difficult for new users to register for e-money accounts.<sup>7</sup> Since BCEAO guidelines were revised in 2015, users have been allowed to create accounts without identification – as long as total monthly transactions remain under 200,000 CFA – and MMOs have taken off.

Because these are fledgling markets, there is not yet an established ecosystem of second-tier services built from the rails of dominant MMOs, as is the case in Kenya with M-Pesa. Because ‘Fintech 2.0’ – the concept of bundling digital finance into lifestyle such that “fintech becomes intrinsically more connected to the economy” – has not yet become the reality in WAEMU in relation to any single MMO, there is still opportunity for operators to gain and lose market share, as was the case with Wave overtaking Orange Money in Senegal within the past half-decade.<sup>8 9</sup>

### 2B: Existing roll-out strategies

Mobile money institutions are either bank-led, mobile network-led or neither (often consisting of some sort of financial technology as its selling point).<sup>10</sup> Existing players and strategies have been mapped onto that classic typology of MMOs as ascertained through several interviews with regional mobile money experts, fin-tech impact investors and leadership from Wave and Orange Money.

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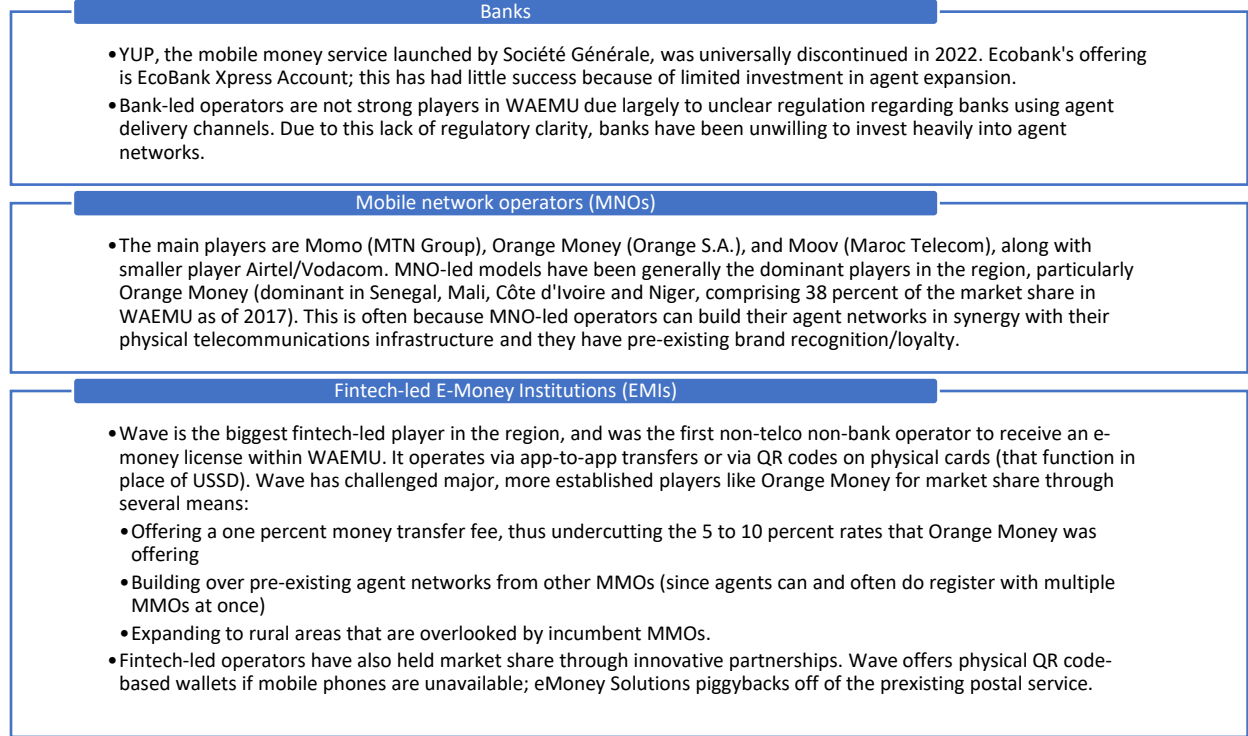
<sup>7</sup> Aker and Carroll, “The State of Digital Financial Services in Francophone West Africa,” 22.

<sup>8</sup> “The Fintech 2.0 Paper,” 14.

<sup>9</sup> Agbaje, Interview: Fintech Investment in Mobile Money.

<sup>10</sup> Merritt, “Mobile Money Transfer Services,” 9–12.

FIGURE 1: EXISTING ROLL-OUT STRATEGIES



11 12 13 14 15 16 17 18

As described above, MMO strategies vary depending on the backing institutions (if any). MNO-led models focus on utilizing existing customer bases and building complementarities between telco towers and mobile money service areas, whereas EMI models – without backing banks or telco infrastructure – have focused on identifying underserved areas and undercutting incumbents through low rates.

## 2C: Priorities for roll-out

Use of a geospatial approach to network expansion has, per conversations with several MMOs in Sub-Saharan Africa, varied not only between MMOs but between country operations of each MMO. Orange, for example, has been one of the main players in West Africa but only in some countries is a geospatial approach applied to expansion into new areas. In some, agent spread is “organic”; in others, sophisticated digital analytics tools from Meta or Alphabet are applied.<sup>19</sup> In some cases, when MMOs are also telecom providers (namely Orange,

<sup>11</sup> “Mobile Money.”

<sup>12</sup> Akogbeto, Interview: Challenges to Mapping Mobile Money.

<sup>13</sup> Aker and Carroll, “The State of Digital Financial Services in Francophone West Africa,” 13.

<sup>14</sup> “State of the Industry Report on Mobile Money 2023.”

<sup>15</sup> Roll, “Mobile Money Startups Are Battling to Change the Way Senegal Does Business.”

<sup>16</sup> Berthelot, Interview: Orange’s Mobile Money in Madagascar and Sub-Saharan Africa Broadly.

<sup>17</sup> Mbodj, Interview: Wave and Mobile Money Networks in Gambia and Senegal.

<sup>18</sup> Agbaje, Interview: Fintech Investment in Mobile Money.

<sup>19</sup> Berthelot, Interview: Orange’s Mobile Money in Madagascar and Sub-Saharan Africa Broadly.

though this may be the case for others), they even take agent viability into consideration in placing their cellular towers.<sup>20</sup>

### Spatial roll-out strategies

**Economic corridors:** Wave has identified “corridors” of economic activity in Senegal, meaning deposit and withdrawal areas along the supply chains of major industries. These include a “fish corridor”, for example, or an “agriculture corridor.” These are distinct from formal supply chains, where companies are often already using formal banking infrastructure. Instead, the aim is to encourage use among actors in the informal economy, such as non-commercial fishermen, since these are some of the most prolific users of mobile money. Once these actors take up the service in sufficient numbers, Wave can then begin targeting person-to-person (P2P) transactions in those same areas. Mohamed Diouf, formerly a regional head of liquidity operations at Wave, described this target population as “not necessarily the value chain of the product itself, it’s mostly the value chain of the human resources.”<sup>21</sup>

**Pre-existing agents and banks:** MMOs have benefited from leveraging existing agent and bank networks. Because WAEMU has mandated non-exclusivity of agents, MMOs have targeted pre-registered agents to sign onto new services. In this way, customers are exposed to new services through known and trusted local agents. Similarly, MMOs have “followed the banks.”<sup>22</sup> Because banks are perceived to have “done the work” of determining where clients are, some MMOs have chosen to place agents in surrounding areas due to guarantees of cash in circulation and commercial activity.

**Telecommunications synergies:** In several countries across Africa, mobile money expansion potential is a factor in expanding telecom towers because they are seen as complementary services; in these contexts, 80% of strategy is telco-driven, and 20% is mobile money driven.<sup>23</sup> For telecom-led mobile money operators, the interplay between their telecommunications and mobile money businesses is an important consideration.

**Social metrics:** In some countries there is a clear strategy driven by digital revenue maximizing tools are used; tools include Facebook population data, telco metrics, but no mobile money specific metrics.<sup>24</sup> Some teams have reported using field sales management software such as Riaktr, which utilizes mapping to summate POS performance and thus recommend agent placement.<sup>25</sup>

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<sup>20</sup> Berthelot.

<sup>21</sup> Diouf, Interview: Wave and Mobile Money Networks in West Africa.

<sup>22</sup> Bello, Interview: National Approaches to Mobile Money.

<sup>23</sup> Berthelot, Interview: Orange’s Mobile Money in Madagascar and Sub-Saharan Africa Broadly.

<sup>24</sup> Berthelot.

<sup>25</sup> “Riaktr: Telecommunications Location Analytics Software.”



## Section 3: A theoretical GIS-based framework for expanding mobile money networks

As discussed, uptake of GIS in field agent management varies widely across MMOs. To that end, this paper then proposes a generalizable framework for using geospatial information systems to identify feasible areas for mobile money agent network expansion based on key criteria determined through expert interviews. These critical criteria, such as cellular service and actively transacting population, can provide valuable guidance regarding which areas have the potential to support mobile money uptake.

**For existing MMOs**, this framework can supplement pre-existing internal allocation strategies that account for where existing agents are as well as other internal additional metrics like agent proximity and rate of transaction.

**From a coordinative perspective**, this framework can inform cooperation across MMOs and regulatory authorities to ensure broad, inclusive financial access. Once urban areas are covered by agent networks, there is diminishing profit to reaching suburban/rural areas; by applying a financial inclusion-focused framework, governments can identify areas outside major population centers that are still viable for effective use of services. Furthermore, a functional and wide-reaching mobile money network could be a complementary “rail” for government/humanitarian payments.<sup>26</sup>

### 3A: Critical datasets

At the national level, several measurable and mappable criteria can guide accurate targeting of agent placement.<sup>27 28 29 30</sup> These are described in categories below:

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<sup>26</sup> Diallo, Kaho, and Sever, “Financial Inclusion in Niger,” 48.

<sup>27</sup> Agbaje, Interview: Fintech Investment in Mobile Money.

<sup>28</sup> Berthelot, Interview: Orange’s Mobile Money in Madagascar and Sub-Saharan Africa Broadly.

<sup>29</sup> Mbodj, Interview: Wave and Mobile Money Networks in Gambia and Senegal.

<sup>30</sup> Diouf, Interview: Wave and Mobile Money Networks in West Africa.

FIGURE 2: NECESSARY DATA



31 32 33 34 35

### 3B: Connecting the data: building a framework

Building on expert consultations, research and pre-existing methodology around financial inclusion targeting, the following framework is proposed:

<sup>31</sup> Berthelot, Interview: Orange’s Mobile Money in Madagascar and Sub-Saharan Africa Broadly.

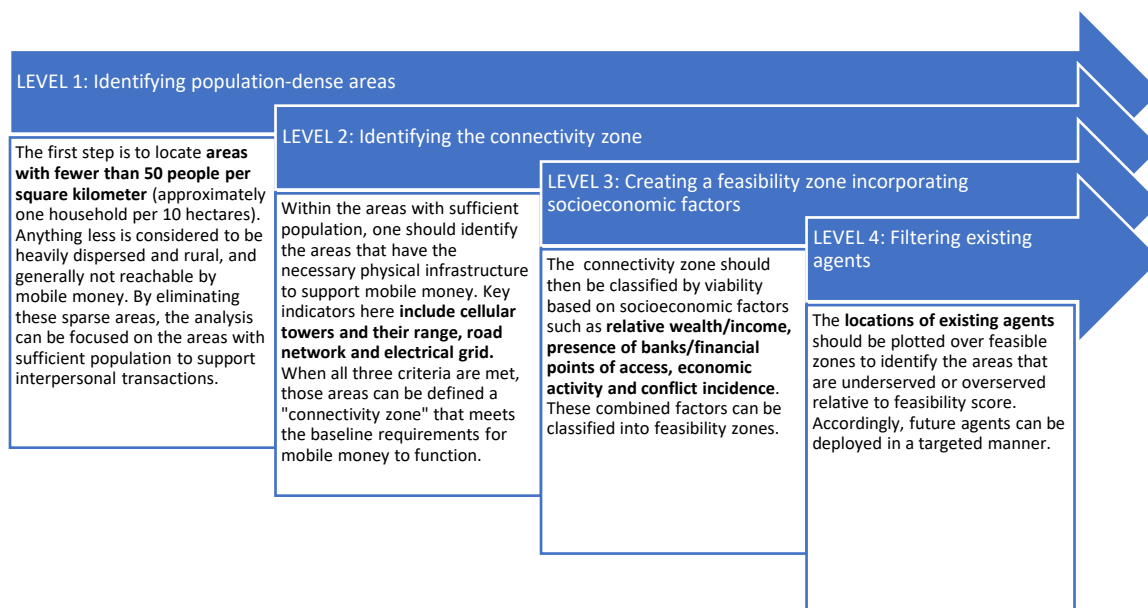
<sup>32</sup> Aker and Carroll, “The State of Digital Financial Services in Francophone West Africa.”

<sup>33</sup> Kendall and Voorhies, “The Mobile-Finance Revolution; How Cell Phones Can Spur Development.”

<sup>34</sup> N’Zue, Interview: Wave and Liquidity Management in CIV.

<sup>35</sup> Diouf, Interview: Wave and Mobile Money Networks in West Africa.

FIGURE 3: FRAMEWORK FOR PLACING MOBILE MONEY AGENTS



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### 3C: The data problem

The data required to implement the above framework requires data that is often difficult to procure. Authoritative government data is often unavailable, especially in contexts where government capacity is limited. Alternatively, there is crowd-sourced data from sources like OpenStreetMap or OpenCelliD. This data relies heavily on the presence of individuals who choose to collect and share firsthand information voluntarily. However, this approach may introduce potential biases, as it tends to be more concentrated in densely populated areas.

Data regarding connectivity infrastructure is additionally challenging because facilities are often private sector, so there is no public obligation to share data. For mobile money specifically, agent locations are generally kept private for safety reasons. These agents, who are responsible for gathering critical information, are often unidentified and can only be recognized by the presence of an MMO's banner displayed at their shop in-person.<sup>37</sup>

Despite these limitations, it is still possible to conduct research and analysis using an incomplete set of the datasets recommended in section 3A; the list therein is a superset of ideal information. This will be demonstrated with Niger data in section 4, using entirely open-access, crowd-sourced data.

<sup>36</sup> Forster, Peachey, and Stahl, "Mapping Proximity: Bringing Products and Services Close Enough to the Poor to Be Meaningfully Usable and Still Keep Them Sustainable for WSBI Partner Banks," 9.

<sup>37</sup> Bello, Interview: National Approaches to Mobile Money.

## Section 4: Niger as a case study

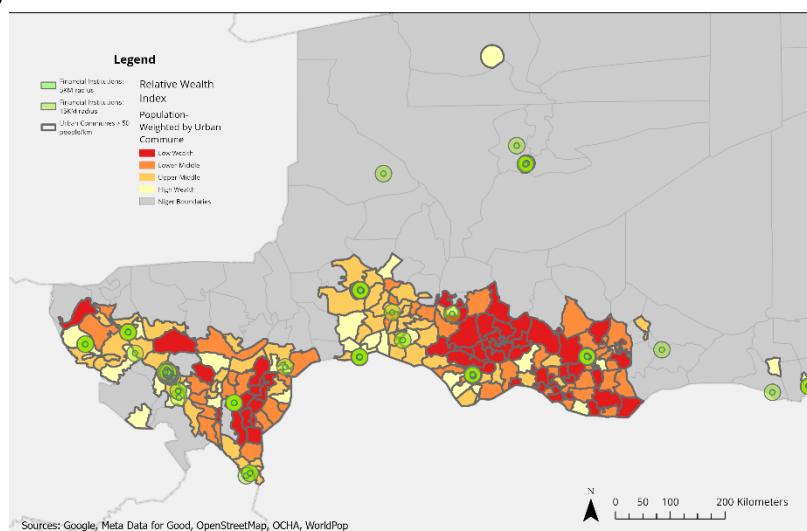
### 4A: Financial inclusion in Niger

Niger is one of the most financially excluded countries in the WAEMU region, with only 14 percent of the population using any form of financial services (2023).<sup>38</sup>

As of December 2017, the country had 169 bank branches and 183 ATMs, of which 56 percent were in the capital region of Niamey. BCEAO reported that there were 9,862 active e-money points of service, but only approximately 1.3 percent of transactions carried out in-country have been made via MMOs.<sup>39</sup>

The National Financial Inclusion Strategy 2019-2023 described key challenges to mobile money uptake as 1) identification of rural users, 2) exclusion of the youth from these services, 3) absence of/insufficient financial education, and 4) low involvement of financial education, and 5) low involvement of financial institutions in e-money.<sup>40</sup> The report further notes Niger has some of the highest bank and loan costs across WAEMU, underscoring the inaccessibility of financial services for the average Nigerien.<sup>41</sup>

FIGURE 4: IN-NEED AREAS



### 4B: Brief background on mobile money in Niger

Niger, a landlocked country within WAEMU, formally introduced mobile money services in 2009, but popularity has remained low.<sup>42</sup> There have been spikes in 2015, when BCEAO relaxed identification requirements for opening e-money accounts, and during the COVID-19 pandemic, when BCEAO took further measures to promote DFS to travel restrictions.<sup>43</sup> Still, uptake remains low. Less than 20 percent of the population in Niger owns an e-money account, whereas the WAEMU average is over 80 percent (Figure 7).<sup>44</sup> As of 2023, the largest

<sup>38</sup> Diallo, Kaho, and Sever, "Financial Inclusion in Niger," 38.

<sup>39</sup> "Publications Du Ministère - Strategie Nationale de Finance Inclusive Révisée et Son Plan d'actions (2019-2023)," 7.

<sup>40</sup> "Publications Du Ministère - Strategie Nationale de Finance Inclusive Révisée et Son Plan d'actions (2019-2023)," 9.

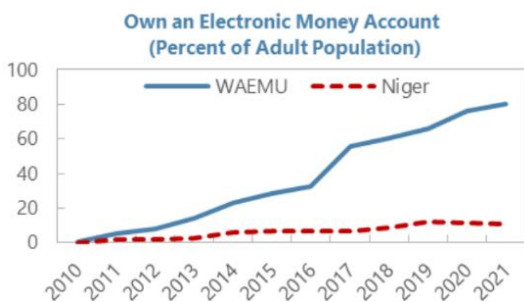
<sup>41</sup> "Publications Du Ministère - Strategie Nationale de Finance Inclusive Révisée et Son Plan d'actions (2019-2023)," 18.

<sup>42</sup> Aker, Prina, and Welch, "Migration, Money Transfers, and Mobile Money," 589.

<sup>43</sup> Diallo, Kaho, and Sever, "Financial Inclusion in Niger," 41.

<sup>44</sup> Diallo, Kaho, and Sever, 40.

FIGURE 5

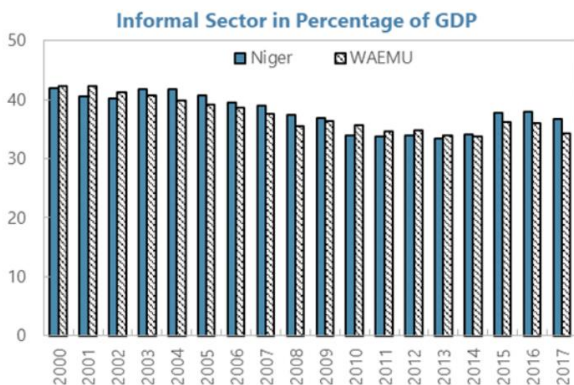


1) Firstly, while mobile phone ownership has increased significantly over the past decade, ranging from 60 to 90 percent of households, mobile money agents are primarily concentrated in urban areas. The population in Niger is more rural than neighboring countries like Mali and Burkina Faso, so networks must expand beyond urban areas to gain a large userbase.

Perception of Nigeriens aligns with this reality of limited access in rural areas: in a survey by Aker

et al., almost all respondents believed that m-money agents were only in urban areas and 40 percent reported that bus was the best way to send money to rural areas.<sup>46</sup> This also has negative externalities; not only are costs to access an agent higher due to travel, but there is also less competition.<sup>47</sup>

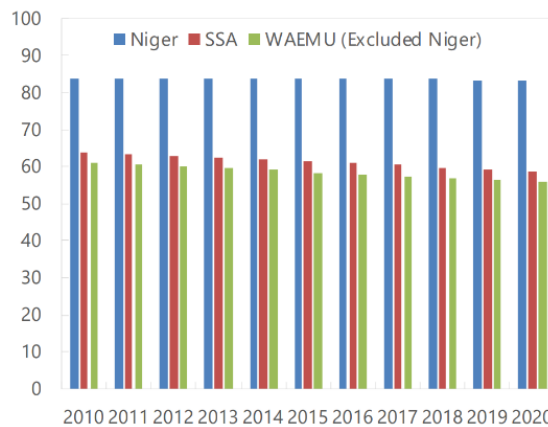
FIGURE 7



MMO, NITA Transfer d'Argent, has only 300 points of service; the second largest operator, Airtel, lags further behind.<sup>45</sup> This limited coverage is a result of several factors that have hindered the widespread adoption of mobile money in the country:

FIGURE 6

Figure 6. Niger: Rural Population (Percent of total population)



Source: WDI and IMF staff calculation.

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2) Secondly, the informal sector in Niger constitutes around 40 percent of the country's GDP (Figure 9). Businesses do not possess documentation required to be registered as official agents as per KYC regulation.<sup>49</sup> Although this constraint is similar to that of other countries in the region, it contributes to tepid m-money uptake.

<sup>45</sup> Mbodj, Interview: Wave and Mobile Money Networks in Gambia and Senegal.

<sup>46</sup> Aker, Prina, and Welch, "Migration, Money Transfers, and Mobile Money," 592.

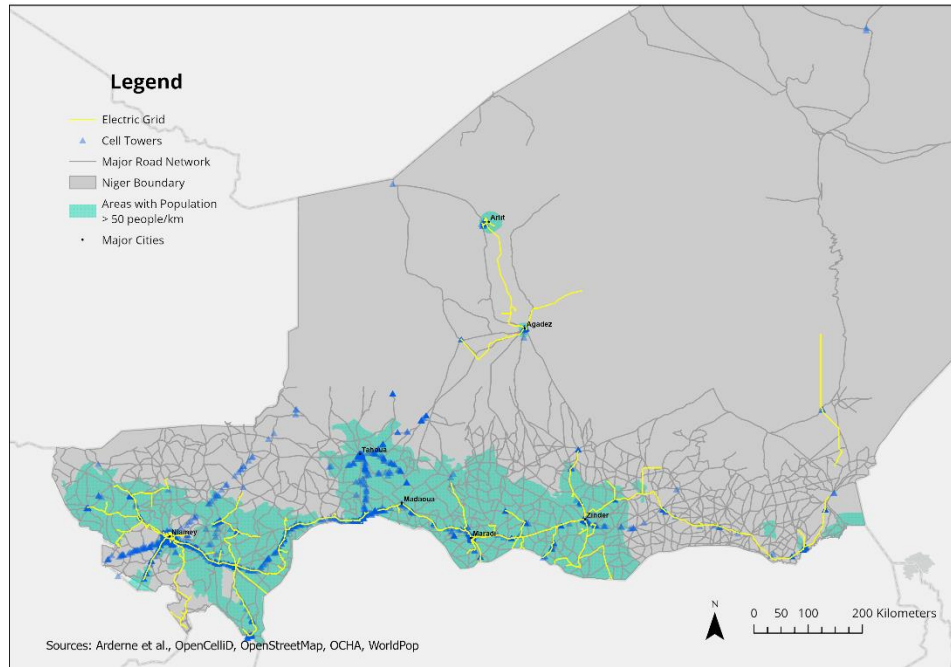
<sup>47</sup> Aker, Prina, and Welch, 592.

<sup>48</sup> Diallo, Kaho, and Sever, "Financial Inclusion in Niger," 44.

<sup>49</sup> Diallo, Kaho, and Sever, 45.

- 3) Thirdly, supporting infrastructure in Niger, including electricity access, phone ownership and internet connectivity, lags behind the rest of the WAEMU region. This limited or often fully absent infrastructure makes it more challenging for mobile money to succeed even if agents were to be present. As per Figure 10, cell tower and electric grid coverage is limited even in populated areas.

FIGURE 8: ENABLING INFRASTRUCTURE



The following GIS analysis examines mobile money gains that can be had using existing data primarily on enabling infrastructure (point #3), given the limited availability of data available otherwise in the Nigerien context.

#### 4C: Applying the framework: mobile money potential in Niger

##### Data sources

Several datasets, listed below, were found for the Nigerien context. All datasets were collected from non-governmental sources (due to lack of availability) and are available for any country, making this a replicable framework. However, it is important to caveat that the majority of data used was crowdsourced and is therefore likely incomplete.

FIGURE 9: DATA SOURCES

<i>Dataset</i>	<i>Preparation</i>	<i>Source</i>
<b>ACCESS: identifying where effective users of mobile money are</b>		

<i>Conflict incidence</i>	All reported conflict incidences from April 2022 to April 2023 were weighted by population density to attain normalized conflict incidences per capita per kilometer.	ACLED <sup>50</sup>
<i>Cell towers</i>	OpenCelliD’s crowd-sourced cell tower location data was used. OpenCelliD’s provided ranges were incomplete, so a 35km radius was assumed per tower.	OpenCelliD
<i>Road network</i>	A raster was created where roads were given a 5km radius to account for walkability. <sup>51</sup>	OpenStreetMap import from Humanitarian Data Exchange <sup>52</sup>
<i>Power transmission grid</i>	Since the dataset seemed to only cover major transmission lines and not distribution lines, a raster was created where powerlines were given a 20km radius.	Predictive power mapping study by Arderne et al. <sup>53</sup>
<b>ECONOMIC SUSTAINABILITY: Identifying where agents can be retained to ensure sustainable service</b>		
<i>Relative wealth</i>	The RWI, built on ground-truth data, “big” data and machine learning, provides a granular poverty index at the 2.4km level. This data was then population-weighted at administrative level 3, the commune, using Meta’s suggested quadkey method. <sup>54</sup>	Meta’s Relative Wealth Index (RWI) <sup>55</sup>
<i>Business density</i>	Businesses reported on OpenStreetMap were used as a proxy for economic activity. Business density was calculated as a raster.	OpenStreetMap export <sup>56</sup>
<i>Existing bank branches</i>	OSM data on existing financial points of access was supplemented with banks listed on Google Maps (scraped using the SerpAPI tool). Overlapping points were compared and consolidated to get a more comprehensive list of existing financial services in Niger. Then a raster was created where: <ul style="list-style-type: none"> <li>- areas within 5km of a bank were penalized since individuals living in these areas were more likely to be financially included</li> <li>- areas further than 15km from a bank were penalized since it would be more difficult to ensure sufficient liquidity to support mobile money in these areas</li> </ul>	OpenStreetMap export, Google Maps scraping via SerpAPI <sup>57</sup>
<b>CONTEXTUAL DATA</b>		
<i>Overall population density</i>	WorldPop population density derived from census, household surveys and satellite imagery was used. Areas with fewer than 50 people per square kilometer – approximately the bottom quantile of population density in Niger – were filtered out due to the	WorldPop Population Density data, UN-adjusted

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<sup>50</sup> “ACLED | Bringing Clarity to Crisis.”

<sup>51</sup> Forster, Peachey, and Stahl, “Mapping Proximity: Bringing Products and Services Close Enough to the Poor to Be Meaningfully Usable and Still Keep Them Sustainable for WSBI Partner Banks.”

<sup>52</sup> “HOTOSM Niger Roads (OpenStreetMap Export) - Humanitarian Data Exchange.”

<sup>53</sup> Arderne et al., “Predictive Mapping of the Global Power System Using Open Data.”

<sup>54</sup> “Tutorial.”

<sup>55</sup> Chi et al., “Micro-Estimates of Wealth for All Low- and Middle-Income Countries.”

<sup>56</sup> OpenStreetMap Contributors, “Niger Businesses, OSM Export.”

<sup>57</sup> Google Maps, “Niger Banks, SerpAPI Scrape.”



	assumption that these areas do not have sufficient population to support mobile money.	estimates, 2020 <sup>58</sup>
<i>Administrative boundaries</i>	The country boundary (administrative level 0) and commune boundaries (administrative level 3) were used as units of analysis.	UN Office for the Coordination of Humanitarian Affairs (OCHA) <sup>59</sup>

Additional indicators described in section 3, including agent locations and registered businesses, were not available and were thus excluded from this analysis.

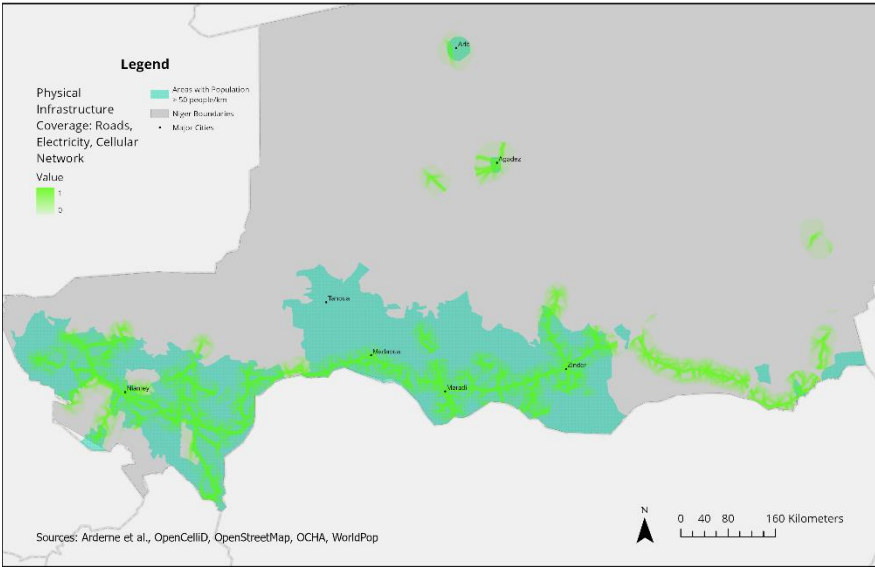
**Analysis**

Analysis followed the 4 levels outlined in section 3B.

**Level 1:** First, population-dense areas were identified. As discussed, areas within the lowest quantile of fewer than 50 people per square kilometer were removed from the area of analysis.

**Level 2:** The “connectivity zone” was identified by combining road, electricity and cell tower datasets.

**FIGURE 10: CONNECTIVITY ZONE**



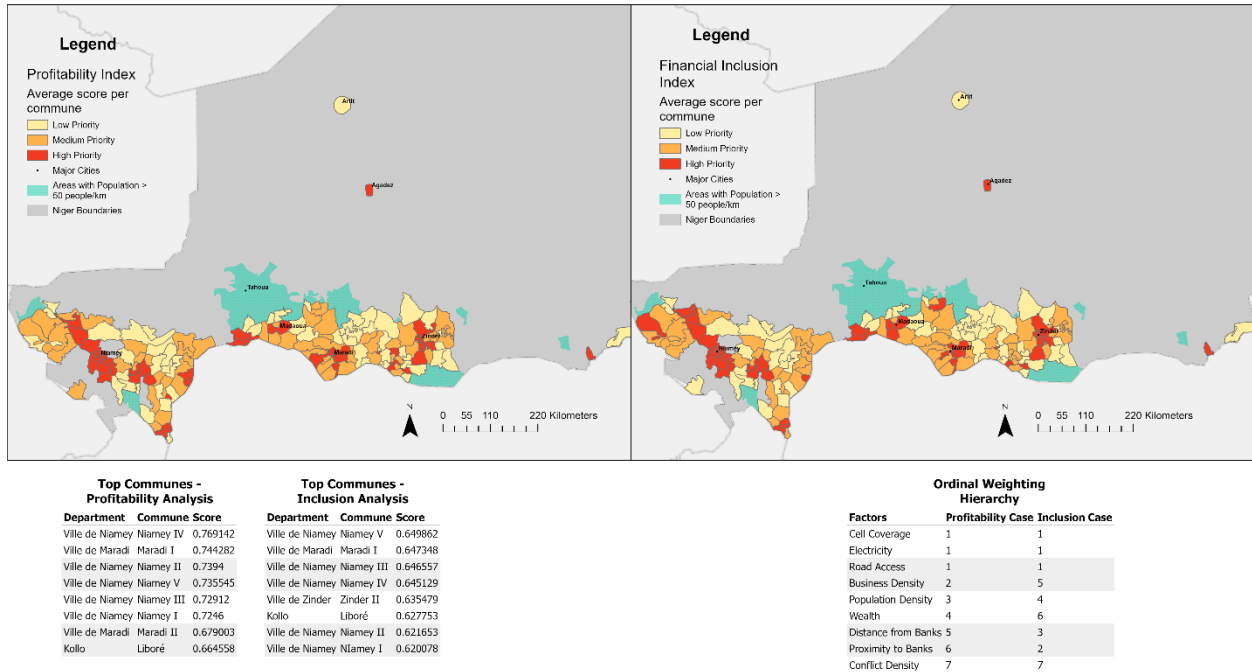
As can be seen on the right in Figure 12, this is also a rudimentary way to identify which areas are excluded from connectivity despite being populated.

**Level 3:** Within areas with sufficient population density and existing physical infrastructure, the aforementioned indicators were then weighted ordinally by perceived order of relevance to identify a “feasibility zone” for agents to be placed. Criteria were weighted in different order of priority depending on whether the priority was financial inclusion or profitability. From there, communes were categorized into three different tiers of feasibility using quantile classification. Top-scoring communes were extracted for targeting.

<sup>58</sup> WorldPop, and Bondarenko, “Individual Countries 1km UN Adjusted Population Density (2000-2020).”  
<sup>59</sup> “Niger - Subnational Administrative Boundaries - Humanitarian Data Exchange.”



FIGURE 11: WEIGHTED FEASIBILITY ZONES



Sources: ACLED, Ardeno et al., OpenCellID, Meta Data for Good, OpenStreetMap, OCHA, WorldPop

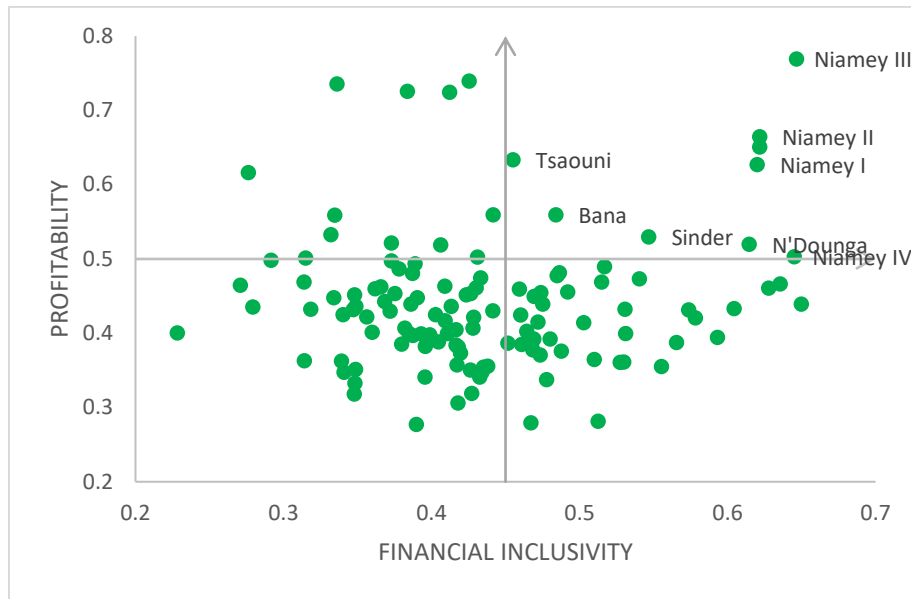
Results were very similar across the two cases. This suggests that there is some overlap between areas that are profitable to expand to and that exhibit high potential for increasing inclusion, but that they are not exactly the same. This means that methods for determining agent location cannot be wholly profit-driven if indeed inclusion is a dedicated goal.

**Level 4:** Level 4 was excluded because existing agent data was not available.

### Actionability of findings

For policymakers, a potential approach to targeting the ideal communes is to combine the cases above and determine which communes are both high-profit and yield high returns in financial inclusion. This can be seen below:

FIGURE 12: COMMUNE PRIORITIZATION MATRIX



By prioritizing districts that score highly in profitability and inclusivity, one can extract a basic list of target communes. These are the communes in the top-right quadrant in Figure 14. This kind of analysis, supplemented with field knowledge, could be a powerful tool in the arsenal of an MMO or central regulatory body.

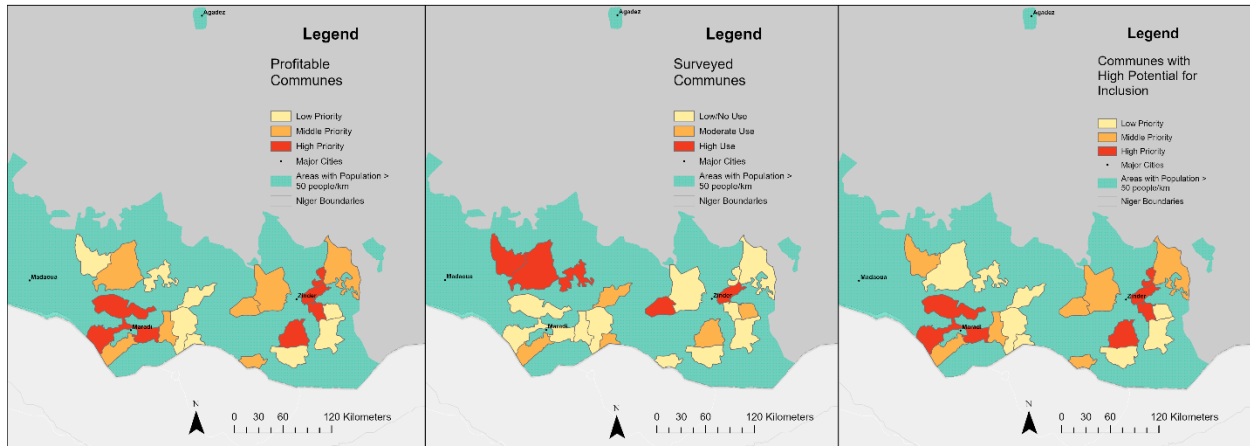
#### Accuracy assessment

The accuracy of the framework above was compared to data from a survey conducted by Jenny Aker in 2022 asking people in markets whether they had used mobile money recently and, if so, with what frequency.<sup>60</sup> By multiplying frequency by respondents who answered “yes” to having used mobile money recently and dividing by total respondents per commune, a rough estimate of percent usage was created for several communes in southern Niger. This is not a statistically significant representation of mobile money use per commune but was used regardless for the purpose of comparison.

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<sup>60</sup> Aker and Awanon, “Mobile Money Data - Niger 2022.”

FIGURE 13: COMPARISON TO SURVEY DATA



Sources: ACLED, Anieme et al., Google, OpenCellID, Meta Data for Good, OpenStreetMap, OCHA, WorldPop

We can observe above that the surveyed communes with highest use (center map) are not the same as those identified by either methodology (left and right maps) to be highest priority. This could be for several reasons, or a combination:

- 1) **Inaccurate weighting.** It could be that the assumptions that have been made in this paper about criteria rankings are not appropriate for the Nigerien context. Ideally this kind of prioritization will be done in collaboration with MMOs and government officials who know the context best.
- 2) **Poor targeting on the part of existing MMOs.** It is possible that MMOs have not been implementing rigorous targeting strategies and are thus not serving areas that have highest potential.
- 3) **Incomplete data.** Existing data is very limited both regarding where agents are and the input parameters for determining feasibility. Bank locations, for example, had to be estimated by scraping Google Maps and combining that with OSM crowd-sourced data. Both Google Maps and OSM may have urban biases, since those areas are simply more likely to have been comprehensively mapped. Cell tower data from OpenCellID was also possibly inaccurate, with data points placed in odd horizontal lines far from roads or settlements.

Perhaps the survey data, due to its very small sample size, does not accurately reflect the distribution of mobile money use. Alternatively, the data used to classify high-potential areas may be misleading. Due to the crowdsourced and incomplete nature of several of the datasets, the conclusions drawn may not accurately reflect the areas that should be targeted.

## Section 5: Recommendations for regulation and industry

The purpose of a framework such as the one described in section 3 is to identify viable places to reach with mobile money, but also to demonstrate the value of geospatial models directing investments in socioeconomic outcomes in data-scarce environments. Geospatial analysis allows analysts to bypass data limitations in part using satellite imagery, and in this way offers an opportunity. In this case, for example, it was used to proxy wealth in absence of official government data. We still, however, need data regarding where critical infrastructure such as roads and cell towers is. Therefore, it is necessary to combine satellite imagery with other data sources to obtain a comprehensive understanding of socioeconomic dynamics.

As such, this study provides a list of which data that one *has to advocate for*. Per the analysis in this paper, the most critical missing datasets have been the following:

- **Agents:** where mobile money agents are located, the quantity of transaction, the number of clients they serve
- **Infrastructure:** where cellular towers are and their range, the locations of electricity distribution and transmission lines
- **Financial Points of Service:** where financial access points are, including bank branches, ATMs and microfinance institutions

This data, especially regarding infrastructure, can be found occasionally and depending on the country; but in emerging economies such as Niger, this data is often absent, incomplete or out-of-date. To address these data challenges, governments and MMOs should make efforts to improve data collection mechanisms, increase data sharing and collaboration among stakeholders, and invest in data integration and analysis infrastructure. Even if this data cannot be made publicly available due to safety concerns, it could be shared with regulators. Comprehensive and accurate data is crucial for evidence-based policy formulation and effective decision-making in socioeconomic development. This is elaborated on in the following section.

### 5A: General policy recommendations

As has been described earlier in this paper, mobile money is a critical channel for financial inclusion. In countries like Cote d'Ivoire where 83 percent of the population uses mobile money but only 19 percent has a bank account, mobile money is the sole way for many individuals to access financial services.<sup>61</sup>

**Universal service:** With this in mind, mobile money can then be considered a *merit good*, meaning “one whose consumption is considered ‘positive’ by the state and thus should be promoted... there is an interest attributable to the overall community that does not result from a ‘simple’ addition, be it vertical or horizontal, of individual interests.”<sup>62</sup> Because mobile money serves public interest by enabling financial inclusion (and often being the sole channel to do so), there is scope for the state to take a more active role; this is especially the case since the private sector, being driven by profit, does not have the same incentive to serve less

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<sup>61</sup> Kobo, “Ivorians’ Aversion to Traditional Banks Is a Boost for Mobile Banking.”

<sup>62</sup> Luis Gómez-Barroso and Pérez-Martínez, “Public Intervention in the Access to Advanced Telecommunication Services,” 492.

profitable populations. We can see this when we recall the Niger model in section 4; the areas in need were *not* those that were necessarily the most profitable, so a blended approach was required.

As such, there is an opportunity for regulation to ensure broad and equitable access to mobile money. In the case of Australia, for example, the *Telecommunications Universal Service Management Agency Act of 2012* established a *Universal Service Obligation (USO)* wherein “policy objectives of public interest telecommunications services are that standard telephone services are to be reasonably accessible to all people in Australia on an equitable basis, wherever they reside or carry on business, and will be supplied to people in Australia on request.”<sup>63</sup> In Africa, these kinds of USOs and Universal Service Funds (USFs) have been implemented for mobile telecommunications but implementation is spotty. A cross-continental study conducted by Arakpogun, Wanjiru, and Whalley in 2017 reviewed USF implementation and determined that USFs are often non-operational and not transparent in spending, despite continued levies from MNOs.<sup>64</sup> Part of this is because quantifying access to mobile telecommunications is so difficult, thanks to multiple SIM cards, inactive lines, etc.<sup>65</sup> Definitions of service are generally ambiguous, requiring access to ‘underserved’ areas or mandating that ‘ICT’ be provided without further description.<sup>66</sup> Despite mixed performance, these USFs present an opportunity. If clear definitions of service can be specified to include mobile money, USOs can capitalize on the existing infrastructure of USFs to facilitate financial inclusion more effectively.

**Collective action:** In implementing any sort of centrally coordinated approach to mobile money via USOs or otherwise, the foremost consideration should be access to data. The datasets described on page 19 are a good place to start, and are generally not available even to public officials.

A top-down approach to universal mobile money access would require regulators in the financial space, including ministries of finance and central banks, to consider consolidating this information from various FSOs and implementing a prioritization strategy similar to the model presented in this paper. By doing so, they can incentivize targeted expansion in specific areas in the form of a national level digital divide policy “aiming at equal provision of infrastructure ... to all segments of the population.”<sup>67</sup> This approach would create a ‘multi-technology’, multi-actor, public-private landscape that would allow for more flexibility in funding and implementing these services and in fostering innovation.<sup>68</sup> Public involvement could also include capacity building as to how to use mobile money and benefits that can be reaped, thus also benefiting private operators by expanding their client bases and increasing transaction volumes, ultimately improving profits.

## 5B: Recommendations for GIS-driven financial inclusion in WAEMU

Several countries with national financial inclusion strategies (NFIS) in the WAEMU region have taken early steps to apply coordinated approaches to improving rural presence of “channels” of digital payments, including bank

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<sup>63</sup> Park et al., “The Multi-Layers of Digital Exclusion in Rural Australia.”

<sup>64</sup> Ogiemwonyi Arakpogun, Wanjiru, and Whalley, “Impediments to the Implementation of Universal Service Funds in Africa – A Cross-Country Comparative Analysis,” 624.

<sup>65</sup> Ogiemwonyi Arakpogun, Wanjiru, and Whalley, 618.

<sup>66</sup> Ogiemwonyi Arakpogun, Wanjiru, and Whalley, 619.

<sup>67</sup> Park et al., “The Multi-Layers of Digital Exclusion in Rural Australia.”

<sup>68</sup> Park et al.

branches, ATMs, and mobile money agents (though this is not yet the norm).<sup>69</sup> A standout example of this has been Nigeria. Shared Agent Network Expansion Facilities (SANEF) Limited was launched in 2019 as a joint initiative between the Central Bank of Nigeria, several banks and cashless banking operators, and federal and state governments, to “meet financial inclusion targets across all geopolitical zones in Nigeria.”<sup>70</sup> SANEF has ensured coordination across all 774 Local Government Areas to increase access points, support account/wallet creation and ensure agent sustainability.

In WAEMU, however, this has not been the case. The latest regional financial inclusion strategy, launched in 2016, aims to “ensure, on a five year horizon [2016-2020], the access and use of a diversified range of financial products and services that are adapted and affordable to 75 percent of the adult population of WAEMU countries, with particular emphasis on [targeted vulnerable populations].”<sup>71</sup> The strategy calls for the formation of a Regional Steering Committee (CRP) and multi-stakeholder National Implementation Monitoring Committees (CNSMOs) within each of the WAEMU countries, but there is no mention of MMOs or telecom companies as relevant partners.

When we dive into country-specific strategies, explicit details about public-private cooperation for universal service are alluded to but remain vague. Niger’s *Strategie Nationale de Finance Inclusive Révisée et Son Plan d’Actions 2019-2023*, for example, acknowledges low mobile money uptake due to lack of access points and limited transport, energy and communication infrastructure in rural areas.<sup>72</sup> The strategy calls for various frameworks and committees for financial inclusion stakeholders to come together and coordinate action and outlines policy reform needed to offer tax incentives to road and energy utility companies to reach rural areas, which is indeed a critical point for expanding enabling infrastructure for mobile money.<sup>73</sup> The missing piece, however, is clear intention to a) collect data about financial needs and physical infrastructure nationwide and b) a clear designation of *which* committee would conduct a needs assessment and determine what combination of physical infrastructure and financial services expansion is required per area, as well as recognition that financial services providers also might need to be incentivized to serve lower-profit areas.

As per Niger’s NFIS and the WAEMU strategy, the obligation to provide universal service to mobile money is presumed as part of a package of financial services, but not explicit nor specifically focused on mobile money. WAEMU would benefit from focusing specifically on mobile money as one of the most critical channels of financial access, rather than including it as a general DFS alongside microfinance. Furthermore, it is essential for WAEMU governments to utilize the opportunity of GIS in expanding points of service, and by necessity, to collect requisite data to enable analysis.

As recommended in section 5A, a national and regional mapping of physical infrastructure, including roads, phone networks and energy access, as well as mandated reporting of FSOs on points of service and transaction

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<sup>69</sup> Bello, Interview: National Approaches to Mobile Money.

<sup>70</sup> “Shared Agent Network Expansion Facilities Limited.”

<sup>71</sup> “Note d’Information: Strategie Regionale d’Inclusion Financiere Dans l’UEMOA,” 4–5.

<sup>72</sup> “Publications Du Ministère - Strategie Nationale de Finance Inclusive Révisée et Son Plan d’actions (2019-2023),” 21–22.

<sup>73</sup> “Publications Du Ministère - Strategie Nationale de Finance Inclusive Révisée et Son Plan d’actions (2019-2023),” 30.

rates, would be effective in this regard. Initiatives like Nigeria's SANEF can be looked to as a model in this, though it will also be critical to include data on roads, telecommunications and energy (which is not the case with SANEF currently) and to include these stakeholders in prioritization strategies.

## Section 6: Challenges and opportunities in implementing a GIS framework to mobile money expansion

Through implementing the proposed framework to Niger in Section 4, several challenges and opportunities presented themselves. These have been outlined below for future analysts to take into consideration:

### 6A: The pain points

#### 1. *WHERE ARE THE AGENTS?*

Across conversations with stakeholders from various MMOs, one of the key considerations for expanding mobile money networks has been agent density. Particularly in brownfield environments where there are already existing MMOs operating in competition, the success or failure of an agent depends on:

- a) whether potential users already have preferred agents or MMOs,
- b) if an agent can handle the number of users, and
- c) whether the number of users per agent is enough for per-transaction commission to be profitable for the agent.

This information is not easily accessible. MMOs do not share the locations of their agents publicly, as this puts those agents at risk. MMOs have in the past internally mapped their competitors by manually counting agents by foot.<sup>74</sup> Orange Money, for example, has had to roll back its “Nearest Agent” identification tool.<sup>75</sup> Furthermore, agents are often registered with multiple mobile money services, especially since WAEMU forbids MMOs to mandate agent exclusivity; so to identify the amount of clients each agent serves, information must be pooled across MMOs down to the level of individual agents.<sup>76</sup>

#### 2. *ARE BANKS COMPLEMENTARY OR SUBSTITUTIVE?*

A common tension point in mapping mobile money success has been what role banks play in its uptake. Intuitively, one would expect that the lack of banks as an existing financial channel would be an opportunity for mobile money agents. However, even mobile money is dependent on physical currency. From a spatial perspective, the CICO model depends on cash going *into* the system and that cash then must be transported. As discussed in section 3B, banks are a channel for liquid assets to enter the local economy, and that wealth can later enter the e-money ecosystem.

This contradiction can perhaps be resolved by seeing mobile money as an extension service, where cash-in-transit companies and super-agents can make regular journeys but the last mile is left to clients to travel to their local agents; but this requires further study.

#### 3. *HOW DOES A MAP REMAIN CURRENT?*

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<sup>74</sup> Bello, Interview: National Approaches to Mobile Money.

<sup>75</sup> Diouf, Interview: Wave and Mobile Money Networks in West Africa.

<sup>76</sup> Akogbeto, Interview: Challenges to Mapping Mobile Money.



As infrastructure develops and agents oscillate between businesses, any findings from this kind of model are bound to change. These kinds of models should be dynamic, regularly being revised to reflect reality and accordingly agent dispersion decisions. In prior e-money mapping projects, collecting regularly updated data has been a significant challenge.<sup>77</sup>

#### 4. HOW DO WE HARMONIZE TOP-DOWN MODELS WITH LOCAL KNOWLEDGE?

Often MMOs agent recruitment is coordinated by local managers who rely upon ‘mental models’ of their areas, and there is a disconnect between providing the data and its uptake among field managers who are the actors identifying agents on the ground. Mathieu Berthelot, CEO for Orange Money Madagascar, described the present of role of internal GIS models as “national-level sanity checks.”<sup>78</sup> It is important to consider the risk that advocating for top-down approaches may be potentially dismissive of local knowledge. In that regard, this framework could be used to narrow targeted zones to sub-regional levels, and then at that point decentralized approaches may be superior.<sup>79</sup> More broadly, regional managers or super-agents should be involved in criteria weighting and in making decisions regarding the rest of these pain points throughout the analysis process.

### 6B: Further opportunities in GIS analysis

**Granular community-level analysis:** By applying geospatial analysis at the community level to allocate agents, one could take street data to conduct a transport network analysis to identify where *exactly* an agent could go. However, this should be done with caution and in harmony with local knowledge and the ‘mental models’ described on page 23.

**Interrogating causality:** In the case that data is procured describing where exactly all the agents are in a specific country or region, Principal Component Analysis or similar methods could be employed to determine which criteria are the most significant predictors of mobile money uptake. This analysis could inform a more rigorous recommendation for weighting of criteria to inform future agent placement.

**Cross-border flows:** One could consider looking at the regional level. Intra-regional corridors are significant especially regarding remittances; there are some early pushes to achieve interoperability across WAEMU, e.g. an AfDB project for 11.3 million USD launching a WAEMU digital financial services interoperability platform. MMOs often also operate across borders, and this could have implications for greater interoperability across countries. For regional MMOs and multi-country initiatives, resource allocation could be assisted by geospatial mobile money need modeling.<sup>80 81</sup>

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<sup>77</sup> Akogbeto.

<sup>78</sup> Berthelot, Interview: Orange’s Mobile Money in Madagascar and Sub-Saharan Africa Broadly.

<sup>79</sup> Forster, Peachey, and Stahl, “Mapping Proximity: Bringing Products and Services Close Enough to the Poor to Be Meaningfully Usable and Still Keep Them Sustainable for WSBI Partner Banks,” 9.

<sup>80</sup> Aker and Carroll, “The State of Digital Financial Services in Francophone West Africa,” 3.

<sup>81</sup> “WAEMU Digital Financial Services Interoperability Platform | Africa Digital Financial Inclusion Facility.”

## 6C: Going beyond GIS

**Investments in effective use:**<sup>82</sup> Expanding the reach of mobile money services involves more than just establishing the necessary technological infrastructure or catering to specific demographic characteristics. While the presence of the appropriate infrastructure is crucial, it is equally important to address the human aspect of adoption and utilization. Digital literacy initiatives and capacity building programs are essential to ensure that potential users use mobile money to maximum benefit, and these investments in enhancing digital literacy can pave the way for a more inclusive and widespread adoption of mobile money, bridging the gap between technological availability and actual engagement.

**Technology-specific considerations:** When evaluating feasibility and effectiveness of mobile money, technology-specific considerations vary depending on the technology employed. The analysis proposed in this paper assumed that the presence of telecom towers alone would be an enabler for a hypothetical mobile money service operating through USSD (Unstructured Supplementary Service Data), as is common. This kind of service operates even when internet connectivity is limited. However, there are also app-based services that rely on high-speed internet connections like 3G and beyond, and this might thus be an additional factor for inclusion in analysis. Furthermore, some MMOs also have second-level ecosystems that may incentivize users to remain in their ecosystems rather than transition to another service, as described regarding M-Pesa on page 5.<sup>83</sup> Understanding and analyzing these ecosystem dynamics can provide valuable insight into why certain mobile money services can gain traction over others.

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<sup>82</sup> Gurstein, "Effective Use."

<sup>83</sup> Kendall et al., "An Emerging Platform: From Money Transfer System to Mobile Money Ecosystem," 58.

## Section 7: Concluding remarks

The expansion of mobile money technology has emerged as a transformative force for financial inclusion in the developing world, and innovations in providing widespread access can be accomplished through coordinated, data-driven policy. On the data-driven end, this paper has delved into the critical role of mobile money agents in expanding financial inclusion and has proposed a geospatial decision-making approach to optimize agent placement within the WAEMU context, demonstrating its applicability in Niger. This framework is the beginning of any applied analysis which would, in practice, be driven by contextual nuances and the pain points described in Section 6A. However, any analysis depends on data reflecting the current situation, and in its absence financial inclusion can be – and often is – ad-hoc. In response, this paper turns to the policy front by describing the existing regulatory challenges and opportunities for coordinated, universal action on financial inclusion.

By both advocating for the collection of geospatial data such as agent locations, infrastructure scope and financial points of service and then applying it to map a concrete path to increased access and inclusion, this paper, therefore, hopes to open the conversation on universal service vis-à-vis physical mobile money access. This approach offers the potential to maximize network efficiency and financial sustainability for mobile money operators while extending financial access to marginalized communities and fostering economic growth across the region.

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