The Politics of Anti-Poverty Artefacts: Lessons from the Computerization of The Food Security System in Karnataka

Silvia Masiero
Department of International Development
London School of Economics and Political Science
8 Houghton Street
London WC2A 2AE
United Kingdom
s.masiero@lse.ac.uk

Amit Prakash
Centre for IT and Public Policy (CITAPP)
International Institute for Information Technology
26/C, Electronics City, Hosur Road
Bangalore, Karnataka, 56100
India
amitprakash@iiitb.ac.in

ABSTRACT
The last few years have seen a rapid increase in the discussion of the role of new technologies in strengthening social safety nets. However, the hypothesis that technology design is intertwined with political agendas - aiming at instilling specific visions and policy objectives in anti-poverty programmes - has remained to a large extent unexplored, being either taken as implicit or neglected by technical discourse. In this paper, we look at computerization of a large food security programme - the Public Distribution System in Karnataka, India - to argue that technology, far from simply affecting the functioning of existing processes, can be built to advance specific political agendas, which carry clear stances on the ways in which social welfare targets are to be reached. However, recipients' perception of these programmes depends highly on how technology affects access to their entitlements, which need therefore to be set at the core of anti-poverty technology design. The case study is used to draw lessons for policy, specifically aimed at countries embarking into computerization of their social safety nets.

Categories and Subject Descriptors
H.1.2 [**Information Systems**]: User/Machine Systems – *human factors, human information processing.*

General Terms
Management, Economics, Reliability, Security, Human Factors, Verification.

Keywords
E-governance, computerization, social safety nets, food security, Public Distribution System, India, Karnataka.

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1. INTRODUCTION
Over the last years, the discourse on the use of information and communication technologies (ICTs) for achievements in the domain of poverty reduction has become one of the dominant themes in ICT4D [6]. Narrative on this domain has peaked in recent times, potentially as a result of the globally increasing reliance on social safety nets: state-level programmes protecting the needful from food insecurity, unemployment, and the "substantial unfreedoms" [20] threatening the quality of their lives are increasingly being leveraged in combating poverty. Anti-poverty programmes - a term that encompasses the social safety nets designed with the purpose of poverty reduction - are increasingly being imbued with technology, in all their phases from design to delivery. Discourse on "end-to-end computerization", aimed at increasing effectiveness and accountability of social welfare providers, is steadily gaining hegemony in this respect.

And still, discourse on digitalization is predominantly crafted in a results-oriented fashion, leading to a focus on "what can be obtained" through the application of ICTs to existing processes. Hegemony of this thematic thread, connecting technology with its actual and expected outcomes in anti-poverty practice, is leading to an intrinsically technical vision of anti-poverty artefacts: dichotomic categorizations (primarily, discourse on "success" and "failure") have become paramount, along with explanatory analyses of the factors that led to such outcomes. On the one hand, a results-oriented vision does serve the purposes of policy prescription, based on identifying best practice and equipping policymakers to avoid failure. Yet, the same perspective may lead to lose sight of the processes into play: human, social, and contextual principles, underlying the construction of anti-poverty artefacts, may disappear from the causal narrative that constitutes the hegemonic discourse.

In contrast, information systems literature [3, 16, 21] has explored the hypothesis that political context may have a role in explaining the architecture of artefacts, along with their practical implementation and usage. The idea that "artefacts have politics" [21], meaning that they constitute the physical embodiment of the vision/objectives of those conceiving them, has been articulated through the prism of *social embeddedness*: in this view, technologies are seen as the byproduct of their context, which in

turn they influence as a result of users' adoption. Over the last decade, the paradigm of social embeddedness has been applied to ICT4D [1]: this results in the argument that ICT-based development programmes arise, in large part, from locally relevant views and needs. This view culminates in the hypothesis that technology can advance a specific *meaning* of development, enacted by policymakers in ICT4D programmes [17].

The hypothesis in point - while widely discussed in information systems - has remained, to a large extent, unexplored by the main discourse on technology for anti-poverty programmes. In this paper, we examine it through a case study of computerization of a large anti-poverty scheme, namely the Public Distribution System (PDS) in Karnataka, southern India. The PDS, a programme based on subsidization of primary necessity items to poorer households, is the main food security net in contemporary India: in Karnataka, its computerization has occurred through a back-end process (development of a database of entitlements, and of a supply chain monitoring system) and a front-end one (biometric tracking of transactions to beneficiaries). Our work, consisting in an in-depth case study of the PDS in Karnataka, aims to shed light on the intertwining between development of an anti-poverty artefact, and the agenda for food security in which it is embedded.

Our results present a mixed picture of the interaction between politics and the system. On the one hand, the Karnataka IT system for PDS - as an ensemble of its back-end and front-end components - is found to be conceived as a carrier of three main functions (prevention of misappropriation, mismanagement, and diversion) which, taken together, configure a clear political agenda against leakage of commodities from the programme. This agenda comes with clear assumptions on the actors of corruption, their behavioural patterns, and the optimal ways to detect them: in practice, the system is constructed to "carry politics" [3] for an agenda against leakage of foodgrains. On the other hand, the extent to which this agenda is perceived by the programme's beneficiaries - as they access the computerized PDS - is limited: technology is seen, by its users, in terms of its effect on entitlements, which are not always made smoother by the transition to a biometric PDS. Citizens' narratives, taken together, lead to place a caveat on anti-poverty technologies: in their design and implementation, these need to be firmly rooted on beneficiaries' access to programme entitlements.

This paper is structured as follows. Section 2 reviews the theoretical perspective of social embeddedness, with a focus on the political context of technology in ICT4D. Section 3 explains our methodology, based on an interpretive case study of the IT system for PDS in Karnataka. Section 4 describes the artefact at the core of our research, which we analyze in Section 5: first, we review the inscription of three functions (prevention of misappropriation, mismanagement, and diversion) in the IT system's design. Then, we examine users' narratives to argue that, for that agenda to be translated into practice, citizens' entitlements should be placed at the core of the anti-poverty information system. Section 6 concludes, drawing lessons for other states engaging in computerization of their social safety nets.

2. THEORETICAL PERSPECTIVE

Discourse on end-to-end computerization of social safety nets, with specific respect to its adoption in anti-poverty programmes, constitutes the broader domain of our research. The theoretical perspective detailed below allows us to convert this problem area into specific questions for our study.

The idea that "artefacts have politics", as articulated by Winner [21], is at the root of the theoretical understanding of computerization presented here. The argument underlying this notion is that artefacts, rather than being just the technical means to carry out pre-determined actions, are actually the physical embodiment of the visions/goals of their makers, or of those in charge of informing their development. These visions, when it comes to the public sector, tend to acquire the nature of *political* projects: this means that artefacts are constructed, and implemented in practice, in order to pursue some political accomplishments, in line with the worldview of policymakers and the objectives stemming from it.

In fact, the vision of technology as a "carrier of politics" (Cordella and Iannacci 2010) could run the risk of been deemed or rejected as technologically deterministic, i.e. as imbued with a too ready causal relation between technology adoption and some given effects. The distinction between a deterministic *tool* view, of technology as a means to specific outcomes, and an *ensemble* view, in which technology emerges from its context of application, is made by Orlikowski and Iacono [16]: in the ensemble view,

> The conceptualization of technology (…) is that of an evolving system embedded in a complex and dynamic social context. Technology is neither an independent nor dependent variable, but instead is seen to be enmeshed with the conditions of its use – hence our label "embedded system". [16: 126]

The ensemble view leads, therefore, to a worldview in which technology, rather than being causally linked to any effect, is *embedded* in its context of action, and emerges from it while, at the same time, influencing its features. Having gained substantial grounds in the information systems domain, the idea of technology as socially embedded is then applied to the specific area of ICT4D:

> Authors of the social embeddedness discourse view innovation as a locally socially constructed course of action (...) its purpose arises from local problematizations, and its course is determined by the way local actors make sense of it and accommodate it in their lives. [1: 135]

In Avgerou's work [1], the discourse of social embeddedness is viewed in opposition to another dominant perspective in ICT4D, namely that of "technology transfer": in this view, developing countries are constructed as keen to "catch up" with the industrialized world, by transferring technologies and knowledge from outside. The argument of social embeddedness disputes this view, by stating that technology is not necessarily "transferred" to the developing world: diversely, developing nations conceive new technologies according to their own needs and perspectives, and implementation is led on the basis of locally relevant content and necessities.

Our perspective is firmly grounded on Avgerou's views, as we devise our contribution to the interdisciplinary domain of ICT4D. Regarding technology as the socially embedded byproduct of its context, we observe two particular points on ICTs in anti-poverty

programmes: first, when it comes to technologies developed for the public sector, the *political* context of action (with regards to the goals of policymaking for poverty reduction) needs to be explicitly taken into account [13]. Second, as we look at programmes which belong to social safety nets in the developing world, the political context embodies a view of what constitutes development - rather than just a general idea of mechanisms for the improvement of social safety nets [17]. Hence, technology may be used to advance a specific vision or *meaning* of development, enacted by policymakers in ICT4D programmes.

Our research is firmly predicated on social embeddedness, intended through the arguments on political context and on the presence of a *meaning* of development in technological artefacts. This perspective led us to structure our problem area into two questions for our research, namely: what links are there between anti-poverty artefacts and the policy agendas behind them? And if a policy agenda surfaces, how is it designed on paper - and articulated in practice, through the perception of beneficiaries? Our methodology, based on an interpretive case study of Karnataka, has been devised in order to provide structured responses to these questions.

3. METHODOLOGY

Our research questions required close observation of the intertwining between technology and political context, with reference to anti-poverty programmes. This led us to approach them through a method - an in-depth, interpretive case study - which is particularly suited to process-related questions, regarding ongoing dynamics unfolding on the field. Our aim, in doing so, is close to Gregor's [5] notion of analytical theory-building: our purpose has been that of generating theory with an inherently *descriptive* nature, on phenomena on which existing knowledge in theory/practice is limited. This descriptive purpose, as conceived in the paper, is coupled with a *normative* one that builds on it, as we use our case study findings to draw lessons for states computerizing their social safety nets.

To answer our questions, we needed a case study of an anti-poverty net that is undergoing the process of end-to-end computerization, to which our problem area refers. This led us to focus on Karnataka, a southern Indian state in which the Public Distribution System (PDS) is currently being computerized. The PDS is the biggest food security programme in India [8]: it consists in subsidization of primary goods such as rice, wheat, sugar and kerosene, which are procured at the central government level and redistributed to below-poverty-line (BPL) households through fair-price shops (known as ration shops) in all states. The PDS contributes to social safety, and ultimately to reductions in the poverty gap index [4], by making primary goods affordable to poorer families, thereby improving their capability of achieving sufficient nutritional levels.

The artefact at the core of our research, i.e. the IT system for the PDS in Karnataka, is described below. Our engagement with the field, including preliminary fact-finding visits, has lasted from January to September 2014. Our data consist primarily of narratives collected from actors involved in the system, largely belonging to the groups of (1) software developers (National Informatics Centre, Karnataka) and technology implementers, (2) policymakers and actors using the IT system to deliver the PDS programme (staff at PDS godowns, and at the ration shops where goods are sold), and (3) citizens using the system (approached primarily inside the ration shops, at the moment of purchase). In observance of the case study method [22], we have triangulated our narrative data with other sources, primarily participant observation conducted in the ration shops - where an IT-based interface, namely a weighing-cum-point of sale machine, structures interactions between the ration dealers and the citizens who make their purchases. As a completion to this, documents related to the PDS in Karnataka, and to the diverse phases of IT implementation within it, have been analyzed by the authors.

4. CASE STUDY

The core mechanism of the PDS, based on a central government agency (the Food Corporation of India – FCI) procuring foodgrains and redistributing them at subsidized prices, was instituted in 1965. The programme was originally designed as universal, i.e. accessible by all citizens: the fiscal crisis of the early 1990s, along with the structural adjustment policies that followed, led the central government to switch to a targeted system in 1997. In the targeted PDS, access is restricted to BPL households, among which the poorest of the poor (coming under the Antyodaya Anna Yojana – AAY classification) are entitled to higher quantities of subsidized goods: only in a few states some limited subsidies are still available for the above-poverty-line (APL).[1] PDS implementation, while informed by central government directives, is conducted at the state level, and this results in sharp differences in the programme's impact on poverty reduction across states [4, 7].

Karnataka has been known, since the establishment of the programme, for operating a quite well-functioning PDS, featuring high levels of utilization by BPL and AAY households [10]. It is a state whose social schemes are closely dedicated to vulnerable groups: attention to poorer households was manifest since 1985, when a "green card" scheme allowed, in the universal PDS, to guarantee specific subsidies to the poor [14]. This, combined with local dynamics that see the PDS at the core of electoral competition [15], has culminated in 2013 with the Anna Bhagya scheme, which provides very high subsidies to the BPL – rice and wheat are sold at Re. 1 per kg., in quantities that vary according to the number of household members, and are fixed at 29 kg. per month for the AAY (see Table 1). As per its construction, the scheme aims at constituting a viable means to food security for vulnerable households.

Table 1: Entitlement to Foodgrains under the Karnataka PDS

Status	Entitlement - quotas (per size of household)	Entitlement - price
APL	None	None
BPL	1 member: 8 kg. 2 members: 16 kg. 3 or more members: 24 kg.	Rice: Rs. 1/- per kg. Wheat: Rs. 1/- per kg.
AAY	29 kg. (any household size)	

[1] The only exception here is Tamil Nadu, which maintained a universal system in spite of the central government's shift to a targeted PDS.

The system suffers, though, from systematic diversion of goods outside its own supply chain. The problem of leakage, fostered by the price difference between PDS and the market, is a nationwide one, with an estimated yearly 57% of PDS commodities not reaching the beneficiaries [19]. On the one hand, a share of these losses might be due to issues in transportation and storage: most problematically though, PDS goods are subject to diversion to black market networks, by agents exploiting the diverse opportunities to do so [11]. In particular, ration dealers across the nation have been severely hit by the shift to a targeted PDS: as a result of the shrink in eligible users (from all citizens to just BPL/AAY), ration shops have become increasingly unviable, and many have been forced to shut down or become corrupted [12].[2] Leakage from the PDS strongly limits the efficacy of the programme, as it reduces the amount of subsidized goods available to users.

Computerization of the Karnataka PDS system started in 2005. The initial idea consisted in construction of a database of all users entitled to the PDS: in this way, a list of genuine beneficiaries would be created, and ration cards (household-based documents of entitlement to the PDS) would be assigned consequently. The following step, with the systems' construction, aimed at ensuring that only people with genuine entitlements could access PDS goods: this was pursued through computerization of the systems' supply chain, including transactions in the ration shops.

The present version of the IT system for PDS, developed by the National Informatics Centre (NIC) Karnataka, is substantiated into three modules, each of which plays a key part in guaranteeing the good functioning of the programme. More specifically:

Module 1, known as Ahara (meaning "food" in the local language), is a ration card database, in which details of all cardholders registered in the state are stored. A ration card reports the household's address,[3] as well as its poverty status and number of family members: for BPL citizens, entitlement is indeed based on these data. The ration card needs to be presented to the ration dealer at all times when buying PDS commodities, as it constitutes the proof of entitlement to the system.

Initially, construction of the database was problematic, after outsourcing to a private vendor ended up in unsuccessful outcomes. In 2009, "temporary ration cards" were released, without proper verification of the identity or entitlement of applicants: as a result, virtually all citizens could benefit from the system, and get subsidized commodities from it. In 2010, ration cards in Karnataka largely exceeded the number of existing households, let alone that of genuine beneficiaries [9]: therefore, needful recipients incurred the risk of being deprived of the commodities reserved to them.

In this situation, under the former Secretary of Food and Civil Supplies, a system was designed to cancel bogus ration cards, and guarantee the authenticity of the existing ones. This was based on two different routes to verification: urban households would have to provide a RR number (signifying a valid electricity connection), whereas rural households would have to provide their property identification number.[4] In this way, a door-to-door survey of users was not required: cardholders were requested to provide their details along with their photographs and finger prints, at photo-bio centres set-up at multiple locations (through franchised outlets in urban areas, and in the offices of the gram panchayats in rural areas). Details of cardholders registered with each ration shop are now available through the database hosted at http://ahara.kar.nic.in.

Module 2 (Financial and Stock Accounting System – FIST) is a software for supply chain monitoring, aimed at checking PDS transactions that occur *before* the goods reach the ration shops. The PDS supply chain, illustrated in Figure 1, consists of three main phases: goods, procured by the FCI and private producers,[5] are distributed at the district level through Authorized Wholesale Dealers (known as wholesale points or godowns), and then lifted by the ration dealers, who in turn provide them to beneficiaries.

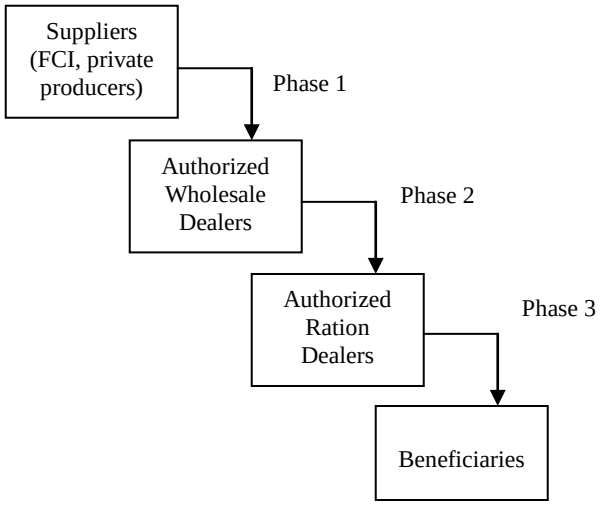

Figure 1: Phases of the PDS Supply Chain

The FIST software, utilized at the wholesale points and operated by their managers, registers the amount of goods that come in from FCI and private producers every month [phase 1 above], and the amount that is lifted by every ration dealer, as the monthly allotment is distributed [phase 2]. The monthly amount of goods assigned to each ration shop is based on the theoretical

[2] Under the targeted system in Karnataka, APL citizens have no entitlement to subsidized foodgrains or sugar, as they have been phased out of the food security programme. The benefits that they receive are limited to subsidized kerosene.

[3] Address is needed on ration cards, as it is on the basis of it that the ration shop of reference is determined – geographical proximity is the criterion for determination.

[4] A recent measure requires registration of EPIC (Electoral Photo Identification Card, issued by the Election Commission of India) or Aadhaar number (issued by the Unique Identification Authority of India, UIDAI) with every ration card, for the purpose of guaranteeing authenticity and uniqueness of the card.

[5] In Karnataka, the FCI provides rice and wheat, which are in turn procured from foodgrain-producing states. Sugar comes, instead, from local mills, whereas kerosene is provided by state-owned oil companies.

requirement, determined through the number and status of ration cards registered at every shop, and the closing balance, i.e. the commodities left in stock at the end of each month. All data are entered in the system by godown managers, who access it through personal logins that lead to traceability of all operations. The function of the FIST software, by tracking all transactions in phases 1 and 2, is that of impeding diversion of commodities at the back-end level.

Module 3 consists in a system to control the transactions conducted at each ration shop. While FIST controls phases 1 and 2 in the supply chain, the transaction tracking system checks phase 3: it consists in biometric weighing-cum-point of sale machines, installed in ration shops and utilized to carry out transactions with the customers. Transaction tracking through the machines has been implemented in only 6 of the 29 districts of the state: end-to-end computerization, when completed, will involve its implementation in all ration shops.

Figure 2: Biometric Weighing-cum-Point of Sale Machine
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The weighing-cum-point of sale machine (Figure 2) for PDS works as follows. Users, as they buy their rations, are identified through their ration card number, which is entered first, and their thumb impression: as they provide these details, the machine recognizes the user, and displays their card number and entitlement on the screen. As the ration dealer weighs commodities, the machine's speakers announce, in local language (Kannada), the type and quantity of goods being sold: as the transaction is completed, a bill for it is printed. The machine's embedded system is constructed to prevent ration dealers from selling less (or more) than one's entitlement at every transaction. On a monthly basis, the machine registers all sales conducted at each ration shop: the closing balance is then submitted to FIST, and contributes to determining the allotment that is due in the subsequent month.

Table 2: Synopsis of E-PDS Modules

E-PDS Modules			
No.	**Name**	**Core Function**	**Nature**
1	Ahara – Ration Card Database	Guarantees authenticity of users' entitlements	Back-end
2	Financial and Stock Accounting System (FIST)	Registers the amount of goods received by wholesale points, and of those lifted by ration dealers, every month	Back-end
3	Biometric Control on Transactions	Guarantees authenticity of users' entitlements and regularity of PDS purchases	Front-end

Table 2 summarizes the three modules of the system, which, taken together, form the anti-poverty artefact at the core of PDS. On the one hand, the implementation of weighing-cum-point of sale machines has gained high attention by media and policy press. In effect, in promoting computerization of the PDS, the Department of Food and Civil Supplies has leveraged quite highly on the machine, as the previous Secretary told us:

> The machine is the real innovation in the system. With it, ration dealers cannot cheat their beneficiaries, and people owning fake ration cards cannot access subsidized goods.

And still, as illustrated in the table, the IT system for the PDS is a *composite* artefact, in which each module acts in completion to the others, rather than as a self-standing unit. In the system, weighing-cum-point of sale machines are based on data stored in Ahara, and provide closing balances to be inserted into the FIST software. As noted by the Technical Director at NIC Karnataka:

> The IT system consists of Ahara, FIST, and biometric machines. All parts are equally important, and together they guarantee computerization of the whole system.

Hence, the object at the core of our study is not to be regarded as a single tool, but as an assemblage composed by three technologies which, in their mutual relations, form a composite anti-poverty artefact. End-to-end computerization is therefore pursued across the three phases of the supply chain.

5. ANALYSIS

So far, we have detailed the properties of the artefact at the core of our work. To answer our research questions, the same artefact needs to be analyzed, in terms of the intertwining between technology and the political domain around it. First, we examine the relation between technology design and food security policy, with regards to the context of reference: then we observe the same relation through the narratives of beneficiaries, whose views of the PDS are mediated by the IT system. From the combination of these perspectives, we draw lessons based on how technology interacts with the politics of food security around it.

5.1 Re-Designing the Public Distribution System through Computerization

In the results-oriented perspective on computerization, technology is seen primarily as a means to greater effectiveness and accountability of social safety nets. It serves, in this view, the purpose of improving existing mechanisms: we explore, instead, the idea that technology design, and the implementation that follows it, may carry a food security agenda, with its own assumptions and priorities. To explore this hypothesis, we interrogate technology design, and the multiple ways in which its contents are transferred into an anti-poverty artefact.

As we observe technology in action, several functions seem to be inscribed in the IT system for the PDS. Actors' recounts led us to appraise three different functions, and the ways in which they relate to each other in practice. Functions elicited in the system are as follows:

Preventing misappropriation of PDS goods from ineligible citizens. As the PDS determines a situation of dual prices, in which the one on the anti-poverty system is lower than that on the market, there is an incentive for citizens to illegally appropriate subsidized goods. This was easier when, through "temporary" ration cards which were not properly verified, virtually everyone could access the PDS. Technology, applied to transactions in the ration shops, aims at preventing non-entitled people from accessing the system, as noted by one of the Technical Directors at NIC Karnataka:

> The biometric machine prevents those with a bogus card from buying goods from the system. This enables people, who really need the PDS, to get the goods from the programme. Bogus cards led to frequent stealing, and to users finding themselves with no goods left for them.

There are two notes to be made here. First, the weighing-cum-point of sale machine does not act on its own in preventing misappropriation. It is, instead, the assemblage constituted by the machine and the ration card database, which prevents the sale of commodities to anyone who is not registered in the system. Second, the assumption that citizens are involved in diversion from the PDS plays a key role here: it is, indeed, to combat this form of leakage that biometric technology has been implemented.

Preventing misbehaviour from ration dealers. In spite of the strong emphasis on biometric identification, non-entitled users are only one of the sources of leakage from the PDS. A large share of the problem is, instead, attributed to misbehaviour from ration dealers, who can either cheat on quantity/price in transactions (sell less commodities at higher price, as compared to entitlements) or pretend having "run out" of goods, and diverting them to the market instead.

Based on awareness of these problems, the weighing-cum-point of sale machine is constructed in order to ensure the regularity of all transactions. This function is inscribed in the machine's design: at the moment of purchase, speakers announce the type, quantity and price of goods being sold, making sure that they correspond exactly to the entitlement of the citizen. Thanks to connection to the Ahara database, the machine recognizes registered beneficiaries, and reveals, upon biometric identification, the exact amount of goods to which they are entitled. This prevents ration dealers from cheating on the quantity and price of goods being sold, as revealed by an official in the Department of Food and Civil Supplies:

> The machine is done in such a way that the user cannot be cheated, because it knows and announces exactly the entitlement of the recipient, and makes it certain that the ration dealer will sell (exactly) those quantities. In this way, we guarantee the poor that their goods are delivered.

Once again, the machine does not work *per se* in this task, but recognizes entitlements on the basis of the Ahara database connected to it. The problem of ration dealers "running out" of goods, and therefore not serving their customers, has been solved by a fixed time schedule, described by the Commissioner of Food and Civil Supplies:

> Every month, ration dealers are obliged to distribute PDS commodities between the 1st and the 10th. Citizens know it, so they know exactly when to go to the ration shop, and expect their rations to be there. If the ration is not there, then they can take action.

Technology seems, therefore, to be part of a broader accountability structure, which has been conceived to guarantee regularity and prevent misbehaviour from ration dealers. The assumption here is that such misbehaviour is embedded in the dynamics of leakage, and is to be faced through a strategy in which technology plays a key role.

Preventing back-end diversion of foodgrains. Attention here focuses on the parts of the supply chain (phases 1 and 2) which unfold before the ration shops, pertaining to transportation of commodities from FCI/private producers to wholesale points, and then from these to ration dealers. The software for finance and stock accounting (FIST) controls regularity of these operations, and is designed in order to detect mismanagement occurring within them. As noted by another official at the Department,

> The software has been designed in such a way that goods are checked both as they come in, and as they leave from godowns. The software has a monitoring function, which verifies that everything is transparent.

This function, with reference to the early stages of the supply chain, is particularly important, as discourse in the social sphere reveals one clear pattern: the largest share of diversion happens here, in the early stages of the supply chain, rather than in the ration shops [18]. As paradigmatically observed by a Food Inspector,

> Transactions in the shops are to be monitored, but the real monitoring has to happen in the godowns. In the ration shop, maybe a few bags of rice will disappear, and go to the private market. But in the earlier phases, entire trucks of rice may be diverted (...) this is why it is so important to monitor this stage.

The third function inscribed in technology is, therefore, that of preventing diversion as it occurs in the early stages of the supply chain. It is a form of corruption that is less visible, as compared to that in the ration shops: but it is, at the same time, the one that seems to affect the system in the most problematic ways.

Combined together, the three functions above provide an answer to our first research question, on the relation between technology and the food security policy behind it. The answer is found in technology design, which breaks leakage in three causal elements (misappropriation from customers, mismanagement from ration dealers, and diversion at earlier stages) and engages in combating them one by one, on the basis of clear assumptions and priorities. Technology does not seem, therefore, to be simply enacting existing processes: it operates, instead, as a means to embody a specific food security agenda.

5.2 Narratives on Technology and its Outcomes on the Food Security System

As per the above, the technology constructed for the PDS in Karnataka seems to be the carrier of a specific policy agenda, focused on combating leakage and maximizing users' capabilities to get their entitlements. Our second research question explores implementation, in terms of how this agenda is translated into practice. This needs to be explored, in the first place, through the eyes of users, for whom technology constitutes a novel means to accessing a core anti-poverty programme.

PDS users access the IT system in terms of its front-end component, namely the weighing-cum-point of sale machine. Their encounter with the system is, therefore, structured through this technology – rather than through the back-end system, which they do not experience in their monthly transactions. In particular, the machine checks that everyone's entitlement is respected, as noted by a BPL user in Tumkur district:

> Before, one could not really be sure on whether the ration dealer was selling the right amount of rice. With the machine, weighing is automatic, hence this is not anymore a problem.

Still, narratives of easy access and greater accountability become somehow more blurred, when explored through the multiple experiences of citizens encountered in the ration shops. On the one hand, technology design is informed through the principles of combating misappropriation, mismanagement and diversion of goods, as illustrated above. Yet, on the other hand, experience of the system gives rise to narratives in which other themes are recurrent:

Absence of monitoring. As observed above, citizens' encounters with technology happen through the front-end interface, rather than through diverse parts of the anti-poverty artefact. One recurrent thread of narrative, among our interviewees, is that of the identification of IT for PDS with "the machine" itself, rather than with the system as a whole. This would not be problematic *per se*, if it did not result in the diffused perception of supply chain monitoring as absent from the PDS: citizens see the machine, as it structures their transactions, but they cannot "see" the software behind it. This leads many to feel unprotected from large-scale corruption, as reported by a user in Bangalore:

> They have put biometric machines in all ration shops, but corruption is not here. Rather, it is in the godowns, from where a lot of goods disappear, and nothing is really done about it (...) why spend loads of money on biometrics, when the real corruption is in another place?

One way to limit the problem of perceived absence of monitoring is that of availing a recently devised SMS service, developed by NIC Karnataka for communication between the wholesale points and the panchayats. Since 2013, all panchayats in the state are registered with a service of SMS alerts, which are automatically sent to them every time one of the local ration dealers lifts their foodgrains from the wholesale point. The system, according to the staff at NIC Karnataka, is in operation throughout the state: however, none of our interviewees was aware of it. If it was utilized, the system could provide a window of observation on back-end monitoring, since most citizens in Karnataka own a basic mobile phone on which SMS can be received.

Furthermore, apart from the lack of monitoring, another form of absence is perceived around quality control of PDS goods. Many users are, indeed, dissatisfied with the quality of PDS foodgrains, to the point that they report being barely able to eat them– if not, some of them say, along with other (more expensive) types of food. In some cases, PDS food is not even considered fit for consumption, as paradigmatically reported by a BPL user in Kolar district:

> PDS rice is not good enough, we feed it to the goats. We still buy it, because it is very cheap, but we feed it to the goats as it is too low quality (to eat it).

Multiple narratives reveal cases of citizens, even BPL, feeding PDS food to the animals because of low quality. Indeed, quality control seems to be the "big absentee" from the PDS, and from the IT monitoring devised for it. On paper, quality control does somehow exist, as "quality inspectors" seem to be operating at the FCI level: also, the description of the ration dealers' job includes providing a sample of PDS rice, for customers to check what expected quality should be. However, none of the ration dealers we visited was aware of this: we have, instead, witnessed the presence of bags of rice that were full of mud, which could probably not have passed any form whatsoever of quality control. Perceived absence of technology is, therefore, a key thread in the narratives of users: this concerns both quantity, as awareness of supply chain monitoring is very limited, and quality, since no control of this kind seems to be in place.

Exclusion of beneficiaries. Another issue is perceived as very critical with respect to technology: this is an issue of exclusion, i.e. access complications that were not there before computerization. This is the case for those citizens who, for various reasons, experienced issues using the biometric machines, and sometimes had rations denied as a result. This leads to clear grievances against the biometric system, which is blamed for denying entitlements rather than simplifying access to them.

There are several problems that can arise from the biometric system. The one that featured most strongly in citizens' narratives regards the users' fingerprint not being recognized by the machine. When that happens, a message on the machine's screen invites the user to send another member of their family, to perform the identification: indeed, all households' members are supposed to have their biometric details registered in the system. If that option works, rations can be sold, otherwise the process can be very long, as revealed by a citizen in Bangalore:

> Cash payments were more risky, because (one) could never know how much rice the ration dealer was selling. They could have cheated easily (...) but now, many citizens cannot really buy their rations, because the system does not recognize them.

Another problem, which may result in rations being denied to citizens, happens when the ration dealer does not pay the connectivity bill. Biometric machines have a 2G connection, through which they can access the ration card database – and perform identification of citizens: ration dealers should pay the bills for this, and the Department of Food and Civil Supplies should then refund them. However, if bills are not paid, changes in ration card details are not registered: hence, whoever had their ration card renewed or modified is unable to get rations from their shop. In a ration shop in Bangalore, we witnessed the case of a woman being denied her ration for the fourth month in a row, as a result of lacking recognition derived from the ration dealers' missed payment of connectivity bills.

According to this narrative thread, the outcome of technology ends up being, paradoxically, the opposite of that inscribed in design. The system, which has been constructed to maximize people's capabilities to access their entitlements, ends up denying these: on the one hand, it is true that this results from errors in implementation (biometric recognition, payment of bills) rather than in the original idea. But still, these errors can lead to profoundly undesired outcomes, in which rations are denied to their intended beneficiaries.

Manipulation of the IT system. The system's capability to enable users' access to entitlements is predicated on its good functioning, and on the fact that those operating it do so in the correct way. But this is not necessarily the case: a third narrative thread, among actors involved with the PDS, is one that suggests the possibility of manipulation, both at the ration shop and at the wholesale point level. This is because, as noted above, an incentive to corruption exists (in particular for ration dealers, whose viability has been put in peril by targeting): who benefits from diversion does, therefore, have an incentive to bypass technology, in order to keep gaining illicit profits.

This is the case for the narratives around ration dealers' behaviour, since the machine is said, by many parts, to be systematically misused, so that exactly the functions that should ensure accountability can be manipulated. In more than half of the ration shops we visited, the speakers – that should announce quantity and price of goods being sold – were muted: that means that people do not know if the goods match their entitlement (there is a bill printed out from the machine, but that is of little use for the many users who cannot read and write). In other cases, users and even Departments' officials sustain that the machine is prone to manipulation, as declared by an official:

> Ration dealers can add weights to the scale, in order to sell less goods to the people, and divert the remaining ones. The problem remains, as they benefit from corruption and do all they can to maintain it.

As well as in the ration shops, technology in the wholesale points can be compromised. Registers of goods coming in and out, while supported by the software, are still paper-based: food inspectors should control the outputs of the system, but often resort to the easier practice (more entrenched in previous routines) to check the paper register instead. If paper-based systems keep operating on the side of computerized ones, the opportunity for diversion remains, because computerized control is not perceived as needed: this leaves room for corrupted practices, and for them to remain unseen in the paper registers. The link between incentive to corruption and mismanagement of technology is made by a Technical Director at NIC Karnataka:

> Corruption is still strong, because it brings advantages to the PDS agents. If the system was being used correctly (according to design), then it would be perfect, but willingness to corruption makes this difficult to achieve.

On the one hand, diversion (especially when located at the back-end level) is hardly observable, hence it is more the object of speculation than that of actual investigations. But on the other hand, one point can be made: computerization, while facing the *effect* of diversion (combating corruption by tracking transactions throughout the supply chain), does not point to its *cause*, or to any of the factors that may determine an incentive to corruption. The system is still targeted, and no major measures are taken for ration dealers to increase the viability of shops: for example, commissions on ration goods could be increased, and explicit plans could be made for the incentive to diversion to be reduced. Misuse of technology would then be attacked at its very basis.

The three narrative threads, recurring among users' recounts and examined here, point to the idea that, in spite of design carrying a clear agenda against leakage, implementation may be unable to translate that agenda into practice. We need, therefore, to regard design and implementation as related to each other, for the gap between them to be reduced.

5.3 Entitlements as the Core of Anti-Poverty Technologies

We have illustrated, in response to our first research question, the existence of a political agenda on food security, inscribed in the IT system for the PDS in Karnataka. In response to our second question, a gap between design and implementation has been identified: technology has been designed to fight the main sources of leakage, but implementation may lead to the undesired outcomes of perceived absence, exclusion and manipulation. There is therefore a dialectics between design and implementation: the image that emerges is that of a technology that is well-designed in principle, but fails to meet the expectations coming with it. As a result, users' entitlements seem to be largely neglected.

A useful way to frame the issue lies in Corbridge et al.'s [2] vision, according to which citizens come to "see the state" through direct encounters with it. For vulnerable groups in India, these encounters are structured through the prism of anti-poverty programmes, through which their entitlements, to escape the "substantial unfreedoms" affecting their lives, are established and regulated. Hence, social safety nets acquire a paramount role as state-citizen mediators: they are not just a means for users to gain benefits, but one for them to access the state, and perceive it ("see" it) in their daily lives.

This perspective, applied to our research domain, leads to regard technology as a factor that modifies citizens' experience of the

state, and that is to be seen in terms of its capabilities to improve access to providers. As a result, when applied to anti-poverty artefacts, technology needs to guarantee users' access to their entitlements, for their sightings of the state to be complete. Through this observation, the dialectics between design and implementation can be led to a synthesis: the objective of greater access, placing *entitlements* of beneficiaries at the core of technology, should guide the harmonization of the two stages.

6. CONCLUSION

Our study, based on the IT system for the PDS in Karnataka, leads us to argue that technological artefacts are able to deeply reconstruct existing anti-poverty structures, enacting new agendas for poverty reduction. This puts into question the idea that technology, when applied to social safety nets, acts as a mere catalyst of process effectiveness: in this paper we have shown that IT creates, instead, whole new routes to accountability within anti-poverty programmes. At the same time, recipients' perception of IT depends highly on how their access to core entitlements is affected: for anti-poverty agendas to achieve good functioning, entitlements should then be at the core of the dialectics of technology design and implementation.

The argument that construction of anti-poverty artefacts should be directly informed by citizens' entitlements lies at the basis of the normative contribution of this paper. On this there are two main lessons, taught by Karnataka to states currently computerizing their social safety nets: first, holistic monitoring of supply chains is preferable, as compared to full focus on the front-end side. In Karnataka, biometric weighing-cum-point of sale machines are only the interface of a composite artefact: the reconstruction of accountability mechanisms is not predicated on them alone, but on their integration with back-end monitoring. Citizens' entitlements are then to be pursued, rather than just through front-end improvements, through the harmonization of the diverse, integrated components of a technological assemblage.

Second, enactment of anti-poverty agendas requires a focus on the root causes of issues, rather than simply on the effects emerging from them. In the case of the PDS, several measures have been adopted to clear corruption by the means of IT: however, little action has been taken to reduce the *incentive* to corruption, for example by devising means to increase the economic viability of ration shops. Should this line of action continue, the source of the core problem will not be addressed, putting in peril the outcomes achieved by thorough computerization of the programme. The final lesson here suggests, therefore, to use IT to address the factors identified as core sources of issues in anti-poverty nets.

Technology, this paper shows, has strong potential to reconstruct anti-poverty mechanisms, on the basis of novel accountability structures. We hope that we have made an illustrative case for this, demonstrating how political agendas come alive in the making and reception of anti-poverty IT systems. And we hope to have drawn, on this basis, illustrative lessons for the making of anti-poverty artefacts, in order for the pursuit of citizens' entitlements to be effectively inscribed in them.

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